

## NETWORKING COMPUTERS: SOME PRACTICAL APPLICATIONS

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This paper describes how one division within a governmental research institute has networked mini-, micro-, and word processing computers. It will describe the nature of problems to which they were applied, the hardware utilized, difficulties encountered and lessons learned. This will include entering clinical research data using proprietary software programs with subsequent transfer into minicomputer for batch analysis. It will include the use of portable bubble memory terminals to enter clinical trial data into minicomputer from the field via telephone. It will include the use of microcomputer word processing programs to generate rough draft documents, their transfer into a primary word processing system for stenographic formatting and final drafting and further transfer of the documents to the Institute minicomputer where they are available for distant field use with access via portable or fixed terminals. All networking was accomplished with proprietary software systems easily understood by the beginner.

The explosive trend in computer technology has resulted in a plethora of hardware and software, most of which appears mutually incompatible. The rapidity with which new products appear on the market and the changing potential for application to the workplace requirements is frustrating to those who must weigh the considerable expense of an initial system against its likelihood for obsolescence. A reasonable fear of those planning to computerize their operation is that they may purchase a system that will do one job today, but will be unable to become part of a larger, more comprehensive system in the future. This fear is fueled by the apparent incompatibility of proprietary systems produced by different manufacturers. The larger manufacturers have recognized the need of hospitals to link patient care information systems with financial and administrative systems. A number of networking capabilities are being offered to link various stand-alone computers so that they may share common patient identification features while retaining their ability to perform the very different and specialized tasks of administrators and providers. The fact that the health care industry consumes over 9% of the United States GNP is a powerful force to attract the attention of the larger computer companies. The lack of such commercial interest should not deter efforts by those with smaller and more specialized needs from making initial purchases of systems that will satisfactorily perform isolated functions initially and will later become a module for more comprehensive future

systems. The purpose of this presentation is to relate the success of one division within a governmental research institute in networking mini-, micro-, and word processing computers. Results achieved were accomplished by computer laymen, with limited professional guidance.

The Division of Preventive Medicine at the Walter Reed Army Institute of Research (WRAIR) is located in the main WRAIR facility on the grounds of the Walter Reed Army Medical Center (WRAMC) in Washington, D.C. and has the dual mission of training future Army Public Health Officers and investigating outbreaks of disease occurring among Army troops world-wide. The staff of the Division is composed principally of three MD epidemiologists, one MD-PhD epidemiologist, one PhD epidemiologist, one Nurse epidemiologist, four residents in General Preventive Medicine, three enlisted Preventive Medicine Technicians, one of whom serves as the office manager, and four clerical persons. In a given year, several major outbreaks of infectious disease will be investigated with results produced in publishable format. In addition, one or more research projects concerned with determining the efficacy of various treatments in preventing specific diseases will be undertaken, and a large number of reports and documents will be generated supporting the residency program and other teaching commitments.

As late as 1979, the computer support for the entire Institute consisted of a ten year old CDC 3500 mainframe computer used primarily for administrative tasks. The Division of Preventive Medicine had a printing terminal and used this system for limited information management. There was no word processing capability and reports of outbreak investigations frequently required months of intensive typing and re-typing before professionally acceptable reports were produced. Data acquisition and analysis was by the "stubby pencil" method. The director of the Division knew little about microprocessor systems but strongly desired to narrow the gap between data acquisition and analysis. He further recognized the efficiency that word processing would bring to the clerical side of the office. When data processing was beginning to be used to analyze outbreak information in 1979, it was decided to purchase two Apple II's. The initial experience with these computers prompted the ordering of seven Apple III's by 1983. Concurrently, word processing capabilities were requested. It was decided to obtain dedicated rather than combined word processing and data processing equipment so that the systems would not compete with each other.

The initial word processing capability was with the Applewriter III proprietary software program. This is an excellent individual word processing program, and with a daisy wheel printer quality documents can be produced. It is not adequate, however, for the day-in and day-out requirements of a high output stenographic pool. Therefore, an NBI, Incorporated, System 8, a modular, software based visual display word processor was acquired. One of the primary reasons it was chosen was that it has an optional full asynchronous communications package that allows it to communicate with other asynchronous systems. Apple Access is a proprietary software program that allows it to operate as an asynchronous "smart" terminal capable of being linked with the NBI System 8 either by hardware via RS-232 connectors or by the use of telephone lines and modems. The latter technology is limited by a transmission rate of no greater than 1200 baud (and often 300 baud) whereas the hardware transmission can occur at 9600 baud and is therefore much more time efficient. Herein is the capability of one of the networks established within the Division. A switched hardware connection was established between an Apple III located at one end of the suite of offices occupied by the Division in a room serving as a central computer repository for the researchers and the NBI System 8 located in the secretaries' office at the other end of the suite. Documents ranging from memos to final publishable reports can easily be generated with the Apple III's located at individual physicians' desks using Applewriter. This prevents a common problem of researchers using the stenographers' work stations to generate their documents and thereby interfering with the work of the clerical staff. Once the general content of the document is established and stored on a floppy disk, the disk is manually carried to the centrally located Apple III and "dumped" into the NBI System 8. The secretaries edit it typographically, put it into proper format, add appropriate administrative information and print out a copy for final review by the originator. This is usually done within an hour and often within minutes of its arrival into the System 8. The originator makes any changes necessary on the review copy, resubmits it to the typist, and the final copy is prepared. A major advantage is that document generation occurs in the researcher's office where he has quiet access to resource materials. Another advantage is that most of the researchers are doing much of their own typing (keyboarding) and this, in effect, greatly reduces the clerical backlog in the office. Almost all documents are prepared in final form the day they are submitted to the secretaries. Approximately one and a half full time equivalent secretaries support the staff of eleven researchers and residents. To accomplish this with workstations on the NBI word processor would be more expensive and would lose the flexibility of having hardware on the researcher's desk that not only performs word processing but data processing and storage as well.

During the period when the Division was acquiring its word processing and microprocessing hardware, the Institute purchased two state-of-the-art Digital Electronics Corporation 11/780 VAX

minicomputers to support both its research and administrative missions. These have many capabilities including 400 megabyte storage and the storage of large statistical packages such as BMDP, Minitab, Datatrieve and other sophisticated information and data processing software. Within the Division there are several dedicated terminals connected to this system. In addition, the NBI System 8 can also be networked to the VAX 11/780 by using the full asynchronous communications package and a hardware connection via RS-232 connectors. Thus, files may be transmitted from the Division dedicated word processor to the Institute VAX. This capability facilitates the dissemination of various reports and other documents of interest to parent and subordinate organizations. Those with a terminal may, through a modem and telephone lines, access the VAX and obtain this information directly. This application enables the Division of Preventive Medicine at WRAIR to serve as a vital resource to the Army Surgeon General's Preventive Medicine consultant in the provision of information required for policy making. Often, data files stored in the VAX may be transmitted into the NBI System 8 and incorporated into a document which then is stored back into the VAX by transmitting in reverse. This may then be accessed as above. Likewise, such information is often used by epidemiologists and Army Public Health Officers in the field who have responsibilities for protecting the health of the soldier.

Now let's look at computer applications involving acquisition of data in the field. The impetus to purchase word processing and data processing equipment initially was a result of the Division Chief's desire to facilitate data analysis, as well as to speed the production and ease of access of reports. As mentioned earlier, one of the primary missions of the Division is to investigate disease outbreaks among American soldiers world-wide and to conduct trials to determine the efficacy of various preventive strategies. When an investigation is undertaken, one of several networking methods is used to shorten the data acquisition-analysis process. Two such methods will now be presented.

In the summer of 1982, an investigation team was sent to a southern Army post to investigate a reported outbreak of infectious conjunctivitis. Prior to departure, a questionnaire was prepared to record demographic and clerical data on cases and controls. Simultaneously, a record definition was established with the VAX whereby sequential files would be established containing the pertinent demographic and clinical data on patients and controls which was collected in the field. In the past, this information had been collected with the questionnaire which was then brought back to the Institute where data clerks transferred information by codes from the questionnaire to the VAX through the terminals located within the Division. The Division acquired a Texas Instruments Silent 765 bubble memory portable terminal and this was taken along on this outbreak investigation. As the questionnaires were completed in the field, they were entered directly into the TI-765, dumped at night to the VAX and results of statistical analysis could be made available in the field at the time of the investigation. In the past, only

a hand-generated analysis would be available until the questionnaires were brought back to the Institute. An additional advantage was the ability to access existing data files in the VAX from the field. In this outbreak, one of the suspected organisms was a virus for which there was available continuously updated epidemiological data. While this method potentially works well, there are problems and it has not been as successful as had been hoped. It was not possible to use the terminal in the motel where the team was staying since it was not compatible with the phone system there. When investigators dialed the VAX and put the phone receiver in the built-in modem on the portable terminal, something in the automatic telephone switching equipment in the motel did not recognize the terminal and would disconnect the circuit. Also, circuits within the hospital were not as available during the night hours as in the daytime. Those available during the day were noisy, might be interrupted, as they were on a push button system, and required that one of the investigators be entering data when he needed to be seeing patients. Also, long distance calls for the time necessary to enter the data were expensive. Because of these problems, the use of this method has been limited.

A second example more satisfactorily demonstrates an application of networking utilizing microprocessors in the field to acquire data. The Division designed a large study to investigate a preventive drug therapy to be used in troops training at the Army Jungle Operations Training Center in the Republic of Panama. Up to ten percent of the soldiers in certain training areas had been acquiring leptospirosis from contact with infectious standing water. Leptospirosis is an acute febrile flu-like illness that may require hospitalization. A group of people had met in a workshop and determined that one of the common tetracycline derivative drugs might be effective in preventing this illness. The Division designed a controlled clinical trial where volunteers from among approximately 1200 soldiers were given either the drug or a placebo. This trial required extensive information about the soldiers before, during and after the trial. This information had to be linked with tests of blood and urine and with clinical records of any soldiers who developed symptoms. After careful planning, it was decided to use the Apple PFS proprietary software program which allows the creation of data files on individuals which can then be stored either on floppy or hard disks and which can be accessed as required for the addition of more information. Because of the length of the records and the number of patients and controls it was decided to use the Apple Profile, a Winchester hard disk system. The filing system was created, tested and found to be adequate. Two Apple II's with Profiles were then taken to Fort Bragg, NC and Fort Lewis, Washington for predeployment interviewing and then on to the Republic of Panama while the investigation team was present and gathering information during the course of the trial. The availability of these machines allowed rapid updating and accessing of information and the generation of current rosters of individuals participating in the study. After the data gathering period was over, the hard disks with their stored information were returned to the

Institute in Washington and the data was "dumped" into the VAX for sophisticated analysis.

#### Summary

Four examples of networking of mini-, micro-, and word processing computers acquired by one division within a government research institute have been discussed. Although those responsible for bringing the division "into the computer age" were computer laymen, they were able to create a system that networks efficiently and effectively simply by capitalizing on easily understood capabilities of existing proprietary systems. The initial goals of the Director, to narrow the gap between data acquisition and analysis and to speed the production of reports by word processing, have been reached. Many other administrative advantages have been realized. Future acquisitions will include optical scanners, which will further facilitate utilization of data and preclude the necessity of sending data processing clerks to the field; and the Apple LISA technology, which allows a "cut and paste" technique from files displayed simultaneously to create more interesting and informative reports.