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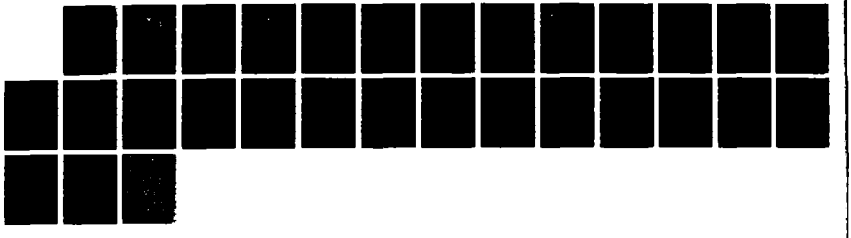

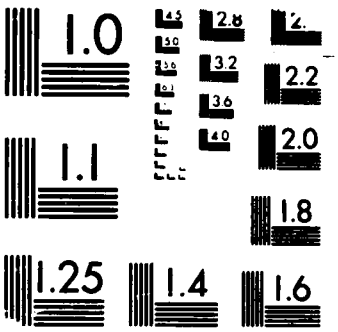

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AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

SHOULD ACSC PURCHASE
A
LOCAL AREA NETWORK?

MAJOR CRAIG D. FRY 88-1000

"insights into tomorrow"

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REPORT NUMBER 88-1000

TITLE SHOULD ACSC PURCHASE A LOCAL AREA NETWORK?

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Submitted to the faculty in partial fulfillment of requirements for graduation.

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ACSC has established a requirement for a Local Area Network (LAN). Is it really a good idea for ACSC to purchase a LAN? This study reviews current technology available to ACSC to accomplish electronic communications needs. It addresses LAN capabilities and limitations, and discusses integration of a LAN into the ACSC mission. Specific ACSC tasks are identified which require or would benefit from a LAN. The study concludes that ACSC should purchase a LAN. Recommendations are made concerning; 1) the network manager's role; 2) distribution of curriculum material via the LAN; 3) a standard database format for the LAN; 4) evaluation of LAN-compatible software for ACSC needs; and 5) laser printer connection to the LAN as a cost-effective method for producing publications-quality text and graphics.

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PREFACE

I became interested in the topic of networking after listening to a talk by RAdm Grace Hopper. The ability to link computers together to greatly expand information processing power intrigued me. Networks, particularly Local Area Networks (LANs), are becoming commonplace, almost the "thing to do." I undertook this project to learn more about the increased capabilities offered by networking, as well as some of the limitations imposed by LANs. This report is intended to provide information to the ACSC Technology Division audience, who must integrate networking into the ACSC mission. The results presented here should also be useful to any reader thinking about implementing a LAN at their facility.

I appreciate the insights offered by the people I interviewed during the research phase of this study. Particularly helpful were Capt Ron Wallace, Capt Ron Ford, Maj Gale Larsen, Mr. Jim Johnson, Capt Bill Kramer, Maj Bob Vogler and Capt Paul Breaux. My research sponsor, Maj Jim Gatewood suggested the topic and offered valuable comments along the way. Maj Mike Huffine, my research advisor, reviewed the numerous drafts and offered prompt feedback and suggestions. The assistance offered by these last two people were key to the successful completion of this project.

ABOUT THE AUTHOR

Major Craig D. Fry is a student at Air Command and Staff College, 1988, at Air University, Maxwell AFB, Alabama. He is a USAF Advanced Weather Officer with a BA in Physics, an MS in Astro-Geophysics, and a PhD in Space Physics. Major Fry has extensive experience in the use of main-frame computers, mini-computers and microcomputers for space environmental support to Department of Defense missions. Air Force tours have included duties as Solar Forecaster, Programmer, Geophysical Systems Analyst, Liaison Officer managing a National Oceanic and Atmospheric Administration facility, and as Senior Division Operations Officer at Air Force Global Weather Central, Offutt AFB, Nebraska. Following ACSC, Major Fry anticipates an assignment as Weather Detachment Commander at Pease AFB, New Hampshire.

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EXECUTIVE SUMMARY

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"insights into tomorrow"

REPORT NUMBER 88-1000

AUTHOR(S) MAJOR CRAIG D. FRY, USAF

TITLE SHOULD ACSC PURCHASE A LOCAL AREA NETWORK?

I. Purpose: This research project investigates the question of whether ACSC should implement a Local Area Network (LAN). It also looks at some critical considerations concerning integrating a LAN into the ACSC mission.

II. Problem: ACSC has established a requirement for a LAN. What experiences have other Air Force facilities faced when installing and using a LAN? What specifically will ACSC do with it's LAN? What functions can only be done with a LAN, and what hardware, software and managerial procedures will allow ACSC to get the most out of a LAN?

III. Data: This research reviews previous studies concerning LANs and ACSC requirements for inter-office computer communications. It reviews current LAN technology, capabilities and limitations. The ACSC hardware and software environment determines the relative ease or difficulty of bringing the LAN on line. Many facilities have found it necessary to assign a full time LAN manager to oversee the network operation. Whatever LAN ACSC obtains must be compatible with the Air Force standard, ULANA. A LAN would let ACSC more efficiently distribute documents, memos, and

curriculum materials. It also would allow the ACSC curriculum to achieve more realistic scenario exercises and war games, for example, by using the seminar microcomputers as message centers and communications devices. The LAN concept allows the sharing of resources, such as files and laser printers. A standardized LAN would allow ACSC to access remote databases and link microcomputers with other facilities. This would benefit faculty and student research efforts, as well as facilitate information exchange with other organizations. Some important considerations include the requirement for a LAN manager and the possible decrease in LAN efficiency and speed through overloading the LAN circuit. Fortunately, the integrated software package used at ACSC, the Smart Software System, will run on the LAN with no additional software cost.

IV. Conclusions: ACSC should proceed with plans to implement a LAN and to integrate it into the ACSC mission. Due to the proliferation of LANs throughout the Air Force, leaders need to appreciate the LAN concept. What better place to be introduced to LANs than in a learning environment such as ACSC?

V. Recommendations: ACSC should proceed with efforts to procure a LAN. One individual should be assigned as LAN manager to ensure the efficient operation of the ACSC LAN. Faculty should use the LAN in seminar preparation and curriculum. A standard database format should be developed so that all users can access and distribute information efficiently. Further research should be done to catalog and evaluate LAN-compatible software for use at ACSC. A laser printer should be purchased to provide all users the capability to produce publications-quality text and graphics in a cost-effective manner.

Chapter One

INTRODUCTION

The rapid growth of computer technology and the use of information systems in today's Air Force have created a need for increased communication capabilities between computer users. In the past, the solution for increased data processing and data flow has been met by throwing larger computer systems at the problem. All users were linked to each other only through a central processing point: the mainframe computer.

Recently, the trend has been to tie several computers together to solve problems which are too large for one computer. The analogy RAdm Grace Hopper used is very appropriate: "When our forefathers worked the land, they used an ox to pull their plows. When the plows got bigger and heavier, they didn't get a bigger ox, they got two oxen" (1:10). The local area network, hereafter referred to as "LAN", is one alternative to link several computers together. A LAN consists of two or more independent computer systems linked together by a communications system. The LAN covers a limited extent, from several meters to several kilometers, typically (9:1).

Statement of the Problem

This research project addresses the questions, "Should Air Command and Staff College (ACSC) purchase a Local Area Network?" and "What hardware, software and managerial procedures will allow ACSC to get the most out of a LAN?" To answer these questions, we must look at current LAN capabilities and limitations, sample LAN implementations, and the current hardware and software environment at ACSC. We must also look at what ACSC missions might be better served through the use of a LAN at ACSC.

Previous studies

The LAN concept is not new at ACSC. Several ACSC research projects have addressed the subject. "A Handbook for Local Area Networks" (12:--) described the LAN hardware and software and communications environment. "A Users Guide to Local Area Network Connectivity" (9:--) gives a basic understanding of

LAN technology, who the LAN managers are, and how to go about justifying and connecting to a LAN. More recently, a research project entitled: "Zenith-100 microcomputer network for Air Command and Staff College" identified several alternatives to link the ACSC microcomputers (10:--). Applications included word processing, spreadsheets, database management, and the transfer of messages, mail, software, and documents. These studies have lacked firm specific applications, or other needs, and have not discussed implementation plans.

In November, 1987, the Air Staff approved the funding of a Program Operating Memorandum (POM) initiative sponsored by Air University for the Maxwell-Gunter Consolidated Local Area Network (MGC-LAN) (14:--). The funding priority was high enough that procurement was almost assured (priority 4). This project would link the Air University organizations to each other through a LAN, as well as link Gunter organizations. The ACSC portion of the requirements and justification for a LAN were addressed in the ACSC Curriculum Technology Upgrade Communications Systems Requirement Document (8:--). A key purpose of this effort was to "improve operational efficiency through interconnectivity and reduction of redundant information" (8:--). The LAN would provide "realism in teaching through simulations, modeling and currency of material" (8:--). Both interconnectivity within ACSC and also with other organizations would allow rapid dissemination of documents and graphics, the sharing of local databases, and the searching of remote databases. The ACSC environment would allow ACSC students to be trained on this new technology (14:--). According to Mr. Johnson, the Air University technical director, "The LAN is the only solution for computer interconnectivity available to Air University" (16:--).

Objectives

The scope of this study is a) to review the current technology available to ACSC to accomplish the ACSC electronic communications needs; b) to identify specific tasks which require a LAN; and c) to make recommendations for the implementation of the LAN at ACSC and the integration of the LAN into the ACSC mission.

In the next chapter, some of the capabilities and limitations of LANs will be discussed in general, and the standard Air Force LAN concept will be introduced. Chapter Three addresses the existing microcomputer environment (hardware and software) at ACSC at the time of writing this report, in the spring of 1988. Some specific requirements for an ACSC LAN will be presented. The last chapter concludes the report with recommendations concerning the ACSC LAN.

Chapter Two

LOCAL AREA NETWORK TECHNOLOGY IN TODAY'S AIR FORCE

LAN CAPABILITIES AND LIMITATIONS

A local area network allows stand-alone data processing systems to communicate with each other. More relevant to ACSC needs, a LAN allows computer users to access and transfer data (messages, mail, graphics and software) to and from other computers or storage devices.

Some trade offs come with this capability. To transfer data from an application, such as a word processing program on one system to a different application on another system, the applications must be compatible. For example, a word processing file won't necessarily transfer to a database file on another system. A user of one integrated software package probably won't be able to communicate with a user of another brand of software package. Even for compatible applications, the data transfer rate may be a limiting factor, particularly for very large files. Even at 9600 Baud (a reasonably fast transfer rate), there is a point at which it is faster for the transmitter to save the data on a floppy disk, walk down the hall, and give the disk to the receiver, accomplishing this task in less time than it takes to pass the information over the LAN.

A SAMPLE LAN IMPLEMENTATION

The Headquarters Air Force Organization of the Joint Chiefs of Staff (OJCS) story is typical of the experiences of large corporations seeking to integrate their information systems (13:--). In 1985, the OJCS established a requirement for a network and distributed data processing system (11:iii). Pentagon officers were using a variety of different data processing systems from several different vendors -- Apple, IBM, Wang, etc. A generic requirement for proposals went out to industry for a system which could perform word processing and would be linked by a local area network. Each action officer would have a work station to use to communicate with other offices, as well as to communicate with units external to the organization. Wang Labs was awarded the contract. Their system consisted of their proprietary LAN called

"WangNet" linking 50 Wang VS-85 cluster controllers. Each cluster could handle 24 to 48 work stations.

Although the Wang system in general ran unattended, certain functions such as hardware maintenance, diagnostics tests, account updates, standards, procedures and policies required operator time. Manpower to accomplish these tasks came out of the organizations "hide " within the OJCS message center (by then renamed the "Information Services Center"). Senior OJCS action officers acted as cluster control operators, in addition to their primary duties. Recently, the cluster control operator tasks were converted to civilian slots. In summary, the LAN lived up to expectations, but the manpower required to operate the system had not been included in the LAN implementation plan.

THE LAN MANAGER CONCEPT

As with any new system designed to perform a task or solve a problem, questions and considerations arise when the system is implemented. In the case of the LAN, these considerations include the subjects of hardware and software maintenance, database maintenance, system and information security, protection of privacy Act information, and so on. An overall network supervisor or "LAN manager" can answer most of these questions (3:--;4:--). Organizations which initially do not have a LAN manager, soon find themselves needing someone to perform the tasks mentioned. An ad hoc manager often arises. This may be a person who initially gets involved in LAN installation or maintenance in order to use the LAN for his own work requirements. Unfortunately, the LAN manager task can quickly evolve into a full-time task. The requirement for an ACSC LAN manager will be addressed in the next chapter.

AN AIR FORCE STANDARD LAN

Stories such as the OJCS example have led the Air Force to look at defining a standard for LAN systems. This standard is being developed by HQ AFCC and HQ ESD and is called ULANA for "Unified LAN Architecture" (9:7-8). The ULANA standard will consist of off-the-shelf hardware and software to provide a broadband (high data rate, high isolation from noise and interference) network for connecting dissimilar computers. The ULANA system should be defined and available sometime in 1988 (16:--).

The industry seems to be moving toward fiber optics transmission media as opposed to coaxial cable. This will provide very high rates of data transfer and in a secure

environment. Fiber optic links can operate at the highest data rates and are difficult to break into, or tap, undetected (2:152).

What does all this mean to ACSC? The LAN system which will be installed at ACSC will provide connectivity between offices, between seminars and between offices and seminars. The system must be reliable, and compatible with the AU MGC-LAN. Therefore it must allow connectivity with the rest of AU and the world. ULANA will be maintained by the Air Force. However, an organization's internal LAN must be maintained by that organization.

In the next chapter, we will examine how the LAN might be configured at ACSC and what specifically ACSC can expect to do with it once it is operational.

Chapter Three

ACSC REQUIREMENTS FOR A LOCAL AREA NETWORK

CURRENT HARDWARE/SOFTWARE ENVIRONMENT AT ACSC

The ACSC LAN will connect the existing microcomputers in each seminar room and office. At this writing, each seminar room at ACSC (44 seminars) has a Zenith Z-158 IBM-compatible microcomputer with 640K internal memory, a 10 Megabyte external hard disk drive, 13-inch color monitor, and an MSP-10 printer. The SMART integrated word processor, database and spreadsheet software package runs on each system. A video switch allows the computer video to be displayed on a 25-inch external color monitor in each seminar room. Twenty-one additional systems are in ACSC offices, bringing the total to 65 systems (14:--).

The current version of the Smart Software System (version 3.1) supports almost thirty different vendor LAN systems (6:23-24). The Smart file format is now compatible with database and spreadsheet software such as Lotus 1-2-3 and dBase II and III (5:1). In addition, Smart allows file and record locking to control user access to the system. ACSC has this version, so we are "network ready" (5:1). Smart can be installed directly on the LAN when the LAN becomes available. This is good news. When the LAN is installed, most of ACSC software requirements will be fulfilled at no additional cost. Some of the uses of the LAN at ACSC will now be discussed.

EXAMPLES OF LAN USAGE AT ACSC

Document Distribution/Electronic Mail

The everyday inter-office communications requirements consume a large quantity of paper and time. The LAN provides a way to transfer correspondence (guidance, memoranda, requests, etc) between offices. Although we may never (and maybe should never) see the paperless office, a lot of our written material might be stored in computer memory at some central location. The material will be displayed on an office's computer monitor when needed. Distribution will be instantaneous and can be sent directly to the intended audience. In this case, the LAN will save both paper and

time.

The LAN opens the door to the Bulletin Board type of communications. Under this concept, a central microcomputer receives, stores and distributes message traffic between users. All of this is done using the LAN. Each user may send messages to other specific offices or seminars where the messages are stored for later retrieval by the addressee. One advantage of this system is the sense of confidentiality provided by the bulletin board. The sender may specify specific addressees, and only these individuals may access the electronic mail intended for them.

Curriculum Development

Local Area Networks have been proven to enhance the curriculum (7:--). The ACSC LAN would provide access to central files of curriculum information. The curriculum developer may access the necessary in-house ACSC databases as well as external databases through the MGC-LAN system. This would decrease the research time involved in curriculum planning. It would also provide essential information to the faculty, such as scheduling information and last-minute corrections. Additionally, seminar guidance and briefing slides may be stored in central files, to be down loaded by the faculty instructor and seminar chairpersons and briefers.

Scenario Exercises

One activity in which the LAN could be used to enhance the ACSC curriculum is the scenario exercise. For example, the terrorism exercise occupies a 2-hour block in the ACSC schedule, during the Low-Intensity Conflict phase of warfare studies. The seminar students are presented with a hypothetical terrorism situation. A group of radicals have taken hostages at the opening ceremonies of the new commissary at a mythical CONUS Air Force base. Through role playing, the students function as members of a crisis management team (CMT) in order to comprehend proper responses to a terrorism threat.

Two students in the seminar act as exercise coordinators and are responsible for monitoring and controlling the timing and tempo of the scenario as the crisis unfolds. The experiences of past exercises have shown that one person alone cannot handle all of the coordinator's duties. The coordinators also control all communications to and from the CMT. They pass messages (by hand) to the CMT leader at scheduled times, and the CMT must communicate with the exercise coordinators by written message. The coordinators act to increase the pressure of time on the players, and to make the exercise as realistic as possible.

The LAN is ideally suited for this type of exercise. The ACSC LAN could increase realism of the exercise with only minor modification of the classroom mechanics. The seminar's microcomputer would act as the communications center and the CMT would be required to communicate with a remote exercise coordinator using the LAN. Messages from the coordinator to the CMT, and responses from the CMT, would be sent via the LAN between the seminar room and the coordinator's terminal. The coordinator would then become physically detached from the CMT and more of an anonymous player, as in a real-world situation. He can also assume the roles of all the remote players in the exercise (on-site commander, local mayor, police, terrorists, and news media personnel) at one time. If an instructor served as the coordinator, all of the students could be actively involved in the conflict resolution as members of the CMT. In addition, an overall exercise coordinator would send certain messages to all the seminars. The seminar exercise coordinator would also handle the unscheduled or contingency inputs and responses.

Wargaming

The Air Force Wargaming Center is tasked and taxed to the limit to provide realistic wargaming capabilities to a variety of users (18:--). The Wargaming Center currently does not have the resources to develop additional wargaming software to run at ACSC. The ACSC LAN would provide a means to use existing software to allow seminar-versus-computer and seminar-versus-seminar type of wargaming exercises. The ACSC curriculum includes running wargaming software on individual microcomputers in each seminar room. The LAN would let seminars communicate with each other as they compete in the wargame.

Later, as more powerful software becomes available, wargaming computer processing will become more interactive, distributing information and processing tasks throughout the LAN. For example, a distributed processing war game would permit each seminar microcomputer to generate its own graphics output. Delegating logistics and order-of-battle calculations to the seminar microcomputers would also free the central control computer to manage the war game. Only networking will permit this capability.

Resource Management

Software costs. One immediate benefit of the ACSC LAN is the area of cost savings in software procurement. This is particularly important in the austere budgeting environment facing the Department of Defense today. This savings comes

about because the LAN version of a software package is usually cheaper overall than the single-user version of the software. For example, the typical integrated software package may cost on the order of $500. License agreements restrict the use of the software to one microcomputer system. Each user must purchase his own copy. On the other hand, the LAN version of the software may cost $700, but additional users need pay only about $100 per station (17:--). The LAN version of software rapidly becomes the cheaper solution.

The laser printer. The capabilities of the ACSC LAN open new communications possibilities. Not the least of which is the ability for several users to share output devices. Most of the microcomputer systems at ACSC already have printers attached which can produce letter-quality text and fair graphics output. Publications-quality graphics must be produced on high-resolution output devices such as laser printers. Laser printers are expensive items, and it seems impractical to purchase one for each microcomputer user.

Although a laser printer is an expensive piece of equipment, using the LAN, the cost per user could be quite low. The author's experience with laser printers while in graduate school provides a good example. The Geophysical Institute's computer facility at the University of Alaska serves up to fifty remote work stations at a time, and yet has only one laser printer. That laser printer handles the publications-quality graphics and text needs of the entire institute. The print files from any number of users are queued up on a temporary buffer file, allowing the laser printer to produce output at its own pace. The ACSC LAN would allow the ACSC microcomputer users to send graphics output to one central laser printer. The host file server would manage queuing of the printer output so that the laser printer would be available to all users with a minimum of delay.

Access to the World's LANs

The implementation of an Air Force standard LAN at ACSC would permit ACSC users to communicate with other organizations as easily as with other ACSC offices and seminars. All of the applications discussed above apply here also. In particular, the rapid distribution of documents, the access to databases world wide, and the potential for communications are mind boggling. Linking the ACSC LAN with other networks will benefit both student and faculty research. On-line searches of databases have greatly improved the efficiency of the data gathering and referencing tasks of research. If the student research report requirement at ACSC remains in the future, the benefits of the LAN are obvious.

IMPORTANT CONSIDERATIONS FOR THE ACSC LAN

Requirement for a LAN Manager

On any LAN system, the LAN manager has ultimate control over access to files. He authorizes and denies file access, locks, unlocks and deletes files when necessary. To avoid chaos, this authority must rest at one central point: the network/LAN manager.

The network manager should install all software on the LAN. This installation procedure requires the user to have full access privileges (6:24), and it is unwise to grant very many people this authority. It would be akin to having too many command pilots in the cockpit. As mentioned in the last chapter, the LAN manager provides a useful, if not essential function.

System Loading Considerations

One important question arises. How much activity can the LAN handle? That is, at what point will the sheer number of users bog the data transfer rate down to the point the LAN can not perform the tasks it was installed to do?

Unfortunately, the answer to this question depends upon the capabilities of the LAN which ACSC procures. This is another area where the LAN manager's role becomes critical. The LAN manager must test the system when it is installed and determine the system's loading limitations. Transmission medium, data flow rate, file storage capacity, and software all influence LAN capabilities (2:--). The network manager can perform the tests to determine such things as how many users can communicate at one time, what size of files may be efficiently transferred, and how many files may be transferred at a time (4:--). Vendor software can monitor system performance as a function of system loading (that is, the number of stations linked to the network, or the amount of activity on the network).

These tests can also help the curriculum planner who will need to know if he can actually use the LAN in the curriculum. For example, can all 44 seminars be connected to the LAN at one time for an exercise? Can the rest of the staff do their LAN tasks at the same time? Who knows? Straight talk with the LAN vendor should provide hints, but the LAN manager must determine whether the LAN will actually live up to expectations.

Smart Software System Considerations

A typical configuration of the Smart Software System might have the software installed on a file server at the LAN host computer. A user would use the software by accessing it via the LAN. As mentioned above, this may bog down the system (increase the response time) when several users try to use Smart at the same time.

Smart documentation suggests the following solution. Work stations with hard disks (almost all of the systems at ACSC) can have Smart installed locally on their hard disk. The users then access Smart locally. Now the users' computers act as stand-alone work stations. They only use the LAN to access files on the remote file server, and transfer data files between the local work station storage device and the remote file server. For multiple users, this speeds up operation and increases through-put (6:42).

What about file access conflicts? "Smart Software System provides protection to prevent loss of data whenever a file could be edited and saved by two users at the same time" (6:53). The Smart Start Guide details what multiple users can and cannot do when simultaneously accessing the same files (6:54-57).

The feature of "customizing" the Smart Software System is very useful. Smart can be set up to satisfy the hardware configurations of the various work stations on the LAN. This allows differing systems, even different brands of systems, to use Smart on the LAN (6:31).

Smart also supports LAN system expandability. "Any number of authorized systems can be added whenever increased need for access to Smart on your LAN justifies it" (6:39). The number of work stations is limited by the LAN capabilities, not the Smart package.

The bottom line: ACSC has the integrated software package in place to meet its data processing and dissemination needs. ACSC just needs the LAN system.

Training

Some training of the LAN users will be necessary. Since all microcomputers at ACSC are using a standard integrated software package, and the package is LAN-ready, software training should be minimal. Access to LAN services are often transparent to the user. For example, when a user copies a file from the remote file server via the LAN, the procedure is the same as copying from one local disk drive to another.

The person who absolutely must become an expert on the LAN system is the LAN manager. He should be thoroughly trained on all aspects of the ACSC LAN. He would then be expected to assist users with procedural problems, and to clarify the information in the LAN and applications software manuals.

Modems

Local Area Networks are fully capable of connecting to all sorts of communications devices, including remote terminals via modems. Several ACSC microcomputers have modems installed already, so modem connectivity with the LAN would not cost anything. Modem access is straightforward. Consider the example of the user with a modem hooked to his office computer. While at home, by using a terminal and another modem, he dials his office telephone number. The office modem answers the phone and connects the user to his office computer. The user logs on to his office computer as usual, and accesses the LAN once logged on. Of course, the user must remember to leave his office computer on! One can see that the flexibility of the LAN can be enhanced by the modem connection.

With the assumption that ACSC will indeed eventually obtain a LAN, the next (and final) chapter presents some specific recommendations and conclusions.

Chapter Four

RECOMMENDATIONS AND CONCLUSIONS

RECOMMENDATIONS

Air Command and Staff should buy a local area network. The LAN would be valuable to the ACSC mission. Networking can play an important part in communications, research, and curriculum roles. There are several important recommendations which should be considered concerning the implementation and operation of the ACSC LAN. These recommendations, based upon this research project's results, are listed below.

Recommendation 1

One individual should be assigned as overall LAN manager. The LAN manager would be responsible for the maintenance of the system, whether performing diagnostics tests, minor repairs, or ensuring contract maintenance does these tasks. He should have adequate diagnostic software to allow him to monitor the status of the LAN system. The LAN manager can accomplish his tasks much more efficiently if he has the necessary LAN monitoring and management software (4:231).

The LAN manager must establish procedures for the granting of access permission, for the orderly operation of the system and for handling system loading problems. This manager also maintains the integrity of files and physical security of the system. In short, the LAN manager will be responsible for the efficient operation and maintenance of the LAN. Especially, he makes sure the LAN is up and running during critical operating periods, such as during seminar exercises.

In addition to maintaining the operational status and efficiency of the ACSC LAN, the LAN Manager would perform ACSC-unique tasks. For example, he would assist the curriculum developer to establish procedures for the distribution of curriculum materials on the network, such as briefing slides.

One person should be assigned as a backup to the LAN manager. This person must be qualified to assume the LAN manager's duties in his absence, and to absorb some of the LAN

manager's workload during particularly busy times. It will also be important to document problems and their solutions. Otherwise, these problems will reappear later on. Documentation also gives some continuity during personnel change over.

Recommendation 2

Those responsible for designing the specific activities for each phase of the curriculum should generate the preferred briefing visual aids using their work stations. The graphics would then be stored on the file server for seminar chairpersons to retrieve as necessary. A standard graphics program should be used throughout ACSC for compatibility among the various microcomputers, and to ease the software training burden.

Some modifications in the classroom environment should be made with respect to presentations of seminars and briefings. The computer/TV monitors in each classroom are presently in the opposite end of the room from the speaker's podium, chalk boards and projection screens. This makes the audiovisual presentations disjointed by forcing the audience to turn around, away from the speaker to look at the graphics displayed on the TV/monitors. For this reason, very few seminar chairpersons use the computer graphics in their presentations, even though they are easy to prepare and readily available.

To enhance visualization, briefing graphics should be displayed on equipment which is adjacent to the speaker. Therefore, the computer/TV monitor should be moved to the opposite diagonal corner from its existing station, in the front corner next to the windows and the chalk boards. Incidentally, moving this equipment will also cut down on the glare from the windows because the TV monitor will then be facing into the classroom away from the windows.

Recommendation 3

A standard database format should be developed so all users can access and distribute information in a common software environment. For instance, student information in one user's database should be in the same format (character length, spacing, etc) as the same type of information in any other ACSC database. An example illustrates this point.

Suppose the ACSC student database exists in the LAN file server. This database may contain student Air Force Specialty Codes (AFSCs) as six-character records. For example AF2546 represents the Advanced Weather Officer AFSC. This record

takes up six characters in the data base. A curriculum developer may want to include the names of all ACSC students with that AFSC in an exercise database. He would use the LAN to access the student database on the file server. Unfortunately, his database is designed to accept four-digit specialty codes, e.g., 2546. There will not be enough room for the AFSC record in his database, so a conflict in format of the record on the two databases must be resolved. The user must either expand his AFSC record to six characters, or strip the "AF" off of each AFSC record before moving the data into his database.

This is a simple example, but it can be a big problem if not considered in the database design early on. A current ACSC research project is addressing this problem (15:--).

Recommendation 4

ACSC should sponsor research to catalog and evaluate available software which can work in the LAN environment. A concerted effort should be made to identify available distributed processing applications which divide the processing among various work stations. This could vastly increase the computing capabilities at ACSC without the need for additional hardware.

Recommendation 5

One Laser printer should be purchased to provide the organization with letter-quality text and publication-grade graphics capabilities. If printer resources are properly managed, one printer should handle ACSC needs, as discussed in the last chapter. Guidelines for using this laser printer must be established and followed. For instance, draft text and graphics should be printed at the local work station printer where lower quality output is acceptable. On the other hand, final publication output would go to the higher quality laser printer. The LAN file server may be used to queue the print output to the laser printer. This procedure would limit LAN loading and keep the laser printer output manageable.

CONCLUSIONS

The Local Area Network provides the ability to connect computers together to perform tasks. There are tangible and intangible benefits of using a LAN in an educational environment. Certain tasks, such as rapid file transfer and instantaneous electronic message traffic, cannot be accomplished without some sort of network. However, an

organization can still rely on the telephone for some types of communication.

Other tasks can be performed more efficiently with a LAN, such as the distribution of prepared information and correspondence. Unfortunately, it is difficult to translate this increased efficiency into dollars or man hours saved without prior basal studies.

As Air Command and Staff College incorporates contemporary and futuristic topics of concern to military commanders, it should also expose these future commanders to the latest technology. Computer interconnectivity will become commonplace in the military, particularly when the Air Force Standard LAN (ULANA) is finalized. Many mid-level career officers will get their first exposure to the capabilities and limitations of local area networks while at ACSC. These future military commanders will form their attitudes concerning the potential of LANs based upon experiences at ACSC. How well these first experiences are received will impact the modernization of our armed forces.

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