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THESIS

Implementing the Modern Office Environment:
Some Experience with Windows for Workgroups,
and Groupware

by

James C. Broadwater
Lieutenant, United States Navy

September, 1993

Thesis Advisor: Tung X. Bui

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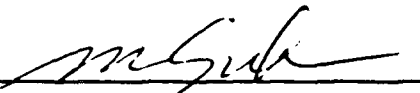MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

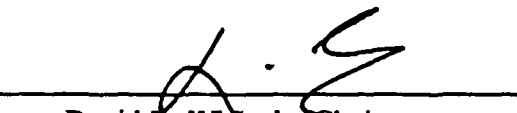from the

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September 1993

Author: _____
James C. Broadwater

Approved by: _____
Tung X. Bui, Thesis Advisor

_____
Myung Suh, Thesis Co-Advisor

_____
David R. Whipple, Chairman
Department of Administrative Sciences

ABSTRACT

This thesis attempts to transform the typical non-digital office into an efficient and productive digital office. The digital office will function as an environment that will operate as a system, integrating routine office functions with groupware. The design will utilize Windows for Workgroups as the network operating system and integrate groupware as tools to enhance office operations. The lessons learned from this experience will serve as a baseline for future experiments in the integration of commercial off-the-shelf products to a networked office environment.

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I. INTRODUCTION

A. BACKGROUND

The term 'groupware' refers to the technology that
supports the collaboration within a workgroup. The design
objective for groupware is to combine a set of collaborative
computing applications to enhance workgroup efficiency and
productivity. The Department of Defense's (DoD) software
acquisition policy dictates that groupware be composed of
items that are of proven technologies, commercial off-the-
shelf products, and proven to DoD personnel. Because of
this constraint many alternatives that are easily feasible
in industry today cannot be utilized in the DoD environment.

Almost any useful computing technology can be useful
towards supporting a groupware environment. The key is for
the application to serve the individual effort while adding
support for group activities. Examples of these activities
include:

- group scheduling and calendaring

- electronic mail

- voice mail

- file sharing

- group decision support

In the article "Why Groupware Applications Fail: Problems in
Design and Evaluation" [Ref. 6], Grudin states:

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Virtually all work is carried out in a social or group context, but 'groupware' requires the designer to consider explicitly that the task is done by a group, with individuals taking on different roles. Thus, consider the differences within these pairs who might work together: author/editor, sender/recipient, speaker/listener, or supervisor/individual contributor. Note too that the same person can shift in role, being author at one moment and then, perhaps when reading a collaborator's contribution, editor. The software must support not only several people working together on a task, but also their potentially different roles in the task.

Another requirement placed on the groupware environment is the ability of software to not only be accessed by all participants but also to identify the person accessing the software and for what specific purpose. [e.g.,Grudin (1989)] For example, a word processor that would support group activities by permitting users to access documents sequentially for the purpose of editing may not qualify as true groupware as it does not permit simultaneous work, identify edits by the user who makes them, or interact with users according to their role. Similar arguments could be made for multi-user databases or scheduling programs. While the premise of this argument is sound, the constraint it adds to system development is often too restrictive. The disparity between those who benefit from the system environment and those that work extra to support it provide the prime area of concern for a successful groupware environment design.

Just as the designer of the first typewriter did not intend to solve all of the potential office paperwork

problems, a groupware design should not present itself as the ideal replacement for anything. It should be the tool set that enhances the efficiency and productivity of an existing operation, i.e.,a collection of tools that can be used by a group over a local area network. It creates a distributed computing environment,exhibiting the capabilities found in the decision room. A groupware design should not be defined in a rigid specification; otherwise "ad-hoc" styled group accomplishment will be prevented through design constraints and limited access privilege. Packaged "one-stop one-box type" of solutions are not the intent of groupware. Instead groupware intends to build an environment that enhances information flow, exhibits an "appealing" ease of use, and most importantly exhibits an equilibrium between the beneficiaries of the environment and those whose work implement and support it.

The wide scope of requirements for a generic groupware is further refined by the activities to be supported within the environment and the familiarity with those activities by the personnel. With the proliferation of the commercial markets with both hardware and software tools packaged as 'groupware' or 'workgroup computing' solutions, it is sometimes difficult to determine which applications to include and which to exclude. Therefore, the groupware design in this thesis will be incremental, starting with the preexisting environment of a typical office within the DoD,

namely the Naval Postgraduate School, and then projecting it
into an environment where more and more tools are to be
integrated. Eventually, the design will meet all the
requirements, creating a truely effective groupware
environment and not a packaged "solution tool."

B. OBJECTIVES

As the definition of groupware becomes more diverse
among academicians, commercial research scientists, and
marketers of "groupware" products, a standard working
definition needs to be made. Products of seemingly great
importance for the future of the digital office, designed on
the leading-edge technology, remain shelved due to
complexity of operation and mostly because they are of
little "real" use to the actual users of the technology.
The differences of opinion in the definition of groupware
have led to many products that demonstrate great advantage
to management but brings inefficiency and more to the actual
users of the technology.

The purpose of this thesis is to prototype a low-cost
groupware that would be truly effective in a typical office
setting. The groupware is expected to enhance the
productivity of co-workers assigned to work on a common
task.

In fact, research during the last few years has resulted
in an increasing number of hardware and software products
that support groupwork such as communication, coordination

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and cooperation. See for example, Grudin (1989.) However, the acceptance and use of groupware has not kept pace with the technological progress. According to Grudin, one of the most significant factors that hinders the acceptance of groupware in organizations is the failure of current groupware technology to adapt into current work practices and flow.

This thesis attempts to provide a groupware environment that can be implemented quickly and inexpensively in any networked IBM-PC compatible computers. The proposed groupware environment is viewed as an enhanced computing environment that supplements the existing computer-based office systems such as word processors and spreadsheet programs.

The benefits of this approach is to introduce groupware functionalities in organizations in the least intrusive way to users, and in a seamless integration with other application programs currently being used on workstations.

The thesis is organized as follows. Chapter II provides a brief overview of groupware technology including the latest effort in exploring the use of multimedia systems, and implementation issues that organizations should consider to enhance the successful use of this new technology. Chapter III develops the groupware environment in a typical office setting and to transform the office into the digital office. Chapter IV describes the implementation of the

groupware environment utilizing tools available to personnel within the Department of Defense. The Appendix details preliminary installation procedures that will optimize the installation of the selected software products used in the prototype.

C. DISCLAIMER

The products described herin are not intended to be the sole solutions nor recommended brand names of the Department of Defense. Also, as with usual software guarantee limitations, the personnel responsible for the design of this prototype assume no responsibility for any failures experienced during replication.

II. A BRIEF OVERVIEW OF GROUPWARE TECHNOLOGY

This chapter provides an overview of groupware both from the point of view of technology and from the point of view of its implementation in organizations.

A. DEFINITION OF GROUPWARE

Groupware is defined as an "electronic or telecommunication tool designed to facilitate the collaboration of teams" [e.g. PC Week, 1991]. In a groupware context, a team is a group of workers who are assigned to a common task. To complete this task, group members typically have to collaborate somehow with a varying degree of coordination, communication, and cooperation. Groupware is designed to provide organizations with the most sensible way to distribute information as effectively as possible to their workers.

B. TEAMWORK IN ORGANIZATIONS

Teamwork is recognized as playing a crucial role in organizations. Management scientists emphasize the importance of teamwork in groups because groups promote: [Ref 1]

- Growth of Knowledge — No one person has all the needed information to the problem at hand; the group has a greater sum of information

- Consolidation of shared vision

- Team members to challenge and build on others ideas

- TQM and consensus building, i.e., working together to make a difference

However, groups in organizations often foster counterproductive habits. These pathologies are caused by some of the following characteristics:

- Members—inadequate communication skills, wrong participants, absenteeism, wishful thinking and belief, commitment to an issue

- Groups—lax risk assessment

- Organization's slow response time, problems in group meetings

- Poor organizational support for groups

- Environment not very conducive to communication, team building and consensus

- Poor meeting skills training

- Lack of facilitation

- Unclear organization/group/individual reward mechanisms

- Missing group support as a mechanism for organizational learning

Groupware can be seen as an avenue to at least partially solve these group problems.

C. GROUPWARE AS A FORM OF COLLABORATIVE COMPUTING

As such, groupware is a form of "collaborative computing" that helps people work together [Ref. 7]. Collaboration between members could take different forms:

- Groupware for Information Sharing

- Groupware for Workflow Management

- Groupware for Group Decision Support

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- Groupware for Negotiation Support

1. Groupware for Information Sharing

The purpose of information sharing is to help the
organization manage "shared" information by delivering
relevant information to appropriate decision makers.
Examples of such groupware include electronic bulletin
boards, electronic mail, electronic boardrooms, and
information centers. The design of these systems is based
on the concepts of environment scanning (collecting
information into repositories), information diffusion to
pertinent decision makers using contextual analysis and
information filtering.

Implementation of groupware to promote information
sharing requires efficient networking (e.g., LAN and WAN)and
concurrency control mechanisms.

2. Groupware for Workflow Management

Groupware for workflow management strives to help
manage processes or workflows for a workgroup. The design
of workflow management software is based on the concept of
shared mental models, coordination theory using data flow
models, intentional models, and coordination expertise.

Process analyses and (re)-engineering are
implementation techniques used to model the management of
group processes.

3. Groupware for Group Decision Support

A team often requires intense negotiation before it can reach a group decision. Group decision support systems seek to help manage group decision processes and outcomes. These systems may be designed for cooperative versus non-cooperative and distributed versus face-to-face decision settings. A groupware to aid in group decision support should include issue structuring and analyzing tools, group decision techniques, and voting methods.

4. Groupware for Negotiation Support

The focus of negotiation is to help search for consensus. An example of this groupware would be a negotiation support system. In designing a negotiation support system, concepts of individual versus group methods of decision making need to be understood. Negotiation models, game theory, and behavioral models of negotiation are techniques used in the implementation of groupware for negotiation support.

D. GROUPWARE: TIME AND SPACE

Th. design of groupware varies depending on the dimensions of time and space it has to bridge. These collaborative systems create an environment that allows the sharing of information without the constraints of time and space. Time/space collaboration systems focus on the time and place of the interaction of the workgroup and may be grouped in the following categories [Ref.7]:

| | TIME | |
PLACE	SAME	DIFFERENT
SAME	**FACE-TO FACE** *Occurs at the same time and place*	**ASYNCHRONOUS** *Occurs at different times but at the same place*
DIFFERENT	**DISTRIBUTED SYNCHRONOUS** *Occurs at the same time but at a different place*	**DISTRIBUTED ASYNCHRONOUS** *Occurs at different times and at different places*

Table 2-1 Collaborative Interaction in the Dimensions of
Time and Space

The interactions illustrated above can be translated

into examples of the different forms of collaboration

between group members as discussed in the previous

section.[Ref.5]

| | TIME | |
PLACE	SAME	DIFFERENT
SAME	*Meeting Facilitation*	*Team Rooms Work Shifts*
DIFFERENT	*Tele- ,Video, Desktop-Conferencing*	*Electronic Mail, Computer Conferences, Collaborative Writing, Workflow Management*

Table 2-2 Collaboration Forms

The dimension of predictability can be added to the two

dimensional environment depicted above to further refine the

collaborative forms of interaction into three dimensions.

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| | TIME | | |
PLACE	SAME	DIFFERENT/ predictable	DIFFERENT/ unpredictable
SAME	*Meeting facilitation*	*Work shifts*	*Team rooms*
DIFFERENT/ predictable	*Tele-, Video-, Desktop Conferencing*	*Electronic and Voice Mail*	*Collaborative Writing*
DIFFERENT/ unpredictable	*Broadcast Seminars*	*Computer Conferences*	*Workflow Management*

Table 2-3 Three Dimensional Map of Technology Areas [Grudin and Poltrock 1992]

The table above depicts the dimensions as barriers that prevent any interaction between the cells. However, work activity actually spans all of the dimensions. Therefore, groupware properly designed and implemented will also span the dimensions to meet its intended use.

E. NEW TECHNOLOGY TRENDS FOR GROUPWARE

Currently, groupware is just out of its infancy. Products are available, but business is only beginning to embrace them and most applications have not had time to mature into efficient and productive workgroup tools. Two important technological trends concerning groupware are:

- Multimedia

- Wireless Connectivity to Support Mobile Computing

1. Multimedia

According to studies, audiences retain 20 percent of what they hear, 40 percent of what they see, and 70 percent of the information learned through interaction [Ref.8]. Existing workgroup applications can be made more productive

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with the addition of multimedia. Multimedia support for workgroup applications requires the addition of high quality audio, compact disc quality video and sound, and the possible use of full motion video. Future interaction among workgroup members may not only replicate face to face meetings but replace them.

2. Wireless Connectivity to Support Mobile Computing

Local area networks and wide area networks are the infrastructure of groupware. In turn, electronic mail (e-mail) across LAN's and WAN's serve as the software foundation of groupware [Ref.13]. While e-mail isn't really groupware, it is the vehicle for most groupware applications.

The current technological trends towards wireless LANs allow many groupware applications to run in a mobile environment. Examples are remote scheduling, voice mail, and remote voting systems.

Dropping prices and more robust technology are the biggest inducers of wireless LAN technology to networks [Ref.4]. As systems evolve to their most optimal use, wireless networks make the environment less formal and portable. Recent academic studies have concluded that traditional meetings may not be the most efficient way of handling traditional business problems. The idea is that face-to-face meetings tend to be dominated by personalities, and since ideas are what meeting organizers are interested

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in, filtering out personalities via structured interactions over a computer networks promote more productive results [Ref.13].

F. EXPECTED BENEFITS

The benefits of groupware such as an Electronic Meeting System (EMS) and a Group Decision Support System (GDSS) are as follows: [Ref.1]

- Enables larger meetings
- Brings structure to unstructured meetings
- Provides corporate memory and timely environmental scanning
- Promotes equal oppoxtunity for participation
- Allows simultaneous and parallel human processing
- Enhances task focus and problem solving
- Permits fewer meetings in less time
- Increases quality of meeting output
- Increases group satisfaction(especially post-meeting data/resolution distribution well appreciated)
- Increases group cohesion
- Changes work group structure
- Suggests that low computer literacy not deterrent
- Underlines the importance of pre-planning

G. ISSUES IN IMPLEMENTING GROUPWARE

Prior to implementing any groupware for a specific workgroup environment, whether it be a small group, planetary group, or decision-making group, there must be

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pre-planned solutions to issues which will impact the
probability of success of the groupware. Some include:
[Ref.1]

- Scope of area to be included in the group

- Composition of the group

- Primary tasks to be completed by the group

- Goals of the group after installation of the
  groupware

- Group hierarchy/access rights

- Impact transformation will have on normal operations

- Training

III. A DESCRIPTION OF A GROUPWARE ENVIRONMENT

The purpose of this chapter is to propose a groupware environment that is cost effective, while mobile or flexible enough to fit a typical teamwork environment. The rationale for this chapter is that if the proposed configuration can be implemented and operational, it will provide a solid proof-of-concept for a customized groupware that would fulfill the requirements of any teamwork.

A.   IMPLEMENTING GROUPWARE AND OFFICE SETTINGS

1.   A Description of a Generic Office

Figure 3-1 depicts a typical office setting in which workers at management levels have their own office with desktop computing power. The office manager or secretary often plays the role of the coordinator by arranging meetings, preparing relevant documentation, keeping the appointment calendar of the office staff, and distributing mail.

In a digital office setting, offices are typically equipped with networked desktop computers, phone systems, facsimile/modem, printers, scanners, OCR, intercoms and software for office use (i.e., word processors, database management system, project scheduler, spreadsheet, presentation/graphics software, and communications software.)
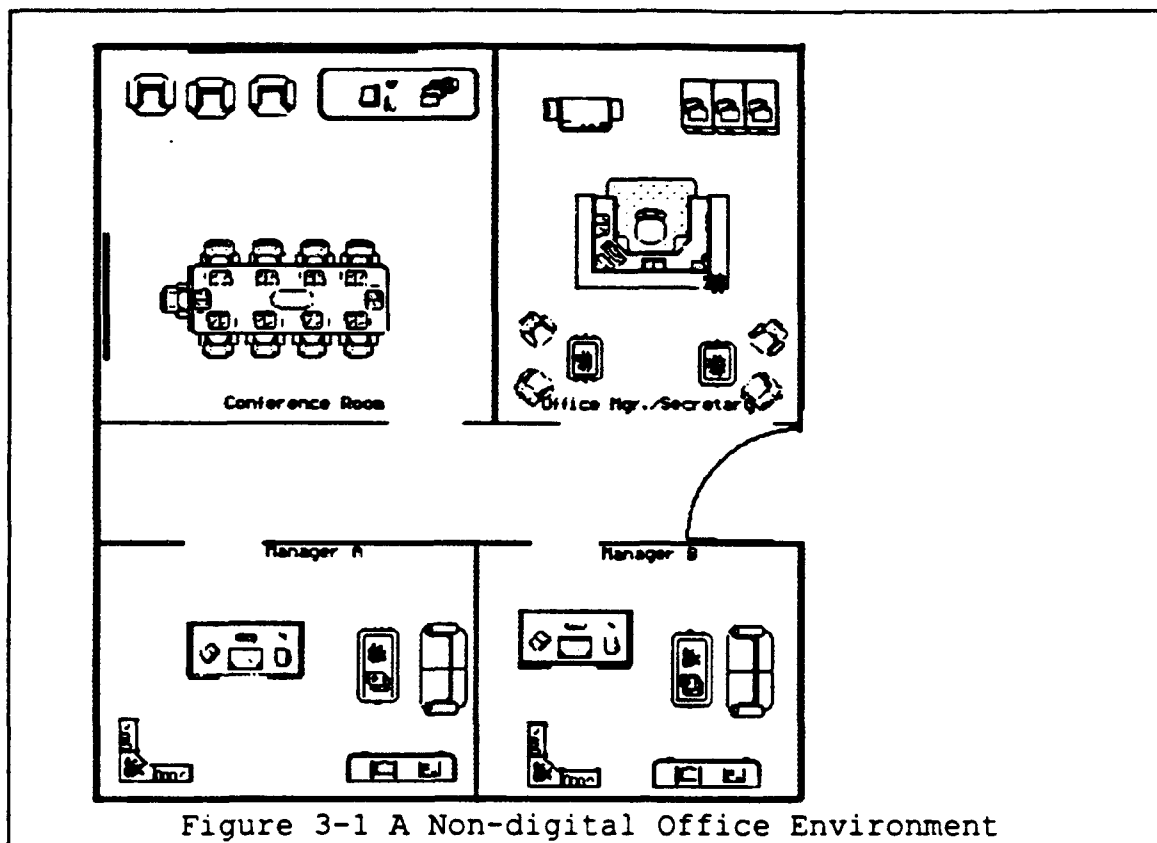
Figure 3-1 A Non-digital Office Environment

The staff often consists of co-workers sharing a same mission but assuming different roles.

2. Configuring the Typical Office to the Groupware Environment

Configuring a groupware for a typical office environment involves attaching PC's to the local area network, installing the network operating system that provides all network functionalities, and installing and executing groupware applications. This procedure would include the selection of the best network operating system, user interface, and the most appropriate application software described in the preceding sections.

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Several alternative configurations can be derived for the basic office setup. Discussion will be limited to the typical office setup, configuring the groupware in one of the following modes: the decision room mode, a distributed decision mode setting, or a combination of the decision room and distributed setting.

3. Decision Room Mode

The decision room mode is incorporated via a facility equipped with leading-edge technology and physical surroundings to maximize comfort, display visibility, and group interactions The installation described by Vogel and Nunnamaker [Ref.14] corresponds to this design mode. Although the physical organization may not be identical to the detail of the decision room described in the reference, this design will provide an optimal setting utilizing criteria from proven designs. The hardware will consist of an appropriate number of PC's, either installed, portable, or laptop. All will be connectable to the network and therefore all will have dynamic access to the software available on at least one of the PC's. This portability of a stationary design provides the advantage that the decision room mode described in the reference cannot, which is the familiarity of using one's own PC. A generic desktop that is supposed to empower the majority of users the majority of the time and is easy to operate by the majority of the people tested is no longer an issue. A facilitator merely

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sets up and tests the groupware environment for easy access.
Attendees simply plug into the network and start their
session. The ancillary equipment will be supplied and
positioned by the facilitator.

Figure 3-2 A Digital Office Environment
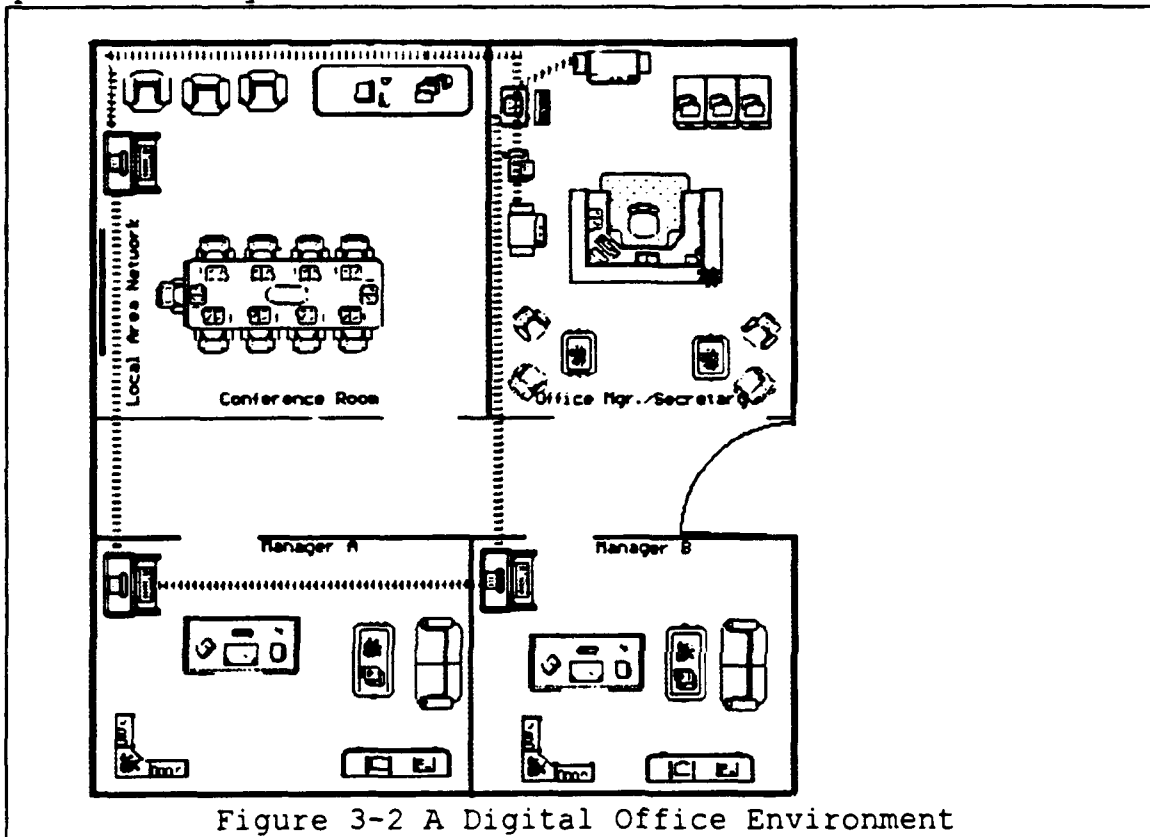
4. Distributed Decision Mode

The distributed decision mode applies to
applications that allow team members to utilize networked
group decision support software within the confines of their
offices. Team members can input their preferences either in
a scheduled electronic meeting at their desktop PC's or even
prior to a decision point deadline when their own time
schedule permits. The advantage of this decision mode is

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that a facilitator is not needed and time is not required by team members for outside attendance.

5. Decision Room/Distributed Decision Mode Combination

In this combination of the two setting modes, members are required to attend decision meetings but attendance is at their own desktop PC's within their offices. Either video applications, voice applications, or recorded sessions may be utilized to facilitate this event.

B. SOFTWARE AND HARDWARE REQUIREMENTS FOR OFFICE GROUPWARE

1. Software Requirements

As described earlier, the broad spectrum of software currently available cloud the description of groupware to the point of uncertainty. The recommended design of the groupware environment will utilize IBM type PC's with the following software functionalities:

- Installed Disk Operating System

- A Network Operating System

In addition to the functionalities of the systems software, the following applications should be supported:

- Word Processing

- Spreadsheet

- Database

- Communications Program

- Electronic Mail

- Voice Mail

- Scheduling/Calendaring Program

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- File Sharing capability

- Group Decision Support Software

The above listed application software is generic to a certain extent. All with the exception of some Group Decision Support software are readily obtainable from commercial vendors. The specific software selected is determined by company or organizational preference and its compatibility with the systems software installed in the workgroup PC's. The following paragraphs will address specifics required of the functional and application software as they relate to optimizing the groupware environment.

2. Hardware Requirements

The hardware includes individual PC's, normally of the IBM or clone type. Although other manufacturer's computers are available it is agreed that the Intel-based PC's are more commonly available and more familiar to personnel within the DoD. Each PC is equipped with:

- a 386 based processor

- at least 4MB RAM, 8MB recommended

- a hard disk of sufficient space to support the operation for which it is specified and for the storage of the data

- two floppy disks drives are to be used, one 5¼" and one 3½"

- A high resolution color monitor with associated VGA or SVGA graphics adapter installed and accompanying software drivers

- a mouse or template-designated function keys to interact with the system

- a 16 bit Ethernet network adapter card and associated software drivers

The following accessories need not be installed in each PC, but at least one of the following is required to be installed on one of the PC's on each associated workgroup:

- modem, at least 2400 data baud, preferably a fax modem operating at V.32bis

- printer, either dot matrix or laser

- remote network access, a capability for remote phone access to the workgroup local area network

- a video display board capable of displaying full-motion video clips as well as stills at reasonable definition, preferably 800X600 pixels. This will give the capability of embedding video into electronic mail messages as well as application's data files

- a sound board capable of playing CD-quality 16-bit audio, as well as business audio which includes voice messages, voice annotation of documents, and voice recognition

- a CD-ROM with associated software drivers

The hardware requirements described above are designed to utilize preexisting equipment while providing the users with the capability of sharing multimedia information if needed to enhance documents and enrich media presentation. While the hardware will support a wide range of capabilities within the scope of the original design environment, the ability to access other distributed information networks influences further groupware optimization.

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a. *Disk Operating System, User Interface, and Network Operating System*

The operating system software must be of a version that is compatible with the version of Windows interface and network operating system. Since these systems software operate in the background for most of the time, with the exception of the user interface, they can be chosen based on the compatibility of the system and application software already in use.

The network operating system will interact with the disk operating system and the Windows user interface software, sometimes replacing the character-based user interface. The network operating system also provides the basis for some of the applications that are required in the groupware environment. Electronic mail, voice mail, file sharing, and scheduling come packaged with some network operating system software.

b. *Word Processing, Spreadsheet, and Database*

Word Processing, spreadsheet, and database programs are usually selected based on a preference or requirement by the company or organization. Since the design constraint dictates the use of equipment previously installed and already in use, these programs are most likely already in place.

c. *Electronic Mail*

Electronic mail provides users with the ability to send messages across the network confines. A "chat" mode

enables users to type on-line messages in real time as a simplex teletype system does. An advanced electronic mail software should also have the capability to share files, add voice and video annotation, and schedule on line.

d. Voice Mail

Voice mail capability as a stand alone is different from the ability to annotate mail documents. Voice mail is more like an telephone answering machine where users leave voice messages that can later be answered as messages left on the senders machine. A voice "chat" mode is also available with some systems so users can chat in real time over the network. This allows users to remain at their workstation and continue working while talking.

e. File Sharing

File sharing can be utilized in many different modes. Most common is the sharing of documents from word processors, spreadsheets, or databases. Shared users can author, annotate revisions or editions, or pass the document on to other users. These processes can also be accomplished by many users simultaneously instead of sequentially. File sharing is accomplished by a file manager either in the disk operating system or the Windows environment. Unlike file sharing in the electronic mail system, this type of sharing involves granting an access to the hard drive of a selected PC on the network. The access may be limited to 'read only' or may extend to full read and write capability. File

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sharing is the most complicated capability to design and implement as it requires a complex plan of access across users. Since these accesses may change, a system administrator may be required to manage these changes. Preplanning of any type of implementation is a requirement and the type of software used will have direct impact on the complexity of the implementation. The groupware environment as designed will require a sort of file sharing access matrix that should be more dynamic than static. Although most workgroup operations should have a plan of action and schedule of events, the groupware environment should not prevent all "ad hoc" type of activities.

f. Group Decision Support Software

In the event that the workgroup needs assistance in attaining a consensus for a decision, a software package to support group decision making may be used. There are two approaches to decision making. One is a cooperative approach where the parties involved make a cooperative decision based on prioritization of decision variables. The other is a negotiating decision based on two parties negotiating for a solution. The ability to accomplish this in a distributed environment or a decision room setting will be discussed in detail in the following section. However, these capabilities will exist transparently across the system in either setting. Other enhancements to the decision support software will include a wireless remote

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voting system. This system will optimize the decision room environment.

IV. AN IMPLEMENTATION OF A GROUPWARE ENVIRONMENT

A. INTRODUCTION

The purpose of this chapter is to illustrate how a groupware environment could be implemented, based on the criteria developed in the previous chapter. In doing so, the network operating system selected was Microsoft Corporation's Windows for Workgroups (WFW). As daily tasks in the office become more complex, the capabilities of the office equipment must be upgraded to meet the needs of the office personnel. WFW is a simple, commercial-off-the-shelf, peer-to-peer network software that readily and inexpensively meets most of the needs of the groupware environment. A peer-to-peer network is one in which all of the associated PC's in the network are essentially equal. That is, there is no one PC which controls or routes work from the others. The other network configuration, the server-based system is one in which all associated PC's, the clients, are controlled from one central PC, the server. WFW is actually Microsoft's Windows version 3.1 with built-in networking and workgroup capabilities. The networking capabilities are easy to set up, learn, and use, and offer a cost-effective way to share information across a standard platform. WFW has the capabilities to share files, peripherals, and applications. This saves each user the requirement to equip each PC with CD-ROM drives, laser

printers, modem, and so on. It also increases productivity because documents can be easily passed throughout the office with the ability to edit, cut, and paste from one person's work to anothers.

The next portion of the operating environment to be described is the effect multimedia will have on the groupware environment. Multimedia is defined as the addition of sound and video to applications to enrich the man-machine interaction. By choosing WFW this addition will be simpler for the most novice of computer users. WFW can easily share CD-ROM drives. Although each PC will be required to have a sound card installed, this addition is well worth the cost. With a sound board installed, a sound system can be incorporated into each workgroup workstation. This greatly enhances the capabilities of the workgroup as all equipped workstations will now be capable of utilizing voice mail and on-line "chat mode," a function of mail. Voice annotation of word processing documents and spreadsheets can also be included as increased capabilities.

Additional capability will be added to the digital office groupware environment by installing two group decision support system programs. CooP™ and NeGo™ will be utilized to aid in the decision making capability of the networked digital office environment.

In defining the operating environment, it was determined that a typical *non-digital office* would be transformed to a

digital office by utilizing the specified groupware applications. A brief description of each selected software will be provided followed by the implementation description.

B. AN OVERVIEW OF WINDOWS FOR WORKGROUPS FEATURES AND SYSTEM REQUIREMENTS

This section will deal with the different features of WFW as applied to the digital office environment. Once installed as directed in the appendix, WFW will have the functionalities as described below.

1. File Sharing and Network Connectivity

The File Manager in Windows ver. 3.1 allows the user to manage local files. In WFW it also performs the necessary network functions such as accessing files located someplace else in the workgroup, sharing files located within your workstation with another workstation accessible by your workgroup, and the sending and receipt of electronic mail. To share files, workstations must be operating in the 386 enhance mode in WFW, but to access directories located elsewhere in the workgroup, either 386 enhanced or the standard mode is acceptable. WFW can be run in two different modes: Standard or Enhanced. The difference is based on what kind of PC is utilized[1]. To access the File Manager, double-click the filing cabinet icon within the Program Manager.

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[1]Basically, standard mode requires a 80286 processor and at least 2 megabytes of memory. Enhanced mode requires at least a 80386SX processor and at least 4 megabytes of memory. [Ref.9]
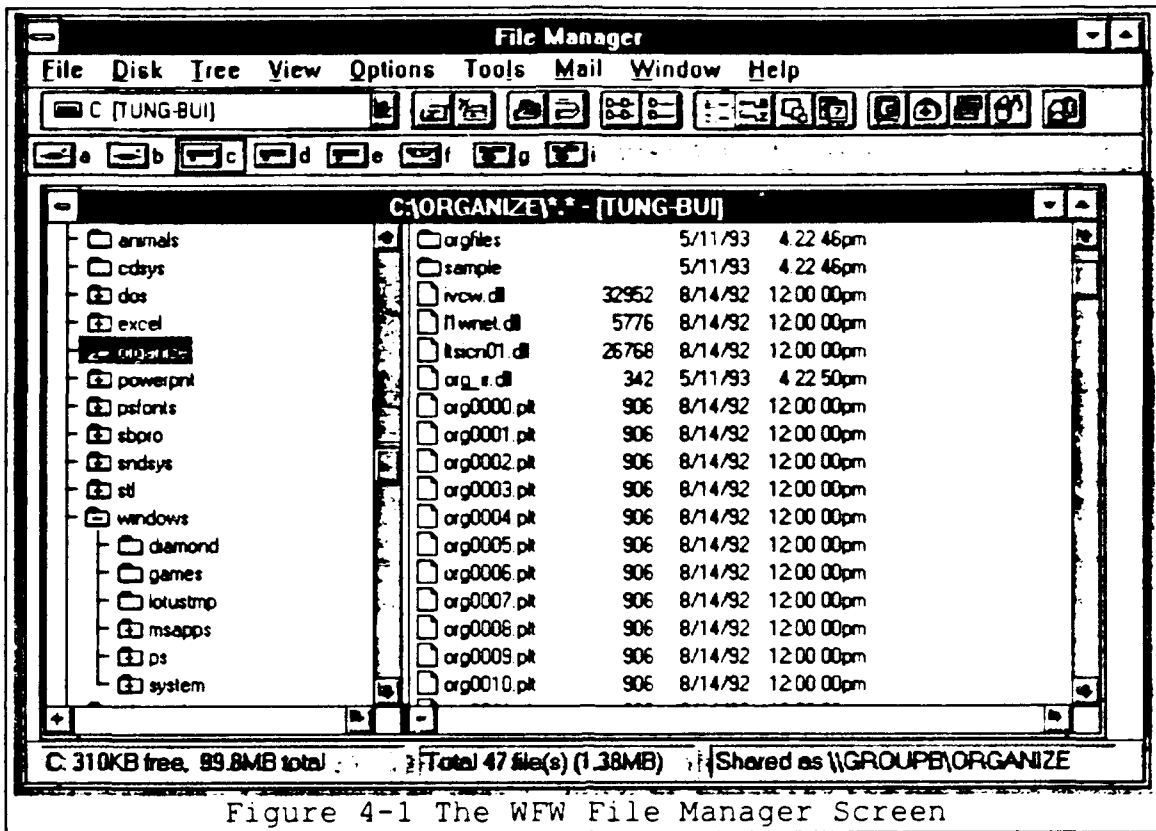
Figure 4-1 The WFW File Manager Screen

Figure 4-1 represents the file manager as it appears in the 386 enhanced mode. To fully utilize the capabilities, the user must be familiar with the Tool Bar which is a row of icons that are exclusive to the WFW file manager. The features of the tool bar are explained below in the same order as they appear on the File Manager screen: [Ref.9]

- *Connect Network Drive* - Click on this to connect to a shared directory

- *Disconnect Network Drive* - Click on this to disconnect from a shared directory. Another way to disconnect from network drives is by choosing Disconnect Network Drive button from the Disk pull-down menu

- *Share As* – To mark a directory for sharing , click on this button, select the directory to share, and click OK

- *Stop Sharing* – To stop sharing a directory, click this button, select the directory to stop sharing, then click OK

- *Show Filenames Only* – Click this button to change the configuration of the file listing on screen. This configuration will display filenames only leaving room to display more filenames

- *Show All File Details* – Click this button to display full information on each file, such as size, date and time it was created

- *Sort Files by Name* – Click this button to sort files alphabetically by name

- *Sort Files by Type* – Click this button to sort files alphabetically by type, i.e., .EXE, .DOC, .TXT, .DLL, etc.

- *Sort Files by Size* – Click this button to sort files by size, the largest being the first to be displayed the smallest being the last

- *Sort Files by Date* – Click this button to sort files by date

- *Send Mail and Attach Selected Files* – Click this button to send mail directly from the File Manager. Just highlight the file or portion of the file to be mailed, click on the Mail button, type the correct password and it will be sent

The most important point to remember when sharing files is that WFW does not control access to individual files, only to directories and subdirectories. Every file and application in a shared directory and all subdirectories beneath it are available to any workgroup member that has access to that directory. Therefore, it is important to plan which files are to be shared. A small workgroup, as

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the digital office depicted in the groupware environment,
might place all shared files in a common workgroup
directory. This will enable individual office members to
still be able to have files that are private and unreachable
by others in the workgroup. To mark a directory for
sharing: [Ref.9]

- Click on the *File Manager* from the Main program
  group

- Select the directory that is to be shared from the
  Drive bar

- Click the *Share As* button on the Toolbar

- The directory that is chosen will automatically be
  entered in the Path line. Also the "Access
  Rights" and "Passwords" sections of the dialog box
  can be filled to select access privilege desired
  and password if required

- Click the OK button

WFW can access files from connected networks such as
LAN Manager© or Novell NetWare©, however users on those
networks cannot access files from WFW workstations even if
those files have been marked as shared. [Ref.9]. As stated
above, once the Share As button is clicked, access right
needs to be determined. There are three levels of access:
Read Only, Full, and Depends on Password. If no password is
entered in the appropriate box, then Read Only or Full
access is granted to everyone in the workgroup, whichever is
selected. Read Only is the default value set to all
directories that are shared. If only certain members of the
workgroup are supposed to have Read Only access, then a Read

Only password would be appropriate. By using this method

only persons with the corr. password would have access to

shared Read Only files. Full access is also known as

read/write access. All files in the directory marked for

Full access can be used by all workgroup members as if they

were residing on their office PC's. As with Read Only the

password function can enhance the security of the

directories given Full access. Lastly, the Depends on

Password utilizes the best functionalities of both of the

aforementioned access controls. Depends on Password allows

the user to assign a password to give Read Only access to

files in a directory, while a different password can give

Full access to the same files in the same directory. This

function can provide great flexibility for the network

within the digital office. A document can be passed around

the office electronically, allowing some individuals to

review it while others have the capability to amend or edit

it.

      After determining the optimal selections for file

sharing and access rights for the digital office setting,

the network connections between workgroup workstations need

to be completed. This is all done within the WFW File

Manager toolbar. As specified in the preceding section,

simply click on the *Connect Network Drive* icon on the

toolbar. A display will appear as in the following figure.

```
┌──────────────────────────────────────────────────────────┐
│ ▬              Connect Network Drive                      │
├──────────────────────────────────────────────────────────┤
│                                                          │
│  Drive:      [□J              ]  ⬍    │   OK    │        │
│                                                          │
│  Path:       [\\GROUPA\        ]  ⬍    │ Cancel │        │
│                                                          │
│              ☒ Reconnect at Startup    │  Help  │        │
│                                                          │
│  Show Shared Directories on:                             │
│  ┌───────────────────────────────────────────────────┐  │
│  │ 🖥 NPS                                             │  │
│  │ ▐ GROUPA                                          │  │
│  │ 🖥 GROUPB                                          │  │
│  │                                                   │  │
│  │                                                   │  │
│  └───────────────────────────────────────────────────┘  │
│                                                          │
│  Shared Directories on \\GROUPA:                         │
│  ┌───────────────────────────────────────────────────┐  │
│  │ 📁 COOP                                           │  │
│  │ 📁 COOP2                                          │  │
│  │ 📁 EXCEL                                          │  │
│  │ 📁 NSS                                            │  │
│  │ 📁 WGPO                                           │  │
│  └───────────────────────────────────────────────────┘  │
└──────────────────────────────────────────────────────────┘
```
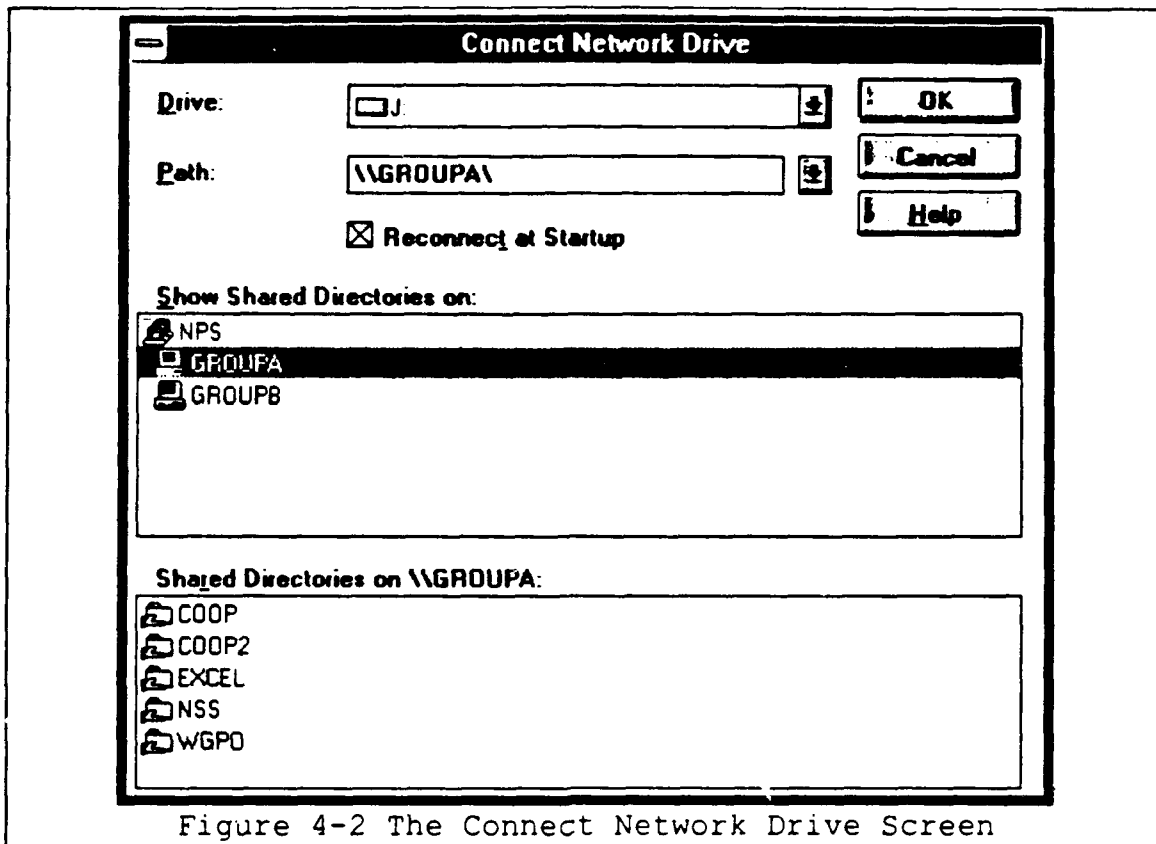
Figure 4-2 The Connect Network Drive Screen

Figure 4-2 displays the shared directories for each defined

workgroup. (See Appendix). Once the proper selection is

made, the Path will be automatically inserted in the correct

box. Each time that the *Connect Network Drive* is utilized

to share directories, a new drive icon is automatically

displayed in the drive box and next to the toolbar in the

File Manager. This enables the user to directly access the

drive by just clicking on the appropriate icon. Remember to

click on the "Reconnect at Startup" box prior to clicking OK

to restart the connection each time the workstation is

turned on. Finally, click the OK button and the connection

is made. The only limitation to this operation is the

number of drives connected to any workstation cannot exceed

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the number listed in the "LASTDRIVE= command in the

CONFIG.SYS file. Once the file sharing matrix of operations

has been determined and implemented using the directions

provided above, WFW should now be tuned for optimal

performance. Perform the following: [Ref.9]

- From the Main program group, Click on Control
  Panel

- Open the *Network* icon. The screen will appear as
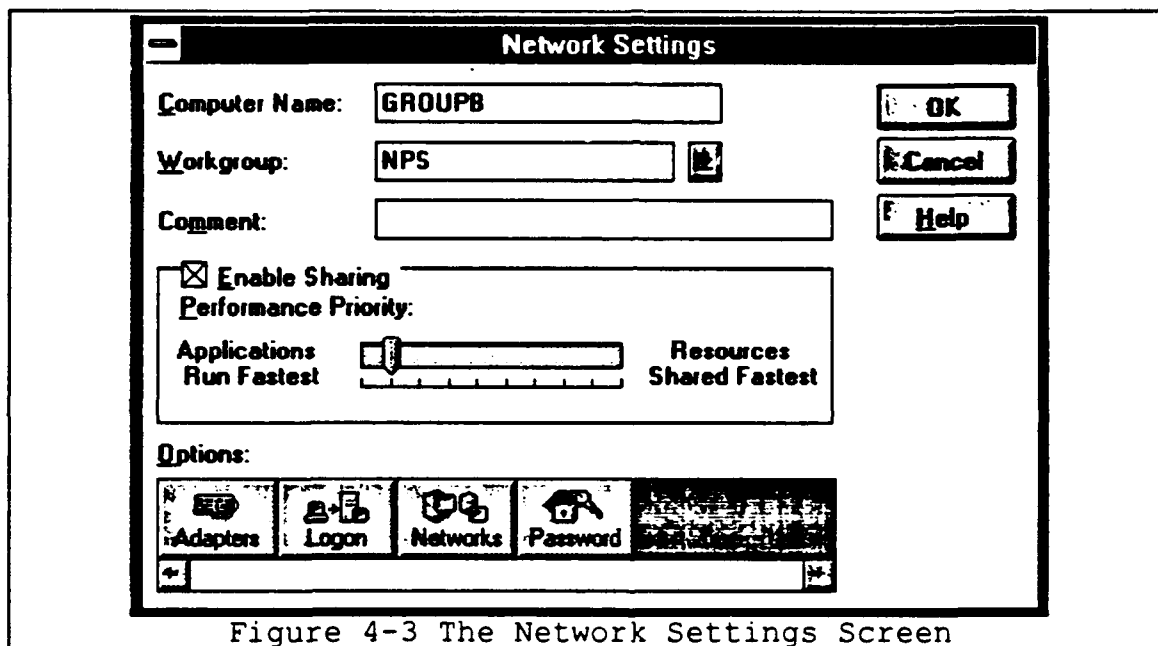 in Figure 4-3 below

Figure 4-3 The Network Settings Screen

The slide bar marked *Performance Priority* is the key

to maximizing WFW performance. To do so select the most

appropriate setting using the following rules of thumb:

- Applications Run Fastest - when the home PC is
  utilized heavily for local work and most
  applications are resident

- Resources Run Fast - home PC is heavily used by
  others in the workgroup and home PC is rarely used
  locally

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The above descriptions only discuss the endpoints of any possible configurations and any operation in-between can best be optimized by trial and error.

There are other ways to share files using WFW. One alternative is if most members of the workgroup use the same applications then network performance can be improved by having all members run their applications locally and share only the data from those files. There are three ways to share data using Windows and WFW: [Ref.10]

- Clipboard for Windows ver. 3.1 and Clipbook for WFW

- OLE (Object Linking and Embedding)

- DDE (Dynamic Data Exchange)

These three alternatives are usually reserved for the more advanced users and to completely master these techniques technical documentation should be reviewed.

2. Printer Sharing

The number of printers assigned to the network will depend on the size and desires of the workgroup. Any combination of printers may be utilized depending on the availability of the printer drivers as they must reside on all PC's in the workgroup for their use to be available to them. Usually a laser and a dot matrix are made available to each workgroup to satisfy most office needs. In order to share printers among workstations in the workgroup the following steps must be completed: [Ref.9]

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- Physically connect the printer to a workstation. This station will be the *Print Server*

- Install the appropriate printer driver on the print server and all workstations that will require use of the printer

- Complete the steps required to make the printer available for sharing

- Connect the other workstations to the network printer

The printer driver is the software that allows WFW to operate the printer or printers. If the printers to be utilized were selected during the WFW installation or upgrade, then the printer drivers were already installed. If unsure, click on the *Print Manager* in the Main program group. If the display does not show the desired printer or printers to be utilized by the workgroup, then the correct printer drivers need to be installed. Installing, adding additional printers, or deleting printers is accomplished in one of two methods:

- From the Main group, click the *Control Panel* icon, then on the *Printers* icon

- From the Main group, click on the *Print Manager* icon, pull down the Options menu, and then choose Print Setup

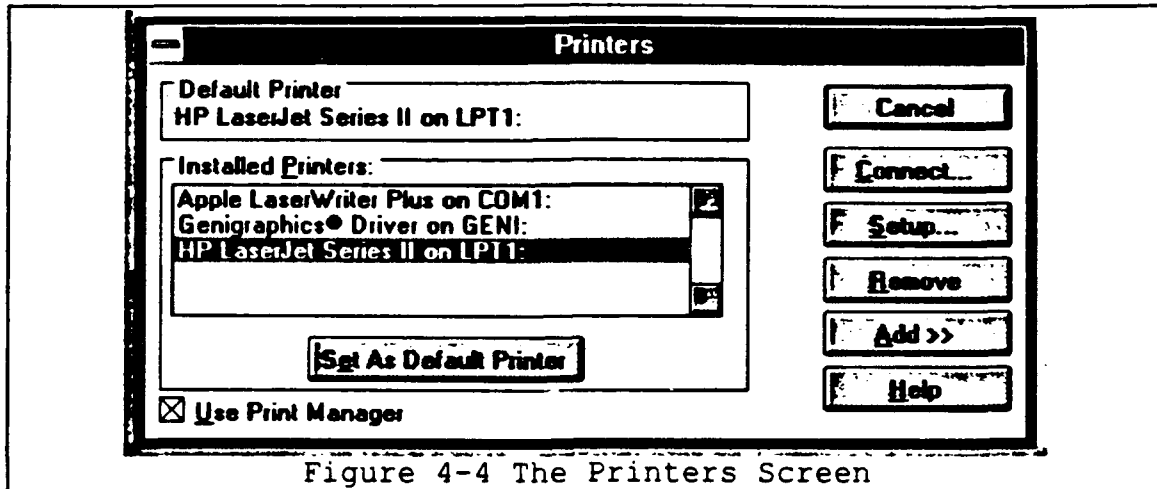In either case the outcome will be the WFW *Printers* screen shown below.

Figure 4-4 The Printers Screen

Figure 4-4 shows the printer installed and a list of printer
drivers available for installation. If a FAX modem is to be
used by the workgroup, its driver will also be displayed in
the Installed Printers box. FAX modems can be shared just
like printers but special "server software" must be
installed on the workstation to which FAX modem is
physically installed and special "client software" must be
installed on each workstation that will share its use.
[Ref.9].

After the printer or printers are physically
installed and the appropriate printer driver software is on
all workstations in the workgroup printers can be made
available for sharing. Like sharing directories
workstations must be running in the 386 enhanced mode to
share printers. To share a printer:

- From the *Print Manager* select the printer for
  sharing

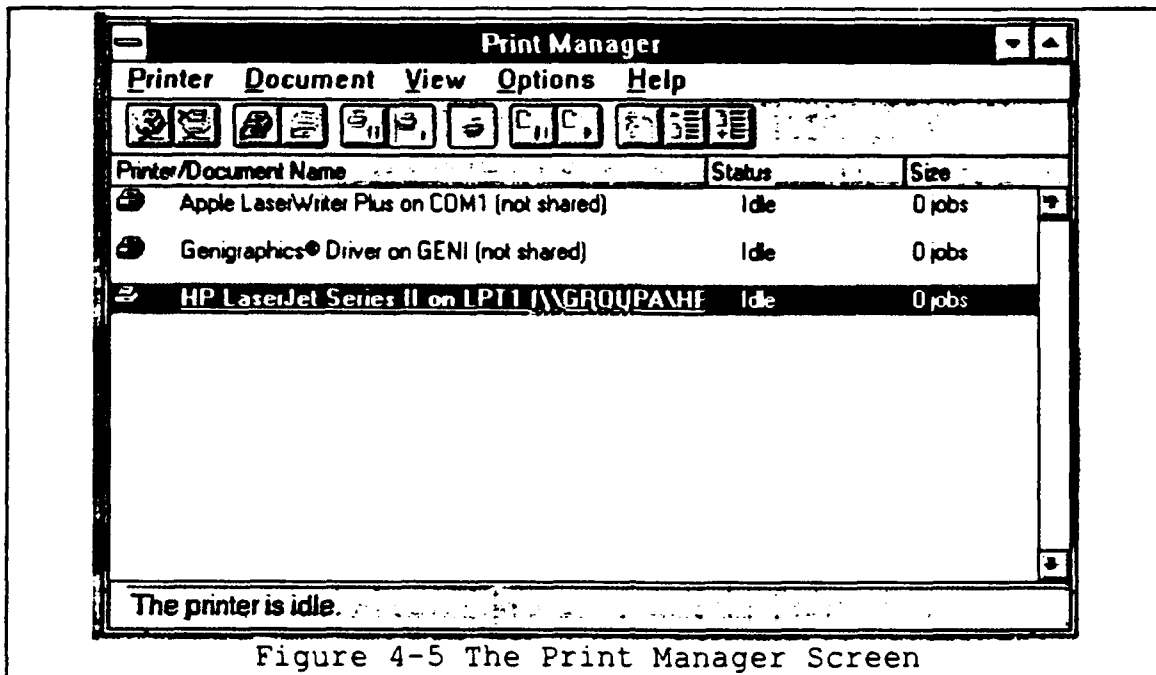- On the Toolbar, click the *Share As* button

Figure 4-5 The Print Manager Screen

Figure 4-5 shows the display where the user will make
selections to share printers with the workgroup. Note that
a password can be used to grant or limit access to the
shared printers.

After the printers are set up for sharing they must
be connected to the other workstations before they are ready
for use. To connect the other workstations to the network
printer accomplish the following:

- From the Print Manager, click the Connect to
  Network Printer button on the Toolbar

- Select the printer to be shared

Notice the similarities to the Connect Network Drive dialog
box. Also, remember to select the Reconnect at Startup box.
In WFW, the Print Manager spools the print jobs from the
workgroup. To check the status of a particular print job,
click the minimized icon of the Print Manager and the status

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of all print jobs in progress will be displayed. To prioritize print tasking use the Print Manager's *Background Printing* option located on the Options pull-down menu to allocate system time between printing and running other applications on the workstation to which the printer is connected. The default setting is the *Normal* setting and usually works best for small workgroups. However, if the printer is used heavily by other workstations on the network or if the workstation to which the printer is connected is used lightly for applications, use *High* priority. *Low* priority is used otherwise. Experimentation with the different priorities should result in optimal setting. Lastly, workstations that do not have a network printer connected directly to them have the most versatility as they can share multiple printers and modems. Workstations that do have a network printer connected directly to them cannot share another printer.

3. Electronic Mail

WFW Mail is a versatile communications package. Usually projects are completed by workgroups of individuals with contributions from different members at different intervals. The ability of workgroup members to communicate electronically and efficiently enables smooth completion of projects on time. The Mail function of WFW enables members of the workgroup to: [Ref.11]

- Send and receive messages

- Attach files created with other applications, such as word processing or spreadsheet data, to messages

- Locate messages based on user selected criteria

- Print messages

- Organize and file messages into preselected folders

Before Mail can be used by the workgroup, a Workgroup Post Office (WGPO) must be set up. The WGPO will contain all of the information about Mail user accounts in the workgroup and act as a mail drop area for the individuals in the workgroup. The location of the WGPO will determine who will be the Post Office administrator. This person will create and manage the WGPO. Each user will have a message file where his or her messages are stored. This message file will be private and password protected. Once signed on to Mail the user will be shown his or her *Inbox* and be able to view message headers. Priorities set by the message originators are displayed with the message headers to alert the recipient of their importance. An exclamation point signifies a high priority and a down arrow identifies a low priority. Messages can be sorted by priority, sender, subject and date. Also, messages can be stored in *folders* which simplify organization. This includes the originator of messages who has the ability to store copies of their sent messages in the *Sent Mail* folder. Received messages are displayed in the following manner. Note that attached files to mail are displayed as icons. Just click on the

icon and the attached file will be displayed. See figure 4-6.

To create a message click on the *Compose* button on the toolbar. A Send Note form will be displayed. See figure 4-7.
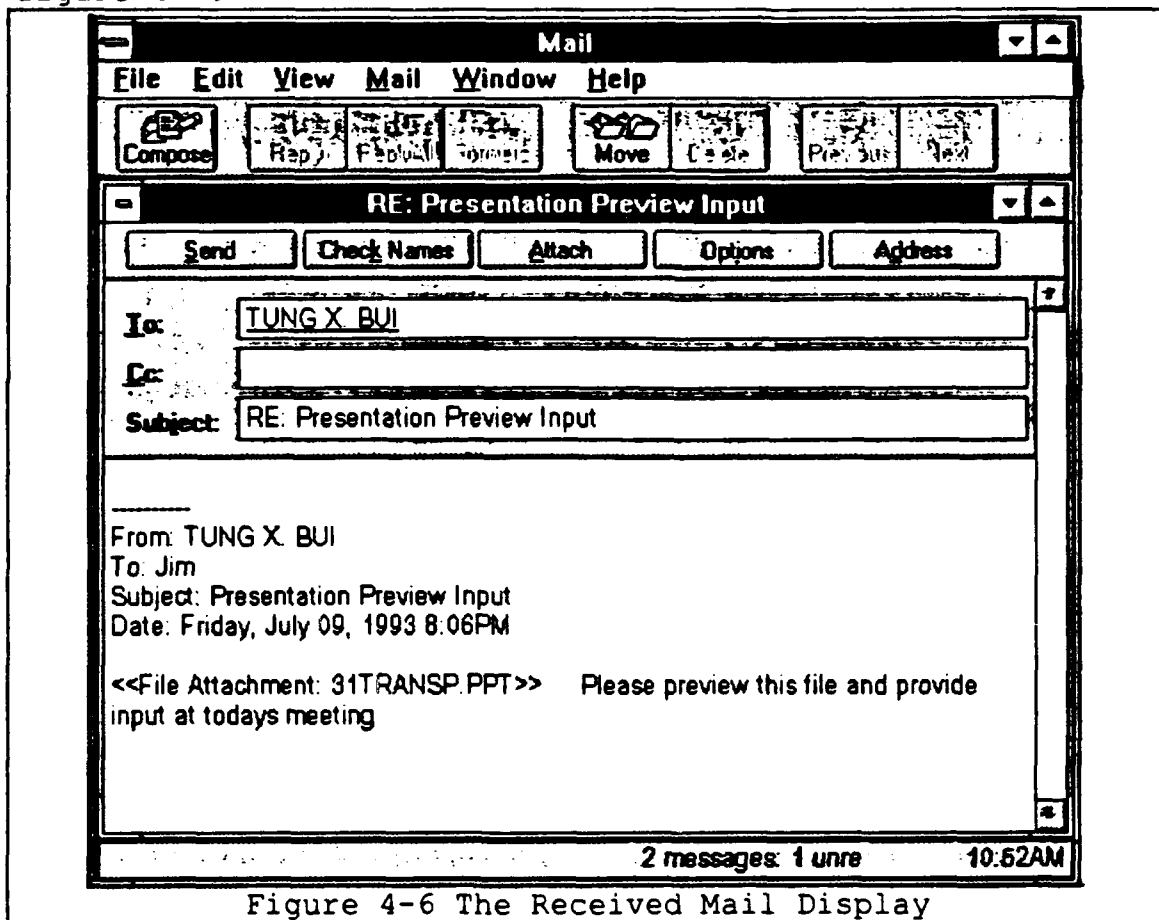

Figure 4-6 The Received Mail Display

The process is simplified as addresses are kept in an address book which is merely a customized version of the WGPO user roster. Click the Address button on the toolbar to bring up the addressee of the message to be sent, then highlight the name and the message header is generated. See figure 4-8.
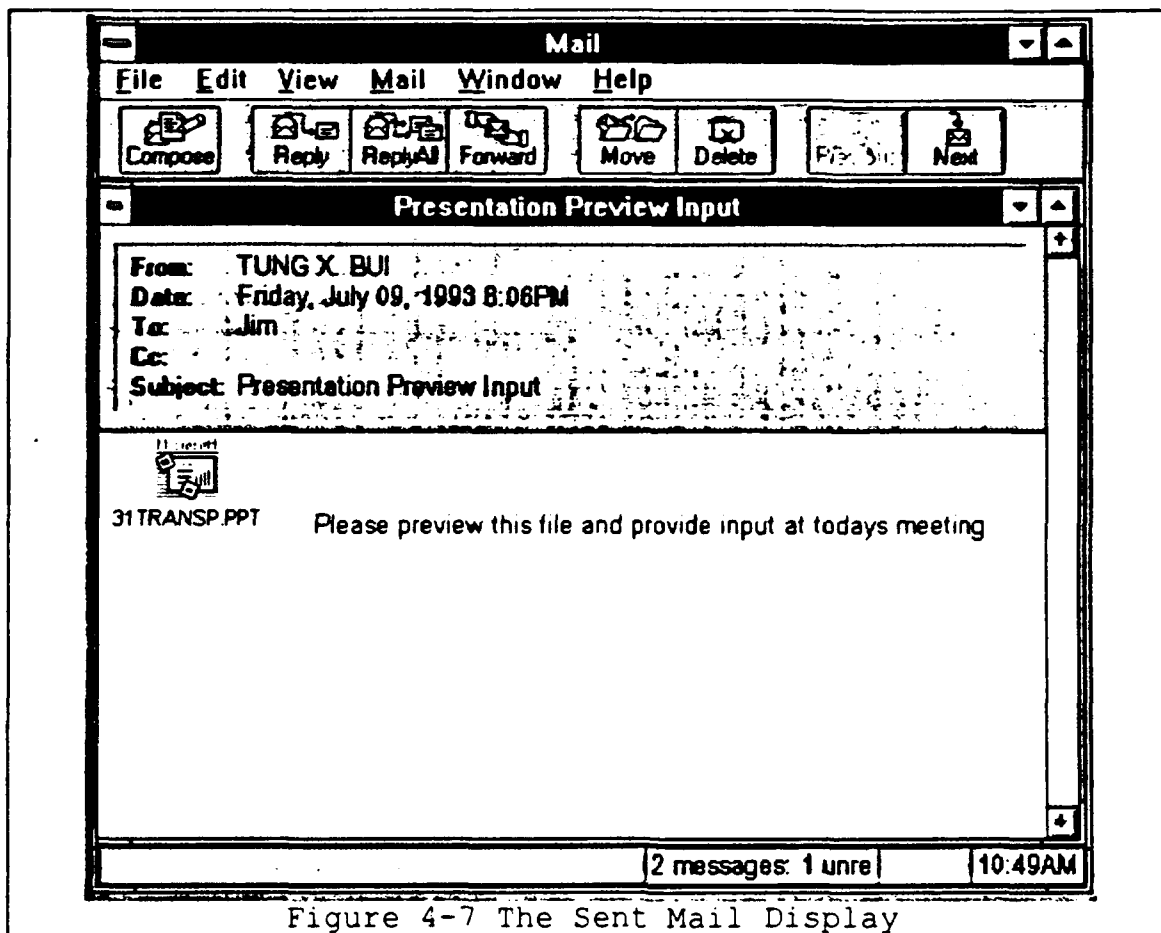
Figure 4-7 The Sent Mail Display

As was addressed earlier, prior to starting Mail for
the first time, the post office must be created and an
account for each individual in the workgroup must be
assigned by the administrator of the WGPO. To connect to a
post office perform the following:

- From the Main program group, click on the Mail
  icon. See figure below

- Select Create a new Workgroup Post office

Once it is confirmed that it is desired to create a
new post office, the system will query as to where the post
office will reside. Either select a local drive and
directory form the window or select a network server by

clicking on the *Network* button. It is recommended that the post office is created in the Windows directory. Next the *Administrators Account Details* screen will be displayed. The administrator should fill in all pertinent information. Once completed, the WGPO is created and all details will be copied to the directories created. If all is correct, a message will appear under a box titled *Mail* which will prompt the administrator to share the WGPO directory since it is required prior to any use of the Mail function. The procedure for sharing the WGPO directory is exactly the same as was demonstrated in the section on File Sharing. It should be remembered to grant *Full* access to mail users to enable sending and receiving of mail and also to select the *Re-share at Start-up* box. Once the WGPO directory is shared, the mail administrator can set-up accounts for all members in the workgroup or allow users to set up their own accounts. Workgroup members can set up their own accounts the first time that they attempt to use Mail. Instead of choosing *Create a new Workgroup Post office* as previously discussed, select *Connect to an existing post office*. This will initiate the process to set-up the individual Mail account. At the *Enter Your Account Details* screen, fill in all of the pertinent information including the password and click OK. Note that if a password is forgotten, it can be retrieved from the Mail administrator if he or she was the one that created the account. If the account was user

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initiated then the MSMAIL.INI file in the local Windows directory must be deleted and the process of starting Mail for the first time repeated.

Clicking on the Options button of the main Mail screen displays a menu with the following selections: [Ref.9]

- Return Receipt - sends a message back to the originator when the recipient picks up their mail

- Save Sent Messages - Saves a copy of all of the messages in the users individual Outbox

- Priority - High places a "!" before messages in the recipients Inbox, Normal is a normal delivery with no distinguishing marks, and Low places the messages at the bottom of the recipients Inbox
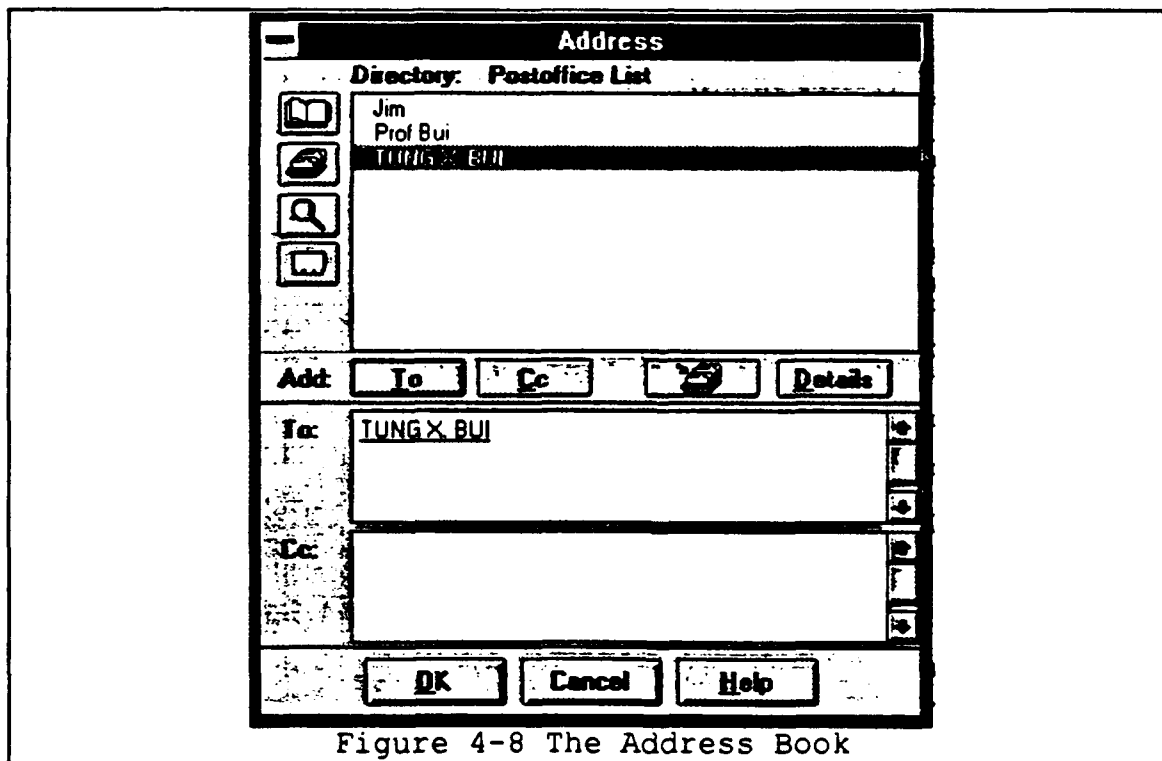

Figure 4-8 The Address Book

Another way to optimize the Mail function is to create Mail Groups. Although address book allows the user

to customize the post office list to a more personal address book, specifically named groups can be created to more efficiently utilize the mail function. To build personal groups, choose *Personal Groups* from the Mail pull-down menu while in the Mail program. If there aren't any previously created personal groups, click on New and the *Personal Groups* screen will be displayed. Fill in the information and the workgroup members names desired. There is no set limit to the number of personal groups that can be created in a workgroup. Creating personal groups in Mail also creates a *folder* specific to each group. This capability aids in the efficiency of an electronic mail function for any workgroup.

One of the most powerful features of Mail is the use of *folders*. Folders do just as the name implies. They are storage areas for Mail messages. WFW Mail can create two types of folders:

- Private folders

- Shared folders

Private folders can only be accessed and read by the individual. Shared folders are obviously open to certain groups or individuals as access is delineated. A hierarchy of folders would provide security and access control to various persons in the workgroup. To create a folder, pull down the File menu in Mail and choose the *New Folder* option.

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Shared folders can be imported and exported to other workstation within the workgroup.

The mail administrator should check the status of memory that the WGPO is using and ensure that there is enough available space to continue operations. The shared folders function is very crucial as Shared folders created by individual workgroup members are stored on the mail server while Private folders are stored on the local workstation on which they were created. Shared folders can be compressed to save disk space using the *Compress* button on the *Shared Folders* screen.

Chat is a useful WFW utility that allows real on-line real-time electronic communications. It is not the Mail as discussed earlier, as Chat only works in real-time and can only be held with one other workgroup member at a time. What is typed is immediately visible on the screen of the workgroup member called as is all that is responded. To start Chat, click the Chat icon initially located in the Accessories group. The screen displayed will be divided into two halves, the top displays the operator's screen and the bottom for the computer screen of the recipient of the call. Chat operates as a telephone conversation does except that words are typed instead of spoken. Chat files are temporary. When either party in the conversation wishes to exit the Chat utility he or she just clicks the Hang-up icon.

Mail can run on a file server that is a part of an existing network such as LAN Manager or Novell NetWare as long as it is connected to the workgroup. Other details of this operation are found in books on advanced operation with WFW.

4. Schedule Plus Network Calendaring System

Schedule is designed to keep track of appointments and tasks, set up group meetings, and manage group resources. [Ref.12] Schedule is Mail-enabled and relies on Mail for logging on, accessing the address book, and sending and receiving messages. To use Schedule, a workgroup post office must have already been set up. To operate Schedule click the Schedule icon in the Mail group.

Once Schedule has started the user can choose to work either Off-line or On-line. In order to work off-line the user must exit WFW, run SHARE.EXE, and restart WFW and Schedule. The Schedule has a dual functionality as it maintains an off-line and an on-line calendar. This permits use as a personal time and task planner resident on a single hard drive off-line and as a workgroup-wide planning tool to coordinate appointments, tasks and resources with the other members of the workgroup on-line. When using Schedule off-line, all calendar files are kept on the local hard drive. When using Schedule on-line (the default), the calendar files are kept on the Mail server's post office. Schedule keeps the on-line and off-line calendars synchronized. A

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personal file will be updated to match the corresponding on-
line file automatically each time that Schedule is started.

The Schedule screen display is shown in Figure 4-9.
The functions of Schedule are illustrated by the tabs along
the left side of the appointment book. They are:

- Today
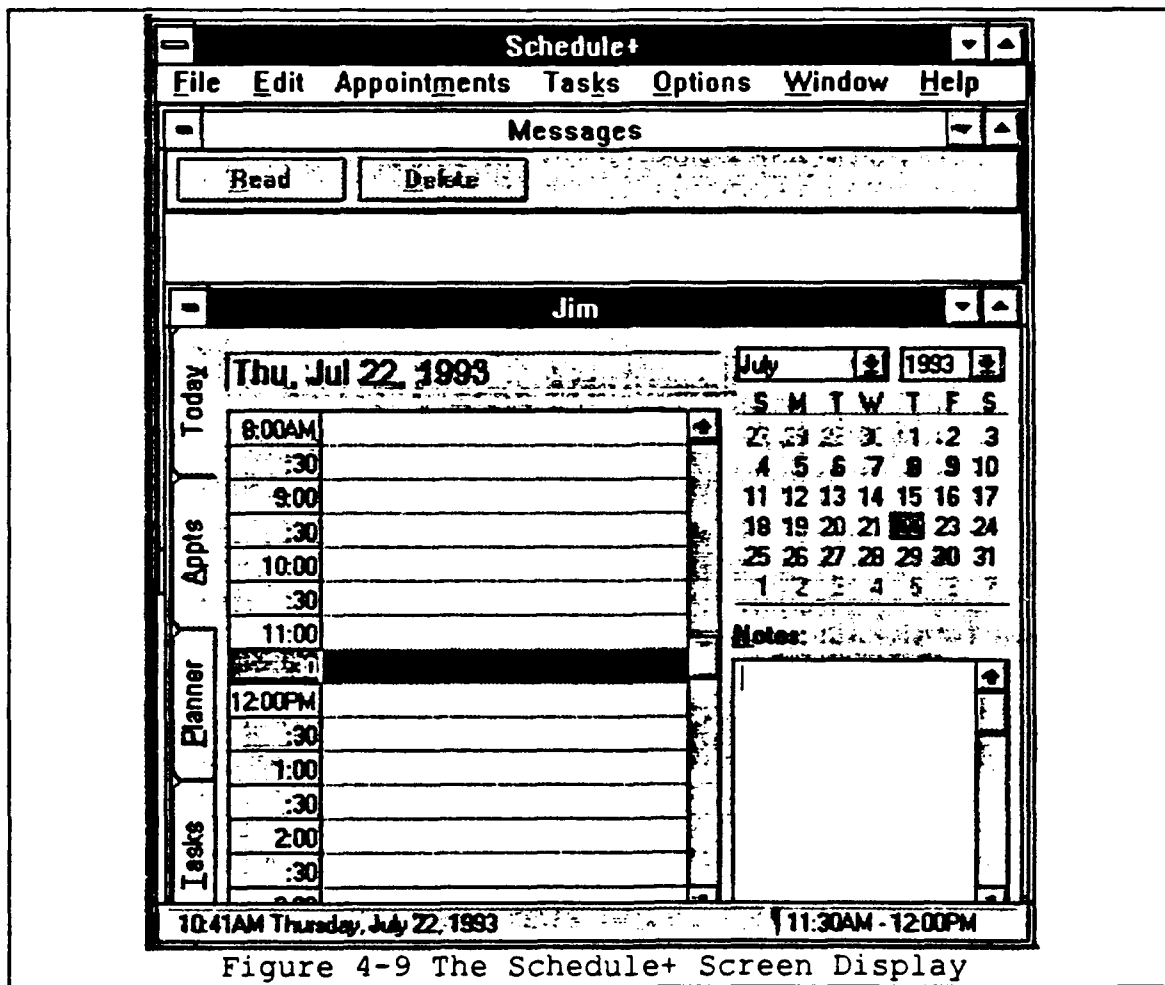
- Appointment

- Planner

- Task List

Figure 4-9 The Schedule+ Screen Display

By clicking the Today button all of the day's
appointments will be displayed. The Appointments tab will

display both tentative and confirmed appointments.
Tentative appointments will appear in gray and confirmed
appointments show as "busy" times on the schedule. The
Planner can be used to scan appointments for several days at
a time or compare them to other persons schedules to choose
an appropriate meeting time. The Task List is a "to-do"
list that can be prioritized by the user. Related tasks can
be grouped together. Also, a task can be copied to a
specific time slot in the appointment book as well.

Recurring appointments can be scheduled
automatically and are indicated as such by an icon at the
beginning of the entry. Schedule can also be programmed to
make reminders to the user for upcoming appointments. The
reminder is a pop-up message and alarm bell. The alarm bell
icon is displayed on appointments for which the user has
selected a reminder. Click on Options to pull-down the
General Options dialog box and select Reminders.

For Group Scheduling, the scheduler of the meeting
must have access privileges to the schedules of all
prospective attendees. The person scheduling the meeting
will click on File, then click Open Other's Appt. Book. The
screen comes up with the post office directory of the
members of the workgroup. Select the people to attend and
their schedules will be merged with the person's calendar
scheduling the meeting. To find a time when the group can
meet is accomplished by selecting a time slot that is

visually open as displayed on the screen or by clicking

Appointments and selecting *Auto-select*. This function will

automatically go to the first available time slot in the

group's Planner. Again, as in the Mail function the process

can be optimized with the use of a customized address book.

After the meeting time is selected, then click the *Request*

Meeting button. A Send Request screen is displayed with the

Ask for Response box selected (default). Schedule will

update the calendars of all attendees as well as the

scheduler of the meeting. The icon of shaking hands will

indicate that the meeting has been confirmed by all

attendees. To cancel a meeting, the user just deletes the

meeting from their own calendar. If the meeting is a group

meeting the screen will display a message asking if the user

wishes to inform the meeting coordinator that they cannot

attend the meeting. If it is the meeting coordinator that

wishes to cancel the meeting then the message will ask if he

or she wants to send a message to all attendees to notify

them that the meeting has been canceled. Response messages

can be checked either by clicking the messages icon or by

choosing messages from the pull-down menu after clicking

Window.

Resources can be managed via a separate schedule for

workgroup use just as a personal schedule. Portable office

equipment such as overhead projectors, big screen

presentation monitors, or portable public address systems

can be managed and scheduled just as personal schedules are.
To do so, a separate account for that resource must be set
up by the Mail administrator of that particular WGPO.

The Task list allows workgroup members to keep track
of tasks and projects and to set priority levels and
deadlines. Reminders can also be added to the task list
just as with the appointment book.

Setting access privilege is very important. Access
privileges for all of the above functions are provided by
clicking the Options menu and selecting the Set Access
Privileges from the pull-down menu. Figure 4-10 below shows
the Access privilege dialog box. All selections are self
explanatory with the exception of Assistant, whose
designation will allow that person full access to all
personal and workgroup calendars. The designated assistant
will be able to do everything in Schedule and Mail on behalf
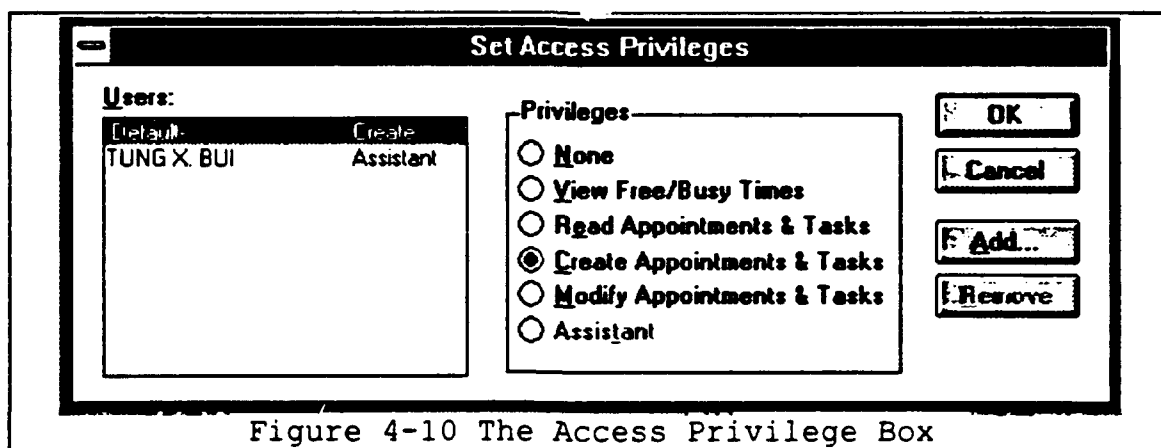of whomever designated that person their assistant.

Figure 4-10 The Access Privilege Box

The calendar file has the potential to become very
large, very fast. In order to ensure that the schedule does

not exceed the available disk space, an Archive process has been added to save data in a compressed format. Click on the File menu and click *Create Archive*. Data older than ten days is the default amount for archiving, however the number of days can be changed. The only other information that is required for the archiving process is the location for the data to be stored, which can be any local or network drive.

C. THE EFFECTS OF MULTIMEDIA ON THE WORKGROUP ENVIRONMENT

Multimedia means different things to different people. The variety of definitions all focus on the addition of a CD-ROM, high quality audio, and the capability to process full-motion video or animation. All of the above capabilities bring a new dimension to workgroup computing. CD-ROM's bring in features of digital high-quality audio, and full-motion video. Also, they can hold over 600MB of data, which will greatly increase the amount of shared resources for the workgroup. CD-ROM's come in a variety of makes and models, both internal and external installations, and with different technical specifications. The most important of the specifications are the *data transfer rate* and the *access time*. Standard data transfer rates range from 150KB to 300KB per second. The access speed is the time it takes for the drive to actually find the data that was requested. Most drives are in the 200-300 millisecond range. These speeds are about ten times slower than most

hard drive access times. The numeric value is deceiving as CD-ROM drives access very large portions of data each time [Ref.9]. To select a CD-ROM that is compatible with WFW, choose one that is MPC (Multimedia PC) or with the "XA" (eXtended Architecture) or "XA-2" (eXtended Architecture version 2) specification. These drives exhibit relatively fast data transfer and access speeds.

To share a CD-ROM drive with a workgroup, version 2.21 of MSCDEX.EXE or higher must be installed in the AUTOEXEC.BAT file. Also the "/s" (share) switch must be used with the MSCDEX.EXE file. The driver will then be automatically installed in the CONFIG.SYS when WFW Setup is run. Note when *sharing* a CD-ROM use the Read-Only access.

Since sound cards are required for most CD-ROM players in order for them to play high-quality audio, they are sometimes considered the core of the multimedia extension to a PC. However, in the digital office, the core of the multimedia extension is "business audio." Examples of business audio are:

- Voice messages

- Voice annotation of documents

- Voice recognition

In order to use multimedia sound within the workgroup, every workstation in the workgroup must be equipped with a sound card. The addition of the sound card will bring the waveform audio (WAV) capability to the workgroup. This is

the type of audio file that creates business audio by permitting voice annotation of documents and Mail. The Schedule function can also be enhanced with voice reminders. Word processing documents and spreadsheets can also display voice recognition so documents can be "proof-read" by the PC. Passing documents or spreadsheets, previewing presentations, or showing CD-ROM "infomercials" allow workgroup members to remain at their workstations while actually meeting with their workgroup.

Multimedia in the digital office environment provides a great enhancement to the form of media available across the local area network. Business audio is the most cost effective multimedia followed by CD-ROM video and high quality audio. Full motion video can be attained by the addition of one of many video application boards. Examples of these are: [Ref.9]

- Television boards which enable cable TV to be displayed on the desktop. Financial news or special reports can be viewed at the workstation

- Video display/capture boards which enable recorded video from a video recorder or VCR to be replayed to the desktop

WFW provides capabilities for all of the digital office functions described in the preceding chapters while satisfying the criteria described for typical DoD installations. The transformation of the non-digital office to a digital one can be accomplished with relative ease and

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little expense taking into account the added capabilities
achieved by following this process.

D. OVERVIEW OF CO-OP: A GROUP DECISION SUPPORT SYSTEM

Co-Op is a Group Decision Support System (GDSS) for
multiple criteria decision making. Installed in the WFW
environment, it is a color-based, multitask window GDSS
which can accommodate several decision members in a face-to-
face or distributed group decision making process. Each
participant of the workgroup has his or her own decision·
support system whose model base is adapted from a multiple
criteria decision methods (MCDM). Recent enhancements to
the software have expanded the model base to include ELECTRE
3, ELECTRE 4, and PROMETHEE. Also, the Minimum Variance and
the Min-Max techniques have incorporated. These consensus
seeking techniques of aggregation of preferences promote
timely, well thought out and planned, selections or
decisions that are made remotely and individually while
seemingly face-to-face within a group setting. This
powerful enhancement to the digital office can very
efficiently replace hours of lost time due to in-house
meetings that limit creativity and judgment because of time
constraint and structure. An example of Co-Op's versatility
in the WFW environment would begin by a meeting scheduled
using the Schedule utility with voice annotation of the
meetings structure and intended outcomes, i.e., a decision
to rent or buy. The Schedule utility would select the first

available time slot to conduct the meeting. Once

acknowledged by all workgroup members, the meeting time is

set. Prior to the official meeting the workgroup could

individually access Co-oP program and input their

preferences and prioritizations of the criteria for the rent

or buy decision. Meanwhile, Co-oP is utilizing the model

base to arrive at a consensus based on the entire workgroups

input. The outcome of the process can be discussed or

debated at the formal scheduled meeting. This process could

also have produced an agreeable outcome to management

without the formal meeting and consensus could have been

attained over the network. This example of efficiency

within the digital office through electronic meeting can

spawn further productivity in operational and research

areas.

After successful installation, Co-Op can be utilized in

the following way. [Ref.3] The Co-Op main menu consists of

six steps: (1) problem definition, (2) group norm

definition, (3) prioritization evaluation criteria, (4)

individual selection alternatives, (5) group selection of

alternatives, (6) consensus seeking and negotiation.

In the first step, the workgroup or portion of the

workgroup selected to make the decision, is to collectively

identify and define a decision, the rent or buy decision.

The workgroup members should share the same decision space.

This could be accomplished by query within the WFW

environment prior to when each individual begins working with Co-Op. Next, the group will identify its members and assign passwords. It also needs to decide on the means in which the decision making software will be utilized, i.e., type of decision technique used and any other constraints. The third step deals with the prioritization of the evaluation criteria. This is done by group members assigning weights to the criteria or using a routine to devise a hierarchical prioritization scheme. The fourth Co-Op process allows individual evaluation of alternatives using the preferred MCDM. Next, is the computation of the group results using a technique of aggregation of preferences. Finally, if unanimity is not obtained, a consensus seeking algorithm can be used. If results are still not obtained users are urged to return to previous steps to refine the process and possibly attain the desired outcome.

Co-Op allows the user to interrupt these processes at any step, thus allowing group work to be completed in part individually and at the user's convenience prior to any deadline if one has been set.

E. OVERVIEW OF NEGOTIATOR: A NEGOTIATION SUPPORT SYSTEM

A Negotiation Support System (NSS) is found to be useful in the digital office environment to help users evaluate claims, decipher opponents' positions, gain additional

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insights, and to maximize opportunities to tactfully negotiate the terms of an agreement. Various proven techniques are incorporated to assist negotiators in reaching a consensus. Negotiator (NeGo) can be used individually as a stand-alone decision tool or in the WFW environment to aid in group problem solving.

NeGo is implemented with three design architecture's: [Ref.2] (1) DSS based on Economic Models of Negotiation, (2) DSS based on Inductive Learning, and (3) A Hybrid Approach to a NeGo's DSS. The third design is a hybrid of the first two designs. As with any negotiation, parties try to gain advantage, to "strike a deal," that satisfies their individual needs or utility. The optimum solution occurs when the utility of one party can no longer be increased without decreasing the utility of the other. This negotiated "optimum solution" therefore exhibits the best deal for both parties. An example of a negotiated solution would entail two parties that are inherently non-cooperative, trying to reach a decision that satisfies both parties requirements, like the price to pay for a home given certain attributes. One party wants to pay what the best price would be for their money, the other wanting to maximize their profit margin based on market value. Somewhere in between the two values is a negotiated settlement.

In the digital office, a negotiated decision can be made within the WFW environment utilizing NeGo. The scenario would be set up similar to the decision making scenario discussed using the Co-Op program. Inputs can be individually entered into NeGo with the outcomes discussed in a structured, formal group setting or in an informal unstructured electronic meeting. The usefulness of both the GDSS and the NSS programs can be made optimal through office training, practice, and when applications supporting their use arise.

V. SUMMARY AND CONCLUSIONS

Transforming the typical *non-digital* office into an

efficient and productive *digital* office brings with it a

separate set of problems regarding the selection of the

appropriate groupware environment. This environment must

satisfy the operating characteristics of both the existing

office applications that will migrate to the new environment

and be compatible with any new features selected to improve

overall office efficiency and effectiveness.

The underlying office operating system will be the local

area network and its associated connections or gateways to

other local area networks and wide area networks. The

selected network operating system will be the backbone of

the environment, providing enhancement to existing office

applications and determining the compatibility of any new

features added to the system.

Office tools that will create the digital office

environment typically will be applications that are routine

to the daily operation of the office and familiar to the

personnel that use them. Also management functions will be

added so as to enhance the environment with tools that

electronically mail, schedule, chat, and aid in decision

making in a group environment. Once bundled into a system

architecture, the environment will be complete and ready for

use. At that time the digital office functionality can be tested and improvements based on experiences gained from the environment and its operation can be implemented.

Windows for Workgroups provides the most acceptable solution to the transformation and integration problems foreseen during the design phase. As a network operating system it is very easily installed and because the Windows operating environment is practically a PC standard, subsequent additions of applications, whether through the software upgrade process or the addition of new functionality, can be expected without unforeseen software compatibility problems. Also the features that come packaged with the network operating system complete the digital office environment without having the need to purchase separate software packages that sometimes do not operate as seemlessly as packaged system software. Windows for Workgroups' installed utilities of electronic mail and group scheduling, along with the Microsoft Windows Open Systems Architecture (WOSA), support standard API's which enhance the ease of addition of new applications.

Groupware as an additional application provides immense possibilities to the digital office environment. Group decision support systems and groupware in general provide the digital office design with a functionality that when meshed with the other office functions becomes a system tool

that greatly enhances the efficient and productive operation
of the total office as a system.

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APPENDIX

INSTALLATION PROCEDURES FOR A GROUPWARE ENVIRONMENT

A. GENERAL INFORMATION

This appendix provides step-by step instructions to quickly set up a groupware environment as described in the previous sections.

B. INSTALLATION PROCEDURES

Installation of hardware and software specific to the generic GDSS prototype is described in the following paragraphs. Care has been taken not only to focus on the general installation procedures contained in the owners manual but to also summarize some of the more user specific functionality reserved for the more experienced users of the individual software packages. The order of installation of the software and hardware is based on a bottom-up design method[1] utilizing a new 486/33 MHz IBM or clone type PC. Variations of the installation procedures for PC's of different types are referred to in the owners manual of the individual software package to identify CPU speed, RAM, and hard disk drive free memory space requirements.

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[1]Bottom-up design refers to a methodology of implementing the lowest level modules on a "stand-alone" basis and then integrating them with other modules as they are designed and tested continuing until the entire system is functional.

1. MS-DOS Installation

If the system that MS-DOS 6.0 is to be installed is
new, check to see that a version of MS-DOS is installed by
typing "*ver*" at the DOS prompt.

a. *MS-DOS Version 3 of Earlier*

If running a version of MS-DOS version 3 or
earlier copy MS-DOS from the floppy disks to the hard disk
using a two step process. The first step uses the System
(sys)command to copy two hidden files that MS-DOS needs in
order to start up from the hard disk drive. Type the
following: [Ref.15]

- *A>sys c:*

MS-DOS responds: *System transferred.*

The second step uses the COPY command to copy
the remaining files to the hard disk drive. Type:

- *A>copy command.com c:*

Create the MS-DOS directory:

- *A>md c:\dos*

Copy the files from the MS-DOS disk to the DOS
directory:

- *A>copy *.* c:\dos*

b. *MS-DOS Version 4*

Version 4 of MS-DOS comes with an installation
program that prompts the installer throughout the
installation process. Insert the floppy diskette labeled

Install into drive A and start or restart the computer, then press enter to begin. From that point on the installation program called *Select* [Ref.15] queries the user to make selections and follows up by prompting the user to insert the correct floppy diskette for proper installation.

c. *MS-DOS Version 5 and 6*

Upgrading from version 5 or 6 has the same installation procedures. Insert Disk 1 of MS-DOS into drive A and type:

- C>A:

- A>*setup*

Setup checks the memory and devices on the computer system, offers help at every stage, and prompts when a response is required. The only difference between version 5 and version 6 is version 6 comes equipped with procedures to make an *Uninstall* diskette in case the setup program fails during installation.

d. *MS-DOS Not Installed*

If a version of DOS is not installed, start by inserting the floppy disk labeled *Disk 1* in drive A. Then start or restart the computer. Setup will guide the user through the entire installation process as described above. [Ref.15]

2. Windows for Workgroups Installation

Windows for Workgroups requires hardware and software installation. Also the minimum requirements for using Windows for Workgroups are a 386SX based system with a hard disk drive, 4MB of RAM, a mouse, and a VGA monitor. [Ref.10] Also, a network card and cabling to connect the workstations, MS-DOS 3.2 or above, and Windows for Workgroups software are required. The network card, cabling, and software are all supplied with the Windows for Workgroups Starter Kit. Also, the above specifications are minimum and for more optimal performance the recommended system should have at least 8MB of RAM, and 14.5MB of free space on the hard disk. A reminder being that with 14.5MB of free space on the hard disk leaves virtually no space for data storage or additional applications. A 60 to 100MB free space area is a reasonable choice.

a. Hardware Installation

Prior to installing the Windows for Workgroups software, a Network Interface Card (NIC), also called a network adapter, must be installed in each computer. Ethernet cards are the most common and the type that is supplied with the Windows for Workgroups Starter Kit. [Ref.10] Token-ring cards are also common, but more expensive and more often used in very large installations. If the system already has a NIC, Windows for Workgroups is compatible with a large number of industry standard boards.

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The installation kit provides a list of supported and non-supported industry standard compatible network adapter cards that will work with Windows for Workgroups. A network can comprise of different types of NIC's as long as they are supported by Windows for Workgroups.

The installation procedures for the NIC are detailed in the Getting Started Manual supplied with the Windows for Workgroups Starter Kit. Below is a synopsis of the installation steps. Any questions concerning the installation should be referred to the manual. To prepare the computer for installation: [Ref.9]

- Quit running all applications

- Turn off and unplug the computer

- Remove the cover from the computer

Once the cover is removed, perform the following installation steps:

- Locate an unused 16 bit slot. Do not use an empty 32 slot in VESA or EISA standard motherboard

- Remove the cover from the associated slot

- Discharge any static electricity from the hands by touching a grounded metal surface

- Remove the NIC from its protective wrapper being careful not to touch the gold contacts on the bottom edge of the card

- Align the card and press firmly into the selected 16 bit slot

- Check to see the card is seated properly and aligns with the other installed cards

- Secure the card in place with the screw that was removed from with the slot cover

- Replace the computer cover and screws

- Reconnect any cables and power cords that were disconnected or unplugged

- Repeat the above procedures for all computer that will be connected to the network

To connect the network coax cables and terminators to the network computers complete the following steps:

- Connect a T-connector to the connector jack on each NIC

- Connect the cable from one side of the T-connector on one computer to one side of the T-connector on the next computer. Continue until all computers in the network or workgroup are connected in series. This should leave the two end units with one end of their T-connectors still open

- At the open ends install a terminator. At this point all T-connectors of all installed computers on the network or workgroup should have either a cable end or a terminator plug installed

b. *Network Interface Card Configuration Settings*

All NIC's use an interrupt, base I/O port, and sometimes use a base memory address. These configuration settings are used by the PC to identify and communicate to the NIC. Interrupts, also known as IRQ's are the way the processor communicates with the NIC. The base I/O port is the memory address through which data is transferred to and from the NIC. The base memory address, sometimes called the

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RAM start address, defines the memory location used by memory that is physically located on the NIC. This is why base memory addresses are not always used as the NIC may not come with it's own RAM. These settings must also not interfere with other existing system components that have the same settings. Most NIC's come preconfigured with standard default settings. Use these whenever possible. However, if the PC to be used in the workgroup has numerous add-on cards such as a sound card or voice mail card, the preconfigured default settings may not work. In this case the configuration settings must be changed. If the user is not sure which interrupts, base I/O ports, or base memory addresses are being used by the PC, run the *Microsoft Diagnostic Utility* supplied with the Windows 3.1 software. *Do not run this utility from Windows!* At the DOS prompt simply type *MSD*. The user can then determine from the utility which configuration settings are conflicting. The NIC must use an interrupt that is not otherwise being used. To change the configuration settings, follow the directions supplied with the NIC. The most common configuration setting required to be changed is the interrupt (IRQ). Each hardware device in the PC uses and interrupt. There are 14 interrupts (2 through 15) available for use. For most systems IRQ's 3, 5, and 15 are available. Table A-1 [Ref.9] displays the standard interrupts for the 80286 processor and above.

IRQ	UTILIZED FOR
2	Graphics Adapter
3	Second Serial Port (COM2)
4	First Serial Port (COM1)
5	Usually free. Used for second printer (LPT2)
6	Floppy disk controller
7	Parallel port (LPT1)
8	System clock
9	Connected to IRQ2
10	Usually free
11	Usually free
12	Usually free
13	Math coprocessor if installed otherwise free
14	Hard disk controller
15	Usually free

Table A-1 Interrupts (IRQ)

Just as each hardware device must have an interrupt, it must also have a unique memory address. Table A-2 [Ref.9] is a list of base I/O addresses.

Port Address	Used for	Port Address	Used for
200-20F	Game port	300-30F	
210-21F		310-31F	
220-22F		320-32F	HDD controller
230-23F	Bus mouse	330-33F	
240-24F		340-34F	
250-25F		350-35F	
260-26F		360-36F	
270-27F	LPT3:	370-37F	LPT2:
280-28F		380-38F	
290-29F		390-39F	
2A0-2AF		3A0-3AF	
2B0-2BF		3B0-3BF	LPT1:
2C0-2CF		3C0-3CF	EGA/VGA
2D0-2DF		3D0-3DF	Color video
2E0-2EF		3E0-3EF	
2F0-2FF	COM2:	3F0-3FF	FDD Controller

Table A-2 Base I/O Addresses

If unsure about which base I/O port to use try
300 as it is usually free. The same goes for base memory
address, try D8000. If there is a base memory address with
the NIC and the system is utilizing MS-DOS *Expanded Memory
Manager*, the base memory address of the NIC must be included
in the *"x="* parameter of the *"device=emm386"* line in the
CONFIG.SYS.

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Once the NIC is installed and the system is setup and is configured so that it operates without interrupts, proceed with the Windows for Workgroups software installation procedures.

c. *Software Installation*

Windows for Workgroups can be installed for two different purposes. Either to upgrade a previous version of Windows or to install Windows for Workgroups for the first time. Before installing the software prepare the hard disk drive by completing the following: [Ref.9]

- Delete all files and applications that are not required

- Run CHKDSK from the MS-DOS prompt to check available space and ensure that there are no problems

- Run a disk defragmentation program. MS-DOS 6.0 has a function that will accomplish this. *Do not run this command from Windows!* The basic command is: C:\>*defrag /f*

- To utilize the defragmentation utility to it's fullest extent refer to the MS-DOS 6.0 manual supplied with the software

- Make a backup of the hard disk drive. Again MS-DOS 6.0 has a built in utility that will accomplish this. To backup all files on drive "C" type the following command at the DOS prompt: C:\>*backup c:\ a: /s*

- Ensure that an Emergency Disk is prepared
  that at least contains a copy of the
  AUTOEXEC.BAT and CONFIG.SYS files that can
  start the computer in its original state
  should a malfunction or interruption occur
  during the installation of the software

The installation of the software is very basic.
Installation can be accomplished from either the A or B disk
drives. Log onto the appropriate disk drive from the DOS
prompt as follows:

- C:\>*a:* or C:\>*b:* then type:

- C:\>*setup* or B:\>*setup* at the prompt

The user is then prompted to choose from EXPRESS
SETUP or CUSTOM SETUP. For most cases it is recommended
that EXPRESS SETUP be used. If upgrading from a previous
version of Windows, EXPRESS SETUP will preserve all
applications, groups, and printer settings. CUSTOM SETUP
provides the user with more control over the setup procedure
with the ability to override some of the default settings
and to choose whether some of the functionality of Windows
for Workgroups is needed. If freeing memory space is
critical to the operation of the system, the user may choose
not to install the complete software package. EXPRESS SETUP
is still recommended in this case as those functionalities
can be deleted after installation.

The setup program will determine if enough
memory space is free on the hard disk drive. Also, if
Windows is already installed on the system, it will ask if

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the user wants to add Windows for Workgroups. If a version
of Windows prior to version 3.1 is installed, setup will
update it to version 3.1. The user should be ready to
supply the following information during the setup procedure:

- name

- company (optional)

- workgroup

- type of printer

- printer port

The computer name identif es the user to others
on the network. The workgroup name will be identical to all
users in the same workgroup. An example would be
"Information Technology Workgroup." After the setup program
has completed, a reboot must be initiated in order to
install the network drivers that the software needs to be
able to communicate with other systems.

d. *Passwords*

The first time that the user starts Windows for
Workgroups, the screen will display the computer name
entered during setup and will ask the user for a password.
If password access is not desired press *Enter*, otherwise
type a password of up to fourteen characters. Next, the
system will ask if the user would like to create a password
file. Choose *"OK"* and press *Enter*. Then the system will ask
the user to type that password again.

When a password is chosen it is encoded into
Windows for Workgroups. If it is forgotten, then the
password list file must be deleted and the password startup
process must be started again from the beginning. The
password list can be viewed from the *SYSTEM.INI* file in the
Windows directory. The appropriate section will appear as
follows:

- [Password Lists]

- WRITERS=C:\WINDOWS\WRITERS.PWL

Deleting the *WRITERS.PWL* file will clear the
password for that particular machine and the user may then
restart Windows for Workgroups and initiate a new password
list.

e. *Bypassing the Logon Password Process*

If the user would prefer to bypass the logon
password process entirely every time that Windows for
Workgroups is started, double click on the Network Icon in
the Windows Control Panel. Click the *Password* button and
the *Change Logon Password* dialog box will appear. Type the
current password in the *Old Password* text box. Leave the
New Password and *Confirm New Password* text boxes blank and
click *OK*. From this point on each time that Windows for
Workgroups is accessed the password box will not appear.

3. ConSensus-Builder Voting System Installation

The ConSensus-Builder Voting System is a fully self-contained portable product. Unlike the products described above, ConSensus-Builder does not require permanent installation within the GDSS prototype. It can be easily attached to any machine in the network to facilitate a voting scheme matched to the experiment being conducted with the GDSS.

a. *Hardware Setup*

To setup the ConSensus-Builder Voting System, follow the directions provided with the system. Simply install the three antenna in the connectors located on the top of the transceiver. Next install the phone-jack adapter in the serial COM2 port on the selected PC in the network. Finally connect phone cable coming from the transceiver to the adapter in the communications port. When to operate, ready turn the power switch to the *on* position.

b. *Software Installation*

The software for ConSensus-Builder is installed utilizing the Setup Program. At the DOS prompt type the following:

- C:\>type *A: or B:*

- C:\>*setup* or B:\>*setup*

Follow the instructions and make selections from the choices provided. The main choice is selecting the type

of keypads to be utilized. The ConSensus-Builder Voting System tested on the GDSS prototype will be using *wireless* keypads. Disk number 2 of the software will automatically install the appropriate keypad driver from this selection. Once software installation is complete the ConSensus-Builder system is ready to operate.

4. Co-oP Installation

Co-oP is a ConSensus searching tool for two groups. No extra hardware is required for operation on a network.

a. *Software Installation*

Co-oP software is installed utilizing the setup program. At the DOS prompt of the drive selected type *setup* as was done with the ConSensus-Builder software described above. Once installed, the software is ready to use.

5. NeGo Installation

NeGo is a negotiating tool selected for use on the GDSS prototype. Extra hardware is not required for operation on a network.

a. *Software Installation*

NeGo software is installed utilizing the setup program. The procedures for installation are the same as those of the Co-oP software.

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