Paper 1027
Windows NT Server for the MPE at Heart

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Ok, I admit that I am biased. I think that HP-3000s are wonderful systems. The MPE/iX operating system is a wonderful software environment. From the first time I worked with one at Wilkes College in 1979 I knew that this computer was something special. Having programmed on and managed HP-3000 systems for over 15 years I have gained a great deal of respect for these workhorse transaction processing systems. The MPE Operating system on the HP-3000 comes with many of the software tools needed to run a business. Unlike some IBM operating systems you do not need to hire one or more systems programmers just to keep the computer running. Hewlett-Packard has done a good job keeping with their performance improvement promises for the 3000 line of computers. Software written decades ago still runs unaltered on the current machines. I have helped to set up and run HP-3000s in remote offices with a minimum of local support staff. They are that easy to use. The hardware and software has been and continues to be extremely reliable with up time measured at GRACO to be above 99% for each of our five HP-3000 systems. Up until two years ago my biggest concern as System Administrator was how well MPE/iX and HP-UX would integrate someday in the future. HP-3000 systems were meeting our needs at GRACO for the present. I knew that someday we may end up with a UNIX system running some applications but that was several years and tens of thousands of dollars away.

Then the world changed.

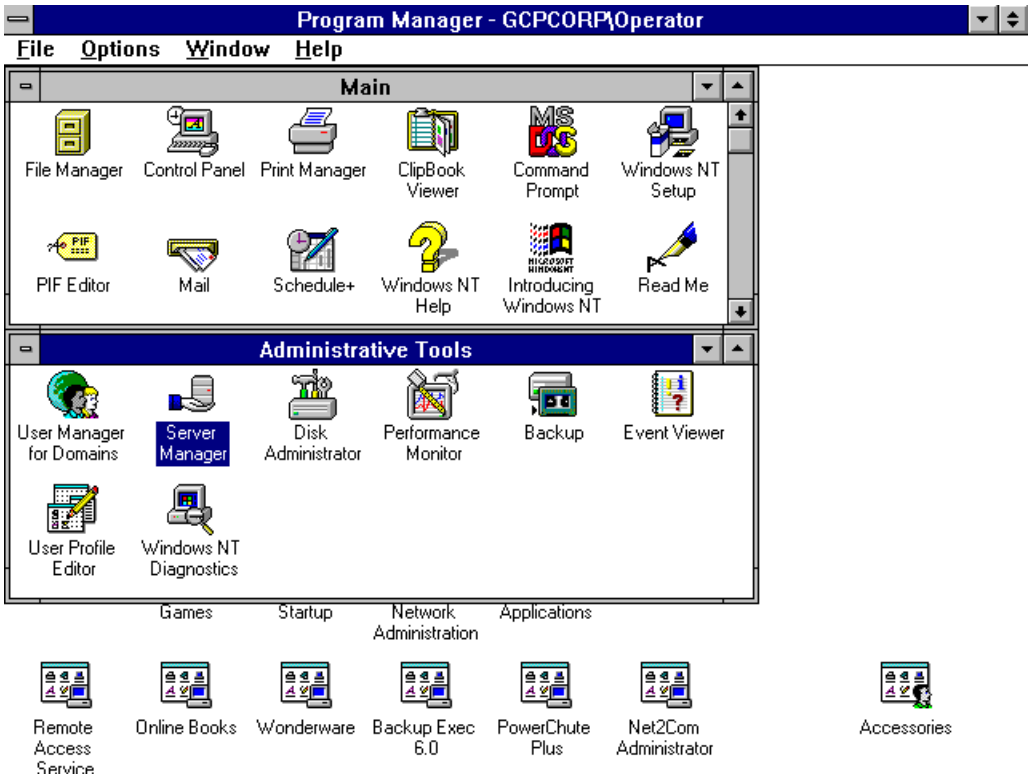
I had heard about Windows NT, now Microsoft's flagship operating system My boss had seen it at the INTEROP conference in the spring of 1994 and praised it highly. I had been reading about it in the trade press. Having had some experience with Novell NetWare 3.11 at a former employer I thought I knew a little bit about what NT was all about. I suppose I looked upon NT as a much improved version of LanManager. Finally in September of 1994 we received a copy of Windows NT 3.5 and installed it on a HP NetServer. My simplistic assumptions of what NT was were immediately destroyed. It has many of the built-in features that makes the MPE/iX operating system special and more. For example the backup utility that comes with NT is very similar in function to the STORE program that comes with MPE. TCP/IP network services are built-in as they are with MPE/iX. 'Out-of-the-box' NT provides many of the features and functions a systems administrator wants to have in an operating system. It is a very attractive system that deserves the attention it is getting.

The system (at least as of the 3.51 version) looks very much like the familiar Windows 3.x software. Utilities such as File Manager, Print Manager, Notepad, Control Panel, and Command Prompt are all there and they are 32-bit versions with some additional features. For example in the Control Panel there are additional utilities for the management of a multi-user server. The File Manager looks very similar to the Windows 3.x version. I found it very easy to get started using Windows NT.

Features of Windows NT 3.51

- Multiple Hardware platforms supported including RISC and Intel-based computers.
- The operating system is multi-threaded and multi-tasking.
- Windows NT has C2 level security.
- Software written to Win32, Win16, OS2 1.x, POSIX, and MS-DOS standards are supported.

- Extensive built-in networking support is available including TCP/IP, IPX, NetBEUI, DEC Pathworks, and Banyan VINES.
- Network Services such as SNMP, WINS, DHCP, and DNS Client are available 'out of the box.'
- Up to 16 exabytes of disk storage and 4 gigabytes of memory are supported by Windows NT.



Windows NT Program Manager

It would be possible to write volumes comparing and contrasting the features and functions of Windows NT Server with MPE/iX. Some of the features of NT that were most appealing to me as a MPE/iX Systems Administrator were the easy-to-use management tools, the maintenance and fault tolerant features, and security, of the systems.

NT Management Tools

Direct comparisons between tools on MPE/iX systems and Windows NT systems can sometimes be hard to draw but there are some tools that are easily recognizable to those with a MPE background. Figure 1 shows some features that are roughly equivalent on both systems.

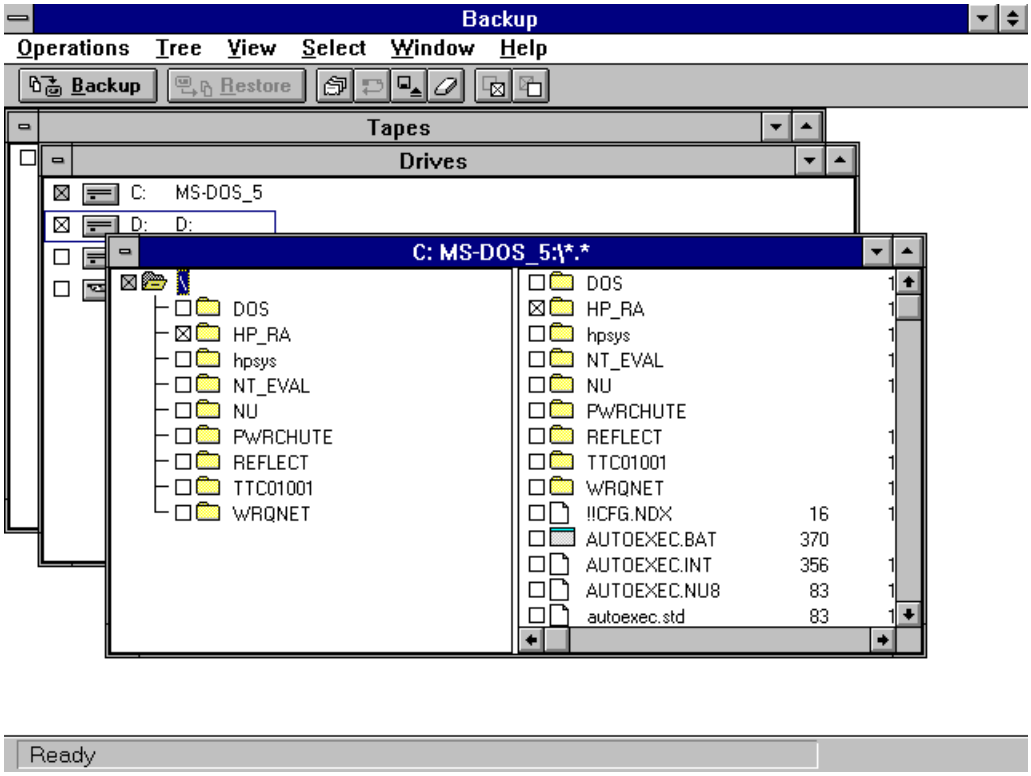
MPE/iX Tool or Function	**Equivalent Windows NT Tool or Function**
STORE/RESTORE	Backup
SHOWJOB	Server Manager
NEWUSER/ALTUSER	User Manager for Domains
SYSGEN/VOLUTIL	Disk Administrator
GLANCE/LaserRX	Performance Monitor
Logging/LOGTOOL	Event Viewer
NMMGR/ARPA Services	Control Panel/Network

Figure 1

There are many more features that could be compared. This sample should provide a beginning understanding of the capabilities of NT that are common with MPE/iX.

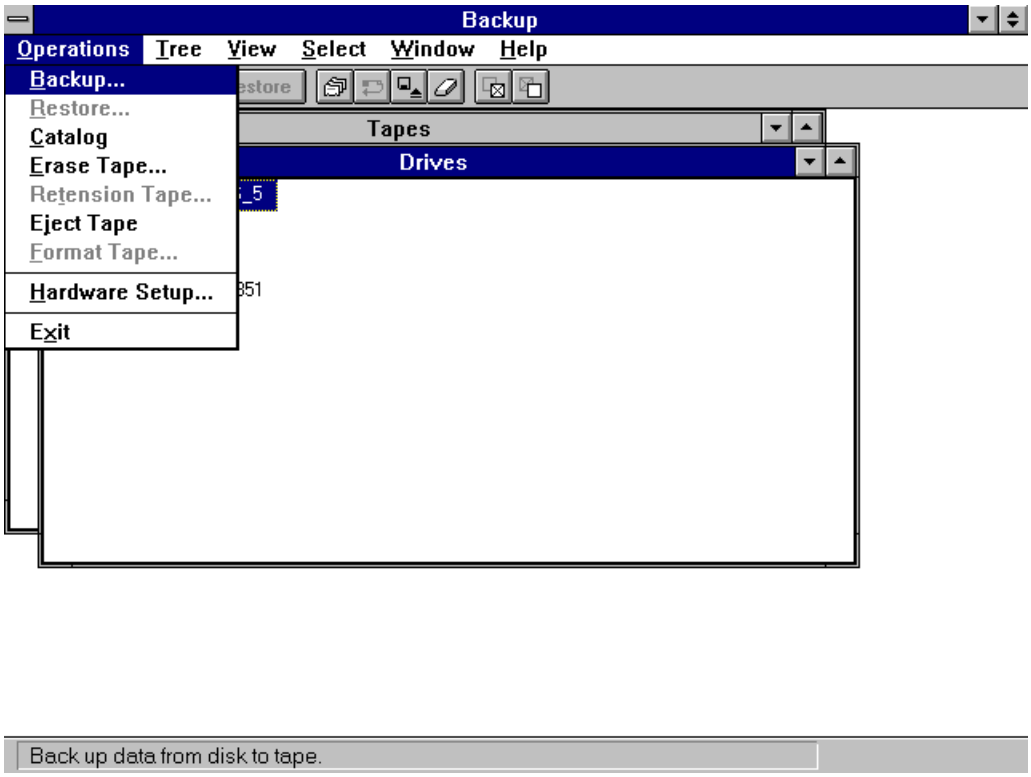
1. Backup

The Windows NT Backup utility that comes with the software is functionally very similar to STORE/RESTORE. The basic product will backup and restore files on your server or workstation. It can also backup and restore to network shares connected to the computer. When doing backup and restores interactively there is a very nice graphical interface that allow you to point and click through the process. Here is a sample screen when running the backup program.



Windows NT Standard Backup Program

You can point and click on the directories and drives you want to store or restore then press the appropriate button to begin the process. The software can handle multiple tape drives but it is not capable of performing on-line backups. From the windows interface you can do other operations such as tape catalogs, erases, retention, eject, or if necessary, format. Many types of tape devices are supported including HP SureStore drives.



Backup Operation Options

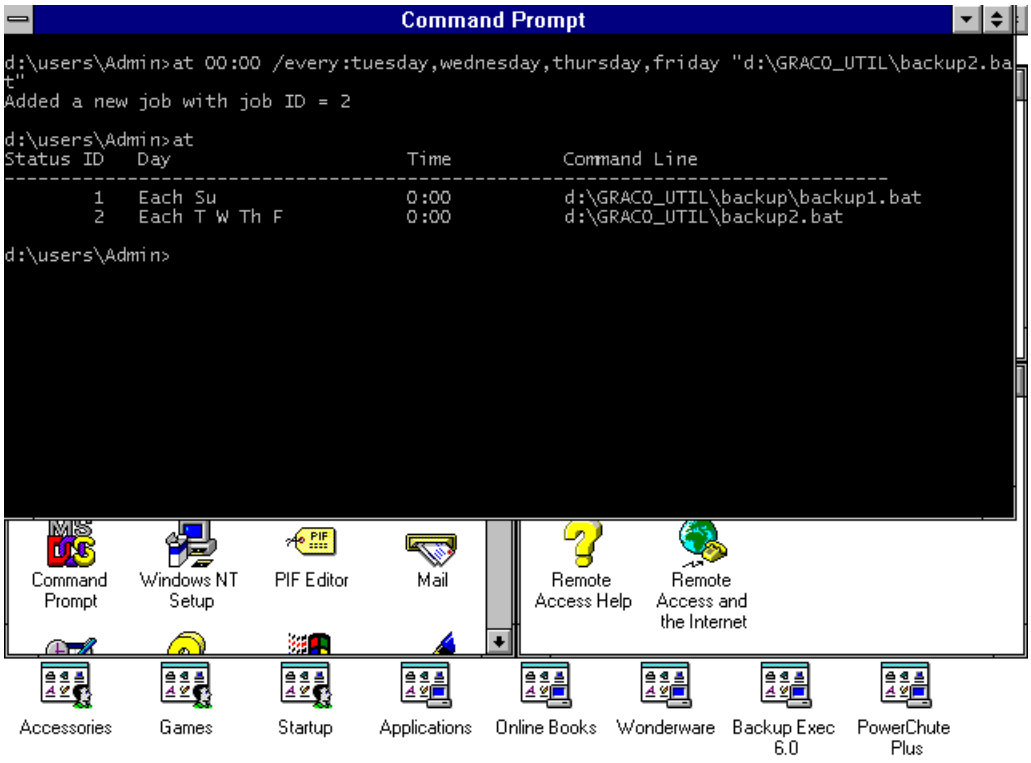
It is possible from the NT Command Prompt to perform backups on a scheduled basis. The 'AT' command will schedule a batch job to run and the 'ntbackup' command will run the program from a batch file. The following figure contains a sample batch job that we used at GRACO for a time to do backups from the server.

```
rem * backup1.bat - 005 - 23 Jun., 1995 (001- 3 Nov., 1994) - SCT
rem *
rem * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
rem *    Backup 'shared' directories to tape.  Intended as a full
backup.
rem *
rem * 002 - Backup selected directories on pcs in production.
28 Nov94
rem * 003 - First pass is server files.  Second is for network
rem *       connected workstations.
30 Nov94
rem * 004 - Added a directory on SJMPC and MISSERVE to backup
19 Jan95
rem * 005 - Now backing up the GCPNTW1 NT Workstation
23 Jun95
rem *
net use l: \\mlrpc\gallery
net use m: \\mlrpc\winword
net use n: \\GCPNTW1\C$
net use o: \\GCPNTW1\D$
net use p: \\sctpc\windows
net use q: \\sjmpc\easyplus COSTACCT
rem *
ntbackup backup c:\ d:\ e:\ /d "Full Server Backup" /v /b /t Normal
/l "d:\graco_util\backup\bk11.log"
```

```
ntbackup backup l: m: n: o: p: q: /a /d "Full Workstation Backup " /v
/t Normal /l "d:\graco_util\backup\bk12.log"
rem *   Disconnect from the shared drives when finished.
net use l: /d
net use m: /d
net use n: /d
net use o: /d
net use p: /d
net use q: /d
```

This batch file would run every Sunday morning at midnight to backup the server and some workstations. It would do a 'normal' backup and store every file. There are options to do incremental and differential backups. There is no concept of a date relative backup as can be done with MPE/iX STORE. The closest approximation is the incremental is a 'relative' backup. Each subsequent incremental since a 'normal' backup would store the files changes since the last incremental store. To recover you must restore the full backup and each relative since the full backup.

Scheduling jobs on an NT Server is relatively easy. The 'AT' command is somewhat similar to the MPE/iX STREAM command with the 'AT=' option. Here is an example of scheduling a job for midnight on Tuesday through Friday for a backup.

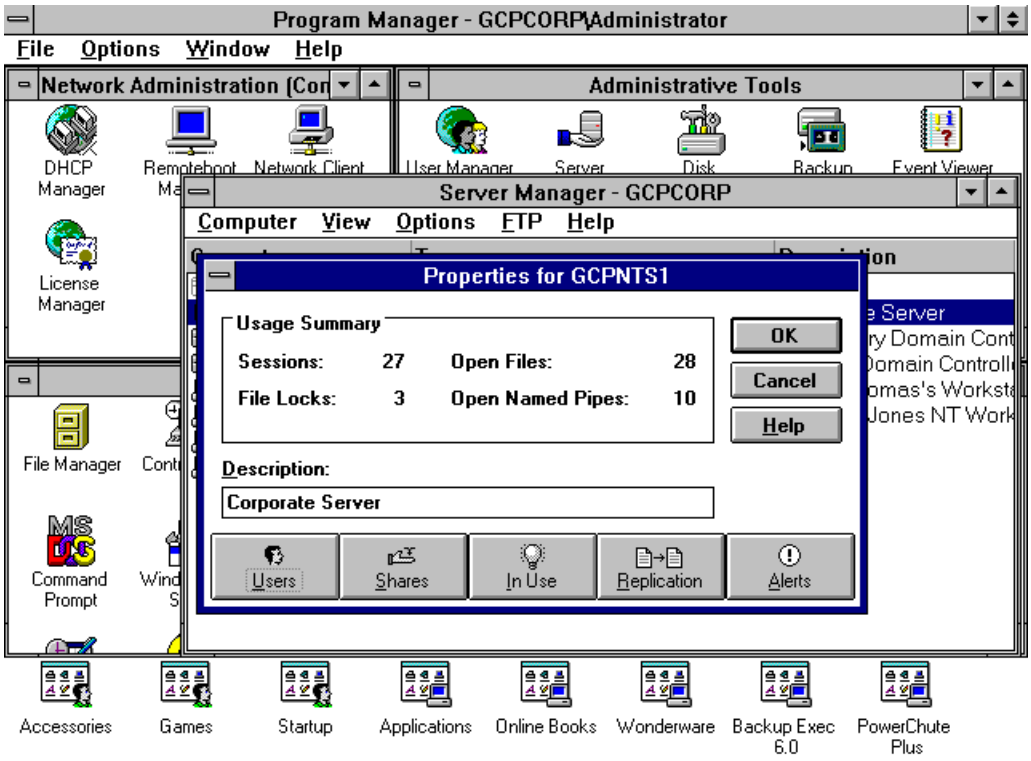


Backup Jobs Scheduled at the Command Prompt

The NT backup program was developed by Arcada which is now part of Seagate software. There are several shrink-wrapped backup solutions that can be purchased. BackupExec from Seagate is the product we use at GRACO. Cheyenne and other software companies have similar products with varying features. Some of the high-end products offer on-line backup.

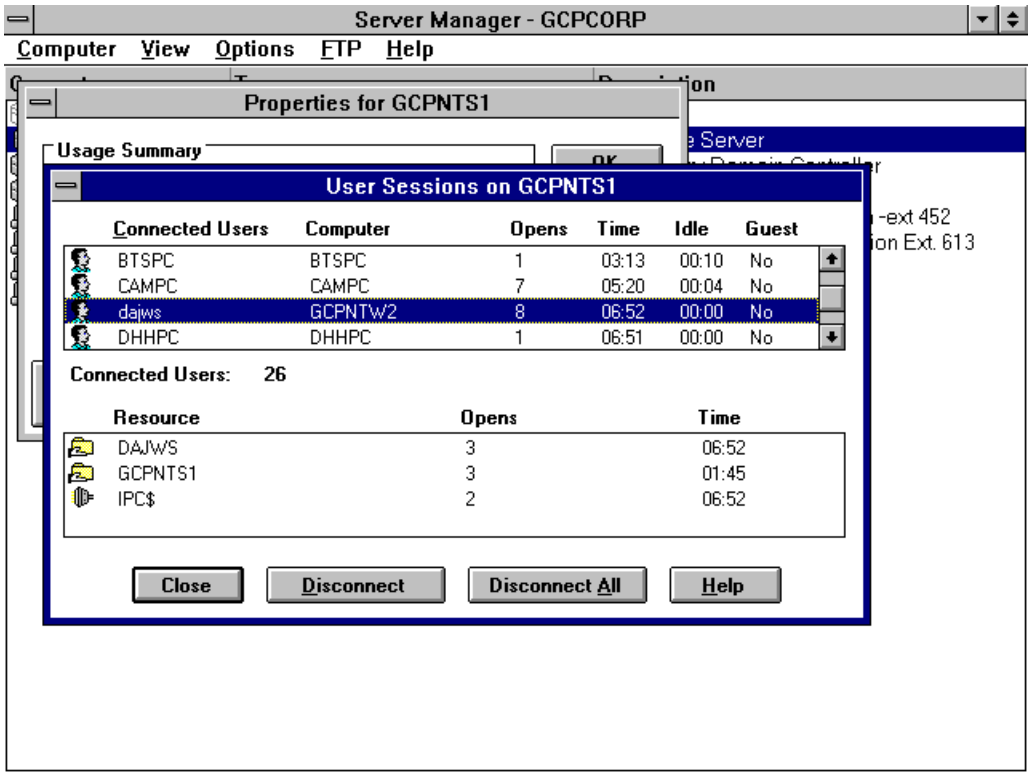
2. User Management

The Server Manager program in Windows NT provides the ability to view who is currently using the server and what resources they are using. In that sense it is like the SHOWJOB command. It also has the capability to display what files are in use by users of the system. It also provides ABORTJOB capability with the Disconnect buttons. Individual users or all logged on users can be disconnected with this utility.



Windows NT 'SHOWJOB' Equivalent

The above picture shows that there are 27 server sessions with 28 individual files open. Three of those files are locked. Named Pipes refer to inter-process communication links. To view individual users press the Users button and another screen is displayed. The other buttons do not have equivalent commands or programs on MPE/iX though some are duplicated by utilities such as MPEX. The Shares button will display all directories shared on the server and the In Use button displays each individual file currently open. Replication displays information on files being 'shadowed' onto other computers. Computer and user problem notification is configured by the Alerts screen. The following picture is a sample of the User screen.



Detail on User Sessions

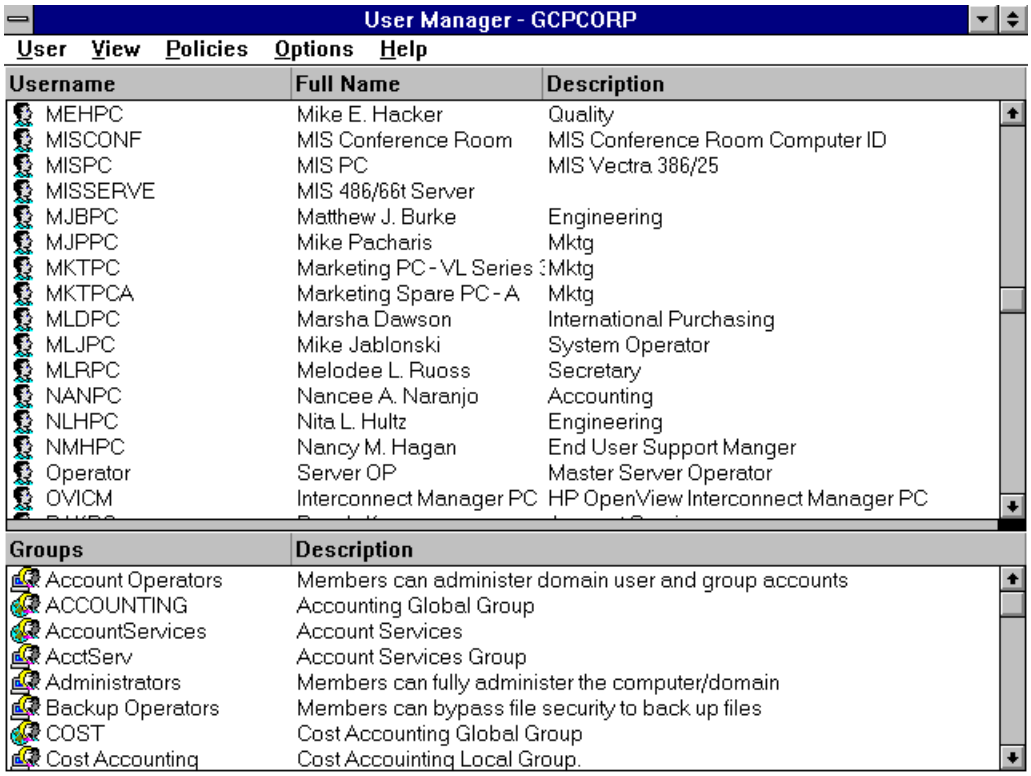
In the above example the user dajws has two IPC 'pipes' open and six files in two directories open. The scroll bar can be used to view the individual users. To disconnect the selected user just press the Disconnect button. The Disconnect All button will disconnect all users connected to the server. The effect of using either button is like an ABORTJOB on an MPE/iX system.

3. Creating User Accounts

A windows-based utility called User Manager for Domains is used to create user accounts on Windows NT Server systems. The Domain is an important concept for NT in many ways particularly with regard to user accounts. A Domain is one or more Windows NT servers that share a security and accounts database. Whether you have one or fifty NT servers in a domain they will all share the list of users stored in a database. That database is shared among all servers. One server is set up as the 'Primary Domain Controller' and has the master copy of the user database and there can be one or more backup controllers to service the users in the event the primary is down.

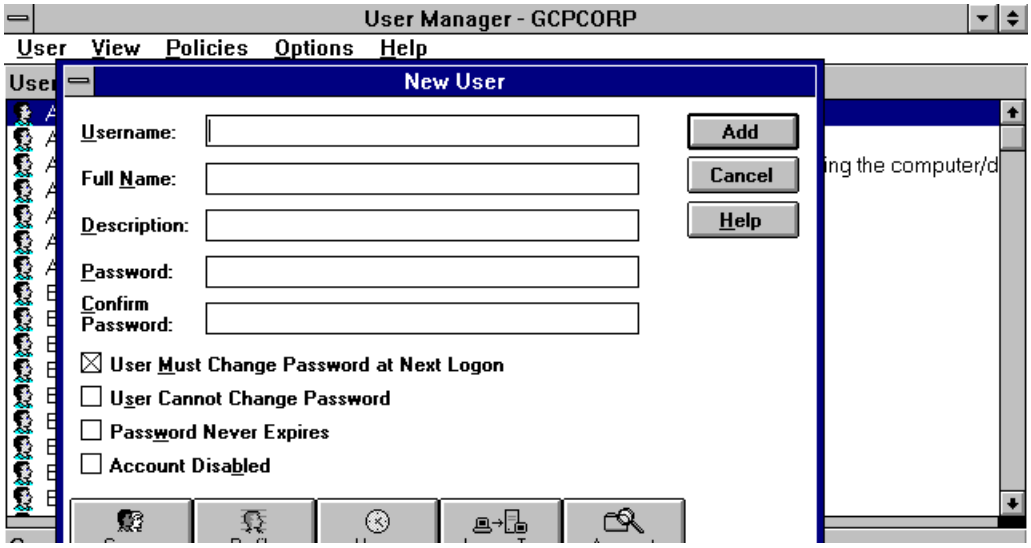
Individual user accounts have more in common with UNIX user accounts than they do with MPE/iX user accounts. There is no concept of a USER.ACCOUNT,GROUP logon with Windows NT. User accounts can be grouped together into Global Groups and Local Groups. Local groups aggregate users on a specific machine. Global groups organize users that can span the machines within a domain. Groups can have special capabilities. There are Operator and Administrator groups that have special privileges on a particular Windows NT server or on a Domain.

To set up a user run the User Manager. On our system we have established all users in a Master Domain so that we can centrally monitor and administer the logons. Each user is issued a specific id to use on GRACO's network.



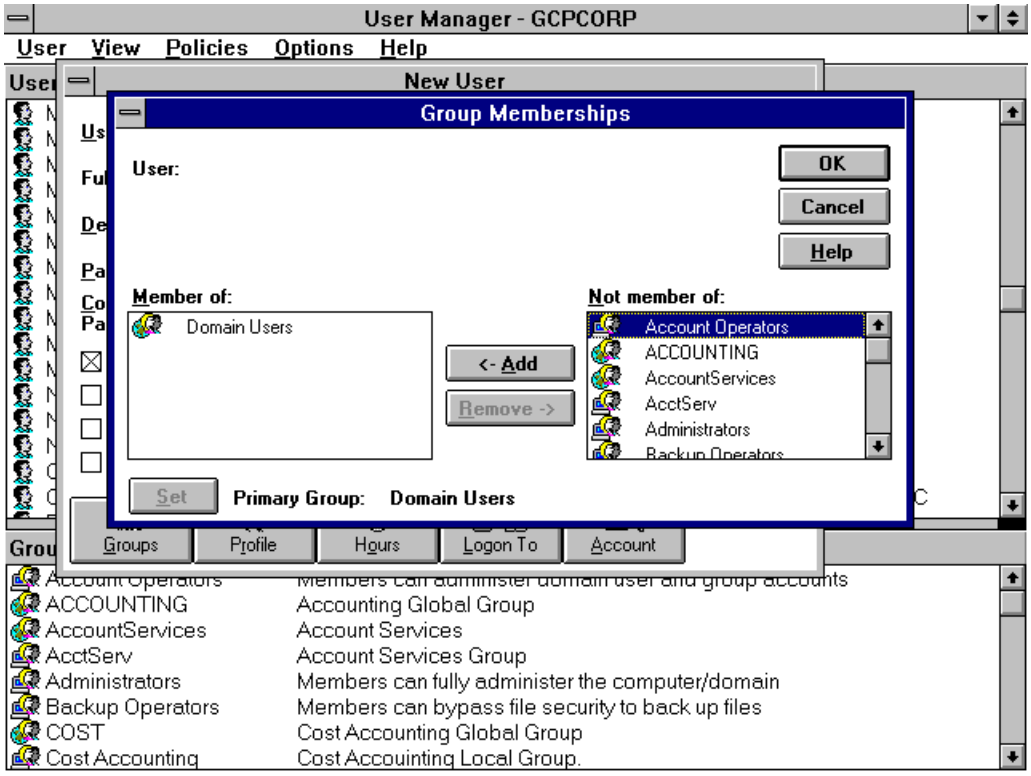
User Manager for Creating Accounts

Clicking on User New brings up the new user screen. By default the new user is prompted to supply their own password. Other options include preventing the user from changing the password, setting a password that bypasses expiration policy, and disabling the account. User names can be up to 20 characters and are not case sensitive. Passwords can contain up to 14 characters and are case sensitive. Unlike MPE/iX, it is impossible to look up a user's password if they forgot it or it is lost. The Administrator must change the password for the user. It is a very bad thing to loose the Administrator's password since that could require the re-installation of Windows NT.



New User Dialog

Every user is assigned to some group. Windows NT has a default group 'Everyone' that all users belong to. Both user-defined and system groups are included in the picture below.

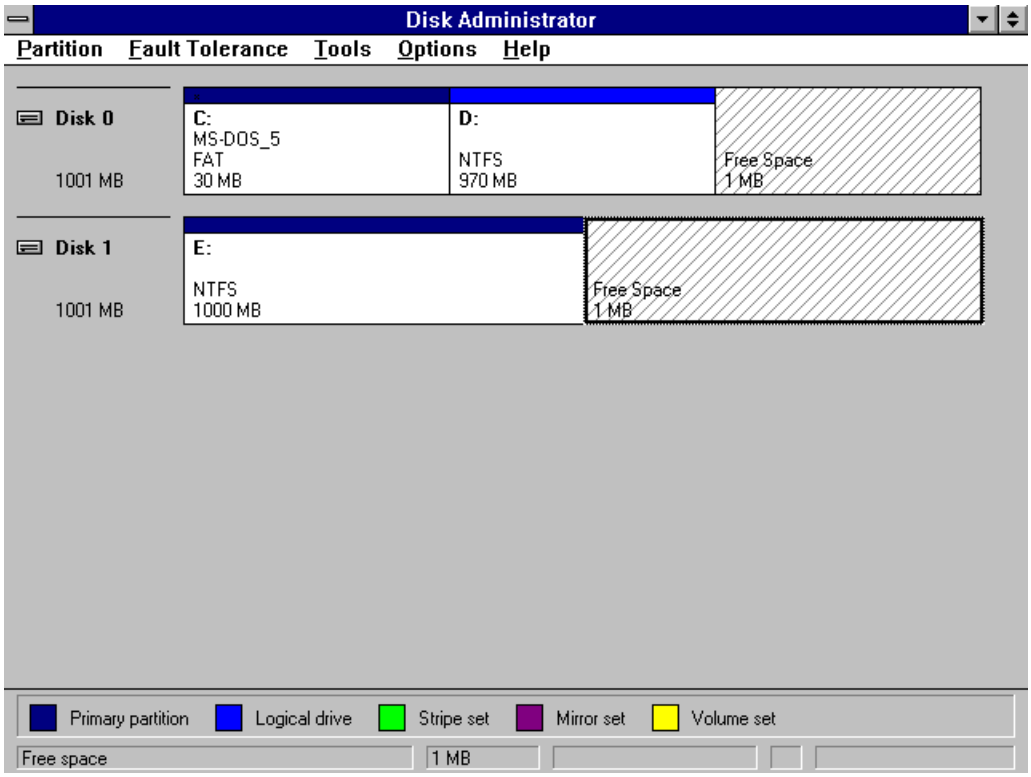


Assigning Group Membership

Profiles can be set for a user to enable a logon script. This is somewhat similar to a logon UDC for a MPE/iX user. The hours of the day and the workstations that a user is allowed to logon to can be restricted when setting up a user account as well. These features are very similar to those available in the VESOFT Security package for the HP-3000. It is also possible to create an account with an expirations date. When the date passes the account is no longer available for use unless the system administrator enables it again.

4. Disk Management

Adding disk drives to the server is very simple on a Windows NT Server. Once the drive is physically installed, the Disk Manager utility helps with the task of formatting and preparing the drive or drives for use.



Windows NT Disk Partition Display

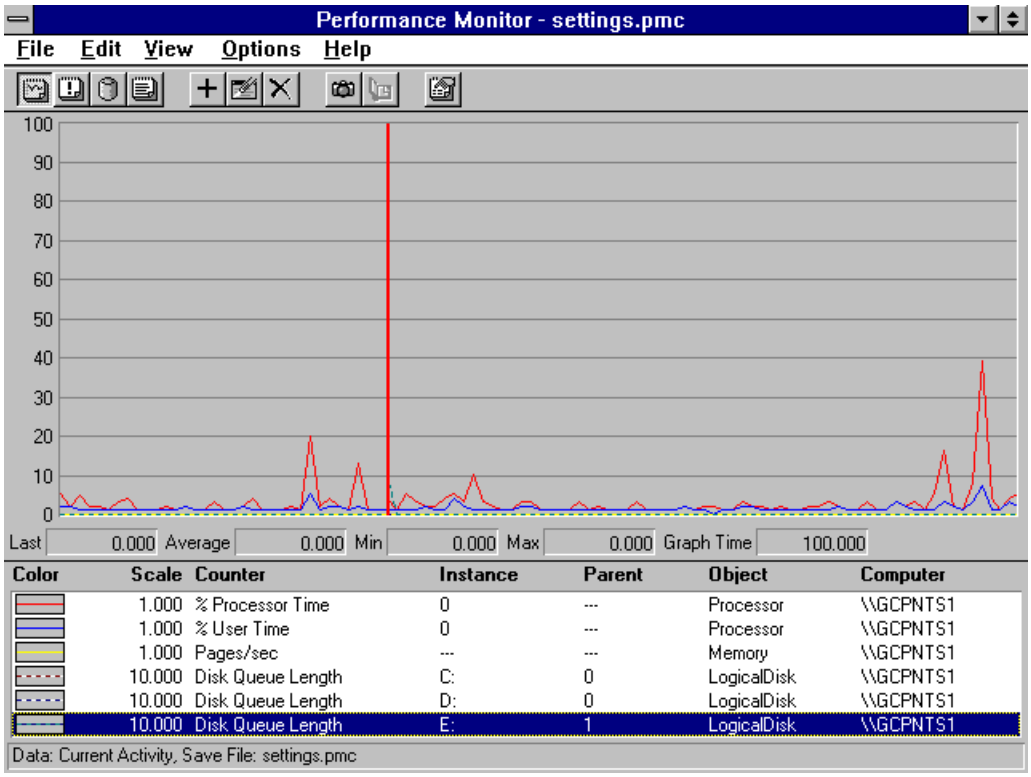
To prepare the drive all that needs to be done is to create a partition on the new drive then format the disk with the File Allocation Table (FAT), High Performance File System (HPFS), or NT File System (NTFS) file system. Depending on the size of the drive or partition the whole process requires but a few minutes. Once formatted the drive is immediately available for use.

In the above example there are two physical drives that are divided into three partitions. The first 30 megabytes of drive 0 are formatted with the FAT file system. This is done so that the system can be booted to DOS if necessary for maintenance. The other 970 megabytes are formatted using the NTFS. One thousand megabytes on drive 1 are set up with the NTFS. Both drives have one megabyte of free space that is not partitioned or formatted.

The NTFS supports logical partitions, stripe sets that span drives, and mirrored disks. These options come with NT. Disk arrays implemented in hardware are also supported. Individual NTFS partitions can be over 7 gigabytes in size.

5. Performance Management

Windows NT comes with a very nice utility called Performance Manager. This utility is similar to the HP Glance software in function and has logging utilities like LaserRX. The Windows NT operating system has available counters for many of the operating system components. It is very easy to measure different parts of the system in a graphical form. There are hundreds of individual items that can be measured organized in 21 groups. Most counters are enabled when Windows NT is installed though a few must be started by the system administrator. Applications such as Microsoft SQL Server can add their own counters to the Performance Monitor. It is very easy to enable the monitor to measure basic system processes.

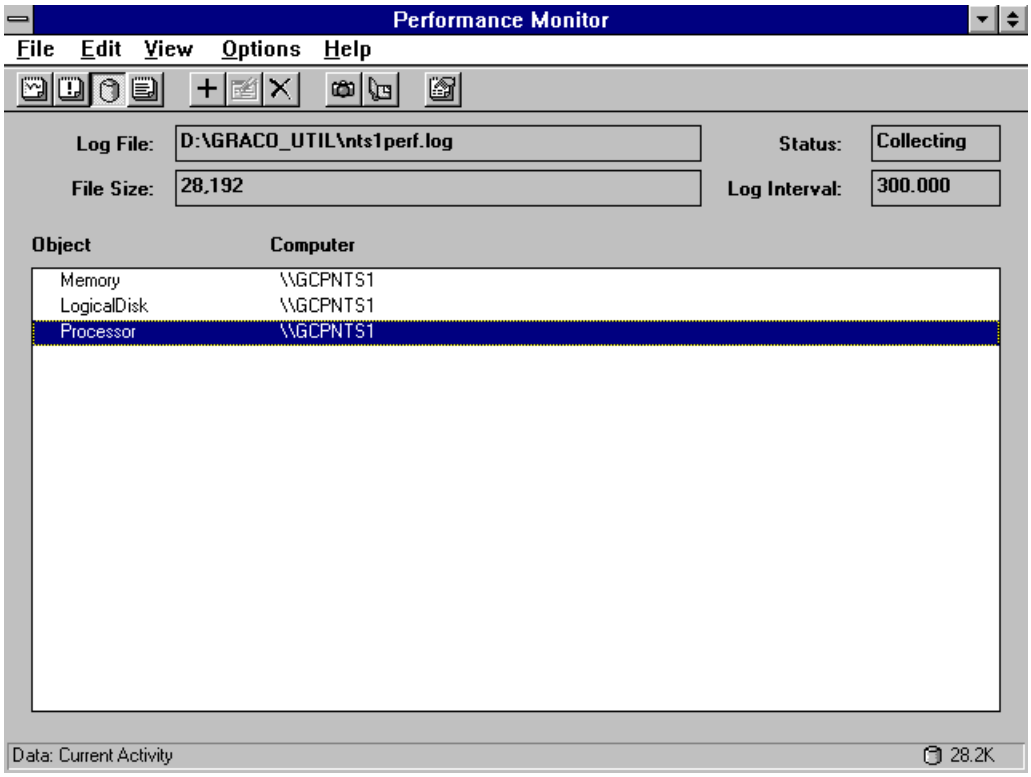


Windows NT Performance Monitor

The above picture is showing the current usage on a lightly-loaded HP NetServer 5/66LF with about 80 megabytes of memory and 25 users logged on. The long vertical line is the current time. The chart is set to refresh at a rate of once per second with the graph completely redrawn after 100 seconds. Data refresh rate is configurable with the NT Performance Monitor. Spikes are processor utilization with the line below being amount of time the computer is spending on user processes. Since this system is lightly loaded there is little movement on the Pages/sec or the Disk Queue Length. The Scale column is used to indicate the scale being used while drawing a particular line. Counter is the particular item being monitored. Instances refers to the particular device either physical or logical that is being measured if applicable. The Performance Monitor can measure individual processors in a multi-processor server or it can measure all processors in aggregate. Parent on the Disk Queue Length counters displays the physical drive identification. Object is the group the counter belongs to and Computer is the system the measurements is taken from. It is possible to measure a remote NT system over the network. In fact that is the preferred method of measuring a systems performance.

Settings can be saved to a file so that it is possible to set particular combinations of counters for reuse. This is particularly handy when monitoring the performance of several servers.

The Performance Monitor in NT is very good at giving the System Administrator data on the performance of a system. Unlike Glance or LaserRX it can do no analysis on its own nor does it by itself provide recommendations. It can not be configured to alert the operations staff if memory gets low or a disk drive has queues that are getting unacceptably large. There is the option to log the data and report it or export it to other applications such as Excel for analysis.



Setting Up Performance Data Logging

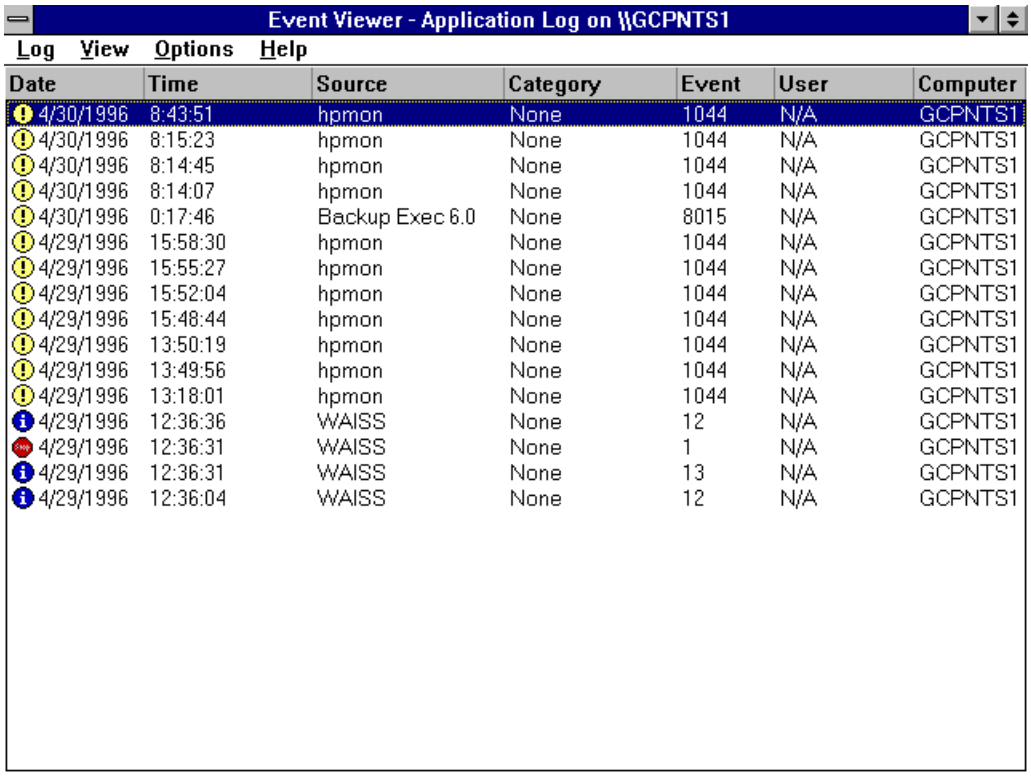
This screen shows that the data for GCPNTS1 is logged to a file called D:\GRACO_UTIL\nts1perf.log every 300 seconds. The current file size is 28.2k bytes. This file can grow VERY large depending on the log interval and the amount of time the log file is collected.

7. Event Logging

There are three basic logs used by Windows NT. They are somewhat similar to MPE/iX log files but they are much easier to view and use. There is a System log that monitors events related to system processes and services. For example, when the system reboots services or server processes that can not start or generate error messages put an entry in the System Log.

The Security Log records password violations, password changes, and other system security related events. When someone dials in to an NT Server there is an event log entry generated. Also when the security log is cleared there is an event recorded.

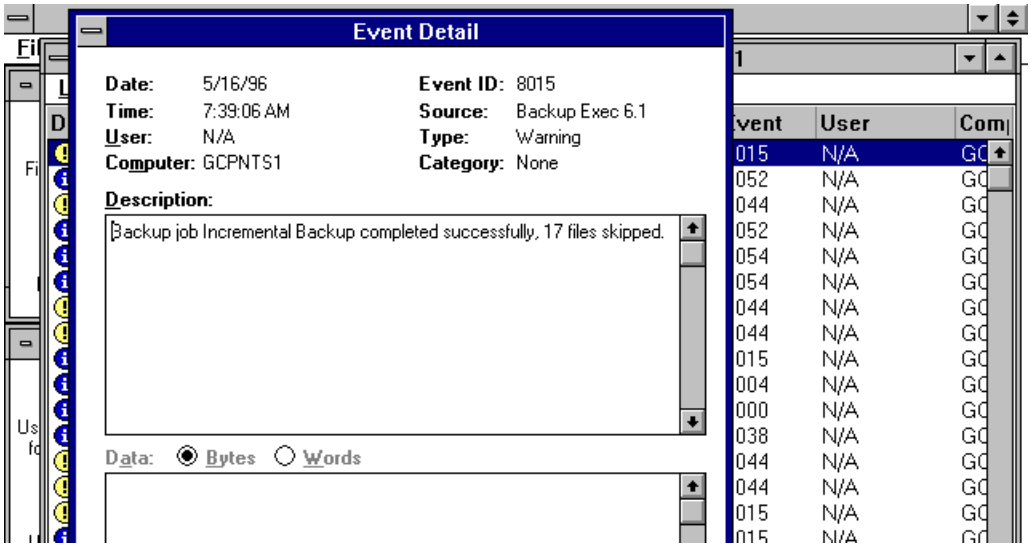
The third standard log file is the Application Log. This records events from software applications and non-system services.



Date	Time	Source	Category	Event	User	Computer
4/30/1996	8:43:51	hpmon	None	1044	N/A	GCPNTS1
4/30/1996	8:15:23	hpmon	None	1044	N/A	GCPNTS1
4/30/1996	8:14:45	hpmon	None	1044	N/A	GCPNTS1
4/30/1996	8:14:07	hpmon	None	1044	N/A	GCPNTS1
4/30/1996	0:17:46	Backup Exec 6.0	None	8015	N/A	GCPNTS1
4/29/1996	15:58:30	hpmon	None	1044	N/A	GCPNTS1
4/29/1996	15:55:27	hpmon	None	1044	N/A	GCPNTS1
4/29/1996	15:52:04	hpmon	None	1044	N/A	GCPNTS1
4/29/1996	15:48:44	hpmon	None	1044	N/A	GCPNTS1
4/29/1996	13:50:19	hpmon	None	1044	N/A	GCPNTS1
4/29/1996	13:49:56	hpmon	None	1044	N/A	GCPNTS1
4/29/1996	13:18:01	hpmon	None	1044	N/A	GCPNTS1
4/29/1996	12:36:36	WAISS	None	12	N/A	GCPNTS1
4/29/1996	12:36:31	WAISS	None	1	N/A	GCPNTS1
4/29/1996	12:36:31	WAISS	None	13	N/A	GCPNTS1
4/29/1996	12:36:04	WAISS	None	12	N/A	GCPNTS1

Sample Application Events

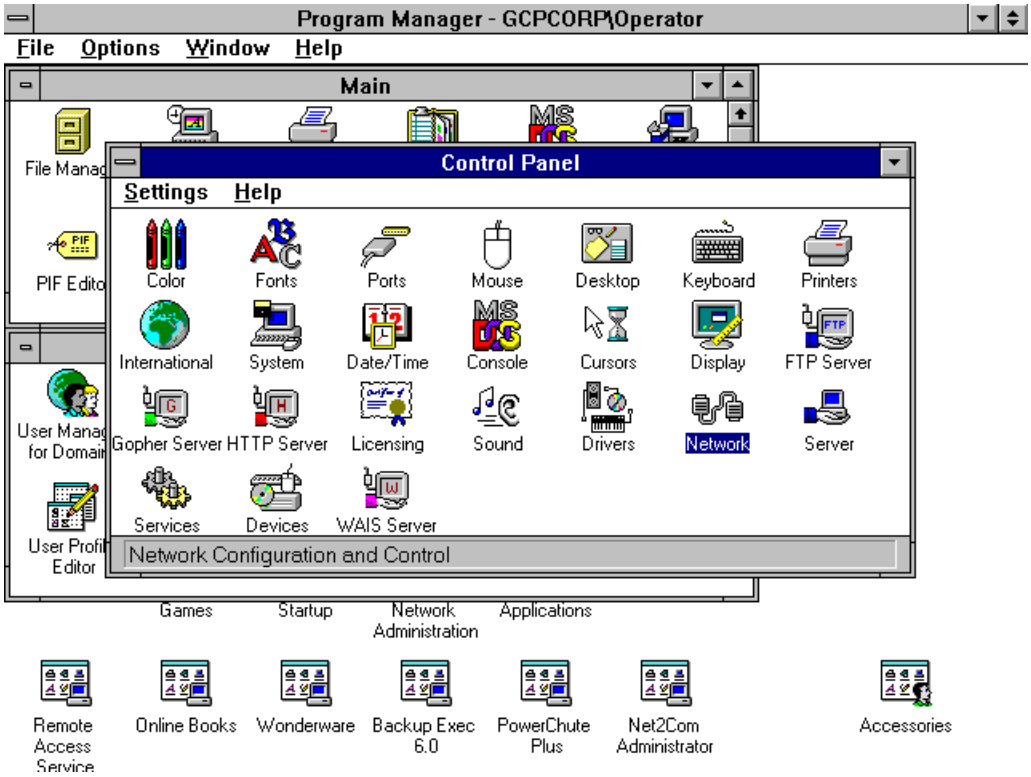
This example lists some of the Application Log entries for the GCPNTS1 server. There are some entries regarding the status of some of the HP LaserJets on the network. Those entries are from the 'hpmon' source. The backup software we use in production Backup Exec 6.0 placed an entry in the log when it performed the nightly backup. A WAISS server being tested placed some entries in the log as well. The log entries marked with a exclamation point denote warning messages. Those marked with an a circle and an 'I' are information only entries. Those marked with a 'STOP' sign designate errors. Below is an example of a warning entry from the Application Log.



Detail on Backup Exec Application Event

7. Network Configuration

Much of Windows NT is configured from the Control Panel just as Windows 3.x is. The Network icon in the Control Panel is the closest corresponding entry to MPE/iX NMMGR utility.



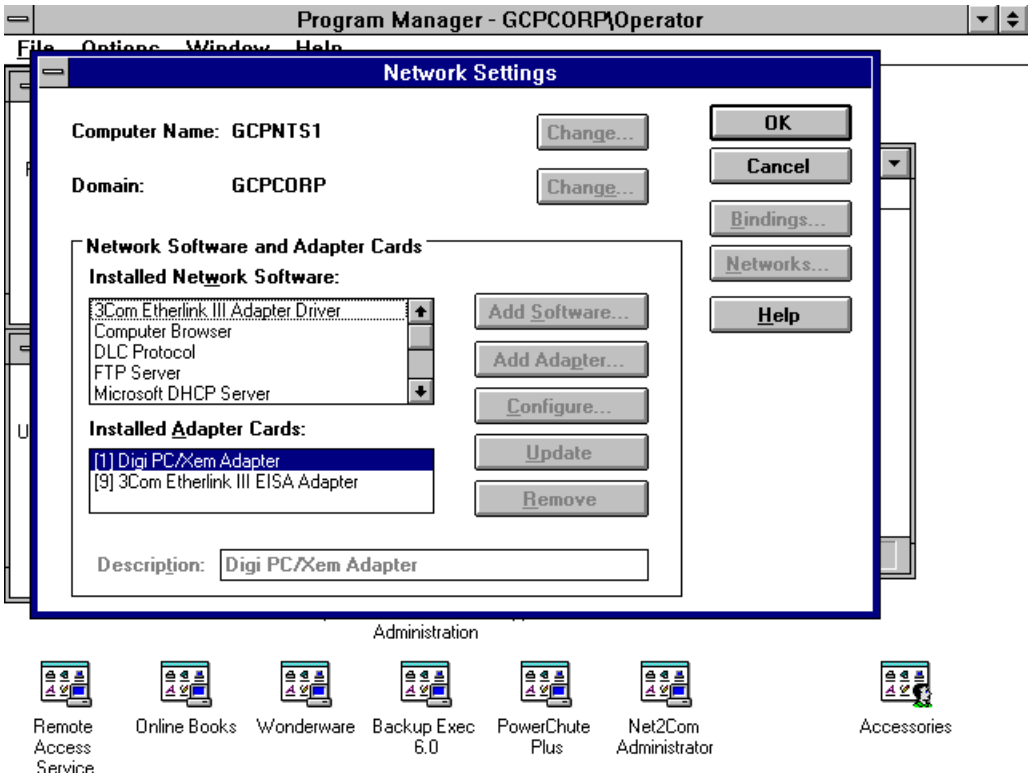
Windows NT Control Panel

The Windows NT Control Panel appears on the surface to be similar to the Windows 3.x version. There are many differences in the individual programs within. The network configuration is just one example of the vast difference.

Protocol Support

	WINDOWS NT 3.51	**MPE/iX 5.0**
IPX/SPX	Standard	Optional (32020B)
NetBEUI	Standard	Not Available
TCP/IP	Standard	Standard
FTP	Included	Included
Telnet	Included	Outbound only
DLC	Standard	Not Available
AppleTalk	Available	Optional (J2244A)

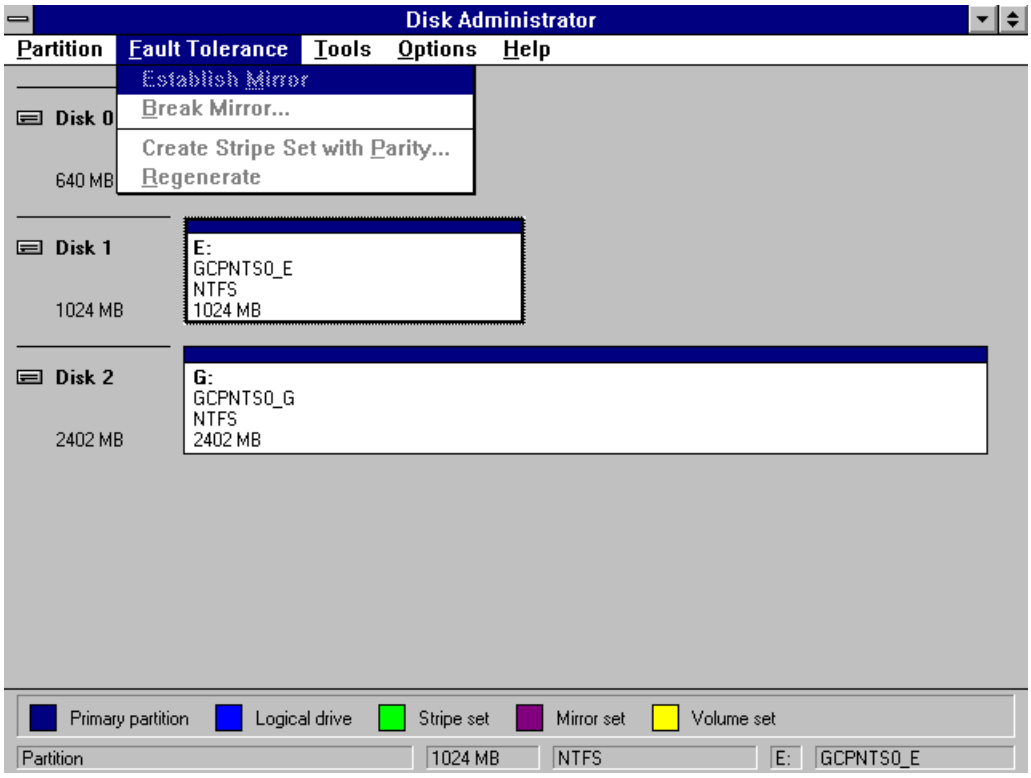
Figure 2



Network Configuration Screen

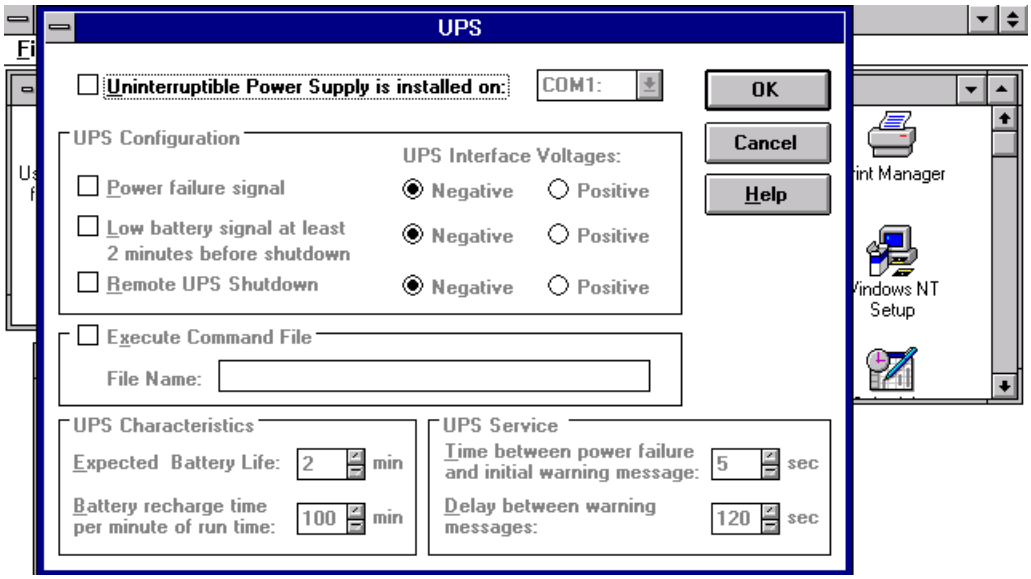
Maintenance and Fault Tolerance

HP-3000s and MPE/iX are very fault tolerant systems. They handle power failures very well and newer models come with built-in UPS systems. MPE/iX has a robust transaction manager that help ensure data integrity. Hardware options like RAID are supported. Software updates and patching MPE/iX has, arguably, become easier over the years and promises to become even better with MPE/iX 5.5. Tools sold by third parties such as Quest software and HP extend the features to add disk mirroring and file shadowing. Windows NT Server includes some fault tolerant features as well. As mentioned earlier disk arrays are supported at a hardware and software level. Out of the box it is possible to set up disk mirror sets and RAID Level 5 arrays.



NT Disk Fault Tolerance Options

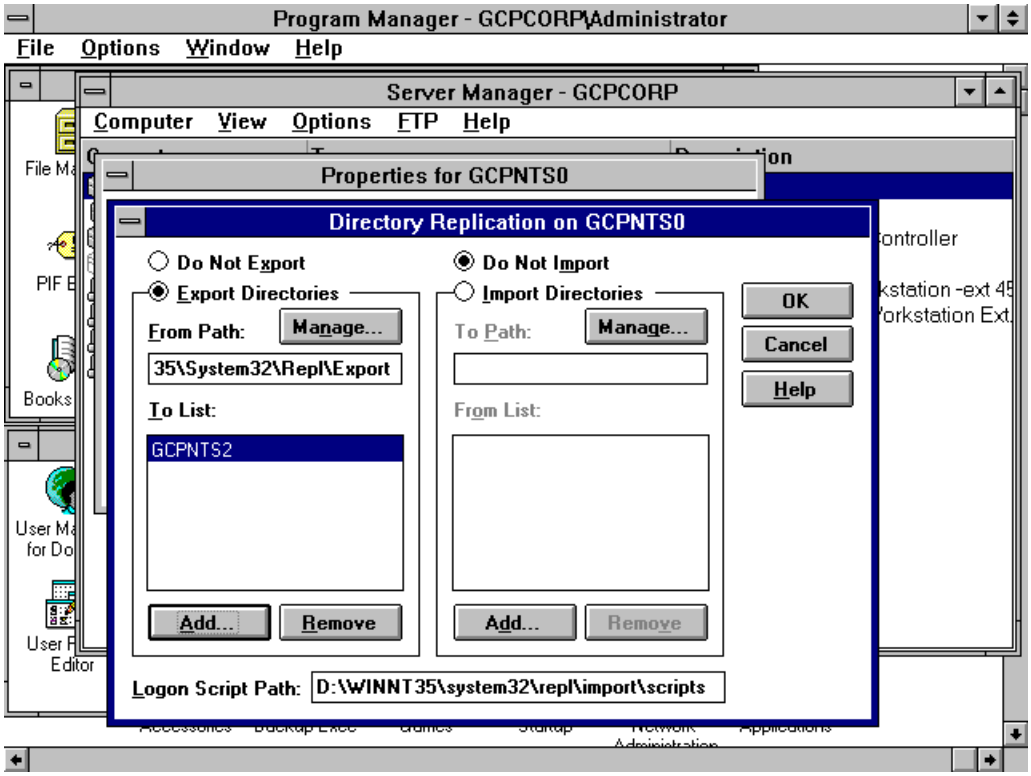
The built-in UPS support in Windows NT will allow just about any power supply that comes with a serial output to be controlled by the operating system. Devices sold by APC, Hewlett-Packard and others frequently have their own software that is optional at extra cost. At GRACO we use APC and Hewlett-Packard UPS devices. Both have similar setup and functional features. The main set up screen for each is not much different that the following picture.



Standard Windows NT UPS Support

This tool installed in the Control Panel on Windows NT. Selecting a COM port enables the software.

Another feature that provides a measure of fault tolerance is the replication feature. Directories and files can be exported to and imported from other Windows NT computers. This feature is intended for logon scripts but can be used for other types of files as well.



Directory Replication Dialog

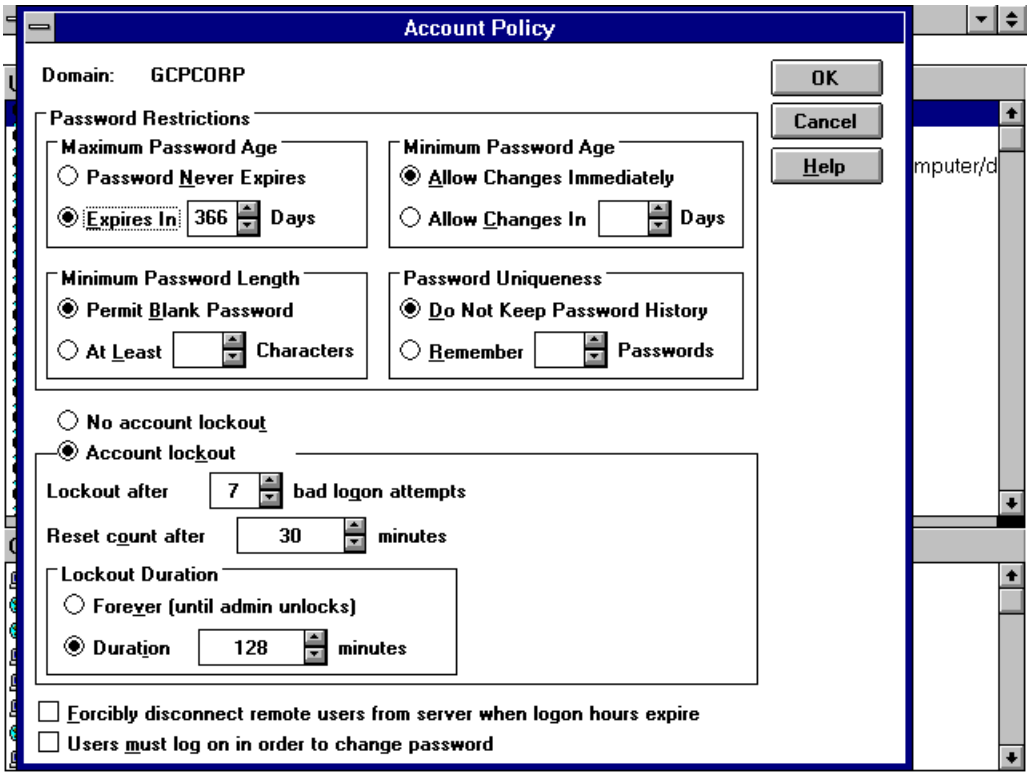
To enable the export enter the path in the From Path box. Files can be exported to or imported from multiple servers on the network. Other Microsoft products such as SQL Server have replication features that allow database replication over the network.

One key feature that Windows NT lacks that is a key benefit to MPE/iX is the Transaction Manager. There is no dynamic recovery of files on NT as there is in MPE/iX.

Patching Windows NT is a very easy and straight forward process. Microsoft Service Packs can be obtained via CompuServe or Microsoft's FTP Server on the Internet. For a fee they are available on the Microsoft TechNet CD-ROM. A CD with only the service pack can be purchased from Microsoft for about $20 plus shipping. Every few months a service pack is issued for current versions of Windows NT by Microsoft. Each service pack is cumulative so that every fix on Service Pack 1 is also on Service Pack 2. To install a Service Pack, copy the file to a temporary directory that can be reached by the system to be updated. Unpack the file then run the UPDATE program. The files will be copied to the appropriate places in the Windows NT installation directory. After a system reboot the Service Pack is installed.

Windows NT System Security

Security features are integrated into Windows NT that provide capabilities beyond what is standard in MPE/iX. The Account Policy dialog is a standard part of NT. With it the system administrator can enforce password aging, length, uniqueness, and reuse. Lock out in the event of bad logon attempts is also available.

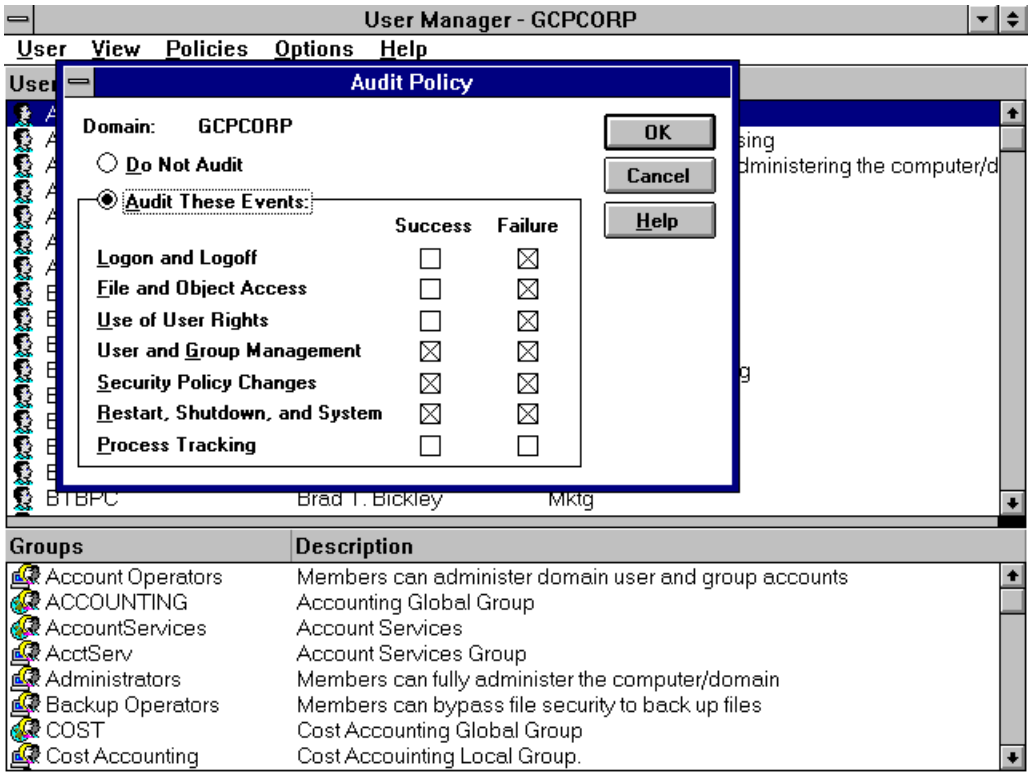


Account Policy Dialog

These features which are a standard part of Windows NT must be purchased separately for MPE/iX.

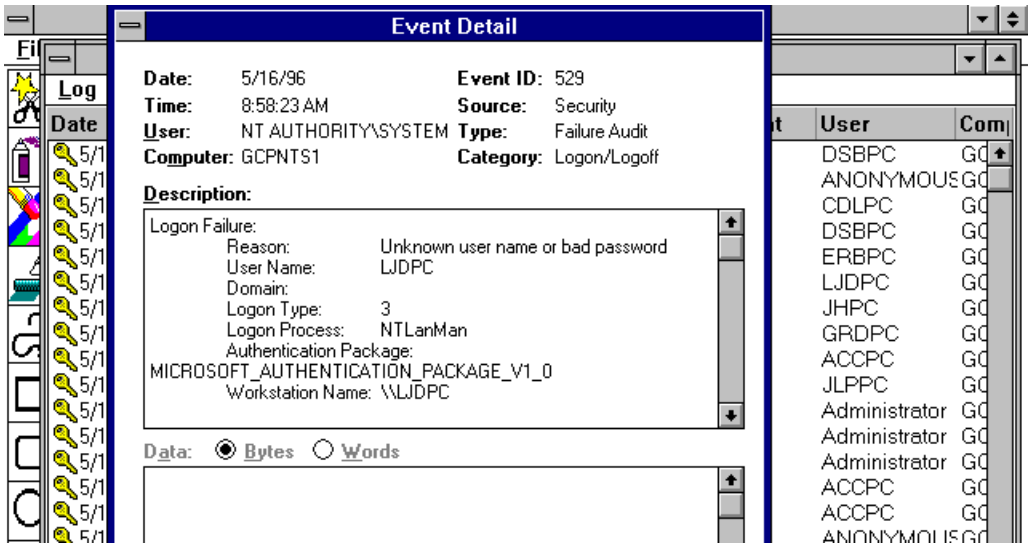
Just as with the ALTACCT and ALTUSER commands, special capabilities can be assigned to users on Windows NT systems. This is done using the User Rights Policy dialog box that is also in the user manager. Assigning special capabilities such as the right to shut down the computer, load device drivers, or take ownership of files for particular users or groups is done from this area. It is very easy to customize user privileges in this manner to provide specific capabilities. As with assigning capabilities on MPE/iX, it is very important to use caution when giving out rights. Particular rights can be revoked from a given user as they can with MPE/iX.

Comprehensive auditing of user account activity is standard with Windows NT as is true with MPE/iX. This audit capability is configurable to provide as much detail as is desired. Events such as logon and logoff, file access, security changes, system shutdown and restart, and user account changes can be logged in detail. Each logged event is placed in the Security Event Log. This log can be configured to a desired size. Whether the log overwrites old entries can be set as well. In the following picture the Audit Policy dialog is set to create a log entry for failure of any activity except Processes. Successful changes to user and group accounts, security policy, and computer reboots are also recorded.



Audit Policy Dialog

If there is an event like a logon failure the event is easily accessible in the Windows NT Security log. Unlike the HP-3000 console there is no message automatically displayed on the Windows NT console.



Sample Logon Event

An interesting feature of NT security is that it is cumulative. If a user belongs to a group that has no rights to a file or a printer then he has no ability to access that object. This is true even if all other groups the user belongs to has the right to access the file or printer. This makes it very easy to secure

objects on the system. It can also lead to extra work when trying to find out why a user can not access a file when the user belongs to many groups.

Assigning the rough equivalent of SM and OP capabilities in Windows NT is done through account structures known as Local Groups. The SM equivalent is the Administrators Local Group. As with SM capability on the MPE/iX systems the Administrator can do all things to the system. Special rights such as the ability to manage logging, take ownership of files, and force remote system shutdowns are assigned to the Administrator's group. Included with those rights is the ability to do tasks such as user and group management, assigning user rights, formatting the server's disks, and sharing directories and printers.

Three groups take the function of OP for operators. These functions are more finely defined than under MPE/iX. There is a Backup Operators group that allows a user in this group to bypass regular security to backup and restore files. This does not give the user the right to read or update the file themselves. Print Operators are capable of handling the printers connected to the server. They can manage spool files, shutdown and restart printers, and share them on the network.. The Server Operator group has the capabilities of both Print Operators and Backup Operators.

Another Operator group that does not have an exact equivalent on MPE/iX is the Account Operator. Members of this group can create user and group accounts on the system. The can not create or modify Administrator accounts. This capability may be somewhat similar to the Account Manager on MPE/iX accounts.

There is a default Users group that is intended for regular server user. As on MPE/iX systems, people with Users capabilities can log on to the server, create and manage files, run programs, attach to other computers they have access rights to, and create a profile. The profile has some similarity to a logon UDC that would set up the user's environment.

A security threat that is very present in the Windows NT environment that is almost unheard of in the MPE/iX environment is virus attack. Windows NT is susceptible to virus attack like DOS and Windows even though Microsoft made some effort to reduce the risk of possible damage. Like UNIX, people have already found security holes that can be exploited by hackers. Some of these have been addressed by the Microsoft Service Packs but others exist. Third party software providers such as McAffee and Norton have anti-virus products available for NT. A nice feature of some of the products is that you can configure them to sweep a server on a regular basis to watch for infection.

We Have Not Canceled the HP-3000 Leases Yet. . .

The four HP-3000 9X7 systems in our data center will not be shoved out the door in favor of Windows NT Servers in the immediate future. Despite some impressive claims from Microsoft it does not appear that Windows NT scales to the on line transaction capacity of our 987 system. In processing power and transaction performance Windows NT running on Intel Pentium processors could rival some of our low end HP-3000s. As of this writing a HP NetServer LS with a 166Mhz processor can be configured with up to four processors, 786 megabytes of memory, and up to 240 gigabytes of disk storage. A system like that can support hundreds, perhaps thousands of users. Digital Equipment Corporation is claiming great performance numbers with Windows NT on their Alpha chip. It will not be long, if it has not happened already, that a system running Windows NT will be the size of HP-3000 99x or HP-9000 T500 computers. With the HP/Intel alliance it will be very interesting to see how Windows NT fits in to the Hewlett-Packard product lineup.

To date there is a limited set of applications written to take advantage of Windows NT. Being a relatively new environment it will take some time for server management and end-user applications to

become plentiful. This too will change with time as it seems many developers are jumping on the NT bandwagon. Particularly pleasing to see is NT support in the OpenView family of products from Hewlett-Packard.

Conclusion

Windows NT Server is a very nice operating environment with many first class features comparable or superior to MPE/iX. It has advantages in that it is available on a variety of hardware platforms, is compatible with many existing Windows applications, and has a growing number of software applications written for it. Windows NT is not yet as mature as MPE/iX nor does it match the Hewlett-Packard operating system in on-line transaction processing features and performance. GRACO will be using both environments over the next few years.

Resources

There are many books available on the market about Windows NT. We have found the following books quite useful as we set up and deployed Windows NT Servers and Workstations. All are from Microsoft Press.

Microsoft Windows Nt Resource Kit for Windows NT Workstation and Windows NT Server Version 3.51. Microsoft Press, Redmond, Washington. 1995.

Support Fundamentals for Microsoft Windows NT. Microsoft Press, Redmond, Washington. 1995.

Microsoft Windows NT 3.5 Guidelines for Security, Audit, and Control. Microsoft Press, Redmond, Washington. 1994.