

**Peer-to-Peer Networking:
An Example Using SAS System for PCs® and Microsoft Windows for Workgroups®**
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ABSTRACT

For years, we have developed SAS® programs in a batch mode environment using IBM® mainframes over dial-up lines and magnetic tape media, often through an intermediary mini-computer. Data processing costs were substantial, and turnaround times were often agonizingly slow. Over the last two years, we have moved almost entirely to personal computers (PCs) running Microsoft Windows for Workgroups (WFW) and SAS System for PCs. WFW allows us to operate a peer-to-peer network over the same lines used for our Novell® network. Even though our machines are state of the art with large disk drives, no one machine can contain all of our data. The peer-to-peer nature of our network, however, allows us to spread our data over many different PCs and even run SAS System for PCs from another staff member's machine. The end result has been a large decrease in data processing costs and turnaround time measured in minutes instead of days.

INTRODUCTION

Our mission within Oak Ridge Institute for Science and Education is to analyze science and engineering education and employment trends. This research necessitates the use of large databases, most of which are provided through the National Science Foundation. The large size of the databases required to do our research analysis prevented us from moving from a mainframe to PCs and to SAS System for PCs. Without a central server or any one hard disk large enough to store all our data sets, we turned to a peer-to-peer network. We now store various data sets on several different PCs connected by the network, which allows PC users in the workgroup to access all the data as easily as if it were on their own computer. This paper describes our experience with the peer-to-peer network and discusses issues arising from its use.

BACKGROUND

As recently as a few years ago, we felt that we were forever tied to the mainframe that we contract to use. Our work as a research group involves the analysis of science and engineering education and employment trends and requires the use of very large databases. The databases, containing such information as doctoral recipients or census data, can have 200,000 records or more and record lengths of over 1,000 bytes. The original data is available to us only on magnetic tape. When the data was downloaded to a PC, we had to devote virtually all of the hard drive to any one file.

Rising computer costs and the need for information systems that were user-friendly and easily customized prompted us to turn to PCs and the SAS System for PCs. Batch jobs were submitted by terminal via a minicomputer to the mainframe. This sometimes made the turnaround time very slow, especially because jobs with large numbers of input/output were assigned a lower priority.

We do not have a dedicated server available on which to store large amounts of data, but the combined hard disk capacity of our small workgroup is substantial. While we could download a large data set to a single PC, if we wished to subset the data set, there wasn't enough disk space. Also, the data set was available only to the PC on which it was downloaded. To take advantage of the combined hard disk capacity of our group and to share files without having to physically move them, we began to investigate peer-to-peer software.

Visual cues for Windows for Workgroups will follow Microsoft's typographic conventions:

bold	Characters that you must type exactly as they appear or menu options.
ALL CAPITALS	Directory names, file names, workgroup names.

PREREQUISITES

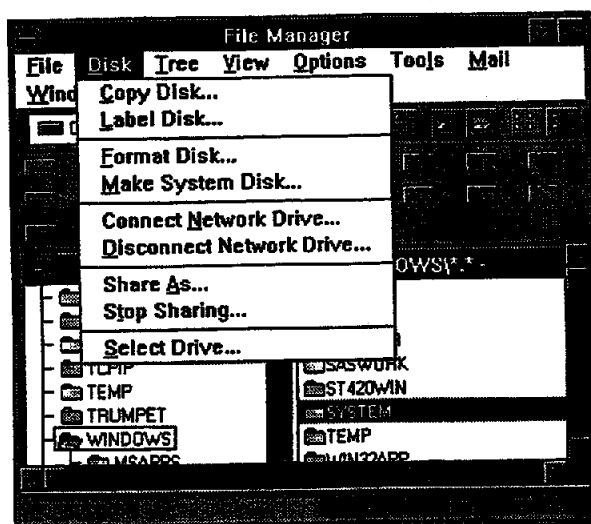
A peer-to-peer network is distinguished from other networks because it does not require a centralized server; each PC acts as a client and/or a server depending on the task it is performing. Several components are necessary for a peer-to-peer network to work properly. In our situation, we needed high-performance PCs with large hard drives. Virtually all of our PCs have 486 processors, with memory ranging from 8MB to 20MB and with hard drives as large as 500MB. A local area network to connect the computers was also needed. We were able to use the cabling systems already in place for our organization's network to create our own peer-to-peer network. This has allowed us to run Novell and a peer-to-peer network on the same 10 base-T Ethernet network simultaneously. Finally, we needed a peer-to-peer software package. Because we had already committed to using Microsoft Windows®, we decided to experiment with WFW, even though neither we nor our network support had any practical knowledge of how WFW works.

SHARING RESOURCES

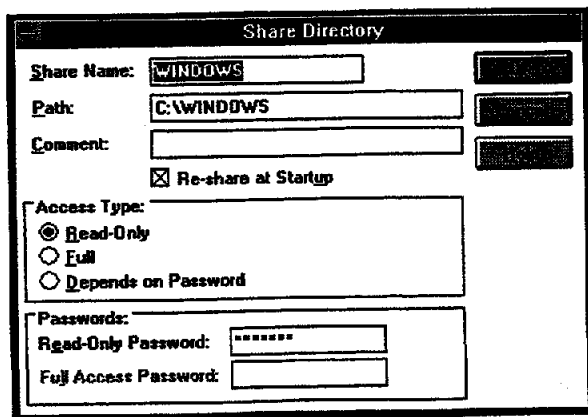
File Manager, a WFW application, is used to share data sets and applications with other PC users and to connect to resources that others are sharing. Resources that are to be shared must be in a shared directory. Only shared resources can be connected to; directories that are not designated as shared can be accessed only by the PC on which the directories reside.

To share directories to make files available to other users:

- Access File Manager.
- Select the directory to be shared.
- Pick Disk from the menu bar, as shown below.
- Choose Share As from the pull-down menu.



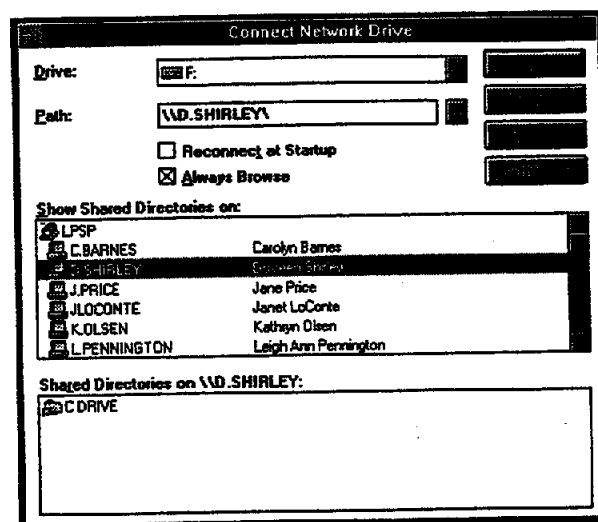
The Share As dialog box, shown below, is used to assign a name to the shared directory and to set password options. The password options protect the shared directory by designating it as Read-Only, Full, or Depends On Password.



CONNECTING TO SHARED DIRECTORIES

Connecting to a shared directory or directories on one or more other PCs is also done through the File Manager. To connect to a shared directory:

- Access File Manager.
- Pick Disk from the menu bar.
- Choose Connect Network Drive from the pull-down menu.
- Select from the shared directories listed in the Connect Network Drive dialog box, as shown below.

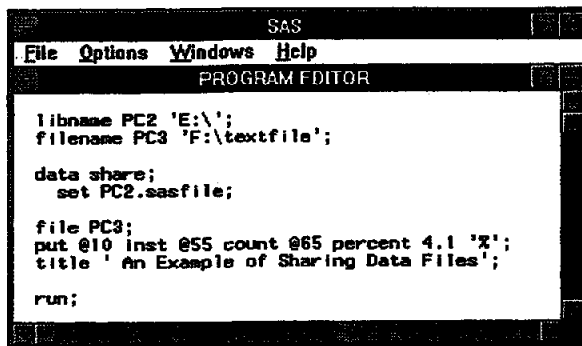


The shared directory is assigned the next available drive letter (F: in the dialog box shown above). This creates a WFW virtual network drive. After connection to a shared directory, the resulting virtual network drive can be used in the same manner as any other drive. Disconnecting from the shared resource eliminates the temporary network drive that only exists during connection.

AN EXAMPLE OF SHARING DATA FILES

To execute a SAS System for PCs application that requires a data file on another PC, the shared directory containing the necessary data file is connected to by using the File Manager. The resulting assigned network drive is then used in the Libname or Infile statement. An application can access resources across any of the PCs in the workgroup.

To illustrate, we will assume that a SAS application requires access to a SAS file that is located on a second PC and that it will write a text file to a third PC. Connection is made to the shared directory on each of the machines. The drive letters assigned during the connections are then used in the Libname and Filename statements as illustrated in the following box.



```

SAS
File Options Windows Help
PROGRAM EDITOR

libname PC2 'E:\';
filename PC3 'F:\textfile';

data share;
  set PC2.sasfile;

file PC3;
put @10 inst @55 count @65 percent 4.1 '%';
title 'An Example of Sharing Data Files';

run;

```

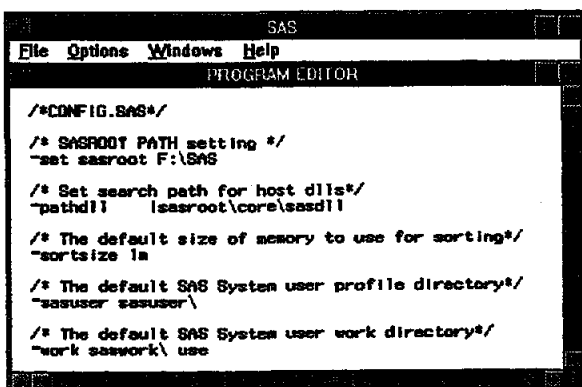
AN EXAMPLE OF SHARING SAS SYSTEM FOR PCs

Software, including SAS System for PCs, and applications can be shared in the same manner as data files. There are several different methods of accessing the SAS System for PCs from another machine. The following is a discussion of the method we use.

The SAS System for PCs requires a CONFIG.SAS file and looks to it to determine the SAS system options that are used to establish a SAS session. Therefore, we copied a CONFIG.SAS file to each PC that would access a shared SAS directory. Also, individual CONFIG.SAS files allow users to personalize their SAS session.

The SASROOT statement in the CONFIG.SAS file, as shown below, must be modified to point to the logical network drive that was assigned when connecting to the directory on another PC that contains SAS.

We have the assigned network drive point to a shared directory that is one level above the !SASROOT directory (the directory into which the SAS System for PCs was installed). This causes the default setups for SASUSER and SASWORK to then point to the directory containing the personalized copy of CONFIG.SAS. The SASUSER and SASWORK files are consequently written to the connecting user's PC.



```

SAS
File Options Windows Help
PROGRAM EDITOR

/*CONFIG.SAS*/

/* SASROOT PATH setting */
-set sasroot F:\SAS

/* Set search path for host dlls*/
-pathdll !sasroot\core\sasdll

/* The default size of memory to use for sorting*/
-sortsize 1a

/* The default SAS System user profile directory*/
-sasuser sasuser\

/* The default SAS System user work directory*/
-work saswork\ use

```

We also install SAS.EXE on each PC that is to be used to access the shared SAS directory. Running the SAS session from the connecting machine makes it possible to share the SAS Systems for PCs as Read-Only.

SECURITY

A possible weakness of peer-to-peer networking is security. Unlike a dedicated-server environment where all security settings are centrally handled, a peer-to-peer network allows security to be handled by the individual user. This may pose some problems if the data are sensitive. WFW offers two levels of security: 1) a password to log onto the WFW network, and 2) passwords assigned to directories being shared over the network.

We have found that password security can be compromised by a WFW option that saves passwords to a password file; after a password is typed correctly one time, it is not asked for again. This option, which is the default, can be turned off so that passwords must be entered each time a new session takes place. We were also surprised to learn that other workgroups within our organization using WFW have access to our shared hard disks because we belong to a set of interconnected local area networks. This prompted us to require password usage in our workgroup.

TRAINING

Because WFW was originally an add-on to Microsoft Windows 3.1, the learning curve for new users already familiar with Windows was relatively small. Accepting the concept of peer-to-peer networking, on the other hand, created a steeper learning curve. The concept of accessing shared data and software located on another computer required a change in thinking. Suddenly, some PC users felt their computer was not their own, but a shared resource available to other PC users at any time without permission. They were assured that their files could be accessed only if they had previously shared their directories on the network. Users also experienced a loss of freedom when they realized they could no longer exit from Windows or turn off their computer if another user was still accessing a shared directory. It was a common misconception that the peer-to-peer network would degrade performance when another user was accessing shared files from a working PC. However, members of our workgroup did not experience any noticeable difference in performance. A WFW environment does demand cooperation and a willingness to share within the workgroup.

ADVANTAGES

A peer-to-peer network works particularly well for our group because of the type of work that we perform. As a research group, our data files tend to be read-only files, which eliminates coordinating file changes and updates. However, peer-to-peer networking has advantages that could apply to any group. One of the biggest advantages is that it is no longer necessary to have copies of the same data file on several different computers. In addition to taking up less hard disk space, peer-to-peer networking also eliminates the problems of different versions of the same file. It is easy to combine two or more data files in a single run even if the files are on different computers. We can also run programs stored on other machines without having to physically move them. Currently, we are moving from SAS System for PCs in the DOS environment to SAS

System for PCs in the Windows environment. Those of us who are running under the DOS environment can connect to a directory containing SAS System for PCs under Windows to become familiar with the new system.

DIFFICULTIES

We have encountered several problems while using WFW starting with its installation. If the WFW installation terminates before completion, we sometimes have to clear the entire subdirectory and begin again by reloading both Windows and WFW. This is because the WFW installation process deletes some files that are needed for Windows to run correctly.

We also encountered problems when changing network adapter cards and when we began using ODI network drivers rather than IPX drivers. Some of the WFW initialization files do not get changed correctly when using the WFW menus to change card or driver options. We had to actually go into the initialization files and delete the old information before WFW would run correctly.

CONCLUSION

Peer-to-peer networking has dramatically reduced our computer charges and improved our turnaround time. We now use PCs almost exclusively without any loss of access to our larger data files. While we still rely on mainframes to make the initial subsetting pass when our data is received on magnetic tapes, we can now move the files to a PC before analyzing the data.

Even those in our group who initially resisted using the peer-to-peer network have become converts after realizing the advantages. In our working environment, a peer-to-peer network has proven to be very successful.

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