

z/OS
Version 2 Release 3

*Distributed File Service
SMB Administration*



Note

Before using this information and the product it supports, read the information in [“Notices” on page 195.](#)

This edition applies to Version 2 Release 3 of z/OS (5650-ZOS) and to all subsequent releases and modifications until otherwise indicated in new editions.

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About this document

Distributed File Service includes an SMB function that is based on the X/Open SMB Version 2 specification and the IETF RFCs on NetBIOS over IP (RFC1001 and RFC1002). The Version 2 specification refers to the publication level and does not imply support of the Microsoft SMBv2 protocol or later.

Note: As of z/OS® Version 1 Release 13, IBM® has withdrawn support for the z/OS Distributed File Service support that uses the Distributed Computing Environment (DCE) architecture. IBM recommends the z/OS Network File System (NFS) implementation as the replacement. For more information about NFS, see *z/OS Network File System Guide and Reference*.

Who should use this document

This document is intended for users and network and system administrators who understand the basic concepts of data communications. A knowledge of Transmission Control Protocol/Internet Protocol (TCP/IP) communications, z/OS UNIX operating system concepts, and Microsoft Windows (referred to as Windows throughout this document) operating system concepts can help you use this guide more effectively.

The z/OS DFS/SMB (Distributed File Service / Server Message Block) server blocks access to all encrypted files (MVS data sets and z/OS UNIX files). There are no plans to enhance DFS/SMB to support encrypted files. Use the Network File System (NFS) file sharing protocol for z/OS when sharing encrypted files between heterogeneous systems.

How this document is organized

The information in this document is divided into the following parts and each part is divided into chapters.

Part 1, “SMB support administration guide,” on page 1 discusses guidance information. The chapters in that part begin with a short introduction and are followed by detailed information.

Part 2, “SMB support reference,” on page 79 discusses reference information.

Conventions used in this document

This document uses the following typographic conventions

Bold

Bold words or characters represent system elements that you must enter into the system literally, such as commands.

Italic

Italicized words or characters represent values for variables that you must supply.

Example Font

Examples and information displayed by the system are printed using an example font that is a constant width typeface.

[]

Optional items found in format and syntax descriptions are enclosed in brackets.

{ }

A list from which you choose an item found in format and syntax descriptions are enclosed by braces.

|

A vertical bar separates items in a list of choices.

< >

Angle brackets enclose the name of a key on a keyboard.

...

Horizontal ellipsis points indicated that you can repeat the preceding item one or more times.

\

A backslash is used as a continuation character when entering commands from the shell that exceed one line (255 characters). If the command exceeds one line, use the backslash character \ as the last non-blank character on the line to be continued, and continue the command on the next line.

When you enter a command from this document that uses the backslash character (\), make sure you immediately press the Enter key and then continue with the rest of the command. In most cases, the backslash has been positioned for ease of readability.

#

A pound sign is used to indicate a command is entered from the shell, specifically where **root** authority is needed (**root** refers to a user with a **UID = 0**).

z/OS information

This information explains how z/OS references information in other documents and on the web.

When possible, this information uses cross document links that go directly to the topic in reference using shortened versions of the document title. For complete titles and order numbers of the documents for all products that are part of z/OS, see *[z/OS Information Roadmap](#)*.

To find the complete z/OS library, go to [IBM Knowledge Center \(www.ibm.com/support/knowledgecenter/SSLTBW/welcome\)](http://www.ibm.com/support/knowledgecenter/SSLTBW/welcome).

DFS information

For information about installing Distributed File Service components, refer to *[z/OS Program Directory](#)*.

Information concerning Distributed File Service-related messages are in *[z/OS Distributed File Service Messages and Codes](#)*.

How to send your comments to IBM

We invite you to submit comments about the z/OS product documentation. Your valuable feedback helps to ensure accurate and high-quality information.

Important: If your comment regards a technical question or problem, see instead [“If you have a technical problem”](#) on page xv.

Submit your feedback by using the appropriate method for your type of comment or question:

Feedback on z/OS function

If your comment or question is about z/OS itself, submit a request through the [IBM RFE Community](http://www.ibm.com/developerworks/rfe/) (www.ibm.com/developerworks/rfe/).

Feedback on IBM Knowledge Center function

If your comment or question is about the IBM Knowledge Center functionality, for example search capabilities or how to arrange the browser view, send a detailed email to IBM Knowledge Center Support at ibmkc@us.ibm.com.

Feedback on the z/OS product documentation and content

If your comment is about the information that is provided in the z/OS product documentation library, send a detailed email to mhvrfs@us.ibm.com. We welcome any feedback that you have, including comments on the clarity, accuracy, or completeness of the information.

To help us better process your submission, include the following information:

- Your name, company/university/institution name, and email address
- The following deliverable title and order number: z/OS Distributed File Service SMB Administration, SC23-6886-30
- The section title of the specific information to which your comment relates
- The text of your comment.

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute the comments in any way appropriate without incurring any obligation to you.

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If you have a technical problem

If you have a technical problem or question, do not use the feedback methods that are provided for sending documentation comments. Instead, take one or more of the following actions:

- Go to the [IBM Support Portal](http://support.ibm.com) (support.ibm.com).
- Contact your IBM service representative.
- Call IBM technical support.

Summary of changes

This information includes terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations for the current edition are indicated by a vertical line to the left of the change.

Summary of changes for SMB for z/OS Version 2 Release 3 (V2R3)

The most recent statements are listed at the top of each section.

New

- [“New release considerations” on page 7](#) was updated to indicate that DFS/SMB does not support encrypted files.
- As part of APAR OA50102, steps were added or changed in [“Creating a shared directory for HFS” on page 43](#).
- The DFSKERN started task can be renamed. See [“Renaming the DFSKERN started task” on page 31](#).

Changed

- As part of APAR OA54275, clarification was added about the Version 2 specification to [Chapter 1, “An overview of SMB support,” on page 3](#).
- [“General configuration guidelines” on page 11](#) was updated as part of APAR OA48316.

Deleted

- References to Windows Vista were removed because Windows Vista is no longer in service.

Summary of changes for SMB for z/OS Version 2 Release 2 (V2R2)

New

- Information was added to [“Using passthrough authentication ” on page 56](#) as a result of APAR OA43395.
- With APAR OA46044, [“z/OS SMB implementation restriction for SMB digital signing” on page 71](#) was added.
- [“Keeping medium weight threads during pthread_exit processing” on page 167](#) was added as a result of APAR OA39909, which described changes by z/OS UNIX that enable applications to specify how medium weight threads handle pthread_exit processing, and APAR OA45175, which describes the SMB updates that were made as a result of the change in threading behavior.

Deleted

- Mentions of the `_IOE_SMB_PROTOCOL_LEVEL` environment variable were deleted. It had been used to allow either NTLMV2 or LanMan protocol, but because LanMan is no longer supported by Microsoft, the environment variable should no longer be used.
- Information about Windows XP was deleted because it is no longer supported.
- Because Windows Server 2003 is no longer supported, these references have been removed:
 - Microsoft Windows Server 2003, Standard Edition and Microsoft Windows Server 2003, Enterprise Edition

- Microsoft Windows Terminal Server on Windows Server 2003

z/OS Version 2 Release 1 summary of changes

See the Version 2 Release 1 (V2R1) versions of the following publications for all enhancements related to z/OS V2R1:

- *z/OS Migration*
- *z/OS Planning for Installation*
- *z/OS Summary of Message and Interface Changes*
- *z/OS Introduction and Release Guide*

Part 1. SMB support administration guide

This section covers guidance information for system administrators and Personal Computer (PC) users

- [Chapter 1, “An overview of SMB support,” on page 3](#)
- [Chapter 2, “Considerations for a new SMB release,” on page 7](#)
- [Chapter 3, “SMB postinstallation processing,” on page 11](#)
- [Chapter 4, “Managing SMB processes,” on page 23](#)
- [Chapter 5, “Networking considerations,” on page 33](#)
- [Chapter 6, “Mapping SMB user IDs to z/OS user IDs,” on page 35](#)
- [Chapter 7, “Sharing files,” on page 39](#)
- [Chapter 8, “Sharing printers,” on page 61](#)
- [Chapter 9, “Locating the SMB server,” on page 63](#)
- [Chapter 10, “Accessing data,” on page 67](#)
- [Chapter 11, “Accessing printers,” on page 73.](#)

Chapter 1. An overview of SMB support

The Distributed File Service Server Message Block (SMB) support provides a server that makes Hierarchical File System (HFS) files and data sets available to SMB clients. At the same time, these files can be shared with local z/OS UNIX applications. In addition, Windows SMB clients can make remote print requests to z/OS printers that are connected to the Infoprint Server for z/OS.

Server Message Block (SMB) is a protocol for remote file/print access that is used by Windows clients. This protocol is also known as Common Internet File System (CIFS). The data sets supported include: sequential data sets on DASD (Direct Access Storage Device), partitioned data sets (PDS), partitioned data sets extended (PDSE) and Virtual Storage Access Method (VSAM) data sets. The data set support is typically referred to as Record File System (RFS) support. To access shared directory paths and shared printers, the SMB protocol is supported through the use of TCP/IP on z/OS. Personal Computer (PC) clients on the network use the file and print sharing functions that are included in their operating systems.

Note: Throughout this documentation, references are made to HFS. Unless otherwise stated, HFS is a generic reference that includes HFS, z/OS File System (zFS), TFS, and AUTOMNT file system data. If you are in a sysplex shared file system environment, SMB support of zFS is limited to zFS compatibility mode file systems that are non-sysplex aware.

Distributed File Service includes an SMB function that is based on the X/Open SMB Version 2 specification and the IETF RFCs on NetBIOS over IP (RFC1001 and RFC1002). The Version 2 specification refers to the publication level and does not imply support of the Microsoft SMBv2 protocol or later.

Supported SMB clients

The supported SMB clients include the following clients:

- Microsoft Windows 7
- Microsoft Windows 8
- Microsoft Windows Server 2008
- Microsoft Windows Server 2012
- Microsoft Windows Terminal Server on Windows Server 2008
- SUSE LINUX with Samba (SUSE LINUX Enterprise Server 9 (s390) - Kernel 2.6.5-7.202.5-s390 with Samba 3.0.14a-0.4)
- Redhat Linux with Samba (Kernel 2.4.20-43.9.legacy with Samba 3.0.20-2).

Restrictions for Linux clients: Linux clients can use many file systems. Only Linux clients with kernels that support the Samba file system (smbfs) can connect to the z/OS SMB server. The smbfs file system is part of the Linux smbfs package. The choice to use smbfs is specified when mounting a file system. For example, the following Linux mount command specifies smbfs (the command itself is typically one long unbroken line but is not shown as one unbroken line due to space limitations):

```
mount -t smbfs //servername/sharename /mountdirectory  
-o username=myusername,password=mypassword
```

The Samba smbmount command automatically uses smbfs (the command itself is typically one long unbroken line but is not shown as one unbroken line due to space limitations):

```
smbmount //servername/sharename /mountdirectory  
-o username=myusername,password=mypassword
```

Consult your Linux client documentation for availability of the smbfs file system or use the Linux man mount command to determine whether the -t smbfs option is available.

SMB support features

PC users work with files on their computers. Files are used to store data, programs, and other information. Files are stored on one or more disks on the computer. Each disk is referred to by a different drive letter (for example, A:, B:, C:, or D:). PC users can read or write files on different disks on their computer by using the appropriate drive letter in the file name (for example, D:\dir1\file1).

PC users also work with printers attached to their computers. When a print request is made, the PC user can choose the printer to which to send the print request.

Disclaimer: The z/OS SMB server supports basic file and print serving. It does not necessarily support all functions that a Windows file server supports. For example, the z/OS SMB server does not support Kerberos authentication or DFS. There might be other functions that are not supported.

Using SMB support, PC users can access files that are on a z/OS system. That is, PC users can access files that are not located on their computer. Remote files are visible to the PC user on one or more separate drive letters. PC users can “connect” an unused drive letter to a “shared resource” on a remote computer. This is sometimes called “mapping a network drive”. This capability is provided by software that resides on the PC (the client), in combination with software that resides on the remote computer (the server). There must also be a TCP/IP network connection between the PC and the remote computer.

In addition, Windows or Linux PC users are able to use remote printers that are attached to a z/OS system. Remote printers are visible as additional printers available to the PC user. Remote printers are installed on PCs using existing commands or install utilities.

SMB processes

SMB support provides a server process that makes file data and printers available to PC users. Administrators can define shared directories and shared printers. It also handles PC requests to connect to the server process to satisfy file or print requests.

Another SMB process is the control process (also known as the DFS control task). It oversees the server process. When SMB support is started, it is really the DFS control task that is started. The DFS control task, in turn, starts the server process. If the server process ends abnormally for some reason, the DFS control task can automatically restart the server process.

Shared directories

A PC accesses files located on a z/OS system through one or more shared directories on the z/OS system. Distributed File Service administrators make files available to SMB clients by creating shared directories. A shared directory is given a share name and specifies a directory path name in a file system. Any directory can be shared with clients. To access shared directories from a PC, clients can map a network drive by choosing an available drive letter and mapping it to a computer name and a share name, or they can use Universal Naming Convention (UNC) mapping. (See [Chapter 10, “Accessing data,”](#) on page 67 for more information about UNC mapping.) The computer name is the name of the Distributed File Service SMB server and the share name is the name of the shared directory created on that server. After this is done, the remote files can be read or written as though they were local files.

Shared printers

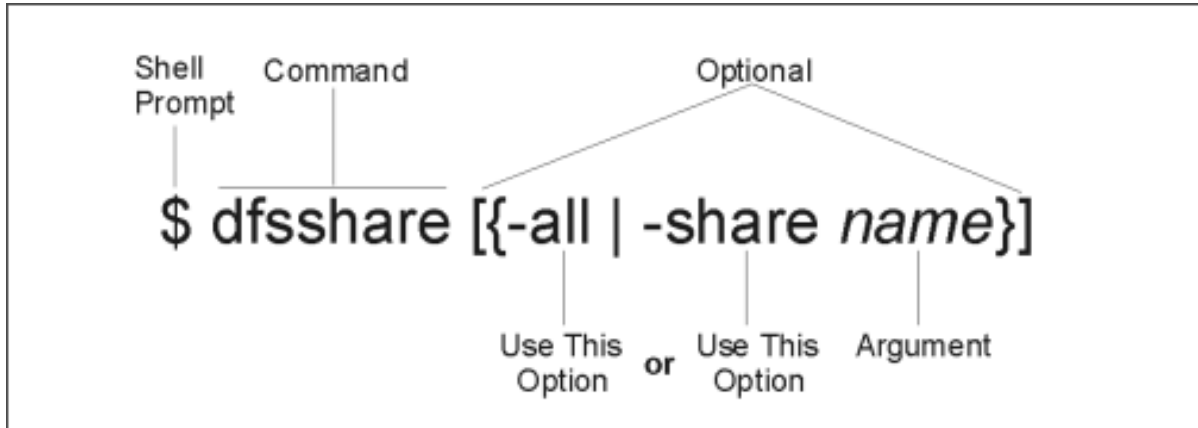
Distributed File Service administrators make z/OS printers available to Windows clients by creating shared printers. A shared printer is given a share name and specifies a z/OS Infoprint Server printer definition name. To access a remote printer from a Windows or Linux PC, clients can install a remote printer or they can use commands. After this is done, remote printers can be used as though they were local printers.

Command structure and help

The SMB commands share a similar structure. The following example shows the basic format of an SMB command.

```
$ command [{-option1 | -option2 name}]
```

The following example illustrates and summarizes the elements of an SMB command:



command

A command consists of the command name. This name directs the server process or program to perform a specific action. The command name always appears in bold font.

options

Command options appear in bold font, are always preceded by a - (dash), and are often followed by *arguments*. In the previous example, -all and -share are options, and *name* is the argument. The { | } (braces separated by a vertical bar) indicate that you can enter only one of two possible options. An option and its arguments tell the server process or program which entities to manipulate when executing the command (for example, the name to assign to the shared directory or printer). In general, you should provide the options for a command in the order presented in the documentation.

arguments

Arguments for options always appear in *italic* font.

Optional Information

Some commands can have optional, as well as required, options. Optional information is enclosed in [] (brackets). The -all and the -share with its *name* argument in the previous example are optional.

Enter each SMB command and its options and arguments on a single line followed by a carriage return at the end of the line. Use a space to separate each element (command name, options, and arguments) on the command line. Also, use spaces to separate multiple arguments. Do not use a space to separate an option from its - (dash).

Command shortcuts

When supplying an argument (such as *name* in the previous example), you can omit the option (such as -share in the example) associated with the argument if:

- All arguments supplied with the command are entered in the order in which they appear in the command's syntax. The syntax for each command is presented with its description in [Part 2, "SMB support reference," on page 79](#).
- Arguments are supplied for all options that precede the option to be omitted.
- All options that precede the option to be omitted accept only a single argument.

- No options, either those that accept an argument or those that do not, are supplied before the option to be omitted.

In the case where two options are presented in { | } (braces separated by a vertical line), the option associated with the first argument can be omitted if that argument is provided; however, the option associated with the second argument is required if that argument is provided.

If you must provide an option, you can abbreviate it to the shortest possible form that distinguishes it from other options of the command. For example, the `-share` option can typically be omitted or abbreviated to be `-s`.

The following example illustrates three acceptable ways to enter the same `dfsshare` command:

- Complete command:

```
$ dfsshare -share name
```

- Abbreviated command name and abbreviated option:

```
$ dfsshare -s name
```

- Abbreviated command name and omitted option:

```
$ dfsshare name
```

Receiving help

You can receive help on the SMB commands by using the `-help` option.

```
$ command -help
```

Chapter 2. Considerations for a new SMB release

If you have an earlier release of the Distributed File Service installed on your system and you plan to install a new release to use the SMB support, it is important to follow the instructions in [z/OS Migration](#) and review the topics in this section.

New release considerations

When migrating to a new release of Distributed File Service, it is not necessary to copy and save your customized files before installing. The files you can customize are listed in [Appendix C, “Customizable files,”](#) on page 169.

Some of the customizable files listed might not be present on your system when installing a new release of Distributed File Service (unless you are reinstalling this version) because the files are new for this release. Most customizable files that do not exist are created as part of Distributed File Service post installation by the `dfs_cpfiles` program from sample files provided in the `/opt/dfsglobal/examples` directory. There are several files that you need to create (if this is your first installation of Distributed File Service) in order to specify the HFS data and shared printers to be made available to PC clients. These include the `smbtab`, `dfstab`, and the `devtab` files. Also, the `smbidmap` file must be created to map PC user IDs to z/OS user IDs.

Review the following list before installing a new release of Distributed File Service:

zFS considerations

The SMB server cannot export zFS read-write file systems when zFS is running sysplex-aware on the same system where the SMB server is running or on the system that owns the zFS file system. If you want to export zFS file systems using the SMB server, ensure zFS is configured as non-sysplex aware (`sysplex=off` in the zFS IOEFSPRM configuration file). Beginning with z/OS V1R12, you also have the option of running zFS sysplex-aware on a file system basis (`sysplex=filesys` in the zFS IOEFSPRM configuration file). With this support, when the SMB server tries to export a file system, it checks the zFS file system configuration to determine whether zFS is running sysplex-aware or non-sysplex aware and only export non-sysplex aware file systems. For additional information, see:

- What's new or changed for zFS in [z/OS Distributed File Service zFS Administration](#).
- [Distributed File Service migration actions in z/OS Migration](#).

DCE considerations

As of z/OS Version 1 Release 13, IBM has withdrawn support for the z/OS Distributed File Service support that utilizes the Distributed Computing Environment (DCE) architecture. (Support for SMB is not affected by the withdrawal of DCE support.) If your installation used DCE DFS support, use the z/OS Network File System (NFS) implementation as a replacement. For more information, see [“DCE migration considerations”](#) on page 10.

Symbolic links considerations

The Distributed File Service customizable files are in the `/etc/dfs` path. During installation, symbolic links are deleted and recreated to link to files in `/etc/dfs`.

If you have replaced any Distributed File Service symbolic links, they are deleted during installation. Save the file data before you install Distributed File Service. These files are listed in [Appendix C, “Customizable files,”](#) on page 169.

Installing Distributed File Service

If you have not already done so, install the current release of Distributed File Service using the instructions in *z/OS Program Directory*.

Note: The following instructions assume that you have copied the preexisting /etc file system for use on the target image of the release installation as recommended in *z/OS Program Directory*.

Stopping the Distributed File Service server.

If the Distributed File Service server is running on the target image, stop the server now using the operator command `stop dfs`. See [Chapter 4, “Managing SMB processes,” on page 23](#) for more information.

RACF database considerations

If you are installing into a target image that uses the same RACF® database as the production image, the preexisting SMB configuration files that were included when the production /etc file system was copied by using the instructions in *z/OS Program Directory* do not need to be modified to change the RACF user IDs. You need to only review and update the target image copy of the configuration files with optional parameters new for this release later in the migration process. Socket option access control is provided with the SERVAUTH class resource `EZB.SOCKOPT.sysname.tcpname.SO_BROADCAST`. If a profile that protects this resource is defined, the SMB server user ID must be given at least READ authority to this profile.

If the target image uses a different RACF database, the `smbidmap` file that is defined by the `_IOE_SMB_IDMAP` environment variable in the `/opt/dfslocal/home/dfskern/envar` file must be updated to define the correct user identifiers. See [Chapter 6, “Mapping SMB user IDs to z/OS user IDs,” on page 35](#) for more details. You might also need to review the `_IOE_MVS_DFSDFLT` environment variable in the `/opt/dfslocal/home/dfskern/envar` file. See [“Logon considerations” on page 54](#) for more details.

Exported data considerations

If you are installing into a target image that can access the same exported file data as the production image, the preexisting `smbtab`, `dfstab`, and `devtab` files in the `/opt/dfslocal/var/dfs` directory can be used.

If the target image cannot access the same exported file data as the production image, or if you do not want to export the production data files during the testing of the new z/OS release on the target image, you must update these files to export and share only test data.

Printers considerations

If you are installing into a target image that can access the same printers as the production image, the preexisting `smbtab` file in the `/opt/dfslocal/var/dfs` directory can be used.

If the target image cannot access the same printers as the production image, or if you do not want to share the production printers during the testing of the new z/OS release on the target image, you must update this file to create different shared printers.

Running the /opt/dfsglobal/scripts/dfs_cpfiles program

Some of the customizable files listed in [Appendix C, “Customizable files,” on page 169](#), might not exist in the `/etc/dfs` file system on the target image when installing a new release of the Distributed File Service (unless you are reinstalling this release). Customizable files that do not exist are created as part of

postinstallation processing by the dfs_cpfiles program from the sample files in the /opt/dfsglobal/examples directory.

If you have not already run the dfs_cpfiles program following the instructions in *z/OS Program Directory*, you should run it now against the target image /etc/dfs to ensure the new release has all the new configuration files.

More information about the dfs_cpfiles program can be found in [Chapter 3, “SMB postinstallation processing,”](#) on page 11.

Note: The dfs_cpfiles program does not create all the files necessary for SMB support. See [“SMB configuration file considerations”](#) on page 9 for more information.

Updating existing configuration files and server startup parameters

Compare your target system customizable files with the example ioepdcf and envvar files in the /opt/dfsglobal/examples directory for this release to determine if any new parameters or variables for this release are applicable to your system.

Authorized programs considerations

SMBPW is the authorized program for the Distributed File Service. See *z/OS Program Directory* for a description of the PARMLIB member updates required for the member IKJTSOxx.

SMB file and print considerations

For SMB support, the _IOE_PROTOCOL_SMB environment variable in the /opt/dfslocal/home/dfskeyn/envvar file for the dfskeyn process must be updated to specify _IOE_PROTOCOL_SMB=ON.

Ensure that the LIBPATH environment variable in the /opt/dfslocal/home/dfskeyn/envvar file is updated. If SMB print serving support is used, specify the LIBPATH environment variable to identify the z/OS Infoprint Server library. If the SMB support for encrypted passwords is used, update the LIBPATH to include the path /usr/lib to find the Open Cryptographic Service Facility (OCSF) library. For example, the environment variable can specify LIBPATH=/usr/lpp/Printsrv/lib:/usr/lib.

The smbtab, dfstab, and devtab files must be created if they do not exist and updated to specify the HFS data to be made available to PC clients. The smbtab file must be created and updated to specify the shared printers to be made available to PC clients. These files are in the /opt/dfslocal/var/dfs directory. See [Chapter 7, “Sharing files,”](#) on page 39 and [Chapter 8, “Sharing printers,”](#) on page 61 for more information about these topics.

SMB and encrypted data sets and files

The z/OS DFS/SMB (Distributed File Service / Server Message Block) server blocks access to all encrypted files (MVS data sets and z/OS UNIX files). There are no plans to enhance DFS/SMB to support encrypted files. Use the Network File System (NFS) file sharing protocol for z/OS when sharing encrypted files between heterogeneous systems.

SMB configuration file considerations

Certain SMB configuration files contain system specific information. These HFS files, if copied to another system, must be modified to contain or point to data on that system. In particular, the smbtab, dfstab, and devtab files point to the data that is to be made available to PC clients. The smbtab can also refer to shared printers that are to be made available to PC clients. The smbimap file and the _IOE_MVS_DFSDFLT dfskeyn environment variable both contain z/OS user IDs that might need to be changed. Other dfskeyn environment variables that might need to be changed include:

- _IOE_SMB_COMPUTER_NAME

- _IOE_SMB_DOMAIN_NAME
- _IOE_SMB_IDMAP
- _IOE_SMB_PRIMARY_WINS
- _IOE_SMB_SECONDARY_WINS
- _IOE_SMB_WINS_PROXY

The dfs_cpfiles program is run during Distributed File Service installation. The dfs_cpfiles program creates (not replaces) certain customizable files with default information if the file does not exist. The files that are copied are listed in [Chapter 3, “SMB postinstallation processing,”](#) on page 11.

DCE migration considerations

As of z/OS Version 1 Release 13, the DFS client function has been removed. The DFS client (DFSCM) is a physical file system that was started during z/OS UNIX initialization, based on a FILESYSTYPE statement in the BPXPRMxx parmlib member. If your installation used the DFS client, you should remove the following statement from the BPXPRMxx parmlib member to prevent the client from initializing.

```
FILESYSTYPE TYPE(DFSC)
ENTRYPOINT(IOECMINI)
PARM('ENVAR("_EUV_HOME=/opt/dfslocal/home/dfscm") /
>DD:IOEDFSD 2>&1')
ASNAME(DFSCM)
```

If you do not remove this statement before the first IPL of a z/OS V1R13 or later system, you receive error message IOEP12402E. z/OS UNIX successfully initializes, but you need to follow the guidance in the message to remove the entry and restart z/OS UNIX. See [z/OS Distributed File Service Messages and Codes](#) for more information.

Also, if you have not already done so, you should use the z/OS UNIX pax command to migrate any data in DCE DFS or Episode file systems to other file systems (for example, zFS). The recommended general procedure is as follows:

1. Set up a zFS file system to receive the data. See [z/OS Distributed File Service zFS Administration](#) for more information.
2. Copy your DCE DFS or Episode file system data to the zFS file system, using the z/OS UNIX pax command. For more information, see [z/OS UNIX System Services Command Reference](#).
3. Set up a z/OS NFS server to allow data access from a remote z/OS UNIX system. See [z/OS Network File System Guide and Reference](#) for details.

Note: RACF DCE segments are still used and are required for SMB encrypted password support. For more information, see [“RACF DCE segments for SMB encrypted password support”](#) on page 59.

Chapter 3. SMB postinstallation processing

This topic contains information to assist you in completing the installation and configuration of the Distributed File Service SMB file and print server support. Before using the SMB support, you must install the z/OS release, Distributed File Service, and the other base elements of z/OS using the appropriate release documentation. During the installation of the z/OS release, you must perform actions to activate the SMB support. If you are migrating from a prior release of Distributed File Service and you want to use the SMB function, review [Chapter 2, “Considerations for a new SMB release,” on page 7](#). For supporting installation and migration information, see [z/OS Install/Migration page \(www.ibm.com/systems/z/os/zos/installation\)](http://www.ibm.com/systems/z/os/zos/installation).

Verifying the installation

After you install SMB, as instructed by the *z/OS Program Directory*, you might want to verify that the installation completed successfully.

The installation verification procedure is typically used to start the DFS server for the first time during the installation step of a new release. But, if the DFS server is already running, be sure to stop the DFS server before you complete the following installation verification sets. Note that the term *DFS server* is used to describe the Distributed File Service server when it provides SMB file/print serving support.

To ensure that the installation completed successfully, start the DFS started task by issuing the following command.

```
S DFS,PARM='-nodfs'
```

View the SYSLOG and look for the following message, which indicates that the DFS server started successfully. However, additional configuration is required before the server can be used as an SMB file/print server. If the DFS server started task does not initialize successfully, contact the IBM Support Center for help.

```
IOEP01103I DFS kernel initialization complete.
```

General configuration guidelines

Before you perform any postinstallation configuration steps, review the following guidelines:

- You have the option of running SMB with either UID(0) or a unique nonzero UID. See [“RACF definitions for SMB” on page 18](#).
- If your system has enable RACF program control, some features might require you to place specific resources under program control. These features include:
 - Hardware encryption using the Open Cryptographic Service Facility (OCSF)
 - SMB encrypted password support configuration
 - Security environment active through the use of the `_IOE_USE_PTHREAD_SECURITY` environment variable

During initialization or program execution, messages can notify you when program control is not active. For example, message ICH420I identifies that CSNBCKI needs program control.

```
ICH420I PROGRAM CSNBCKI FROM LIBRARY SYS1.CSF.SCSFMODE CAUSED THE
ENVIRONMENT TO BECOME UNCONTROLLED.
BPXP014I ENVIRONMENT MUST BE CONTROLLED FOR SERVER (BPX.SERVER)
```

- To use the SMB File/Print support, you might also need to install and configure the Open Cryptographic Service Facility (OCSF) or the Infoprint Server Feature of z/OS.
 - If you plan to use encrypted passwords and you want to use hardware encryption, you need to install and configure the Open Cryptographic Services Facility (OCSF) base component of the Cryptographic Services element. If you plan to use password encryption and you do not want to use hardware encryption, you do not need to install and configure OCSF and you should set the dfskern environment variable _IOE_SMB_OCSF=OFF.
 - If you plan to use the SMB print serving support, you need to install and configure the Infoprint Server feature.

To use the SMB support, you must configure the support on the system using the following topics:

- [“Installing and configuring the SMB file and print server” on page 12](#), which includes configuration tasks such as:
 - Activating the SMB file/print serving function
 - Specifying optional DFS process options
 - Defining SMB users
 - Defining HFS and RFS data sets to export and directories to share for access by SMB clients
 - Defining printers to share for access by SMB clients
 - Updating SMB client PC machines running Windows or other operating systems that issue requests to file/print servers using the SMB protocol.
- [“Creating the default DFS configuration files” on page 16](#)
- [“Defining SMB administrators” on page 15](#)
- [“RACF definitions for SMB” on page 18](#)

Note: During dfskern initialization, a small file (opt/dfslocal/var/dfs/rfsfile) is created (or updated) to keep track of RFS file identifiers. Do not erase or change this file.

During initialization of the DFS server, the IOEGLUE module is loaded into the OMVS address space used by z/OS UNIX. This module provides file and data consistency between local OMVS users and remote SMB client user access for file systems that are exported by the DFS SMB server. The initialization of IOEGLUE must be performed after OMVS has completed its initialization and the BPXI004I OMVS INITIALIZATION COMPLETE message has been generated. Initializing IOEGLUE prior to the BPXI004I OMVS initialization complete message will result in OC4 abends by the IOEGLUE module. Additionally, the BPX1MSS mount callable service could generate a CEE5101C message that will cause IOEGLUE to fail initialization. To prevent this failure, ensure that both manual and automated attempts to start DFS and DFSKERN are not performed until after the BPXI004I OMVS INITIALIZATION COMPLETE message has been generated.

Installing and configuring the SMB file and print server

Before you begin this process, you must ensure that the user ID the SMB Server is running under has authorization to the BPX.DAEMON and BPX.SERVER resources in the RACF FACILITY class. If you are configuring SMB for the first time, or for a new release, see [“RACF definitions for SMB” on page 18](#).

To install, configure, and access the Distributed File Service server (dfskern) for SMB file and print server operation, perform the following steps:

1. Install and perform postinstallation processing of the Distributed File Service by using the applicable instructions in *ServerPac: Installing Your Order* (for ServerPac users) and *z/OS Program Directory* (for CBPDO users).

The following list summarizes the information in those documents:

- a. Ensure that the target and distribution libraries for the Distributed File Service are available.
- b. Run the prefix.SIOESAMP(IEISMKD) job from UID 0 to create the symbolic links that are used by the Distributed File Service. This job reads the member prefix.SIOESAMP(IEEMKDIR) to delete and create the symbolic links.
- c. Ensure that the DDDEFS for the Distributed File Service are defined by running the prefix.SIOESAMP(IEISDDD) job.
- d. Install the Load Library for the Distributed File Service. The Load Library (hlq.SIEALNKE) must be APF-authorized and must be in link list.
- e. Install the samples (hlq.SIOESAMP).
- f. If you plan to use encrypted passwords (recommended) and optionally, you want to use OCSF and hardware encryption, ensure that the appropriate authorizations were given to the DFS server user ID to use OCSF services. For information, see "Cryptographic Services OCSF customization considerations" in *z/OS Program Directory* and "Configuring and Getting Started" section in *z/OS Integrated Security Services Open Cryptographic Enhanced Plug-ins Application Programming*.

If you are using Integrated Cryptographic Service Facility (ICSF), define the following service names to the CSFSERV resource class:

CSFCKI	CSFDEC	CSFENC	CSFKEX	CSFKGN
CSFKIM	CSFKPI	CSFKRW	CSFKRC	CSFKRD
CSFKRR	CSFMGN	CSFOWH	CSFRNG	

You might also need to PERMIT the user ID DFS READ access to the profiles in the CSFSERV general resource class. For more information about the CSFSERV resource class, see *z/OS Cryptographic Services ICSF Administrator's Guide*.

- g. The SMB server process (DFSKEKN) needs a relative dispatching priority set less than TCP/IP and UNIX System Services, but not too low. When the dispatch priority is too low, TCB and associated SRBs are not processed quickly enough, which can result in possible resource contention and hang conditions.

The SMB server uses an Event Notification Facility (ENF) exit for event code 51 (contention). When this event occurs, an SRB is scheduled to queue a request to the SMB server. If the SMB server dispatching priority is too low, the requests can become backed up and the system can eventually run out of resources. The SMB server needs a dispatching priority that is high enough to permit these requests to be processed in a timely manner.

2. Stop the Distributed File Service server (dfskekn), if it is already running, by using the instructions in Chapter 4, "Managing SMB processes," on page 23.
3. Define administrators on the host system using the instructions in "Defining SMB administrators" on page 15.
4. Create the default DFS configuration files using the /opt/dfsglobal/scripts/dfs_cpfiles shell script, if they were not created during the installation process.

These configuration files, which are required by SMB file and print server, are typically created before the Distributed File Service installation is verified by the /opt/dfsglobal/scripts/dfs_cpfiles shell script, as indicated in *z/OS Program Directory*. See "Creating the default DFS configuration files" on page 16 for more information about dfs_cpfiles.

5. Modify the /opt/dfslocal/home/dfskekn/envar file to activate SMB file and print servers by setting the environment variable _IOE_PROTOCOL_SMB=ON.

If you are using OCSF, ensure that the `/opt/dfslocal/home/dfskern/envar` file has a LIBPATH that adds the directory that contains the OCSF DLLs. Be sure that the directory added is the directory indicated in *z/OS Program Directory*.

If you are using the print capability of the SMB file and print server, ensure that the Infoprint Server is installed and customized using the applicable instructions in *z/OS Program Directory*. In addition, ensure that the `/opt/dfslocal/home/dfskern/envar` file has a LIBPATH entry that adds the directory that contains the Infoprint Server DLLs. Be sure that the directory added is the directory indicated in the “Infoprint Server Customization Considerations” section of *z/OS Program Directory*.

For example, a LIBPATH that specifies both the OCSF DLL directory and the Infoprint Server DLL directory might be `LIBPATH=/usr/lib:/usr/lpp/Printsrv/lib`.

There is a relationship between number of threads that are specified for the SMB server and the maximum number of threads that z/OS UNIX permits in a process. The following DFSKERN environment variables affect the number of threads that are created for the SMB server:

- `_IOE_RFS_WORKER_THREADS`
- `_IOE_SMB_CALLBACK_POOL`
- `_IOE_SMB_MAIN_POOL`
- `_IOE_TKMGLUE_SERVER_THREADS`

There are also a number of dynamically created DFSKERN threads (approximately 25). The total of the DFSKERN threads must be less than the z/OS UNIX MAXTHREADS specification in the BPXPRMxx. If this is not the case, DFSKERN can abend during thread creation. The number of z/OS UNIX MAXTHREADS can be increased using the `SETOMVS MAXTHREADS=nn` operator command. The number of MAXTHREADS specified by z/OS UNIX can be displayed using the `D OMVS,O` operator command. See *z/OS MVS System Commands* for additional information about these operator commands.

6. Because the SMB file and print server runs as an APF-authorized server, you must ensure that any DLLs that are used by the SMB file and print server are APF-authorized. This can be accomplished by using the `z/OS UNIX extattr +a` command. If you are using the Infoprint Server or OCSF, see the “Infoprint Server Customization Considerations” section in *z/OS Program Directory* and the “Cryptographic Services OCSF Customization Considerations” section in *z/OS Open Cryptographic Services Facility Service Provider Module Developer's Guide and Reference* for information about the location of the DLLs and setting the APF-authorized extended attribute. The DFS load library is called `hlq.SIEALNKE`.
7. SMB clients must be able to find the server on the network in order to use the shares that the SMB server makes available. If you are using Windows, you should ensure that your computer name (specified in the `_IOE_SMB_COMPUTER_NAME` environment variable in the `/opt/dfslocal/home/dfskern/envar` file) is the same as your TCP/IP host name. See Chapter 5, “Networking considerations,” on page 33.
8. SMB communicates over several TCP/IP ports. Check your TCP/IP profile data set and verify that there are no reserves for ports 137, 138, 139, and 445. See *z/OS Communications Server: IP Configuration Reference* for information about TCP/IP configuration and reserving ports.
9. Define SMB users by modifying the `smbidmap` file that is identified by the `_IOE_SMB_IDMAP` environment variable of `dfskern`. Map SMB users to z/OS users on the host system using the instructions in Chapter 6, “Mapping SMB user IDs to z/OS user IDs,” on page 35.

In addition, z/OS users should put the following line in their `.profile` file in their home directory or in `/etc/profile`. This value is then set for all z/OS UNIX users.

```
export _EUV_AUTOLOG=NO
```

10. Determine whether you intend to use passthrough authentication. See “Using passthrough authentication” on page 56 for information about passthrough authentication. Users in the domain

will be authenticated using a Windows Server acting as a domain controller. Users that are not in the domain and that fail the domain authentication will additionally attempt local authentication (at the SMB server). This local authentication will use clear or encrypted passwords based on what the Domain Controller chose (most likely encrypted passwords) independent of the `_IOE_SMB_CLEAR_PW` environment variable. In the case of encrypted passwords, those users that get authenticated locally will need to store their SMB password in their RACF DCE segment.

11. Determine whether you intend to use password encryption. For more information, see the `_IOE_SMB_CLEAR_PW` environment variable [Appendix A, “Environment variables in SMB,”](#) on page 145. Before you enable password encryption, your PC users must store their SMB password into their RACF DCE segment. Otherwise, they are not able to log on except possibly as a guest user.
12. Determine whether you intend to permit guest users. Guest users are PC users that have (limited) access to files and printers on the SMB server without identifying themselves. Guest users are permitted when the `_IOE_MVS_DFSDFLT` environment variable in the `dfskeɹn` process is set to a valid z/OS user ID. Guest users can access any data or files that z/OS user ID can access. If guest users are permitted, users that specify an incorrect password or no password become the guest user ID. It is better to deny guest users until you are certain you need this capability and that it meets your security guidelines.
13. Determine whether you intend to use the dynamic export capability. It is controlled by the `_IOE_DYNAMIC_EXPORT` environment variable of `dfskeɹn`. The default is OFF, meaning that dynamic export is not enabled. Dynamic export permits the SMB server to support file systems that are mounted by using the z/OS automount facility. See *z/OS UNIX System Services Planning* for information about the automount facility. Dynamic export also permits the SMB server to dynamically discover mounted file systems without the need to provide `dfstab` and `devtab` entries for the file systems. For information about using the dynamic export capability of the SMB server, see [“Dynamic export for HFS”](#) on page 45.
14. Define shared directories if the SMB file and print server is run on the host system to export file data sets for access by PC clients by updating the `smbtab`, `dfstab`, and `devtab` files and optionally, for RFS, by specifying an `rfstab` file in the `/opt/dfslocal/var/dfs` directory. Define file systems and file sets using the applicable instructions in [Chapter 7, “Sharing files,”](#) on page 39. For RFS, the DFS server user ID (typically DFS) must have RACF ALTER authority to the data sets that are made available to PC users. Alternatively, you can give the DFS server user ID the OPERATIONS attribute. If you specify a single level prefix in the `devtab`, you must use the OPERATIONS attribute because you cannot create a data set profile that covers a single level prefix. (The OPERATIONS attribute can be limited so that the DFS server user ID has authority only to the required data sets. See *z/OS Security Server RACF Security Administrator's Guide* for information about the OPERATIONS attribute).
15. Define shared printers if the SMB file and print server is run on the host system to export Infoprint Server printers for access by PC clients. Define the print shares by updating the file `/opt/dfslocal/var/dfs/smbtab`. See [Chapter 8, “Sharing printers,”](#) on page 61 for more information.
16. SMB server performance can be significantly enhanced using the Language Environment® `HEAPPOOLS(ON)` parameter. See [“ioepdcf”](#) on page 101 on how to specify `HEAPPOOLS` for the SMB server. See *z/OS Language Environment Programming Guide* for information about `HEAPPOOLS`.
17. Start the Distributed File Service server (`dfskeɹn`) by following the applicable instructions in [Chapter 4, “Managing SMB processes,”](#) on page 23.
18. Configure PC client workstations to access the SMB file and print server by using the instructions in [Chapter 9, “Locating the SMB server,”](#) on page 63.

Rule: If you modify the RACF FSSEC class to activate or deactivate ACL checking, the SMB server must be restarted. The SMB server caches permissions and does not get notified of changes to the FSSEC class.

Defining SMB administrators

The SMB Administrator must have root authority on the z/OS system. This means a z/OS user ID with a UID=0 or superuser authority assigned through the BPX.SUPERUSER resource in the RACF FACILITY class or the equivalent for another security-based product. This authority is required in order to issue certain

commands and to define shared directories and shared printers. For additional details on assigning superuser authority, see the topic on using the BPX.SUPERUSER resource in the FACILITY class in [z/OS UNIX System Services Planning](#).

Two types of users can start or stop the Distributed File Service server address space and the processes controlled by DFSCNTL (see [Chapter 4, “Managing SMB processes,”](#) on page 23):

- A user with z/OS operator privileges.
- A user who has update privilege to the DFSKERN.START.REQUEST profile in the RACF FACILITY class. This profile is created during the installation of DFS.

The following environment variable should be specified in the SMB Administrator’s z/OS UNIX environment (for example, in the SMB Administrator’s \$HOME/.profile file).

```
export _EUV_AUTOLOG=NO
```

Creating the default DFS configuration files

The /opt/dfsglobal/scripts/dfs_cpfiles program is a shell script that creates customizable configuration files in /opt/dfslocal subdirectories. dfs_cpfiles copies IBM-supplied files from the /opt/dfsglobal/examples directory to /opt/dfslocal subdirectories. The dfs_cpfiles program creates files that do not exist. It does not replace an existing file to preserve any installation configuration data from a previous release.

/opt/dfslocal is a symbolic link to /etc/dfs. Therefore, all the files that are created by the dfs_cpfiles program are actually created in the /etc file system. See [“Symbolic links to /etc/dfs created during installation”](#) on page 170 for more information about the symbolic links that are defined to identify the configuration files.

Steps for using dfs_cpfiles program

Before you begin, you need to have all the configuration files in the /opt/dfslocal subdirectories in the /etc file system, even though some configuration files can be created in other directories and identified by **envvar** specifications.

Perform the following steps to invoke **dfs_cpfiles**.

1. Log in as **root** on the local system (**UID=0** or superuser authority).
2. Enter the following command in the shell environment to invoke the **dfs_cpfiles** program.

```
/opt/dfsglobal/scripts/dfs_cpfiles
```

Note: To ensure that any existing user customized data is not overlaid, any existing DFS configuration file is not replaced.

When you complete these steps, the **dfs_cpfiles** program creates customizable files for all aspects of the Distributed File Service. A subset of these files are applicable to the SMB file and print server. [Figure 1 on page 17](#) lists the customizable files that are applicable to the SMB file and print server.

```

/opt/dfslocal/etc/ioepdcf
/opt/dfslocal/home/daemonct/envvar
/opt/dfslocal/home/dfscntl/envvar
/opt/dfslocal/home/dfsexport/envvar
/opt/dfslocal/home/dfskern/envvar
/opt/dfslocal/home/dfskern/smbidmap
/opt/dfslocal/var/dfs/devtab
/opt/dfslocal/var/dfs/dfstab
/opt/dfslocal/var/dfs/hfstab
/opt/dfslocal/var/dfs/hfsattr
/opt/dfslocal/var/dfs/rfstab
/opt/dfslocal/var/dfs/smbtab

```

Figure 1: Customizable files for the SMB file and print server

The **smbtab**, **dfstab**, and **devtab** files in the `/opt/dfslocal/var/dfs` directory are created by **dfs_cpfiles**. They must be updated to define shared directories. See [Chapter 7, “Sharing files,”](#) on page 39 for more information.

- The **smbtab** file must be updated to define shared printers. See [Chapter 8, “Sharing printers,”](#) on page 61 for more information.
- The **smbidmap** file must be updated to map PC user IDs to z/OS user IDs. See [Chapter 6, “Mapping SMB user IDs to z/OS user IDs,”](#) on page 35 for more information.
- Optionally, the **hfsattr** and **rfstab** files can be updated to first define HFS data translation by file name extension attributes and next by RFS attributes for RFS files. See [Chapter 7, “Sharing files,”](#) on page 39 for more information.

Figure 2 on page 17 displays the possible output and messages produced after using **dfs_cpfiles** to create the customizable configuration files for the Distributed File Service.

- If a file already exists, an example of this message is:

```
File /opt/dfslocal/etc/ioepdcf already exists.
```

- If an error occurs creating the file, an example of this message is:

```
File /opt/dfslocal/etc/ioepdcf not created
```

```

*****
**          Distributed File Service          **
**      Default Configuration Files Creation Program      **
*****
Attempt to Create envvar Files...
File /opt/dfslocal/home/daemonct/envvar created
File /opt/dfslocal/home/dfscntl/envvar created
File /opt/dfslocal/home/dfsexport/envvar created
File /opt/dfslocal/home/dfskern/envvar created

Attempt to Create Miscellaneous Configuration Files...
File /opt/dfslocal/etc/ioepdcf created
File /opt/dfslocal/var/dfs/devtab created
File /opt/dfslocal/var/dfs/dfstab created
File /opt/dfslocal/var/dfs/rfstab created
File /opt/dfslocal/var/dfs/smbtab created
File /opt/dfslocal/var/dfs/hfsattr created
File /opt/dfslocal/home/dfskern/smbidmap created

```

Figure 2: Example output of **dfs_cpfiles**

Migration Tips:

1. If you are migrating to a new release of the Distributed File Service and **dfs_cpfiles** created a new set of customizable files, you might need to add your customization data to the newly created files.
2. If you are migrating to a new release of z/OS and new customizable configuration files were not created by **dfs_cpfiles**, you might want to update preexisting customizable files with new customization options available with this release of Distributed File Service. See [Chapter 2, “Considerations for a new SMB release,”](#) on page 7 for more information about what is new in this release.
3. The SMB user identity mapping file is identified by the environment variable `_IOE_SMB_IDMAP`. It is recommended that the `/opt/dfslocal/home/dfskeyn/smbidmap` file created by the **dfs_cpfiles** program should be used by the installation for user identity mapping.

RACF definitions for SMB

You must define SMB clients and servers to the z/OS Security Server RACF (or equivalent security product) so they have the correct authorization to initialize and perform required system services. Access to z/OS file data is done using the authorization of the user accessing the data or the default authorization defined by your installation.

For more information about RACF administration tasks, see [z/OS Security Server RACF Security Administrator's Guide](#).

See [z/OS Security Server RACF Messages and Codes](#) for information about RACF messages.

Note: If the RACF FSACCESS class is used on your system to restrict access to z/OS UNIX file systems, the following authority levels are required:

1. The user ID under which SMB runs (typically, this is "DFS") must have update authority to any SMB-exported file system that is protected by FSACCESS.
2. Each MVS™ user ID that is mapped to an SMB user ID and requires access to an FSACCESS protected file system must also be given update authority to the file system.

For more information, see [z/OS UNIX System Services Planning](#).

Setting up a new SMB installation to run under a UID(0) TSO user

Perform the following steps if you are setting up SMB for the first time and you want the TSO/E user for SMB to have UID(0) authority:

1. Define DFSGRP as a group. For example you could issue the following command:

```
ADDGROUP DFSGRP SUPGROUP(SYS1) OMVS(GID(2))
```

2. Create a RACF-defined UID(0) TSO/E user, under which the SMB server will run. For example, you could issue the following command. (Note that this command would be entered on one line.)

```
ADDUSER DFS OMVS(HOME('/opt/dfslocal/home/dfsctl1')) UID(0))  
DFLTGRP(DFSGRP) AUTHORITY(CREATE) UACC(NONE)
```

3. Define DFS and DFSKERN as started tasks. For example:

```
RDEFINE STARTED DFS.** STDATA(USER(DFS))  
RDEFINE STARTED DFSKERN.** STDATA(USER(DFS))  
SETROPTS RACLIST(STARTED) REFRESH
```

4. Create a profile in the FACILITY class for DFSKERN, and give the user ID that runs DFS, SMB, or both server functions UPDATE access to the profile. For RACF, use the following commands:

```
RDEFINE FACILITY DFSKERN.START.REQUEST UACC(NONE)
PERMIT DFSKERN.START.REQUEST CLASS(FACILITY) ID(DFS) ACCESS(UPDATE)
SETROPTS CLASSACT(FACILITY)
```

5. If profiles have not been defined to protect the BPX.SERVER and BPX.DAEMON resources in the FACILITY class, define them in RACF. For example:

```
RDEFINE FACILITY BPX.SERVER UACC(NONE)
RDEFINE FACILITY BPX.DAEMON UACC(NONE)
```

6. Give the TSO/E user authorization to the BPX.SERVER and BPX.DAEMON resources in the RACF FACILITY class. For example:

```
PERMIT BPX.SERVER CLASS(FACILITY) ACCESS(READ) ID(DFS)
PERMIT BPX.DAEMON CLASS(FACILITY) ACCESS(READ) ID(DFS)
SETROPTS RACLIST(FACILITY) REFRESH
```

7. If your system is set up for RACF program control protection, allow the SMB daemon control task (IOEPDCT) to run using your installation's procedures.

Setting up new SMB installation to run under a unique nonzero UID TSO/E user

Perform the following steps if you are setting up SMB for the first time and have a requirement that the TSO/E user that SMB runs under is a unique nonzero UID:

1. Define DFSGRP as a group. For example:

```
ADDGROUP DFSGRP SUPGROUP(SYS1) OMVS(GID(2))
```

2. Create a RACF-defined TSO/E user under which the SMB server will run. Do not use "DFS" as the TSO/E user ID for a unique nonzero UID setup because "DFS" is already in use for zFS. In this example, NEWID is new user ID. (Note that this command would be entered on one line.)

```
ADDUSER NEWID OMVS(HOME('/opt/dfslocal/home/dfscntl')) UID(unique UID))
DFLTGRP(DFSGRP) AUTHORITY(CREATE) UACC(NONE)
```

3. If a profile has not already been defined in the RACF FACILITY class protecting the resource BPX.SUPERUSER, define one and give the user ID you just defined authorization to it. For example:

```
SETROPTS CLASSACT(FACILITY)
RDEFINE FACILITY BPX.SUPERUSER UACC(NONE)
PERMIT BPX.SUPERUSER CLASS(FACILITY) ACCESS(READ) ID(NEWID)
```

4. Define DFS and DFSKERN as started tasks. For example:

```
RDEFINE STARTED DFS.** STDATA(USER(NEWID))
RDEFINE STARTED DFSKERN.** STDATA(USER(NEWID))
SETROPTS RACLIST(STARTED) REFRESH
```

5. Create a profile in the FACILITY class for DFSKERN, and give the user ID that runs DFS, SMB, or both server functions UPDATE access to the profile. For RACF, use the following commands:

```
RDEFINE FACILITY DFSKERN.START.REQUEST UACC(NONE)
PERMIT DFSKERN.START.REQUEST CLASS(FACILITY) ID(NEWID) ACCESS(UPDATE)
```

6. If profiles are not defined protecting the BPX.SERVER and BPX.DAEMON resources in the RACF FACILITY class, define them. For example:

```
RDEFINE FACILITY BPX.SERVER UACC(NONE)
RDEFINE FACILITY BPX.DAEMON UACC(NONE)
```

7. Permit the user ID to the BPX.SERVER and BPX.DAEMON RACF FACILITY class profiles. For example:

```
PERMIT BPX.SERVER CLASS(FACILITY) ACCESS(READ) ID(NEWID)
PERMIT BPX.DAEMON CLASS(FACILITY) ACCESS(READ) ID(NEWID)
SETROPTS RACLIST(FACILITY) REFRESH
```

8. If your system is set up for RACF program control protection, allow the SMB daemon control task (IOEPDCT) to run using your installation's procedures.

Modifying an existing SMB installation to run with a unique nonzero UID

Perform the following steps if you are modifying an existing SMB setup that runs under a TSO/E user with UID(0) authority to run under a TSO user without UID(0) authority. In this procedure, you create a new unique nonzero UID user ID that SMB will run under, establish the user ID's relationship with the existing RACF defined group, and give the new user ID the appropriate RACF authorizations.

Do not use DFS as the TSO/E user for a unique nonzero UID setup because DFS is already in use for zFS.

1. Create a RACF-defined TSO/E user under which the SMB server will run. The following procedure uses NEWID as the example new TSO user ID. (Note that this command would be entered on one line.)

```
ADDUSER NEWID OMVS(HOME('/opt/dfslocal/home/dfscntl1')) UID(unique UID))
DFLTGRP(DFSGRP) AUTHORITY(CREATE) UACC(NONE)
```

2. Create a profile in the RACF FACILITY class protecting the resource BPX.SUPERUSER and give the new user ID access to it.

```
RDEFINE FACILITY BPX.SUPERUSER UACC(NONE)
PERMIT BPX.SUPERUSER CLASS(FACILITY) ACCESS(READ) ID(NEWID)
```

3. Give the new user ID UPDATE access to the resource DFSKERN.START.REQUEST in the FACILITY class.

```
PERMIT DFSKERN.START.REQUEST CLASS(FACILITY) ID(NEWID) ACCESS(UPDATE)
```

4. Update the current generic started task definition for the unique nonzero UID user, NEWID, that the SMB server will run under by issuing the following commands.

```
RALTER STARTED DFS.** STDATA(USER(NEWID))
RALTER STARTED DFSKERN.** STDATA(USER(NEWID))
SETR RACLIST(STARTED) REFRESH
```

5. Give NEWID READ access to the BPX.SERVER and BPX.DAEMON resources in the RACF FACILITY class.

```
RDEFINE FACILITY BPX.SERVER UACC(NONE)
RDEFINE FACILITY BPX.DAEMON UACC(NONE)
PERMIT BPX.SERVER CLASS(FACILITY) ACCESS(READ) ID(NEWID)
PERMIT BPX.DAEMON CLASS(FACILITY) ACCESS(READ) ID(NEWID)
SETROPTS RACLIST(FACILITY) REFRESH
```

6. In some cases, you might have to modify the **dfscntl** and **dfskern** environment variable files to ensure they have the correct permissions (that is, file permissions set to 644). The files originally have owner, group, and other permissions set to 644 (owner read/write, group read, other read); but, over time, the file permission can change. If the nonzero UID created in the preceding steps is not able to read the **dfscntl** and **dfskern** files, you can receive a RACF ICH408I message (or unauthorized request message from equivalent security products). Check the following files to ensure the file permissions are set correctly:

- /opt/dfslocal/home/dfscntl/envvar
- /opt/dfslocal/home/dfskern/envvar

For example, the correct permissions display in this format.

```
-rw-r--r--  1 DFSID    DFSGRP      267 Dec  3 08:56 envvar
```

If they are not set correctly, you can change the permissions using the chmod command.

```
chmod 644 envvar
```


Chapter 4. Managing SMB processes

The SMB daemons (DFSCNTL, DFSKERN, and EXPORT) run as separate processes in the DFS address space, as shown in [Figure 3 on page 23](#). DFSCNTL controls the starting of the DFSKERN and EXPORT daemons.

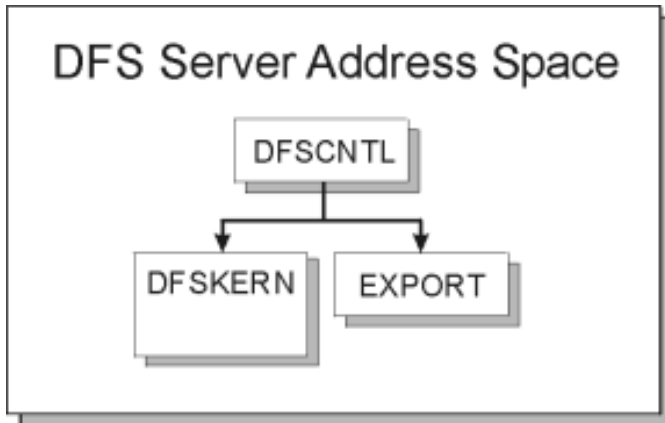


Figure 3: Address space for the DFS server

If the SMB server daemons are not started as instructed, they fail with the following return codes. The return codes for the IOEDFSCL and IOEPDCT daemons are shown as follows:

4

The module is not APF-authorized.

8

The module was not started independently through JCL.

12

The module is not running as a started task; instead, it is running as EXEC PGM=xxxxxxx started from JCL.

The codes for the IOEDFSKN and IOEDFSXP daemons are shown as follows:

4

The module is not APF-authorized.

8

The module was started independently through JCL.

[Figure 3 on page 23](#) shows dfscntl (the DFS Control Task) acting as the parent process to all the DFS server daemons. The DFS server daemons (dfskern and export) run as child processes of dfscntl. The export daemon communicates with dfskern to make the specified file systems available on the network and then stops. The dfskern daemon remains active to handle incoming file and print requests. dfskern can be run in the DFS Server address space or in its own address space. This is controlled by the `_IOE_DAEMONS_IN_AS` environment variable, which is set in the `/opt/dfslocal/home/dfscntl/` `envvar` file.

If the `_IOE_DAEMONS_IN_AS` environment variable is not specified, dfskern runs in the DFS Server address space.

If it is specified as `_IOE_DAEMONS_IN_AS=DFSKERN`, dfskern runs in its own address space (called the dfskern address space) as shown in [Figure 4 on page 24](#).

Running dfskern in its own address space might reduce contention for resources and provide better failure recovery. IBM recommends that dfskern be run in its own address space. MODIFY commands are unchanged whether dfskern runs in its own address space or not. Ensure that the dfskern JCL is available

and the daemonct envar file is in the daemonct home directory (/opt/dfslocal/home/daemonct) if you want to run dfskern in its own address space. Then, if you want to change where dfskern runs, add or remove the dfscntl environment variable (in the /opt/dfslocal/home/dfscntl/envar file), _IOE_DAEMONS_IN_AS=DFSKERN, stop DFS if it is running, and then restart DFS.

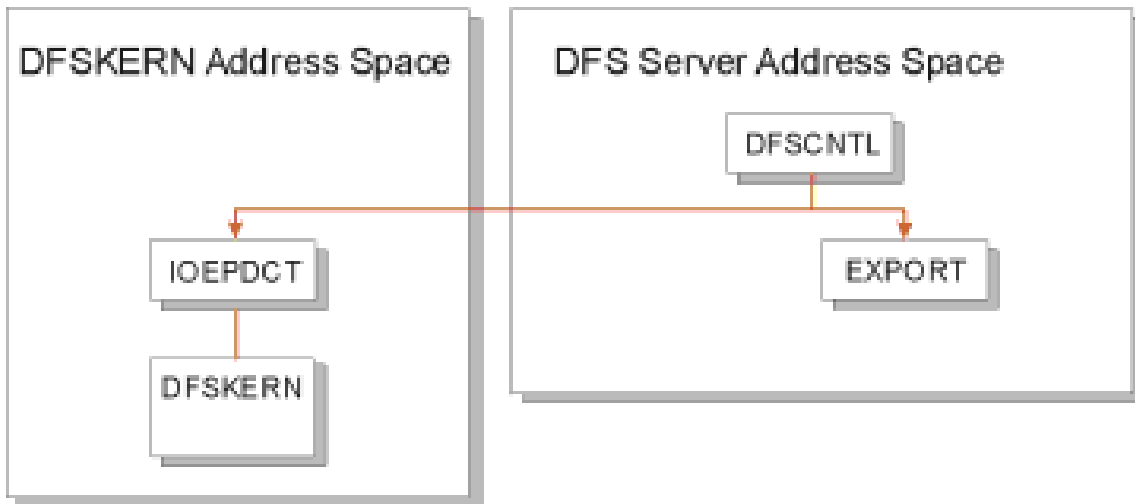


Figure 4: DFSKERN in a separate address space

After the DFS server address space is configured, both daemons (dfskern and export) are started automatically when the DFS server address space is started.

All requests to DFS are directed to dfscntl, that performs the requested action. The DFS server daemons can be started and stopped using an operator command. In starting and stopping the daemons, dfscntl uses a Daemon Configuration File (that is, the ioepdcf file) that contains information about the daemons that were previously configured on the host. The Daemon Configuration File contains runtime options, startup parameters, and restart information for its subprocesses. For details on the Daemon Configuration File, see [“The daemon configuration file”](#) on page 28.

Besides starting and stopping the DFS server daemons, dfscntl can also detect a daemon that has prematurely stopped and tries to restart it automatically. The algorithm used by dfscntl in starting and restarting the DFS server daemons is summarized in [“How dfscntl starts the DFS server daemons”](#) on page 29.

The following are the PDS member names for the DFS processes started by dfscntl:

dfskern

The load module name for the dfskern daemon. The name, dfskern, is an alias for the load library entry, IOEDFSKN.

export

The export process is started by dfscntl and executes the load library entry, IOEDFSXP. The export process has no alias.

Who can start and stop DFS server daemons?

Two types of users can start and stop the DFS server daemons in DFS:

- A user with z/OS operator privileges.
- A user who has update privilege to the DFSKERN.START.REQUEST profile in the RACF FACILITY class. This profile is created during the installation of DFS. For more information, see *z/OS Program Directory*.

Starting DFS server daemons

DFS server daemons are started in any of the following ways:

- During the system IPL
- Using the MODIFY DFS operator command
- Using the START operator command.

Based upon the control files for `dfscntl` set up by the DFS administrator, all of the DFS server daemons can be automatically started when the DFS started task is started.

The DFS daemons can all run in one address space (except for possibly `dfskern`) which is a started task (default name DFS). A user with z/OS operator privileges can start and stop the DFS started task. The DFS server address space can be started automatically during system IPL. To start the DFS server address space, use the z/OS START command as shown in the following example.

```
start dfs
```

Ideally, the daemons run continuously in the background and do not need to be started or stopped again. However, you might start the DFS server daemons manually in certain situations, for example, if a daemon ends abnormally. You can use the MODIFY operator command to manually start or stop the DFS server daemons.

Each of these alternatives is discussed briefly in the following sections. For complete details, see [Chapter 12, “z/OS system commands,”](#) on page 81.

MODIFY DFS operator command

The DFS server daemons (processes) can be started or stopped using the MODIFY DFS operator command. Using MODIFY DFS, you can also view the status of the DFS server daemons. Following is the syntax of the MODIFY DFS command:

```
MODIFY DFS,command daemon[,options]
```

DFS is the name of the DFS server address space.

command

Is the action that is to be performed on the SMB server daemon or daemons. It can have any of the following values:

start

Starts the DFS server daemon or daemons.

stop

Stops the DFS server daemon or daemons.

query

Displays the state of the DFS server daemon or daemons.

send

Sends requests to the DFS server daemon or daemons.

daemon

Is the name of the DFS server daemon for which the action is being requested. It can have any of the following values:

dfskern

DFS kernel program (includes the SMB file and print server).

export

Export program to make file systems available for exporting and shares available to PC users.

unexport

Unexport program to unexport file systems and delete shares.

all

All the DFS server daemons (dfskern, export, dfscntl, and unexport).

options

Values that are passed to the daemons.

Using MODIFY DFS to start DFS server daemons

With the MODIFY DFS operator command, you can use a single command to start either an individual daemon or all the daemons.

To start the dfskern daemon, issue the following command:

```
modify dfs,start dfskern
```

To start all daemons, issue the following command:

```
modify dfs,start all
```

Do not use the MODIFY command to start the DFS server daemons while the DFS server address space is still initializing. During initialization, DFS attempts to start all the DFS server daemons that have been configured on the z/OS host. If you issue the MODIFY command while DFS is initializing, the DFS server daemons can start out of order or stopped erroneously. This can lead to unexpected errors during initialization and cause DFS to end abnormally.

It is recommended that you wait until DFS has issued a log message indicating that DFS server initialization has completed before using the MODIFY commands. For complete details about MODIFY, see [Chapter 12, “z/OS system commands,” on page 81](#).

Order of starting DFS server daemons

When individual DFS server daemons are started manually, the successful startup of some daemons depends on the availability of the services provided by other daemons. Therefore, the DFS server daemons must be started in the following sequence:

1. dfskern
2. export

This is only applicable if you need to start any of the DFS server daemons individually. If the DFS server daemons are started collectively, (for example, using the start all option of the MODIFY DFS command), DFS ensures that the correct starting sequence is followed.

For example, to successfully start the export daemon, the dfskern daemon must already be up and running.

If you are using the SMB capability of the DFS servers to do printing, Infoprint Server should be started before the dfskern server daemon. Otherwise, you need to issue the dfsshare command to share the printers defined in smbtab.

Stopping DFS

DFS server daemons are stopped in any of the following ways:

- Using the STOP operator command.

- Using the MODIFY DFS operator command

Using the STOP command to stop DFS server daemons

To stop the DFS server address space, use the STOP operator command to ensure the normal shutdown of the address space.

To stop the DFS server address space and all DFS server daemons, enter the following command:

```
stop dfs
```

To stop the DFS server daemons, but not the DFS server address space, use the STOP ALL command. The STOP ALL command causes dfscntl to stop all daemons that it controls. For example:

```
modify dfs,stop all
```

Using MODIFY DFS to stop DFS server daemons

With the MODIFY DFS operator command, you can either stop an individual daemon or all the daemons that are configured on the host using a single command.

To stop the dfskern daemon, issue the following command:

```
modify dfs,stop dfskern
```

To stop all daemons, issue the following command:

```
modify dfs,stop all
```

Viewing the status of DFS server daemons

You can query the status of the DFS server daemons using the **QUERY** option of the **MODIFY** system command. You do not need the special privileges of a DFS administrator or an operator to use the **QUERY** option.

For example, to query the status of the **dfskern** daemon, enter the following command.

```
modify dfs,query dfskern
```

A message about the status of the daemon is written on the system log. This message also contains the **process ID** of the daemon. The status of the daemon can be any of the following, as shown in the following examples.

READY

Indicates that the daemon is running, has been initialized, and is ready to receive and process incoming requests.

ACTIVE

Indicates that a manual process is running. When an active process stops, it is never considered an error and it is never restarted automatically.

INITIALIZING

Indicates that the daemon has been started, but is not yet ready to receive and process incoming requests.

STOPPING

Indicates that a request to stop the daemon has been received and that the daemon is in the process of stopping.

DOWN

Indicates that the daemon is not active.

UNKNOWN

Indicates that the status of the daemon cannot be determined. This can occur if the daemon was started, but no response was received by the system indicating a change in its status. You can issue a command to stop a daemon if it is in the UNKNOWN state.

Figure 5 on page 28 is an example of a query command to **dfscntl**. The output is sent to the z/OS console.

```
modify dfs,query dfskern
IOEP00022I DFS daemon DFSKERN status is READY and process id is 781.
```

Figure 5: Example output from query command to *dfscntl*

Figure 6 on page 28 shows an example of the output produced by a **modify dfs,query all** command.

```
IOEP01101I DFS daemon DFSCNTL status is READY and process ID is 67108898.
IOEP01101I DFS daemon DFSKERN status is READY and process ID is 16777252.
IOEP01101I DFS daemon EXPORT status is DOWN and process ID is 0.
IOEP01101I DFS daemon UNEXPORT status is DOWN and process ID is 0.
```

Figure 6: Example output from query all command

Starting DFS server daemons during IPL

Because the DFS server daemons are contained in the DFS server address space (except for possibly DFSKERN), these daemons are started during the initialization of DFS. This gives you the ability to configure the host to automatically start the DFS server address space during the system IPL.

DFSCNTL uses the daemon configuration file to determine which daemons can be started, and the parameters to pass to the daemon load module when starting the daemon. The DFS server address space can be started automatically during system IPL. To start the DFS server address space, use the z/OS start command, as shown in the following example.

```
start dfs
```

The daemon configuration file

The daemon configuration file is used by **dfscntl** to obtain necessary information when starting the DFS server daemons. It contains the following information:

- The name of the process to be started.
- A parameter that specifies actions to be taken when the process is started. It can have the following values:

Y

Start the process during initialization. If the process ends abnormally, then restart it automatically.

N

Do not start the process automatically or manually.

I

Start the process during initialization. The process can be started manually. If the process ends, it does not restart.

M

Can be started manually.

- Parameters that are passed to the load module when a daemon is started, called the argument list (including Language Environment runtime options).
- The Minimum Restart Interval. `dfscntl` attempts to restart a daemon that ends abnormally only if the daemon was running for at least this time interval. If a daemon ends during this time interval, it is not restarted.
- The Time-out Period, which is the maximum time interval that `dfscntl` waits for the daemon to complete its initialization after it has been started. When this time interval elapses, and `dfscntl` has not received confirmation from the daemon that initialization has completed, the status of the daemon is set to UNKNOWN.

The path name to the daemon configuration file is `/opt/dfslocal/etc/ioepdcf`. [Figure 7 on page 29](#) shows the typical contents of the Daemon Configuration file.

```
DFSKERN  CONFIGURED=Y  LMD=DFSKERN  ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfskern')/  
>DD:DFSKERN  2>&1"    RESTART=300  TIMEOUT=300  
EXPORT  CONFIGURED=I  LMD=IOEDFSXP  ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfsexport')/-all -verbose  
>DD:EXPORT  2>&1"    RESTART=300  TIMEOUT=300  
UNEXPORT CONFIGURED=M  LMD=IOEDFSXP  ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfsexport')/-detach -all -ver  
>DD:UNEXPORT 2>&1"    RESTART=300  TIMEOUT=300
```

Figure 7: Daemon configuration file

In the **ARG** (argument list) field of this example, `ENVAR` indicates the Language Environment environment variables used; in this case, the `_EUV_HOME` environment variable is specified to identify the daemon's home directory. (The home directory contains the daemon's `envar` file. See [“envar” on page 99](#) for more information.) Anything after the `/` character are program parameters. The character is the redirection character, which indicates that the output is redirected to the DD name that follows.

The daemon configuration file is optional. When it is omitted, the defaults are as listed in [Figure 7 on page 29](#). The daemon configuration file can only be modified when the DFS server address space is not running.

Under typical circumstances, you do not need to edit the daemon configuration file. Although there might be certain situations when you modify the Daemon Configuration File, it is recommended that it is done under the supervision of an IBM service representative.

How dfscntl starts the DFS server daemons

When a request arrives to start DFS server daemons, **dfscntl** looks at the Daemon Configuration File to see if the particular daemon or daemons are configured on the host. If the daemon is configured and is not running, **dfscntl** starts it and waits for the daemon to initialize successfully.

In case of the abnormal ending of any DFS server daemon, **dfscntl** tries to restart the daemon. **dfscntl** attempts to restart the daemon only if the daemon was running for at least the duration of the Minimum Restart Interval, as specified in the Daemon Configuration File. If the daemon ended within this time interval, it is not restarted.

Note: When **dfscntl** restarts an abnormally terminated daemon, it does not correct the problem that caused the daemon to end unexpectedly. Thus, depending on the cause of the abnormal ending, the daemon can fail again after restarting because of the same error condition.

Using the -nodfs option to start dfscntl

You can start the DFS server address space without starting the configured DFS server daemons by using the **-nodfs** option of the **START** operator command. For example, the command would have the following format.

```
start dfs,param='-nodfs'
```

Changing environment variables

Each SMB server process uses environment variables to control how it behaves. When any processes environment variables are changed in the **envvar** file in the home directory of the process, the process must be restarted to make them take effect.

Changing mappings

The **dfskern** process optionally supports a mapping between SMB user IDs and z/OS user IDs. The **smbidmap** file is located by means of the **_IOE_SMB_IDMAP** environment variable of **dfskern**. If the **smbidmap** file is updated (to add, change, or delete mappings), you must issue the **modify dfs,send dfskern,reload,smbmap** operator command to make them take effect. If you change the location of the **smbidmap** file, then the **_IOE_SMB_IDMAP** environment variable must be updated and the **dfskern** process must be restarted. It is recommended that the **smbidmap** file is located in the **/opt/dfslocal/var/dfs** directory so that it is contained with the other customizable files.

Changing shared directories or shared printers

Shared directories and shared printers are defined in the **smbtab** file. If the **smbtab** file is changed to add or delete a share, the **dfsshare** command must be issued to make it take effect. Use the **-share** parameter of the **dfsshare** command to add a new share defined in **smbtab**. Use the **-detach** parameter of the **dfsshare** command to delete a share. The **dfsshare -detach** command for the share must be issued before removing the share from the **smbtab**.

If the shared directory is contained in a file system that has not been exported before, or if there are additional file systems (under the file system containing the shared directory) that you want available to PC users, then you should add those file systems to the **dfstab** and the **devtab** and then issue the **dfsexport** command before issuing the **dfsshare** command.

If, however, you are using the dynamic export capability of the SMB server, **dfstab** and **devtab** entries are not required for file systems that are mounted under the file system containing the shared directory. See [“Dynamic export for HFS” on page 45](#) for information about the dynamic export capability.

Shared printers do not need entries in the **dfstab** nor the **devtab** and do not require the **dfsexport** command.

Changing the hfsattr or the rfstab

The **hfsattr** contains directives that map a file name extension (suffix) to an indication whether the data should be translated from ASCII to EBCDIC and vice versa. Its location is specified in **_IOE_HFS_ATTRIBUTES_FILE** environment variable of the **dfskern** process. The **rfstab** contains creation (and other) attributes for RFS files. Its location is globally specified in the **_IOE_RFS_ATTRIBUTES_FILE** environment variable of the **dfskern** process. It can also be specified on an RFS file system basis in the **devtab attrfile** parameter. When the **hfsattr** or the global **rfstab** file is modified, the **dfskern** process must be restarted to make it take effect. If an RFS file system's **rfstab** is modified, the file system must be

re-exported. That is, if it is already exported, it must be unexported and then exported. This is accomplished with the **dfsexport** command.

Changing the Infoprint Server DLL

If a new release of the Infoprint Server is installed or it is enabled, it can be activated for the SMB server by the **modify dfs,send dfskern,reload,print** system command. You also need to issue the **dfsshare** command to share the printers defined in **smbtab**.

Renaming the DFSKERN started task

DFSKERN is a daemon that starts from the DFSCNTL daemon. It runs in either in the DFS Server address space or the DFSKERN address space. For more information about SMB processes, refer to [Chapter 4, “Managing SMB processes,”](#) on page 23.

You might decide that you want to provide a name for the DFSKERN started task (daemon) when running DFSKERN in the DFSKERN address space. Before that can be done, the administrator must perform the following steps, which include replacing <newstc> with the chosen name. The new name for the DFSKERN started task must be 8 characters or less and start with an alphabetic character. (The remaining characters can be alphanumeric). The name cannot be EXPORT, UNEXPORT, DFS, ALL, NONE, LEVEL.

1. Locate the following environment variable files:

- /opt/dfslocal/home/dfscntl/envvar
- /opt/dfslocal/home/dfskern/envvar
- /opt/dfslocal/home/daemonct/envvar

These are the default locations. If you are not using the default locations, you must find these files.

2. For each file listed in Step 1, make these changes:

- a. Add or set `_IOE_DAEMONS_IN_AS=<newstc>`.
- b. Add `_IOE_ENABLE_ALT_STC=YES`.

A new message is displayed on SMB startup if the value for `_IOE_DAEMONS_IN_AS` does not meet the name restrictions. For example:

```
IOEN00516A The DFSKERN envvar _IOE_DAEMONS_IN_AS in
/opt/dfslocal/home/dfskern/envvar contains the incorrect value of new@stc.
```

3. In the /opt/dfslocal/etc/ directory, make a backup copy of the ioepdcf file.

4. Edit the ioepdcf file and change the DFSKERN line as follows:

- a. Change the process name to <newstc> and change DD: to <newstc>. This is what the DFSKERN line looks like when the ioepdcf file was created during the installation process. It might have been changed, so use the following updates for reference.

```
DFSKERN CONFIGURED=Y LMD=DFSKERN
ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfskern')/
>DD:DFSKERN 2>&1" RESTART=300 TIMEOUT=300
```

The updated line should look like the following:

```
<newstc> CONFIGURED=Y LMD=DFSKERN
ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfskern')/
>DD:<newstc> 2>&1" RESTART=300 TIMEOUT=300
```

5. In the system.proclib, or the proclib that your system is using, copy the DFSKERN proc to <newstc> proc. Edit this proc and change all instances of DFSKERN to <newstc>.

6. Make these RACF (or equivalent security product) changes to define <newstc> as a started task:

```
RDEFINE STARTED <newstc>.** STDATA(USER(DFS))
SETROPTS RACLIST(STARTED) REFRESH
```

The preceding RDEFINE statement assumes that your system is set up for SMB to start under the DFS user ID. If it is not, you will need to specify the user ID that you are using as follows. For more information about RACF definitions for SMB, refer to [“RACF definitions for SMB” on page 18](#).

```
REFINE STARTED <newstc>.** STDATA(USER(<yourid>))
SETROPTS RACLIST(STARTED) REFRESH
```

7. Restart SMB using "Stop DFS" and after the stop is complete.

Start DFS

When this function is enabled, DFSKERN will no longer be displayed in the ISPF job status panel (ISPF S.ST), but the <newstc> name will be displayed. Also, any DFS commands that are sent to the DFSKERN daemon must now be sent to the <newstc> daemon.

Examples:

```
Modify dfs,stop <newstc>
Modify dfs,send <newstc>,trace,print
Modify dfs,send <newstc>,query,servthreads
```

Many messages have "DFSKERN" as part of the message. These messages will not change. If a message contains the daemon name as a replacement variable, the <newstc> daemon name is displayed in the message.

Chapter 5. Networking considerations

To use the shares that the SMB server makes available, PC clients must be able to find the server on the network. The communications mechanism that is used is TCP/IP and the methods of server discovery follow:

- The Domain Name Service (DNS)
- The Windows Internet Naming Service (WINS)
- Clients on the same workgroup and same subnet as the server
- The LMHOSTS file.

The order in which a server name is resolved to a TCP/IP address might vary depending on the client software and the service pack level of the Windows client software.

TCP/IP networks can use the Domain Name Service (DNS) to map server system names to IP addresses. In a DNS network, an entry tells clients in the network how to map the name of the server to its proper TCP/IP address.

Note: The SMB server does not support Internet Protocol version 6 (IPv6). Use Internet Protocol version 4 (IPv4) instead.

If you want PC clients to access the SMB server by using DNS, then you must ensure that the host name and IP address are added to the DNS database. Using DNS is generally the easiest way for clients to access the SMB server on a distributed network. In this case, you should ensure that the (TCP/IP) host name and the (SMB) computer name are the same. (This is the default if you do not specify a computer name for the SMB server by using the `_IOE_SMB_COMPUTER_NAME` environment variable of `dfskeyn`.)

The supported Windows SMB clients make SMB calls directly over TCP or through NetBIOS over TCP/IP. When connecting directly over TCP, the client makes calls using a TCP/IP connection to server port 445. When using NetBIOS over TCP/IP, the client makes calls to ports 137, 138 and 139. When connecting to the server, these clients will attempt to connect to ports 445 and 139 to establish a session. The `_IOE_SMB_TRANSPORTS` environment variable specifies the enable modes as NetBIOS (port 139), DIRECT (port 445), or BOTH (ports 445 and 139). The default is NetBIOS. Many SMB clients have configuration options to enable NetBIOS over TCP/IP, SMB directly over TCP/IP, or both. The server responds on the enabled ports; the client software can choose to attempt one protocol prior to the other or both in parallel.

Microsoft Windows servers can provide the Windows Internet Naming Service (WINS) which allows clients to map a computer name to the computer's actual TCP/IP address. If you use a WINS server in your network, you can configure the SMB server to announce itself to the WINS server. Then you can configure PC clients to connect to the SMB server by using the WINS server. The SMB server announces itself to the primary WINS server (identified by the `_IOE_SMB_PRIMARY_WINS` environment variable of `dfskeyn`). If the primary WINS server cannot be contacted, the SMB server announces itself to the secondary WINS server (identified by the `_IOE_SMB_SECONDARY_WINS` environment variable of `dfskeyn`). The SMB server does not, itself, act as a WINS server. It can, however, act as a WINS proxy. That is, it can accept WINS requests from PC clients and forward them to a WINS server if the `_IOE_SMB_WINS_PROXY` environment variable of `dfskeyn` is specified as ON. The PC clients would have the IP address of the SMB server that is specified as the WINS Server IP address.

In the `_IOE_SMB_DOMAIN_NAME` environment variable of `dfskeyn`, you can specify the name of the domain or workgroup that the SMB server should be a member of. This can be the name of an existing domain or workgroup in your LAN environment. If possible, put your SMB server in the same domain or workgroup as your client PCs.

An SMB server that is in the same workgroup and the same subnet as the PC clients appear in the network directory without any additional configuration on the server or those PC clients. An SMB server that is on the same subnet as a Primary Domain Controller that is acting as a WINS server appears in the Network directory of PCs that contain the WINS server IP address. The SMB server announces itself to the Browser

by using subnet broadcast on User Datagram Protocol (UDP) port 138. It does this at every Browser announcement interval (specified by the `_IOE_SMB_BROWSE_INTERVAL` environment variable of `dfskeyn`). Those PC clients can also find the SMB server by using subnet broadcast to UDP port 137. The SMB server responds to this broadcast. PC clients that want to use the Network and Sharing Center function should have the NetBEUI protocol installed.

PC client operating systems can provide static configuration files that can map server system names to TCP/IP addresses. These files are typically more difficult to manage than a solution that involves more centralized control (for example, a DNS or WINS server). This is because the network administrator must configure each PC client individually. Static configuration files are useful, however, in large, distributed networks. In this environment, clients and servers exist in different subnets (network segments) and possibly different workgroups (domains). Static configuration files help clients locate servers.

To enable the Network and Sharing Center directory function, there must be a Master Browser on the same network segment as the SMB server. Typically, Windows clients and servers are configured to act as Master Browsers by default; therefore, a Windows client or server should already meet this requirement.

Windows clients provide the LMHOSTS file that can map server computer names to IP addresses. LMHOSTS contains IP addresses and server computer names for which to map those addresses. You can use these files to map the IP address of the SMB server for clients. This allows clients to find the SMB server in a large, distributed network environment.

You can find more information about LMHOSTS files in the sample LMHOSTS file that is provided with your Windows operating system. Additional information is available in your PC operating system documentation.

Chapter 6. Mapping SMB user IDs to z/OS user IDs

The local security subsystem (for example, RACF) determines if the client is authorized to access HFS or RFS directories and files. Because the local security subsystem does not recognize SMB user IDs, the SMB user ID that comes to the SMB server must be mapped to a local user ID. This mapping is defined in the **smbidmap** file, which is read during **dfskern** initialization or as a result of the **modify dfs,send dfskern,reload,smbmap** operator command. The **smbidmap** file is an HFS file, a sequential data set or a member of a PDS, and its location is specified in the **_IOE_SMB_IDMAP** environment variable of **dfskern**. It contains SMB user IDs and their corresponding z/OS user IDs. This information is used by **dfskern** to map SMB user IDs to z/OS user IDs.

The following procedure can be used to map SMB user IDs to z/OS user IDs; each of these procedures are described in the following sections:

1. Create an **smbidmap** file.
2. Set the **_IOE_SMB_IDMAP** environment variable.
3. Stop and restart the **dfskern** process.

If **_IOE_SMB_IDMAP** environment variable already has the name of the **smbidmap** file and the **smbidmap** is just being updated, the **modify dfs,send dfskern,reload,smbmap** command can be used to activate the updated mappings.

Restriction: To limit the number of calls to the security manager, the default behavior of the SMB server is to cache user credential information, including the Security Server RACF group information, when it is started. The cached information is not refreshed. To ensure the SMB server recognizes user credentials, you must stop and restart the SMB server. To change the default behavior to dynamically recognize changes to user credential information, set the **_IOE_USE_PTHREAD_SECURITY** environment variable to ON.

Creating an smbmap file

The **smbidmap** file is a text file that the administrator creates and maintains. It can be an HFS file, a sequential data set, or a member of a PDS. If you are using an HFS file, any editor that is available on z/OS UNIX can be used (for example: **oedit** or **vi**). The **smbidmap** file contains one or more mapping declarations and has the following general format.

```
SMB-user-ID1
z/OS-user-ID1

SMB-user-ID2
z/OS-user-ID2
...
```

Each entry has two elements: SMB user ID and z/OS user ID. A blank line is optional between entries (but is suggested for readability). The following list explains each element in an SMB user ID mapping entry:

SMB-user-ID or Domain/SMB-user-ID or Workgroup/SMB-user-ID or Domain/*

Specifies the client's SMB identity. This can be a simple SMB user ID (when the domain of the SMB user ID is unimportant) or a fully qualified name (for clients within and outside the domain/workgroup) or a domain name with an asterisk (for all clients in a particular domain). The SMB user ID can be up to 20 characters in length. A Domain (Workgroup) name can be up to 15 characters in length.

- *SMB-user-ID* is assumed to be in any domain.
- *Domain/SMB-user-ID* is assumed to be in the specified domain.
- *Workgroup/SMB-user-ID* is assumed to be in the specified workgroup.

When a PC user is in a workgroup, the PC client sends the computer name as the domain name (not the workgroup name).

z/OS-user-ID

Specifies the z/OS user ID of the client. All potential SMB clients must have z/OS user IDs on the system where the SMB server is running. This field is case-sensitive. The case of the z/OS user ID is important if you are using the &USERID keyword of the smbtab file. When a PC user does a net use to a shared directory that has &USERID in the directory path name field of the smbtab entry, the z/OS user ID is taken from the smbimap entry for that PC user and is used to reference (with the exact case specified for the z/OS user ID) the directory. When this directory reference causes automount to occur, a directory with this exact case is created by automount. Make sure you specify the z/OS user ID with the correct case so that the directory that is created by automount has the correct name. (For example, it might need to match the user ID in the definition of the user home directory in the RACF OMVS segment of the user's profile.) The z/OS user ID is folded to uppercase when used to logon to z/OS.

For information about other entries in the smbimap file, see “smbimap” on page 103.

The SMB user ID is used (as received over the wire) for the z/OS user ID for an &USERID value that is specified in the smbtab. In this case, the PC user ID as specified on the Windows logon (or on the net use command) is used by automount to create a directory. This is case-sensitive in that the directory is created with the exact case as received from the PC. Some clients fold the PC user ID to uppercase before sending it to the SMB server. In this case, if the directory created by automount needs to be lowercase or mixed case, the administrator needs to add an entry to the smbimap file to map the uppercase PC user ID to the correct case z/OS user ID.

Each SMB user can only have one mapping to a z/OS user. Conversely, you can map different SMB users to the same z/OS user.

Setting the _IOE_SMB_IDMAP environment variable

The _IOE_SMB_IDMAP environment variable must be set to the name of the smbimap file used by the SMB server. The declaration of this environment variable can be made in the envvar file of the dfskern process located in /opt/dfslocal/home/dfskern/envvar.

For example, if the HFS path name of the smbimap file is /opt/dfslocal/home/dfskern/smbimap, this variable is set by the following entry in the envvar file.

```
_IOE_SMB_IDMAP=/opt/dfslocal/home/dfskern/smbimap
```

If the smbimap file is contained in data set HLQ.DFSKERN, member name SMBIDMAP, this variable is set by the following entry in the envvar file.

```
_IOE_SMB_IDMAP=/'HLQ.DFSKERN(SMBIDMAP)'
```

Modifying and deleting identity mapping entries

Edit the **smbimap** file to modify or delete mapping entries. For these changes to take effect, you must either restart the SMB server or reload the **smbimap** file by using the **modify dfs,send dfskern,reload,smbmap** command. See Chapter 12, “z/OS system commands,” on page 81 for more information about the **modify** command.

Determining the z/OS user ID from the SMB user ID

The following decisions are made for how **dfskern** determines the z/OS user ID from the SMB user ID:

- The **smbidmap** table is read during SMB server initialization or when you enter the **modify dfs,send dfskern,reload,smbmap** command.
- When an SMB comes to the SMB server,
 - If an SMB user ID and domain are in the SMB, then search for a match in **smbidmap** in a case insensitive manner.
 - If no match, use just the SMB user ID from the SMB and search for a match in the SMB user ID and “don’t care” domain in a case insensitive manner. (These are entries in **smbidmap** that do not have a domain.)
 - If there is still no match, see if there is an *** =** entry. If yes, use the SMB user ID from the SMB as a z/OS user ID.
 - If a match was found, attempt a logon with the mapped ID and the password.
 - If there is still no z/OS user ID, or if the logon attempt was unsuccessful, see if the **_IOE_MVS_DFSDFLT** environment variable is specified. If yes, use its value as the z/OS user ID (without a password). This is sometimes known as a guest login.

The SMB client request is denied if the SMB server cannot determine a mapping to a z/OS user ID. For example, if the SMB user ID is unspecified or not mapped, or mapped but not in RACF and if **_IOE_MVS_DFSDFLT** is not specified or the **_IOE_MVS_DFSDFLT** user ID is not in RACF, the client request is denied.

How the SMB user ID is determined

The SMB user ID is determined from the user ID the user specifies when logging on to Windows. This user ID is mapped to a z/OS user ID, and the password is taken as the password for the z/OS user ID (when using clear passwords) or the user’s SMB password in their RACF DCE segment (when using encrypted passwords). See “Logon considerations” on page 54 for information about clear passwords and encrypted passwords.

The simplest method for using the SMB server is to logon to Windows with your SMB user ID that the SMB server can map to a z/OS user ID. When a drive letter is mapped to a shared directory, that user ID is sent to the SMB server. If you are prompted to enter your password, you should enter your z/OS password (when using clear passwords) or your SMB password from your RACF DCE segment (when using encrypted passwords).

The password that you logged onto Windows with is sent to the SMB server. If your z/OS password (when using clear passwords) or your SMB password from your RACF DCE segment (when using encrypted passwords) is different than your Windows password, you should specify your z/OS or SMB password on the **net use** command. If your Windows password is different than your z/OS or SMB password and you do not specify it on the **net use** command (or you specify it incorrectly), you are logged in as the DFSDFLT user ID, if the **_IOE_MVS_DFSDFLT** environment variable is specified on the SMB server. If the **_IOE_MVS_DFSDFLT** environment variable is not specified and you specified an incorrect password, you might be prompted for the correct password or denied.

On Windows clients, you can specify your SMB user ID on the map network drive pull down and you can specify your SMB user ID (and password) on the **net use** command. This gives you the ability to use a different SMB user ID than the one used to logon to Windows.

Chapter 7. Sharing files

Before PCs can access files, a shared directory must be created. A shared directory represents the starting point or top directory of a “tree” of directories and files. A PC user can access the shared directory and the subdirectories and files based on the user’s authorization to those items. A PC user cannot reference a directory (or file) that is higher than the shared directory (except by accessing an absolute symbolic link when the **_IOE_SMB_ABS_SYMLINK** environment variable in the **dfskern** process is **ON**).

Considerations for exporting file systems

Before a shared directory can be created, the file system that contains the directory to be shared must be exported. (A file system is identified by its file system name.) The following discussion assumes that you are familiar with HFS file systems, z/OS UNIX concepts, and data sets. The file system types supported by the SMB server are HFS, zFS, TFS, and AUTOMNT. If you are in a sysplex with shared file system files, SMB support of zFS is limited to zFS compatibility mode file systems. The NFS and DFSC file system types are not supported. Unless otherwise noted, when the term HFS is used, it includes all the supported file system types.

To export an HFS file system, that file system must be owned by the system that the SMB server is running on. When export is attempted on a (sysplex) shared file system that is owned by a system other than the one that the SMB server is running on, the SMB server attempts to move the ownership of a shared file system to the system that the SMB server is running on (when the **_IOE_MOVE_SHARED_FILESYSTEM** environment variable is **ON** in the **dfskern** process). If this is unsuccessful (when, for example, the file system is being exported by another SMB server on the other system), the SMB server is unable to export that file system and it is not available to PC clients. When the SMB server is running with dynamic export enabled and the move of ownership of file systems enabled, you should run a single SMB server on a sysplex. Otherwise, each SMB server might try to export (and move the ownership of) the same file system and one of them will fail.

When the SMB server tries to export a file system, it checks the zFS file system configuration to determine whether zFS is running sysplex-aware or non-sysplex aware and only exports a non-sysplex aware file system. To check whether zFS is running sysplex-aware, use the `zfsadm configquery -sysplex_state` command. If it returns 2, it is running sysplex-aware. To check whether zFS is running sysplex-aware on a read/write file system basis, use the `zfsadm configquery -syslevel` command or the `modify zfs,query,level` operator command. If it returns with the field `sysplex(filesys,norwshare) interface(3)` or `sysplex(filesys,rwshare) interface(3)`, zFS is running sysplex-aware on a file system basis.

Sharing HFS files

This section discusses interactions with the HFS file system.

Exporting and sharing HFS file systems

An HFS file system must be exported before a directory contained in it can be shared. Exporting is done on an HFS file system basis and tells z/OS UNIX that a file system is being made available to clients by a File Exporter (that is, the Distributed File Services SMB File/Print Server).

PC clients access data on HFS through sharing that is done on a directory tree basis. For a directory to be shared, the file system that the directory is contained in must be exported. Suppose we had the (purposely simplified) entire file hierarchy on a z/OS system shown in [Figure 8 on page 40](#).

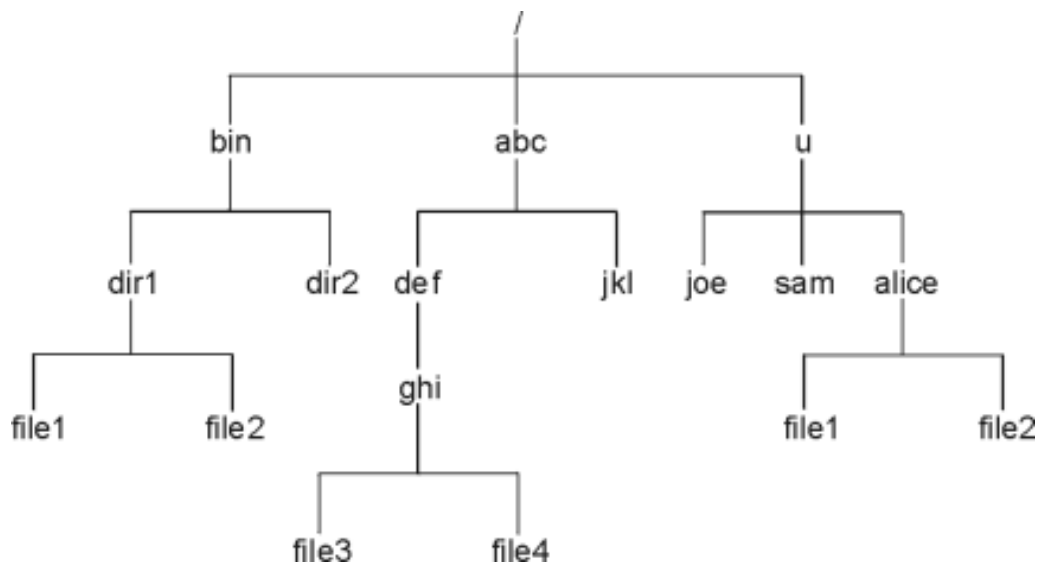


Figure 8: Example of simplified file hierarchy on a z/OS system

This file hierarchy is made up of separate file systems mounted together, as [Figure 9 on page 40](#) shows.

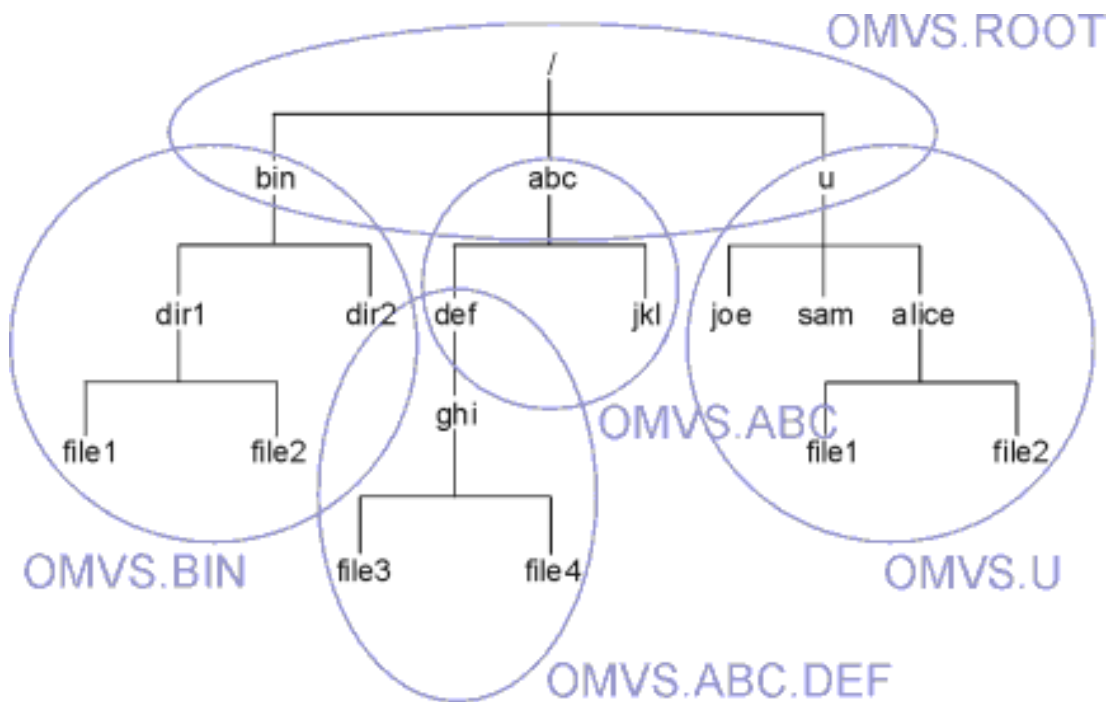


Figure 9: Example of separate file systems that are mounted together

The ovals represent the individual file systems. There are five file systems in this hierarchy. Each of these file systems has a data set name. The top file system is referred to as the root file system. Its data set name is OMVS.ROOT. Each of the underlying file systems are mounted on top of a directory in the file system above it. There are three file systems mounted on three directories that are contained in the root file system. One is mounted on the directory /bin (data set OMVS.BIN), another is mounted on /abc (data set OMVS.ABC), and the third is mounted on /u (data set OMVS.U). The fifth file system is mounted on /abc/def (data set OMVS.ABC.DEF). The data set name of a file system can be displayed with the `df` command. [Figure 10 on page 41](#) examines the /abc/def/ghi path more closely.

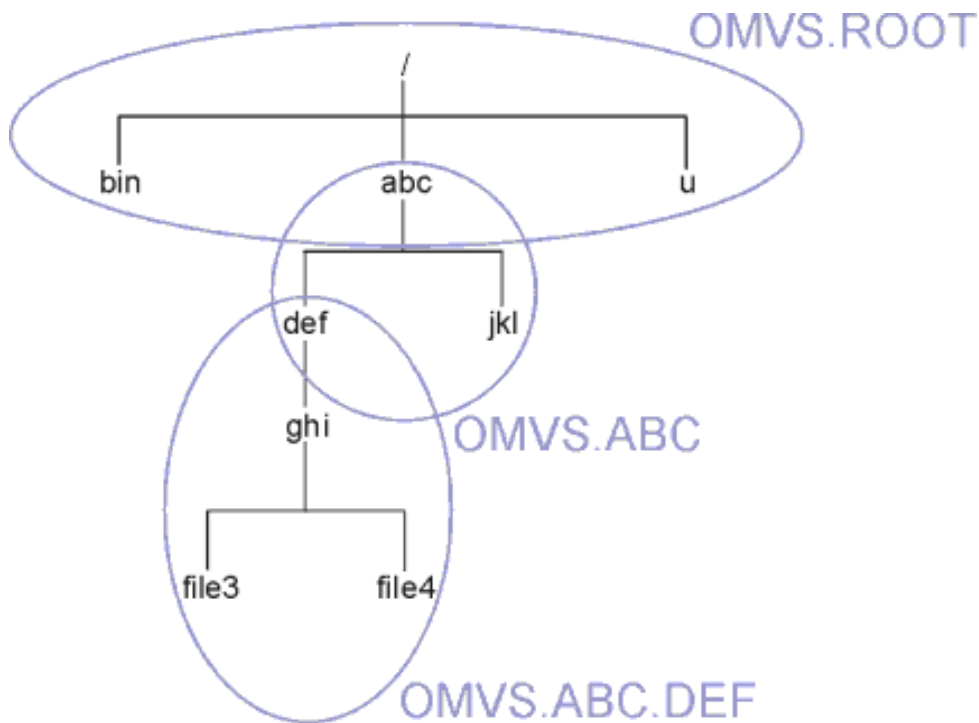


Figure 10: Example of three file systems

The `/abc/def/ghi` path consists of three file systems mounted, as shown in Figure 11 on page 41. If you want to create a share for directory `/abc/def/ghi`, you must export the file system where the (`/ghi`) directory resides (OMVS.ABC.DEF).

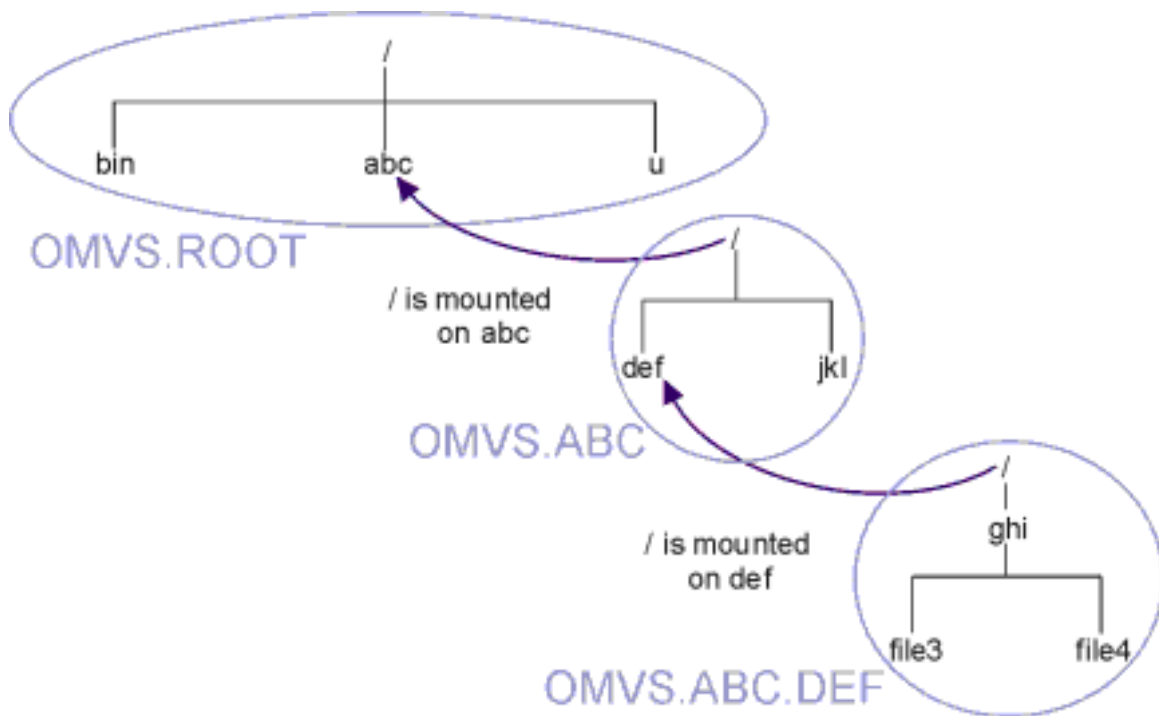


Figure 11: Example of where file systems are mounted

In addition, if there are other file systems below the file system containing the shared directory, you might want to also export these so that PC clients can reference data in those file systems. They should be added to `dfstab` and `devtab` and exported using the `dfsexport` command (see [“The smstab, dfstab,](#)

and devtab entries for HFS” on page 42 for more information). Otherwise, a PC client is denied access to directories and files in file systems that are not exported.

The smbtab, dfstab, and devtab entries for HFS

The files that the SMB File Server uses to relate the shared directory and its exported file system are the smbtab, the dfstab, and the devtab. (They are all located in /opt/dfslocal/var/dfs.) A common minor device number is used to tie related entries in these three files together. The smbtab is used to define the shared directory. The dfstab and the devtab are used to define the file system to be exported.

In smbtab, the minor device number is specified using the format /dev/ufs*n*, where *n* is a locally-assigned unique minor device number ; this number must refer to the HFS file system data set where the root of the shared directory path name resides (that is the file system where the first / resides). This should always be the file system where the directory that you want to share resides. Note that when you are sharing a mount point, you would specify the file system that is mounted on the mount point in devtab and / as the directory in smbtab.

In dfstab, the minor device number is specified by using the format /dev/ufs*n* to identify the assigned unique identifiers for the HFS file system.

In devtab, the minor device number is specified by using the format define_ufs*n* to identify the data set name for the HFS file system.

For example, if the shared directory is /ghi, then the smbtab, dfstab, and devtab entries might be:

smbtab	/dev/ufs2 myshare ufs “My share description” r/w 100 /ghi
dfstab	/dev/ufs2 hfs2 ufs 101 0,,1715
devtab	define_ufs 2 OMVS.ABC.DEF

Notice that you did not need to export the file systems that are above the OMVS.ABC.DEF file system. That is, you did not need to create dfstab and devtab entries for OMVS.ROOT and OMVS.ABC.

However, if there were additional file systems under the shared directory that you want to export, specify them in the dfstab and devtab. PC users might want to access these directories and files. Alternatively, you can use the dynamic export capability. Refer to “Dynamic export for HFS” on page 45.

As another example, if you wanted to share the entire file hierarchy with PC users from the root on down, then the smbtab, dfstab, and devtab entries might be:

smbtab	/dev/ufs4 hfsroot ufs “My share description” r/w 100 /
dfstab	/dev/ufs2 hfs2 ufs 101 0,,1715 /dev/ufs3 hfs3 ufs 102 0,,1718 /dev/ufs4 hfs4 ufs 103 0,,1721 /dev/ufs5 hfs5 ufs 104 0,,1724 /dev/ufs6 hfs6 ufs 105 0,,1727

devtab

```
define_ufs 2
OMVS.ABC.DEF
define_ufs 3
OMVS.ABC
define_ufs 4
OMVS.ROOT
define_ufs 5
OMVS.BIN
define_ufs 6
OMVS.U
```

Notice that only one share is required (in smbtab) since only one directory is being shared but all the HFS file systems must be exported (by including them in the dfstab and devtab or by using dynamic export) since we want the PC user to be able to reference any file or directory under the root directory. If you are including them in dfstab and devtab, you should issue the `dfsexport -all` command to ensure that all the file systems are exported before the `dfsshare -share hfsroot` command is issued to share the directory. (For more information, see [“dfsexport” on page 109](#) and [“dfsshare” on page 113.](#))

Creating a shared directory for HFS

Creating a shared directory for HFS data requires certain steps. The HFS file system must be locally mounted on the system.

- See *z/OS UNIX System Services Planning* for information about creating and mounting an HFS file system.
- See *z/OS Distributed File Service zFS Administration*, for information about creating and mounting a zFS file system.

To create a shared directory, use the following steps:

1. Choose the HFS directory that you want to share. (For example, `/abc/def/ghi`)
2. Determine the HFS file system data set name that the directory `/abc/def/ghi` resides in. If you do not know the HFS file system data set name, the `df` command can help with this task. The `df` command displays file system data set names and their mount points. Refer to *z/OS UNIX System Services Command Reference* for information about the `df` command. (For example, data set `OMVS.ABC.DEF` might be mounted on `/abc/def`.)

Following is an example of the `df` command that might help with this determination.

```
# df /abc/def/ghi
Mounted on      Filesystem      Avail/Total      Files      Status
/abc/def        (OMVS.ABC.DEF)  544/1440         4294967295  Available
```

This shows the mount point and the HFS file system data set name of the file system mounted on that mount point. The HFS file system data set name is in parentheses (in this example, `OMVS.ABC.DEF`).

3. If there is no entry in the `devtab` file for this HFS file system, you must add an entry in `/opt/dfslocal/var/dfs/devtab` which maps a unique minor device number to the HFS file system you want to export and share. Choose a unique minor device number (for example, **2**) that is not in any other `define_ufs` statement and put it in the `define_ufs` statement. Put the HFS file system name (in this example, `OMVS.ABC.DEF`) on the next line. An example of an entry for an HFS file system might look like the following.

```
* HFS devices
define_ufs 2
OMVS.ABC.DEF
```

4. If there is an entry in `devtab` for this HFS file system, you must add a corresponding entry in `dfstab`. Use the same minor device number (in this example, `2`) in the device parameter (so in this example, it would be `/dev/ufs2`). Use a unique file system name (for example, `hfs2`), a file system type of `ufs`

and a unique file system ID (for example, 101). Finally, use a unique fileset ID (for example, 0,,1715). An example `dfstab` entry might look like this.

```
/dev/ufs2 hfs2 ufs 101 0,,1715
```

You can use the same number for all the numeric values in an individual `dfstab` entry, as long as the number used is unique between `dfstab` entries. For example, the `dfstab` entry might look like this:

```
/dev/ufs2 hfs2 ufs 2 0,,2
```

5. Add an entry in `smbtab` for the directory you want to share. Use the same minor device number (in this example, 2) in the device name parameter (so in this example, it would be `/dev/ufs2`). Choose a unique share name (for example, `myshare`), a file system type of `ufs`, a description, share permission (for example, `r/w`), maximum users (for example, 100), and the directory name (in this example, `ghi`). The directory name is relative to the root of the file system that the device name refers to.

```
/dev/ufs2 myshare ufs "My share description" r/w 100 /ghi
```

6. Ensure that the default `rfstab` file or file that is specified by the `_IOE_RFS_ATTRIBUTES_FILE` environmental variable for DFSKERN exists. By default, the `rfstab` file is in the `/opt/dfslocal/var/dfs` directory. This file is created during the SMB postinstallation steps that are listed in [“Creating the default DFS configuration files” on page 16](#) by running the `dfs_cpfiles` shell script.
7. Issue the `dfsshare` command.

```
# dfsshare -share myrfsshare
```

At this point, a PC user can connect to this share.

If there are more file systems below the shared directory, you can export them so that PC users can access those directories and files. That is, if there are one or more subdirectories below the `ghi` directory, and there are one or more file systems mounted on those directories or their subdirectories, those file systems could be exported to make them available to PC users of the share named `myshare`. Those file systems would be specified in `dfstab` and `devtab` with different unique minor device numbers. Alternatively, you can use the dynamic export capability. Refer to [“Dynamic export for HFS” on page 45](#).

If another directory exists at the same level as the `ghi` directory and you wanted to share that directory, the minor device number would be the same as the share for the `ghi` directory (that is, it would be 2) because that directory is also contained in the OMVS.ABC.DEF file system.

If you mount (or unmount) a file system on (from) a directory that is in the directory path specified on an `smbtab` entry and you have already shared the directory, then you should unshare (detach) and reshare the shared directory using the `dfsshare` command.

Removing a shared directory for HFS

A shared directory can be made unavailable by issuing the `dfsshare` command with the `-detach` option. For example, if you want to stop the shared directory named `myshare` from being available to PC clients, you would issue the following `dfsshare` command.

```
# dfsshare -share myshare -detach
```

This command makes the shared directory unavailable until the SMB server is restarted or the `dfsshare` command is issued to make it available. Because the shared directory is still in the `smbtab`, the shared directory would be made available again to PC clients. In order to make the shared directory permanently unavailable, it must be removed from the `smbtab` file.

Making a shared directory unavailable does not affect whether the underlying file systems are exported (that is, they remain exported). There might be other shares that apply to those underlying file systems. Use the `dfsexport` command to unexport file systems.

Dynamic export for HFS

Previously, in order to make HFS file systems available to PC users through the SMB server, the administrator had to create a **dfstab** and **devtab** entry for each HFS file system for the SMB server to export them at SMB server start up or on command. HFS file systems must also be mounted at the time the SMB server exports them. This meant that the SMB server could not support HFS automounted file systems.

The SMB server now has an optional function called dynamic export to support HFS automounted file systems. That is, when dynamic export is used, PC clients are able to access data in HFS file systems that are automounted. (See [z/OS UNIX System Services Planning](#) for information about automounted file systems.)

The SMB server attempts to move the ownership of a shared file system to the system that the SMB server is running on when the shared file system is owned by a different system if the **_IOE_MOVE_SHARED_FILESYSTEM** environment variable is **ON** in the **dfskern** process. If this is unsuccessful (when, for example, the file system is being exported by another SMB server on the other system), the SMB server will not be able to export that file system and it will not be available to SMB clients.

An environment variable (**_IOE_DYNAMIC_EXPORT=ON**) in the **dfskern** process, enables dynamic export. When dynamic export is enabled, the SMB server can "discover" file systems that are mounted but not yet exported, and can dynamically export them. A file system is discovered by the SMB server when a PC user references a directory (for example, using the **cd** command) that is a mount point. This causes the SMB server to "cross into" the mounted file system. (The capability to cross file systems is controlled by the **_IOE_SMB_CROSS_MOUNTS** environment variable in the **dfskern** process.) If it is determined that the file system is not yet exported, the SMB server (dynamically) exports it. The SMB server then continues to handle the PC user request. This dynamic export occurs even though there might be no **dfstab** or **devtab** entry for the file system. The information that would be in the **dfstab** and **devtab** entry can be determined (or assigned) by the SMB server. Note that when a PC user references a remote directory that is under control of automount, this causes the SMB server to reference the directory and this in turn causes the correct file system to be automounted. So, the file system is mounted by the time the SMB server gets control back from referencing it.

Dynamic export is actually independent of whether automount is used. That is, the discovery and dynamic export of file systems occurs if the file system was automounted or statically mounted. This means that if you do not specify **dfstab** and **devtab** entries for file systems that are "crossed into", the SMB server takes care of those file systems on its own. The only file systems that must have a **dfstab** and **devtab** entry are file systems that are the root of a share (that is, file systems that are represented as the first / in the **smbtab** Directory Path Name entry).

As a simple case, when dynamic export is used, it is possible to make the entire HFS tree (including automounted file systems) available to PC users by specifying / of the root file system as the shared directory in **smbtab** and the root file system in **dfstab** and **devtab**. (The root file system is also referred to as the version file system.) No other entries are required. Of course, PC users can only access data that they are authorized to. Also, they cannot write to file systems that are mounted read-only. [Table 1 on page 45](#) shows an example of **smbtab**, **dfstab**, and **devtab** entries.

Table 1: Example of making the entire HFS tree available to PC users

Directory path name	Entry
smbtab	/dev/ufs4 hfsroot ufs "My share description" r/w 100 /
dfstab	/dev/ufs4 hfs4 ufs 103 0,,1721

Table 1: Example of making the entire HFS tree available to PC users (continued)

Directory path name	Entry
devtab	define_ufs 4 OMVS.ROOT

When dynamic export is used, it is still allowable for the administrator to specify **dfstab** and **devtab** entries. You can use your current **dfstab** and **devtab** entries and still take advantage of the dynamic export function. When dynamic export assigns numbers for file systems, it uses large numbers such as:

- Minor device numbers start at 10000
- File system IDs start at 100000
- Fileset IDs start at 100000.

If you add **dfstab** and **devtab** entries, you should use numbers that are lower than these so as not to interfere with dynamically assigned numbers.

In addition, a **devtab** entry can be specified without a **dfstab** entry to set the translation option for a file system. This entry is used when the SMB server crosses into that file system and dynamically exports it. Alternatively, the translation option can be inherited from the parent file system when there is no **devtab** entry. The `_IOE_INHERIT_TRANSLATION=ON` environment variable in the **dfskern** process controls whether the file system translation option can be inherited from the parent file system.

If a file system is not referenced for a period of time (and you are using dynamic export), the administrator has the ability to control whether the SMB server should dynamically unexport a file system if it has not been referenced for a period of time. Only file systems that are not the root of a share are dynamically unexported. The `_IOE_EXPORT_TIMEOUT` environment variable in the **dfskern** process is used to specify this. Unexporting an unreferenced file system frees resources in the SMB server. Later, if the file system is referenced again, it is dynamically exported again. There is a relationship between the SMB server export timeout value and the z/OS Automount Facility **delay** timeout value. Automount waits (at least) the automount **delay** timeout period after the file system has been dynamically unexported before attempting to unmount it again.

As the PC user **cd's** down the tree, they might encounter file systems of different file system types. Some are supported by the SMB server and some are not. SMB servers supports HFS, zFS, TFS, and AUTOMNT file systems. If you are in a sysplex with shared file system, SMB support of zFS is limited to zFS compatibility mode file systems. SMB does not support sysplex-aware zFS (on V1R11 and above) or NFS and DFSC file system types.

Working with automounted file systems and home directories:

It is common for a z/OS UNIX user's home directory to be automounted. The user's home directory does not exist and the file system is not mounted until the home directory is referenced. See [z/OS UNIX System Services Planning](#) for information about automount. Using dynamic export, you can specify the root of the automount file system as the shared directory. For example, consider the following configuration files:

Automount Facility Master File	/u	/etc/home.map
MapName Policy File: (/etc/home.map)	Name	*
	Type	HFS
	Filesystem	OMVS.HOME.<uc_name>
	Mode	rdwr
	Duration	60
	Delay	0

smbidmap	smith cmsmith jones TSJONES
smbtab	/dev/ufs10 homeshare ufs "Root of Home Directories" r/w 100 /
dfstab	/dev/ufs10 hfs10 ufs 10 0,,10
devtab	define_ufs 10 "AMD/u" text

Notice that the cmsmith z/OS user ID is in lowercase letters. The case of the z/OS user ID in the smbmap file has implications on directories that are mount points for automounted file systems and used in smbtab entries with &USERID. Use the same case for the z/OS user ID in the smbmap file as that used in the user ID portion of the user's home directory. (The z/OS user ID will be folded to uppercase when it is used to log on to z/OS.)

With this configuration, users can connect to the shared directory named homeshare (net use h: \computer1\homeshare). They could then cd to their home directory (cd h:\cmsmith). This action causes automount and dynamic export of the user's home file system to occur.

However, some usage problems are possible.

- When a user connects to the shared directory, the shared directory is referenced (for example, /u on OMVS), but the actual home directory is not referenced (for example, /u/cmsmith on OMVS). Therefore, the cmsmith directory is not listed if a user does a DIR from an MS-DOS window or uses Windows Explorer to click the shared directory drive letter (since the home directory does not exist yet). The home directory is not created by the Automount Facility until it is directly referenced by name. This requires the user to cd to the home directory in an MS-DOS window. (If the user tries to create a new folder with the home directory name, Windows first tries to create a folder named New Folder. This causes the Automount Facility to try to mount a file system called OMVS.HOME.NEW FOLDER, which is an invalid name.)
- In addition, the name that the user needs to cd to is not the Windows user ID but rather the z/OS user ID (the z/OS user ID that is mapped by the smbmap file; or the guest user ID). This name might not be obvious to the PC user.
- Even after the user issues cd to the correct directory, the file system can get unexported and unmounted after a while if there is no access to the file system for a period of time. This can put the user back into the situation where the home directory no longer exists.

To resolve this, you can create a separate shared directory for each user that points directly to the user's home directory. For example:

smbtab	/dev/ufs10 smith ufs "Smith's Home Directory" r/w 100 /cmsmith /dev/ufs10 jones ufs "Jones' Home Directory" r/w 100 /tsjones :
dfstab	/dev/ufs10 hfs10 ufs 10 0,,10
devtab:	define_ufs 10 "AMD/u" text

This technique also has several disadvantages:

- You need a separate **smbtab** entry for each user. As users are added and deleted from the system, you must add or delete an **smbtab** entry.
- Since each shared directory resides in a corresponding automounted file system, none of those file systems ever get unexported (or unmounted) after they are referenced.
- Each PC user must net use to a different shared directory name.

Recommended technique for PC user access to automounted home directories

The SMB server defines a special keyword to be used in the **Directory path name** in an **smbtab** entry. The keyword is **&USERID**. It represents the PC user's z/OS user ID. This keyword allows a single shared directory (that is, a single **smbtab** entry) to mean a different directory based on the z/OS user ID of the PC user connecting to the shared directory name. When a user connects to this shared directory name, a new (special) share is be created. This share has a connection reference count that is incremented when the PC user connects to the shared directory name. The reference count is decremented when the PC user disconnects from the shared directory name by issuing a **net use h: /d**. When the reference count is zero, the user's home file system is eligible to be unexported by the SMB server and then unmounted by the Automount Facility. The user would need to connect to the shared directory name again to access the home directory. In addition, if the user was inactive on the session for the **_IOE_SMB_IDLE_TIMEOUT** time period, the session would be disconnected. This would also decrement the reference count and if zero, an unexport and unmount would occur. In this case, when the user references the drive letter again, the mount and export would occur automatically. For example, with the following entries, user **smith** could issue the following **net use** command.

net use h: \\computer1\myhomedir							
smbtab							
	/dev/ufs10	myhomedir	ufs	"Each user's Home Directory"	r/w	100	/&USERID
	/dev/ufs10	homeshare	ufs	"Root of All Home Directories"	r/w	100	/
dfstab							
	/dev/ufs10	hfs10	ufs	10	0,,10		
devtab							
	define_ufs 10 "AMD/u" text						

This would cause the SMB server to reference the **/u/cmsmith** directory. This would cause the Automount Facility to create the cmsmith directory in the ***AMD/u** file system. Then, the Automount Facility would mount smith's home directory file system on the **/u/cmsmith** directory. The SMB server would then export smith's home directory file system and then create a (special) share and increment the reference count. PC user smith would then be able to issue **DIR** in an MS-DOS window for the drive letter or use Windows Explorer to click the drive letter to see the contents of the home directory.

If necessary, smith could still access jones' home directory (assuming proper authorization) by issuing **net use x: \\computer1\homeshare** and then **cd x:\TSJONES**.

The z/OS user ID specified in the **smbidmap** file determines the directory name (with the exact case) that will be substituted for the **&USERID** keyword in the **smbtab**. If a **net use** to that shared directory in the **smbtab** causes the automount to occur, it will also cause the directory to be created in the ***AMD/u** file system with that exact case. You should specify the z/OS user ID in the **smbidmap** file exactly as the user ID in the user's home directory is specified. Otherwise, you might create a directory that does not match the user's home directory and that user will not be able to log on locally to OMVS.

File data translation for HFS

Distributed File Service SMB support provides basic support for character data translation. Some mechanisms give you the ability to specify when file data should be translated. Character data translation can be:

- Based on the HFS file tag (if Enhanced ASCII is active in the SMB server, that is, the **_IOE_HFS_FILETAG** environment variable is set to **QUERY** or **SET** in **dfskeyn**),

- Based on the HFS file format attribute,
- A global specification based on the file name suffix (`hfsattr` file),
- Specified on a file system basis (`devtab hfs-data-set-name` text or binary option),
- Specified on a file system basis based on file contents (`devtab hfs-data-set-name` auto option),
- Inherited from a parent file system's translation option (`_IOE_INHERIT_TRANSLATION` environment variable is set to ON in `dfskern`),
- A global specification to translate or not for all HFS file systems exported (`_IOE_HFS_TRANSLATION` environment variable set to ON or OFF in `dfskern`),
- A global specification based on file's contents for all HFS file systems exported (`_IOE_HFS_TRANSLATION` environment variable set to AUTO in `dfskern`).

The following sequence determines if file data is translated:

1. If the file exists and Enhanced ASCII is active in the SMB server (`_IOE_HFS_FILETAG` is QUERY or SET in the `dfskern` process) and the file is tagged, then when the tag indicates binary, no translation is done. When the tag indicates text, translation is done based on the code page in the tag.
2. If the file exists and has no file tag (or Enhanced ASCII is not active in the SMB server) and has a nonzero file format attribute, then a value of 1 (meaning binary) causes no translation to be done. A value greater than 1 causes translation to be done. See *z/OS UNIX System Services Programming: Assembler Callable Services Reference* for information about the `stat` and the `chattr` callable services. These callable services can be used to query or change a file format attribute. The SMB server does not convert between different end of line delimiters.

The z/OS UNIX ISPF Shell (IShell) can be used to query or set the file format attribute for a file. Choose a file and then choose attributes. This shows the file format attribute (NA, Binary, NL, CR, LF, CRLF, LFCR, CRNL). Choose Edit and then File Format. You can then change the file format. The IShell uses choice numbers for the file format attributes that are one greater than those used for the actual file format value (that is, a file format of binary has a value of 1 but the Binary choice in the IShell is 2).
3. If the file does not exist or has a zero file format attribute, then, if an `hfsattr` file is specified (by the `dfskern _IOE_HFS_ATTRIBUTES_FILE` environment variable), and the file name suffix matches a directive in the `hfsattr` file, then that controls whether translation occurs. For more information, see [“hfsattr” on page 100](#).
4. The file system's `devtab` translation option (text, binary, or auto) is used when no `hfsattr` file is specified, or if the file name suffix does not match any of the directives in the `hfsattr` file, or the file name has no suffix. Refer to [“devtab” on page 94](#).
5. The file systems' inherited translation option is used if `_IOE_INHERIT_TRANSLATION` is ON in the `dfskern` process and no `devtab` translation option is specified for the file system.
6. The `dfskern _IOE_HFS_TRANSLATION` environment variable is used if the file system does not inherit a translation option. Refer to the `_IOE_HFS_TRANSLATION` environment variable.

The file format attribute for HFS files is set, if it is not already set, and either `anhfsattr` file was used to determine whether to translate or auto (on the file system or globally) was used to determine whether to translate. If the file is determined to be text, the file format attribute is set to 2 (NL). If the file is determined to be binary, the file format attribute is set to 1 (Binary). In addition, if the file is determined to be text, the file is being created and the `_IOE_HFS_FILETAG` environment variable in the `dfskern` process equals SET, the file tag is set to the code page from the MOUNT TAG (if it exists) or the local code page of the `dfskern` process.

Translation is done using ISO8859-1 for network data (or the code page that is specified in the `_IOE_WIRE_CODEPAGE` environment variable of `dfskern`) and the local code page for the `dfskern` process is used for data in HFS. See [“ioepdcf” on page 101](#) for information about how to change the local code page for the `dfskern` process.

Use caution if you change an HFS `devtab` option from binary to text or from text to binary. If you have already stored a file under one option (for example, text), and then you change the option (to, for example, binary), the data has been translated from ASCII to EBCDIC when it was originally written to HFS, but is not translated back from EBCDIC to ASCII when it is read. This causes the data to appear garbled to the

PC user. Also note that if you are using dynamic export and translation inheritance, the translation option is effectively changed if you first mount the file system (that has no devtab translation option) under a text file system and later under a binary file system

Authorization for HFS

When a PC user attempts to access a directory or file, the normal HFS file authorization mechanism is used (including Access Control Lists (ACLs)). The PC user's SMB user ID is mapped to a local z/OS user ID and that z/OS user ID is used to determine if the user is authorized to the file or directory. Refer to Chapter 6, "Mapping SMB user IDs to z/OS user IDs," on page 35 for information about how SMB users are mapped to z/OS users. A z/OS user ID's authorization to a directory or file is determined by the permission bits and the user and group IDs of the directory or file. Refer to the [z/OS UNIX System Services User's Guide](#) for more information about HFS security.

The only authorization that a PC user can directly change is the write (w) permission of a file. It can be changed by modifying the read-only attribute of a file. Setting the read-only attribute on turns the write permission off, and vice versa. To change the read-only attribute, use the **attrib** command or right click the file from Windows Explorer and choose Properties. The PC user must be the owner of the file (or must have a **UID=0**) to change the write permission. The read-only attribute for a directory does not stop a user from creating or deleting files in the directory. So, modifying the read-only attribute of a directory does not change the write permission of a directory and is in effect, ignored by the SMB server.

Note that when the read-only attribute is turned on (which turns off write permission), all the write permissions (for user, group and other) are turned off. When the read-only attribute is turned off (which turns on write permission), only those write permissions that intersect with the default create permissions are turned on. Default create permissions are specified in the **smbtab** entry for the shared directory or globally, on the **_IOE_SMB_DIR_PERMS** and the **_IOE_SMB_FILE_PERMS** environment variables.

From experimentation, it appears that when a read-only file is copied via drag and drop, the read-only attribute is maintained on the new file. However, when the MS-DOS **copy** command is used, the read-only attribute is not maintained.

When a PC user does not have read and execute permission to a directory, the contents of the directory is not listed. The user is allowed to **cd** to the directory but when a **dir** is issued, access is denied or the contents of the directory shows up as if it were empty. The user is not allowed to access files in that directory. When a PC user does not have write and execute permission to a directory, they are not able to create, erase, or rename a file (or directory) that is contained in that directory. When a PC user does not have read permission to a file, they are not able to read (or execute) the file. When a PC user does not have write permission to a file, they are not able to change the contents of the file.

Free space for HFS

The amount of free space that is reported for a drive letter that is mapped to a shared directory that resides in an HFS file system is based on the amount of free space in the file system that contains the shared directory. That is, if you cross into an underlying file system by referencing subdirectories that reside in a lower file system, the free space does not reflect the amount of free space in the underlying file system. Rather, the free space left in the file system that contains the shared directory is reported.

Sharing RFS files

This section discusses the RFS file system. The RFS file system supports reading and writing, but it is more suitable for applications that only read files. (You can limit an RFS shared directory to read-only access by making it read-only in the **smbtab**.) Applications can write to RFS files, but there are many restrictions. An application that writes to or creates RFS files must abide by all the restrictions imposed by RFS. Refer to ["RFS restrictions" on page 71](#) for a full description of RFS restrictions.

Exporting and sharing RFS file systems

A Record File System (RFS) is a collection of data sets with a common data set name prefix. The data sets supported include sequential data sets (on DASD), partitioned data sets (PDS), partitioned data sets extended (PDSE) and Virtual Storage Access Method (VSAM) data sets. The supported VSAM data set types are key sequential (KSDS), relative record (RRDS) and entry sequence (ESDS). These data sets are then exported by the SMB server as a single “file system”. An RFS file system is not locally mounted so it is not part of the HFS hierarchy. It can still be exported by the SMB server, even though it is not part of the HFS hierarchy. An RFS file system must be exported by the SMB server before a directory contained in it can be shared. Exporting is done on an RFS file system basis.

Sharing is done on a directory tree basis and allows PC clients to access data in an RFS file system. To allow a directory to be shared, the file system that the directory is contained in must be exported.

For example, suppose the following data sets are on a z/OS system:

```
USERA.PCDSNS.SEQ1  
USERA.PCDSNS.SEQ2.DATA  
USERA.PCDSNS.VSAM1  
USERA.PCDSNS.PDS1() with members M1 and M2  
USERA.PCDSNS.PDS2.SOURCE() with members S1 and S2
```

As [Figure 12 on page 51](#) shows, these data sets would be represented by the following RFS hierarchy.

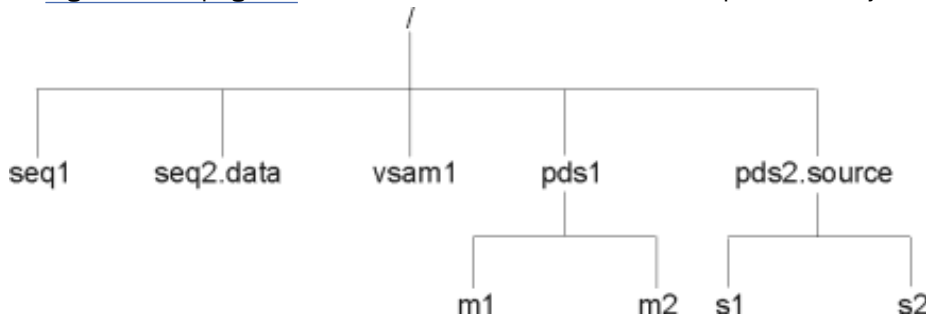


Figure 12: RFS file system hierarchy

This hierarchy is made up of data sets that all begin with the same prefix (USERA.PCDSNS). Notice that the RFS file names do not include the prefix. The files are all directly below the root of the file system. PDSs and PDSEs appear as directories with their members as files in the directory. All file and directory names appear in lowercase. (This is controlled by a setting in the **rfstab** file for this file system.)

The RFS file system is defined by the data set name prefix. The RFS file system includes all data sets that begin with that data set name prefix, as shown in [Figure 13 on page 51](#).

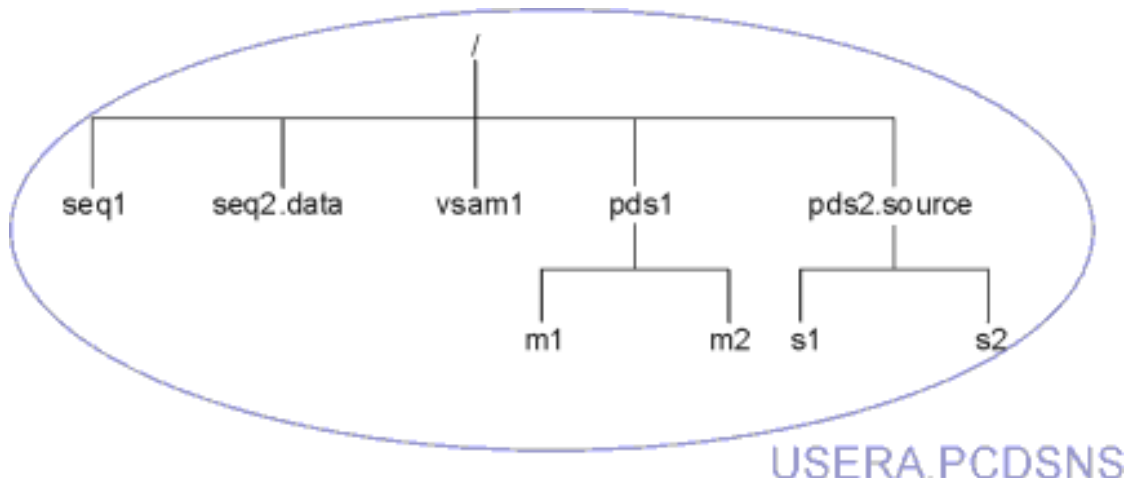


Figure 13: Representation of the RFS file system

smbtab, dfstab, and devtab entries for RFS

The files that the SMB server uses to relate the shared directory and its exported file system are the **smbtab**, the **dfstab**, and the **devtab**. (They are all located in `/opt/dfslocal/var/dfs`.) A common **minor device number** is used to tie related entries in these three files together. The **smbtab** is used to define the shared directory. The **dfstab** and the **devtab** are used to define the file system to be exported.

In **smbtab**, the minor device number is specified using the format `/dev/ufsn`, where *n* is a locally-assigned unique minor device number that must refer to the file system data set where the root of the shared directory path name resides (that is, the file system where the first `/` resides). This should always be the file system where the directory that you want to share resides.

In **dfstab**, the minor device number is specified using the format `/dev/ufsn` to identify the assigned unique identifiers for the file system.

In **devtab**, the minor device number is specified using the format **define_ufs *n*** to identify the data set name prefix for the RFS file system.

If the shared directory is `/`, then the **smbtab**, **dfstab**, and **devtab** entries might be:

smbtab	<code>/dev/ufs10 myrfsshare ufs "My rfs share description" r/w 100 /</code>
dfstab	<code>/dev/ufs10 rfs10 ufs 110 0,,1730</code>
devtab	<code>define_ufs 10 rfs USERA.PCDSNS</code>

Creating a shared directory for RFS

This section describes the steps that are involved in creating a shared directory for RFS data. Refer to *z/OS DFSMS Using Data Sets* for information about how to use data sets. (RFS file systems are not locally mounted in the HFS hierarchy.)

To create a shared directory, perform the following steps:

1. Choose a set of data sets with a common data set name prefix that you want to share with PC clients (for example, `USERA.PCDSNS`).
2. Choose the RFS directory that you want to share. Usually, it is `/`. `/` is a virtual directory that is the root of the RFS file system and contains all the data sets that begin with the common data set name prefix.
3. Add an entry to the `devtab` file (`/opt/dfslocal/var/dfs/devtab`) for this RFS file system. This entry maps a unique minor device number to the RFS file system you want to export and share. Choose a unique minor device number (for example, 10) that is not in any other `define_ufs` statement and put it in the `define_ufs` statement for this RFS file system. Put the RFS file system data set name prefix (in this example, `USERA.PCDSNS`) on the next line. An example entry for an RFS file system might look like the following example.

```
* RFS devices
define_ufs 10 rfs
USERA.PCDSNS
```

4. You must add a corresponding entry in the `dfstab` file (`/opt/dfslocal/var/dfs/dfstab`) for this RFS file system. Use the same minor device number (in this example, 10) in the device parameter (so in this example, it would be `/dev/ufs10`). Use a unique file system name (for example, `rfs10`), a file system type of `ufs` and a unique file system ID (for example, 110). Finally, use a unique filesset ID (for example, 0,,1730). An example `dfstab` entry might look like the following example.

```
/dev/ufs10 rfs10 ufs 110 0,,1730
```

You can use the same number for all the numeric values in a `dfstab` entry as long as the number is unique. For example, the `dfstab` entry might look like the following example.

```
/dev/ufs10 rfs10 ufs 10 0,,10
```

5. Add an entry in `smbtab` (`/opt/dfslocal/var/dfs/smbtab`) for the directory you want to share (the directory you chose in Step “2” on page 52). Use the same minor device number (in this example, 10) in the device parameter (so in this example, it would be `/dev/ufs10`). Choose a unique share name (for example, `myrfsshare`), a file system type of `ufs`, a description, share permission (for example, `r/w`), maximum users (for example, 100) and the directory name (in this example, `/`). For example, the `smbtab` entry might look like the following example.

```
/dev/ufs10 myrfsshare ufs "My rfs share description" r/w 100 /
```

6. Ensure that the default `rfstab` file or file that is specified by the `_IOE_RFS_ATTRIBUTES_FILE` environmental variable for `DFSKERN` exists. By default, the `rfstab` file is located in the `/opt/dfslocal/var/dfs` directory. This file is created during the SMB postinstallation steps that are described in “Creating the default DFS configuration files” on page 16 by running the `dfs_cpfiles` shell script.
7. Issue the `dfsshare` command.

```
# dfsshare -share myrfsshare
```

At this point, a PC user can connect to this share.

Removing a shared directory for RFS

A shared directory can be made unavailable by issuing the **dfsshare** command with the **-detach** option. For example, if you want to stop the shared directory named **myrfsshare** from being available to PC clients, you would issue the following **dfsshare** command.

```
# dfsshare -share myrfsshare -detach
```

This command makes the shared directory unavailable until the SMB server is restarted or the **dfsshare** command is issued to make it available. Since the shared directory is still in the **smbtab**, the shared directory would be made available again to PC clients. In order to make the shared directory permanently unavailable, it must be removed from the **smbtab** file.

Making a shared directory unavailable does not affect whether the underlying file systems are exported (that is, they remain exported). There be other shares that apply to those underlying file systems. The **dfsexport** command be used to unexport file systems.

File data translation for RFS

Distributed File Service SMB support provides basic support for character data translation. Character data translation can be specified globally (that is, for all RFS file systems) or on a per RFS file system basis. Character data translation can be:

- Specified on an RFS file system basis (**devtab***rfs_data_set_name_prefix* **text** or **binary** option),
- Specified in the attributes file (**rfstab**) on an RFS file system basis (**devtab** **attrfile** option),
- Specified in a global attributes file (**rfstab**) (`_IOE_RFS_ATTRIBUTES_FILE` environment variable in the **dfskern** process),
- Specified globally (`_IOE_RFS_TRANSLATION` environment variable in the **dfskern** process).

The following sequence determines if RFS file data is translated:

1. The RFS file system’s **devtab** translation parameter (**text** or **binary**) is used to determine if translation is done.
2. If there is no translation parameter on the **devtab** for the RFS file system, then translation is controlled by the attributes file (**rfstab**) for the RFS file system’s **text** or **binary** specification.

3. If there is no attributes file (**rfstab**) for the RFS file system, or if there is no **text** or **binary** specification in the **rfstab**, then translation is controlled by the global attributes file (**rfstab**). The global attributes file is specified in the **_IOE_RFS_ATTRIBUTES_FILE** environment variable of the **dfskern** process.
4. If there is no global attributes file (**rfstab**), then translation is controlled by the global translation specification for RFS file systems. The global translation specification for RFS file systems is specified in the **_IOE_RFS_TRANSLATION** environment variable of the **dfskern** process.

Translation is done using ISO8859-1 for network data (or the code page specified in the **_IOE_WIRE_CODEPAGE** environment variable of **dfskern**) and the local code page for the **dfskern** process is used for data in RFS. See [“ioepdcf” on page 101](#) for information about how to change the local code page for the **dfskern** process.

When translation of RFS data occurs, the end of line character used when the data set records are converted to byte stream data is controlled by the **attributes** file (**rfstab lf** or **crlf** entry) that is controlling the RFS file system.

You should use caution if you change a translation option from **binary** to **text** or from **text** to **binary**. If you have already stored data under one option (for example, **text**), and then you change the option (to, for example, **binary**), the data has been translated from ASCII to EBCDIC when it was stored in RFS, but is not translated back from EBCDIC to ASCII when it is read. This causes the data to appear garbled to the PC user.

Authorization for RFS

When a PC user attempts to access a directory or file, the normal data set authorization mechanism is used. The PC user's SMB user ID is mapped to a local z/OS user ID and that z/OS user ID is used to determine if the user is authorized to the data set. Refer to Chapter 6, “Mapping SMB user IDs to z/OS user IDs,” on page 35 for information about how SMB users are mapped to z/OS users. A z/OS user ID's authorization to a data set is determined by the local security subsystem (for example, RACF).

A PC user cannot directly change any attributes of an RFS file. Attempting to change an RFS file attribute using the **attrib** command or right clicking on the file from Windows Explorer and choosing Properties appears successful but is ignored by the SMB server.

When a PC user does not have authority to a PDS, the contents of the directory is not listed. The user is allowed to **cd** to the directory but when a **dir** is issued, access is denied or the contents of the directory shows up as if it were empty. The user is not allowed to access files in that directory. When a PC user does not have update authority to a PDS, they are not able to create new members or delete or update existing members. When a PC user does not have read authority to an RFS file, they are not able to read the file. When a PC user does not have update authority to an RFS file, they are not able to change the contents of the file.

Free space for RFS

The amount of free space that is reported for a drive letter that is mapped to a shared directory that resides in an RFS file system is a fabricated number. This is due to the fact that there really is no RFS file system, but only a set of data sets with the same data set name prefix. The SMB server always reports a capacity of 122,880,000 bytes with half (61,440,000 bytes) available. Free space for RFS is actually controlled by various aspects of the system such as z/OS DFSMS System Managed Storage, free space on a volume, primary and secondary allocations, etc.

Logon considerations

In order for you to create a session and access resources (files or printers) from a PC, the SMB server must be able to identify you in terms of a local z/OS user ID. This session creation occurs on the first command or communication with the SMB server. The SMB server can identify you either by authenticating you by a user ID and password that you supply, or if that fails, by allowing you to run unauthenticated with a guest z/OS user identification. If both of these fail, your session is denied.

1. To authenticate you, the SMB server must receive an SMB user ID and password. The SMB user ID that is received is usually the user ID you specified when you logged on to your PC. You can, however, specify a user ID on a Windows `net use` command. The SMB user ID that is received must be mapped to a z/OS user ID. This mapping is accomplished through the **smbidmap** file. Refer to [Chapter 6, “Mapping SMB user IDs to z/OS user IDs,”](#) on page 35 for information about the **smbidmap** file.

The password is either a clear text password or it is an encrypted password. The type of password expected by the SMB server depends on whether passthrough authentication is enabled (see the `_IOE_SMB_AUTH_SERVER` dfskern environment variable) and if not, the setting of the `_IOE_SMB_CLEAR_PW` environment variable for the **dfskern** process.

- a. When passthrough authentication is enabled, this means that when the SMB server receives a logon request, the SMB server forwards the logon request to a Windows Server acting as a domain controller for authentication. In this case, the user ID and password must be the user's Windows Domain user ID and password. If the domain controller successfully authenticates the user, then the SMB server maps the SMB user ID to a local z/OS user ID using the **smbidmap** file.
- b. If `_IOE_SMB_CLEAR_PW` is set to `REQUIRED` (or it is unspecified), then the SMB server tells your PC to send a clear password for authentication. This password needs to be your z/OS password. Typically, your PC sends the password that you specified when you logged on to your PC; therefore, it must match your z/OS password. The SMB server supports mixed case passwords for your z/OS password.

Some levels of Windows do not send a clear password unless a Registry entry is added. See [Appendix B, “Additional information about using the SMB server,”](#) on page 163 for more information about this topic.

If, however, you specify a password on a `net use` command, then that is sent to the SMB server and that password must match your z/OS password. In this case, your PC logon password and your z/OS password do not need to be the same.

If the password is not specified on `net use`, you will be prompted for a password; that password is then sent to the SMB server. Some commands do not prompt (for example, **net view**) and, therefore, fail to create a session. In this case, first issue the `net use` command; then you will be prompted for the password and can create a session.

- c. If `_IOE_SMB_CLEAR_PW` is set to `NOTALLOWED`, then the SMB server tells your PC to send an encrypted form of the password. (The PC does not actually send an encrypted password over the network. An algorithm called *challenge/response authentication* is used that does not actually send any passwords over the network.) Your PC encrypts the password that you specified when you logged on to your PC. Because the SMB server needs to determine your actual SMB password for authentication, your PC logon password must be stored into your RACF DCE segment by using the z/OS UNIX `smbpw` command before creating a session with the SMB server. If you change your PC logon password, you must also change the SMB password in your RACF DCE segment.

If, however, you specify a password on a `net use` command, then that is used for authentication and must match the SMB password in your RACF DCE segment. In this case, your PC logon password and your SMB password do not need to be the same.

2. If authentication fails, then you may be allowed to run as a guest z/OS user ID. This is determined by the `_IOE_MVS_DFSDFLT` environment variable for the **dfskern** process. If `_IOE_MVS_DFSDFLT` is set to a valid z/OS user ID, then the SMB server allows you to run with this user ID. Otherwise, your session is denied.

Using Windows Terminal Server as a client to the z/OS SMB server

When a PC connects to the z/OS SMB server, each PC usually has its own communications session to the z/OS SMB server. See [Figure 14 on page 56](#) for an example.

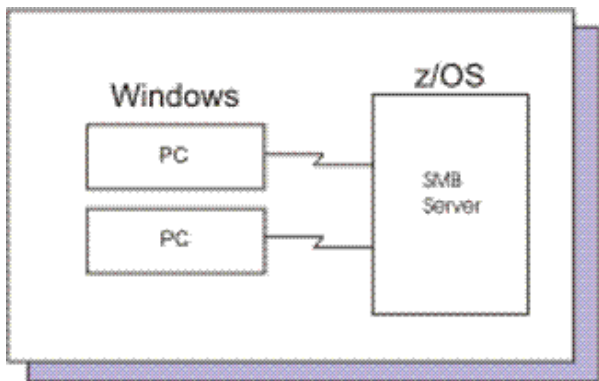


Figure 14: SMB server with a single user session on each communications session

When the Windows Terminal Server is used by a PC, multiple PC users connect to the Windows Terminal Server. They see another entire Windows system screen in a window of their local PC. This window represents applications running on the Windows Terminal Server machine. If the PC user issues a net use command inside that window, that net use command will actually be executed on the Windows Terminal Server machine. The Windows Terminal Server machine can create multiple user sessions (one for each Windows Terminal Server client) on a single communication session to the z/OS SMB server. See [Figure 15 on page 56](#) for an example.

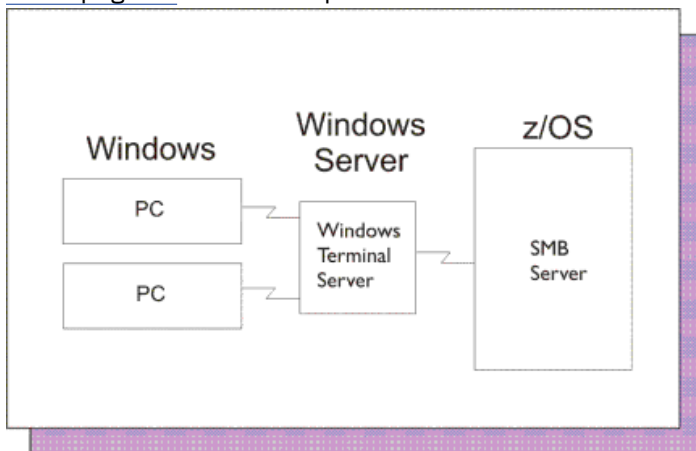


Figure 15: SMB server with multiple, concurrent users on a single communications session

Using passthrough authentication

Passthrough authentication gives you the ability to use your Windows Server acting as a domain controller to authenticate PC users in your domain for access to data through the SMB server. When PC users change their password on the domain controller, there is no other password that needs to be changed to access data through the SMB server. You must have a domain controller and your PC users must be enrolled in it. Also, PC users must be mapped to a local z/OS user ID.

Passthrough authentication is enabled by using the following environment variables in the `/opt/dfslocal/home/dfskern/envvar` file:

_IOE_SMB_AUTH_SERVER

Used to set the IP address of the primary domain controller to authenticate PC users.

_IOE_SMB_BACKUP_AUTH_SERVER

Used to set the IP address of the backup domain controller (if it exists).

_IOE_SMB_AUTH_SERVER_COMPUTER_NAME

Used to set the computer name of the primary domain controller.

_IOE_SMB_BACKUP_AUTH_SERVER_COMPUTER_NAME

Used to set the computer name of the backup domain controller (if it exists).

_IOE_SMB_AUTH_DOMAIN_NAME

Used to set the domain name of the Windows domain.

If authentication at the domain controller fails, and the domain of the client is not the same as the domain of the domain controller, the login is attempted locally (encrypted or clear based on the method that is chosen by the domain controller), otherwise, the authentication fails. If the authentication fails (including the case where a local authentication failed), you be able to run as a guest z/OS user ID, as described in [“Logon considerations” on page 54](#).

When passthrough authentication is enabled, the SMB server forwards the logon request to a Windows Server acting as a domain controller to perform the authentication of the user. The domain controller determines what security protocol (for example; Kerberos, NTLM, or NTLMv2) will be used during authentication. The domain controller replies back to the SMB server with the method that it requires for the authentication. The SMB server implementation supports the NTLM and NTLMv2 authentication protocol. If the authentication method does not allow for the use of the NTLM or NTLMv2 protocol, the authentication to the domain controller will fail and local authentication might be attempted. During the authentication to the domain controller, audit records are produced in the Windows security event log of successful and unsuccessful authentication attempts. Reviewing this log be used to determine the reason for the failed passthrough authentication attempt. For details on setting the authentication levels for Windows clients, see [“Adjusting the authentication level” on page 58](#).

Passthrough authentication does not allow multiple sessions when digital signing is active. An example of this would be an SMB client concurrently running multiple Windows processes to the SMB server, such as applications running as scheduled tasks. Therefore, multiple sessions are only supported with passthrough authentication when digital signing is not required.

To properly authenticate using passthrough authentication, the SMB server must establish a communications session with the domain controller. This communications session must be maintained in order for the SMB server to handle new user authentications. If the communications session that the SMB server has with the domain controller drops, new users who are coming to the SMB server (and existing users who are attempting to reauthenticate due to idle timeout of the PC communications session) will not be able to be authenticated until a domain controller communications session can be reestablished. In addition, new users on an existing PC communications session will not be able to authenticate until that PC communications session is reestablished (that is, resynchronized with the domain controller communications session). The SMB server will attempt to reestablish a domain controller communications session and to resynchronize existing PC communication sessions as soon as possible.

Passthrough authentication is not used if the domain controller allows guests. In this case, local authentication is used.

Restriction: When using Windows Server 2008 or Windows Server 2012 as a domain controller for passthrough authentication, digital signing is not supported. Digital signing is a local security configuration option on both Windows clients and Windows servers. You must ensure the digital signing options match what is shown in the following steps. To access the local security policy:

1. From a Windows command, prompt type `secpol.msc`.
2. Select Local Policies > Security Options.

On the Windows clients ensure that the fields are set as follows:

Microsoft network client: Digitally sign communications (always) Disabled

Microsoft network client: Digitally sign communications (if server agrees) Either Enabled/Disabled

Note: If the client is being used to support multiple sessions, the setting must be set to disabled. An example of this is an SMB client that is concurrently running multiple Windows processes to the SMB server, such as applications running as scheduled tasks.

3. On the Windows server, ensure that the fields are set as follows:

Microsoft network server: Digitally sign communications (always) Disabled

Microsoft network server: Digitally sign communications (if client agrees) Disabled

When using passthrough authentication, any request that attempts to enforce digital signing will result in access being denied. In these cases, the domain controller returns an error status code of

x'C00000022' (STATUS_ACCESS_DENIED). To determine if you are encountering this problem, obtain an SMB trace and find the failing session/negotiate setup as follows:

- a. Issue the modify command to reset the SMB trace:

```
f dfs,send dfskern,trace,reset
```

- b. Attempt the access from the client.

- c. Issue the modify command to print the SMB trace:

```
f dfs,send dfskern,trace,print
```

- d. Browse the DFSKERN job log and locate the trace statement that corresponds to the SMB negotiate (x73) command of the client:

```
>>>-SMB-sess=0DD29CE8 refct=00000002 csp=0DC87218 com=x73
issue_aio_request: rb=7E6C8D60 s=10 cmd=134 pools=00000001 rv=0
--SMB Session Setup & X LAN username=<Administrator>
...
--SMB session setup & X PT got DC resp, com=x73 err32=220000C0
The err32 code 220000C0, endian decoded to x'C00000022'.
```

Adjusting the authentication level

Perform the following procedure to adjust the authentication level on clients that run supported Windows platforms (for the complete list, see [“Supported SMB clients”](#) on page 3).

1. Open **Control Panel**, and then **Administrative Tools**.
2. Select **Local Security Policy > Local Policies > Security Options > Network security: LAN Manager authentication level**.
3. Using [Table 2 on page 58](#), select the correct setting for your environment.

[Table 2 on page 58](#) shows the possible level settings and descriptions for the LAN Manager authentication.

Table 2: Authentication settings and descriptions for the LAN manager

Value	Settings	Description
0	Send LM & NTLM responses	Clients use LM and NTLM authentication and never use NTLMv2 session security. Domain controllers accept LM, NTLM, and NTLMv2 authentication.
1	Send LM & NTLM - use NTLMv2 session security if negotiated	Clients use LM and NTLM authentication, and use NTLMv2 session security if the server supports it. Domain controllers accept LM, NTLM, and NTLMv2 authentication.
2	Send NTLM response only	Clients use NTLM authentication only and use NTLMv2 session security if the server supports it. Domain controllers accept LM, NTLM, and NTLMv2 authentication.
3	Send NTLMv2 response only	Clients use NTLMv2 authentication only and use NTLMv2 session security if the server supports it. Domain controllers accept LM, NTLM, and NTLMv2 authentication.
4	Send NTLMv2 response only/refuse LM	Clients use NTLMv2 authentication only and use NTLMv2 session security if the server supports it. Domain controllers refuse LM and accept only NTLM and NTLMv2 authentication).
5	Send NTLMv2 response only/refuse LM & NTLM	Clients use NTLMv2 authentication only and use NTLMv2 session security if the server supports it. Domain controllers refuse LM and NTLM (they accept only NTLMv2 authentication).

RACF DCE segments for SMB encrypted password support

This section assumes that you are using the IBM Security Server RACF support. For more information about the RACF commands that are referenced in the following instructions, see [z/OS Security Server RACF Security Administrator's Guide](#). If you are using an equivalent security product, see the appropriate documentation to perform the equivalent functions.

To permit the SMB server to use encrypted passwords, each z/OS user (that a PC user is mapped to) must be set up for SMB encrypted password support. Setting up an z/OS user for SMB encrypted password support requires defining a RACF DCE segment and storing the SMB password for the z/OS user into the user's RACF DCE segment. The RACF commands are issued from TSO.

An outline of the steps required to set up the z/OS system to have the SMB server use encrypted passwords processing is as follows:

- Activate class KEYSMSTR, as shown in the following example.

```
SETROPTS CLASSACT(KEYSMSTR)
```

- Activate class DCEUIDS, as shown in the following example.

```
SETROPTS CLASSACT(DCEUIDS)
```

- Define entry DCE.PASSWORD.KEY in class KEYSMSTR, being sure to supply a 16 position KEYMASKED value.

```
RDEFINE KEYSMSTR DCE.PASSWORD.KEY SSIGNON(KEYMASKED(nnnnnnnnnnnnnnnn))
```

A complete example of this command follows.

```
RDEFINE KEYSMSTR DCE.PASSWORD.KEY SSIGNON(KEYMASKED(0034639986ACCFDE))
```

- Define a RACF DCE segment for each z/OS user ID that requires the SMB encrypted password capability using the ALTUSER command.

```
ALTUSER user_id DCE
```

A complete example of this command follows.

```
ALTUSER g1dfst2 DCE
```

- You can display the RACF DCE segment for a user by using the LISTUSER command.

```
LISTUSER user_id NORACF DCE
```

A complete example of this command follows.

```
LISTUSER g1dfst2 NORACF DCE
```

- To enable the SMB server to use encrypted passwords, set the **_IOE_SMB_CLEAR_PW dfskern** environment variable to **_IOE_SMB_CLEAR_PW=NOTALLOWED** and restart the SMB server.
- After encrypted passwords have been enabled, each user must enter the following command from OMVS to connect to the SMB server; note that the PC user's SMB password must be specified twice.

```
$ smbpbw smb_login_password smb_login_password
```

Chapter 8. Sharing printers

Before a PC client can print to a z/OS Infoprint Server printer through the SMB server, a shared printer must be created. A shared printer represents a z/OS printer controlled by the Infoprint Server. Once the PC client is connected to the shared printer, PC users can print to that z/OS printer as though it were a local printer.

Steps for creating a shared printer

This section describes the steps that are involved in creating a shared printer for an Infoprint Server printer. Before you begin, the printer must be defined on the z/OS system. Refer to [z/OS Infoprint Server Operation and Administration](#) for information about how to define printers on z/OS. The SMB server can be running during this procedure.

Perform the following steps to create a shared printer:

1. Choose the Infoprint Server printer that you want to share (for example, `printname1`). You can determine the printer definitions that are available on the system by using the `OMVS lpstat -p` command. Refer to [z/OS Infoprint Server User's Guide](#) for information about the `lpstat` command.
2. Add an entry in `smbtab` for the printer you want to share.
 - a. Choose a unique minor device number (for example, 1) in the device parameter (in this example, it would be `/dev/prt1`).
 - b. Choose a unique share name (for example, `myprt`), a file system type of `prt`, a description, and put the printer definition name in the entry (for example, `printname1`).
 - c. In addition, put the printer type information in the entry (for example, "Generic / Text Only"). Choose a printer type that is compatible with the printer that you chose in step "1" on page 61. See [z/OS Infoprint Server Operation and Administration](#) for information about z/OS printers and their supported printer types.

Note: The `dfstab` and `devtab` files do not apply to shared printers.

An example of an `smbtab` entry follows.

```
/dev/prt1 myprt prt "Department printer" printname1 "Generic / Text Only"
```

3. If the SMB server is running, issue the `dfsshare` command to cause the new shared printer to be made available to PC users.

```
# dfsshare -share myprt
```

4. If the SMB server is not running, start the SMB server with the following z/OS system command.

```
start dfs
```

You know you have created a shared printer when you can connect to this share or you can run the Windows Add Print Wizard to connect to this shared printer.

Steps for removing a shared printer

A shared printer may be made unavailable by issuing the **dfsshare** command with the **-detach** option. For example, if you want to stop the shared printer, named *myprt*, from being available to PC clients, you would issue the following **dfsshare** command.

```
# dfsshare -share myprt -detach
```

This command makes the shared printer unavailable until the SMB server is restarted or the **dfsshare** command is issued to make it available. Since the shared printer is still in the **smbtab**, the shared printer would be made available again to PC clients. In order to make the shared printer permanently unavailable, it must be removed from the **smbtab** file.

Print data translation

When a PC user prints a file, no data translation is done by the SMB server. Any data translation is provided by the Infoprint Server. The Infoprint Server provides data transforms (for example, PDF to AFP, PostScript to AFP, and PCL to AFP). It also provides conversion from one code page to another (such as, ASCII to EBCDIC). For print requests that come through the SMB server, the SMB server specifies ISO8859-1 (or the code page specified in the **_IOE_WIRE_CODEPAGE** environment variable of the **dfskern** process) in the **document-codepage** job attribute. For more information, refer to *z/OS Infoprint Server Operation and Administration*.

Authorization

When a PC user prints a file, the PC user's SMB user ID is mapped to a local z/OS user ID. The z/OS user ID shows the owner of the print request on the SDSF view of the JES output queue. Refer to [Chapter 6, "Mapping SMB user IDs to z/OS user IDs,"](#) on page 35 for information about how SMB users are mapped to z/OS users. If you are displaying a printer queue from a PC, refer to [Chapter 11, "Accessing printers,"](#) on page 73.

Chapter 9. Locating the SMB server

You can use the SMB server with your PC and Linux clients to access z/OS files and printers. Selecting and configuring the PC client connection to the SMB server ensures that network clients can use the server properly.

Setting up the SMB server

This section discusses setting up the SMB server for use with Windows and Linux clients. For the list of supported clients, see [“Supported SMB clients”](#) on page 3.

PC clients can use the following methods of connecting to the SMB server on a TCP/IP network:

- User Datagram Protocol (UDP) Broadcast
- Domain Name Service (DNS)
- Windows Internet Naming Service (WINS)
- LMHOSTS static configuration files.

Using UDP Broadcast

If the SMB server and your Windows client are in the same workgroup (domain) and the same subnet (network segment), then no additional set up on the client is necessary because the Windows client finds the SMB server by using UDP broadcast. If you are using Dynamic Host Configuration Protocol (DHCP) to assign client machine IP addresses, the steps to assign DNS addresses and WINS addresses on your clients might be unnecessary.

Using DNS, WINS, or LMHOSTS file on Windows clients

The following sections describe different methods to locate the SMB server; the methods vary, depending on the level of Windows that is running on the PC client. Before you begin the steps provided for each client, you must ensure that your Windows client can locate the SMB server on the network.

Note: On Windows clients, the following steps might vary slightly, depending on how your workstation is set up (for example, whether you use the Start Menu or the Classic view).

Using DNS for Windows clients

Perform the following steps to configure your Windows client using DNS.

1. Open the **Control Panel**.
2. Access the **Network and Sharing Center** option; the steps to do this vary, depending on how you are viewing this window:
 - a. If you are viewing by **Category**: select **Network and Internet** and then select **Network and Sharing Center**.
 - b. If viewing by the Large or Small icon: select **Network and Sharing Center**.
3. Select **Change Adapter Settings**.
4. Right-click **Local Area Connection** for the connection used to connect with the z/OS SMB Server.
5. Select **Properties**.
6. Click **Internet Protocol Version 4**.
7. Click **Properties**.
8. Click **Advanced**.
9. Click the **DNS** tab.

10. Click **Add** in the **DNS Server Addresses: in order of use** area to enter the IP address of one or more of your TCP/IP DNS Servers.
11. Click either **Append primary and connection specific DNS suffixes** or **Append these DNS suffixes (in order)** and click **Add** after entering one or more TCP/IP Domain Suffixes.
Note: The previous information might already be supplied for you.
12. Click **OK**.
13. Click **OK** on the **General** tab of the Internet Protocol (TCP/IP) Properties window.
14. Click **Close** on the **Networking** tab of the Local Area Connection Properties window.

Using WINS for Windows clients

Perform the following steps to configure the Windows client using WINS.

1. Open the **Control Panel**.
2. Access the **Network and Sharing Center** option; the steps to do this vary, depending on how you are viewing this window:
 - a. If you are viewing by **Category**: select **Network and Internet** and then select **Network and Sharing Center**.
 - b. If viewing by the Large or Small icon: select **Network and Sharing Center**.
3. Select **Change Adapter Settings**.
4. Right-click **Local Area Connection** for the connection used to connect with the z/OS SMB Server.
5. Select **Properties**.
6. Click **Internet Protocol Version 4**.
7. Click **Properties**.
8. Click **Advanced**.
9. Click the **WINS** tab.
10. Enter one or more IP addresses of WINS server machines in the **WINS addresses: in order of use** area for each WINS IP address and click **Add** for each.
11. Make sure **Enable NetBIOS over TCP/IP** is selected. If it is not selected, click it.
12. Click **OK**.
13. Click **OK** on the **General** tab of the **Internet Protocol (TCP/IP) Properties** window.
14. Click **Close** on the **General** tab of the **Local Area Connection Properties** window.

Using the LMHOSTS file

If you are using the LMHOSTS file, configure the LMHOSTS file with the IP address and the computer name of the SMB server. To configure your Windows client using the LMHOSTS file, perform the following steps.

1. Open the **Control Panel**.
2. Access the **Network and Sharing Center** option; the steps to do this vary, depending on how you are viewing this window:
 - a. If you are viewing by **Category**: select **Network and Internet** and then select **Network and Sharing Center**.
 - b. If viewing by the Large or Small icon: select **Network and Sharing Center**.
3. Select **Change Adapter Settings**.
4. Right-click **Local Area Connection** for the connection used to connect with the z/OS SMB Server.
5. Select **Properties**.
6. Click **Internet Protocol Version 4**.
7. Click **Properties**.

8. Click **Advanced**.
9. Click the **WINS** tab.
10. Make sure that the Enable LMHOSTS Lookup box is checked. If it is not checked, click the box.
11. Click **OK**.
12. Click **OK** on the General tab of the **Internet Protocol (TCP/IP) Properties** window.
13. Click **Close** on the General tab of the **Local Area Connection Properties** window.

Finding the SMB server

This section discusses how to find the SMB server and access shared resources from the supported SMB clients (see “Supported SMB clients” on page 3). The process varies, depending on the platform (Linux or Windows) and the level of the operating system. For example, Windows clients can use one of the following methods for finding the SMB server:

- Network Folder
- Network and Sharing Center
- Search Computer.

Note:

1. To enable the Network and Sharing Center directory function, there must be a Master Browser on the same network segment as the SMB server. Typically, Windows clients and servers are configured to act as Master Browsers by default; therefore, a Windows client or server should already meet this requirement.
2. On Windows clients, the following steps might vary slightly, depending on how your workstation is set up (for example, whether you use the Start Menu or the Classic view).

Using Linux

Linux clients can use the fully-qualified name in the **mount** command; for examples, see [“Linux Samba clients”](#) on page 68.

Using the Network Folder

If the SMB server and your Windows client are in the same workgroup (domain), perform the following steps using the Network Folder to find the server:

1. Open **Windows Explorer**.
2. Select **Network** in the panel to view the computers.
3. The computer name of the SMB server, for example `\\Z0SS1`, should be visible.
4. If the SMB server is not visible, ensure that the Network Discovery feature is enabled.
5. If the SMB server is still not visible, right-click on **Network** and follow the instructions in [“Mapping shared directories to logical drives”](#) on page 67.

Searching to find the server

To locate the SMB server from a Windows client, perform the following steps.

1. Click **Start**.
2. In the Search programs and files bar, enter the z/OS SMB server's computer name or domain name. For example, you could enter `\\Z0SS1`.

Troubleshooting

If you cannot locate the SMB after you have tried the appropriate method described in the previous sections for your Windows client, you can use one of the following alternate methods.

- If you know its computer name, you can contact the SMB server by using the Map Network Drive function.
- Windows clients can contact the SMB server by using its DNS domain name in the `net use` command. Some Windows systems may also require an LMHOSTS file.

For more information, refer to [“Using SMB server shared directories” on page 67](#).

Chapter 10. Accessing data

When your PC client has located the SMB server, it can then access the shared directories to read and write file data on the z/OS system. You can use shared directories and access different types of data.

Using SMB server shared directories

This section discusses how you can access shared directories on the SMB server from the supported SMB clients (Windows and Linux). For the complete list, refer to [“Supported SMB clients” on page 3](#).

If you are using clear text passwords in the SMB server (`_IOE_SMB_CLEAR_PW=REQUIRED`), you might need to update your Windows registry. See [“Checking whether the client can communicate” on page 164](#).

Note: On Windows clients, the following steps might vary slightly, depending on how your workstation is set up (for example, whether you use the Start Menu or the Classic view).

Windows clients

For Windows clients, use one of the following methods to access shared directories on the SMB server. You might find it easier, however, to work with logical drive letters, as opposed to UNC mapping.

- Map shared directories to logical drives
- Universal Naming Convention (UNC) mapping

Mapping shared directories to logical drives

You can map an SMB server shared directory to a logical drive. Follow these steps:

1. Open **Windows Explorer**.
2. Right click **Computer** (or **This PC**) and then click **Map Network Drive**.
3. Choose the letter of a free drive for the shared directory (it might already be completed).
4. Enter the path name of an SMB shared directory in the Folder field.

For example, you could enter the following information, where `zOSS1` is the computer name and `myshare` is the shared directory name.

```
\\zOSS1\myshare
```

5. Click **Finish**.

However, if your z/OS password (when using clear passwords) or your SMB password in your RACF DCE segment (when using encrypted passwords) is not the same as your Windows password, you should use the `net use` command with your z/OS or SMB password from the command prompt. This avoids the possibility of being logged in as DFSDFLT (that is, a guest user) if you specify DFSDFLT on the `_IOE_MVS_DFSDFLT` environment variable.

For example, you could enter the following command, where `x` is an available drive letter, `zOSS1` is the computer name, `myshare` is the shared directory name, and `mypassword` is your password.

```
net use x: \\zOSS1\myshare mypassword
```

You might also need to specify your domain name on the `net use` command, as shown in the following example:

```
net use x: \\Z0SS1\myshare mypassword /user:smbdomain\smbuser
```

Using Universal Naming Convention (UNC) mapping on Windows clients

On supported Windows clients, you can also use Universal Naming Convention (UNC) mapping to access SMB server shared directories. To do so, perform the following steps.

1. Enter the following command, where `z0SS1` is the computer name and `myshare` is the shared directory name.

```
net use \\z0SS1\myshare
```

2. Enter the following command to display the computer name and the shared directory.

```
net use
```

The following output is displayed:

Status	Local	Remote	Network
OK		\\z0SS1\myshare	Microsoft Windows Network

3. You can enter the following command to delete the shared directory.

```
net use \\z0SS1\myshare /d
```

Linux Samba clients

You can use a Linux Samba client to access shared directories on the SMB server by mapping shared directories to mount points. To do so, use the Linux **mount** command or the Samba **smbmount** command to mount shared file systems to mount points. [Figure 16 on page 68](#) shows the use of the Linux Samba command line to mount and unmount SMB fileshares.

```
mount -t smbfs //smbserver.com/fileshare /mnt -o username=user,password=userpw
password=pw,workgroup=subdomainname

umount /mnt

smbmount //smbserver.com/fileshare /mnt -o username=user,password=userpw

umount /mnt
```

Figure 16: Linux mount and unmount commands issued from a Linux UID 0 user

Accessing HFS data

The following sections discuss how to access HFS data.

Case sensitivity considerations for HFS directories and file names

The SMB server makes HFS file system data available to PC clients. The HFS file system is case-sensitive. Windows clients are not case-sensitive (that is, they treat uppercase letters and lowercase letters as the

same when you are searching for a file). The case of file names is significant in case-sensitive file systems and can consist of both uppercase and lowercase characters.

For example, the HFS file system might contain three files with the names shown in [Figure 17 on page 69](#). Because the HFS file system is case-sensitive, these files have technically different names; as such, they represent three distinct, separate objects on z/OS.

```
DFSSMB.DAT
DFSsmb.dat
dfssmb.dat
```

Figure 17: Example of case-sensitive file names

All of the Windows clients that the SMB server supports are not case-sensitive. This means that the case of file names is insignificant. For example, although [Figure 17 on page 69](#) shows three files, only one is recognized. Which one depends on how the user specified the name and whether the client code folded the name to uppercase.

The SMB server uses the following algorithm to search for a file or directory name in HFS. (Note that many clients can fold a name to uppercase letters before sending the name over the network.)

- The name received over the network is searched as is.
 - If found, that name is returned.
 - If not, the name is folded to lowercase letters.
- Then, the HFS directory is searched for that name.
 - If found, that name is returned.
 - If not, then the name received in the SMB (still folded to lowercase) is compared against each name in the HFS directory folded to lowercase letters. The first match found is returned. Otherwise, the name is not found.

When a new file or directory is created, the name received over the network is used as the name of the object. When a file or directory is renamed, the object is located, as previously described; if it is found, its name is replaced with the new name, as received over the network.

HFS symbolic links

This section discusses how symbolic links are treated on the SMB server. See *z/OS UNIX System Services User's Guide* for information about symbolic links. A symbolic link is a special “file” that contains another path name. It can be created by z/OS UNIX commands (for example, `ln -s old new`) and applications. It is used to redirect access to another file or directory in the file system hierarchy. In Windows terminology, the closest analogy to a symbolic link is called a *shortcut*; however, they are not the same thing. A Windows application cannot create a symbolic link. However, if a symbolic link exists, a Windows application can access it through the SMB server with some restrictions. The SMB server supports relative symbolic links (that is, symbolic links that do not begin with a `/`). In addition, the SMB server supports absolute symbolic links (that is, symbolic links that begin with a `/`) when the `_IOE_SMB_ABS_SYMLINK` environment variable is set to ON in the `/opt/dfslocal/home/dfskern/envvar` file. Windows applications can then refer to a directory or file that is outside the shared directory tree. Directories and files can only be accessed if the PC user is authorized to the data.

In general, symbolic links can be referenced by Windows applications if they are accessing them in a read-only manner. However, this access fails if the symbolic link contains one of the following:

- A path name that begins with `/` (that is, it is an absolute path name) unless the `_IOE_SMB_ABS_SYMLINK` environment variable is set to ON in the `/opt/dfslocal/home/dfskern/envvar` file.
- Is circular (it traverses more than 50 symbolic links).

- A path to an object that does not exist.
- A path to an object that goes out of the shared directory tree, unless the `_IOE_SMB_ABS_SYMLINK` environment variable is set to ON in the `/opt/dfslocal/home/dfskeirn/envvar` file.

For these cases, the path name does not display as a file of zero length (for example, if listed with a `dir` command).

Other than these restrictions, symbolic links can be used during path name resolution. For example, if you `cd` to a path name that contains a symbolic link as part of the name resolution, it is successful (and follows the symbolic link) if none of preceding restrictions apply and the user is authorized to all the components in the path name. Reading a file whose name is really a symbolic link that points to another file that exists is also successful. In general, a Windows user is not able to tell when the path name being used is a symbolic link or traverses one or more symbolic links.

Writing to a file whose path name is a symbolic link is allowed in some cases. If the file exists (that is, if the symbolic link and the linked file both exist), then opening the file for update, append, or truncate succeeds. An open for create fails (regardless of whether the linked file exists or not) because the symbolic link exists.

The symbolic link itself can be renamed if it remains in the same directory. Otherwise, it is denied. A symbolic link cannot be removed by a PC user.

SMB restrictions

The SMB server does not support the use of the MS-DOS move command to move directories across z/OS UNIX files systems. However, you can use any of the following alternative methods to move directories and files across z/OS UNIX file systems.

- Issue the copy command to copy the source directory to the target file system; then, issue the erase command to delete the directory from the source file system.
- Use Windows Explorer to move directories across z/OS UNIX file systems. (Each file system must be independently mapped to a separate network drive; they must also be statically mounted and shared.) To do so, you can use either of the following methods:
 - Copy the directory from the source file system, then paste it to the target file system.
 - Drag the directory and files from the mapped source drive and then drop them to the mapped target drive. The drag and drop option will work across z/OS UNIX file systems if the target directory exists and has the same name as the source directory. If you use this method, you must specify the copy option.

In either case, you should delete the source directory after you have copied it over to the new target directory.

Accessing RFS data

This section discusses accessing RFS (Record File System) data.

RFS directory and file name considerations

The SMB server makes RFS data available to PC clients. The supported data sets include:

- sequential data sets (on DASD)
- partitioned data sets (PDS)
- partitioned data sets extended (PDSE)
- Virtual Storage Access Method (VSAM) data sets, which include:
 - key sequential (KSDS)
 - relative record (RRDS)
 - entry sequence (ESDS)

RFS restrictions

RFS has many restrictions because RFS files are not hierarchical, byte stream files. Rather, they are z/OS data sets that store record-oriented data that must follow data set rules. Among the restrictions are the following (see [Appendix D, “Using data sets,”](#) on page 173 for more information about accessing RFS files):

- Data set names are always uppercase.
- The data set name prefix plus the file name is limited to 44 characters. (Note that the data set name prefix is not included in file names displayed at the PC.)
- A data set name segment (characters between the dots) cannot be longer than 8 characters.
- The characters in a data set name are more limited than file names in HFS. See [z/OS DFSMS Using Data Sets](#) for more information of data set naming rules.
- Use lowercase file names at the PC. Data set names are mapped to uppercase and are displayed as lowercase if maplower is specified in `rfstab` (this is the default). Mixed case file names should not be used.
- A PDS or PDSE cannot be created under another PDS or PDSE.
- PDS and PDSE member names are limited to 8 characters.
- Only one PDS member can be open for write at a time.
- PDS members cannot be moved between PDSs. Copy and erase must be used.
- PDS member aliases and data set aliases are not supported and are not displayed.
- If an attempt is made to write a record that exceeds the maximum record size, the write fails.
- Editors or commands (for example, Wordpad or copy) that truncate the file to zero length before rewriting a file typically work. Editors or commands that try to replace without truncate to zero attempts to replace each record and this requires that each record be exactly the same size it was before. This is not likely and therefore the writes probably fail.
- Some editors (for example, Notepad and WordPad) do not automatically put an end of line character at the end of the last line. To RFS, this is an incomplete record. When RFS closes the data set, the incomplete record will be discarded. To avoid this problem, hit enter at the end of the last line before saving the file or use an editor that automatically places an end of line character at the end of the last line (for example, Visual SlickEdit).
- SMB access is limited to RFS data sets that are no larger than 4 GB.
- The SMB server does not support DFSMS large format data sets.

In general, data sets that contain variable length text data work correctly as far as record processing is concerned (although VSAM files do not support zero length records).

z/OS SMB implementation restriction for SMB digital signing

The z/OS Distributed File Service SMB server does not support server-side SMB digital signing. The determination of whether to use and enforce digital signing is performed during the initial negotiation and session setup of SMB transactions between the supported clients, the z/OS DFS/SMB server, and the Microsoft Domain controllers if passthrough authentication is configured.

If digital signing is used, attempts to connect to sessions or to access exported shares will fail with access denied or unexpected network error messages.

Refer to Microsoft documentation for information about setting the value for the digital signing option. These options can be set with the group policy editor `secpol.msc` or the `regedit` Microsoft utility.

How to determine the current settings

Use the Group Policy settings and its corresponding values to determine the settings for client-side and server-side digital signing.

Group Policy setting for client-side signing using secpol.misc:

- Microsoft network client: Digitally sign communications (if server agrees)
- Microsoft network client: Digitally sign communications (always)

Corresponding registry value for client-side signing using regedit:

```
HKEY_LOCAL_MACHINE SYSTEM CurrentControlSet Services  
Lanmanworkstation Parameters Enablesecuritysignature  
HKEY_LOCAL_MACHINE SYSTEM CurrentControlSet Services  
Lanmanworkstation Parameters Requiresecuritysignature
```

Group Policy setting for server-side signing using secpol.msc:

- Microsoft network server: Digitally sign communications (if server agrees)
- Microsoft network server: Digitally sign communications (always)

Corresponding registry value for server-side signing using regedit:

```
HKEY_LOCAL_MACHINE SYSTEM CurrentControlSet Services  
Lanmanserver Parameters Enablesecuritysignature  
HKEY_LOCAL_MACHINE SYSTEM CurrentControlSet Services  
Lanmanserver Parameters Requiresecuritysignature
```

Recommended configuration for the z/OS SMB implementation

On the Windows clients, ensure that the fields are set as follows:

- Microsoft network client: Digitally sign communications (always) Disabled
- Microsoft network client: Digitally sign communications (if server agrees) Either Enabled/Disabled

On the Windows server, ensure that the fields are set as follows:

- Microsoft network client: Digitally sign communications (always) Disabled
- Microsoft network client: Digitally sign communications (if client agrees) Disabled

Chapter 11. Accessing printers

Once your supported PC client can locate the SMB server, it can then access shared printers that have been created. This allows the PC client to print data on z/OS printers. For a summary of the supported clients, see “Supported SMB clients” on page 3. This section explains how to access the SMB server shared printers and how to add a printer from the supported SMB clients.

Mapping shared printers to logical printers on Windows clients

I You can map an SMB server shared printer to a logical printer on the Windows clients by performing the following steps.

Note: On Windows clients, these steps might vary slightly, depending on how your workstation is set up (for example, whether you use the Start Menu or the Classic view).

1. Open an MS-DOS window.
2. Enter the following command at the DOS prompt to get a list of printers shared by SMB servers; *zOSS1* is the computer name of the SMB server:

```
net view \\zOSS1
```

3. Choose a shared printer name from the list provided.
4. Enter the following command, where *lpt2* is the name of the logical printer that you want to map the shared printer to, *zOSS1* is the computer name of the SMB server, *myprt* is the name of the desired shared printer, and */persistent:yes* is an optional parameter specifying that the shared printer connection should be restarted by the client after reboot.

```
net use lpt2: \\zOSS1\myprt /persistent:yes
```

If no other shared file systems are attached for this Windows client, you must also specify a password.

```
net use lpt2: \\server\printshare pw /u:user /persistent:yes
```

I Windows clients must also specify a valid Domain name on the */u:* option if no other shared file systems are attached.

```
net use lpt2: \\server\printshare pw /u:domain\user /persistent:yes
```

I Note also that Windows clients cannot specify port LPT1 on the *net use* command.

Mapping shared printers to logical printers on Linux clients

You can map an SMB server shared printer to a logical printer on Linux clients through interactive or command-line access.

Use the following steps for **interactive access**:

1. Open a Linux command-line window.

2. Enter the following command to obtain a list of SMB server shared printers, where *zOSS1* is the computer name of the SMB server, *username* is the name of a Linux user mapped to a TSO/E user, and *password* is the CLEAR or encrypted password for the mapped user.

```
smbclient -L //zOSS1 -U username%password
```

3. Enter the following command to gain interactive access to a shared printer, where *shared-printer* is the name of the SMB server's shared printer.

```
smbclient //zOSS1/shared-printer -U username%password
```

4. Enter the following command to print a local Linux file whose fully-qualified path name is */root/.profile*. You can use *-W* option to specify the workgroup, where *subdomainname* is the name of a valid subdomain.

```
print /root/.profile -W subdomainname
```

5. Enter *queue* to view the queue of print job requests.
6. Enter *quit* to exit the interactive session.

Use the following steps for **command-line** access:

1. Open a Linux command-line window.
2. Enter the following command to obtain a list of SMB server shared printers, where *zOSS1* is the computer name of the SMB server.

```
smbclient -L //zOSS1 -U username%password
```

3. Enter the following command to print a local Linux file whose fully-qualified path name is */root/.profile* and *prt1* is the name of the SMB server's shared printer.

```
smbclient //server/prt1 -U user%pw -c "print /root/.profile"
```

4. Enter the following command to view the queue of print job requests made through the preceding print command:

```
smbclient //zOSS1/prt1 -U user%pw -c "queue"
```

To cancel a print job, you can issue the following command.

```
smbclient //zOSS1/prt1 -U user%pw -c "cancel jobid"
```

Accessing shared printers

This section shows you how to access shared printers using the various supported Windows clients. See [“Supported SMB clients”](#) on page 3 for the complete list of these clients.

Note: On Windows clients, the following steps may vary slightly, depending on how your workstation is set up (for example, whether you use the Start Menu or the Classic view).

Windows clients

To access shared printers on the SMB server using a Windows client, perform the following steps.

1. Click the **Start** button.
2. Enter the computer name of the z/OS SMB server in the search bar.

For example, you can enter the following command.

```
\\dcefv8.pdl.pok.ibm.com
```

3. Double-click the found computer name.
4. You might need to enter a Windows user ID and password that is associated with that user's credentials.
5. If the printer you selected has been defined to the PC client, you get a list of jobs that are queued to print for that printer.
6. If the printer you selected has not been defined to the PC client, click Yes to set up the printer on your computer. If you are prompted further, select the appropriate printer characteristics to get the drivers set up. At this step, ensure you choose **local printer** and not **network print**.
7. Click the **Finish** button.

Alternatively, you can issue a net use command from a MS-DOS command prompt window (note that port LPT1 cannot be used with Windows clients). The following command shows an example of how to do so.

```
net use lpt2: \\dcefv8.pdl.pok.ibm.com\ddecolor dfs111smb /u:SMBFVTDOM\client1
```

Adding a printer

This section explains how to add a printer using a supported Windows client. You might get prompted to specify a print driver if the Printer type specified on the smbtab entry for this shared printer does not exist on your PC.

Authentication occurs during the Add a printer wizard process. For successful authentication to complete, you might be prompted to enter a Windows user ID and password. If authentication fails, Windows issues a message indicating it could not connect to the printer and that access is denied.

Note: On Windows clients, the following steps might vary slightly, depending on how your workstation is set up (for example, whether you use the Start Menu or the Classic view).

Windows clients

You can add a printer from a Windows client by performing the following steps:

1. Open the **Control Panel**.
2. Select **Devices and Printers**.
3. Click **Add a printer**, then select **Add a Local Printer**.
4. In the **Choose a printer port** window, select the **Create a new port** radio button (if you have not already created a new local port name for this shared printer).
 - a. From the drop-down box, select **Local Port** and click the **Next** button.

- b. In the Port Name dialogue box that opens, enter the SMB server host name and shared printer name in the following format:

SMB host name/shared printer name

5. In the Install Printer Driver dialogue box, choose a brand and model that matches (or most closely matches) the type of printer mentioned in the smbtab file for the SMB shared printer you are trying to access. The printer information will be in the remarks (comments within double quotes) on the record.
6. Enter a new printer name in the next dialogue box.
7. Select **No** for shared printing.
8. Click the **Finish** button.

Displaying a printer queue

The following sections describe how you can display a printer queue on Windows and Linux clients.

Displaying a printer queue on Windows clients

Perform the following steps to display a Windows PC printer queue. Some of the steps vary, depending on the level of Windows running on the client.

1. Open the Control Panel and click **Devices and Printers**.
2. Determine which printer you want to display and double-click it.

For print requests that come through the SMB server, the SMB server specifies the SMB user ID of the submitter in the name-text job attribute (see [z/OS Infoprint Server Operation and Administration](#) for more information). When the printer is displayed, it shows one line for each print request for that printer that has not printed yet. When a print request contains a name-text job attribute, the following fields are displayed.

Document Name

The JES Jobname followed by the JES Job ID (as shown on the SDSF output queue panel). For a print request submitted through the SMB server, the JES Jobname is the z/OS user ID for the SMB user that submitted the print request. (See [Chapter 6, "Mapping SMB user IDs to z/OS user IDs,"](#) on page 35 for information about how SMB user IDs are mapped.) The JES Job ID is usually comprised of the characters "PS", followed by a number assigned by the Infoprint Server. Print jobs submitted by using the SMB server always have JES Job IDs less than 65536.

Owner

The name-text job attribute. For a print request submitted using the SMB server, this is the SMB user ID of the submitter.

For print requests that do not have a name-text job attribute, the Document Name typically contains the file name of the print request and the Owner contains the z/OS user ID of the submitter.

Avoid leaving a window for a remote printer open for long periods of time. While the remote printer window is open, the server is continually queried to update the window with the latest printer status. This continual query might lead to unnecessary network contention.

Displaying a printer queue on Linux clients

To display a printer queue on Linux clients, you can use either the interactive or command-line mode.

Perform the following steps to display a Linux printer queue in interactive mode:

1. Open a Linux command-line window.

2. Enter the following command to get a list of SMB server shared printers, where *zOSS1* is the computer name of the SMB server.

```
smbclient -L //zOSS1 -U username%password
```

3. Enter the following command to gain interactive access to a shared printer (*shared-printer* is the name of the SMB server's shared printer, *username* is the name of a Linux user mapped to a TSO user, and *password* is the CLEAR or encrypted password for the mapped user).

```
smbclient //zOSS1/shared-printer -U username%password
```

4. Enter the following command to view the queue of print job requested through the previous command.

```
queue
```

5. Enter the following command to exit the interactive session.

```
quit
```

Perform the following steps to display a Linux printer queue in command-line mode:

1. Open a Linux command-line window.
2. Enter the following command to get a list of SMB server shared printers, where *zOSS1* is the computer name of the SMB server. The *-W* option specifies the workgroup, where *subdomainname* is the name of a valid subdomain.

```
smbclient -L //zOSS1 -U username%password -W subdomainname
```

3. Enter the following command to view the queue of print job requested through the preceding command (*prt1* is the name of an SMB server shared printer, *user* is the name of a Linux user mapped to a TSO/E user, and *pw* is the CLEAR or encrypted password for the mapped user).

```
smbclient //server/prt1 -U user%pw -c "queue"
```

Using PC client print drivers with SMB server shared printers

The SMB server acts as a print server that makes the services of the Infoprint Server available to PC clients. This allows clients with the proper print drivers to submit print jobs to the Infoprint Server through the SMB server. The available print types include the following:

- Postscript
- PCL
- Text
- Advanced Function Printing (AFP)

You can access print drivers for supported Windows clients in either of these two ways:

- If the printer type specified on the **smbtab** (for example, **Generic / Text Only**) is available on the Windows system, Windows automatically uses that printer type (and print driver) when the printer is added by the Add Print Wizard.

- Print drivers are available to download from Ricoh Infoprint Solutions, at [z/OS Print Management Software \(www.ibm.com/systems/z/os/zos/printsoftware\)](http://www.ibm.com/systems/z/os/zos/printsoftware).

Part 2. SMB support reference

This section contains reference material.

- [Chapter 12, “z/OS system commands,” on page 81](#)
- [Chapter 13, “Distributed File Service SMB files,” on page 87](#)
- [Chapter 14, “SMB commands,” on page 109](#)
- [Chapter 15, “Tuning and debugging guidelines,” on page 119.](#)

Chapter 12. z/OS system commands

This section covers the following commands:

- **MODIFY**, a system command which enables you to start, stop, and query the status of the SMB daemons.
- **START** and **STOP**, system commands that enable you to start and stop the DFS Control Task (**DFS**).

You can use these commands from the operator console or from a System Display and Search Facility (SDSF) screen.

modify dfs processes

Purpose

The **modify dfs** command can start, stop, or query the status of DFS control task daemons or send a command string to the **dfskern** daemon. For additional **modify dfs** command options, see [Chapter 15, “Tuning and debugging guidelines,”](#) on page 119.

Format

You can use either of the following formats for this command.

```
modify procname,{start | stop | query} daemon
modify procname,send dfskern,[reload,{print | smbmap}]
[trace,{reset | print | tsize,nnM | qtab}]
```

Parameters

procname

The name of the DFS control task. On DFS, the default procname is **DFS**.

command

The action that is performed on DFS daemon or daemons. This parameter can have one of the following values:

start

Starts either a single DFS daemon or all the DFS daemons.

stop

Stops either a single DFS daemon or all the DFS daemons.

query

Displays the status and process identifier (PID) of the DFS daemon or DFS daemons. See *z/OS Program Directory* for more information.

send

Sends a command string to the **dfskern** daemon.

daemon

The name of the DFS control task daemon for which the action is being requested. This parameter can have one of the following parameters:

dfskern

The **dfskern** daemon is the DFS File Exporter process. The **dfskern** daemon parameter of the send command can be further modified through the following parameters:

modify dfs processes

reload

Reload or reinitialization based on the following options:

print

Causes reload or reinitialization of the Infoprint Server DLL. See *z/OS Program Directory* for more information.

smbmap

Ensures that new SMB identity mappings are used by first eliminating any cached SMB identity mappings and then reloading the updated **smbidmap** file.

trace

Reset, print, resize, or query the internal SMB trace table based on the following options:

reset

Resets the internal (wrap around) trace table to empty.

print

Format and print the trace records.

tsize,nnM

Sets the size specification for the trace table. The variable *nn* represents a numeric multiplier and *M* represents the multipliers KB (1024 bytes), or MB (1024 x 1024 = 1 048 576 bytes).

qtab

Display the current size of the **dfskern** internal trace table.

export

The **export** daemon. The **export** server daemon permits exporting and sharing of HFS File Systems.

unexport

The **unexport** daemon. The **unexport** server daemon permits unexporting and unsharing of HFS File Systems.

all

All of the DFS daemons.

Usage

The **modify dfs daemon** command is used to manually start or stop one or more DFS daemons, or to view the status of the daemons. It is especially useful in situations where a daemon has stopped abnormally. On DFS, the DFS daemons are contained in the **dfs** address space (with the possible exception of **dfskern**).

Using the **MODIFY** system command, you can perform the following tasks:

- Start or stop one daemon or all the daemons configured on the host.
- View the status of the DFS daemons from the operator console, using the query option
- Send a parameter to the **dfskern** daemon.

The **reload,print** parameter causes the print DLL used by the SMB File/Print Server to communicate with the Infoprint Server to be reloaded and reinitialized. See *z/OS Program Directory* for more information about the Infoprint Server DLL. This enables or updates the Infoprint Server without the need to restart **dfskern**. (You may need to update **smbtab** and you may need to issue the **dfsshare** command.) Print jobs in the process of being submitted may need to be resubmitted. An open window for a remote printer may need to be refreshed.

The **reload,smbmap** parameter eliminates any cached identity mappings and reloads a new **smbidmap** file to update identity mappings between SMB user IDs and z/OS user IDs. The new identity mappings take effect for new connections.

Privilege required

This command is a z/OS system command.

Examples

The following example starts the DFS **dfskern** process.

```
modify dfs,start dfskern
```

The following example starts all the DFS daemons.

```
modify dfs,start all
```

The following example views the status of all the DFS Control Task daemons that are currently active on the host.

```
modify dfs,query all
```

The following example resets the internal trace table to empty.

```
modify dfs,send dfskern,trace,reset
```

In the following example, the **dfskern** daemon is instructed to eliminate existing identity mappings and to reload an updated **smbidmap** file that includes recently added or deleted user identity mapping information.

```
modify dfs,send dfskern,reload,smbmap
```

Related information

Files:

ioepdcf
smbidmap

start dfs

Purpose

Starts the DFS Control Task.

Format

```
start procname[, 'start_options']
```

stop dfs

Parameters

procname

The name of the DFS Control Task. On DFS, the default procname is **DFS**.

start_options

The value passed to the **START** command. On DFS, *start_options* has only one value, *parm='-nodfs'*. You can use the *parm='-nodfs'* option to start the DFS Control Task without starting the DFS Control Task daemons. (This is usually used during installation verification.)

The *start_options* values **must** be within single quotation marks. The **START** command converts all user-supplied *start_options* values to uppercase characters, unless they are within single quotation marks.

Usage

The **START** command is used to initiate the DFS Control Task. You can use the *parm='-nodfs'* option to start the DFS Control Task without starting the DFS Control Task daemons.

Privilege Required

This command is a z/OS system command.

Examples

The following command starts the DFS Control Task and all daemons on DFS.

```
start dfs
```

The following command starts the DFS Control Task without starting the DFS daemons.

```
start dfs,parm='-nodfs'
```

Related Information

File:

ioepdcf

stop dfs

Purpose

Stops the DFS Control Task processes and the DFS Control Task.

Format

```
stop procname
```

Parameters

procname

The name of the DFS Control Task. On DFS, the default procname is **DFS**.

Usage

The STOP command stops the DFS Control Task (**dfscntl**) and the processes controlled by the **dfscntl** process. These processes are:

dfskern

The **dfskern** daemon. The **dfskern** server daemon is the SMB File Server process.

export

The **export** daemon. The **export** daemon permits exporting of HFS file systems.

Privilege Required

This command is a z/OS system command.

Examples

The following command stops the DFS Control Task and all daemons on DFS.

```
stop dfs
```

Related Information

File:

ioepdcf

stop dfs

Chapter 13. Distributed File Service SMB files

This section introduces the Distributed File Service SMB files, which are listed in alphabetic order. These files contain configuration parameters for server processes and define HFS files and Infoprint Server printers for sharing with Windows clients. These are EBCDIC files and each line is typically delimited by a newline (X'15'). They can also be delimited by carriage return/line feed (X'0D15'), as is the case if they are edited from a Windows application.

Attributes file (rfstab)

Purpose

The attributes file (which is sometimes referred to as the **rfstab** file) contains tables that describe the attributes used to manipulate RFS files in the SMB server. It also contains descriptions for:

- Data set creation attributes
- Processing attributes
- Site attributes.

The PC user can also modify data set creation attributes that provide information about a data set to the SMB server, such as the type of data set, or how the data set is allocated (for example, blocks, cylinders, or tracks). Processing attributes and site attributes can only be modified by the system administrator.

Examples

The following is an example of an attributes (**rfstab**) file; an example attributes file can be found in /opt/dfsglobal/examples.

```
startfileattributes:
file: b.c, b.c.d
binary, space(50,0), dsorg(ps)
file: x.y
text
endfileattributes: blksize(6160)
dir(250)
dsntype(pds)
dsorg(ps)
keys(64,0)
lrecl(80)
recfm(fb)
recordsize(512,4K)
nonspanned
space(100,10),blks
blankstrip
lf
executebiton
nofastfilesize
filetimeout(30)
mapleaddot
maplower
noretrieve
setownerroot
bufhigh(2M)
percentsteal(20)
```

Implementation specifics

The attributes file is in either an HFS file, a fixed-block partitioned data set, or a fixed-block sequential data set with a record length of 80. The file's location is specified by the `_IOE_RFS_ATTRIBUTES_FILE` environment variable for the **dfskern** process. For example, `_IOE_RFS_ATTRIBUTES_FILE=/opt/dfslocal/var/dfs/rfstab` is the default location.

Attributes file (rfstab)

The SMB server can use the same attributes file as the DFSMS NFS server. For example, `_IOE_RFS_ATTRIBUTES_FILE=// 'NFSADMIN.NFSS(NFSSATT) '`, causes the SMB server to use the member NFSSATT in PDS NFSADMIN.NFSS for the RFS attributes. (The NFS server attributes file is specified in the NFSATTR DD statement of the NFS server startup procedure.) NFS server attributes that are not supported by the SMB server are ignored. See [“Unsupported attributes” on page 94](#) for a list of attributes that are not supported.

An attributes file can also be specified on an RFS file system basis. Its location can be specified in the **devtab** entry for the RFS file system on the same line as the data set prefix name: **attrfile** *attributes_file* (where *attributes_file* is the path name of the attributes file that controls the data set creation, processing and site attributes for this RFS file system). For example, a **devtab** entry might display follows.

```
* RFS devices
define_ufs 10 rfs
USERA.PCDSNS attrfile /opt/dfslocal/var/dfs/rfstab2
```

If no **attrfile** parameter is specified in the devtab entry for the RFS file system, the attributes are taken from the global attributes file specified in the `_IOE_RFS_ATTRIBUTES_FILE` environment variable in the **dfskern** process.

If no `_IOE_RFS_ATTRIBUTES_FILE` environment variable is specified, then the SMB server system defaults are used for RFS attributes.

A DFS attributes file can specify file attributes (creation and processing) on an individual file basis. These file attributes are specified at the beginning of the attributes file, delimited by the **startfileattributes:** and **endfileattributes:** keyword pair. Between these two keywords there can be multiple **file:** keywords. Each **file:** keyword is followed by one or more file names. The file name specified is the z/OS data set name minus the exported prefix. The attributes for this file or files are specified on subsequent lines and delimited by another **file:** keyword or the **endfileattributes:** keyword. If a file being accessed is not found in the specific file attributes section of the attributes file, its attributes are taken from the general section of the attributes file.

Related information

Commands:

```
dfsexport
dfsshare
```

Files:

```
devtab
dfstab
hfsattr
smbtab
```

Specifying the location of the attributes file (rfstab)

The attributes file is in an HFS file, a fixed-block partitioned data set, or a fixed-block sequential data set with a record length of 80. The file's location is specified by the `_IOE_RFS_ATTRIBUTES_FILE` environment variable for the **dfskern** process. For example, `_IOE_RFS_ATTRIBUTES_FILE=/opt/dfslocal/var/dfs/rfstab` is the default location.

The SMB server can use the same attributes file as the DFSMS NFS server. For example, `_IOE_RFS_ATTRIBUTES_FILE=// 'NFSADMIN.NFSS(NFSSATT) '`, causes the SMB server to use the member NFSSATT in PDS NFSADMIN.NFSS for the RFS attributes. (The NFS server attributes file is specified in the NFSATTR DD statement of the NFS server startup procedure.) NFS server attributes that are not supported by the SMB server are ignored. See [“Unsupported attributes” on page 94](#) for a list of attributes that are not supported.

An attributes file can also be specified on an RFS file system basis. Its location can be specified in the **devtab** entry for the RFS file system on the same line as the data set prefix name: **attrfile** *attributes_file* (where *attributes_file* is the path name of the attributes file that controls the data set creation, processing and site attributes for this RFS file system). An example **devtab** entry might display as in the following example:

```
* RFS devices
define_ufs 10 rfs
USERA.PCDSNS attrfile /opt/dfslocal/var/dfs/rfstab2
```

If no attrfile parameter is specified in the devtab entry for the RFS file system, the attributes are taken from the global attributes file specified in the `_IOE_RFS_ATTRIBUTES_FILE` environment variable in the **dfskern** process.

If no `_IOE_RFS_ATTRIBUTES_FILE` environment variable is specified, then the SMB server system defaults are used for RFS attributes.

Specifying attributes for a specific file

A DFS attributes file can specify file attributes (creation and processing) on an individual file basis. These file attributes are specified at the beginning of the attributes file, delimited by the startfileattributes: and endfileattributes: keyword pair. Between these two keywords, there can be multiple file: keywords. Each file: keyword is followed by one or more file names. The file name that is specified is the z/OS data set name minus the exported prefix. The attributes for this file or files are specified on subsequent lines and delimited by another file: keyword or the endfileattributes: keyword. If a file that is being accessed is not found in the specific file attributes section of the attributes file, its attributes are taken from the general section of the attributes file.

Using multipliers

Instead of entering numeric values for the attributes, you can use the multipliers K (1024), M (1024 x 1024), or G (1024 x 1024 x 1024) for specifying sizes. For example, `lrecl(8192)` is the same as `lrecl(8K)`.

Attributes for data set creation

The data set creation attributes are used to define the structure of data sets when creating a file. These attributes correspond to the data control block (DCB) or the job control language (JCL) parameters that are used to define a data set when it is created. See [z/OS MVS JCL Reference](#) for more detailed information about data set creation attributes.

The data set creation attributes are described in Table 3 on page 89; defaults are underlined. You can override these attributes by specifying an attributes file in the devtab entry for the RFS file system or by using a file creation command. For PDS and PDSE, members have the same attributes as the data set attributes, therefore the file creation attributes for members are ignored.

Table 3: Attributes for data set creation	
Data set creation attribute	Description
blks	Specifies that disk space (see the space attribute in this table) is allocated by blocks, except for VSAM data sets.
cyls	Specifies that disk space (see the space attribute in this table) is allocated by blocks, except for VSAM data sets.
recl	Specifies that disk space is allocated by records for VSAM data sets. blks and recl are identical for VSAM data sets
trks	Specifies that disk space is allocated by tracks.
blksize(<u>0</u> <i>quan</i>)	Specifies the maximum length, in bytes, of a physical block on disk. <i>quan</i> is a number <u>0</u> (the default) to 32,760. If blksize(0) is specified, the system determines an optimal block size to use.

Table 3: Attributes for data set creation (continued)

Data set creation attribute	Description
dataclas (<i>class_name</i>)	Specifies the data class associated with the file creation. The <i>class_name</i> must be defined to DFSMS before it can be used by the client. The system-managed storage automatic class selection routine must also assign a storage class to the file being created. For more information about data classes, see z/OS DFSMSdfp Storage Administration .
dir (27 <i>quan</i>)	Specifies the number of 256-byte records that are needed in the directory of a PDS. Use it with the <code>mkdir</code> command when you are creating a PDS. <i>quan</i> is a number from 1 to 16,777,215 (the default is 27). The maximum number of PDS members is 14,562.
dsntype (<i>library</i> pds)	Specifies whether a PDSE or a PDS is to be created when the <code>mkdir</code> command is used. <i>library</i> is for PDSE. pds is for PDS. You cannot create a PDS (or PDSE) within another PDS (or PDSE). If you need help deciding whether to create a PDS or a PDSE, see z/OS DFSMS Using Data Sets .
dsorg (<i>org</i>)	Specifies the organization of a data set. <i>org</i> can be a physical sequential (ps) data set, direct access (DA) data set, VSAM KSDS (indexed), VSAM RRDS (numbered), or VSAM ESDS (nonindexed). This attribute is ignored for directory-oriented client commands. If you are using VSAM data sets in binary mode, then nonindexed is recommended.
keys (<i>len,off</i>)	Specifies the length and offset of the keys for VSAM KSDS data sets. Keys can only be specified when using dsorg(indexed) . <i>len</i> and <i>off</i> are specified in bytes. <i>len</i> is in the range of 1 - 255 (the default is 64); <i>off</i> is in the range of 0 - 32,760 (the default is 0). When you create a VSAM KSDS data set, the records you are loading into it must be keyed-sequenced or the write fails. Each write of the data set is treated as a first load, and requires that the records being loaded are in ascending key sequence.
lrecl (8196 <i>quan</i>)	Specifies: - The length, in bytes, for fixed-length records. - The maximum length, in bytes, for variable-length records. If the blksize attribute is specified, the value must be at least 4 bytes less than the blksize quantity. <i>quan</i> is a number from 1 to 32,760 (the default is 8196).
mgmtclass (<i>mgmt_class_name</i>)	Specifies the management class associated with the file creation. The <i>mgmt_class_name</i> must be defined to DFSMS before it can be used by the client. The system managed storage automatic class selection (ACS) routine must also assign a storage class to the file being created. For more information about management classes, see z/OS DFSMSdfp Storage Administration .
model (<i>dsname</i>)	The name of the cataloged VSAM data set from which to copy data set creation attributes when creating a new VSAM data set. The <i>dsname</i> is a fully qualified MVS data set name without quotation marks. The model attribute must be used with one of the dsorg attributes which imply a VSAM organization. You can do this by specifying the dsorg attributed for a VSAM in the command. See the dsorg entry in this table.

Table 3: Attributes for data set creation (continued)

Data set creation attribute	Description
recfm(cccc)	Specifies the format and characteristics of the records in the data set. <i>cccc</i> can be 1 to 4 characters, in one of the following combinations: <pre>f fb fs fbs u v vb vs vbs</pre> Valid record format characters: b Blocked. f Fixed-length records. s Spanned for variable records, standard format for fixed records. u Undefined-length records. v Variable-length records. In recfm, codes <i>v</i>, <i>f</i>, and <i>u</i> are mutually exclusive. The <i>s</i> code is not allowed for a PDS or PDSE
recordsize(avg,max)	The average and maximum record size for VSAM data sets. <i>avg</i> and <i>max</i> are specified in bytes. They can each range from 1 - 32,760 (the defaults are 512 and 4096 , respectively). These values must be equal for VSAM RRDS.
rlse	Specifies that unused space should be released from the data set the first time a new data set is closed. For slow clients with long pauses between writes, the rlse attribute causes space to be released from the primary extent prematurely. Further writes cause secondary space to be allocated.
norlse	Specifies that unused space should not be released from the data set.
shareoptions(xreg,xsys)	Specifies the cross-region and cross-system share options for a VSAM data set. <i>xreg</i> is a number from 1 to 4; <i>xsys</i> is either 3 or 4. The defaults are 1 and 3 , respectively.
space(prim[,aux])	Specifies the amount of primary and auxiliary space that is allocated for a new data set on a direct access volume. <i>prim</i> is the number (from 0 to 16,777,215) of primary tracks, cylinders, or data blocks in the data set. <i>aux</i> (optional) is the number (from 0 to 16,777,215) of additional tracks, cylinders, or blocks allocated if more space is needed. If this attribute is not specified, the default is used. The defaults are 100 and 10 , respectively.
spanned	Applies to VSAM data sets only. For spanned records of non-VSAM data sets, see the entry for recfm, in this table. Specifies that VSAM KSDS or ESDS data sets can contain records that span control intervals (spanned records),
nonspanned	Applies to VSAM data sets only. For spanned records of non-VSAM data sets, see the entry for recfm, in this table. Specifies that data sets do not have spanned records.
storclas(class_name)	Specifies the storage class associated with the file creation. The <i>class_name</i> must be defined to the DFSMS before it can be used by the client. For more information about storage classes, see z/OS DFSMSdfp Storage Administration .

Table 3: Attributes for data set creation (continued)

Data set creation attribute	Description
unit (<i>unit_name</i>)	Specifies the unit on which to create a data set. <i>unit_name</i> is a generic or symbolic name of a group of DASD devices. The <i>unit_name</i> must be specified as 3390 for extended format data sets. You cannot create or access tape data sets on a z/OS host using the SMB server. You also cannot create extended format data sets with the SMB server, except by ACS routines.
vol (<i>volser</i>)	Specifies the name of the DASD volume to be used to store the created data set. <i>vol</i> is the keyword and <i>volser</i> represents the volume name. If a data set is to be system-managed, as is determined by the DFSMS automatic class selection (ACS) routines, you can omit this attribute.

Processing attributes

Processing attributes are used to control how files are accessed by clients. The processing attributes are described in Table 4 on page 92; defaults are underlined. The administrator can override the default processing attributes in the **devtab** entry for the file set. The client user cannot override processing attributes.

Table 4: Processing attributes

Processing attribute	Description
binary	Indicates that the data is processed between the client and server using binary format and no data conversion occurs between ASCII and EBCDIC formats.
text	Converts the contents in the data set between EBCDIC and ASCII formats. Use this format to share text between clients and z/OS applications. In text mode, the following attributes apply: • blankstrip and noblankstrip. • End-of-line specifiers (lf, cr, lfcr, crlf, or noeol) are used to indicate the logical record boundary.
<u>blankstrip</u>	With text mode, strips trailing blanks at the end of each record of a fixed-length text file when the file is read. Pads the end of each file or record with blanks when a text file is written.
noblankstrip	Does not strip trailing blanks at the end of fixed-length records when a fixed-length text file is read. Does not pad records when writing a text file. The file must be of the correct size or an I/O error is reported to the client. For information about the text mode, see the text option of “ devtab ” on page 94.
<u>executebiton</u>	Turns on the execute bits in user, group, and other (as reported with the ls (list) AIX® or z/OS UNIX command) for files. Use when storing executables or shell scripts on the z/OS system. Note: This is ignored for Windows clients.
executebitoff	Turns off the execute bits in user, group, and other for the mount point’s files. Note: This is ignored for Windows clients.
fastfilesize	Causes the SMB server to approximate the file size. For more information, see “ Handling of the file size value ” on page 186.
<u>nofastfilesize</u>	For direct access data sets (PDSs and PDSEs) and non-system managed data sets, this specifies to read the entire file or member to get the file size. Using this attribute might cause a noticeable delay when first accessing very large data sets. For more information, see “ Using fastfilesize to avoid read-for-size ” on page 187.

Table 4: Processing attributes (continued)	
Processing attribute	Description
<u>mapleaddot</u>	Turns on mapping of a single leading . from a client file name to a leading \$ on z/OS systems. This option is typically enabled for access by AIX and z/OS UNIX clients.
<u>nomapleaddot</u>	Turns off mapping of a single leading . from a client to a leading \$ on z/OS systems.
<u>maplower</u>	Turns on mapping of lowercase file names to uppercase when accessing files on z/OS systems, and back when sending to the network. This option is typically enabled for access by PC, AIX, or z/OS UNIX clients.
<u>nomaplower</u>	Turns off mapping of lowercase file names to uppercase and back when using files on z/OS systems.
<u>setownerroot</u>	Sets the user ID in a file's attributes to root.
<u>setownernobody</u>	Sets the user ID in a file's attributes to nobody.

With text mode, use one of the following end-of-line specifiers:

lf

Line Feed is the end-of-line terminator (standard AIX or z/OS UNIX).

cr

Carriage Return is the end-of-line terminator.

lfcr

Line Feed followed by Carriage Return is the end-of-line terminator.

crlf

Carriage Return followed by Line Feed is the end-of-line terminator (standard DOS).

noeol

No end-of-line terminator. For information about the text mode, see the **text** option of [“devtab”](#) on page 94.

The SMB server uses DFSMSHsm to recall or delete migrated files. The action that the server takes against the migrated files depends on which of the **retrieve** or **notretrieve** attributes is active.

- When the **retrieve(nowait)** attribute is active, the server does not wait for the recall to finish, and immediately returns a “device not available” message. You can try accessing the file later when the recall has completed.
- When the **noretrieve** attribute is active, the server does not recall the file, and can return a message that device is not available after a lookup, an rdwr, or a create request for a file. For more information, see [“Retrieve attributes”](#) on page 93.

Retrieve attributes

The server deletes the migrated file upon a remove request for a file, regardless of whether the **retrieve** or the **noretrieve** attribute is active. Typically, a remove request is preceded by a lookup request. If the data set was migrated with DFSMS/MVS 1.2 or below, retrieve attribute causes a recall because lookup processing needs to open the data set and read for size. If the data set was migrated under DFSMS/MVS 1.3 and DFSMSHsm 1.3 or later, and is SMS managed, its attributes were saved on DASD; therefore it is not always necessary to recall the data set to read for size and the data set can be deleted without recall. If the **noretrieve** attribute is active, the lookup can return a “device not available” message. If the client code decides to ignore the error and go with the remove, the migrated file is then deleted.

The z/OS UNIX command **ls mvsusera** does not issue requests for individual files under the `mvsusera` directory. Migrated files under the `mvsusera` directory are displayed, but are not recalled. However, the z/OS UNIX command **ls -l mvsusera** issues lookup requests for individual files under the `mvsusera` directory.

Site attributes

The site attributes are used to control SMB server resources. These attributes are described in [Table 5](#) on page 94. Site attributes can be overridden in the **devtab** entry for the file set.

Table 5: Site attributes	
Site attribute	Description
bufhigh(<i>n</i>)	Specifies the maximum size (in bytes) of allocated buffers before buffer reclamation (see the percentsteal attribute in this table) is initiated. <i>n</i> is an integer from 1MB to 128MB (the default is 2MB). If the combined total specified in the bufhigh and logicalcache attributes is greater than the available storage in the extended private area (implied by the REGION parameter in your procedure) at startup, the server shuts down immediately. A higher number means more caching and potentially better read performance.
filetimeout(<i>n</i>)	Specifies the amount of time, in seconds, before a data set is closed and data is written to DASD. The minimum specification is 30. The default is 30 .
percentsteal(<i>n</i>)	Specifies the percent of the buffers reclaimed for use when the bufhigh (<i>n</i>) limit has been reached. A higher value means that a reclaim operation is performed less often, but the cached data is significantly trimmed on each reclaim. This can result in poor read performance because readahead buffers might be stolen. Lower values result in more frequent reclaim operations, but the cached data typical water mark is higher, meaning possibly better performance by reading out of cached data. <i>n</i> is an integer from 1 to 99 (the default is 20).

Unsupported attributes

The following NFS Server attributes are not supported by the SMB server and are ignored.

- **attrtimeout**
- **cachewindow**
- **logicalcache**
- **maxrdforszleft**
- **noattrtimeout**
- **noreadtimeout**
- **nowritetimeout**
- **readaheadmax**
- **readtimeout**
- **retrieve**
- **retrieve(wait)**
- **writetimeout**.

devtab

Purpose

Stores identifying information for all HFS and RFS file systems to be exported (and shared). (Unless otherwise noted, HFS includes file systems of type HFS, zFS, TFS, and AUTOMNT. If you are in a sysplex with shared file system, SMB support of zFS is limited to zFS compatibility mode file systems.)

Format

The **devtab** file contains the following lines:

```
* comment
define_ufs n [hfs | rfs]
{hfs-file-system-name [text | binary | auto] |
 rfs-data-set-prefix [text | binary] [attrfile attributes-file] |
 rfs-data-set-name [text | binary] [attrfile attributes-file]}
```

Options

* comment

Specifies a comment line.

define_ufs n [hfs | rfs]

Defines an HFS file system or RFS file system, *n* specifies a minor device number, which is a unique number 1 - 65535. Specifying **hfs** (Hierarchical File System) or **rfs** (Record File System) determines the type of file system. **hfs** is the default.

hfs includes file systems of type HFS, zFS, TFS, and AUTOMNT. If you are in a sysplex with shared file system, SMB support of zFS is limited to zFS compatibility mode file systems.

hfs-file-system-name

Identifies the file system name of the HFS, zFS, TFS, or AUTOMNT file system that you want exported. If you are in a sysplex with shared file system, SMB support of zFS is limited to zFS compatibility mode file systems.

If you do not want the *hfs-file-system-name* to be folded to uppercase, put the name within double quotation marks; for example, `"/tmp"`. This is typically appropriate for file systems of type TFS and AUTOMNT. It might be appropriate for HFS or zFS if the HFS file system was mounted with lowercase characters in the file system name (using an environment that does not fold the file system name to uppercase, for example, `ishell`). To determine if a mounted file system's name includes lowercase characters, use the `df` command.

rfs-data-set-prefix

Identifies the prefix of the record data sets that you want exported.

rfs-data-set-name

Identifies the data set name of a Partitioned Data Set (PDS) or Partitioned Data Set Extended (PDSE) that you want exported.

Note: If you export a PDS or PDSE rather than a data set name prefix, the data set will remain allocated for the entire time it is exported.

attrfile *attributes-file*

Identifies the name of the attributes file (**rfstab**) to be used for this RFS file system.

text | binary

Specifies whether the data needs to be translated (**text**) or not (**binary**). The default is controlled by the `_IOE_HFS_TRANSLATION` environment variable setting in the **dfskern** process (for HFS file systems) and by the `_IOE_RFS_TRANSLATION` environment variable setting in the **dfskern** process (for RFS file systems).

auto

Specifies that the decision to translate HFS data is based on whether the first 255 bytes of the file are deemed to be valid characters.

Usage

The **devtab** file is used to define HFS file systems and RFS file systems to be exported. The **devtab** file resides in the directory named `/opt/dfslocal/var/dfs`. HFS and RFS file systems must be exported in order to be accessible by PC users. The file system containing the shared directory is automatically exported when the `dfsshare` command is issued (assuming it has the appropriate **dfstab**, **devtab**, and

smbtab entries). HFS file systems under the shared directory must be explicitly exported by using the `dfsexport` command if they are being made available to PC users (unless you are using dynamic export).

The **devtab** file is an EBCDIC file that can be edited with a text editor. You must have write (w) and execute (x, sometimes called search) permissions on the `/opt/dfslocal/var/dfs` directory to create the file. You must have write permission on the file to edit it.

To export an HFS or RFS file system, it must be defined to SMB. It is defined by creating an entry in the **devtab** file. Entering **define_ufs** *n* in the **devtab** file defines the type of file system as **ufs**, an HFS file system, and maps a unique minor device number, *n*, to the HFS file system you want to export. You can also enter **define_ufs** *n* **rfs** to the **devtab**, where **rfs** indicates that the file system is an RFS file system. The minor device number is a unique identifier that can be any number greater than zero. This number becomes part of the name of the device name (in the **dfstab** entry). Each HFS or RFS file system being exported must have a unique device number defined. The file system name of the HFS file system or the data set name prefix for RFS is entered in the **devtab** file on the next line after the device number definition. Before exporting an HFS file system, the HFS file system must be locally mounted. For information about allocating and mounting zFS file systems, see *z/OS Distributed File Service zFS Administration*. For information about allocating and mounting HFS file systems, see *z/OS UNIX System Services Planning*. RFS file systems are not locally mounted.

You can also specify an optional character data translation parameter on the same line after the file system name of the HFS file system or the data set name prefix of the RFS file system. The possible values for the translation control parameter are the following:

binary

Do not translate the data.

text

Translate the data with the default translation tables. The default for local data is the local code page for the **dfskern** process. The code page for network data is ISO8859-1 (or the code page specified in the `_IOE_WIRE_CODEPAGE` environment variable of the **dfskern** process). See [“Examples”](#) on page 97 for an example using the text parameter.

An additional translation control parameter value (auto) for HFS is available for HFS file systems and an additional translation configuration file (**hfsattr**) is available for HFS.

The additional translation control parameter value for HFS is as follows:

auto

Determine whether to translate the data based on the contents of the data. The algorithm is as follows:

- Outgoing data (client read). If the first 255 bytes of data are valid EBCDIC characters then translate to ASCII
- Incoming data (client write). If the first 255 bytes of data are valid ASCII characters then translate to EBCDIC.

Valid characters include POSIX C printable characters plus carriage-return, newline, and tab. In EBCDIC, the POSIX C printable characters include: X'40', X'4B'-X'50', X'5A'-X'61', X'6B'-X'6F', X'79'-X'7F', X'81'-X'89', X'91'-X'99', X'A1'-X'A9', X'AD', X'BD', X'CO'-X'C9', X'D0'-X'D9', X'E0', X'E2'-X'E9', X'F0'-X'F9'. Tab is X'05', carriage-return is X'0D', and newline is X'15'.

In ASCII, the POSIX C printable characters include X'20'-X'7E'. Tab is X'09', carriage-return is X'0D', and newline is X'0A'.

If the translation control parameter is omitted, the default is controlled by the `_IOE_HFS_TRANSLATION` environment variable setting in the **dfskern** process (for HFS file systems) and by the `_IOE_RFS_TRANSLATION` environment variable setting in the **dfskern** process (for RFS file systems).

In the case of an RFS file system, you can also optionally specify the name of an attributes file (**rfstab**) on the same line after the *rfs-data-set-prefix* or *rfs-data-set-name* by using the `attrfile` keyword. See [“Attributes file \(rfstab\)”](#) on page 87 for more information about the attributes file.

Examples

The following examples show **devtab** entries for HFS and RFS file systems. All entries beginning with an asterisk (*) are comment lines.

The first example shows a **devtab** entry for an HFS file system. The second line, `define_ufs 2`, defines the type of file system as **ufs**, an HFS file system. A unique minor device number of 2 is assigned. The line following the definition of the HFS file system minor device number, **omvs.user.abc**, identifies the name of the HFS file system being exported and specifies a translation control parameter of text. A translation control parameter of text means data is translated. The HFS file system device name is `/dev/ufs2` with 2 representing the device's minor number.

```
* HFS devices
define_ufs 2
omvs.user.abc text
```

The next examples show other file system types.

```
* ZFS devices
define_ufs 6
omvs.priv.compat.aggr001 text
* TFS devices
define_ufs 4
"/dev" text
* AUTOMNT devices
define_ufs 5
"*AMD/home" text
```

The following example shows a **devtab** entry for an RFS file system. The second line, `define_ufs 3 rfs`, defines the type of file system as **ufs** and the **rfs** parameter qualifies it as an RFS file system. A unique minor device number of 3 is assigned. The next line, **USERA.PCDSNS**, is the prefix of the record data sets that you want to export as a single RFS file system. The RFS file system device name is `/dev/ufs3` with 3 representing the device's minor number.

```
* RFS devices
define_ufs 3 rfs
USERA.PCDSNS text
```

Note: An example **devtab** file can be found in `/opt/dfsglobal/examples`.

In summary, the **define_ufs 2** entry in the **devtab** corresponds to the `/dev/ufs2` entry in the **dfstab** and **smbtab**. The **define_ufs 3 rfs** entry in the **devtab** corresponds to the `/dev/ufs3` entry in the **dfstab** and **smbtab**.

Implementation specifics

The **devtab** file is stored as an EBCDIC file in HFS.

Related information

Commands:

```
dfsexport
dfsshare
```

Files:

```
dfstab
hfsattr
rfstab
smbtab
```

dfstab

Purpose

Specifies HFS and RFS file systems that can be exported.

Usage

The **dfstab** file includes information about each file system that can be exported from the local disk and then shared with SMB clients. The file is read by the **dfsexport** command, which exports specified HFS and RFS file systems. (It is also read by the **dfsshare** command, which initializes SMB shares.) The **dfstab** file must be in the directory named **/opt/dfslocal/var/dfs**. The **dfsexport** command looks in that directory for the file; if the file is not there, no file systems can be exported.

The **dfstab** file is an EBCDIC file that can be edited with a text editor. You must have write (**w**) and execute (**x**, sometimes called search) permissions on the **/opt/dfslocal/var/dfs** directory to create the file. You must have write permission on the file to edit it.

The file contains a one-line entry for each HFS or RFS file system available for exporting and sharing. Each entry in the file must display on its own line.

The fields in the following list must appear for each entry; they must appear in the order listed, and each field must be separated by at least one space or tab.

Device name

The device name of the HFS or RFS file system being exported; for example, **/dev/ufs2**.

File system name

The name associated with the HFS or RFS file system being exported. A file system name can contain any characters, but it can be no longer than 31 characters. It must be different from any other file system name in the **dfstab** file. File system names cannot be abbreviated, therefore you should use a short, descriptive name; for example, **hfs2**.

File system type

The identifier for the type of file system. For HFS and RFS file systems, it must be **ufs**. Enter the identifier in all lowercase letters.

File system ID

A positive integer different from any other file system ID in the **dfstab** file.

File set ID

The unique file set ID number associated with the HFS or RFS file set. File set ID numbers are represented as two positive integers separated by a pair of commas. For example, the file set ID number of the first file set is **0,,1**. When specifying a new file set, increment the file set ID. When the integer after the commas becomes greater than 2^{32} , the integer before the commas becomes 1 and the integer after the commas returns to 0 (zero) (that is, **1,,0**). This number must be different from any other file set ID in the **dfstab**.

When the **dfsexport** command is executed, it reads the **dfstab** file to verify that each HFS and RFS file system being exported is listed in the file. A file system must have an entry in the **dfstab** file if it is being exported unless you are using dynamic export. To ensure that it does not export a file system that is currently exported, the **dfsexport** command refers to a list (in memory) of all currently exported file systems.

Examples

The following **dfstab** file specifies that an HFS file system and an RFS file system (**/dev/ufs2** and **/dev/ufs3**) can be exported.

```
/dev/ufs2  hfs2  ufs  101  0,,1715
/dev/ufs3  rfs3  ufs  102  0,,1718
```

The **dfstab** entry does not distinguish between an HFS file system and an RFS file system. It is the corresponding entry in the **devtab** (**define_ufs 3 rfs**) that indicates to the SMB server that the file system is an RFS file system.

Note: You can put comments in the **dfstab** file. Comments have a **#** in column 1. An example **dfstab** file can be found in **/opt/dfsglobal/examples**.

Implementation specifics

The **dfstab** file is stored as an EBCDIC file in HFS.

Related information

Commands:

dfsexport
dfsshare

Files:

devtab
smbtab

envar

Purpose

Specifies the environment variables for a process.

Usage

The **envar** file contains the environment variables for each Distributed File Service process. There is one **envar** file for each process. Each **envar** file is located in the corresponding home directory of each process. (For example, the environment variables for the **dfskern** process are contained in the **/opt/dfsglobal/home/dfskern/envar** file.) See [Chapter 3, “SMB postinstallation processing,” on page 11](#) for information about process home directories. The **envar** file is read during process initialization; each environment variable specified in the file is set for the process.

Environment variables are specified in the **envar** file in the following format.

```
variable-name=value
```

Note: There should be no space between the *variable-name=value* statement or the *value* and the equal sign that separates them.

An environment variable:

- Cannot be longer than 4096 characters
- Must have an =
- Must begin in column 1

- Can be continued by terminating the line with \

A line that begins with # is treated as a comment.

The **envvar** file is an EBCDIC file that can be edited with a text editor. You must have write and execute permissions on the process home directory to create the file. You must have write permission on the file to edit it. See [Table 9 on page 145](#), for information about all the environment variables supported for SMB processing.

The **envvar** file cannot contain any blank lines between environment variables. If blank lines are found when the **envvar** file is parsed, ABEND U4093 will occur and the initialization for that daemon will fail. If you want to have a line between entries, you can use the # symbol (comment) at the beginning of a line and then enter an environment variable on the next line.

Examples

The following **envvar** file entry (located in the /opt/dfslocal/home/dfskeern/envvar) specifies that SMB processing should be on.

```
_IOE_PROTOCOL_SMB=ON
```

Note: Example **envvar** files can be found in /opt/dfsglobal/examples.

Implementation specifics

The **envvar** file is stored as an EBCDIC file in HFS.

hfsattr

Purpose

Contains directives that map a file name extension (suffix) to an indication whether the SMB File Server (**dfskeern**) should translate the file data from ASCII to EBCDIC and vice versa (encoding).

Usage

The **hfsattr** file is a text file that is stored in HFS. The File Server locates the **hfsattr** file during startup (or restart) by examining the **_IOE_HFS_ATTRIBUTES_FILE** environment variable for the **dfskeern** process. The **hfsattr** file has the following format:

```
AddType .suffix representation encoding [quality]
```

The **hfsattr** AddType directive has the same format as the WebSphere® Application Server uses in its configuration file (httpd.conf). You can point the File Server to this file. All other directives are ignored. The File Server only examines the first, second, and fourth fields. The others are ignored. Comments can be created by using the # character. All fields are case-sensitive.

AddType

A keyword that indicates a directive to map a suffix to an encoding.

.suffix

The file name suffix. Wildcard characters are not permitted.

representation

The MIME type and subtype you want to bind to files that match the corresponding suffix. This field is ignored by DFS.

encoding

The type of data the file contains. The only value that the File Server looks for is **ebcdic**. This means that incoming data should be translated from ASCII (ISO8859-1 or the code page specified in the **_IOE_WIRE_CODEPAGE** environment variable of the **dfskern** process) to EBCDIC (IBM-1047 or the current code page for the **dfskern** process). Outgoing data should be translated from EBCDIC to ASCII. All other values for encoding are ignored and the data is not translated. Before data is translated, it is checked for valid characters to avoid translating data that is already in the correct format.

quality

This is an optional indicator of the relative importance (on a scale of 0.0 to 1.0) for the content type. This field is ignored by DFS.

If the file name suffix is not found in the **hfsattr** file, or the file name has no suffix, then translation is determined by the **devtab** translation control parameter or the **dfskern _IOE_HFS_TRANSLATION** environment variable. For more information about **devtab**, see [“devtab” on page 94](#), and for the **_IOE_HFS_TRANSLATION** environment variable.

Examples

The following is an example of an **hfsattr** file.

```
# Map suffixes to the encoding
AddType .bin application/octet-stream binary 1.0
AddType .ps application/postscript ebcdic 0.8 # PostScript
AddType .PS application/postscript ebcdic 0.8 # PostScript
AddType .c text/plain ebcdic 0.5 # C source
AddType .html text/html ebcdic 1.0 # HTML
AddType .htm text/html ebcdic 1.0 # HTML on PCs
AddType .gif image/gif binary 1.0 # GIF
```

Implementation specifics

The **hfsattr** file is stored as an EBCDIC file in HFS.

Related information

File:

devtab

ioepdcf**Purpose**

Specifies the processes to be started by the DFS Control Task.

Usage

The **ioepdcf** file, also referred to as the Daemon Configuration File, is an EBCDIC text file used by the DFS Control Task to determine which daemons can be started during the initialization of DFS. The file is located in the `/opt/dfslocal/etc` directory. The information contained in the **ioepdcf** file includes the following:

Process Name

The name of the process to be entered in the **ioepdcf** file. Valid processes associated with SMB are:

dfskern

The **dfskern** server daemon is the SMB file and print server process.

export

The **export** server daemon permits exporting of HFS file systems.

Configuration Type

The configuration type for each server. Available types for z/OS are:

CONFIGURED=Y

Specifies that the process starts during initialization. If the process abends or fails for any reason, it is automatically restarted by the DFS Control Task.

Do not use this configuration type for the **export** process. This process executes one time and then stops. The **export** process must not be automatically restarted after it has run. Use

CONFIGURED=I or **CONFIGURED=M**.

CONFIGURED=N

Specifies that the process is not started by the DFS Control Task nor can the process be started manually.

CONFIGURED=I

Specifies that the process is started during initialization or when the **MODIFY** command, **START ALL** is issued. The process can be started manually. The process does not restart if it abends or ends for any reason.

CONFIGURED=M

The process is not started by the DFS Control Task, but can be manually started by using the **MODIFY** system command. The specified process does not restart if it ends for any reason.

Load Module Name

The name of the load module (**LMD**) in a partitioned data set. The load module refers to the name of the member in the xxx.SIEALNKE (where xxx is installation dependent) data set created during installation (for more information, see *z/OS Program Directory*). The following are the PDS member names for the processes started by the DFS Control Task:

dfskern

The **dfskern** daemon load module name. The name, **dfskern**, is an alias for the load library entry, **IOEDFSKN**.

In addition, the **export** process is started by the DFS Control Task and executes the load library entry, **IOEDFSXP**. The **export** process has no alias.

Special Parameters

Parameters that are passed to the load module when a daemon is started (including Language Environment runtime options). This is also called the argument list. Any runtime overrides such as storage specifications and redirection of output can also be added. The first argument is the home directory for each process. The home directory points the process to the directory holding the environment variable (**envar**) file for the process. Program parameters for the DFS process are preceded with a slash, /, in the argument list.

The **ioepdcf** file can be used to override the default parameter options for the following daemons:

dfskern

The **dfskern** server daemon is the SMB file and print server. There are no options that need to be overridden for this process for SMB file and print serving.

export

The **export** daemon permits exporting of HFS file systems. See *z/OS Program Directory* for information about options available for this process.

Additional special parameters that control restart and timeout intervals might also be entered in the **ioepdcf** file. These parameters are:

Restart

The interval defined for the DFS Control Task to attempt a restart of the process. Restart values are entered in seconds.

Timeout

The maximum interval that the Control Task waits for the process to complete initialization. Timeout values are entered in seconds. If this interval is exceeded with no confirmation of successful completion received by the Control Task, the status of the process is set to **UNKNOWN**.

Examples

The following example is an **ioepdcf** file entry for the **dfskern** process. Note that this should be entered on one line, even though multiple lines are used in this example.

```
dfskern CONFIGURED=Y LMD=IOEDFSKN ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfskern',
'LANG=En_US.IBM-1047'),HEAPP(ON)/-mainprocs 7
>DD:dfskern 2>&1" RESTART=300 TIMEOUT=300
```

The configuration type is **Y**, specifying that the process start during DFS initialization. The load module, **LMD**, is identified as **IOEDFSKN**. In the argument list, **ARG**, **ENVAR** indicates the environment variables to be used. The home directory is identified as **_EUV_HOME=/opt/dfslocal/home/dfskern** and the local code page is specified as **LANG=En_US.IBM-1047** (which is the default). An Language Environment runtime option is specified: **HEAPP(ON)**. Parameters for the **dfskern** process follow the **/**. The **>** symbol is a redirection character which indicates that the output is redirected to the DD name that follows. In this example, the redirection of the **STDERR** to **STDOUT** of the process (**dfskern**) is specified by: **>DD:dfskern 2>&1**. **RESTART** and **TIMEOUT** values are both set at 300 seconds.

Implementation specifics

The **ioepdcf** file is stored as an EBCDIC file in HFS. This file is optional. If it does not exist, the following default values are used.

```
DFSKERN CONFIGURED=Y LMD=DFSKERN ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfskern')/
>DD:DFSKERN 2>&1" RESTART=300 TIMEOUT=300
EXPORT CONFIGURED=I LMD=IOEDFSXP ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfsexport')/-all -verbose
>DD:EXPORT 2>&1" RESTART=300 TIMEOUT=300
UNEXPORT CONFIGURED=M LMD=IOEDFSXP ARG="ENVAR('_EUV_HOME=/opt/dfslocal/home/dfsexport')/-detach -all -ver
>DD:UNEXPORT 2>&1" RESTART=300 TIMEOUT=300
```

smbidmap

Purpose

Maps an SMB user ID to a z/OS user ID. The mapping is used to determine the SMB user's corresponding z/OS user ID. This determines access permissions for shared file system and RFS directories and files and owners for print requests sent to shared printers. If no **smbidmap** file is specified or it does not exist, then the SMB user ID is mapped to the default user ID (specified in the **_IOE_MVS_DFSDFLT** environment variable of **dfskern**). If no default user ID is specified, the request is denied.

Usage

The **smbidmap** file is a text file that the administrator creates and maintains. This can be created as a z/OS UNIX file, a sequential data set, or a member of a partitioned data set. The location of this file is specified in the **_IOE_SMB_IDMAP** environment variable of **dfskern**.

The **smbidmap** file contains one or more identity mapping declarations and has the following general format:

```
SMB-user-ID1
z/OS-user-ID1
```

This format illustrates an SMB user ID mapping entry. Each entry has two elements: SMB user ID and z/OS user ID. A blank line is required between entries. The following explains each element in an SMB user ID mapping entry:

SMB-user-ID or Domain/SMB-user-ID or Workgroup/SMB-user-ID

Specifies the client's SMB identity. This can either be a simple SMB user ID (when you do not care what the domain of the SMB user ID is) or a fully qualified name (for clients within and outside the domain/workgroup). The SMB user ID can be up to 20 characters in length. A Domain/Workgroup name can be up to 15 characters in length.

- *SMB-user-ID* is assumed to be in any domain.
- *Domain/SMB-user-ID* is assumed to be in the specified domain.
- *Workgroup/SMB-user-ID* is assumed to be in the specified workgroup.

z/OS-user-ID

Is the z/OS user ID of the client. All potential SMB clients must have z/OS user IDs on the system where the DFS server is running.

One of the following entries can also be in **smbidmap**:

Entry	Details
* or Domain/* =	If = is used in the second line, the z/OS user ID is used exactly as is.
* or Domain/* <	If < is used in the second line, the z/OS user ID is used in lowercase.
* or Domain/* >	If > is used in the second line, the z/OS user ID is used in uppercase.

Note: If a Domain/* entry is used (the Domain from the SMB matches, but no Domain/SMB-user-ID was found in the smbmap file), any SMB-user-ID from that Domain is used as the z/OS user ID.

If no z/OS user ID can be determined (because the SMB user ID cannot be found in the **smbidmap** file) and the SMB user ID (in the SMB) is eight characters or less, the SMB user ID (passed in the SMB) is used as the z/OS user ID. If you want, this can be the only entry in **smbidmap**. This is also relevant for use with &USERID in the smbtap.

The order of search in the **smbidmap** file for a matching domain and SMB-user-ID is:

- Domain/user ID
- Domain/*
- User ID
- *

See “Working with automounted file systems and home directories:” on page 46 and “Recommended technique for PC user access to automounted home directories” on page 48for information about &USERID.

Examples

In the following example, the SMB user ID **smith** in **domain1** is mapped to the z/OS user ID CMSMITH and SMB user ID **jones** (in any domain) is mapped to the z/OS user ID TSJONES.

```
domain1/smith
CMSMITH

jones
TSJONES
```

You can put comments in **smbidmap** file. Use a semicolon (;) to begin the comment. (The semicolon is not valid as an SMB-user-ID nor as a z/OS-user-ID.) Comments can begin in any column. After the semicolon, all data on the line is ignored. The following statements are examples of comment usage.

```
; this whole line is a comment
usera ; the userid is usera and the rest of the line is a comment
abc#def; the userid is abc#def and the rest of the line is a comment
```

Implementation specifics

The **smbidmap** file is stored as an EBCDIC file in HFS, or a sequential data set or a member of a PDS.

smbtab

Purpose

Specifies HFS and RFS shared directories and shared printers being made available to PC clients.

Usage

The **smbtab** file includes information about each shared directory and each shared printer that can be made available to PC clients. It resides in the directory **/opt/dfslocal/var/dfs**.

The file contains a one-line entry for each shared directory or shared printer. Each entry in the file must appear on its own line.

The shared directory fields in the following list must appear for each entry; they must appear in the order listed, and each field must be separated by at least one space or tab.

Device Name

For shared directories, the device name of the HFS or RFS file system that contains the root of the directory path name being shared; for example, **/dev/ufs2**. This must match the device name of the file system in the **dfstab**.

Share name

The name to be associated with the HFS or RFS directory being shared. A share name can contain numbers (0-9), letters (A-Z), and the following special characters: \$ % ' _ @ ~ ` ! () ^ # &. To ensure that a client can connect to an SMB share, you should limit yourself to these characters. A share name can be up to 12 characters.

Device type

The device type identifier for the type of device housing the share. For HFS and RFS directories this must be **ufs**. Enter the identifier in all lowercase letters.

Share description

The text description of the share. It can be up to 40 characters and is within quotation marks; for example, **"Department HFS files"**.

Shared directories permissions

For shared directories, specifies whether the share is limited to read-only access or whether read-write access is permitted. Read-only access is specified as **r/o**. Read-write access is specified as **r/w**.

In addition, permissions used during a create of a file or directory can be specified. They are specified directly after **r/w**. For example, you might specify **r/w,f=700,d=755**. These permissions override the global create permissions (**_IOE_SMB_DIR_PERMS** and **_IOE_SMB_FILE_PERMS** environment variables in **dfskern**) for this shared directory. Create permissions cannot be specified for **r/o** access.

Maximum users

For shared directories, the maximum number of users that can be connected to a share name. It can be a number in the range of 0 - 4294967295. 0 means that there is no limit to the number of users.

Directory path name

For shared directories, specifies the path name of the HFS or RFS directory (relative to the root of the file system referred to by the **Device name**) that this share represents. For HFS, the directory must be in a locally mounted HFS file system. For RFS, the directory must be the root of the RFS file system (/) or a directory (that is, PDS or PDSE) within the RFS file system. The file system must be exported (see [“dfstab” on page 98](#)). The directory path name can be up to 1024 characters. It must be within quotation marks if it contains embedded blanks. For HFS, you might want to export HFS file systems below this directory in order to permit all path names below this directory to be accessible by this share or you might want to use dynamic export. See [“Dynamic export for HFS” on page 45](#) for information about using the dynamic export capability of the SMB server.

If you are using dynamic export, you can specify a special keyword in the **Directory path name** field. The keyword is **&USERID**. It represents the PC user's z/OS user ID. It permits a single **smbtab** entry to mean a different directory depending on which user connects to the shared directory. See [“Recommended technique for PC user access to automounted home directories” on page 48](#) for more information about the usage of the **&USERID** keyword.

The shared printer fields in the following list must appear for each entry; they must appear in the order listed, and each field must be separated by at least one space or tab.

Device name

For shared printers, the device name of the printer being shared; for example, **/dev/prt1**.

Share name

The name to be associated with the printer queue being shared. A share name can contain numbers (0-9), letters (A-Z), and the following special characters: \$ % ' _ @ ~ ` ! () ^ # &. To ensure that a client can connect to an SMB share, you should limit yourself to these characters. A share name can be up to 12 characters.

Device type

The device type identifier for the type of device housing the share. For printers this must be **prt**. Enter the identifier in all lowercase letters.

Share description

The text description of the share. It can be up to 40 characters and within quotation marks. For example, **“Department printer”**.

Printer definition name

For shared printers, specifies the name of the printer definition. The printer definition name is created during the definition of the printer. See [z/OS Infoprint Server Operation and Administration](#).

Printer type

For shared printers, specifies the type of printer. This can be the name of a printer type supplied by Windows. See [z/OS Infoprint Server Operation and Administration](#).

When the **dfsshare** command is executed, it reads the **smbtab** file to verify that each directory or printer to be shared is listed in the file. A directory or printer must have an entry in the **smbtab** file if it is being shared. If a directory or printer is currently shared, it is not shared again. The **smbtab** file is also read and shared directories and shared printers are created during server initialization.

Examples

The following **smbtab** file specifies that an HFS directory, an RFS directory, and one printer should be shared.

```
/dev/ufs2  myshare    ufs  "My share description"    r/w  100  /ghi
/dev/ufs3  rfsshare1  ufs  "USERA.PCDSNS z/OS data sets"  r/o  50  /
/dev/prt1  myprt       prt  "Department printer"      printname1  "Generic / Text Only"
```

You can put comments in **smbtab** file. Comments start with # in column 1.

Implementation specifics

The **smbtab** file is stored as an EBCDIC file in HFS. An example **smbtab** file can be found in **/opt/dfsglobal/examples**.

Related information

Commands:

dfsexport

dfsshare

Files:

devtab

dfstab

Chapter 14. SMB commands

This section provides an alphabetical listing of all relevant SMB commands.

These commands are issued from the z/OS UNIX environment. z/OS UNIX users should have the following line in their `.profile` file in their home directory.

```
export _EUV_AUTOLOG=NO
```

Alternatively, the preceding line can be placed in the `/etc/profile` file. This causes it to take effect for all z/OS UNIX users.

dfsexport

Purpose

A z/OS UNIX command that exports (or unexports) HFS and RFS file systems. This action makes underlying file systems available so that directories contained in them can be shared (see *z/OS Program Directory*).

Format

```
dfsexport [{-all | -aggregate name | -filesystem name}] [-detach]
[-verbose] [-force] [-type] [-level] [-help]
```

Options

-all

Specifies that all HFS and RFS file systems that are listed in the `/opt/dfslocal/var/dfs/dfstab` file are being exported. Use this option or use `-filesystem`; omit both options to list all file systems currently exported.

-aggregate name | -filesystem name

Specifies the file system name of the HFS or RFS file system to be exported. This name is specified in the first or second field of the entry for the HFS or RFS file system in the **dfstab** file. Use this option or use `-all`; omit both options to list all HFS file systems currently exported.

If you enter this command in TSO/E, the name parameter must be within quotation marks ("").

-detach

Used with the `-all` option, specifies that the file systems indicated with the command's other options are to be detached (no longer exported), which makes the corresponding shares unavailable to Windows clients. Use `-all` or `-filesystem` with this option to indicate that the exports are to be detached.

Use the `-detach` option only when no users are accessing data on the HFS or RFS file systems to be detached or when a serious emergency warrants its use. When the `-detach` option is used, the command breaks all oplocks for data on a corresponding share before the file system is detached.

To permanently detach a file system, it must also be removed from the `dfstab` file. Otherwise, the `dfsexport` command exports file systems the next time it is run.

-force

This option is no longer supported; if specified, it is ignored.

-level

Prints the level of the `dfsexport` command. This information is useful when you are diagnosing a problem. All other valid options that are specified with this option are ignored.

-type

Specifies that only aggregates or file systems whose file system types match the type that is specified with this option are to be exported. The SMB server only supports `-typeufs`. Use this option only with the `-all` option; it is ignored if it is specified without the `-all` option.

-verbose

Directs the command to report on its actions as it executes.

-help

Prints the online help for this command. All other valid options that are specified with this option are ignored.

Usage

The `dfsexport` command exports underlying HFS and RFS file systems so that directories can be shared from z/OS to PC clients. Directories and printers that are shared are still available to other z/OS users. Issue this command with no options to list the file systems already exported. The binary file for the `dfsexport` command resides in `/opt/dfsglobal/bin/dfsexport`.

The `dfsexport` command exports HFS and RFS file systems that are based on the values that are provided with its options. If the `-all` option is provided, the command shares all file systems listed in the `/opt/dfslocal/var/dfs/dfstab` file. If the `-filesystem` option is provided, it exports only the file system whose name is specified with the option. The specified name must be listed in the `dfstab` file.

When `dfsexport` executes, it reads the `dfstab` file on the local disk of the machine to determine the file systems available to be exported. A file system must have an entry in the `dfstab` file if it is being exported. Because this command reads the `dfstab` file, information supplied with its options must match exactly the information for a file system that is specified in that file.

The `dfsexport` command reads a list of all currently exported file systems that is maintained in the SMB server of the local machine. The command does not export a file system that is exported.

Issuing the `dfsexport` command with no options lists the file systems that are currently exported from the local file server.

The `dfsexport` command is normally executed automatically when the SMB server is started. This is controlled by the export entry of the `ioepdcf` file, see [“ioepdcf” on page 101](#) for more information. When export is enabled, all indicated HFS and RFS file systems listed in the `dfstab` file are exported and all HFS and RFS directories listed in `smbtab` that are contained in those exported file systems are shared.

Before using this command to export a file system for the first time, perform the following:

1. For HFS file systems, ensure that the file system is mounted locally; it can contain data or it can be empty. The SMB server must be running on the z/OS system that owns the HFS file system. (RFS file systems cannot and need not be locally mounted.)
2. Create an entry for the file system in the `devtab` file on the z/OS system on which the file system resides. This entry maps the minor device number to the HFS or RFS file system data set you wish to export. It also allows you to (optionally) specify if character data translation should occur when the data is read or written by PC clients. For more information, see [“devtab” on page 94](#).
3. Create an entry for the file system in the `dfstab` on the machine on which the partition resides. Use a unique file system name and ID number and a unique fileset ID number in the appropriate fields of the entry for the file system.

Before exporting a file system, also make sure that no local users have files open on the file system. The SMB server cannot effectively synchronize file access between users who opened files from a file system before the file system was exported and users who open files from the file system after the file system is exported because only the latter have tokens.

Privilege required

The issuer must be logged in as root on the local machine. On z/OS, root refers to a user with a UID = 0 or BPX.SUPERUSER authority.

Cautions

Before using the -detach option with this command, make sure that no users are currently accessing data from file systems to be detached. The command does not verify that a device is not in use before removing it from the namespace. A user who is accessing data that is housed on a file system when it is detached is not able to save the data back to the device. Any attempt to perform an action that involves a detached file system elicits a message reporting that the device is Unknown.

Examples

On SMB, the dfsexport process, by default, is started automatically by the DFS control task program, dfscntl. dfscntl and its child processes are, in turn, controlled in SMB by the system command, MODIFY.

You can also use the MODIFY system command to export and unexport file systems SMB.

The following command causes the dfsexport program to run with the parameters specified in the ioepdcf configuration file. By default, this command exports all of the file systems that have entries in the machine's dfstab file.

```
modify dfs,start export
```

The following command causes the dfsexport program to run with the parameters specified in the ioepdcf configuration file. In this example, the command unexports all of the file systems that have entries in the dfstab file.

```
modify dfs,start unexport
```

The following command exports the file system whose device name (as it appears in the dfstab file) is /dev/ufs1.

```
# dfsexport /dev/ufs1
```

The following examples illustrates the steps that are needed to detach a file system named OMVS.PRIV.DCESVSR.HOME. You must first find the file system ID value followed by its device name.

In this example, OMVS.PRIV.DCESVSR.HOME was exported during the server initialization. To find the file system ID value, issue the following MODIFY command. The file system ID is listed in the Aggr # column of the output:

```
F DFS,SEND DFSKERN,QUERY,FILES
```

Output:

Fileset Name	Aggr #	Flg	SMBs	Local
PLEX.LOCAL.ROOT	101	AME	6	0
OMVS.PRIV.DCESVSR.HOME	110	AME	1	0

The file system ID value is 110. Next, determine the device name that matches this value. Use the output from the `dfsexport` command to find the device name. For example:

```
/SYSTEM/home/susvsr/> dfsexport
```

Output:

```
IOEX18114I Dfsexport: /dev/ufs1, ufs, 101, 0,1700
IOEX18114I Dfsexport: /dev/ufs6, ufs, 110, 0,1728
```

Using the file system ID value of 110, locate the line from the `dfsexport` command output. The device name is the value following the `Dfseport:` keyword. In this case, the device name is `/dev/ufs6`.

To detach the file system `OMVS.PR.VDCESVSR.HOME`, reissue the `dfsexport` command with this device name along with the detach option.

```
dfsexport -filesystem /dev/ufs6 -detach
```

It might be possible that the file system to be detached has been dynamically exported. Dynamically exported file systems do not have entries in the `dfstab`, `devtab` and `smbtab` files. The file system ID and device name are assigned as part of dynamic export process. Typically the file system ID values start at 100000 and are incremented by 1.

Query of a dynamic exported file system:

```
F DFS,SEND DFSKERN,QUERY,FILES
```

Output:

Fileset Name	Aggr #	Flg	SMBs	Local
PLEX.LOCAL.ROOT	101	AME	14	0
OMVS.PR.VDCESVSR.HOME	100000	AME	5	0

From the preceding output, the file system ID value is 100000. Next, determine the device name that matches this value.

```
/SYSTEM/home/susvsr/> dfsexport
IOEX18114I Dfsexport: /dev/ufs1, ufs, 101, 0,1700
IOEX18114I Dfsexport: /dev/ufs10000, ufs, 100000, 0,100000
```

For this dynamic exported file system, the device name is `/dev/ufs10000`.

To detach this file system issue:

```
dfsexport -filesystem /dev/ufs10000 -detach
```

Implementation specifics

The `dfsexport` process on SMB, by default, is started automatically by the DFS control task program, `dfscnt1`. The `dfsexport` process on DFS runs under the control of the `dfscnt1` DFS control task. `dfscnt1` and its child processes are controlled on DFS by the `MODIFY` system command. For more information, see [“modify dfs processes” on page 81](#).

After `dfsexport` exports the file systems specified, it creates any shared directories defined in `smbtab` that refer to those file systems. No shared printers are created. When `-detach` is specified, `dfsexport` unshares any shared directories that refer to file systems being unexported before unexporting the file systems.

This command can be issued from TSO/E or a z/OS shell.

To export an HFS file system, that file system must be owned by the system that the SMB server is running on. When export is attempted on a (sysplex) shared file system that is owned by a system other than the

one that the SMB server is running on, the SMB server attempts to move the ownership of a shared file system to the system that the SMB server is running on (when the `_IOE_MOVE_SHARED_FILESYSTEM` environment variable is ON in the `dfskern` process). If this is unsuccessful (when, for example, the file system is being exported by another SMB server on the other system), the SMB server will not be able to export that file system and it will not be available to PC clients.

If you want to export zFS file systems in a shared file system environment, the SMB server can check the zFS file system configuration to determine whether zFS is running sysplex-aware or non-sysplex aware and only export non-sysplex aware file systems. To check whether zFS is running sysplex-aware, use the `zfsadm configquery -sysplex_state` command. For more details, see [Chapter 7, “Sharing files,”](#) on page 39.

Related information

Files:

- devtab
- dfstab
- smbtab

dfsshare

Purpose

A z/OS UNIX command that shares (or unshares) HFS and RFS directories or printers with SMB clients.

Format

```
dfsshare [{-all | -share name}] [-type name] [-detach] [-verbose] [-help]
```

Options

-all

Specifies that all HFS and RFS directories and printers that are listed in the `/opt/dfslocal/var/dfs/smbtab` file are shared with SMB clients. Use the `-type` option with this option to export only HFS and RFS files or only Infoprint Server printers. Use this option or use `-share`; omit both options to list all shared files and shared printers that are shared with SMB clients.

-share *name*

Specifies the share name of the HFS or RFS shared directory or shared printer. This name is specified in the second field of the entry for the HFS directory or printer in the `smbtab` file. Use this option or use `-all`; omit both options to list all HFS directories and printers that are shared with SMB clients. Some share names cannot be specified on z/OS UNIX commands or must be enclosed in single quotation marks. A share name that begins with dollar (\$) must be enclosed in single quotation marks.

-type *name*

Specifies that only shared directories or shared printers whose type matches the type that is specified with this option are shared. The type can be specified as `ufs` to share only HFS and RFS directories, or it can be specified as `prt` to share only printers. The type of each share appears in the third field of the entry for the device in the `smbtab` file.

Use this option only with the `-all` option; it is ignored if it is used without the `-all` option. If it is omitted and `-all` is used, the command shares both `ufs` and `prt` types.

-detach

Used with the `-all` option, specifies that the shared directories and shared printers that are indicated with the command's other options are detached (no longer shared), making them unavailable to SMB

clients. Use `-all` or `-share` with this option to indicate the shares to be detached; use the `-type` option with `-all` to detach only one type of share.

Use the `-detach` option only when no users are accessing data on the HFS or RFS shared directories to be detached or when a serious emergency warrants its use.

To permanently detach a share, it must also be removed from the `smbtab` file. Otherwise, the `dfsshare` command shares the directories and printers the next time it is run (provided the directories or printers are included in the specification for the types to be shared).

-verbose

Directs the command to report on its actions as it executes.

-help

Prints the online help for this command. All other valid options that are specified with this option are ignored.

Usage

The `dfsshare` command shares HFS and RFS directories and printers from z/OS to Windows clients. Directories and printers that are shared are still available to other z/OS users. Issue this command with no options to list the directories and printers already shared. The binary file for the `dfsshare` command resides in `/opt/dfsglobal/bin/dfsshare`.

The `dfsshare` command shares HFS and RFS directories, printers, or both based on the values provided with its options. If the `-all` option is provided, the command shares all directories and printers listed in the `/opt/dfslocal/var/dfs/smbtab` file. If the `-share` option is provided, it shares only the directory or printer whose share name is specified with the option. The specified name must be listed in the `smbtab` file.

The `-type` option can be used with the `-all` option to indicate that only directories or only printers are shared. If `ufs` is provided with the `-type` option, the command exports only directories; if `pri` is provided with the `-type` option, it exports only printers. If the `-type` option is used, the `-all` option must also be included; otherwise, the `-type` option is ignored.

When `dfsshare` executes, it reads the `smbtab` file to determine the directories and printers available to be shared. A directory or printer must have an entry in the `smbtab` file if it is shared. This command also invokes `dfsexport` to ensure that the underlying HFS or RFS file system that contains the shared directory is exported. Therefore, the corresponding HFS or RFS file system information must exist in `dfstab` and `devtab` for the shared directories that are being created. If there are additional file systems that are mounted under the shared directory that you want to allow PC users to access, those file systems must be exported also. The `dfsexport` command can be used for this purpose.

The `dfsshare` command reads a list of all shared directories and printers that is maintained in the SMB Server of the local machine. The command does not share a directory or printer that is shared. If you want to change the parameters for a printer or an HFS or RFS directory that is already shared, you must first detach (by using the `dfsshare -share name -detach` command) and then reshare (by using the `dfsshare -share name` command) for the new parameters to take effect.

Issuing the `dfsshare` command with no options lists the directories and printers that are currently shared to SMB clients.

The `dfsshare` command is automatically executed when the SMB server is started (with SMB processing enabled). This is controlled by the export entry of the `ioepdcf` file, see [“ioepdcf”](#) on page 101 for more information. When export is enabled, all indicated HFS and RFS directories listed in the `smbtab` file are shared and all HFS and RFS file systems that are listed in `dfstab` and `devtab` are exported. In addition, all printers listed in the `smbtab` are shared (if the Infoprint Server is enabled) regardless of the export entry in the `ioepdcf` file.

Privilege required

The issuer must be logged in as root on the local machine. On z/OS, *root* refers to a user with a UID = 0 or BPX.SUPERUSER authority.

Implementation specifics

The `dfsshare` command exports the file system that is referred to by the shared directory (if it is not already exported) before creating the shared directory. When `-detach` is specified, the shared directory is unshared but no file systems are unexported.

The `dfsshare` command can only be issued from the z/OS shell. It is not supported as a TSO/E command.

To export an HFS or zFS file system, that file system must be owned by the system that the SMB server is running on. When export is attempted on a (sysplex) shared file system that is owned by a system other than the one that the SMB server is running on, the SMB server attempts to move the ownership of a shared HFS file system to the system that the SMB server is running on (when the `_IOE_MOVE_SHARED_FILESYSTEM` environment variable is ON in the `dfskeyn` process). If this is unsuccessful (when, for example, the file system is being exported by another SMB server on the other system), the SMB server will not be able to export that file system and it will not be available to PC clients.

Related information

Files:

devtab
dfstab
smbtab

Command:

dfsexport

dfssyntax

Purpose

The `dfssyntax` command is an SMB command that checks the syntax of an environment variable file.

Format

```
dfssyntax [filename]
```

Options

filename

The name of the environment variable file that will be checked for syntax errors.

Usage

The `dfssyntax` command performs automatic syntax checking on an environment variable. If no other environment variable file is specified, it checks the default file `/opt/dfslocal/home/dfskeyn/envvar`. The `dfssyntax` command writes messages to the console explaining the line number where the syntax mistake is located and any other problems it finds. Examples of syntax errors include blank lines, wrong environment variable name, wrong value for environment variable, trailing blanks, and others.

Privilege required

No privileges are required.

Related information

Files:

envair

Command:

dfssyntax

smbpw

Purpose

A z/OS UNIX command that stores the SMB password of a z/OS user in the RACF database for use with SMB encrypted password support. Encrypted password support is used when the SMB server is configured to support encrypted passwords by using the `_IOE_SMB_CLEAR_PW` environment variable in the `dfskern` process.

Format

```
smbpw [-pw1 newpassword -pw2 newpassword] [-help]
```

Options

-pw1 newpassword

Specifies the SMB password to be stored in the current z/OS user's RACF DCE segment. The SMB password can be up to 14 characters. If the user issues the `smbpw` command without providing the password, `smbpw` prompts the user for the SMB password.

-pw2 newpassword

Specifies the same password again. This is to verify that the password was entered correctly.

-help

Prints the online help for this command. All other valid options that are specified with this option are ignored.

Usage

During SMB login processing, when encrypted password processing is configured, the SMB server retrieves the user's SMB password from the user's RACF DCE segment. The `smbpw` command is used when a user needs to initially store or change the SMB password in their RACF DCE segment. The password entered is case-sensitive. That is, it is stored in the RACF DCE segment exactly as the user typed it. In general, the password should be entered in lowercase. It is folded to uppercase by the SMB server, if necessary. This command requires that the changed password is entered twice.

The user can provide none or both occurrences of the password on the command line. If none is supplied, the system prompts for the changed password and then prompts for the changed password again. These passwords are verified to match.

The `smbpw` command does not verify that the password specified is the same as your Windows password. If you enter an incorrect password twice, the password is saved. If you determine that you have stored an incorrect password, use `smbpw` again, supplying the correct password.

If you cancel of the `smbpw` command and remain in hidden mode, you can reset your terminal to make input invisible by usage of the `stty -sane` command. See [z/OS UNIX System Services Command Reference](#) for more information about the `stty` command.

Privilege required

No privileges are required.

Examples

In this example, mynewpw is the SMB password to be stored in the RACF DCE segment.

```
$ smbpw mynewpw mynewpw
```

The following example is the same as the preceding example except that the user is prompted for the new password.

```
TEST1:/home/test1/> smbpw
IOEW16057I Enter Password: mynewpw
IOEW16058I reenter Password: mynewpw
IOEW16055I Your password has been updated.
```

Passwords are not displayed when they are entered at the prompt. If you use a shell metacharacter (for example, \$) in your password and you specify it on the command line (as opposed to allowing smbpw to prompt for the password), you must use the escape character to keep the shell from interpreting it. For example, a password of p\$w must be specified: `smbpw p\$w p\$w` For more information about shell metacharacters, see [z/OS UNIX System Services User's Guide](#).

Implementation specifics

The smbpw command can only be issued from the z/OS shell. It is not supported as a TSO/E command. The user issuing the smbpw command must have a RACF DCE segment.

z/OS users should put the following line in their `.profile` file in their home directory: alternatively, the line may be placed in the `/etc/profile` file.

```
export _EUV_AUTOLOG=NO
```


Chapter 15. Tuning and debugging guidelines

This information is provided for administrators of the z/OS Distributed File Service SMB server; it describes the SMB tuning and debugging guidelines. The examples presented here are for illustrative purposes only; it is normal for the output of some reports to wrap.

As Figure 18 on page 119 shows, like most file system servers, SMB is dependent on many factors. If problems arise, SMB provides diagnosis information to help determine the sources of bottlenecks or the effect of a hardware or software change on SMB performance. SMB also provides environment variables and the output of QUERY commands. The default settings are sufficient for most installations.

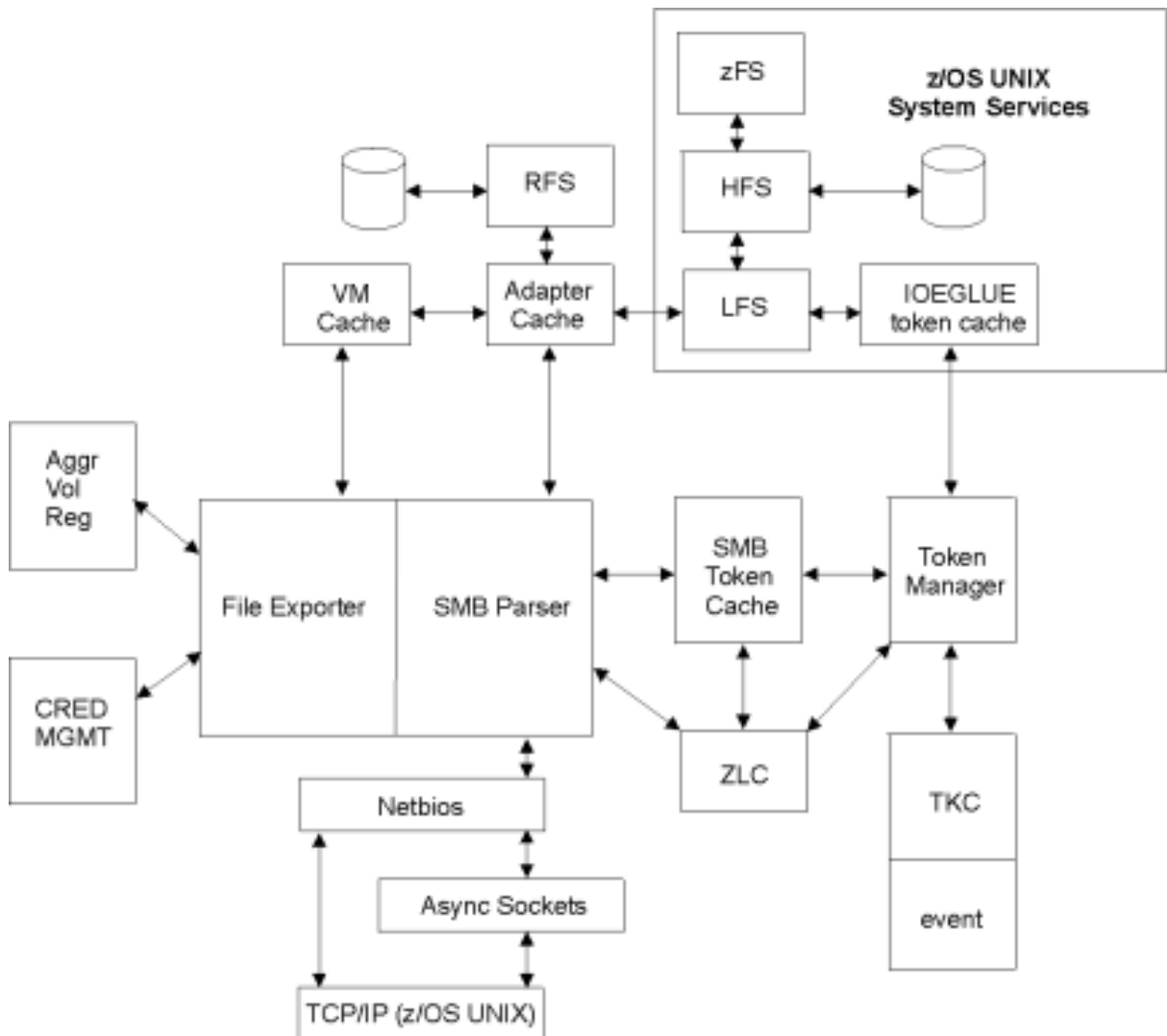


Figure 18: SMB server components

Tuning considerations and recommendations

z/OS Distributed File Service SMB server provides a **QUERY** command that provides information that is useful for gauging SMB performance and determining the effect of a change to a tuning option. In this document, tuning of the SMB server means:

- Determining the size of thread pools responsible for handling work

- Determining the amount of storage to reserve for various types of caches

Many of the SMB default settings or values work for most installations, but there are some defaults that might not be sufficient for larger installations. The most important tuning options are described in the following sections.

Threading

If the SMB server has a unit of work that needs to be dispatched on a processing thread and there are no available threads, that work needs to be placed on a queue to wait for an available service thread. The queue wait time increases server response time, therefore ensuring that the SMB server has enough defined processing threads. Distributed File Service default values for the number of processing threads is sufficient for smaller installations, but might be inadequate for larger production use. Each processing thread requires a certain amount of storage, therefore increasing the number of threads increases the storage requirements for the SMB server.

The following environment variables provide tuning options that control threading.

_IOE_SMB_MAIN_POOL

This **dfskern** environment variable controls the number of threads available to process incoming SMBs for the file server. This is an important tuning option for customers running SMB workloads.

_IOE_RFS_WORKER_THREADS

This **dfskern** environment variable controls the number of threads available to process RFS file system data set open or close requests. This is important for customers using RFS on a larger scale.

Caching

The following environment variable provides tuning options for disk caching.

_IOE_VM_CACHE_SIZE

This environment variable indicates how much file data to cache for SMB servers using disk caching. This is applicable to all server workloads, SMB, and all file systems such as zFS and HFS.

bufhigh

This rfstab (attribute file) site attribute indicates how much data to store in the RFS data set cache for RFS workloads. High RFS file read/write activity might require an increase in the size of this cache. See [Table 5 on page 94](#).

I/O balancing

There are no server tuning options that can be used to balance I/O among disks or networks. That is a function of the physical placement of the hardware and where file systems reside. However, the SMB **QUERY** commands can possibly point out a bottleneck in a particular disk or the overall network. I/O response times reported by SMB might show the effect of a bottleneck or the effect of the removal of a bottleneck.

QUERY command

The SMB **QUERY** command is useful for debugging problems and capturing performance information. The output of the **QUERY** command goes to the system log and the job output.

The syntax of the command follows; also, see [“modify dfs processes” on page 81](#) for related information.

```
modify dfs,send dfskern,query,<report>
```

Reports available for SMB

The following SMB query reports are listed in alphabetical order. References to z/OS UNIX physical file system (PFS) in this section include zFS, HFS, and TFS.

ADAPTERS

Shows the storage usage and performance of the SMB file server file status, directory contents, file name lookup, and file security cache used by the PFS and RFS. It also shows the number of calls made by the SMB protocol to the PFS and RFS and the average response time of each call. [“Diagnostics for file system cache” on page 137](#) shows sample output.

ALL

Shows every report described in this section.

FILESETS

Queries the fileset information. As shown in the following example, it includes the fileset name (file system), aggregate ID, flag field (A = attached, M = mounted, E = exported), number of SMB's, and number of local accesses.

```
modify dfs,send dfskern,query,filesets
```

Fileset Name	Aggr #	Flg	SMBs	Local
SUIMGK0.PRIVATE.FVT2.TESTSHR3	103	AME	6184	46
SUIMGK0.PRIVATE.FVT2.TESTSHR4	104	AME	1837	12
OMVS.PRIV.DCEIMGK0.HOME	55	AME	1	0
SUIMGK0.PRIVATE.FVT.TESTSHR1	101	AME	1	0
SUIMGK0.PRIVATE.FVT2	67	AME	1	0
SUIMGK0.PRIVATE.SMBC1	151	AME	1	0
SUIMGK0.PRIVATE.FVT	66	AME	1	0
SUIMGK0.PRIVATE.FVT.TESTSHR2	102	AME	1	0
SUIMGK0	110	A	1	0
G1SVT1	112	A	1	0

LEVEL

Queries the SMB service level. As the following example shows, it includes the module prefix, z/OS version and release identifier, service level, and FMID.

```
modify dfs,send dfskern,query,level

IOEN00195I DFSKERN: z/OS    Distributed File Service
Version 00.00.00 Service Level 00000000 00000000
Created on DAY DATE TT:TT:TT TIME ZONE YEAR.
IOEN00119I DFSKERN: SEND command - QUERY,LEVEL completed successfully.
```

LOCKING

Shows the SMB lock facility statistics. It includes the number of lock waits, the average lock wait time, and the time threads sleep waiting for certain specific events. [Figure 27 on page 142](#) shows an example.

RFS

Shows the access method counts and response times for the RFS physical file system. See [“Diagnostics for RFS” on page 140](#) for an example.

SERVTHREADS

Queries the running service threads. As shown in the following example, it includes the thread ID (TCB), thread start time, and thread run time.

```
modify dfs,send dfskern,query,servthreads

SMB Service Threads
-----

Coordinate Universal Time (UTC) is Mon Aug 07, 2006 13:09:54.452857

TCB          Thread Start Time (UTC)      Run Time (sec)
-----
007C9968    Mon Aug 07, 2006 13:09:54.215317      0.237540
007C9E88    Mon Aug 07, 2006 13:08:55.643607      58.809250

IOEN00119I DFSKERN: SEND command - QUERY,SERVTHREADS completed successfully.
```

SESSFS

Queries the SMB file systems per session. It includes the computer name, number of open files, socket number, IP address, SMB user ID, username, number of SMB requests, and file system names with open files for each session.

```
f dfs,send dfskern,query,sessfs

DFS/SMB Filesystems Per Session
-----

Number of active SMB clients = 4

Computer Name  Open Files Socket  IP Address  Uid  Username  Requests  Filesystem
-----
SMBCLIENT2    0      24    127.0.0.1  001E  TTT2      1
1234SMBCLI4    1      26    127.0.0.1  0014  TTT1     517
1234SMBCLI4    4      10    127.0.0.1  0001  JUS1    398228
SMBCLIENT1    0      23    127.0.0.1  0018  JUS2     333
IOEN00119I DFSKERN: SEND command - QUERY,SESSFS completed successfully.
```

SMBCOMM

Shows the TCP/IP asynchronous socket calls made by the file server for SMB client communications and the amount of queuing for incoming SMB requests. See [Figure 23 on page 131](#) for an example.

SMBINT

For the SMB file server, this report shows the number and type of remote Windows client SMB file requests made to the server, the average file server response and CPU times to process those requests, and the TCP/IP send and receive times that can be used to determine the network overhead for file server response times. See [Figure 21 on page 129](#) for an example.

SMBMAP

Queries the SMB map table and displays the current mappings of SMB user to z/OS user.

SMBPRT

Shows the number and type of calls made to the Infoprint Server and the average response time and CPU time of the Infoprint Servers per call. This is used to determine the performance of the Infoprint Server. See [Figure 22 on page 130](#) for an example.

SMBSESS

Queries the SMB sessions. As shown in the following example, it includes the computer name, number of open files, socket number, IP address, SMB user ID, username, and number of SMB requests for each session.

```
f dfs,send dfskern,query,smbseSS
                                     DFS/SMB Session Information
                                     -----

Number of active SMB clients = 4

Computer Name  Open Files Socket  IP Address      Uid  Username      Requests
-----
SMBCLIENT1ABCD      2      10   127.0.0.1      00CD TTT1      65
1234SMBCLI4         2      22   127.0.0.1      005E TTT5      2191
1234SMBCLI4         0      20   127.0.0.1      0186 STU1     25766
JUSER              1      23   127.0.0.1      01BF TSU2       73

IOEN00119I DFSKERN: SEND command - QUERY,SMBSESS completed successfully.
```

SMBUSERIDSHARES

Queries the automounted file systems. It includes the auto-mounted file system name, the z/OS user ID that was used to create the directory, and the number of users accessing the file system.

```
f dfs,send dfskern,query,smbuseridshares
                                     SMB Dynamic UserID Shares

Name/UserID      Users
-----
MYHOME/suimgko      1

IOEN00119I DFSKERN: SEND command - QUERY,SMBUSERIDSHARES completed successfully.
```

SMBTKC

Shows the storage usage and performance of the SMB token cache used to obtain tokens for remote SMB clients. It also shows SMB opportunistic lock callbacks and average callback response time. See [Figure 25 on page 133](#) for an example.

STORAGE

Shows the total storage used by the DFS file server. It includes storage obtained from the Language Environment heap, storage obtained from MVS subpools, and TCB owned storage. See [Figure 28 on page 143](#) for an example.

THREADS

Queries currently running threads. It includes the thread ID (TCB), the stack the thread is running on, the stack size, the routine that is running, the state of the thread, and the offset within the routine. [Figure 19 on page 126](#) shows an example.

TKM

Shows the token manager statistics for the SMB file server. It includes the size of the token manager cache and the token manager request rates. [Figure 24 on page 133](#) shows an example.

VM

Shows the storage usage and performance of the DFS file data cache that is stored in virtual memory. It is used to reduce disk I/O rates and physical file system calls. See [Figure 26 on page 135](#) for an example.

VNODE

Queries the vnodes. It includes the maximum number of vnodes, number of vnodes in use, number of root vnodes, and number of directory vnodes. These fields are not mutually exclusive.

```
modify dfs,send dfskern,query,vnode

VNODE Statistics
-----

Max vnodes:          6144
Vnodes in use:       16
Root vnodes:         12
Directory vnodes:    17
-----

IOEN00119I DFSKERN: SEND command - QUERY,VNODE completed successfully.
```

VOLREG

Queries the file system information in the volume registry. It includes the volume ID to file system name association and one the following status indicators:

- incorrect association
- exported
- not exported

RESET command

The **RESET** command clears the statistics monitored by the SMB file server. The **QUERY** command always displays the statistics since the server startup or since the last **RESET**. This allows an administrator to query performance for a given time period, such as during peak usage times.

The syntax for the server is as follows, where *report* is one of the following reports.

```
f dfs,send dfskern,reset,<report>
```

- ADAPTERS
- FILESETS
- LOCKING
- RFS
- SMBCOMM
- SMBINT
- SMBPRT
- SMBTKC
- STORAGE
- TKM
- VM

For example, the following command would clear the statistics kept for the STORAGE report.

```
f dfs,send dfskern,reset,storage
```

TRACE command

Restriction: You should only change tracing options under the advisement of your IBM service representative. An important aspect of SMB problem determination is its tracing capability. SMB has an internal (wrap around) trace table that is always tracing certain events. The initial size of the trace table is controlled by the **_IOE_TRACE_TABLE_SIZE** environment variable, but can be adjusted using the *tsize* subcommand on the **TRACE** command. For complete details, see [“modify dfs processes”](#) on page 81.

SMB hang detection

Restriction: Hang detection environment variables should only be changed under the advisement of your IBM service representative.

The SMB hang detector monitors the current location of the various tasks that are processing in SMB. At intervals, which are set through the **_IOE_HANG_DETECT_INTERVAL** environment variable, the hang detector scans the current user requests called into SMB. When the hang detector determines that a thread has remained in the same location for a predefined period of time, it flags the task as a potential hang and produces a dump to preserve problem data.

Occasionally, SMB hang detection might produce false hang dumps and an actual hang might go undetected. If **dfskern** issued a hang detection dump, or you suspect that **dfskern** is hung for some other reason (users are not getting a response), you can use the following procedure to determine if you have a hung thread.

1. In **dfskern**, issue the **f dfs,send dfskern,query,threads** command at 30 second intervals for two to three minutes and compare the output.
2. Compare tasks that remain in the same status (tcb,stack,routine,state,offset) across several different instances of **query,threads** output. If an entry is identical in each of **query,threads** output, there is presumably a hang.

Figure 19 on page 126 shows some typical threads in wait for work states that are common to see persist across multiple instances of **query,threads** output:

```
f dfs,send dfskern,query,threads

      Currently Running Threads
-----
TCB      Stack      Size      Routine      State
-----
006D0370 1440FC20      77824  async_service_thread  WAITECB  off=F366CE
D0 rtn=async_service_thread
006BEE88 1459AC20      8192  keep_alive_thread    SLEEP    off=00E8
rtn=keep_alive_thread
006B6D90 0C4CEC20      8192  tpq_HelperThread      SLEEP    off=0E6E
rtn=tpq_HelperThread
006CEBF8 0CE2C210     16384  ioeglue_service_thre  WAITECB  off=041C
rtn=ioeglue_service_thread
006D3738 0CE6E5F0      8192  tkm_TokenGcThread      SLEEP    off=0C30
rtn=tkm_TokenGcThread
006CDE88 1363EC20      8192  ioe_modifyClient      RUNNING
006CD748 136CDC20      8192  ipc_listen_thread      RUNNING
006C6350 1451CC20      8192  zlsNSReqResp          SLEEP    off=044C
rtn=MsgQueue::receive(int*,int)
006B65E0 0C4DDC20      8192  tpq_DispatcherThread  SLEEP    off=108E
rtn=tpq_DispatcherThread
006D6588 0CE80208         0  main                  PAUSED   off=80001C
84 rtn=main
006CD9D8 136C1C20      8192  fileset_timeout_hand  SLEEP    off=012C
rtn=fileset_timeout_handler
006BE968 145A4C20     16384  hang_daemon           SLEEP    off=02DC
rtn=hang_daemon
006D6258 0CD9A690      8192  sleeper_thread        CONDWAIT
006CD528 13C19C20      8192  ScavengerThread       SLEEP    off=02DA
rtn=TSrvEvent::waitEvent(unsigned)
006CDC68 136C6C20     16384  sync_daemon           SLEEP    off=01E2
rtn=sync_daemon
006BE138 1513DC20      8192  HostAnnounceThread    SLEEP    off=02DA
rtn=TSrvEvent::waitEvent(unsigned)
```

Figure 19: Typical thread states

Figure 20 on page 126 shows an entry for task 6856D8 that indicates a hang in **dfskern** when its status persists across multiple instances of **query,threads** output.

```
f dfs,send dfskern,query,threads

      Currently Running Threads
-----
TCB      Stack      Size      Routine      State
-----
006B56D8 1454EC20      77824  async_service_thread  SLEEP    off=2BF0
rtn=internal_item_obtain
```

Figure 20: Possible abnormal thread state

Conversely, if you reviewed the outputs and task 6856D8 changes status between outputs, you do not have a hang. For example, if the first **query,threads** command shows:

```
006B56D8 1454EC20      77824  async_service_thread  SLEEP    off=2BF0
rtn=internal_item_obtain
```

Then, 30 seconds later it shows the following output; this indicates the thread is progressing and not hung in `rtn=internal_item_obtain`.

```
006B56D8 1454EC20      77824  async_service_thread  WAITECB  off=WAITECB  off=F366CED0
rtn=async_service_thread
```

Data normalization

When analyzing performance information, you can normalize a performance metric with respect to the external request rate. For example, the SMBINT report records the number of SMBs received by the file server and the average SMB response time. Additionally, SMB provides many other fields that show count and average response times. When analyzing data, it is often easier to normalize a statistic per the average request response time.

For example, from the SMBINT report, the following was shown from a **QUERY** command:

```
Total SMB calls      5649396
Average DFS Response Time per SMB      2.158
```

Additionally, from the same QUERY command, the LOCK report showed the following:

```
Total waits for locks:      1366750
Average lock wait time:      0.535 (msecs)
```

Therefore, to get average SMB lock wait time per SMB, you could perform the following calculation. In this example, SMB lock wait time is approximately 25% of the overall response time.

```
Avg. Lock Waits per SMB = Total waits for locks / Total SMB calls = 0.242
                        -----
Avg. DFS lock wait time per SMB = Avg. Lock Waits per SMB X Average lock wait time
                                = 0.522
```

SMB server tuning

The following sections discuss considerations for tuning the SMB server.

Workloads

File server performance is controlled by many factors. Some factors are external, such as the requests the clients present to the server. The client workload determines much of the file server performance characteristics. For example, are there many large file reads or writes? Do the clients request many metadata operations such as file renames or deletions. Other factors include the file read to write ratio and write intensity of the workload.

SMB workloads

Because SMB Windows clients do not cache file status or directory contents nearly as often as other clients do, SMB workloads characteristically send much more file lookups and directory reads than other clients. While SMB workloads have much higher message rates per client user task or command, SMB caches data to return requests as fast as possible.

Tuning options

The following tuning options control the type of SMBs that flow from clients to servers. These are all environment variables that would be specified in the `dfskeyn` environment variable file. Refer to [Appendix A, “Environment variables in SMB,” on page 145](#) for possible values.

_IOE_SMB_RAW

Controls if the client can use the raw mode SMBs that send data in large amounts to the server. Enabling raw mode improves large file read and write performance but the administrator can disable this if desired. Enabling raw mode allows the client or server to send or receive up to 64K of data in one packet. Additionally, the transmission is optimized. For some networks, disabling raw mode improves performance and, therefore, SMB allows the administrator to disable raw mode transmission.

_IOE_SMB_MAXXMT

Controls how much data can be sent in one SMB. This variable controls how much data a client or the server sends in one SMB and determines the maximum size of single file read or write request. Any time a client desires to send more data in one SMB, it uses raw mode transmission for the read or write. A good test to determine the optimal settings for your network would be to make a simple test to copy large files to, or from, an idle server and track the response time. The test could be repeated with different options enabled at the server.

_IOE_SMB_OPLOCKS

Controls if clients are allowed to request an opportunistic lock when a file is opened for read or write. Opportunistic locks allow clients to cache the file data in certain cases, cache byte range lock requests, and perform read-ahead and write-behind optimizations. It is recommended that you run with oplocks enabled, which is the default.

_IOE_SMB_PROTOCOL_LEVEL

Determines the level of protocol negotiated with remote clients. It is the dialect that the client and server use to communicate with each other. The default is NTLMv2, which is the highest level of authentication protocol available.

Diagnostics

[Figure 21 on page 129](#) shows sample output from the SMBINT report. Use this information to determine the amount and type of file related calls made to the SMB file server by clients. Headings that refer to HFS can refer to any z/OS UNIX physical file system, such as HFS, zFS, and others.

SMB Call	Average DFS Count	Time (msecs) Response Time	CPU Time
smb_mkdir	20	144.581	31.926
smb_rmdir	20	96.246	19.172
smb_close	1779	3.310	2.195
smb_unlink	207	151.634	35.641
smb_mv	15	133.500	14.208
smb_getattr	1872	11.284	0.778
smb_setattr	469	8.206	0.872
smb_write	8644	343.186	12.129
smb_chkpath	45	6.176	0.516
smb_readBraw	154	6.149	4.993
smb_writeBraw	21	274.119	63.503
smb_setattrE	404	46.993	0.544
smb_getattrE	445	0.556	0.445
smb_lockingX	37	0.305	0.245
smb_openX	2008	30.339	6.214
smb_readX	20883	4.295	1.850
smb_trans2	2219	10.424	0.636
T2: find first	941	12.764	0.366
T2: find next	20	0.173	0.151
T2: qfsinfo	344	0.030	0.027
T2: qpathinfo	540	5.778	0.183
smb_findclose	20	3.793	3.670
smb_negprot	0	0.000	0.000
smb_sesssetupX	0	0.000	0.000
Total SMB calls	39262		
Average DFS Response Time per SMB		82.411	
Average DFS CPU Time per SMB		4.442	
TCP/IP Session read count:	47751	Avg Time:	0.136 (msecs)
TCP/IP Session write count:	39301	Avg Time:	0.252 (msecs)
Average TCP/IP call time per SMB		0.418	

Figure 21: Sample output from SMBINT report

This report shows the workload that is presented to the server from the SMB clients. It shows the type and performance of each SMB and an overall average. Additionally, the session read and write counts show performance of the TCP/IP calls made to read or write data on the client socket. This call time is included in the overall SMB response time but is not controllable by the SMB file server.

The administrator could use this information in the report to determine the effect of the setting of a tuning option or a hardware change on server SMB performance. Excessive TCP/IP send/receive times relative to the average SMB response time might indicate a network bottleneck. If the TCP/IP send plus receive time is greater than 50% of the overall SMB average response time, a network bottleneck is probably present.

Note: Only the SMB types that were received by the server since the last statistics reset are shown.

Figure 22 on page 130 shows sample output from the SMBPRT report. The SMBPRT report shows the calls that are made to the Infoprint Server on behalf of print requests that are received by the SMB server, the average response time, and CPU time of each call. This information can be used to determine the performance of the Infoprint Server and the portion of the SMB response time represented by Infoprint Server calls.

Infoprint Server API	Average Print Time (msecs)		Response Time	CPU Time
	Count	Failed		
AbortPrintFile	0	0	0.000	0.000
BeginEnumJobs	30	0	1.395	0.496
BeginEnumPrinters	0	0	0.000	0.000
CancelJob	1	0	23.560	2.879
ClosePrintFile	3	0	31.473	2.806
CreatePrintFile	3	0	15.222	2.475
EndEnumJobs	30	0	0.042	0.041
EndEnumPrinters	0	0	0.000	0.000
EnumJobs	60	0	0.574	0.314
EnumPrinters	0	0	0.000	0.000
GetJobInfo	8	0	1.422	0.798
GetPrinterInfo	110	3	1.886	0.530
HoldJob	0	0	0.000	0.000
InitAPI	2	1	558.078	37.522
ReleaseJob	0	0	0.000	0.000
SetTerminationHandler	1	0	0.016	0.016
TermAPI	0	1	0.000	0.000
WritePrintFile	55	0	0.271	0.253
Total Infoprint Server calls	303			
Average Response Time per call		5.251		
Average CPU Time per call	0.684			

Figure 22: Sample output from SMBPRT report

The calls to CreatePrintFile, ClosePrintFile, and WritePrintFile occur when files are being printed by PC clients on printers that are managed by the Infoprint Server. The response time listed is the average time the print request actually spent in the Infoprint server, processing the request, or waiting for a request to complete.

Having a PC client printer queue window open results in a high volume of GetPrinterInfo and xxxEnumJobs requests to be made to the Infoprint Server. A high value for this number can represent the fact that these windows stay open for extended periods of time. Doing this can lead to unnecessary network traffic, and network contention.

Each of these remote printer queue requests uses a thread that is represented by the dfskern environment variable _IOE_SMB_MAIN_POOL to execute. The system administrator should use this information to ensure that enough threads are present to process these requests along with the file-related requests from PC clients. If this number is too low, it can appear that the response time of the File portion of the SMB server is slow, but actually the file-related requests are being queued instead of immediately handled. See the SMBINT (Figure 21 on page 129) and SMBCOMM (Figure 23 on page 131) reports for more information about how the SMB requests are actually being received and handled by the SMB server.

SMB service threads

The SMB server has two thread pools to service incoming requests. If all threads are busy then incoming requests are queued until a service thread becomes available. There is a primary pool that is used to service most SMB requests and a secondary pool to handle callbacks from clients and is used to ensure that client callbacks have available threads to process them.

Tuning options

The following environment variables control the size of the SMB file server main and secondary thread pools. The storage requirements of an SMB processing thread is shown in the SMBCOMM report.

_IOE_SMB_MAIN_POOL

A whole number that indicates the number of threads to assign to the SMB file server main thread pool; the default is 14. This is shown as pool number 0 in the SMBCOMM report.

_IOE_SMB_CALLBACK_POOL

A whole number that indicates the number of threads to assign to the SMB file server secondary thread pool; the default is 2. This is shown as pool number 1 in the SMBCOMM report.

The default may not be good for all your workloads. If you have a large number of active clients you want to increase the size of the main thread pool. The following section provides a diagnostic aid that can help an administrator determine the optimal thread pool size.

Diagnostics

Figure 23 on page 131 shows sample output from the SMBCOMM report. This report indicates the incoming requests to the SMB file server and the amount of queuing that occurs.

SMB Asynchronous I/O Statistics					

Service	Thread	Stack	Size=76K	Number of	Pools=2
Pool: 0	Threads:	40		Pool: 1	Threads: 2
	SRB Accepts :		0	SRB Requests :	387008
	SRB Queued :		5		
	Schedules :		0	Accepts :	0
	Reads :		0	Readvs :	0
	Recvs :	386875		Recvfroms :	136
	Writes :	0		Writevs :	0
	Sends :	0		Sendtos :	0
	Cancelas :	0		Cancelsockets :	0

Figure 23: Sample output from SMBCOMM report

The number of threads in the pool and the size of each thread's stack is shown to allow for an approximate determination of the amount of storage required if a thread pool is adjusted in size. The SRB Accepts field indicates the number of new clients connecting since the statistics were reset (or since startup). The SRB Requests field is a raw count of client requests received by the server. The SRB Queued field indicates the number of requests that needed to be queued due to lack of service threads. The administrator should ensure that the percentage of requests queued is not more than 5% of the total requests since this represents increased response time to process SMB requests.

Token management

The following sections discuss token management.

Central SMB token manager

The SMB file server central token manager is a cache of tokens with a fixed maximum size. The administrator can tailor the maximum size. A large amount of file access activity increases the cache of tokens. When the central token manager runs out of tokens, it performs garbage collection to reclaim a large amount of tokens from clients. For more information, see **_IOE_TKM_MAX_TOKENS** in [Table 9 on page 145](#). It is possible to ensure garbage collection does not happen at all.

Local user glue

Local user access to file systems exported by SMB also obtain tokens to ensure remote client caches remain correct. The Distributed File Service glue code caches tokens in the UNIX System Services kernel address space. For all local user access to file systems exported by SMB, the glue code gets control and ensures needed tokens are obtained before the request is processed by the file system. If the tokens are in the cache then no call to the central token manager is needed. Administrators can set the size of this cache. When a token is needed from the central token manager a task switch is required. There are a pool of threads in the SMB file server address space reserved to process local user token requests and the administrator can set the size of this thread pool.

SMB token cache

To ensure proper file sharing semantics and client cache consistency, SMB uses token cache to obtain tokens for requests from the central token manager. Windows (SMB) clients use a form of caching called opportunistic locking. These opportunistic lock requests are mapped to SMB token requests. The server caches SMB tokens from the central token manager to reduce path lengths. Opportunistic locks may

require a callback to the client. The frequency of these callbacks and their average round-trip response time are shown in the SMBTKC report. The administrator can control the size of this cache by using tuning options. Although the SMB token cache can be set larger than the central token manager cache, the SMB token cache never uses more tokens than are available in the central token manager cache. The central token manager does not allow the cache maximum to be exceeded.

Tuning options

The central token manager cache maximum size can be set by using the following tuning options. For defaults, see [Table 9 on page 145](#).

_IOE_TKM_MAX_TOKENS

Maximum number of tokens that the central token manager can hold. The size of each token (in bytes) is shown in the TKM report.

The following tuning option controls the number of threads available to process local PFS user token requests. This is important if PFS file systems are updated concurrently from remote SMB clients and local PFS users.

_IOE_TKMGLUE_SERVER_THREADS

The number of threads available for processing requests from local PFS users to get tokens from the central token manager.

_IOE_TKCGLUE_CACHE_SIZE

Maximum number of files for the DFS glue token cache. When more files are cached, the need to obtain tokens from the central token manager decreases. The glue provides this cache in the z/OS UNIX Systems Services kernel address space.

The following tuning option controls the size of the SMB token cache.

_IOE_SMB_TOKEN_FILE_MAX

The SMB token cache allows the administrator to set the number of files that can have tokens cached. Although the maximum size is allowed to be exceeded (the central token manager really determines the maximum number of tokens and files with tokens), the SMB token cache tries to reuse its internal file structures before exceeding the maximum size. Setting the SMB token cache too small is permitted, though path lengths are larger because of the execution of the file reuse logic trying to keep the number of files or tokens cached below the maximum. The storage for an internal file and token structure is shown in the SMBTKC report ([Figure 25 on page 133](#)).

Diagnostics

[Figure 24 on page 133](#) shows sample output from the TKM report. The TKM report shows the maximum number of tokens allowed in the cache (Max Tokens) which is the administrator setting. The Allocated Tokens field indicates how many tokens are allocated and In Use indicates how many are in use by clients at the given time. Similarly, the Max Files, Allocated Files, and Files in Use indicate the file maximum, the number currently allocated in memory, and the number in use to hold client tokens. The most important fields in this report are GC Invocations and GC Failures. These numbers should be as close to 0 as possible. (0 is optimal). Do not invoke garbage collection more than a few times per day or peak period.

Token Management Statistics			

Token Ceiling:	262144	Allocated Tokens:	7168
Max Tokens:	17408	In Use:	111
Min Tokens:	128	Free Tokens:	7057
GC Invocations:	0	GC Failures:	0
Tokens Obtained:	220035	Tokens Returned:	208916
Tokens Revoked:	2237	Revokes Refused:	95
Max Files:	18496	Files Allocated:	5120
Min Files:	3082	Files Freed:	5107
Files In Use:	3095	Files Recycled:	57964
Max Filesets:	18496	Filesets in use:	43
Token struct size: 80 File struct Size: 120 Fileset struct size: 168			
IOEN00119I DFSKERN: SEND command - QUERY,TKM completed successfully.			

Figure 24: Sample output from TKM report

Figure 25 on page 133 shows sample output from the SMBTKC report, which shows a number of statistics related to SMB token cache performance. The important fields are the Total Callbacks To Clients and Average Callback Response Time. The counts should not be much more than a few percent of the total number of SMBs that are shown on the SMBINT report. The Files allocated and in-use count should be examined. If these values are greater than the maximum, then the SMB token cache is low on tokens. Server response times are increased slightly because of increased pathlength.

SMB Token Cache Statistics			

	Allocated	In-use	
	-----	-----	
Hosts	3	3	
Files	190	68	(Max: 4096, Struct size: 152)
Tokens	189	67	(Struct size: 72)
Open Holds	21	0	(Oplocked: 0)
Lock Holds	21	0	
Data Holds	55	1	
	Count		Count
	-----		-----
Token Obtains:	239	Token Returns:	212
Fast Revokes:	217	Slow Revokes:	0
File Opens:	1779	Compatibility:	0
Oplocks:	1779	Exclusive Grants:	0
Batch Grants:	0	Pre-CIFS Grants:	1509
Level2 Grants:	0	Failed Opens:	0
File Locks:	0	Permitted Checks:	29702
Tkset Adds:	43277	Longterm Holds:	40
Total Callbacks to clients:	72	Response Waits:	72
Average Callback Response Time: 20.335 (msecs)			

Figure 25: Sample output from SMBTKC report

Virtual memory file cache

The SMB file server has a cache that is used to contain file data to reduce disk I/O and perform read-ahead and write-behind of file data. This cache is hereafter referred to as the virtual memory (VM) cache. The administrator can tailor the maximum number of files to cache and how much storage is used to contain the cache. This disk cache is like most disk caches. It has least recently used (LRU) algorithms used to keep to most recently used file data in memory. This cache is used for all SMB server file systems: zFS, HFS, and RFS. The following sections are guidelines for tuning this cache for the different types of workloads and file systems.

SMB workloads

Windows (SMB) clients cache directory and file status information in some cases. It performs limited file data caching but the data is not cached. Therefore, the VM cache is important to these workloads. As with all data caching systems, the base measure of performance is the file read hit ratio. This is the percentage of times that a read request is satisfied from the cache rather than requiring a disk I/O. This ratio for SMB workloads should be at least 80-90%. The VM cache provides diagnostics and tuning options that allows the administrator to determine the performance of the cache and alter the cache performance. The PFS file systems also caches data in the address space, but the VM cache is used for the PFS file systems to reduce calls and hence reduce pathlength. A production SMB file server should be run with a larger VM cache for SMB workloads than the current 1 M default.

When running large workloads from many SMB remote clients, especially if accessing (create, write, delete) the same files, it might be beneficial to change defaults for a number of environment variables. You must ensure that you have sufficient real storage so that paging is not significantly increased. For example, in a test environment for 50 SMB clients running up to 100 active sessions, generating over 2 billion SMB calls in 24 hours, the following environment variable settings showed a significant improvement:

```
_IOE_SMB_MAIN_POOL=64 (This is related to the z/OS UNIX MAXTHREADS value.)
_IOE_TKM_MAX_TOKENS=256000
_IOE_VM_CACHE_SIZE=256M
_IOE_VM_MAX_FILES=32768
_IOE_VNODE_CACHE_SIZE=18432
```

Tuning options

The basic VM cache tuning options control how much storage is used for the cache and the maximum number of files allowed to be cached. The number of files can be set large because each in-memory structure that represents a file in the VM cache is not too large. The size of each file structure is shown in the VM report ([Figure 26 on page 135](#)). For the default values of these environment variables, see [Appendix A, “Environment variables in SMB,” on page 145](#).

_IOE_VM_MAX_FILES

Maximum number of files to cache.

_IOE_VM_CACHE_SIZE

Maximum size in bytes of the VM cache. The user can prefix the size with K or M to indicate kilobytes or megabytes, respectively. The following example sets the cache size to 256 MB.

```
_IOE_VM_CACHE_SIZE=256M
```

Diagnostics

[Figure 26 on page 135](#) shows sample output from the VM report. This report shows the performance of the virtual memory caching system since last reset or since server startup (whichever is most recent). [Table 6 on page 135](#) describes the important fields in the report.

Virtual Memory Caching System Statistics					

External Requests:					

Reads	37871	Fsyncs	251	Opens	119818
Writes	35362	Truncates	12723	Unmaps	3805
Asy Reads	2882	Getatttrs	283760	Schedules	7610
File System Reads:					

Reads Faulted	28075	(Fault Ratio	74.13%)		
Writes Faulted	0	(Fault Ratio	0.00%)		
Read Waits	1829	(Wait Ratio	4.83%)		
Total Reads	30766				
File System Writes:					

Scheduled Writes	35362	Sync Waits	223		
Error Writes	0	Error Waits	0		
Page Reclaim Writes	0	Reclaim Waits	168		
Write Waits	3	(Wait Ratio	0.01%)		
File Management: (File struct size=128)					

Total Files	4096	Free	3447	Pending	0
Unreferenced	649	Referenced	0	File Waits	0
Lookups	119818	Hits	80213 (Hit Ratio	66.95)	
Misses	39605	Reuses	0 (Reuse Ratio	0.00)	
Page Management (Segment Size = 64K) (Page Size = 4K)					

Total Pages	8192	Free	10	Pending	0
Unreferenced	8182	Referenced	0	Page Waits	0
Steal Invocations	15640	Steals From Self	0		
Files Stolen From	40164	Steals From Others	40164		
Waits for Reclaim	17				

Figure 26: Sample output from VM report

Table 6: Sections of the VM report

Report section	Contents
External Requests	Number of requests presented to the VM cache system. The most significant fields are Reads and Writes, which represent read and write requests made to the cache.
Reads Faulted	Read miss ratio, which is the opposite of hit ratio. Obtaining the hit ratio, you subtract the miss ratio from 100%. In this case, the hit ratio would be 100-74 = 26%.
Reclaim Waits	Number of times a thread had to be suspended when reclaiming cache pages for an in-progress I/O (an I/O for file data written in write-behind mode). This number should be low relative to the number of external requests. It represents a thread waiting on disk I/O. A higher number means slower general response time
File Waits	Number of times a thread had to be suspended waiting to obtain an in-memory VM cache file structure. It means that all the VM cache files are in-use and represents an extreme shortage of VM cache file structures. The preferred value is 0.
Total Pages	Total number of pages allocated to the VM cache. A page is 4K in size. In this case, there are 8192 pages, therefore, 32M.
Page Waits	Number of times a thread had to wait for a free page in the cache to become available. It represents cases where there is an extreme shortage of pages in the cache. This number should be low, preferably 0, and should not be more than 1% of the total external requests.

Table 6: Sections of the VM report (continued)

Report section	Contents
Waits for Reclaim	The VM cache allows only one thread at a time to reclaim pages from the cache for use for a new file read or write request. If another thread requires a page and it finds another thread is already running reclaim processing, it waits. The occurrence of this depends on how many concurrent threads are running at a time and how often reclaim needs to run. This count should be low (not more than a few percent of the total number of external requests).

The administrator can use these indicators and set the cache size to obtain an optimal size of the cache for their environment. If File Waits is high, then the number of files should be increased by setting the `_IOE_VM_MAX_FILES` environment variable to a higher number. If the number of Waits For Reclaim or Page Waits is high, then the maximum storage should be increased by setting the `_IOE_VM_CACHE_SIZE` environment variable to a higher number. See [Appendix A, “Environment variables in SMB,”](#) on page 145 for more information about these environment variables.

File system caches

Any z/OS UNIX System Services file system can share a cache that is used to store file status information, such as: owner ID, file change time, file permissions, directory contents, and directory name to vnode mappings. A vnode in SMB is much like a UNIX inode. It is the data structure used to represent a file system object, such as a directory or file. The RFS file system uses MVS access methods to manipulate data sets, while zFS is accessed through z/OS UNIX System Services. This cache hides zFS/RFS implementations that do not use the same interfaces as the rest of SMB. It also provides pathlength reduction because it reduces calls substantially to MVS access methods or zFS. The performance of this cache is essential for RFS performance.

Status

File status is cached in an extension to the vnode. By caching this status, calls are reduced to z/OS UNIX System Services or z/OS data set access methods. By caching vnode handles, the number of calls are reduced to z/OS UNIX System Services to obtain and return handles. The size of this cache is controlled by the administrator.

Permissions

The file system cache stores user permissions to file system objects. This is done by querying the permissions from SAF or z/OS UNIX System Services. By saving the permissions, calls to z/OS UNIX System Services or SAF are reduced.

Directory contents

The directory cache stores directory contents in SMB format. Use of this cache reduces lookup and directory read calls made to z/OS data set access methods or zFS.

Name lookup cache

The name lookup cache saves the directory entry name to associated vnode mappings; this reduces calls to obtain vnode handles.

Tuning options

An important tuning option for the shared SMB cache is the size of the directory cache. A larger cache allows directories to be cached and results in less calls to the associated physical file system routines. However, for large production systems, using a large vnode cache might be desirable.

`_IOE_VNODE_CACHE_SIZE`

Number of vnodes provided in the cache; the default is 6144. More vnodes are provided, if needed, resulting in less calls to physical file system to read file status, file permissions, and obtaining vnode handles. The size of a vnode structure is shown in the ADAPTER report. Also see, [VNODE report](#).

_IOE_DIRECTORY_CACHE_SIZE

Number of 512 byte blocks that can be used to store directory contents and name to vnode mappings.
The default is 2048 blocks, which is one megabyte of storage.

Diagnostics for file system cache

The following output is sample output from the ADAPTER report. Use the ADAPTER command to determine the performance of the shared PFS and RFS cache and the performance of the PFS. For an explanation of the report's contents, see [Table 7 on page 138](#).

```
Adapter Caching Statistics
-----
Vnode Cache Size = 6144 vnodes, structure size = 488 bytes
Vnode lookups = 1368121, hits = 1326732, ratio = 97%
Vnode invalidations = 41342
Directory Cache Size = 2048 (512 byte) blocks, Free = 729
Directory buffer refreshes = 0
Directory buffer reads = 5494594, hits = 5494594, ratio=100%
Get attributes calls = 2451296, hits = 2394971, ratio=98%
Name cache lookups = 5300598, hits = 5054509, avoided=246089, ratio=100%
Avoided set attributes calls = 1462
Access checks = 8145852, hits = 8063074, ratio=99%
Access cache invalidates = 82731

HFS Adapter Vnode Op Counts

Vnode Op                      Count      Vnode Op                      Count
-----
xoefs_hold                     1158433    xoefs_readdir                 143600
xoefs_rele                     7651388    xoefs_create                  41387
xoefs_inactive                  0           xoefs_remove                  41343
xoefs_getattr                  2043702    xoefs_rename                  8684
xoefs_setattr                   316196    xoefs_mkdir                   0
xoefs_access                    519908    xoefs_rmdir                   0
xoefs_lookup                    5313507    xoefs_link                    0
xoefs_getvolume                 0           xoefs_symlink                 0
xoefs_getlength                 0           xoefs_readlink                0
xoefs_ahsfid                    8149223    xoefs_rdw                      0
xoefs_fid                       0           xoefs_fsync                   14362
xoefs_vmread                    150510     xoefs_translate                0
xoefs_vmwwrite                  101034

Total HFS Vnode Ops    25653277
VFS Call               Count      Response Time      Average HFS Time (msecs)
-----
v_access                82778         1.443              0.021
v_lookup                 0             0.000              0.000
v_get                    0             0.000              0.000
v_getattr                56325         18.862             0.024
v_setattr                356120        7.694              0.065
v_create                 41387         41.396             0.196
v_link                   0             0.000              0.000
v_mkdir                  0             0.000              0.000
v_rdw                     265906        49.819             0.171
v_readdir                0             0.000              0.000
v_readlink               0             0.000              0.000
v_rel                    41342         3.549              0.041
v_remove                 41343         26.775             0.154
v_rename                  8684          28.960             0.349
v_rmdir                  0             0.000              0.000
v_rpn                    0             0.000              0.000
v_export                 0             0.000              0.000
v_symlink                 0             0.000              0.000
v_fstatfs                10140         0.059              0.041

Total VFS calls          904025
Average HFS Response Time per Call    22.553
Average HFS CPU Time per Call         0.101

RFS Adapter Vnode Op Counts

Vnode Op                      Count      Vnode Op                      Count
-----
xrda_hold                 0           xrda_readdir                  40
xrda_rele                  0           xrda_create                   219
xrda_inactive              0           xrda_remove                   197
xrda_getattr               17692      xrda_rename                   10
xrda_setattr               1479       xrda_mkdir                    20
xrda_access                21456      xrda_rmdir                    20
```

xrda_lookup	7555	xrda_link	0
xrda_getvolume	0	xrda_symlink	0
xrda_getlength	0	xrda_readlink	0
xrda_afsfid	50687	xrda_rdwir	0
xrda_fid	0	xrda_fsync	0
xrda_vmread	1591	xrda_translate	10059
xrda_vmwwrite	8468		
Total RFS Vnode Ops	119493		
RFS Adapter VFS Op Counts			
VFS Op	Count	VFS Op	Count
-----	-----	-----	-----
r_get	0	r_readdir	20
r_rel	222	r_create	219
r_getattr	57	r_remove	197
r_setattr	1259	r_rename	10
r_access	478	r_mkdir	20
r_lookup	5	r_rmdir	20
r_export	0	r_link	0
r_fstatfs	2	r_symlink	0
r_rpn	0	r_readlink	0
		r_rdwir	10059
Total RFS Operations	12568		

Table 7: Sections of the ADAPTER report

Report section	Contents
Adapter Caching Statistics	Details the performance of the caches. The hit ratios of the various caches should be approximately 80% or more. If the hit ratios are low, then the size of the vnode or directory caches could be increased. Vnode cache size Size of the vnode cache. It determines how many files or directories status and file permissions can be cached in the zFS/RFS cache. It also displays the size of an zFS/RFS vnode. Vnode lookups Number of searches for vnodes based on the inode (file number) and the hit ratio; the higher the hit ratio, the better. Directory cache size Size of the directory cache. Directory buffer reads Number of directory buffer read requests and the percentage of time the directory buffer was in storage. Get attributes calls Number of calls made to obtain file status information and the percentage of time valid attributes were found in the cache. Name cache lookups Number of calls made to find the vnode associated with a given file name. The percentage of times the vnode was found without a call to the HFS or RFS physical file system is also shown. Access checks Number of permission checks made and the percentage of times the permissions for a user were found cached.
HFS Adapter Vnode Op Counts	Number of each type of call made by the SMB protocol servers to the zFS adapter. Many of these calls do not result in a zFS call due to the presence of the shared cache.

Table 7: Sections of the ADAPTER report (continued)

Report section	Contents
Average zFS or HFS Time	Average response time and CPU time in milliseconds for each HFS or zFS physical file system call. The administrator determines the portion of the overall SMB response time that is represented by zFS or HFS calls, if desired. Changes to disk configurations would affect the performance of these response times because disk I/O wait time would be the predominant factor in these response times. Large HFS call times relative to the average SMB server response time could indicate DASD I/O bottlenecks.
RFS Adapter Vnode Op Counts	Number of calls made to the SMB protocol servers to the RFS adapter. Many of these calls do not result in an RFS file system call due to the presence of the shared cache.
RFS Adapter VFS Op Counts	Number of calls made to the SMB RFS physical file system. Response times are not given for these calls because SMB provides the support for RFS. The RFS report shows the z/OS access method response times.

HFS

In addition to the shared file system/RFS cache, most of the performance and tuning considerations are a function of the HFS file system. Use the appropriate HFS publications to tune the HFS file system.

RFS

The RFS file system maps POSIX based file I/O and maps them to z/OS data set access method calls. It uses z/OS access methods to store file status information into z/OS catalogs and retrieves the information later. The important factors regarding RFS performance is the number of access method and z/OS dynamic allocation calls made and their corresponding response times. SMB attempts to perform I/O efficiently to and from the corresponding data sets. It tries to read/write a large number of blocks when performing I/O and attempts to overlap processing with I/O as much as possible. However, much of RFS is gated by the access method performance and disk I/O performance and is therefore the most important measure of performance. Additionally, because of the nature of z/OS data sets, certain file access patterns such as random file access and file update patterns of Windows clients, RFS may be forced to perform small I/Os to the data sets or may perform synchronous I/O.

Tuning options

The adapter cache tuning options and VM cache tuning options are important for RFS performance because the larger those caches are the smaller the number of access method calls RFS needs to make. The following RFS tuning options are important.

_IOE_RFS_WORKER_THREADS

Sets the number of worker threads required to process RFS data set open/close requests. z/OS has a restriction where a data set must be closed by the same task that opened the data set. Because the SMB protocol exporters manage the threads to process incoming requests there is no control available to RFS to ensure a close request is processed by the same thread that opened the data set. SMB handles this restriction by making available a pool of threads used exclusively for data set open/close processing. The default size of this pool is one thread.

bufhigh

Many RFS processing options are specified in an RFS attributes file stored in the local z/OS UNIX physical file system. An important option is the size of the cache used to store BSAM data set blocks. The VM cache caches the file contents in POSIX byte stream format. BSAM record data sets require additional control information imbedded in the disk blocks; therefore, I/O to the data sets must use disk blocks properly formatted for the data set. RFS provides a buffer cache used to hold these blocks in raw data set format. A sufficient size for it should be provided. This size should be set to the average number of bytes being read/written at a moment in time by the server. The default is 2M.

blksize

Another RFS processing option is the *blksize* data set creation parameter. This can be specified on the user command line and/or the RFS attributes file. This option is used for creation of BSAM files.

Records should either be large, or should be grouped into large block sizes for efficient I/O performance. z/OS allows applications to specify a block size of 0 which means z/OS will determine optimal block size, this is the recommended setting by SMB for BSAM data sets (sequential data sets and PDS or PDS/E members).

recordsize

The RFS processing option specified in the RFS attribute file. This sets the size of the records for VSAM data sets. SMB will read/write up to 64K of data at a time to a VSAM data set. However, I/O is more efficient with larger records.

space

Another RFS processing option allows the administrator or user to specify the primary and secondary extent sizes of a data set. Data set creation and initial write takes longer if secondary extents are needed. It is best to use only a primary extent if possible, or at least make the secondary extents large enough so contents of the data set are not scattered.

Diagnostics for RFS

The following output is a sample output from the RFS report. The important fields in the RFS report are the access method counts, response times, and the open/close service threads statistics. The following output provides more information about the fields in this report.

```

                                FILBLK Management Statistics
                                -----
Active NAMEBLKs = 108
Active FILBLKs = 66
FILBLK inactivations = 0
FILBLK invalidations = 0

                                Logical I/O Statistics
                                -----
Logical Cache High = 4194304 (4096K) (4M)
Logical Cache Used = 0 (0K) (0M)
Cache Window Per File = 16
Logical Read Requests = 7752
Read-for-size Requests = 0
Read-for-offset Requests = 5
Out-of-sequence Reads = 0
Logical Write Requests = 12404
Out-of-sequence Writes = 0
Writes With Holes = 0
Logical File Syncs = 48
Logical File Sync Closes = 19

                                RFS Open/Close Thread Statistics
                                -----
Number of threads: 5 (stack size = 16K)
Open requests:      809   Queued:      0 (0.0%)
Close requests:     797   Queued:     24 (3.0%)
AsyClose requests:   12   Queued:      1 (8.3%)

                                Physical I/O Statistics
                                -----
Buffer Cache High = 2097152 (2048K) (2M)
Buffer Cache Used = 0 (0K) (0M)
Buffer Cache Steal Percent = 20%
Buffer Cache Trims = 249
Buffer Steals = 1108
Buffer Closes = 12

Dynamic Allocation Calls = 289
Dynamic Unallocation Calls = 267

                                Call Counts By Access Method
Access Method      OPENs      CLOSEs      GETs      PUTs      CHECKs      WAITs      *Total*
                   -----      -----      -----      -----      -----      -----      -----
                   READs      WRITEs
BPAM                40         40           0         15          30         15 |         140
BSAM               263        263        509        704       1276       1213 |        4228
QSAM                20         20          20         0           0         0 |          60
VSAM               526        526        640       4062        903         0 |        6657
*Total*            849        849       1169       4781       2209       1228 |       11085

                                Average Time Per Call By Access Method
Access Method      OPENs      CLOSEs      GETs      PUTs      CHECKs      WAITs      *Avg*
                   -----      -----      -----      -----      -----      -----
                   READs      WRITEs

```

BPAM	4.901	7.276	0.000	0.163	0.015	2.708	3.790
BSAM	10.202	23.315	0.200	0.186	0.120	4.688	3.521
QSAM	11.428	2.705	0.008	0.000	0.000	0.000	4.714
VSAM	44.727	42.300	1.894	0.891	0.694	0.000	7.696
Avg	31.371	112.676	1.124	0.785	0.353	4.664	8.630
Average CPU Time Per Call By Access Method							
Access Method	OPENS	CLOSEs	GETs READs	PUTs WRITEs	CHECKs	WAITs	*Avg*
BPAM	1.785	1.621	0.000	0.100	0.015	0.031	0.991
BSAM	2.097	1.705	0.112	0.104	0.055	0.028	0.292
QSAM	2.488	1.206	0.008	0.000	0.000	0.000	1.234
VSAM	13.534	9.203	1.628	0.495	0.581	0.000	2.334
Avg	9.177	26.340	0.940	0.436	0.269	0.028	1.532

Table 8: Sections of the RFS report

Report section	Contents
RFS Open/Close Thread Statistics	Shows the Number of threads available to process open/close requests, the number of requests, and the number of requests that needed to be queued (because all of the service threads were busy). If a large portion of open/close requests need to be queued, then response times increase because of open/close queue wait time when reading/writing files or directories. The size of each thread's program stack is shown to allow an approximation of the required storage if the number of service threads is changed.
Physical I/O Statistics	The Buffer Cache Steals and the Buffer Cache Trims sections indicate cases where storage needed to be stolen from other files in the cache, allowing an I/O to be performed for a given file. A high steal rate relative to the total number of RFS xida_vmread and xida_vmwrite calls (from the ADAPTER report) might indicate that the RFS buffer cache could be too small and the bufhigh RFS tuning option might need adjustment.
Access Method Statistics	RFS performance is determined by the response time of the z/OS access methods. SMB tries to read/write to files in large (64 K) amounts but certain client access patterns might prevent that. From this report, and the reports that detail external client requests, an administrator can determine the relative amount of access method calls per SMB and determine what portion of the response time the access methods use.

Locking and serialization

The following sections describe the information that the SMB server provides about internal lock performance.

I/O wait time affects lock wait time

In certain cases, the file systems require a lock to be held over an I/O operation. I/O waits are long relative to processor speed. The slower the disk response time, the longer the I/O waits. Therefore, disk I/O wait time affects not only those threads waiting on the I/O, but also other threads if the I/O waiter is holding a lock. Improving I/O response time often improves lock wait time and then overall file server performance.

File operation queuing

The SMB file server monitors certain events. One event is file operation queuing for SMB clients. The SMB protocol exporter queues file write operations and truncation operations on an internal file handle. This is done to ensure client requests are presented to the physical file system in order. This queuing does not introduce additional serialization because the physical file system locks the file in write mode when performing a write operation. However, file operation queue waits are part of the overall server response time. Hence, the locking and serialization diagnostics provide an indication of file operation queuing. This

queue time is directly related to physical file system performance, which is related to disk response times and the efficiency of physical file system file write algorithms.

Diagnostics

Figure 27 on page 142 shows sample output from the LOCK report. The important fields from the LOCK report are the Total waits for locks, Average lock wait time, Total monitored sleeps, Average monitored sleep time. These fields indicate average amount of time a thread processing an SMB request must wait on a lock or for access to a shared resource.

In Figure 27 on page 142, the SMB CS File Operation Queue Wait is not too large; therefore, the disk performance and the file system performance were good. File operation queue waits occur more frequently and the average wait time is longer when a disk is overloaded and occurs infrequently when the disk is not a bottleneck.

Locking Statistics					
Untimed sleeps:	16766	Timed Sleeps:	4769	Wakeups:	443450
Total waits for locks:	8900506				
Average lock wait time:	0.552 (msecs)				
Total monitored sleeps:	7048				
Average monitored sleep time:	5.347 (msecs)				
Top 15 Most Highly Contended Locks					
Thread Wait	Async Disp.	Pct.	Description		
-----	-----	-----	-----		
4977280	0	55.1%	LFS vnode main lock		
1959305	0	21.7%	LFS main transaction lock		
1272775	0	14.1%	LFS main equivalence class lock		
254672	0	2.8%	SMB time of day services lock		
154204	79264	2.6%	SMB AS queue lock		
81346	0	0.9%	LFS log map lock		
34953	33162	0.8%	SMB TKC global file LRU and free list lock		
42055	0	0.5%	LFS volume handle lock		
24416	0	0.3%	LFS buffer lock		
18548	0	0.2%	VM cache all file lock		
0	17195	0.2%	OSI Global queue of threads waiting for locks		
14504	0	0.2%	LFS allocation handle lock		
12283	0	0.1%	LFS vnode lock		
11319	0	0.1%	SMB CS handle table lock		
8014	0	0.1%	LFS file zero lock		
Top 10 Most Common Thread Sleeps					
Thread Wait	Pct.	Description			
-----	-----	-----			
7048	100.0%	SMB CS File Operation Queue Wait			
0	0.0%	VM Page Wait			
0	0.0%	VM File Wait			
0	0.0%	VM Page Reclaim Wait			
0	0.0%	SMB TKC Tkset Revoke Wait for Tkset Holds			
0	0.0%	SMB TKC Tkset Wait For Pending Revoke			
0	0.0%	SMB TKC Get Token Wait			
0	0.0%	SMB TKC Open-in-progress Wait			
0	0.0%	SMB TKC Callback Response Wait			
0	0.0%	SMB CS Oplock Break Read-Raw Wait			

Figure 27: Sample output from LOCK report

Storage usage

The SMB file server and client provides a command that reports storage usage of the runtime heap; this is storage that SMB allocates directly from base z/OS storage subpools. Therefore, all SMB allocated storage is shown, with the exception of storage that is allocated for thread stacks. There is no way for SMB to track that information, but Language Environment runtime options can show you that information. For more information, see [z/OS Language Environment Programming Guide](#).

Diagnostics

Figure 28 on page 143 shows sample output from the STORAGE report. The OSI Storage Statistics indicates current SMB program use of heap storage. The MVS Obtained Storage and TCB Owned Storage statistics sections indicate the number of bytes allocated directly from z/OS storage subpools.

```

                                OSI Storage Statistics
                                -----
Current allocated storage size: 49515778 (48355K) (47M)
Number of storage allocations: 722977
Number of storage frees: 721684

                                MVS Obtained Storage Statistics
                                -----
Current allocated storage size above 16M line: 303387036 (296276K) (289M)
Number of storage allocations above 16M line: 0
Number of storage frees above 16M line: 0

Current allocated storage size below 16M line: 1092 (1K) (0M)
Number of storage allocations below 16M line: 0
Number of storage frees below 16M line: 0

                                TCB Owned Storage
                                -----
Lock storage allocations: 157
Lock storage allocated:   11304
Non-lock storage allocations: 804
Non-lock storage allocated: 2317976
```

Figure 28: Sample output from STORAGE report

Appendix A. Environment variables in SMB

Table 9 on page 145 lists the environment variables that affect the behavior of the SMB components. The environment variables that begin with `_IOE` are interpreted by Distributed File Service processes. The other environment variables are interpreted by other z/OS components (for example, z/OS Language Environment).

Note: All the examples that are shown in the table must be entered on one line, with no blanks, even though some of them appear on multiple lines.

Table 9: Environment variables in SMB	
Name	Description
_EUV_AUTOLOG	This environment variable was formerly used to control whether DCE autologin processing is attempted. However, with the removal of DCE support in z/OS V1R13, this environment variable should always be set to NO for all SMB server processes. SMB users that use the <code>smbspw</code> command to store their SMB password should also specify NO in their z/OS UNIX environment. The valid value is: NO Do not enable single sign-on processing.
_EUV_SVC_MSG_LOGGING	This environment variable controls where SMB server messages are routed and displayed. Default value NO_LOGGING Expected value NO_LOGGING All messages are suppressed. It is not recommended to set (or default) to this value. CONSOLE_LOGGING This is the recommended setting. All messages are routed to the operator console. All messages are in English (the <code>NLSPATH</code> environment variable is not used). STDIO_LOGGING All messages are routed to the standard output file (the JES output). If it exists, <code>NLSPATH</code> is used for messages. Example <code>_EUV_SVC_MSG_LOGGING=CONSOLE_LOGGING</code> Where used All SMB server processes.
DCE_START_SOCKET_NAME	The path name that is used as the well-known socket name by the SMB server processes during initialization. Default value <code>/opt/dfslocal/home/dfskearn/ioepk.soc</code> Expected value Character string. Example <code>DCE_START_SOCKET_NAME=/opt/dfslocal/home/dfsctl1/ioepk.soc</code> Where used All programs. If the default is not being used, this environment variable must be coded in the <code>envvar</code> file for each process.

Table 9: Environment variables in SMB (continued)

Name	Description
LIBPATH	The path names used to find DLLs. Default value None Expected value Character string. Example LIBPATH=/usr/lib:/usr/lpp/Printsrv/lib Where used DFSKERN
NLSPATH	A POSIX environment variable that is used by SMB that sets the search path for message catalogs. Default value /usr/lib/nls/msg/En_US.IBM-1047/%N: /usr/lib/nls/msg/%L/ %N: /usr/lib/nls/msg/prime/%N Where used All SMB server processes.
TZ	Sets the time zone that is used by a process. The TZ environment variable is used for the process only and is not used to set the create or update time of the z/OS UNIX file. Default value localtime Where used All SMB server processes.
_IOE_DAEMONS_IN_AS	This environment variable controls whether the DFSKERN process runs in its own address space or in the DFS Server Address Space. Default value The default is ". If " is specified or the environment variable is not specified, dfskern runs in the DFS server address space. Expected value DFSKERN or " Example In this case, DFSKERN runs in its own address space. <pre>_IOE_DAEMONS_IN_AS=DFSKERN</pre> Where used DFSCNTL
_IOE_DFS_MODIFY_PATH	The path that is used as the well-known socket name by the SMB processes when registering with DFSCNTL to receive MODIFY commands (F DFS,QUERY DFSKERN). Default value /opt/dfslocal/home/dfscntl/modify.rendezvous Expected value Character string. Example _IOE_DFS_MODIFY_PATH=/opt/dfslocal/home/dfscntl/ test.rendezvous Where used All programs. If the default is not being used, this environment variable must be coded in the envvar file for each process.

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_DIRECTORY_CACHE_SIZE	The number of 512-byte blocks that are used to cache HFS directory entries. Default value 2048 Expected value The value that is specified must be a numeric value greater than or equal to 768. Example _IOE_DIRECTORY_CACHE_SIZE=4096 Where used DFSKERN
_IOE_DYNAMIC_EXPORT	If ON, when a client crosses a local mount point into a file system that is not known to the SMB server, the file system is dynamically assigned values and exported. Default value OFF Expected value ON or OFF Example _IOE_DYNAMIC_EXPORT=ON Where used DFSKERN
_IOE_EXPORT_TIMEOUT	The number of minutes that a file system must be idle before it is dynamically unexported. The root of a share is never dynamically unexported. Default value 15 Expected value OFF or a number of minutes greater than 0 and less than or equal to 480 (8 hours). Example _IOE_EXPORT_TIMEOUT=OFF Where used DFSKERN
_IOE_HANG_DETECT_DUMP_LIMIT	Specifies the maximum number of dumps for the hang detector to take. Default value 5 Expected value A number greater than or equal to five. Example _IOE_HANG_DETECT_DUMP_LIMIT=5 Where used DFSKERN
_IOE_HANG_DETECT_INTERVAL	Specifies the interval, in seconds, for which hangs are checked. Default value 10 Expected value A number greater than or equal to zero. Example _IOE_HANG_DETECT_INTERVAL=10 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_HANG_DETECT_OENODE_TIMEOUT	Specifies the period of time, in seconds, a thread must be hung before it is detected. When zero is specified, the hang detect function is off. Default value 0 Expected value A number greater than or equal to zero. Example IOE_HANG_DETECT_OENODE_TIMEOUT=30 Where used DFSKERN
_IOE_HANG_DETECT_THREAD_TIMEOUT	Specifies the period of time, in seconds, a thread must wait before it is detected as a hung thread. When zero is specified, the hang detect function is off. Default value 0 Expected value A number greater than or equal to zero. Example _IOE_HANG_DETECT_THREAD_TIMEOUT=50 Where used DFSKERN
_IOE_HFS_ATTRIBUTES_FILE	Specifies the path name of the hfsattr file that contains the definition of file name suffixes that controls if the data should be translated by the SMB server. Default value None Expected value Character string, 132 characters or less. Example _IOE_HFS_ATTRIBUTES_FILE=/etc/httpd.conf Where used DFSKERN This file contains AddType statements. All statements other than AddType are ignored. IBM supplies an example file in /opt/dfsglobal/examples/cmattr. This file can be copied and modified appropriately. It is recommended that the modified file reside in the /opt/dfslocal/var/dfs directory so that it is with the other customizable files.
_IOE_HFS_FILETAG	The valid values are as follows: IGNORE Do not query or set file tags. QUERY Honor tags when reading or writing but do not set tags when a file is created. SET QUERY and also set tags when files are created. Default value IGNORE Expected value IGNORE, QUERY, or SET. Example _IOE_HFS_FILETAG=QUERY Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_HFS_TRANSLATION	This environment variable controls the conversion of HFS data to the appropriate data format. Converts incoming data from ASCII ISO8859-1 (or the code page that is specified in the _IOE_WIRE_CODEPAGE environment variable of the <code>dfskern</code> process) to the local code page. Converts outgoing data from the local code page to ASCII ISO8859-1 (or the code page that is specified in the _IOE_WIRE_CODEPAGE environment variable of the <code>dfskern</code> process). Refer to “File data translation for HFS” on page 48 for information about data translation. Default value OFF Expected value ON, OFF, or AUTO ON means that all data is translated. OFF means that no data is translated. AUTO means that data that is received by (client write) or output from (client read) the SMB server is examined to determine if the data is text or not. When data is received by (client write) the SMB server, the first 255 bytes of data are compared against a table of valid text (ASCII) characters. If all 255 characters are valid characters, the file is marked for translation and all data is translated. Otherwise, the data is not translated. When data is output from (client read) the SMB server, the first 255 bytes of data are compared against a table of valid EBCDIC text characters. If all 255 characters are deemed to be valid characters, the file is marked for translation and all data is translated. Otherwise, the data is not translated. Refer to “devtab” on page 94 (auto parameter) for a list of valid code points. Example _IOE_HFS_TRANSLATION=ON Where used DFSKERN
_IOE_INHERIT_TRANSLATION	When ON, for a dynamically exported file system, the translation option of the parent file system is inherited. Default value ON Expected value ON or OFF Example _IOE_INHERIT_TRANSLATION=OFF Where used DFSKERN
_IOE_MOVE_SHARED_FILESYSTEM	Specifies whether the SMB server should attempt to move the ownership of (sysplex) shared file systems when it exports them. Default value OFF Expected value ON or OFF Example _IOE_MOVE_SHARED_FILESYSTEM=ON Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_MVS_DFSDFLT	The name of a RACF-defined user that is associated with unauthenticated users attempting to access shared directories or shared printers. This ID must be RACF-defined with a z/OS UNIX segment. Default value None Expected value A character string, eight characters or less. Example _IOE_MVS_DFSDFLT=DFSDFLT Where used DFSKERN
_IOE_PROTOCOL_RPC	An environment variable that controlled if the DCE DFS protocol is supported (using DCE RPC). As of z/OS Version 1 Release 13, with the removal of DCE support, this environment variable was disabled and is no longer used. Default value ON Expected value ON or OFF Example _IOE_PROTOCOL_RPC=OFF Where used DFSKERN
_IOE_PROTOCOL_SMB	An environment variable that controls if the SMB protocol is supported (using TCP/IP). Default value OFF Expected value ON or OFF Example _IOE_PROTOCOL_SMB=ON Where used DFSKERN
_IOE_RFS_ALLOC_TIMEOUT	Specifies the time period (in seconds) that an RFS data set remains allocated after there has been no access to the data set through the DFS/SMB server. After this time period, the data set is deallocated and is available to other applications such as ISPF. Default value 300 (5 minutes) Expected value A number greater than or equal to 30. Example _IOE_RFS_ALLOC_TIMEOUT=600 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_RFS_ATTRIBUTES_FILE	Specifies the name of the <code>rfstab</code> file that contains the table for describing the attributes that are used to manipulate RFS files. The value can be the name of an HFS file, a fixed block partitioned data set, or a fixed-block sequential data set with a record length of 80. Default value /opt/dfslocal/var/dfs/rfstab Expected value Character string that describes the attributes file being used (maximum 255 characters). Example _IOE_RFS_ATTRIBUTES_FILE=/'NFSADMIN.NFSS(NFSSATT)' Where used DFSKERN This environment variable can be overridden for specific file systems in the <code>devtab</code> file. See “devtab” on page 94.
_IOE_RFS_STATUS_REFRESH_TIME	Specifies the time interval (in seconds) that the SMB server uses to refresh its cache of exported record data set names and attributes. Default value 600 (10 minutes) Expected value A number greater than zero. Example _IOE_RFS_STATUS_REFRESH_TIME=360 Where used DFSKERN
_IOE_RFS_TRANSLATION	Specifies if RFS data should be translated. If conversion is on, incoming data is translated from ASCII ISO8859-1 (or the code page that is specified in the <code>_IOE_WIRE_CODEPAGE</code> environment variable of the <code>dfske</code> process) to the local code page. Outgoing data is converted from the local code page to ISO8859-1 (or the code page that is specified in the <code>_IOE_WIRE_CODEPAGE</code> environment variable of the <code>dfske</code> process). Default value OFF Expected value ON or OFF Example _IOE_RFS_TRANSLATION=ON Where used DFSKERN This environment variable can be overridden for specific file systems in the <code>devtab</code> file. Refer to “devtab” on page 94.
_IOE_RFS_WORKER_THREADS	Specifies the number of threads to be started in <code>dfske</code> to service open and close requests for RFS files. Default value 1 Expected value A number greater than zero. Example _IOE_RFS_WORKER_THREADS=3 Where used DFSKERN Note: This specification is related to the z/OS UNIX MAXTHREADS value. For more information, see step 5 in “Installing and configuring the SMB file and print server” on page 12.

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SERVER_NAME	The network name of the system. This environment variable should be used if there are several network connections on the z/OS system and the primary connection is not being used for the DFS system. Default value The name that is returned from the TCP/IP function, gethostname(). The name is the default name as determined from the TCP/IP TCPDATA file; it may not reflect the actual network name for the device being used for the DFS network. Expected value Character string that contains the network name of the system without a domain. Because TCP/IP returns the name in uppercase letters, you should also enter this name in uppercase.) Example _IOE_SERVER_NAME=RANDOM Where used All programs that use the TCP/IP function, gethostname().
_IOE_SMB_ABS_SYMLINK	Specifies whether the SMB server can use absolute symbolic links. Default value OFF Expected value ON or OFF Example _IOE_SMB_ABS_SYMLINK=OFF Where used DFSKERN
_IOE_SMB_AUTH_DOMAIN_NAME	Specifies the domain name of the Domain Controller. Default value None Expected value Domain name, 15 characters or less. Example _IOE_SMB_AUTH_DOMAIN_NAME=DOMAIN1 Where used DFSKERN
_IOE_SMB_AUTH_SERVER	Specifies the IP address of the domain controller that is used to authenticate PC users. Default value None Expected value An IP address (<i>n.n.n.n</i>, where <i>n</i> is a number in the range of 0 - 255). Example _IOE_SMB_AUTH_SERVER=9.200.150.99 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_AUTH_SERVER_COMPUTER_NAME	Specifies the computer name of the Domain Controller that is used to authenticate PC users. This name is used to pass the NetBIOS computer name of the Domain Controller to the Domain Controller. This name is not used to find a Controller. _IOE_SMB_AUTH_SERVER and _IOESMB_BACKUP_AUTH_SERVER are used for that purpose. Default value None Expected value Computer name, 15 characters or less. Example _IOE_SMB_AUTH_SERVER_COMPUTER_NAME=MYCOMPUTER Where used DFSKERN
_IOE_SMB_BACKUP_AUTH_SERVER	Specifies the IP address of the domain controller that is the backup for PC user authentication. Default value None Expected value An IP address (<i>n.n.n.n</i>, where <i>n</i> is a number from 0 to 255). Example _IOE_SMB_BACKUP_AUTH_SERVER=9.200.150.98 Where used DFSKERN
_IOE_SMB_BACKUP_AUTH_SERVER_COMPUTER_NAME	Specifies the computer name of the backup domain controller that is used to authenticate PC users. This name is used to pass the NetBIOS computer name of the Domain Controller to the Domain Controller. This name is not used to find a Domain Controller. _IOE_SMB_AUTH_SERVER and _IOESMB_BACKUP_AUTH_SERVER are used for that purpose. Default value None Expected value Computer name, 15 characters or less Example _IOE_SMB_BACKUP_AUTH_SERVER_COMPUTER_NAME= MYOTHERCOMPUTER Where used DFSKERN
_IOE_SMB_BLKSIZE	Specifies the block size value that is used by SMB clients. Default value 32 K Expected value 0 K, 8 K, 16 K, or 32 K (the K is required). If you specify zero, the SMB server returns the block size that is assigned by the PFS. Example _IOE_SMB_BLKSIZE=32K Where used DFSKERN
_IOE_SMB_BROWSE_INTERVAL	Specifies the maximum browser announcement interval (in milliseconds). Default value 720000 (12 minutes) Expected value A number in the range of 600000 (10 minutes) - 720000 (12 minutes). Example _IOE_SMB_BROWSE_INTERVAL=600000 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_CALLBACK_POOL	Specifies the number of secondary pool threads for processing SMB callback requests. Default value 2 Expected value A number greater than 0. Example _IOE_SMB_CALLBACK_POOL=3 Where used DFSKERN Note: This specification is related to the z/OS UNIX MAXTHREADS value. For more information, see step 5 in “Installing and configuring the SMB file and print server” on page 12.
_IOE_SMB_CLEAR_PW	Specifies the SMB server policy for flowing the SMB password in the clear. - REQUIRED specifies that passwords in the clear are required. - ALLOWED specifies that passwords in the clear are allowed. Authentication is attempted using encrypted passwords, if the client supports it. Otherwise, authentication is attempted, assuming an unencrypted (clear text) password was used. - NOTALLOWED specifies that passwords in the clear are not allowed. Authentication is attempted using encrypted passwords only. Because all supported clients include encrypted password support, the ALLOWED setting is not recommended. IBM suggests you use REQUIRED for clear passwords and NOTALLOWED for encrypted passwords. Default value REQUIRED Expected value REQUIRED, ALLOWED, or NOTALLOWED Example _IOE_SMB_CLEAR_PW=NOTALLOWED Where used DFSKERN If passthrough authentication is used, see “Using passthrough authentication” on page 56 for additional information.
_IOE_SMB_CONNECT_MSGS	This environment variable is for use in debugging or determining problems with connection issues. When in use, messages are issued for session connects, session configuration, and session cancels. Default value 0 (zero) Expected value 0 - No connection messages are issued. 1 - Only error connection messages are issued. 2 - All error and informational connection messages are issued. Example _IOE_SMB_CONNECT_MSGS=1 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_COMPUTER_NAME	Specifies the name being used by SMB redirectors (that is, clients) to contact this server. If a Windows Internet Naming Service (WINS) server is available (refer to the <code>_IOE_SMB_PRIMARY_WINS</code> environment variable), the SMB computer name is used to identify this server to the WINS server. Default value The TCP/IP host name of this system. Expected value Character string, 15 characters or less. Example <code>_IOE_SMB_COMPUTER_NAME=OS390DATA1</code> Where used DFSKERN If you are using Windows clients, this environment variable must specify (or be defaulted to) the TCP/IP host name to allow Search Computername functionality to work.
_IOE_SMB_CROSS_MOUNTS	When ON, SMB clients cross local mount points (as in prior releases). When OFF, SMB clients go under local mount points. Default value ON Expected value ON or OFF Example <code>_IOE_SMB_CROSS_MOUNTS=OFF</code> Where used DFSKERN
_IOE_SMB_DESCRIPTION	Specifies the description of this server that appears on the PC. Default value DFS/MVS CIFS Server Expected value Character string, 50 characters or less Example In this example, there are embedded blanks. <pre>_IOE_SMB_DESCRIPTION=z/OS File Server</pre> Where used DFSKERN
_IOE_SMB_DIR_PERMS	The permissions for a directory that is created by the SMB server at the request of an SMB client. (This can also be specified on a shared directory basis. See “smbtab” on page 105.) Default value 777 Expected value The specified value must be a three-digit numeric value, where each digit is greater than or equal to 0 and less than or equal to 7. Example <code>_IOE_SMB_DIR_PERMS=755</code> Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_DOMAIN_NAME	Specifies the name being used as the domain name for this server. If possible, specify the same domain or workgroup as your client PCs. Default value WORKGROUP Expected value Character string, 15 characters or less Example _IOE_SMB_DOMAIN_NAME=OS/390DOMAIN1 Where used DFSKERN
_IOE_SMB_FILE_PERMS	The permissions for a file that is created by the SMB server at the request of an SMB client. (This can also be specified on a shared directory basis. Refer to “smbtab” on page 105.) It also limits which write permission bits can be turned on by an SMB client. Default value 777 Expected value The specified value must be a three-digit numeric value where each digit is greater than or equal to 0 and less than or equal to 7. Example _IOE_SMB_FILE_PERMS=750 Where used DFSKERN If read-only is set, the write permissions (222) are turned off. In this case, a file with permissions of 750 would become 550. If Read-only is cleared, the write permissions that intersect with this specification are turned on. In the example, the intersection of 750 and 222 would cause 200 to be or'd into the permissions of the file.
_IOE_SMB_IDMAP	Specifies the location of the smbimap file. The smbimap file contains the mapping of SMB user IDs to z/OS user IDs. Default value None Expected value Character string specifying the path name of the smbimap file. Example <pre>_IOE_SMB_IDMAP=/opt/dfslocal/home/dfskern/smbimap _IOE_SMB_IDMAP=/'USERID.SMB.OPTIONS(SMBIDMAP)'</pre> Where used DFSKERN
_IOE_SMB_IDLE_TIMEOUT	Specifies how long (in seconds) an SMB session can remain inactive before it is terminated. Default value 400 Expected value A number in the range of 0 - 4294967295. Example _IOE_SMB_IDLE_TIMEOUT=4000 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_MAIN_POOL	Specifies the number of primary pool threads for processing SMB requests. This is the number of SMB requests that can be handled by the SMB server at the same time without queuing them. If you have a large number of concurrently active PC clients, consider increasing this number. We are referring to concurrently active users, not just logged on users. Concurrently active users are sending SMB requests to the SMB server at the same time. This number should be set to your best estimate of the maximum number of concurrent requests that might be received at the SMB server at the same time. Default value 14 Expected value A number greater than 0. Example _IOE_SMB_MAIN_POOL=20 Where used DFSKERN This specification is related to the z/OS UNIX MAXTHREADS value. For more information, see step 5 in “Installing and configuring the SMB file and print server” on page 12.
_IOE_SMB_MAXXMT	Specifies the maximum server buffer size that is returned on the SMB Server Negotiate response. Default value 65535 bytes Expected value A number in the range of 1024 - 65535 Example _IOE_SMB_MAXXMT=8192 Where used DFSKERN
_IOE_SMB_NT_SMBS	Specifies whether new SMBs in the NT protocol dialect are to be accepted from PC clients. There might be some workloads that perform better with this set to OFF. Default value ON Expected value ON or OFF Example _IOE_SMB_NT_SMBS=OFF Where used DFSKERN
_IOE_SMB_OCSF	Specifies whether OCSF is used for encrypted passwords. To use encryption hardware, OCSF (and, therefore, ON) is required. Default value ON Expected value ON or OFF Example _IOE_SMB_OCSF=OFF Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_OPLOCK_TIMEOUT	Specifies the Opportunistic Lock Timeout period (in seconds). Default value 35 Expected value A number in the range of 1 - 4294967295 Example _IOE_SMB_OPLOCK_TIMEOUT=60 Where used DFSKERN
_IOE_SMB_OPLOCKS	Specifies whether the server permits clients to use opportunistic locks on files and let some SMB clients cache data at the client. This can improve performance. Default value ON Expected value ON or OFF Example _IOE_SMB_OPLOCKS=OFF Where used DFSKERN
_IOE_SMB_PRIMARY_WINS	Specifies the IP address of the Windows Internet Naming Service (WINS) server that this server announces itself to and forwards proxy WINS requests to. Default value None Expected value An IP address (<i>n.n.n.n</i>, where <i>n</i> is a number in the range of 0 - 255). Example _IOE_SMB_PRIMARY_WINS=9.120.44.55 Where used DFSKERN
_IOE_SMB_RAW	Specifies whether raw mode is supported in the SMB Server Negotiate response. Raw mode is used for large data transfers. Default value ON Expected value ON or OFF Example _IOE_SMB_RAW=OFF Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_SETATTR_OVERRIDE	Specifies whether the SMB server should appear to allow a user who is not the owner of a file to set the modtime of the file to an explicit value. z/OS UNIX does not allow a user who is not the owner of a file to explicitly set the modtime to a specific value. However, when any user updates a file, the modtime is updated implicitly to the current time. So normally, when a file is updated, there is no need to explicitly set the modtime to a specific time value. Some Windows applications attempt to set the modtime explicitly when a file is saved. When the user is not the owner of the file, this attempt will fail and this failure is reflected back to the PC user. This attempt to update the modtime is unnecessary because the modtime will be updated implicitly to the current time. When this environment variable is set to ON, the SMB server will ignore the failure (to set the modtime to an explicit value) and avoid the failure of saving the file. The modtime will be set to the current time. Default value OFF Expected value ON or OFF Example _IOE_SMB_SETATTR_OVERRIDE=ON Where used DFSKERN
_IOE_SMB_SCOPE	Specifies the Scope ID for the Windows Internet Naming Service (WINS) server. The Scope ID defines a group of computers that recognize a registered NetBIOS name. (This should normally be omitted.) Default value None Expected value Character string, 224 characters or less Example _IOE_SMB_SCOPE=MYDEPARTMENTSCOPE Where used DFSKERN
_IOE_SMB_SECONDARY_WINS	Specifies the IP address of the Windows Internet Naming Service (WINS) server that this server announces itself to and forwards proxy WINS requests to if the Primary WINS server does not respond. Default value None Expected value An IP address (<i>n.n.n.n</i>, where <i>n</i> is a number in the range of 0 - 255). Example _IOE_SMB_SECONDARY_WINS=9.120.66.77 Where used DFSKERN
_IOE_SMB_TOKEN_FILE_MAX	Specifies the maximum number of files that the SMB token cache should keep tokens for. Default value 4096 Expected value A number greater than or equal to 4096. Example _IOE_SMB_TOKEN_FILE_MAX=6144 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_SMB_TRANSPORTS	Specifies whether SMB uses the TCP DIRECT mode (port 445) or NETBIOS mode (port 139) Default value NETBIOS Expected value NETBIOS, DIRECT, or BOTH Example _IOE_SMB_TRANSPORTS=BOTH Where used DFSKERN
_IOE_SMB_WINS_PROXY	Specifies whether this server can act as a Windows Internet Naming Service (WINS) server proxy. WINS requests sent to this server are forwarded to a WINS server on another computer (refer to the _IOE_SMB_PRIMARY_WINS environment variable). Default value OFF Expected value ON or OFF Example _IOE_SMB_WINS_PROXY=ON Where used DFSKERN
_IOE_TKGLUE_CACHE_SIZE	Specifies the number of file tokens for local HFS access that can be cached. Default value 4096 Expected value A number greater than or equal to 4096. Example _IOE_TKGLUE_CACHE_SIZE=8192 Where used DFSKERN
_IOE_TKM_MAX_TOKENS	Specifies the maximum number of tokens that can be held in the SMB server memory. Default value 10240 Expected value A positive number. The minimum value is 10240. Example _IOE_TKM_MAX_TOKENS=20480 Where used DFSKERN
_IOE_TKMGLUE_SERVER_THREADS	The number of threads to be started in DFSKERN to service token requests from the glue layer. The glue layer makes token requests during local HFS access. Default value 5 Expected value The specified value must be a numeric value greater than or equal to 5. Example _IOE_TKMGLUE_SERVER_THREADS=8 Where used DFSKERN This specification is related to the z/OS UNIX MAXTHREADS value. For more information, see step 5 in “Installing and configuring the SMB file and print server” on page 12.

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_TRACE_TABLE_SIZE	Specifies the size, in bytes, of the DFSKERN trace table. Default value 64 MB. Do not change this setting unless you are instructed to do so by IBM Service. Expected value A positive number 4 - 256 MB. The value can be a whole positive integer followed by a K (denoting kilobytes), or a whole positive integer followed by an 'M' (denoting megabytes). Example _IOE_TRACE_TABLE_SIZE=64M Where used DFSKERN
_IOE_USE_PTHREAD_SECURITY	When this environment variable is ON, pthread_security_np() is used to establish the user security environment. This results in security updates becoming active without restarting DFSKERN. Default value OFF Expected value ON or OFF Example _IOE_USE_PTHREAD_SECURITY=ON Where used DFSKERN
_IOE_VM_CACHE_SIZE	Specifies the size, in bytes, of the virtual memory used by DFSKERN for all file systems that are exported. The virtual memory is used for data in all file systems that are exported. Default value 10 M Expected value A positive number. The value can be a whole positive integer followed by a 'K' (denoting kilobytes), or a whole positive integer followed by an 'M' (denoting megabytes). Example _IOE_VM_CACHE_SIZE=2M Where used DFSKERN
_IOE_VM_MAX_FILES	Specifies the maximum number of files that can be contained in the virtual memory used by DFSKERN for all file systems that are exported. Default value 4096 Expected value A positive number. The minimum value is 4096. Example _IOE_VM_MAX_FILES=6144 Where used DFSKERN
_IOE_VNODE_CACHE_SIZE	The size of the HFS vnode cache, that is, the number of vnodes. Default value 6144 Expected value The specified value must be a numeric value greater than or equal to 6144. Example _IOE_VNODE_CACHE_SIZE=6144 Where used DFSKERN

Table 9: Environment variables in SMB (continued)

Name	Description
_IOE_WIRE_CODEPAGE	Specifies the code page to be used for text data on the wire for clients. Default value ISO8859-1 Expected value ISO8859-1 or <i>codepage</i> Note: The SMB server does not support translation of double-byte character set (DBCS) data. Example _IOE_WIRE_CODEPAGE=ISO8859-1 Where used DFSKERN

Appendix B. Additional information about using the SMB server

Important Note: The information provided in this section is outside the scope of the z/OS Distributed File Service SMB server. However, it is included here because it might be helpful to the SMB administrator or the PC user.

Resolving authentication issues

If you are attempting to use unencrypted passwords (for example, you are using environment variable `_IOE_SMB_CLEAR_PW=REQUIRED`), the local security policy might need to be updated to permit unencrypted passwords. You might have to update the registry setting on your PC client.

If you are using the encrypted password support and your users entered their SMB password in RACF using the z/OS UNIX `smbpw` command, this registry change is not necessary. Users who make this change to the registry do not need to remove it to use encrypted passwords.



Attention: Using Registry Editor incorrectly can cause serious, system-wide problems that may require you to reinstall Windows to correct them. Microsoft cannot guarantee that any problems resulting from the use of Registry Editor can be solved. Use this tool at your own risk.

Updating the registry for Windows clients

This section shows you how to update the registry for the supported Windows clients (see [“Supported SMB clients”](#) on page 3). The steps might vary depending on the Windows platform in use.

- 1. Open the **Control Panel**.
- 2. Double-click **Administrative Tools**.
- 3. Double-click **Local Security Policy**.
- 4. Expand Local Policies (under Security Settings).
- 5. On the left pane, click **Security Options**.
- 6. Double-click Microsoft network client: Send unencrypted password to third-party SMB servers.
- 7. Click Enabled, and then click **OK**.

If the registry still does not permit unencrypted passwords, do the following tasks:

- 1. Type `Regedit` in the search box. The Registry editor will open in a new window.
- 2. On the left pane, expand `HKEY_LOCAL_MACHINE`.
- 3. On the left pane, expand `SYSTEM`.
- 4. On the left pane, expand `CurrentControlSet`.
- 5. On the left pane, expand `Services`.
- 6. On the left pane, expand `Lanmanworkstation`.
- 7. On the left pane, click parameters.
- 8. On the right pane, select **EnablePlainTextPassword**.
- 9. Click Edit and select **Modify**.
- 10. Update value data to hex `"1"`.
- 11. Restart the client machine for the registry change to take effect.

Checking whether the client can communicate

If your Windows client is not communicating with the SMB server, make sure that the SMB traffic can communicate over the following TCP/IP ports, depending on which method you are using:

137-139

NetBIOS

445

TCP/IP direct option

It is possible that the SMB traffic is being restricted from getting to the SMB server; for example, a firewall may be in place. Contact your network or system administrator to verify that this traffic is permitted.

Insufficient space errors

Before saving certain files, some client applications attempt to determine whether there is sufficient disk space available. An SMB request is sent to the server to query the space available in that file system. The request is against the file system at the share name; the request is not in the file system where the saved file will reside. As a result, you might receive a message similar to the following message, which indicates that insufficient space is available to save the file.

The disk you were saving to or the disk used for temporary files is full.
Free some space on this disk and try again, or save to a different disk.

When crossing through multiple file systems or mount points, the SMB query only looks for space available at the share name and not in the file system below that point. This behavior is consistent with SMB implementations on other supported platforms.

Use one of the following scenarios to resolve this issue:

1. Statically exported file systems (_IOE_DYNAMIC_EXPORT=OFF)

Verify that sufficient space exists in the file system at the exported share name mount point. Increase the size of the file system defined by the entry in the **devtab** configuration file.

2. Dynamically exported file systems (_IOE_DYNAMIC_EXPORT=ON)

Verify that sufficient space exists in the file system at the exported share name mount point that represents the parent file system to any dynamically mounted file systems. Dynamically mounted file systems under the parent file system have no bearing on the amount of space returned from the query.

3. Automounted file systems scenarios (_IOE_DYNAMIC_EXPORT=ON and automount)

a. Accessing an SMB share using the **smbtab** & **USERID** keyword

Verify sufficient space is available for the automounted file system reference. For example, refer to the sample configuration files in [Figure 29 on page 165](#). If the user `smbuser` performed a `net use` command to `myhomedir` and entered the `dir` command, the file system `smbuser.auto.home` is automounted and exported by the SMB server. Insure sufficient space in that file system exists when saving in this file system or in any file systems mounted below this point.

b. Accessing an SMB share at the automount file system

z/OS UNIX System Services reserves this file system for automount processing. The response to a file system query at this point will return zero space available. In this scenario, add a static entry in your **devtab**, **dfstab**, and **smbtab** for that file system and access through that exported share name mount point to save the file.

For example, refer to the sample configuration files in [Figure 29 on page 165](#). If the user `smbuser` performed a `net use` command to `homedir`, and then proceeds to traverse into a directory called `smbuser`, that triggers the mount of the file system `smbuser.home.auto`. If the user attempts a save there, the query file response would return zero bytes available.

```

smbtab entry:
/dev/ufs10    myhomedir    ufs    "Each user's home directory"    r/w    100    /&USERID
/dev/ufs10    homedir        ufs    "Each user's home directory"    r/w    100    /

dfstab entry:
/dev/ufs10    hfs10          ufs    0,,10

devtab entry:
"*AMD/home/automnt"    binary

u.map entry:
name                *
type                HFS
filesystem            <uc_name>.AUTO.HOME
mode                rdwr
duration            nolimit
delay                10

auto.master entry:
/home/automnt /etc/u.map

```

Figure 29: Sample configuration file

Editor or word processor changes the owner/permissions of the HFS file

When many editors and word processors save a file, they do not simply update the file. Rather, to avoid losing data if the system should fail during the save operation, they first create a file with a temporary name and save the data there; they then erase the original file and then rename the file with the temporary name to the original file name. Because a new file was created, it is owned by the user that created it. This user might be different from the owner of the original file. Also, the file permissions are changed to the default permissions, which might be different from the original permissions.

Editor or word processor cannot save a file to HFS

When many editors and word processors save a file, they do not simply update the file. Rather, to avoid losing data if the system should fail during the save operation, they first create a new file with a temporary name and save the data there, then they erase the original file, and then they rename the file with the temporary name to the original file name. Since a new file is being created, the user must have write and execute permission to the directory that the file is contained in and read and write permission to the file. If the user does not have the required permissions on both the directory and the file, the save is denied.

Different end of line characters in text files

The PC environment and the z/OS UNIX environment normally use different end of line characters in text files. The end of line characters are placed into the file as the text lines are written by the application (for example, an editor) based on the environment the application is running on (Windows versus z/OS UNIX). If you are sharing text files between the PC environment and the z/OS UNIX environment, one of the environments sees end of line characters at the end of each line of text that it does not normally expect. Some applications might not process a text file if the wrong end of line characters are in the text file. For example, the C/C++ compiler does not compile source code with PC end of line characters. You should try to use applications on the PC that support z/OS UNIX end of line characters. Microsoft WordPad correctly displays text files that have z/OS UNIX end of line characters. However, when the file is saved, the end of line characters are changed to Windows end of line characters. There are also PC applications that optionally create a text file with z/OS UNIX end of line characters. An example of an application that creates a text file with z/OS UNIX end of line characters is MicroEdge Visual SlickEdit. Many PC applications tolerate z/OS UNIX end of line characters.

To determine which end of line characters are contained in a text file, you can use the following z/OS UNIX command to display the hexadecimal values of the characters in a file, where *textfile.txt* is the name of the text file you want to display.

```
od -cx textfile.txt
```

When a text file has PC end of line characters, you can create another file with the same data but with z/OS UNIX end of line characters. To do so, issue the following z/OS UNIX command, where *textfile.txt* is the text file with PC end of line characters and *newfile.txt* is a new text file with z/OS UNIX end of line characters.

```
tr -d '\r' <textfile.txt >newfile.txt
```

In general, z/OS UNIX text files contain a newline character at the end of each line. In ASCII, newline is X'0A'. In EBCDIC, newline is X'15'. (For example, ASCII code page ISO8859-1 and EBCDIC code page IBM-1047 translate back and forth between these characters.) Windows programs normally use a carriage return followed by a line feed character at the end of each line of a text file. In ASCII, carriage return/line feed is X'0D'/X'0A'. In EBCDIC, carriage return/line feed is X'0D'/X'15'. The `tr` command shown in the preceding example deletes all of the carriage return characters. (Line feed and newline characters have the same hexadecimal value.) The SMB server can translate end of line characters from ASCII to EBCDIC and back but it does not change the type of delimiter (PC versus z/OS UNIX) nor the number of characters in the file.

PC clients disconnect during high DASD I/O activity

When there is high DASD I/O activity on an HFS file system, there may be a long delay for HFS requests. This may cause the PC clients to disconnect from the SMB server because they think the SMB server is down. A possible bypass to this situation is to mount the HFS file system with a sync interval that is less than 60 seconds. For example, the following command sets the sync interval to 30 seconds for the HFS file system specified.

```
MOUNT FILESYSTEM('OMVS.ABC.DEF') MOUNTPoint('/abc/def') TYPE(HFS) MODE(RDWR) PARM('SYNC(30)')
```

See the TSO/E MOUNT command in [z/OS UNIX System Services Command Reference](#) for information about the sync interval parameter.

Note: This does not apply to zFS file systems.

Writing of data appears successful but data is not there

If a write failure occurs due to the file system being full, the error will be returned on close. If the application / client ignores the error, the operation will appear to be successful. This can also occur if the end of line characters cannot be found in text data.

Opening Excel spreadsheets stored on z/OS

If a user (user A) opens a Microsoft Excel spreadsheet that is stored on z/OS, and then a second user (user B) opens the same spreadsheet, a popup window appears that gives user B three choices:

1. Open the file read-only
2. Open the file read-only and be notified when the file has been saved or closed

3. Cancel - do not open the file.

In the popup window, the user that is indicated as having the file locked for editing might be inaccurate. If the current user that has the file open for write is using the z/OS SMB server and has not saved any updates, the editing user displayed is the last user that updated the file (possibly a while ago). See also [“Editor or word processor changes the owner/permissions of the HFS file” on page 165](#). Excel apparently causes the owner to change when the spreadsheet is saved. A user (who is mapped to a different z/OS user) might be denied access to the file. The error message displayed did not indicate an authorization problem but that the file was read-only or encrypted.

Inconsistent file attributes on copy

When the file copy operation is initiated, the file attributes are queried. In this scenario, the file has `r_x` authority. After the new file is created, an SMB can be issued to reset the write file attribute. If the file is later edited by the user, attempts to save the file might result in messages about the file being denied access. This behavior might be confusing because the user is the owner and, therefore, should have write access to the file.

The application performing the copy can determine how the file write permission is to be handled and can issue a set file attribute SMB call to reset the write permission file attribute.

For example, the DOS XCOPY command by default resets the read-only file attributes. If the `/k` option is specified, the file attributes are preserved.

Keeping medium weight threads during pthread_exit processing

APAR OA39909 describes changes by z/OS UNIX that enable applications to specify how medium weight threads handle pthread_exit processing. APAR OA45175 describes the SMB updates that were made as a result of the change in threading behavior. Because of the changes, SMB users must now specify that medium weight threads are to be kept by using the `_BPXK_UNUSEDTASKS=KEEP` environment variable.

Perform the following steps to set up this option in the environment file:

1. Locate the environment variable file:

```
/opt/dfslocal/home/dfscntl/envar
```

2. Set it as follows:

```
_BPXK_UNUSEDTASKS=KEEP
```

3. Recycle the DFS/SMB server processes (DFSCNTL/DFSKERN) to pick up the `_BPXK_UNUSEDTASKS` environment variable. Issue these commands:

```
C DFS
S DFS
```

If you try to STOP DFS (P DFS) instead of canceling it, you will see:

```
IOEP01104I DFS kernel has received STOP command.
IOEP01130A DFS kernel cannot end process 50331677.
EDC5143I No such process
```

If you try to RESTART DFSKERN without first canceling DFS(DFSCNTL), you will see:

```
IOEP01119A Daemon DFSKERN cannot be started because it has status of READY
```


Appendix C. Customizable files

Table 10 on page 169 summarizes the Distributed File Service example files that are supplied by IBM and where they are placed; you can customize these files to meet your local SMB support requirements. Files that apply to support that is not being used are created, but they do not need to be modified.

Most of the IBM-supplied files are copied from the `/opt/dfsglobal/examples` directory to the target subdirectory in `/opt/dfslocal (/etc/dfs)` by the `/opt/dfsglobal/scripts/dfs_cpfiles` program, which is run as part of the postinstallation processing for Distributed File Service. For more information, see Chapter 3, “SMB postinstallation processing,” on page 11.

The `dfs_cpfiles` program does not replace a file in the target directory if it already exists. When installing a new Distributed File Service release, you can compare the contents of the IBM-supplied files with your current customized files to determine if there are any new optional parameters that you might want to consider specifying.

The customizable files that are used for a previous release can be used for a new release if the same IP address, RACF user definitions, and exported file definitions also apply to the target image for the new release. If any of these definitions are not the same for the target image, the customizable files should be reviewed and modified, as required.

Table 10: DFS customizable files

IBM-supplied file	Customizable file
<code>/opt/dfs/global/examples/daemonct.envar</code>	<code>/opt/dfslocal/home/daemonct/envar</code>
<code>/opt/dfs/global/examples/devtab</code>	<code>/opt/dfslocal/var/dfs/devtab</code>
<code>/opt/dfs/global/examples/dfs.ioepdcf</code>	<code>/opt/dfslocal/etc/ioepdcf</code>
<code>/opt/dfs/global/examples/dfscntl.envar</code>	<code>/opt/dfslocal/home/dfscntl/envar</code>
<code>/opt/dfs/global/examples/dfsexport.envar</code>	<code>/opt/dfslocal/home/dfsexport/envar</code>
<code>/opt/dfs/global/examples/dfskern.envar</code>	<code>/opt/dfslocal/home/dfskern/envar</code>
<code>/opt/dfs/global/examples/dfstab</code>	<code>/opt/dfslocal/var/dfs/dfstab</code>
<code>/opt/dfs/global/examples/cmattr</code>	<code>/opt/dfslocal/var/dfs/hfsattr</code> Defined by environment variable <code>_IOE_HFS_ATTRIBUTES_FILE</code> .
<code>/opt/dfs/global/examples/rfstab</code>	<code>/opt/dfslocal/var/dfs/rfstab</code>
<code>/opt/dfsglobal/examples/idmap</code>	<code>/opt/dfslocal/home/dfskern/smbidmap</code> Defined by environment variable <code>_IOE_SMB_IDMAP</code> .
<code>/opt/dfs/global/examples/smbtab</code>	<code>/opt/dfslocal/var/dfs/smbtab</code>

Files and directories in the `/opt/dfsglobal` directory

Table 11 on page 170 lists the directories and files in the `/opt/dfsglobal` directory. These files or directories are created during the installation process. The symbolic link `/opt/dfsglobal` refers to the directory `/usr/lpp/dfs/global`.

Table 11: Files and directories in /opt/dfsglobal.

File or directory	Description
/opt/dfsglobal/bin	Contains commands: dfsshare, dfssyntax, and smbpcw.
/opt/dfsglobal/examples	Contains example files for devtab, dfstab, ioepdcf, and rfstab; it also contains the example environment variable files for the DFS server processes. In addition, the directory contains the following program files: asc2eb.cmd Converts ASCII characters to EBCDIC characters. eb2asc.cmd Converts EBCDIC characters to ASCII characters.
/opt/dfsglobal/lib/nls/msg/En_US.IBM-1047	Contains message catalogs for Distributed File Service.
/opt/dfsglobal/src/COPYRIGHT.DFS	Contains the copyright information for Distributed File Service.
/opt/dfsglobal/script/dfs_cpfiles	Contains the z/OS shell script for the program that creates the default configuration files for z/OS Distributed File Service.

Symbolic links to /etc/dfs created during installation

Table 12 on page 170 lists the frequently-used symbolic links that are created during installation.

Table 12: Symbolic links created to /etc/dfs during installation

Symbolic link	Linked file
/bin/dfsexport	../usr/lpp/dfs/global/bin/dfsexport
/bin/dfsshare	../usr/lpp/dfs/global/bin/dfsshare
/bin/dfssyntax	../usr/lpp/dfs/global/bin/dfssyntax
/etc/ioepdcf	../etc/dfs/etc/ioepdcf
/opt/dfslocal	../etc/dfs
/opt/dfsglobal	../usr/lpp/dfs/global

Directories in /opt/dfslocal

Table 13 on page 170 lists the directories in /opt/dfslocal. All of these directories are created by the installation process.

Table 13: Directories in /opt/dfslocal.

Directory name	Description
/opt/dfslocal/etc	Contains the daemon configuration (ioepdcf) file.
/opt/dfslocal/bin	Contains binary files
/opt/dfslocal/home	Contains the home directories of the Distributed File Service daemons.
/opt/dfslocal/home/daemonct	Home directory of the daemonct process.
opt/dfslocal/home/dfscm	Home directory of the dfscm process
/opt/dfslocal/home/dfscntl	Home directory of the dfscntl process.

Table 13: Directories in /opt/dfslocal. (continued)

Directory name	Description
/opt/dfslocal/home/dfsexport	Home directory of the dfsexport process.
/opt/dfslocal/home/dfskern	Home directory of the dfskern process.
/opt/dfslocal/lib/nls/msg	Contains the DFS message catalogs.
/opt/dfslocal/syscall	Used to contain the socket for AFS_SYSCALL.
/opt/dfslocal/var/dfs	Contains administration and configuration files.
/opt/dfslocal/var/dfs/adm	Contains log files for the DFS server processes.
Note: The symbolic link /opt/dfslocal refers to the directory /etc/dfs.	

Customizable files in opt/dfslocal

Table 14 on page 171 identifies the files in the /opt/dfslocal subdirectories that can be customized. Many of these files are copied from the IBM-supplied files in the /opt/dfsglobal/examples directory to the applicable operational directory by the /opt/dfsglobal/scripts/dfs_cpfiles program. These files can be updated by an administrator using an editor such as OEDIT to specify environment variable values and other configuration information. These files should only be updated using the commands. The symbolic link /opt/dfslocal refers to the directory /etc/dfs.

Table 14: Files in the opt/dfslocal directory that can be customized.

File	Created by
/opt/dfslocal/etc/ioepdcf	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/home/daemonct/envvar	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/home/dfscntl/envvar	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/home/dfsexport/envvar	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/home/dfskern/envvar	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/home/dfskern/smbidmap	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/syscall/rendezvous	Server processing and is not customizable.
/opt/dfslocal/var/dfs/devtab	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/var/dfs/dfstab	The dfs_cpfiles program and is customizable by OEDIT.
/opt/dfslocal/var/dfs/hfstab	The dfs_cpfiles program and is customizable by OEDIT.
opt/dfslocal/var/dfs/hfsattr	The dfs_cpfiles program and is customizable by OEDIT.

Table 14: Files in the `opt/dfslocal` directory that can be customized. (continued)

File	Created by
<code>/opt/dfslocal/var/dfs/rfstab</code>	The <code>dfs_cpfiles</code> program and is customizable by OEDIT.
<code>/opt/dfslocal/var/dfs/smbtab</code>	The <code>dfs_cpfiles</code> program and is customizable by OEDIT.

Appendix D. Using data sets

This appendix explains what you need to know when you use data sets from a PC client. The SMB server can export record files (sequential, PDS, PDSE, and Virtual Storage Access Method (VSAM)). This makes record data available to PC client applications. The data is presented as byte stream data.

Note: Generation Data Groups (GDG) and multi-volume data sets (except for striped) are not supported.

Mapping between the PC client's view and record data

In z/OS, a file is called a data set. These two terms are used interchangeably. The files for a computer system are organized into a file system. The PC client environments use a byte file system that is a hierarchy of directories that can contain other directories or files. Record data, however, uses a non-hierarchical file system in which groups of data sets are referred to by specifying a high-level qualifier.

The high-level qualifier can include the first (leftmost) qualifier of data sets, or the first and second qualifiers, or the first, second, and third qualifiers, and so on. For example, SMITH is the high-level qualifier for the files named SMITH . TEST . DATA and SMITH . PROJ7 . SCHED, while SMITH . TEST is the high-level qualifier of SMITH . TEST . DATA and SMITH . TEST . DOCS.

Note: Only Integrated Catalog Facility (ICF) cataloged data sets are supported by the SMB server. Tape data sets are not supported.

The SMB server exports a set of files with a specified prefix as a single file system. All files with the specified prefix are shown as one level of hierarchy. If the data sets specified include partitioned data sets, a second level of hierarchy is shown.

Because RACF requires a data set profile that covers the prefix specified on the **devtab**, you must specify two levels of prefix to have it covered by a profile. For example, prefix USERA . PCDSNS is covered by data set profile 'USERA . **'. Otherwise, you must give the user the OPERATIONS attribute.

Mapping data sets onto an RFS file system

The example in this section refers to the data sets shown in [Figure 30 on page 173](#).

USERA.PCDSNS.B()	with members M1 and M2
USERA.PCDSNS.B.C	
USERA.PCDSNS.B.C.D	
USERA.PCDSNS.X.Y()	with members M1 and M2
USERA.PCDSNS.X.Y.Z	

Figure 30: Example of data sets to map to an RFS file system

The following sequence shows an example of SMB server commands and operations to export an RFS file system that contains data sets that begin with the prefix USERA . PCDSNS.

1. Add an **rfs** file system to the **devtab** file.

```
* RFS devices
define_ufs 3 rfs
USERA.PCDSNS
```

2. Add the **rfs** file system to the **dfstab**, file using the same minor device number in the device parameter (in this example, it would be /dev/ufs3). Use a unique file system name (for example, **rfs3**), a file

system type of **ufs** and a unique file system ID (for example, **102**). Finally, use a unique fileset ID (for example, **0,,1718**). An example **dfstab** entry might look like this:

```
/dev/ufs3 rfs3 ufs 102 0,,1718
```

You can use the same number for all the numeric values in a **dfstab** entry, as long as the number used is unique. For example, the **dfstab** entry might look like this:

```
/dev/ufs3 rfs3 ufs 3 0,,3
```

3. Add an entry in **smbtab** for the directory you want to share. Use the same minor device number in the device name parameter (in this example, it would be **/dev/ufs3**). Choose a unique share name (for example, **mvsusera**), a file system type of **ufs**, a description, share permission (for example, **r/w**), maximum users (for example, 100) and the directory name (in this example **/**). The directory name is relative to the root of the file system that the device name refers to.

```
dev/ufs3 mvsusera ufs "mvsusera data sets" r/w 100 /
```

RFS has many restrictions when writing to or creating files. If it is appropriate, you may want to specify read-only access to avoid these restrictions by using **r/o** in the share permission field of the **smbtab** entry.

4. Issue the following **dfsshare** command to cause the new share to be made available to PC users.

```
# dfsshare -share mvsusera
```

At this point, a PC user can connect to this share.

5. The PC user can now connect to the shared directory using the following **net use** command.

```
C:\>net use r: \\computer1.abc.com\mvsusera password
```

Figure 31 on page 174 represents a view of the data set hierarchy.

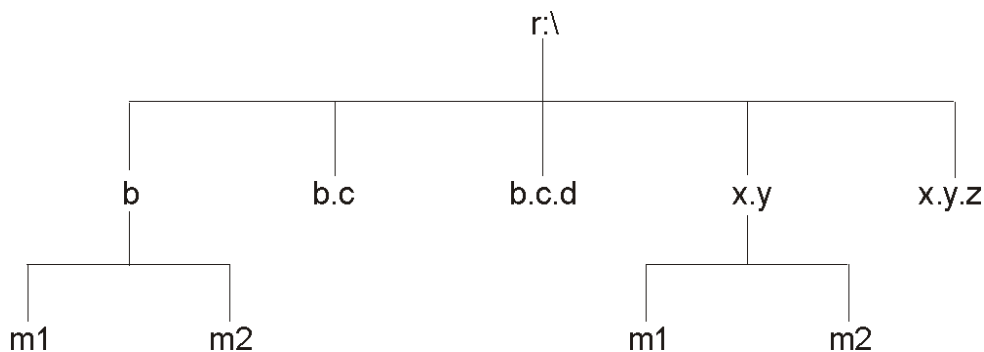


Figure 31: View of data set hierarchy

You can define one level of directory under the shared directory (at **r:**). Thus, you can issue **mkd1r** to create a directory (stored as a PDS or PDSE) and then create files (stored as PDS or PDSE members) within that directory.

Alternatively, if the prefix specified in the **devtab** is an actual data set, the SMB server attempts to export the data set. If the data set is a PDS (or PDSE), it is handled as a directory and the members are exported. However, in this case, sharing with local z/OS record applications is not supported. That is, the data set remains allocated the entire time that the data set is exported. If it is any other type of data set, the export for that data set fails. (The name that is specified for export must be able to be handled as a directory.)

Reading, writing, and creating data sets

You can use the SMB server to read data stored in a data set from your PC client system. You can also write data to a data set (stored on DASD) from your PC client system. The data sets appear as files on the drive letter on your PC client system.

You can create data sets from a PC client using the SMB server. The default record data set creation attributes specified by the system administrator are used to create data sets, unless the user overrides them. These attributes determine how the data set is structured and where it is stored. You can override the data set creation attributes at file creation time.

Sharing data

The sharing semantics that local z/OS applications accessing record data expect and the semantics that PC clients expect are very different. PC clients can potentially allow multiple users to be able to open a file for write. The file integrity is protected through the use of byte range locks. Local z/OS applications, in general, do not expect other users to be writing to the file (data set) while their application is writing.

Also, SMB clients request opportunistic locks when opening a file. Possession of an exclusive opportunistic lock means that the client can act on the file without communicating to the SMB server. The SMB server keeps track of opportunistic locks it has given out. When a PC client requests an opportunistic lock that conflicts with another opportunistic lock that the SMB server has given out, the SMB server issues a callback (requests that it be given back to the server) for that opportunistic lock. PC clients that receive callbacks give back the opportunistic lock as soon as they can. PC clients expect that all requesters are properly requesting and returning opportunistic locks. Local z/OS applications using record data sets do not request opportunistic locks.

As a result, the SMB server must provide one set of semantics and opportunistic lock management to the PC clients and another set of semantics with no opportunistic lock management to record data applications. In order to provide this, the SMB server must construct a "wall" between the PC clients and the record data applications that are attempting to access the same record file. PC clients or record applications can write the data, but not both. In some cases, they can both read the data.

Note that none of the following techniques for freeing the data set are supported when an actual data set (as opposed to a data set prefix) is specified in the **devtab**. This means that the RFS file system must be unexported to permit a batch job that needs access to the data set to continue. For example, the z/OS UNIX command **dfsexport /dev/ufs4 -detach** would unexport the data set (assuming that the **devtab** entry for the data set begins with **/dev/ufs4**).

The general technique that the SMB server uses to accomplish this is to do a dynamic allocate on any record data set that a PC client is attempting to access.

1. If the PC client is attempting to read record data, and the data set is not a PDS, the SMB server attempts a DISP=SHR allocation for the data set.

- a. If the data set is free, then the dynamic allocate issued by the SMB server is successful and the SMB server provides the record data set to its PC clients for reading.

A batch job that subsequently attempts to access that same record data set with an allocation of DISP=SHR successfully accesses the data set.

A batch job that subsequently attempts to access that same record data set with an allocation of DISP=OLD waits for the unallocate to occur. The SMB server is notified that a batch job is waiting for the unallocate. (The SMB server uses the Event Notification Facility (ENF) and an event supported by Global Resource Serialization (GRS) for resource contention. See *z/OS MVS Programming: Authorized Assembler Services Reference ALE-DYN* for information about the Event Notification Facility.) In this case, the SMB server frees up the record data set as soon as it can.

- b. If the data set is not free, the SMB server denies access to the data set. It appears to the PC clients that the data set is unavailable. (PC clients cannot wait an indefinite amount of time for the batch job to complete.)

2. If the PC client is attempting to write record data, or the data set is a PDS, the SMB server attempts a DISP=OLD allocation for the data set.

- a. If the data set is free, then the dynamic allocate issued by the SMB server is successful and the SMB server provides the record data set to its PC clients for writing.

A batch job that subsequently attempts to access that same record data set with an allocation of DISP=SHR or DISP=OLD waits for the unallocate to occur. The SMB server is notified that a batch job is waiting for the unallocate. In this case, the SMB server frees up the record data set as soon as it can.

- b. If the data set is not free, the SMB server denies access to the data set. It appears to the PC clients that the data set is unavailable. (PC clients cannot wait an indefinite amount of time for the batch job to complete.)

Releasing data sets

ISPF users attempting to access a record data set that has been accessed by PC clients may be denied access because the SMB server may still have the data set allocated. ISPF (and TSO users) use dynamic allocation, which does not cause resource contention (and therefore no resource contention event occurs). The allocation request is simply denied. The SMB server does not recognize that the data set is being requested for use. However, the SMB server deallocates data sets that have had no activity for a period of time. This makes the data sets available to other applications such as ISPF. The time period is controlled by the **_IOE_RFS_ALLOC_TIMEOUT** environment variable. The default time period is 5 minutes.

To make a data set available immediately, the user can submit a simple batch job that allocates the data set. This causes resource contention and, therefore, causes the SMB server to free up the data set as soon as it can. [Figure 32 on page 176](#) shows a simple batch job.

```
//JOBNAME JOB
//STEP1 EXEC PGM=IEFBR14
//DD1 DD DSN=USERA.PCDSNS.B.C,DISP=OLD
```

Figure 32: Sample batch job to make a data set available

If you are using JES3 to protect the data sets that are being shared with PC clients, resource contention does not occur (and, therefore, no resource contention event occurs). The SMB server does not recognize that the data set is being requested for use. In this case, you could request that JES3 bypass these data sets (by using the DYNALDSN statement). See *z/OS JES3 Initialization and Tuning Reference* for information about the DYNALDSN statement. Alternatively, you can use one of the other techniques that follow to free up the data set.

Another technique can be used by PC client users with the proper authority to force the SMB server to free up a data set. A user with RACF ALTER authority to the data set can issue the **mkdir "name,release"** command from a PC client machine. For example, **mkdir "b.c,release"** would cause the SMB server to free up the **USERA.PCDSNS.B.C** data set as soon as it can. (If *name* is a member of a PDS or PDSE data set, the entire PDS or PDSE data set is released.)

When you issue the **mkdir** release command, a **mkdir** error message is expected. As the following example shows, if the release was successful, the message indicates that the system attempted to access the file but the system could not do so because the object already exists.

```
E:\>mkdir "r:\b.c,release"
A subdirectory or file r:\b.c,release already exists.
```

This is because the PC client sends this request as a make directory request. Since we are not really making a directory at the server (rather, we are doing release processing against a file or set of files), we must send an error code indicating that the object already exists back to the PC client when the release

processing is completed successfully to keep the PC client from continuing with its create directory processing.

If the user does not have RACF ALTER authority to the file, the SMB server sends back EACCES (the user does not have the required permission) to the PC client. For a Linux Samba client, the **mkdir release** command can also be used. For example:

```
linux001:/mnt/rfs # mkdir "b.c,release"
mkdir: cannot create directory `b.c,release': File exists
```

Forcing a data set to be freed by SMB

An operator force command (**modify dfs**) is provided to force the SMB server to free up a data set if an important batch job has been waiting too long. In the following example, *data-set-name* is the name of the data set that the SMB server should make available.

```
modify dfs,send dfskern,release,data-set-name
```

Refreshing RFS file names

The SMB server uses the Event Notification Facility to determine when a batch job is attempting to allocate a data set that is currently being accessed by PC clients. When the SMB server detects this, it issues callbacks for all opportunistic locks and unallocates the data set (thus making it available to the batch job).

Because there is no event to indicate when data sets are created, deleted, or renamed by a batch job, the SMB server refreshes its cache of exported data set names and attributes at a regular interval. This interval is controlled by the **_IOE_RFS_STATUS_REFRESH_TIME** environment variable in the **dfskern** process. The time is specified in seconds and the default is 600 (ten minutes). In this case, a PC client listing file names when positioned at an **rfs** root directory may not see a new file created by a z/OS job for up to ten minutes after it is created.

This only affects commands that list file names and attributes. If a PC client creates an RFS file, that file can be directly referenced immediately after creation. Data sets or files created by a TSO user, a batch job or any z/OS application are not visible or immediately accessible to the PC client, until the deallocation time period (**_IOE_RFS_ALLOC_TIMEOUT**) and the refresh time interval (**_IOE_RFS_STATUS_REFRESH_TIME**) expire. In addition, if the data set or file remains opened by the z/OS user, batch job, or application after it is created, it is not visible or accessible to the PC client, until it is closed and both the deallocation time period and the refresh time interval expire. For details about the **_IOE_RFS_ALLOC_TIMEOUT** and **_IOE_RFS_STATUS_REFRESH_TIME** environment variables, see Appendix A, "Environment variables in SMB," on page 145.

Special considerations for record data

In addition to mapping between the PC client's view and z/OS file systems, you should be aware of the other ways in which the record data might differ from hierarchical byte data. These differences include:

- Selecting a data storage format
- File size determination and time stamps
- Client caching
- Record file names.

Selecting a data storage format for record data

PC clients can access data sets. These data sets are record oriented and can be sequential, direct, VSAM, partitioned, and so forth, and also can contain variable or fixed-length records. PC client environments, however, are byte-oriented and may write or read at certain byte offsets in the file.

The SMB server can map PC client requests to most types of data set organizations. However, how the time stamps and file size value are handled depends on the type of data set used, and the file size processing can affect performance.

Direct reads with the data set attributes **recfm(fbs)** or **recfm(f)** can be fast because in some cases, the SMB server can determine the physical block addresses from the record offsets. The z/OS sequential file organization with **recfm(f)** or **recfm(fbs)** on DASD allows for efficient updating or reading at any offset in the file. Other supported z/OS access methods (for example, VSAM) may not perform as efficiently.

Determining file size and time stamps

The SMB server determines how to handle the file size value and time stamps depending on the type of data set used and the attributes used to access the data set. Refer to [“Handling of the file size value” on page 186](#) for more information of file size determination and to [“Handling of the time stamps” on page 188](#) for more information about handling time stamps.

PC client caching

Record file data is cached at PC clients in the normal manner. PC clients request and return opportunistic locks as usual. However, if the SMB server fails and restarts, and you are currently positioned within an RFS file system, then you need to change directory (**cd**) back to the root of that RFS file system before you can access files within that RFS file system.

Record file names

As explained in “Mapping between the PC client’s view and record data” on page 173, record file names consist of segments separated by a dot with a maximum length of 44 characters. Each segment can be from one to eight alphanumeric characters. (See *z/OS DFSMS Using Data Sets* for information about data set naming.) Each record file appears as a byte file to PC clients. A PDS appears as a directory with the members appearing as files within the directory. PDS member names are limited to eight characters.

Data set names are always in uppercase characters. This means that file names would be displayed to PC client users in uppercase and would need to be entered in uppercase. There is, however, a processing attribute in the attributes file (refer to “Attributes file (rfstab)” on page 87 called **maplower**. **maplower** is the default. When this attribute is specified or defaulted in the attributes file, users can enter lowercase letters for file names and they are mapped to uppercase by the SMB server. Also, when the (uppercase) file names are displayed to the user, they are mapped to lowercase by the SMB server.

You are cautioned, however, that when the **maplower** processing attribute is in effect, you should only use lowercase letters for file names. If you create a file with the name AbCd, it becomes a data set named ABCD. When the file name is displayed to the (PC client) user, it appears as abcd. The file name would be displayed as a different name than the user entered when it was created.

Also, many byte file systems typically have file names that begin with a dot (.). This is an invalid name for a data set. However, a processing attribute in the attributes file called **mapleaddot** causes a leading dot in a file name to be mapped to a dollar sign in the data set name and back to a dot for the PC client. **mapleaddot** is the default.

Using the fastfilesize attribute

Read-for-size operations can be resource-intensive and can require long time cycles because the entire file must be read to obtain the exact file sizes. Consequently, the fastfilesize attribute for PDS, PDSE, DA, or non-system-managed data set might be used to improve performance. This attribute avoids read-for-size file operations by estimating the file size without opening and reading the entire file.

The method of obtaining directory and file information depends on what transactions are sent to the server by the SMB client or service (for example Windows File Explorer). If the fastfilesize attribute is defined, the file sizes might be displayed with a file size of zero. The client might not have requested the actual file size or the server might not have calculated an estimated file size. In addition, the size might not be current because the purpose of the fastfilesize attribute is to avoid a read-for-size file operation.

Due to this behavior, do not use the fastfilesize attribute. Instead, use the nofastfilesize attribute.

Creating z/OS files

This section describes how to create the various types of data sets (files) supported by the SMB server. The examples shown are for an MS-DOS session. Any examples for other platforms have been indicated.

Overriding data set creating attributes

When you create a z/OS file, default file creation attributes are applied, unless you override them. The attributes are passed to the z/OS host. Data set creation attributes are controlled in the following ways, in increasing order of priority:

- Default server data set creation attributes (refer to [“Attributes file \(rfstab\)”](#) on page 87)
- Default installation data set creation attributes, specified by the system administrator in the attributes file (refer to [“Attributes file \(rfstab\)”](#) on page 87)
- DFSMS data class attributes
- Data set creation attributes specified for the fileset in the **devtab** file (refer to [“devtab”](#) on page 94)
- Data set creation attributes specified at file creation, for example, in the **mkdir**, **notepad** (edit), or **copy** commands (highest priority).

The following data class attributes are not supported by the SMB server:

- Retention period/Expiration date
- Number of volumes
- VSAM imbed index option
- VSAM replicate index option
- CI size of data component
- Percentage of CI or CA free space.

Preparing to create a z/OS file

When you create a z/OS file, you may want to specify what type of file to create. These following types of files are supported by the SMB server:

- Physical sequential (PS)
- Direct access (DA)
- Partitioned data sets (PDS)
- Partitioned data sets extended (PDSE)
- VSAM KSDS
- VSAM ESDS
- VSAM RRDS
- Sequential Access Method (SAM) extended format data sets.

Note:

1. Keyed access to files is not supported by PC clients.
2. You can only share a PDSE between systems in the same parallel sysplex; z/OS does not support sharing PDSE between sysplexes.

Naming z/OS files

When naming conventional z/OS files, you must follow the file naming conventions, as described in [z/OS DFSMS Using Data Sets](#).

A file name (or data set name) can consist of one or several simple names joined so that each represents a level of qualification. For example, the file name DEPT58.SMITH.DATA3 is composed of three qualifiers.

The following characteristics apply to the file name:

- Each qualifier consists of 1 to 8 alphanumeric characters, national characters (@, #, \$), or a hyphen (-).
- Each qualifier must start with an alphabetical or national character.
- The period (.) separates simple names from each other.
- Including all simple names and periods, the length of the file name must not exceed 44 characters.
Note that the high-level qualifier that was exported (in [Figure 32 on page 176](#), it is `USERA.PCDSNS`) is added as a prefix to the file name. So, if you created file `r:\b.c.d.e`, the SMB server would create data set **USERA.PCDSNS.B.C.D.E**.
- PDS and PDSE member names can be up to 8 characters long.

Restrictions using alias names for z/OS files

For PDSs and PDSEs, alias names (for member names) are not supported. They are not displayed when you list the names in a directory (that is really a PDS or PDSE). You cannot access a file (member) by its alias name. If you try to create a file in the directory that has the same name as an alias, it is denied.

Creating physical sequential files

Note that the following examples assume that an **rfs** fileset is mapped to the `⌐:` drive and the data set prefix in **devtab** is `SMITH`. It is also assumed that these files are translated between ASCII and EBCDIC characters by an administrator specification of:

- `_IOE_RFS_TRANSLATION=ON`, or
- Text in the **devtab** entry for **rfs** fileset, or
- Text in the **attributes** file for the **rfs** fileset.

When creating a physical sequential (PS) file, specify the `dsorg(ps)` attribute (if it is not the default already) with a file creation command, such as the `notepad` command.

```
C:\>notepad "⌐:\new.txt,dsorg(ps)"
```

When you save the file using `notepad`, you have just created a new PS file named `SMITH.NEW.TXT`.

You must specify the `.txt` suffix on the file name. If you do not, `notepad` will automatically append it and will try to create `"new,dsorg(ps).txt"`, which will not be successful. You must also type a carriage return after the last line (or the only line) of the file. `Notepad` does not do this automatically.

An example for Linux Samba follows:

```
linux001:/mnt/rfs # vi "new.txt,dsorg(ps)"
```

When reading or changing data in a Physical Sequential file with fixed-length records in text mode, the `blankstrip` processing attribute in the attributes file controls how trailing blanks are handled. If `blankstrip` is specified in the attributes file, trailing blanks are removed from the end of each record when it is read, and blanks are padded to the end of each record when it is written. `blankstrip` is the default. If `noblankstrip` is specified in the attributes file, trailing blanks are not removed from the end of each record when it is read, and blanks are not padded to the end of each record when it is written. In this case, each record written must be the correct size or an I/O error is reported.

When copying a file to an RFS file system, if you are overriding the data set creation attributes, you must specify the target file name in the copy command. [Table 15 on page 181](#) shows examples of the how to do so correctly.

Table 15: Examples of commands to copy a file to an RFS file system

Form	Command example
Correct	C:\>copy file1 "r:\newfile1,space(2,5),cyls"
Incorrect	C:\>copy file1 "r:\,space(2,5),cyls"
Correct	linux001:/mnttrfs # cp file1 "newfile1,space(2,5),cyls"
Incorrect	linux001:/mnttrfs # cp file1 ",space(2,5),cyls" cp: cannot create regular file ',space(2,5),cyls': Invalid argument

Creating direct access files

When creating a direct access (DA) file, specify the **dsorg(da)** attribute (if it is not the default already) with a file creation command, such as the **notepad** command.

```
C:\>notepad "r:\new.txt,dsorg(da),blksize(80),lrecl(80),recfm(f)"
```

You have just created a new DA file named SMITH.NEW.TXT

You must specify the .txt suffix on the file name. If you do not, **notepad** will automatically append it and will try to create "new,dsorg(da),blksize(80),lrecl(80),recfm(f).txt", which will not be successful. You must also type a carriage return after the last line (or the only line) of the file. Notepad does not do this automatically.

An example of Linux Samba follows:

```
linux001:/mnttrfs # vi "new.txt,dsorg(da),blksize(80),lrecl(80),recfm(f)"
```

When reading or changing data in a Direct Access file with fixed-length records in text mode, the **blankstrip** processing attribute (in the attributes file) controls how trailing blanks are handled. If **blankstrip** is specified or defaulted to in the attributes file, trailing blanks are removed from the end of each record when it is read, and blanks are padded to the end of each record when it is written. If **noblankstrip** is specified in the attributes file, trailing blanks are not removed from the end of each record when it is read, and blanks are not padded to the end of each record when it is written. In this case, each record written must be the correct size or an I/O error is reported.

Creating PDSs and PDSEs

Partitioned data sets (PDSs) and partitioned data sets extended (PDSEs) can be used as directories, and their members are files within those directories. An illustration of the use of PDSs to act as directories is shown on page. For general information about PDSs and PDSEs, refer to [z/OS DFSMS Using Data Sets](#).

Note:

1. You cannot create new directories within a PDS or PDSE, due to the nature of these data structures.
2. You can only share a PDSE between systems in the same parallel sysplex; z/OS does not support sharing PDSE between sysplexes.

Creating a PDS or PDSE -- mkdir dsntype(pds), dsntype(library)

To create a PDS or PDSE, perform the following steps:

1. If creating a PDSE, use the **mkdir** (make directory) command specifying the **dsntype(library)** attribute to create a PDSE named smith.datalib:

```
C:\>mkdir "r:\datalib,dsntype(library)"
```

If creating a PDS, use the **mkdir** (make directory) command specifying the **dsntype(pds)** attribute as follows:

```
C:\>mkdir "r:\datalib,dsntype(pds),dir(20)"
```

You can omit specifying the **dsntype(pds)** attribute, if **pds** has been specified for the **dsntype** attribute in the attributes file listed in [Table 3 on page 89](#).

Examples for Linux Samba follow:

```
linux001:/mntifs # mkdir "datalib,dsntype(library)"
linux001:/mntifs # mkdir "datalib,dsntype(pds),dir(20)"
```

2. You can use the **copy** command to create a PDS or PDSE member named **smith.datalib(member1)**:

```
C:\>copy c:\otherfile.txt r:\datalib\member1
```

An example for Linux Samba follows:

```
linux001:/mntifs # cp otherfile.txt datalib/member1
```

You have now created a PDS or PDSE member. You can use the **type** command (the **cat** command for Linux) to view the contents of your PDS or PDSE member.

The SMB server supports a maximum of 14,562 members in a PDS or PDSE data set. When a PC read-directory request on a PDS or PDSE is processed, the SMB server returns up to 14,562 member names. Other requests, such as read and write, to individual members are not affected.

Removing a PDS or PDSE -- erase, rmdir

To remove a PDS or PDSE, first make sure that the PDS or PDSE is empty. You can delete all members under the directory using the **erase** command. Then use the **rmdir** (remove directory) command. The example shown in Figure 33 on page 182 removes the **datalib** directory, and confirms its removal by a failed try to query it (**dir** is the list files command).

```
C:\>dir r:\DATA LIB
Volume in drive R has no label.
Volume Serial Number is 0000-0000

Directory of r:\datalib

06/29/00  09:04p      <DIR>      .
06/29/00  10:51a      <DIR>      ..
08/01/96  12:19p           298 butcvsm
02/17/95  02:13p       1,019 copyunld
09/20/96  09:20a           550 su2aloc
09/18/96  07:13a           548 test
07/02/99  06:49a             0 testttext
07/02/99  07:56a            38 testtxt3
09/20/96  07:50a           547 textaloc
          9 File(s)          3,000 bytes
                           61,440,000 bytes free

C:\>erase r:\datalib\*
C:\>rmdir r:\datalib
C:\>dir r:\datalib
File Not Found
```

Figure 33: Example commands to remove a PDS or PDSE

Figure 34 on page 183 shows an example of Linux Samba commands that produce the same results as the commands shown in Figure 33 on page 182.

```
linux001:/mntifs # ls datalib
.  ..  butcvsm  copyunld  su2aloc  test  testtext  testtxt3  textaloc
linux001:/mntifs # rm datalib/*
linux001:/mntifs # rmdir datalib
linux001:/mntifs # ls datalib
/bin/ls: datalib: No such file or directory
```

Figure 34: Example of Linux commands to remove a PDS or PDSE

Accessing PDS or PDSE members

There is more than one way to access PDS and PDSE members. For example, you could display the existing PDS member `smith.source(bigblue)` by entering either of the command sequences shown in Figure 35 on page 183; these two approaches are equivalent.

```
C:\>type r:\source\bigblue
or
C:\>cd r:\source
C:\>type r:bigblue
```

Figure 35: Example commands to access PDS or PDSE members

Figure 36 on page 183 shows two examples of similar commands for Linux Samba follow.

```
linux001:/mntifs # cat source/bigblue
or
linux001:/mntifs # cd source
linux001:/mntifs/source # cat bigblue
```

Figure 36: Example of Linux commands to access PDS or PDSE members

Updating or extending a PDS or PDSE member

The SMB server does not generally support updating or extending a PDS or PDSE member directly. To update or extend a PDS or PDSE member, a client program must follow these steps:

1. Copy the file to the client machine
2. Update or extend the copied version on the local system
3. Truncate the original file to zero size by sending a SETATTR request with zero file size
4. Copy the updated version on the local host to z/OS by writing request.

Some client editors, such as the AIX and z/OS UNIX `vi` editor, follow the preceding steps. Other editors, such as the Notepad editor, do not follow those steps. In the latter case, the user must save the updated version into a new file. You cannot save the updated version into the PDS or PDSE, because Notepad will attempt to append `.txt` to the member name. You must save it somewhere else (for example, `c:\saved_updates.txt`) and then copy it into a new member in the PDS. For example:

```
C:\>copy c:\saved_updates.txt r:\datalib\member2
```

When reading or changing data in a PDS member or PDSE member with fixed-length records in text mode, the **blankstrip** processing attribute in the attributes file controls how trailing blanks are handled. If **blankstrip** is specified in the attributes file, trailing blanks are removed from the end of each record when it is read, and blanks are padded to the end of each record when it is written. **blankstrip** is the default. If **noblankstrip** is specified in the attributes file, trailing blanks are not removed from the end of each record when it is read, and blanks are not padded to the end of each record when it is written. In this case, each record written must be the correct size or an I/O error is reported.

Renaming or moving a PDS or PDSE member

Record file system (RFS) files and directories can only be renamed or moved in a way that does not cause them to be moved from one directory to another.

If you are writing to a PDS or PDSE member and a timeout occurs, the timeout causes the member to close. The remaining write requests appear to append to a PDS or PDSE member. This operation is not supported and causes an I/O error. To avoid timing out, increase the timeout setting.

Wildcard copy to a PDS or PDSE

To ensure that a wildcard copy, copy `c:\mydir\* r:\source`, to a PDS or PDSE can be completed successfully, a prior PDS member is closed and dequeued (if necessary) to allow the creation of a new member.

Limitations of writing to a PDS

The PDS support in the SMB server adheres to the conventions used in z/OS. For example, you cannot have more than one member of a PDS open for writing at a time. If you try to write to a member of a PDS while another member is open for write by a different user, you get a *** Permission denied message.

A PDS member stays open for the timeout period specified in the appropriate timeout processing attribute, **filetimeout**, or until you try to create or write to another member.

Concurrent writes to a PDSE

The SMB server supports concurrent writes to a PDSE. If you are writing to one member of a PDSE, another client can write to any other member in the same PDSE.

Creating VSAM files

The SMB server supports three types of VSAM files; however, keyed access and relative-number access to the files are not supported.

- Key-sequenced (KSDS)
- Entry-sequenced (ESDS)
- Relative record (RRDS).

If you plan to update a VSAM data set (for example, with the Notepad editor or with the copy command), the data set must have been defined with the REUSE option. Trying to write back a VSAM data set that was not defined as reusable results in an I/O error, failure to open, or similar error message. When you create a VSAM file through the SMB server, the REUSE option is always specified by the server. For more information about VSAM files, refer to [z/OS DFSMS Using Data Sets](#).

For example, in [Figure 37 on page 185](#), the attributes indicate the following information:

- Spanned records are allowed
- Organization is key-sequenced
- Keys are 8 bytes long and start in position 0 of each record
- Average record size is 1024
- Maximum record size is 4096
- Space is allocated for 50 records with a secondary allocation of 10

- Cross-region and cross-system share options are provided
- The file is to be created on a volume named D80CAT.

```
notepad "r:\ksds.new2.txt,spanned,dsorg(indexed),keys(8,0),recordsize(1k,4k),  
space(50,10),shareoptions(1,3),vol(d80cat)"
```

Figure 37: Example command to create a VSAM file

Similarly, [Figure 38 on page 185](#) shows an example of a Linux Samba command.

```
linux001:/mntifs # vi "ksds.new2.txt,spanned,dsorg(indexed),keys(8,0),recordsize(1k,4k),  
space(50,10),shareoptions(1,3),vol(d80cat)"
```

Figure 38: Example Linux command to create a VSAM file

[Figure 39 on page 185](#) shows an example command that creates a VSAM ESDS file that has the following attributes:

- Spanned records are allowed
- Organization is entry-sequenced
- Average record size is 1024
- Maximum record size is 4096
- Space is allocated for 50 records with a secondary allocation of 10
- Cross-region and cross-system share options are provided
- The file is to be created on a volume named D80CAT.

```
notepad "r:\esds.new3.txt,spanned,dsorg(nonindexed),recordsize(1k,4k),  
space(50,10),shareoptions(1,3),vol(d80cat)"
```

Figure 39: Example command to create a VSAM ESDS file

[Figure 40 on page 185](#) shows a similar command example using Linux Samba.

```
linux001:/mntifs # vi "esds.new3.txt,spanned,dsorg(nonindexed),recordsize(1k,4k),  
space(50,10),shareoptions(1,3),vol(d80cat)"
```

Figure 40: Example Linux command to create a VSAM ESDS file

In [Figure 41 on page 186](#), the attributes specified on the command indicate the following information:

- Spanned records are not allowed
- Organization is relative record, numbered in ascending order
- Average record size is 1024
- Maximum record size is 1024
- Space is allocated for 50 records with a secondary allocation of 10
- Cross-region and cross-system share options are provided
- The file is to be created on a volume named D80CAT.

```
notepad "r:\irids.new4.txt,nonspanned,dsorg(numbered),recordsize(1k,1k),  
space(50,10),shareoptions(1,3),vol(d80cat)"
```

Figure 41: Example command to create a VSAM ESDS file (non-spanned records)

Figure 42 on page 186 shows an example of a Linux Samba command.

```
linux001:/mntifs # vi "irids.new4.txt,nonspanned,dsorg(numbered),recordsize(1k,1k),  
space(50,10),shareoptions(1,3),vol(d80cat)"
```

Figure 42: Example of a Linux command to create a VSAM ESDS file (non-spanned records)

Specifying attributes multiple times

Specifying an attribute several times on a line does not cause an error. The line is read from left to right, and the last of any duplicate attribute is used. For example:

```
C:\>notepad "r:file,recfm(vb),recfm(fb)"
```

An example of Linux Samba follows; this command results in a file created with a fixed-blocked format.

```
linux001:/mntifs # vi "file,recfm(vb),recfm(fb)"
```

Exploiting SAM striped files

With SAM striping, data I/O is done in parallel to improve performance. For a file with 16 stripes, data is processed on the first track of the allocated space on the first volume (that is, the first stripe), then on the first track of the second volume, and so on for all 16 volumes. Then, processing continues with the second track of all the volumes, then the third, and so on.

The SMB server can support data set striping through the use of data class and storage class attributes that define extended format data sets. The SMB server can exploit the performance of extended format data sets by reading multiple blocks at a time when reading ahead.

For more information about striped files, see [*z/OS DFSMS Using Data Sets*](#).

Handling of the file size value

Many file system commands (such as **dir**) require the file size to be returned. This appendix explains some performance and accuracy considerations in obtaining the file size value. The meaning of the file size value returned by the SMB server and how fast the file size is returned depends on:

- Whether you use **text** or **binary** processing mode
- The type of data set being accessed
- If the data set is system-managed
- Whether you use **fastfilesize** or **nofastfilesize** processing.

Storage of the file size value

Whether the file size value is already stored on your z/OS system affects how quickly files are accessed and depends on the type of z/OS data set used.

System-managed PS, VSAM, and PDSE data sets

For system-managed data sets, text and binary file size are saved on non-volatile storage (DASD) and maintained by the SMB server for the following data set types:

- Physical sequential (including striped)
- VSAM ESDS
- VSAM KSDS
- VSAM RRDS
- PDSE members.

When the SMB server accesses a data set for the first time, it performs a read-for-size to get the text or binary file size and stores this value on DASD. Subsequent file size requests from clients do not cause the server to read for size, thus improving performance. However, when the data set is modified outside the server by a non-PC application (for example, by the TSO editor), the stored file size could be incorrect. When the data set is accessed again by the server, read-for size is done to determine the correct file size.

Migrated data sets

A data set that is migrated cannot be accessed. It must be recalled before it can be accessed. Whether a data set is recalled or not is based on the **retrieve** / **noretrieve** specification in the attributes file (rfstab). When a migrated data set is referenced, the request fails and the data set is recalled if **retrieve** (no wait) is specified in **rfstab**. Later, when the data set has been recalled, the data set can be accessed. If **noretrieve** is specified in **rfstab**, the request fails and the data set is not recalled.

Non-system managed, PDS, and DA data sets

The file size value for non-system managed data sets, PDS members, and DA data sets is cached in virtual storage until released but not written to DASD. Therefore, for these types of data sets, the file size value is regenerated after the file is released or after the server is restarted.

How the file size is generated

When a file is first accessed (for example with **dir**), usually the entire file is read to determine its size, except for when specifying the **recfm(f)** or **recfm(fbs)** attributes where the binary size can be computed without reading the file. If the file is a system-managed PS, VSAM, or PDSE member, both binary and text file sizes are stored on DASD, so that subsequent file size requests do not require the file to be read.

Binary file size can be quickly generated by using **recfm(f)** or **recfm(fbs)** to specify a fixed-length record format for the data set. With this format type, the server pads the last logical record with binary zeros in **binary** mode processing, because z/OS always expects complete logical records. If the application tolerates these zeros, using **recfm(f)** or **recfm(fbs)** allows the binary size to be computed quickly because the number of bytes can be computed from the number of blocks, which is stored by z/OS.

If you need the exact file size and are using **binary** mode processing, map it to a variable-format, sequential data set on DASD so that the SMB server does not need to pad a partially filled last logical record to a record boundary.

For reading small files or the beginning of files, the read-for-size might not add any processing time. As the file is being read for size, the beginning of the file is stored in the buffers set aside by the **maxrdfsleft** site attribute, until the buffers are full. When the application reads the beginning of the file, this read is fast because it reads directly from the buffer.

z/OS stores the number of blocks (rather than the number of bytes) in a z/OS file. For most files, therefore, without reading the entire file, the SMB server can only give an estimate of the number of bytes in the file, not the exact number of bytes in the file.

Using fastfilesize to avoid read-for-size

If you can use an approximate file size for a PDS, PDSE, DA, or non-system managed data set, you can specify the **fastfilesize** attribute to improve performance. With this attribute, the server estimates the size without opening and reading the entire file.

PDS members	For PDS and PDSE members, the fastfilesize attribute gets the file size from ISPF statistics if they exist; otherwise, the size of the entire PDS or PDSE data set is returned as the member size.
PS or DA data sets	For PS or DA data sets, an approximate file size is calculated based on the device characteristics, the number of disk tracks in use, and the block size of the data set.
VSAM	For non-system-managed VSAM data sets, the estimated size using fastfilesize is the size of the data set.

The **fastfilesize** attribute speeds up data set access by calculating approximate file sizes during data set access. Use this only when you are displaying file names and sizes (using the **dir** Windows command, for example) because many commands (such as **copy** and editors) and many applications might not work correctly if **fastfilesize** is set. When modifying or copying a data set, the **nofastfilesize** attribute should be used to ensure accurate results.

nofastfilesize

When you use the default, **nofastfilesize** attribute, the SMB server reads the entire file or member to get the file size. It stores the file size value in cache until release. Using this attribute might cause a delay when first accessing very large data sets.

Handling of the time stamps

z/OS UNIX file attributes define the following time stamps:

atime

Last time the file was accessed (read).

mtime

Last time the file was modified (write).

ctime

Last time the file status was changed (chmod).

The SMB server handles time stamps differently for these types of data sets:

- System-managed PS data sets and system-managed VSAM data sets
- Direct Access data sets and non-system managed PS data sets
- Non-system managed VSAM data sets
- PDS and PDSE members.

Time stamps for system-managed VSAM and PS data sets

For system-managed PS data sets and system-managed VSAM data sets, *atime* and *mtime* are fully maintained, and the *ctime* is set to the *mtime*.

Time stamps for non-system managed PS and DS data sets

For non-system managed PS and DA data sets, consider the following:

- How time stamps are stored
- The requirements of your workstation programs
- The type of data set used to store the file.

Storing time stamps

For non-system managed PS and DA data sets, the SMB server temporarily stores the time stamps in virtual storage, but not on DASD. These cached attributes are purged when the file is released or when the server is restarted. When the file is accessed again, the time stamps are regenerated.

Client program requirements

Some workstation-based utilities (such as **make**) rely on date and time stamps. For example, **make** checks the update time of the object file with the source file and recompiles if the source has been updated. Before storing these types of files using the server, examine them before moving them to ensure that these attributes are unimportant. In an environment which relies on such utilities, use HFS.

Generating time stamps

Figure 43 on page 189 shows how the SMB server generates the *atime* and *mtime* values for non-system managed PS and DA data sets from the dates.

```
atime = mtime = reference_date + time_increment
ctime = creation_date + time_increment
```

Figure 43: How time stamps for non-system managed PS and DA data sets are generated

The *time_increment* is either the server local time or 23:59 hours. If *reference_date* or *creation_date* is equal to the server local date, the server local time is added. Otherwise, a fixed value of 23 hours and 59 minutes is added.

If *reference_date* = 0 (that is, the file has not yet been referenced), *atime* and *mtime* are set equal to *ctime*.

Time stamps for non-system managed VSAM data sets

The time stamps for these types of data sets are set to the current time.

Time stamps for PDSs and PDSEs

A PDS data set can act as a directory. Members of the PDS are files within the directory. When the directory is accessed by the client, the z/OS UNIX times are expected for each file.

Ordinarily, z/OS does not maintain time stamps for members of a PDS. The z/OS UNIX time stamps here are generated from the z/OS creation and reference dates of the PDS data set containing the members. Figure 44 on page 189 shows how the time stamps for PDS members are generated

```
atime = mtime = reference_date + time_increment
ctime = creation_date + time_increment
```

Figure 44: How time stamps for PDS members are generated

ISPF is a z/OS base element that maintains some additional statistics for each member. They include the creation date and the last modification date and time. Figure 45 on page 189 shows how the server generates the time stamps and initializes the z/OS UNIX times, if the ISPF time stamps are present for a PDS member.

```
atime = mtime = modification_date + modification_time
ctime = ISPF_creation_date + time_increment
```

Figure 45: How time stamps for PDS members are generated with ISPF times stamps

The *time_increment* is either server local time or 23:59 hours, as described for non-system managed PS and DA data sets.

The server also creates new ISPF statistics for PDS members created by the clients. The ISPF statistics are created even if existing members do not have statistics.

The time stamp information is saved in the PDS directory according to ISPF conventions. If STATS=ON was specified when the member was created, the server uses them to get more accurate attributes. Even if STATS=ON was not specified originally, the server writes back new time stamp information if the member is modified from the workstation.

Time stamp generation for a PDSE member is identical to that of a PDS with one exception. Accurate *mtime* of a PDSE member is returned to a client as the result of a file attribute request for that PDSE member.

Setting time stamps

PC clients can issue commands that result in SETATTR requests (such as, Windows Explorer, right-click on file, and Choose Properties) to set the *atime* and *mtime* for a system-managed PS or VSAM data set. For PDSE members, setting *mtime* is allowed, but setting *atime* is not supported. PDSE member *mtime* is also maintained by PDSE access methods, so it is modified when a TSO user modifies the PDSE member.

Appendix E. Accessibility

Accessible publications for this product are offered through [IBM Knowledge Center \(www.ibm.com/support/knowledgecenter/SSLTBW/welcome\)](http://www.ibm.com/support/knowledgecenter/SSLTBW/welcome).

If you experience difficulty with the accessibility of any z/OS information, send a detailed email message to mhvrdfs@us.ibm.com.

Accessibility features

Accessibility features help users who have physical disabilities such as restricted mobility or limited vision use software products successfully. The accessibility features in z/OS can help users do the following tasks:

- Run assistive technology such as screen readers and screen magnifier software.
- Operate specific or equivalent features by using the keyboard.
- Customize display attributes such as color, contrast, and font size.

Consult assistive technologies

Assistive technology products such as screen readers function with the user interfaces found in z/OS. Consult the product information for the specific assistive technology product that is used to access z/OS interfaces.

Keyboard navigation of the user interface

You can access z/OS user interfaces with TSO/E or ISPF. The following information describes how to use TSO/E and ISPF, including the use of keyboard shortcuts and function keys (PF keys). Each guide includes the default settings for the PF keys.

- [*z/OS TSO/E Primer*](#)
- [*z/OS TSO/E User's Guide*](#)
- [*z/OS ISPF User's Guide Vol I*](#)

Dotted decimal syntax diagrams

Syntax diagrams are provided in dotted decimal format for users who access IBM Knowledge Center with a screen reader. In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), they can appear on the same line because they are considered a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that the screen reader is set to read out punctuation. All the syntax elements that have the same dotted decimal number (for example, all the syntax elements that have the number 3.1) are mutually exclusive alternatives. If you hear the lines 3.1 USERID and 3.1 SYSTEMID, your syntax can include either USERID or SYSTEMID, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number 3 is followed by a series of syntax elements with dotted decimal number 3.1, all the syntax elements numbered 3.1 are subordinate to the syntax element numbered 3.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, it is preceded by the backslash (\) character. The * symbol is placed next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element *FILE with dotted decimal number 3 is given the format 3 * FILE. Format 3* FILE indicates that syntax element FILE repeats. Format 3* * FILE indicates that syntax element * FILE repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol to provide information about the syntax elements. For example, the lines 5.1*, 5.1 LASTRUN, and 5.1 DELETE mean that if you use more than one of the LASTRUN and DELETE syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the % symbol, it indicates a reference that is defined elsewhere. The string that follows the % symbol is the name of a syntax fragment rather than a literal. For example, the line 2.1 %OP1 means that you must refer to separate syntax fragment OP1.

The following symbols are used next to the dotted decimal numbers.

? indicates an optional syntax element

The question mark (?) symbol indicates an optional syntax element. A dotted decimal number followed by the question mark symbol (?) indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element, (for example 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that the syntax elements NOTIFY and UPDATE are optional. That is, you can choose one or none of them. The ? symbol is equivalent to a bypass line in a railroad diagram.

! indicates a default syntax element

The exclamation mark (!) symbol indicates a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicate that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the dotted decimal number can specify the ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In the example, if you include the FILE keyword, but do not specify an option, the default option KEEP is applied. A default option also applies to the next higher dotted decimal number. In this example, if the FILE keyword is omitted, the default FILE (KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP applies only to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

*** indicates an optional syntax element that is repeatable**

The asterisk or glyph (*) symbol indicates a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data area, you know that you can include one data area, more than one data area, or no data area. If you hear the lines 3* , 3 HOST, 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

Notes:

1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you can write HOST STATE, but you cannot write HOST HOST.

3. The * symbol is equivalent to a loopback line in a railroad syntax diagram.

+ indicates a syntax element that must be included

The plus (+) symbol indicates a syntax element that must be included at least once. A dotted decimal number followed by the + symbol indicates that the syntax element must be included one or more times. That is, it must be included at least once and can be repeated. For example, if you hear the line 6.1+ data area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. Similar to the * symbol, the + symbol can repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loopback line in a railroad syntax diagram.

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