IBM General Parallel File System for AIX:

Installation and Administration Guide

SA22-7278-02

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Before using this information and the product it supports, be sure to read the general information under “Notices” on page ix.

| **Second Edition (October 1998)**

| This is a major revision of SA22-7278-01.

| This edition applies to Version 1 Release 2 of IBM General Parallel File System for AIX (5765–B95) and to all subsequent releases
| and modifications until otherwise indicated in new editions. Significant changes or additions to the text and illustrations are indicated
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About This Book

This book describes how to install and manage the IBM General Parallel File System for AIX (GPFS) licensed program product. It includes information to help you plan and configure your GPFS system, and explains how to use the commands and programming interface unique to GPFS.

Throughout this publication you will see various command and component names beginning with the prefix **mmfs**. This is not an error. GPFS shares many components with the IBM Multi-Media LAN Server, a related product.

Who Should Use This Book

Use this book if you are considering installing the General Parallel File System for AIX licensed program product.

Use this book for installing and administering a GPFS file system.

What You Need to Know First

Before using this book, you should be familiar with, and have documentation for, the following:

- RS/6000 SP system administration, as described in *IBM Parallel Systems Support Programs: Administration Guide*, SA22–7348.
- The AIX operating system, including the Logical Volume Manager subsystem as described in *IBM AIX Version 4.3 System Management Guide: Operating System and Devices*, SC23–4126.
- The IBM Virtual Shared Disk information in *IBM Parallel Systems Support Programs: Managing Shared Disks*, SA22–7349.
- The IBM Virtual Shared Disk and High Availability information in *IBM Parallel Systems Support Programs: Administration Guide*, SA22–7348.
- The IBM Virtual Shared Disk commands in *IBM Parallel Systems Support Programs: Command and Technical Reference*, SA22–7351.
- Configuration and tuning information in *IBM RS/6000 SP Management: Easy, Lean, and Mean*, GG24–2563.

Most of the RS/6000 SP hardware and software books are available from the IBM RS/6000 web site at **http://www.rs6000.ibm.com**.

How This Book is Organized

This book consists of the following chapters:

- Chapter 1, “Introducing General Parallel File System for AIX” on page 1 provides an overview of GPFS and describes its features.
- Chapter 2, “Planning for GPFS” on page 5 contains planning information to help you prepare for GPFS installation, configuration, and file systems creation.

- Chapter 3, “Installing GPFS” on page 23 contains the procedures for GPFS installation and configuration.
- Chapter 4, “Migrating to the Latest Level of GPFS” on page 29 contains the procedures for GPFS migration, and information on coexistence and compatibility.
- Chapter 5, “Performing GPFS Administration Tasks” on page 33 deals with administration tasks and contains procedures for file system creation and maintenance.
- Chapter 6, “Tuning GPFS Performance” on page 73 discusses tuning issues and how you can improve GPFS performance.
- Chapter 7, “GPFS Commands” on page 77 contains the command reference pages.
- Appendix A, “GPFS Programming Interface” on page 151 contains GPFS programming interface information.
- Appendix B, “Considerations for GPFS Applications” on page 153 describes some differences in how GPFS calls standard UNIX routines, and how these calls might affect certain applications.

Typography and Terminology

This book uses the following typographical conventions:

Convention	Usage
Bold	**Bold** words or characters represent system elements that you must use literally, such as commands, subcommands, flags, path names, directories, file names, values, and selected menu options.
Bold Underlined	**Bold Underlined** keywords are defaults. These take effect if you fail to specify a different keyword.
Italic	• *Italic* words or characters represent variable values that you must supply • *Italics* are used for book titles • *Italics* are used for general emphasis
`Monospace`	All of the following are displayed in `monospace` type: • Displayed information • Message text • Example text • Specified text typed by the user • Field names as displayed on the screen • Prompts from the system • References to example text
[ ]	Brackets enclose optional items in format and syntax descriptions.
{ }	Braces enclose a list from which you must choose an item in format and syntax descriptions.
< >	Angle brackets (less-than and greater-than) enclose the name of a key on the keyboard. For example, <**Enter**> refers to the key on your terminal or workstation that is labeled with the word Enter.
...	An ellipsis indicates that you can repeat the preceding item one or more times.
<**Ctrl**-*x*>	The notation <**Ctrl**-*x*> indicates a control character sequence. For example, <**Ctrl**-**c**> means that you hold down the control key while pressing <**c**>.

Obtaining Documentation

| In order to use the GPFS man pages or access the GPFS HyperText Markup Language (HTML) and Portable Document Format (PDF) formats of this publication, the **gpfsdocs** file set must first be installed.

| To view the GPFS HTML publications, you need access to an HTML document browser such as Netscape. An index file into the HTML files that are provided with the **gpfsdocs** file set is installed in the **/usr/lpp/mmfs/gpfsdocs** directory. Once installed, you can also view the HTML files from the RS/6000 SP Resource Center. See "Installing the GPFS HTML Files" on page 24.

| To view the GPFS PDF publication, you need access to the Adobe Acrobat Reader 3.0.1. The Acrobat Reader is shipped with the AIX Version 4.3 Bonus Pack and is also freely available for downloading from the Adobe web site at URL **http://www.adobe.com**.

| You can also view or download this book from the IBM RS/6000 web site at **http://www.rs6000.ibm.com/resource/aix_resource/sp_books**.

Related Information

The *General Parallel File System for AIX: Problem Determination Guide*, a softcopy document shipped on the product media and installed in the **gpfsdocs** file set, contains procedures for correcting error conditions, as well as additional information that can help you optimize GPFS performance under unusual operating conditions. For the latest updates, visit the RS/6000 SP Product Documentation Library site on the World Wide Web, **http://www.rs6000.ibm.com/resource/aix_resource/sp_books**.

The *International Technical Support Organization GPFS: A Parallel File System*, SG24—5165, contains additional information on GPFS.

If you have a question about the SP, PSSP, or a related product, the following online information resources make it easy to find the information you are looking for:

- Access the new SP Resource Center by issuing the command:

  /usr/lpp/ssp/bin/resource_center

  If you have the Resource Center on CD ROM, see the readme.txt file for information on how to run it.

- Access the RS/6000 Web Site at:

  http://www.rs6000.ibm.com

What's New

This section summarizes all the changes made to IBM General Parallel File System for AIX .

What's new for GPFS 1.2

GPFS 1.2 provides several scalability and usability enhancements:

- Migration to a new release of GPFS can be tested on a GPFS configuration. This will ease your migration by allowing you to test the new level of code without inhibiting your production level code. See “GPFS Configurations for Migration” on page 29.
- An external programming call, which provides the ability to preallocate space for a file, has been added to GPFS. This will allow you to preallocate an amount of space for a file that has already been opened, prior to writing data to the file. See Appendix A, “GPFS Programming Interface” on page 151.
- The number of files possible in a GPFS file system is no longer fixed at file system creation. The number of i–nodes is now extendible up to a fixed limit, specified at file system creation, and changeable via the **mmchfs** command. See “Modifying File System Attributes” on page 50, and “mmchfs” on page 96.
- The GPFS token manager has been moved from the AIX kernel to the GPFS daemon. This provides additional kernel heap storage for system functions and quicker recovery in case of token manager failures.
- The stripe group descriptor limits have been increased. The limit of 512 disk descriptors has been increased to 1024.
- There is increased flexibility in the use of memory. Memory usage for GPFS can be changed by issuing a command without stopping and reinitializing GPFS. See “mmchconfig” on page 87.
- The maximum file system size supported has been increased. The maximum file system size of 1TB has been increased to 5TB. See“Maximum File System Size” on page 10 and Table 1 on page 12.

Future Migration

For information on migrating your system to the latest level of GPFS, see Chapter 4, “Migrating to the Latest Level of GPFS” on page 29.

Chapter 1. Introducing General Parallel File System for AIX

IBM General Parallel File System for AIX (GPFS) provides file system services to parallel and serial applications running on the RS/6000 SP. GPFS allows users shared access to files that may span multiple disk drives on multiple SP nodes.

GPFS is designed for seamless integration in your UNIX** environment. Almost all applications run exactly the same under GPFS as they do with other file systems. AIX file system utilities are also supported by GPFS. This means that users can continue to use the UNIX commands they have always used for ordinary file operations. The only unique commands are those for administering the GPFS file system. (See Appendix B, “Considerations for GPFS Applications” on page 153 for more information.)

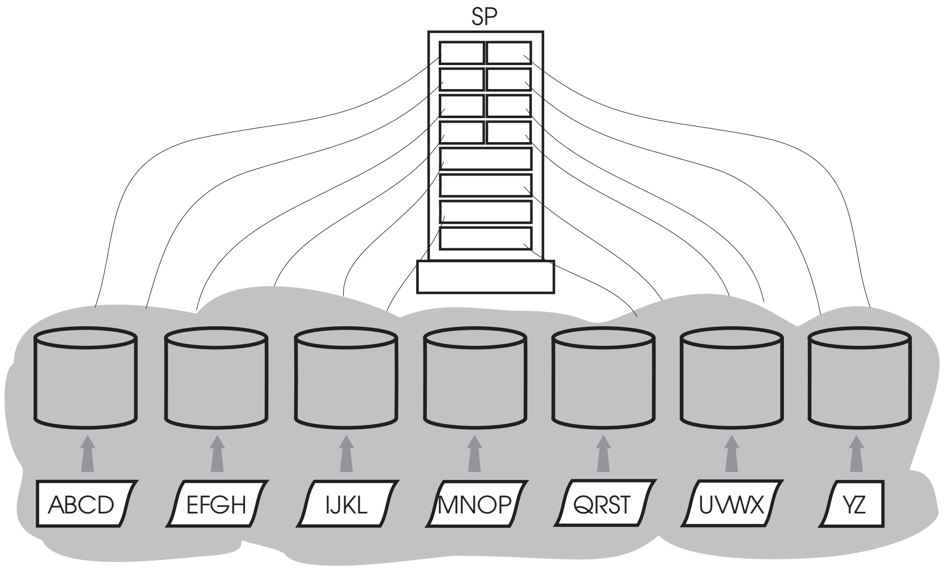


Figure 1. Files Can Span Multiple Disks on Multiple SP Nodes

GPFS allows parallel applications simultaneous access to the same files, or different files, from any node in the configuration while managing a high level of control over all file system operations. It offers extremely high recoverability while maximizing data accessibility.

GPFS Improves System Performance

Using GPFS to store and retrieve your files can improve system performance by:

- Allowing multiple processes or applications on all nodes of the SP system simultaneous access to the same file using standard file system calls.
- Increasing aggregate bandwidth of your file system by spreading reads and writes across multiple disks.
- Balancing the load evenly across all disks to maximize their combined throughput. One disk is no more active than another.
- Supporting large amounts of data and allowing you to have bigger file systems.

- Allowing concurrent reads and concurrent writes to files in the file system — very important in parallel processing.

GPFS builds on the shared disk concept at the heart of the IBM Virtual Shared Disk component of the Parallel System Support Programs for AIX by taking advantage of the speed of the SP Switch and using it to accelerate parallel file operations that would overload serial file system management.

GPFS Assures File Consistency

GPFS uses a sophisticated token management system to guarantee data consistency while providing multiple, independent paths to the same file—by the same name—from anywhere in the SP system. Even when nodes are down or hardware resource demands are high, GPFS can find an available path to file system data.

GPFS Increases Data Availability

GPFS is a logging file system that creates separate logs for each SP node. These logs record the allocation of metadata and aid fast recovery and consistency of data in the event of node failure, even when a node fails while modifying file data.

GPFS failover support allows you to organize your hardware to minimize single points of failure. You can guard against loss of file system availability by configuring backup servers and mirroring data.

The *replication* feature of GPFS allows you to determine how many copies of a file to maintain. File system replication assures that the latest updates to critical data are preserved in the event of disk failure. During configuration, you assign a replication factor to indicate the total number of copies you wish to store. Replication allows you to set different levels of protection for each file or one level for an entire file system. Since replication uses additional disk space and requires extra write time, you might want to consider replicating only files that are frequently read but seldom written.

Once your file system is created, you can have it automatically mounted whenever the GPFS daemons are started. The automount feature assures that whenever the SP system and disks are up, the file system will be available.

GPFS Enhances System Flexibility

With GPFS, your system resources are not frozen. You can add or delete disks while the file system is mounted. When the time is right and system demand is low, you can rebalance the file system across all currently configured disks.

You can configure one or more nodes as dedicated disk servers, or allow applications to share server nodes as well. Later, you can reconfigure GPFS to enlarge file size capacity or to increase throughput depending on your applications, hardware, and workload. Set up your GPFS environment for today's applications and users, secure in the knowledge that you can expand in the future without jeopardizing your data. GPFS capacity can grow as your hardware expands.

GPFS Simplifies Administration

All GPFS administration tasks, from installation to maintenance and reconfiguration, can be performed from any node in the SP configuration. GPFS administration commands are similar in name and function to UNIX file system commands, with one important difference: the GPFS commands operate on multiple nodes. A single GPFS multi-node command can perform a file system function across the entire SP system. GPFS administration tasks can also be executed from SMIT menus.

Chapter 2. Planning for GPFS

Although you can modify your GPFS configuration after it has been set, a little consideration before installation and initial setup will reward you with a more efficient and immediately useful file system.

GPFS configuration requires you to specify several operational parameters that reflect your hardware resources and operating environment. Later, during file system creation, you have the opportunity to specify additional parameters based on the expected size of the files. These parameters define the disks for the file system and how data will be written to them.

This chapter, and the ones that follow, contain a series of examples that step through the planning process leading to the configuration of a typical GPFS system. The creation and subsequent modification of two GPFS files systems are also illustrated.

Configuration Considerations

Configuration involves defining the nodes to be included in the GPFS subsystem and specifying how they operate. You can provide a list of nodes as input to configuration, or allow GPFS to configure all the nodes in your SP system. You also have the option of installing a sample configuration file with preset values that you can accept as defaults or modify to suit your needs, or you can create and install a configuration file of your own.

Planning Nodes

When you configure GPFS for your SP system, you have the opportunity to specify a list of all the nodes that will mount GPFS file systems. Later, when you create a file system, you have the opportunity to specify an estimate of how many nodes the file system will be mounted on. These two specifications serve different purposes.

Estimating Node Count

When creating a GPFS file system, overestimate the number of nodes that will mount the file system. This input is used in the creation of GPFS data structures that are essential for achieving the maximum degree of parallelism in file system operations. Although a larger estimate consumes a bit more memory, insufficient allocation of these data structures can limit node ability to process certain parallel requests efficiently, such as the allotment of disk space to a file. If you cannot anticipate the number of nodes, allow the default value of 32 to be applied. Specify a larger number if you expect to add nodes, but avoid wildly overestimating, which can affect buffer operations. This value cannot be changed later.

Creating a Node List

Before you configure GPFS on your SP, prepare a file that lists all the nodes in the system. The list must contain only one entry per line. During configuration, GPFS copies this list to the **/etc/cluster.nodes** file and uses it for setup.

Although the list can include any of the following formats, be sure to identify nodes by their switch hostnames. The use of Ethernet hostnames results in much slower I/O performance.

Format	**Example**
Short Hostname	k145s02
Long Hostname	k145s02.dpd.ibm.com
IP Address	9.119.19.102

If you do not provide this list when configuring GPFS, the switch hostnames of all nodes in the System Data Repository (SDR) are added to the **/etc/cluster.nodes** file.

Creating a Preferences File

On large complex systems before you configure GPFS, it may be advisable to create a file that lists preferred nodes to become the stripe group manager. There is one stripe group manager per file system. If a stripe group manager should fail for any reason, a new stripe group manager is selected by the configuration manager and all functions continue without disruption, except for the time required to accomplish the takeover. (For more information on the configuration manager, see the *GPFS Problem Determination Guide*.)

The preferences file should be specified as **/var/mmfs/etc/cluster.preferences** and should be identical on each node in the file system. If the file is not consistent across nodes, the configuration manager may not select the appropriate node. The stripe group manager consumes both CPU cycles and memory in performing its functions. As a result you may want to designate nodes whose usage will not impact the performance of your applications. Since VSD buddy buffers compete for the same kernel memory, avoid including VSD server nodes. These preferences are honored except in certain failure situations where multiple failures occur. For more information on multiple failures, see the *GPFS Problem Determination Guide*.

This file is formatted with one hostname per line and the hostname must be the switch hostname:

```
sp1sw01.ibm.com
sp1sw02.ibm.com
sp1sw04.ibm.com
sp1sw06.ibm.com
```

Quorums

GPFS also uses the list of nodes to establish a quorum requirement. A quorum is the minimum number of nodes that must be running in order for the GPFS daemon to start. GPFS uses the quorum to maintain data consistency. By default, a quorum is one plus half the number of nodes in the GPFS configuration. (Quorum cannot be met by including the control workstation.) Refer to *GPFS Problem Determination Guide* for more information.

Starting GPFS Automatically on Nodes

You can configure GPFS to start automatically on all nodes whenever they come up, by specifying the autoload (**–A**) option for the **mmconfig** command. See “mmconfig” on page 99. This eliminates the need to start GPFS manually when the nodes have been rebooted.

Cache

GPFS creates a number of cache segments on each node in the SP system. This pinned memory is used to increase performance through *read-ahead* and *write-behind* operations, as well as for reuse of cached data. On a dedicated IBM Virtual Shared Disk server, cache can be the minimal size of 4MB, but on nodes where GPFS supports application usage, larger cache sizes usually improve GPFS performance.

During configuration, you can specify two parameters, **mallocsize** and **pagepool**, that control how much cache is dedicated to GPFS. These values can be changed later, so experiment with larger values to find the optimum cache size that improves GPFS performance without affecting other applications.

In order for the changed value for **mallocsize** to take effect, you must restart GPFS. The changed value for **pagepool** can take effect immediately by using the –**i** option on the **mmchconfig** command, otherwise you must restart GPFS.

Note: The sum of these two parameters must not exceed 80% of real memory.

mallocsize
This area is used exclusively for GPFS control structures. It can range from a minimum of 2MB to a maximum of 128MB per node. This value must be specified with the character **M**, for example `8M`. The default is `4M`.

pagepool This is the size of the cache on each node. It can range from a minimum of 4MB to a maximum of 512MB per node. This value must be specified with the character **M**, for example `80M`. The default is `20M`.

Related parameters:

maxFilesToCache This is the number of i–nodes to cache for recently used files that have been closed. Storing a file's i–node in cache permits faster reaccess to the file. The default is 200 but increasing this number may improve throughput for workloads with high file reuse. However, an excessively large value for this parameter will cause additional token conflicts and increase storage consumption. You may wish to test different values for your workload.

Each cached file requires space in the mallocpool for an i–node plus approximately 800 bytes of metadata. GPFS will not use more than 50% of the mallocpool for this purpose. If you increase **maxFilesToCache**, you should also increase the **mallocsize** parameter to a value equal to 2 x (maximum i–node size for the file system + 800) x **maxFilesToCache**. For example, to set **maxFilesToCache** to 1000 for a file system with a maximum i–node size of 4096, **mallocsize** should be approximately 10MB.

Performance

The only configuration parameter that directly addresses performance is **priority**. Sometimes called scheduling priority, this parameter sets the UNIX priority for the GPFS daemon. The default is 40. Priority increases with lower values. Refer to AIX Documentation for details.

Refer to Chapter 6, “Tuning GPFS Performance” on page 73 for information about other UNIX tunables and additional methods of adjusting GPFS performance.

File System Creation Considerations

Each GPFS file system can be mounted separately. Within each file system, files are written to disk as traditional UNIX file systems, using i-nodes, indirect blocks, and data blocks. Each file has an i-node containing information such as file size and time of last modification. The i-nodes of small files also contain the addresses of all disk blocks that comprise the file data. A large file can use too many data blocks for an i-node to address. In such a case, the i-node points instead to indirect blocks that are large enough to hold data block addresses.

I-nodes and indirect blocks are considered *metadata*, as distinguished from data, or actual file content. You can control which disks GPFS uses for storing metadata when you create a file system.

| **Note:** There is a maximum of 32 file systems that may exist within a GPFS
| configuration.

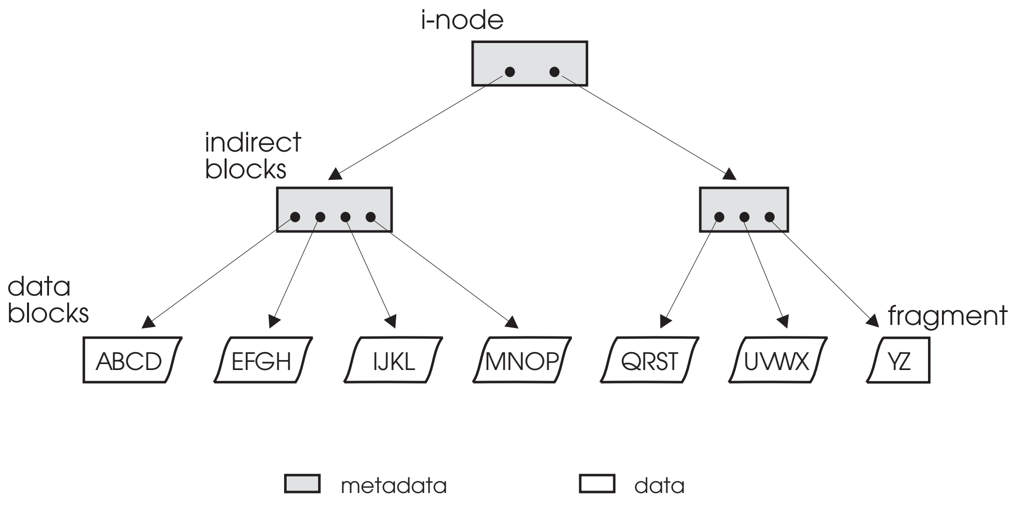


Figure 2. GPFS Files Have Traditional UNIX Structure

File System Sizing

Before creating a file system, consider how much data will be stored and how large the files are likely to grow. You should also try to anticipate how great will be the demand for the files in the system. Will several users want to read a file at the same time? How many users will be writing to it? Each of these factors can help you to determine how much disk resource to devote to the file system, where to store data and metadata, and how many replicas to maintain.

Block Size

GPFS offers a choice of three block sizes at file system creation time: 16KB, 64KB, or 256KB. Familiarity with the applications running on your system will help you determine which block size to use. Many technical applications handle large amounts of data in a single read/write operation. These are better served by a larger block size. A smaller block size may result in more efficient use of disk space for smaller files.

The default block size is 256KB.

Note: If you plan to use RAID devices (Redundant Arrays of Independent Disks) in your file system, a larger block size may be more effective and help you to avoid the penalties involved in small block write operations to RAID devices.

Fragments and Subblocks

GPFS divides each block into 32 *subblocks*. If the block size is the largest contiguous amount of disk space allocated to a file (and therefore, the largest amount of data that can be accessed in a single I/O operation), then the subblock is the smallest unit of disk space that can be allocated. For a block size of 256KB, GPFS reads as much as 256KB of data in a single I/O operation and small files can occupy as little as 8KB of disk space. With a block size of 16KB, small files occupy as little as 512 bytes of disk space (not counting the i-node), but GPFS is unable to read more than 16KB in a single I/O operation.

Files smaller than one block size are stored in *fragments*, which are made up of one or more subblocks. Large files are stored in a number of full blocks plus one or more fragments to hold the data at the end of the file.

I-Nodes

The i-node, or file index, is the internal structure that describes an individual file to AIX. The size of a file's i-node defaults to 512 bytes, the standard disk sector size. You can specify a larger i-node size at file system creation time if you anticipate larger files. The maximum i-node size is 4KB.

“Maximum Number of Files” on page 11 describes how to estimate the number of i-nodes for your file system.

Indirect Blocks

Another parameter that affects file capacity is indirect block size. This is the unit of disk space GPFS allocates for data block addressing of large files. Indirect block size can be as small as a single sub–block or as large as one full block, provided it does not exceed 32KB. The only additional requirement is that it be a multiple of the sub–block size (1/32 of BlockSize).

Applications that read and write large amounts of data in a single I/O operation work better with larger indirect blocks. If you run such applications, specify a larger indirect block size rather than a larger i-node size. Larger i-nodes may waste disk space when applied to small files, while large indirect blocks incur a disk space penalty only for large files. The recommended value for the indirect block is *block size* / *n*, where *n* is a power of 2. The default indirect block size is *block size*/16, which is equal to 2 subblocks.

Two additional parameters affect maximum file size and control replication. *MaxMetaDataReplicas* sets the maximum number of copies of metadata GPFS maintains, and *MaxDataReplicas* sets the maximum number of data copies. Although replication is a recoverability consideration (see “Recoverability” on page 15 for a more detailed discussion), remember that it has a dramatic effect on potential file size. The more data and metadata replicas GPFS maintains, the more limited your potential file size. The more metadata replicas GPFS maintains, the more limited your number of files, because a single file with replicated metadata uses the same number of i-nodes as two files. A quick look at Table 1 on page 12 gives you an idea how this relationship works.

Putting it All Together

This leads to the final and perhaps most important characteristic of any file system, capacity. How big can your files grow, and how much can the file system hold?

Maximum File Size: Block size, indirect block size, and i-node size, combined with the maximum replication factors for data and metadata, determine the maximum possible file size in a GPFS file system. The following formula illustrates these relationships.

$$\text{max\_fsize} = \left(\frac{i - 104}{6M}\right) \times \left(\frac{I - 44}{6R}\right) \times B$$

where all units are bytes:

B	= Block Size
i	= I-Node Size
I	= Indirect Block Size
M	= Maximum Metadata Replication
R	= Maximum Data Replication

For example, the maximum file size for an unreplicated file system with a block size of 64KB, an indirect block size of 16KB, and an i-node size of 1KB would be calculated as follows:

$$\text{max\_fsize} = \left(\frac{1024 - 104}{6}\right) \times \left(\frac{16384 - 44}{6}\right) \times 65536 = \frac{27366377244.44}{1024^3}\text{GB} = 26.1\text{GB}$$

If the same file system were modified to allow replication, the formula shows how the maximum file size is substantially reduced:

$$\text{max\_fsize} = \left(\frac{1024 - 104}{12}\right) \times \left(\frac{16384 - 44}{12}\right) \times 65536 = \frac{6841594311.11}{1024^3}\text{GB} = 6.4\text{GB}$$

Maximum File System Size: Once you know the maximum file size (max_fsize), you can determine the maximum size of a GPFS file system using the following formula:

$$\text{max\_fs\_size} = \text{blks\_per\_fs} \times B$$

where

blks_per_fs = max_fsize / 24

B	= Block Size

| We could calculate a maximum file system size using the maximum file size value arrived at in the example above:

$$\text{max\_fs\_size} = \left(\frac{27366377244.44}{24}\right) \times 65536 = \frac{74728454128829}{1024^3}\text{GB} = 69596.3\text{GB}$$

| (Please note that 5 terabytes is the maximum supported file system size for GPFS 1.2. File systems greater than 5 terabytes in size are not supported by IBM service.)

Maximum Number of Files: Since one i-node is required for each file, the number of files a GPFS file system can hold depends on the number of i-nodes specified when you create the file system, but there are two ways to get a more realistic estimate:

1. Divide the maximum file system size (max_fs_size) by the average file size
2. Divide the maximum file size (max_fs_size) by the i-node size

The actual number of i-nodes your file system supports will usually be closer to the second estimate. If you are in doubt, plan for a maximum number of files according to the smaller of the two estimates. If you do not specify this parameter, it defaults to the size of the file system at creation, divided by 1MB.

Table 1 on page 12 illustrates how block size, indirect block size, i–node size, and replication affect both maximum file size and maximum file system size by showing selected parameter values with the capacities they yield. For purposes of simplification these calculations use the same replication values for both data and metadata.

Table 1. Sample GPFS Block Sizes and Related Parameters

(*B*) Block Size	(*I*) Indirect Block Size	(*i*) I-Node Size	(*M, R*) Maximum Replication	Approx. Maximum File Size	Approx. Maximum File System Size
16KB	1KB	512	1	173.5MB	115.7GB
			2	43.4MB	28.9GB
16KB	4KB	512	1	717.5MB	478.3GB
			2	179.4MB	119.6GB
16KB	16KB	512	1	2.9GB	1.9TB
			2	723.4MB	482.3GB
64KB	4KB	512	1	2.8GB	*5TB
			2	717.5MB	1.9TB
64KB	4KB	1KB	1	6.4GB	*5TB
			2	1.6GB	4.3TB
64KB	4KB	2KB	1	13.7GB	*5TB
			2	3.4GB	*5TB
64KB	16KB	512	1	11.5GB	*5TB
			2	2.9GB	*5TB
64KB	16KB	1KB	1	26.1GB	*5TB
			2	6.5GB	*5TB
64KB	16KB	2KB	1	57.8GB	*5TB
			2	13.8GB	*5TB
64KB	32KB	512	1	23.1GB	*5TB
			2	5.8GB	*5TB
64KB	32KB	1KB	1	52.2GB	*5TB
			2	13.0GB	*5TB
64KB	32KB	2KB	1	110.4GB	*5TB
			2	27.6GB	*5TB
256KB	16KB	512	1	46.3GB	*5TB
			2	11.5GB	*5TB
256KB	16KB	4KB	1	452.9GB	*5TB
			2	113.2GB	*5TB
256KB	32KB	512	1	90.5GB	*5TB
			2	22.6GB	*5TB
256KB	32KB	4KB	1	901.1GB	*5TB
			2	226.8GB	*5TB

*

* 5 terabytes is the maximum supported file system size. File systems greater than 5 terabytes in size are not supported by IBM Service.

IBM Virtual Shared Disks

GPFS accesses data using the facilities of the IBM Recoverable Virtual Shared Disk Licensed Program, and the IBM Virtual Shared Disk component of the Parallel System Support Programs for AIX, which allows application programs executing on different SP nodes to access a logical volume as if it were local at each node. IBM Recoverable Virtual Shared Disk, which allows a secondary or backup server to be defined for such a logical volume, is required even when there are no twin-tailed disks that can be physically accessed from more than one node because it provides fencing capabilities that preserve data integrity in the event of certain failures. *Managing Shared Disks* contains installation, management, and usage information for both IBM Virtual Shared Disk and IBM Recoverable Virtual Shared Disk.

Proper planning for GPFS installation provides:

- Sufficient processing capability for IBM Virtual Shared Disk servers to deliver data to clients.
- Sufficient disks to meet the expected I/O load.
- Sufficient connectivity (adapters and buses) between disks and IBM Virtual Shared Disk servers.
- Sufficient free disk space for the correct operation of the IBM Recoverable Virtual Shared Disk and PSSP components used by GPFS

IBM Virtual Shared Disk Servers

Will your IBM Virtual Shared Disk servers be dedicated or will you also be using them to run applications? If you will have non-dedicated VSD servers, consider running less time-critical applications on these nodes.

The actual processing capability required for IBM Virtual Shared Disk service is a function of the application I/O access patterns, the type of node, the type of disk, and the disk connection. You can run **iostat** on the server to determine how much of a load your access pattern will place on an IBM Virtual Shared Disk server.

Note: If you plan to run time-critical applications on an IBM Virtual Shared Disk server, remember that servicing disk requests from other nodes might conflict with the demands of these applications.

Assure that you have sufficient resources to run the IBM Virtual Shared Disk program efficiently. This includes enough buddy buffers of sufficient size to match your file system block size, as well as sufficient *rpoolsize* and *spoolsize* values in the communications subsystem.

Buddy Buffers: The IBM Virtual Shared Disk server node uses buddy buffers to temporarily store data for I/O operations originating at a non-server node. Buddy buffers are used only when a shortage in the switch buffer pool occurs, or to handle large I/O operations. In contrast to the data in the cache buffer, the data in a buddy buffer is purged immediately after the I/O operation completes.

Buddy buffer space is allocated in powers of two. If an I/O request size is not a power of two, the smallest power of two that is larger than the request is allocated. For example, for a request size of 24KB, 32KB is allocated on the server.

If you do not plan to create any GPFS file system with a block size larger than 16KB, two or three buddy buffers of 16KB each on IBM Virtual Shared Disk server nodes should suffice. Create one buddy buffer of 16KB on each non-server node.

If you do plan to create a GPFS file system with a block size larger than 16KB, one buddy buffer equal to the largest block size used will do for non-server nodes, but the number of buddy buffers on IBM Virtual Shared Disk server nodes should be sufficient to handle the maximum number of disk I/Os expected at any given time. Start with two buffers per physical disk attached to a server. If you monitor the output of the **statvsd** command for queued buddy buffer requests, you can determine whether this setting is correct.

For more information on buddy buffers, see *Managing Shared Disks*.

Disks

Plan how to distribute your disks among the IBM Virtual Shared Disk servers. Two considerations should guide your decision. One involves providing sufficient disks and adapters on the system to yield the required I/O bandwidth. The other involves knowing approximately how much storage capacity you will need for your data. Dedicated IBM Virtual Shared Disk servers should have sufficient disks and
| adapters to drive the I/O load you expect them to handle. The current maximum
| number of disk descriptors that can be defined for a file system is 1024.

Connectivity

If your disks are capable of connection to multiple nodes (twin-tailing) and you wish to exploit this capability, you must select an alternate node as the backup IBM Virtual Shared Disk server. See the *Managing Shared Disks* publication for help in selecting these nodes.

Free Disk Space

Sufficient free disk space needs to be kept in **/var** for the correct operation of the IBM Recoverable Virtual Shared Disk and PSSP components used by GPFS. While GPFS does not use major amounts of **/var**, PSSP components require several MB to correctly support GPFS recovery. Failure to supply this space on all nodes may appear as a hang in your GPFS file system when recovering failed nodes.

Defining IBM Virtual Shared Disks

GPFS uses IBM Virtual Shared Disks to let application programs executing at different nodes access raw logical volumes as if they were local at each of the nodes. Although *Managing Shared Disks*, the IBM Virtual Shared Disk publication, is the definitive source for instructions on how to create IBM Virtual Shared Disks, you can have GPFS create them automatically when you create your file systems.

In order to simplify file system creation, GPFS creates one IBM Virtual Shared Disk for each physical disk specified for the file system, and assigns an optimal partition size based on the disk's capacity. An IBM Virtual Shared Disk name is also automatically generated. If you want to take advantage of the flexibility available in creating IBM Virtual Shared Disks, follow the instructions in Managing Shared Disks and then pass the existing IBM Virtual Shared Disk to the GPFS file system by specifying the VSD name.

In order to define IBM Virtual Shared Disks for your GPFS file system, you will need to know the names of the disks and their servers, and then decide whether to store only data, only metadata, or both on the disks. You may also wish to assign

IBM Virtual Shared Disks to specific failure groups in order to avoid single point of failure situations. “Building Disk Descriptors” on page 39 describes the procedure.

Recoverability

GPFS provides several layers of protection against failures of various types:

1. Node failure
2. Server failure
3. Disk failure
4. Connectivity failure

Node Failure

This basic layer of protection covers the failure of file system nodes, and requires that Group Services (the high availability subsystem of Parallel System Support Programs for AIX) and IBM Recoverable Virtual Shared Disk be set up on your system. When an inoperative node is detected by Group Services, GPFS uses the facilities of IBM Recoverable Virtual Shared Disk to fence it off and prevent it from performing write operations that might interfere with recovery. Recovery involves rebuilding metadata structures, which may have been under modification at the time of the failure, and takes place automatically with no administrative action required.

File system recovery from node failure should not be noticeable to applications running on other nodes, except for delays in accessing objects being modified on the failing node. If the failing node is the coordinator of locks for a file system, the delay will be longer and proportional to the activity on the file system at the time of failure, but no administrative intervention will be needed.

Server and Disk Failure

The two most common reasons why data becomes unavailable are disk failure and IBM Virtual Shared Disk server failure. In the event of either type of failure, GPFS discontinues use of the disk and awaits its return to an available state. You can guard against loss of data availability from such failures using one or more of the following methods to maintain additional copies of files.

One means of protection is the use of a Redundant Array of Independent Disks controller, which masks disk failures with parity disks. An ideal configuration is shown in Figure 3, where a RAID device is twin-tailed to two nodes. This protects against server failure as well.

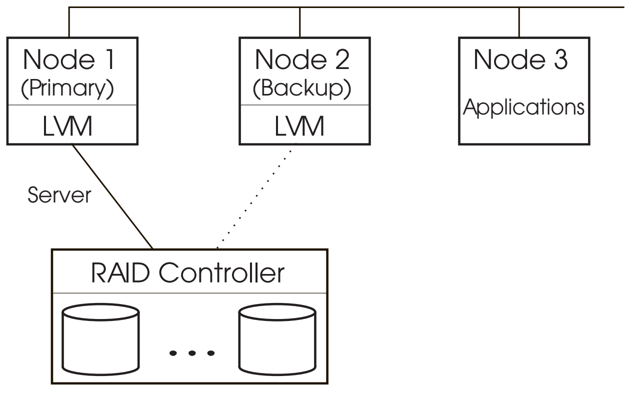


Figure 3. Primary Node Serving RAID Device

If node 1, the primary server, fails, its responsibilities are assumed by node 2, the backup server, as shown in Figure 4 on page 16.

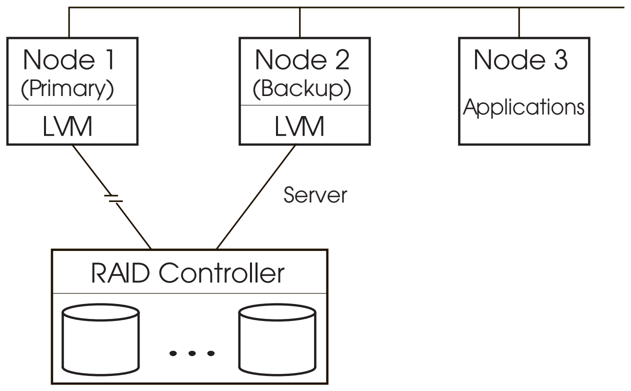


Figure 4. Backup Node Serving RAID Device

You can also protect your file system against disk failure by *mirroring data* at the logical volume manager (LVM) level, writing the data twice to two different disks. The addition of twin-tailed disks to such a configuration adds protection against server failure by allowing the IBM Recoverable Virtual Shared Disk program to route requests through a backup server.

GPFS offers yet another method of protection, *replication*, which overcomes both disk failure and server failure at the expense of additional disk space. GPFS allows replication of both file data and metadata. This means that two instances of data, or metadata, or both, can be automatically created and maintained for any file in a GPFS file system. If one instance becomes unavailable due to disk failure, another instance is used instead. You can set different replication specifications for each file, or apply default settings specified at file system creation.

Metadata and data replication are specified independently. Each has a default replication factor and a maximum replication factor. Although replication of metadata is less costly in terms of disk space than replication of file data, excessive replication of metadata also affects GPFS efficiency because all metadata replicas must be written. In general, more replication uses more space.

Each method of protection has its cost, whether it be the installation of additional hardware or the consumption of large amounts of disk space. If your primary concern is loss of data, and you can tolerate temporary loss of data availability while an IBM Virtual Shared Disk server reboots, a RAID device may be the most inexpensive protection for you. If, on the other hand, you cannot tolerate loss of data access if a server fails, and you are willing to restore data from a backup tape, a twin-tailed disk, with or without LVM mirroring, might be your best protection. Should the installation of a RAID controller and a twin-tailed disk be equally unappealing, and you want protection from both server and disk failure, replication is the choice for you.

Connectivity Failure

Plan to organize your GPFS disks into a number of *failure groups*. A failure group is a set of disks that share a common point of failure that could cause them all to become simultaneously unavailable. In order to assure file availability, GPFS maintains each instance of replicated data on disks in different failure groups. Even if you do not specify replication when creating a file system, GPFS automatically replicates recovery logs in separate failure groups.

At minimum, organize failure groups that protect against server failure. All disks that share an IBM Virtual Shared Disk server (but do not share any attachment hardware, such as an SSA loop) should belong to a unique failure group, as shown in Figure 5. GPFS builds such discrete failure groups by default if you do not specify *Failure Group* parameters when creating your file system.

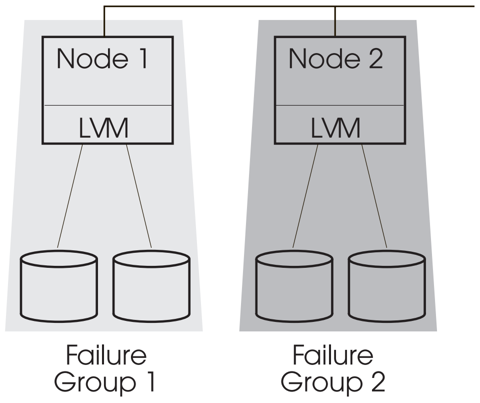


Figure 5. Basic Failure Groups with Servers and Disks

If you plan to use both twin-tailed disks and replication, assign disks to the failure groups with their primary servers, as shown in Figure 6. This arrangement would assure availability of replicated data if either server failed.

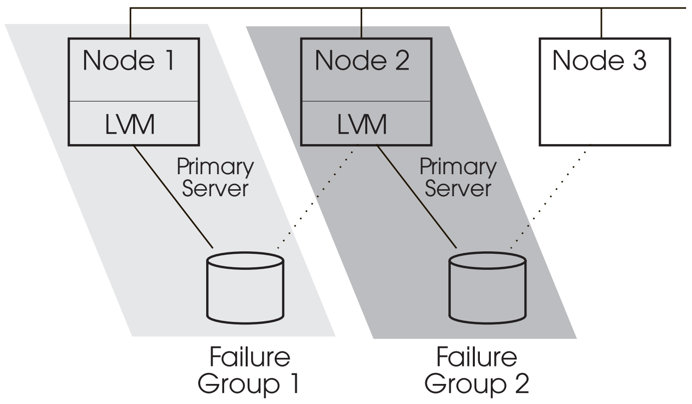


Figure 6. Failure Groups with Twin-Tailed Disks

Recoverability Parameters

Sound file system planning includes consideration of replication, as well as structuring your data so that information is not vulnerable to a single point of failure. It also includes distributing data across a large number of disks. The following parameters enable you to create a highly available file system with fast recoverability from node or disk failure.

At the File System Level: The following recoverability parameters are set at the file system level and apply to all files. They can be changed for an existing file system but modifications only apply to files subsequently created.

Default Metadata Replicas
: This is the default replication factor for metadata. This value must be equal to or less than *MaxMetadataReplicas*, and cannot exceed the number of failure groups with disks that can store metadata. The allowable values are 1 or 2, with a default of 1 (no replication). This parameter also controls the number of copies of i-nodes, directories, and indirect blocks for all files in the file system.

Maximum Metadata Replicas
: This is the maximum replication factor for metadata. This parameter also controls the maximum number of copies of i-nodes, directories, and indirect blocks for all files in the file system. The allowable values are 1 or 2, with a default of 1 (no replication).

Default Data Replicas
: This is the default replication factor for data blocks. This value must be equal to or less than *MaxDataReplicas*, and the value cannot exceed the number of failure groups with disks that can store data. The allowable values are 1 and 2, with a default of 1 (no replication).

Maximum Data Replicas
: This is the maximum replication factor for data blocks. The allowable values are 1 and 2, with a default of 1 (no replication).

At the Disk Level: You can include these positional parameters in any disk description when creating a GPFS file system or adding or replacing disks in your GPFS file system.

Disk Usage
: What is to be stored on the disk. **metadataOnly** specifies that this disk may only be used for metadata, not for data. **dataOnly** specifies that only data, and not metadata, is allowed on this disk. You can limit vulnerability to disk failure by confining metadata to a small number of conventional mirrored or replicated disks. The default, **dataAndMetadata**, allows both on the disk.

  Note: RAID devices are not well-suited to storing metadata. Their inefficient handling of I/O in small block sizes may affect GPFS performance.

Failure Group
: A number identifying the failure group to which this disk belongs. All disks that have a common point of failure, such as disks that are attached to the same IBM Virtual Shared Disk server node, should be placed in the same failure group. GPFS uses this information during data and metadata placement to assure that no two replicas of the same block will become unavailable due to a single failure. You can specify

any value from –1 (where –1 indicates that the disk has no point of failure in common with any other disk) to 4000. If you specify no failure group, the value defaults to the server node number plus 4000, assuring that replicated data remains available in the event of server failure.

Additional File System Considerations

Two more parameters can be set when you create a file system using the **mmcrfs** command, and can be changed at a later time:

–A yes | no
Automatic Mount option. Indicates whether the GPFS file system should automatically mount when system reboots and the GPFS daemon starts, provided that enough nodes are up to meet quorum requirements. The default is **yes**.

–s *StripeMethod*
Set the stripe method for this file system. Possible values are:

roundRobin
Places one block on all of the disks in the file system before writing to the first disk again, repeating the same sequence of disks as the file grows. This is the default.

random
Places the next block randomly, subject only to the constraint that no two replicas of a block be in the same failure group.

balancedRandom
Randomly places one block on all of the disks in the file system before repeating one.

Planning a Sample GPFS Configuration

The first step in planning a GPFS configuration is to evaluate the hardware. Let us say that we have one SP system with two RAID devices and eight disks. Although our SP currently has only one frame with eight nodes, we anticipate adding a second frame of eight nodes next year. Therefore, we estimate the **node count** to be 16.

Next, we create a node list, which we name **gpfs1.nodes**, using the switch hostnames as follows:

```
sp1sw00.ibm.com
sp1sw01.ibm.com
sp1sw02.ibm.com
sp1sw03.ibm.com
sp1sw04.ibm.com
sp1sw05.ibm.com
sp1sw06.ibm.com
sp1sw07.ibm.com
```

Although we could use the Ethernet hostnames, such as sp1en01.ibm.com, in our list, we specify the switch hostnames because we want GPFS to take advantage of the faster switch communication.

We will allow the default values to be applied for **pagepool** and **mallocsize**, as well as **priority.** If we feel performance can be improved, we will reconfigure GPFS with new values for these parameters later. See “mmchconfig” on page 87.

We want GPFS to start automatically whenever the nodes have been shut down and brought back up, so we will specify the **autoload** option.

This planning exercise provides the information needed to follow the procedure in “Configuring GPFS” on page 34. We have more information to collect, however, before we can actually create a GPFS file system. “Planning a Sample GPFS File System” describes a process leading to this information.

Planning a Sample GPFS File System

File system planning is divided into two phases, one for file system sizing, and one for IBM Virtual Shared Disks.

Sizing Sample File Systems

We want to store two different kinds of files using GPFS: small files that users keep in their home directories, and larger files characteristic of technical applications. Small files do not require high bandwidth for acceptable I/O operations, but large files do. Therefore, the best approach is to create two separate file systems, which we will call **/gpfs/fs1** and **/gpfs/fs2**. This allows each file system to have its own block size and indirect block size. The **gpfs** directory will be mounted in the root (**/**) directory.

Since **fs1**, where user home directories will reside, will have few files greater than 256KB in length, a **block size** of **16KB** will allow the most efficient use of disk space. The default **i-node** size of **512 bytes** will allow inexpensive storage of small files. The formula below shows that if we replicate metadata but do not replicate data, the largest file size we can expect to have with a **block size** of **16KB**, an **i-node** size of **512 bytes,** and an **indirect block size** of **1KB** is **86.7MB**. Since this is more than we expect to need, these are the values we choose for **fs1**.

$$\text{max\_fsize} = \left(\frac{i - 104}{6M}\right) \times \left(\frac{I - 44}{6R}\right) \times B$$

$$\text{max\_fsize} = \left(\frac{512 - 104}{12}\right) \times \left(\frac{1024 - 44}{6}\right) \times 16384 = \frac{90985813.33}{1024^2}\text{MB} = 86.7\text{MB}$$

The majority of files in **fs2**, where our large, technical application files will be stored, will be greater than 128MB in length, so we will define a **block size** of **256KB** to provide faster read/write operations. Since there will be some smaller files, we can accept the default **i-node** value of **512 bytes** to avoid wasting disk space. We want to allow files in **fs2** to grow as large as **20GB**, and the formula tells us that an **indirect block size** of **16KB**, used with a **block size** of **256KB**, and an **i-node** size of **512 bytes**, will allow that capacity if we replicate metadata but not data.

$$\text{max\_fsize} = \left(\frac{512 - 104}{12}\right) \times \left(\frac{16384 - 44}{6}\right) \times 262144 = \frac{245583489706}{1024^3}\ \text{GB} = 228.7\text{GB}$$

Planning Sample IBM Virtual Shared Disks

Now that we know the characteristics of the two GPFS file systems we want to create, we can plan how to store them on our two RAID devices and eight disks.

The relatively small size of files in the **fs1** file system makes the RAID devices ill-suited for their storage, since RAID operates more efficiently with larger block sizes. Therefore, we decide to store **fs1** only on the non-RAID disks, which have a capacity of 4GB each. We will dedicate the RAID devices, each of which holds 50GB, to **fs2**, as Figure 7 shows.

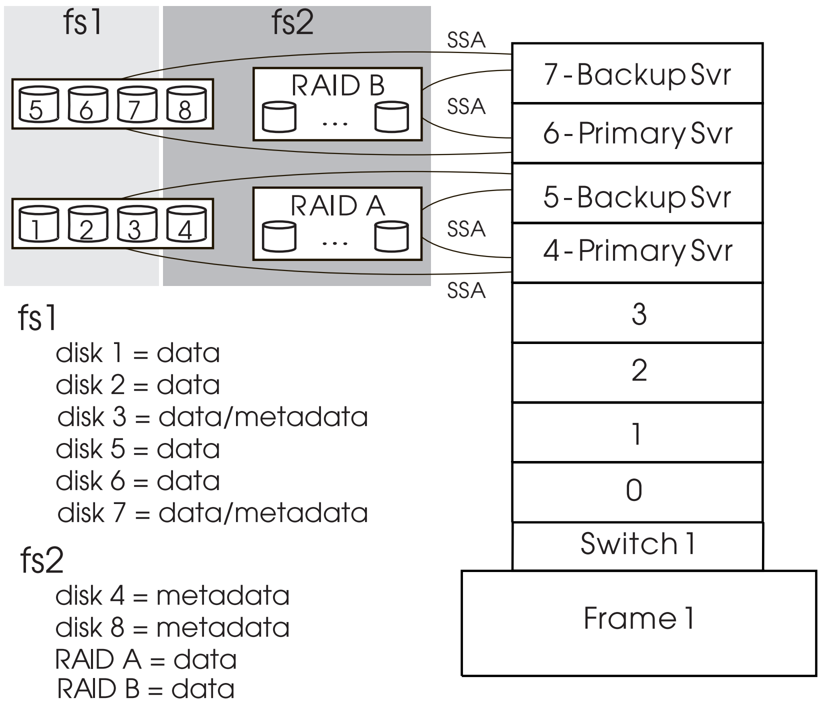


Figure 7. Planning Disks for Sample File Systems

We have decided not to replicate **fs1** data because it will be backed up regularly, and a brief period of unavailability will not be intolerable if it must be restored. We will not replicate **fs2** data either, because the RAID controller will handle recovery. We will, however, replicate metadata for both file systems.

We want to replicate **fs1** metadata in order to limit the impact of a disk failure. Metadata replication will ensure that files with no data blocks on a failed disk will still be accessible, and we will be able to create new files even when the disk is down. Without metadata replication, a large fraction of files would become inaccessible and we might be unable to write to the file system.

We also want to replicate **fs2** metadata to ensure availability, but we do not want to place metadata on RAID disks because of its smaller indirect block size.

According to our plan, **fs1** data will be striped across disks 1, 2, 5, and 6, and part of disks 3 and 7. The **fs1** metadata will be written on the other part of disk 3 and replicated on part of disk 7. (We could also distribute metadata across all disks in **fs1**, which might be more efficient under some usage conditions.) This allows 20GB of disk space (4 X 4GB + 2 X 2GB) for **fs1** data. Since 20GB does not seem sufficient for anticipated growth, we plan to double this capacity in the coming year. Therefore, we can estimate the number of i-nodes we will need for **fs1** by dividing the maximum projected file size of 89MB by the maximum i-node size, 512, giving us **182,272 i-nodes**.

Data in **fs2** will be striped across the RAID A and RAID B arrays. Metadata will be written to disk 4 because the relatively small indirect block size of 32KB is inappropriate for RAID devices. The **fs2** metadata will be replicated on disk 8. Although our two RAID devices hold a total of 100GB, we can foresee the need to add six more RAID devices. Therefore, we can divide a future total capacity of 400GB by an average file size of 64MB for an estimated **i-nodes count of 6000** for **fs2**.

Since both our RAID devices would consume too much I/O bandwidth for one server to support, we've decided to create two servers and two backup servers. As Figure 7 on page 21 shows, switch node 4 is the server for RAID A and disks 1 through 4, while switch node 6 serves RAID B and disks 5 through 8. Switch node 5 is the backup server for node 4 and node 7 backs up node 6. The disk devices are all twin-tailed and are connected through SSA loops, but SCSI adapters could also be used.

When we create the file systems, we will have GPFS create 10 IBM Virtual Shared Disks. These will be automatically partitioned for optimal storage based on capacity.

We will have GPFS create two failure groups organized by servers. **Failure group 1** will contain the **fs1** disks served by node 4. **Failure group 2** will contain **fs1** disks served by node 6. Likewise, **failure group 3** contains **fs2** disks served by node 4, **failure group 4** contains **fs2** disks served by node 6.

These specifications are input to disk descriptor files we will create in “Building Disk Descriptors” on page 39.

Chapter 3. Installing GPFS

Although GPFS installation is straightforward, you will benefit from reading Chapter 2, "Planning for GPFS" on page 5 before continuing.

Do not attempt to install GPFS if you do not have the hardware and software prerequisites listed in "Installation Requirements."

Assure that the **PATH** environment variable on your control workstation and on each SP node includes the following:

- **/usr/lpp/csd/bin**

The path on each SP node must include:

- **/usr/lpp/mmfs/bin**

Throughout this procedure you will see various component names beginning with the prefix **mmfs**. This is not an error. GPFS shares many components with the IBM Multi-Media LAN Server, a related product.

Installation Requirements

GPFS is designed for optimum performance in a specific environment. Before attempting installation, be sure that your environment meets the following requirements.

Hardware Requirements

1. RS/6000 SP
2. High Performance Switch or SP Switch
3. Enough Disks to contain file system

Software Requirements

| 1. AIX Version 4 Release 3.2 (5765–C34) or later modifications

| 2. Parallel System Support Programs for AIX, Version 3 Release 1 or later
| (5765–D51) with the following options installed:

| - SP System Support Package (ssp.basic)
| - SP Communication Subsystem Package (ssp.css)
| - Cluster Technology basic function (rsct.basic.rte)
| - RS/6000 Cluster Technology basic function (rsct.basic.sp)
| - Cluster Technology client function (rsct.clients.rte)
| - RS/6000 Cluster Technology client function (rsct.clients.sp)
| - SP Sysctl Package (ssp.sysctl)
| - Compatibility for ssp.ha and ssp.topsvcs clients (ssp.ha_topsvcs.compat)
| - IBM Virtual Shared Disk graphical user interface (ssp.vsdgui)
| - IBM Virtual Shared Disk Centralized Management Interface (vsd.cmi)

- IBM Virtual Shared Disk sysctl commands (vsd.sysctl)
- IBM Virtual Shared Disk device driver (vsd.vsdd)
- IBM Recoverable Virtual Shared Disk Connection Manager (vsd.rvsd.hc)
- IBM Recoverable Virtual Shared Disk Connection Daemon (vsd.rvsd.rvsdd)
- IBM Recoverable Virtual Shared Disk Recovery Scripts (vsd.rvsd.scripts)

Installing the GPFS HTML Files

The **gpfsdocs** file set includes HTML files that contain online versions of the GPFS publications. Once you have installed the **gpfsdocs** file set, the GPFS publications will be located at **/usr/lpp/mmfs/gpfsdocs**. Since other parts of GPFS link to the HTML publications, these files should not be moved from the **/usr/lpp/mmfs/gpfsdocs** directory.

Step 1. Installation Procedure

Follow these steps to install the GPFS software using the **installp** command. This procedure installs GPFS on all SP nodes at once. The use of SMIT requires you to install GPFS on each SP node individually, and is not recommended. The recommended procedure is to install from the control workstation.

Create GPFS Directory

On the control workstation, create a subdirectory in **/spdata/sys1/install/pssplpp/PSSP-3.1** with the following command:

```
mkdir /spdata/sys1/install/pssplpp/PSSP-3.1/mmfs
```

Then copy the installation images from the tape to the new directory, using the **bffcreate** command:

```
bffcreate –qvX –t /spdata/sys1/install/pssplpp/PSSP–3.1/mmfs –d /dev/rmt0.1 all
```

Note: If your tape drive is other than /dev/rmt0, be sure to substitute its no–rewind–on–close device name in place of /dev/rmt0.

This will place the following GPFS images in the image directory:

1. mmfs.base.usr.3.1.0.0
2. mmfs.gpfs.usr.1.2.0.0
3. mmfs.util.usr.3.1.0.0
4. mmfs.msg.en_US.usr.3.1.0.0
5. mmfs.man.en_US.shr.3.1.0.0
6. mmfs.gpfsdocs.shr.3.1.0.0

You can also copy files to this directory from other LPPs that you want to install on the same nodes, such as IBM Recoverable Virtual Shared Disk.

Create Installation Image

1. Make the new image directory the current directory:

   ```
   cd /spdata/sys1/install/pssplpp/PSSP-3.1/mmfs
   ```

2. Use the **inutoc** command to create a **.toc** file. The **.toc** file is used by the **installp** command.

   ```
   inutoc .
   ```

3. To view the product **README** after creating the installation images:

   ```
   installp –i –d . mmfs | more
   ```

Install GPFS on Network

Install GPFS according to one of the following procedures, depending on whether or not your network has a shared file system.

Set the **WCOLL** environment variable to target all nodes in the GPFS configuration for the **dsh** command. *IBM Parallel Systems Support Programs: Administration Guide* , *IBM Parallel Systems Support Programs: Command and Technical Reference*, and *IBM RS/6000 SP Management: Easy, Lean, and Mean* all contain information on the **WCOLL** environment variable.

To Install on Shared File System Network...

1. Assure that image directory is NFS-exported to the SP nodes. For example, check the output of the **showmount –e sys1cws** command, where *sys1cws* is the hostname of the control workstation. You must specify a control workstation name that is known to the nodes on the SP Ethernet. Your control workstation IP address may also be used.

   Look for the following return:

   ```
   export list for sys1cws.pok.ibm.com:
   /spdata/sys1/install/pssplpp/PSSP-3.1
   ```

2. NFS mount the image directory from every SP node:

   ```
   dsh mount sys1cws:/spdata/sys1/install/pssplpp/PSSP-3.1 /mnt
   ```

3. Run the **installp** command on all nodes from the GPFS installation directory:

   ```
   dsh –f4 installp –agXd /mnt/mmfs all
   ```

   Note: Fanning by 4 nodes is suggested to avoid overloading the SP Ethernet.

To Install on Non-Shared File System Network...

If the GPFS installation directory is not in a shared network file system, copy the images to each node as follows:

```
dsh mkdir /tmp/mmfs
cd /spdata/sys1/install/pssplpp/PSSP-3.1/mmfs
hostlist | pcp –w – mmfs.base.usr.3.1.0.0 /tmp/mmfs
hostlist | pcp –w – mmfs.gpfs.usr.1.2.0.0 /tmp/mmfs
hostlist | pcp –w – mmfs.util.usr.3.1.0.0 /tmp/mmfs
hostlist | pcp –w – mmfs.msg.en_US.usr.3.1.0.0 /tmp/mmfs
hostlist | pcp –w – mmfs.man.en_US.shr.3.1.0.0 /tmp/mmfs
hostlist | pcp –w – mmfs.gpfsdocs.shr.3.1.0.0 /tmp/mmfs
hostlist | pcp –w – .toc /tmp/mmfs
```

Then, install on each node from its local GPFS installation directory:

```
dsh installp –agXd /tmp/mmfs all
```

Install Control Workstation Image

Install the **mmfs.gpfs** image on the control workstation.

```
installp –agXd /spdata/sys1/install/pssplpp/PSSP-3.1/mmfs mmfs.gpfs
```

Step 2. Verify GPFS Installation

Use the **lslpp** command to verify the installation of GPFS filesets on each SP node:

```
dsh lslpp –l mmfs*
```

Output similar to the following should be returned:

```
Fileset                      Level  State      Description
  ----------------------------------------------------------------------------
Path: /usr/lib/objrepos
  mmfs.base.cmds             3.1.0.0  COMMITTED  GPFS File Manager Commands
  mmfs.base.rte              3.1.0.0  COMMITTED  GPFS File Manager
  mmfs.gpfs.rte              1.2.0.0  COMMITTED  GPFS File Manager
  mmfs.msg.en_US             3.1.0.0  COMMITTED  GPFS Server Messages -
                                                 U.S. English
  mmfs.util.cmds             3.1.0.0  COMMITTED  GPFS Server Utilities
  mmfs.util.smit             3.1.0.0  COMMITTED  GPFS Server SMIT Panels

Path: /etc/objrepos
  mmfs.base.rte              3.1.0.0  COMMITTED  GPFS File Manager
  mmfs.gpfs.rte              1.2.0.0  COMMITTED  GPFS File Manager

Path: /usr/share/lib/objrepos
  mmfs.man.en_US.data        3.1.0.0  COMMITTED  GPFS Server Man Pages -
                                                 U.S. English
```

Step 3. Tune Switch

If the **rpoolsize** and **spoolsize** values are not already set to 16777216, issue the following **dsh** command and reboot :

Note: Do not set these values on the control workstation.

```
dsh /usr/lpp/ssp/css/chgcss -l css0 -a rpoolsize=16777216 -a spoolsize=16777216
```

Ignore returned message saying `...new value != default`.

Step 4. Configure sysctl

Make the following change on all GPFS nodes, including the control workstation:

- Edit and uncomment the file located at **/etc/sysctl.mmcmd.acl** to change the Kerberos realm to the correct name for your SP system.

Refer to *IBM Parallel Systems Support Programs: Administration Guide* or *IBM RS/6000 SP Management: Easy, Lean, and Mean*, for more information about Kerberos and **sysctl**.

Step 5. Tune IBM Virtual Shared Disk

GPFS requires each of its nodes to enter IBM Virtual Shared Disk parameters in the System Data Repository (SDR). These IBM Virtual Shared Disk parameters must be set to sufficient values in order for GPFS to operate efficiently:

- IP Packet Size
- Cache Buffers
- Request Count
- Buddy Buffers
- | pbufs

Consult the *Managing Shared Disks* manual for detailed descriptions.

“IBM Virtual Shared Disk Parameters and GPFS Performance” on page 74 contains more information on buddy buffers.

| Step 6. Reboot

| If any values were changed in either Step 3. Tune Switch, or Step 5, Tune IBM
| Virtual Shared Disk, reboot.

Chapter 4. Migrating to the Latest Level of GPFS

This chapter contains information to help you migrate your GPFS configuration to the latest level.

Migrating to GPFS 1.2

Due to the changes in the token manager function in GPFS 1.2, it is required that all nodes that use a given file system are not only at the same level of GPFS, but are also upgraded to that level at the same time. This is required to ensure the use of identical locking protocols to maintain the integrity of user data. It would not be possible to maintain the integrity of your data if GPFS 1.1 and GPFS 1.2 were to share the management of the same file system. GPFS 1.2 will reject any GPFS 1.1 image from coexisting within the same configuration.

New function existing in GPFS 1.2, extendible i–nodes and preallocation, will create data structures which are not recognizable by GPFS 1.1. In order to ease your migration, GPFS 1.2 will not allow you to exploit these new functions until you have explicitly authorized these changes by issuing the **mmchfs** command with the **-V** option. See "mmchfs" on page 96.

GPFS Configurations for Migration

A GPFS configuration is a group of nodes that all run the same level of GPFS code and operate on the same file systems. You have the ability to define more than one GPFS configuration in the same SP complex. This allows you to create a separate configuration for testing the new level of GPFS code without inhibiting the main GPFS configuration running at production level.

Your system should have a minimum of 5 nodes in order to use multiple GPFS configurations and do a staged migration. If you have less than 5 nodes, it is recommended you do a full migration. See "A Full Migration" on page 31.

GPFS configurations are created using SMIT or the **mmconfig** command. Each configuration is assigned an integer identifier, beginning with 1 and increasing sequentially. Optionally, you can specify a specific identifier that you want associated with the configuration. This identifier is a string of up to 8 characters and may not contain a period. See "Configuring GPFS" on page 34 and "mmconfig" on page 99.

Each node may belong to only one GPFS configuration. Use the **mmlsnode** command to display the GPFS configuration identifiers and the nodes that belong to them. See "mmlsnode" on page 134.

Nodes may be removed from one GPFS configuration and added to another using either SMIT or the **mmdelnode** and **mmaddnode** commands. See "Managing Nodes" on page 61.

A GPFS file system may only be accessed from a single GPFS configuration. To display the identifier of the GPFS configuration to which a given GPFS file system is associated, issue the **mmlsfs** command with the **-C** option. See "mmlsfs" on page 132. To change the GPFS configuration with which a file system is associated, issue the **mmchfs** command with the **-C** option. See “mmchfs” on page 96.

In general, when a command is issued it affects only the nodes that belong to the same GPFS configuration as the node from which the command is issued. Exceptions to this are commands which are global in nature, such as **mmconfig** and **mmlsnode**.

A GPFS configuration may be deleted by deleting all nodes that belong to it. A configuration cannot be deleted if GPFS is active on any of its nodes or if there are any file systems still associated with the configuration. See “mmdelnode” on page 115.

A Staged Migration

In a staged migration you will first install the new level of GPFS only on the control workstation and a small subset of nodes as a *test configuration*. Once you are satisfied with the new code, you can upgrade the rest of the nodes.

A staged migration to GPFS 1.2 consists of the following steps:

1. Decide which nodes will be used to test the new level of GPFS. It is recommended that you use at least three nodes for this purpose.
2. Position the new code on the test configuration nodes and on the control workstation. This requires copying the install images as described in “Create GPFS Directory” on page 24.
3. Stop GPFS on all test configuration nodes:

   ```
   stopsrc —s mmfs
   ```
4. Using SMIT or the **mmdelnode** command, delete the test configuration nodes from the main GPFS configuration. See “Deleting Nodes from the GPFS Configuration” on page 62.
5. Install the new code on the control workstation and the test configuration nodes. The install process will not affect your main GPFS configuration. See Chapter 3, “Installing GPFS” on page 23.
6. Reboot all test configuration nodes. This is required so the kernel extensions can be replaced.
7. Create a file with the names of the nodes of the test configuration. Using SMIT or the **mmconfig** command, create the test configuration. See “Configuring GPFS” on page 34.
8. Using SMIT or the **mmcrfs** command, create a file system for testing GPFS 1.2. See “Creating a File System” on page 39.

   Note: If you want to use an existing file system, move the file system by issuing the **mmchfs** command with the **-C** option. See “mmchfs” on page 96. If the file system was created under GPFS 1.1, you must explicitly migrate the file system (**mmchfs -V**) before you can use the **-F** option of the **mmchfs** command or utilize the **gpfs_prealloc()** subroutine.
9. Operate with the new level of code for awhile to make sure you want to migrate the rest of the nodes.

If you decide to go back to GPFS 1.1, see “Migrating Back to GPFS 1.1” on page 31.

10. Once you have decided to permanently accept GPFS 1.2, issue the following command for each of the file systems:

    ```
    mmchfs filesystem –V
    ```

    Note: Remember you CANNOT go back once you do this step!

    Any attempt to mount this file system on a GPFS 1.1 system will be rejected with an error.

    You may now operate with the new level of GPFS code.

11. When you are ready to migrate the rest of the nodes in the main GPFS configuration, follow steps 2, 3, 5, and 6.

A Full Migration

A full migration from GPFS 1.1 to GPFS 1.2 consist of the following steps:

1. Position the new code at all nodes. This requires copying the install images as described in “Create GPFS Directory” on page 24.
2. Stop GPFS on all nodes:

   ```
   stopsrc –s mmfs
   ```

3. Install the new code on all nodes. See Chapter 3, “Installing GPFS” on page 23.
4. Reboot all nodes. This is required so the kernel extensions can be replaced.
5. Operate with the new level of code for awhile to make sure you want to migrate.

   If you decide to go back to GPFS 1.1, see “Migrating Back to GPFS 1.1.”

6. Once you have decided to permanently accept GPFS 1.2, issue the following command for each of the file systems:

   ```
   mmchfs filesystem –V
   ```

   Note: Remember you CANNOT go back once you do this step!

   Any attempt to mount this file system on a GPFS 1.1 system will be rejected with an error.

   You may now operate with the new level of GPFS code.

Migrating Back to GPFS 1.1

If you should decide not to continue the migration to GPFS 1.2, and you have not issued the **mmchfs -V** command, you may reinstall GPFS 1.1 using the following steps:

1. Position the GPFS 1.1 code on all affected nodes.
2. Stop GPFS on all affected nodes:

   ```
   stopsrc –s mmfs
   ```

3. If you used a test configuration for testing GPFS 1.2, return all test configuration nodes to the main configuration:

   a. Delete all file systems in the test configuration that have version number 2. Use the **mmlsfs** command to display the version number of the file system.
   b. Either delete or move to the main GPFS configuration, all file systems that are still at version 1.
   c. Use SMIT or the **mmdelnode** command to delete all nodes from the test configuration.
   d. Use SMIT or the **mmaddnode** command to add all of the nodes back into the main GPFS configuration.
4. Run the deinstall program to remove files which are not used in a GPFS 1.1 file system.

   It is necessary to remove these files to allow access to user data. This program will not remove any customized or SDR files.

   ```
   installp –u mmfs
   ```
5. Install the original install images and all required PTFs.
6. Reboot all nodes.

Coexistence

Within a Partition

Due to the changes in the token manager function, it is not possible for different levels of GPFS to coexist in the same configuration. However, it is possible to run multiple configurations at different levels of GPFS.

Multiple Partitions

A GPFS file system may only be accessed from a single SP partition.

Compatibility

All applications which executed on GPFS 1.1 will execute on GPFS 1.2. File systems created under GPFS 1.1 may continue to be used under GPFS 1.2. However, once a GPFS 1.1 file system has been explicitly changed to GPFS 1.2 by issuing the **mmchfs** command with the **–V** option, the disk images can no longer be read by a GPFS 1.1 file system. You will be required to recreate the file system from the backup medium and restore the content if you choose to go back after this command has been issued.

Chapter 5. Performing GPFS Administration Tasks

The administration and maintenance of GPFS is organized in six categories:

1. “Configuring GPFS” on page 34
2. “Managing File Systems” on page 38
3. “Managing Disks” on page 54
4. “Managing Nodes” on page 61
5. “Managing GPFS Quotas” on page 64
6. “Managing Access Control Lists” on page 69

Notes:

1. Root authority is required to perform all GPFS administration tasks except those with a function limited to listing GPFS operating characteristics or modifying individual user file attributes.
2. Kerberos authentication is required to perform most GPFS administration tasks. If you do not have Kerberos authentication, issue the **kinit** command.
3. GPFS administration tasks **cannot be performed on the control workstation**. Perform these tasks from one of the GPFS nodes.

Most GPFS administration tasks can be performed using either SMIT menus or by entering command strings. Whenever you want to perform one of these tasks using SMIT, you can begin by invoking SMIT and selecting Applications→GPFS Administration, or by entering:

```
smit gpfs
```

The SMIT GPFS Administration Menu (Figure 8 on page 34) is displayed:

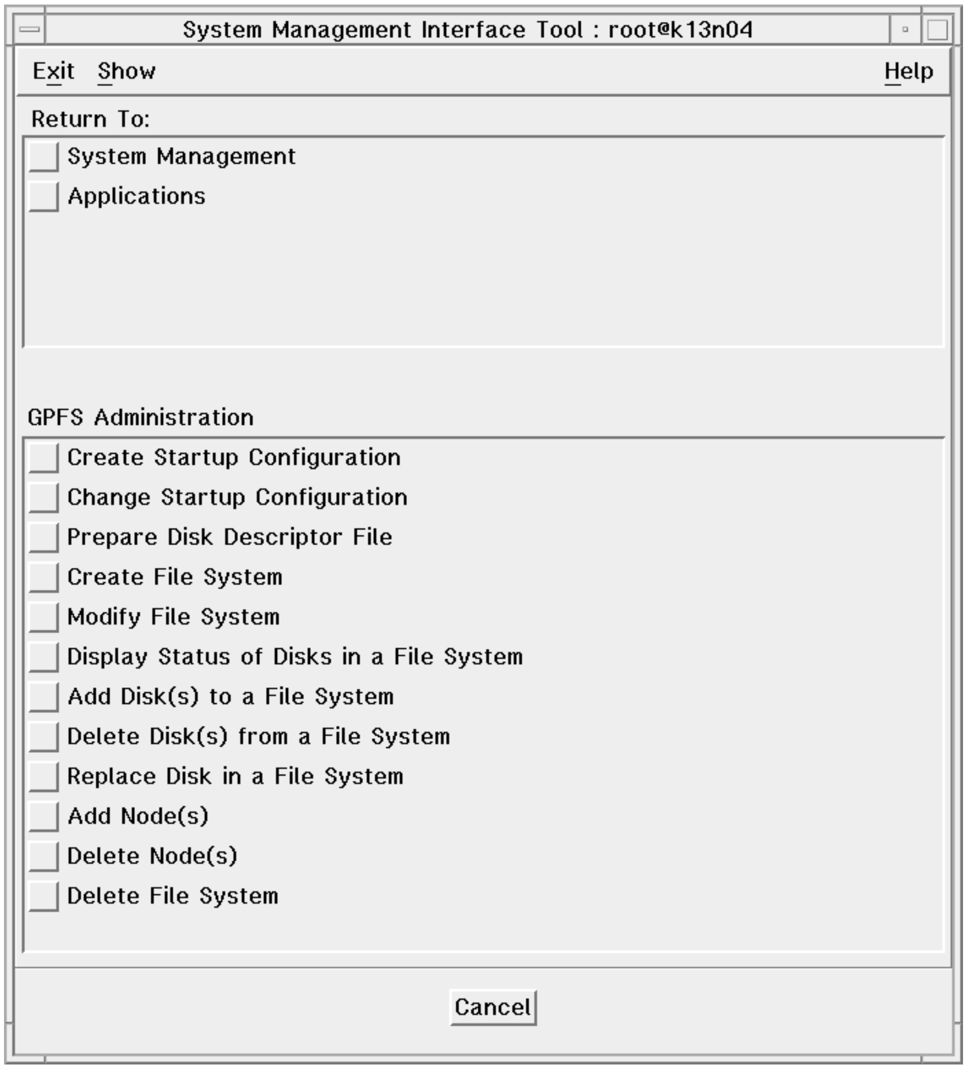

System Management Interface Tool : root@k13n04
Exit
Show
Help
Return To:
System Management
Applications
GPFS Administration
Create Startup Configuration
Change Startup Configuration
Prepare Disk Descriptor File
Create File System
Modify File System
Display Status of Disks in a File System
Add Disk(s) to a File System
Delete Disk(s) from a File System
Replace Disk in a File System
Add Node(s)
Delete Node(s)
Delete File System
Cancel

Figure 8. SMIT GPFS Administration Menu

You can display help information from the SMIT GPFS Administration Menu by selecting `Help` from the menu bar at the top. All GPFS SMIT dialogs display help information at the task level when you click on the question mark (**?**) button.

Configuring GPFS

Configuration sets up GPFS to run on a partition of SP nodes. It creates the **/etc/cluster.nodes** file and identifies GPFS nodes in the System Data Repository. It also defines settings for GPFS use of memory and control of parallel operations. No GPFS commands can be run until GPFS is configured.

See “Configuration Considerations” on page 5 before performing this procedure.

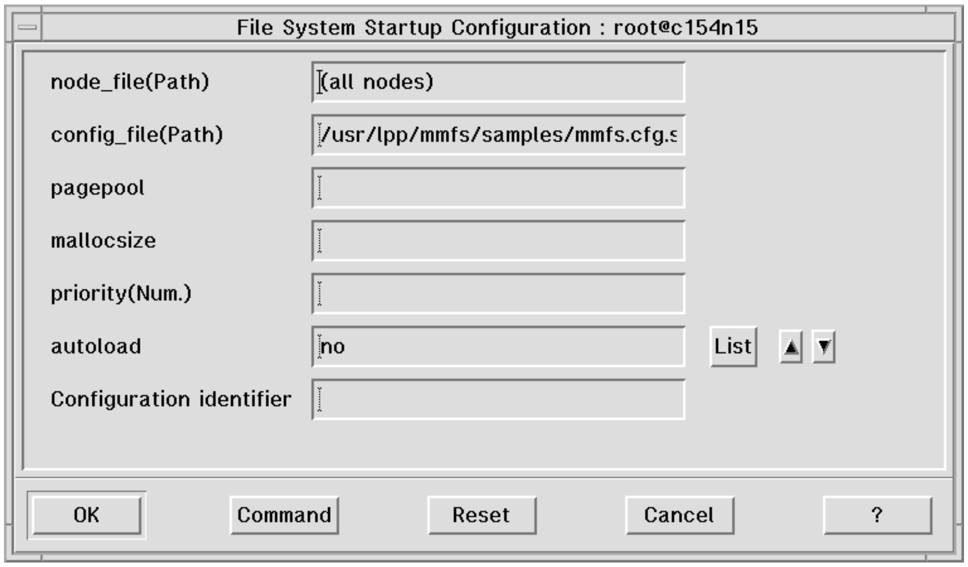
Use SMIT or the **mmconfig** command to configure GPFS on the SP system.

Configure Using SMIT

1. On the SMIT GPFS Administration Menu (Figure 8 on page 34) and select `Create Startup Configuration`, or enter the command,

   ```
   smit mmconfig
   ```

   The following SMIT panel is displayed:



File System Startup Configuration : root@c154n15

node_file(Path)	(all nodes)
config_file(Path)	/usr/lpp/mmfs/samples/mmfs.cfg.s
pagepool	
mallocsize	
priority(Num.)	
autoload	no
Configuration identifier	

| *Figure 9. File System Startup Configuration Menu*

   All parameters on this menu are optional.

   If *node_file* is not specified, all nodes in the System Data Repository are added to the configuration.

   If *config_file* is not specified, any other parameters left blank default to the values contained in the sample configuration file, **/usr/lpp/mmfs/samples/mmfs.cfg.sample**.

   For example, Figure 9 shows the path name of the node file we created in "Planning a Sample GPFS Configuration" on page 19. **Yes** in the space provided next to autoload specifies that we want the GPFS daemons to start automatically whenever the SP nodes boot up. All other parameters are left to default.

Configure Using mmconfig Command

You can use the **mmconfig** command to configure GPFS. For example, to configure all SP nodes and start GPFS automatically when they boot up, enter:

```
mmconfig -A
```

To configure all the nodes in our sample configuration file, **gpfs1.nodes** (see "Planning a Sample GPFS Configuration" on page 19), and have GPFS automatically started when the nodes boot up, we would enter:

```
mmconfig -n /gpfs/gpfs1.nodes -A
```

See "mmconfig" on page 99 for a command description and usage information.

Starting and Stopping GPFS

Before Starting GPFS

1. **You must have created at least one IBM Virtual Shared Disk (not necessarily for use by GPFS) before starting the GPFS daemons.**

   This is a requirement of IBM Recoverable Virtual Shared Disk, which GPFS uses. If no IBM Virtual Shared Disk exists in your system, GPFS will not start.

2. **DO NOT** start GPFS until it is configured. The first time you start GPFS, you must do so manually using the **startsrc** command. If you configure GPFS to start automatically when the nodes boot up, you will not have to start GPFS manually the next time you reboot your nodes.

   If you have not configured GPFS, using either SMIT or the **mmconfig** command, starting GPFS will load dummy kernel extensions and you will be unable to create a file system. If this occurs, configure GPFS and reboot the nodes.

3. Verify that the **/etc/sysctl.mmcmd.acl** file on each node contains the correct name for the Kerberos realm. (See "Step 4. Configure sysctl" on page 26.)

Starting GPFS

1. Set the **WCOLL** environment variable to target all nodes in the GPFS configuration for the **dsh** command. *IBM Parallel Systems Support Programs: Administration Guide*, *IBM Parallel Systems Support Programs: Command and Technical Reference*, and *IBM RS/6000 SP Management, Easy, Lean, and Mean* all contain information on the **WCOLL** environment variable.

2. Assure that the required availability services groups are established by issuing the following command:

   ```
   lssrc -l -s hags
   ```

   Check for the following two groups in the output:

   - `cssMembership`
   - `ha.vsd`

     If `ha.vsd` does not appear in the list even though IBM Recoverable Virtual Shared Disk is installed, it may be that the node has not yet been rebooted. If you believe this to be the case, check the **/etc/inittab** file for the following command entry:

     ```
     rvsd:2:once:/usr/lpp/csd/bin/ha_vsd > /dev/console 2>&1
     ```

     If the entry exists, you can run the command as follows:

     ```
     /usr/lpp/csd/bin/ha_vsd
     ```

     If you rerun the **lssrc** command now, both groups should appear in the output.

3. Start the daemons by entering:

   ```
   dsh startsrc -s mmfs
   ```

   The GPFS daemons will start on all nodes that the configuration process recorded in the **/etc/cluster.nodes** file.

Check the messages recorded in **/var/adm/ras/mmfs.log*** on one node for the following:

```
mmfsd initializing ...
mmfsd ready for sessions.
```

This indicates successful startup of a quorum of nodes.

If these messages are not written to the log, your system may not have met the requirements for a quorum. See “Quorums” on page 6 for more information.

Stopping GPFS

If it becomes necessary to stop GPFS, you can do so from the command line by entering:

```
dsh stopsrc -c -s mmfs
```

Changing Your GPFS Configuration

Once GPFS has been configured, your file system operations should function efficiently. You may, however, be able to tune your configuration for better performance by reconfiguring one or more attributes. Refer to Chapter 6, “Tuning GPFS Performance” on page 73 for a detailed discussion.

| You can use SMIT or the **mmchconfig** command to change the following
| configuration attributes after the initial configuration has been set:

| 1. pagepool
| 2. dataStructureDump
| 3. mallocsize
| 4. maxFilesToCache
| 5. priority
| 6. autoload

| Changes to **pagepool** may take effect immediately if the **–i** option is chosen,
| otherwise the changes will take effect the next time GPFS is started. Changes to
| **dataStructureDump**, **mallocsize**, **maxFilesToCache**, and **priority** take effect the
| next time GPFS is started. Changes to **autoload** require that the nodes be
| rebooted before new values take effect.

Before You Change the GPFS Configuration

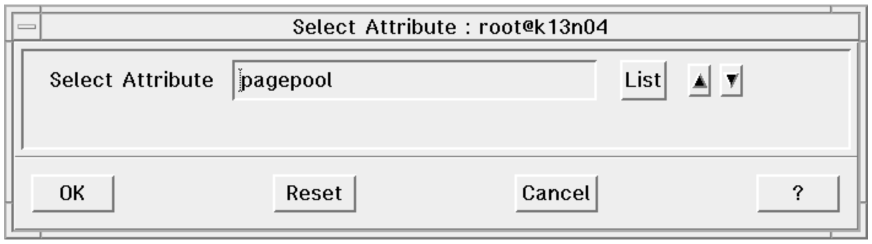
Consider how the changes will affect GPFS operation. Refer to Chapter 6, “Tuning GPFS Performance” on page 73.

Changing Configuration Using SMIT

1. On the SMIT GPFS Administration Menu (Figure 8 on page 34), select `Change Startup Configuration` or enter the command,

   ```
   smit mmchconfig
   ```

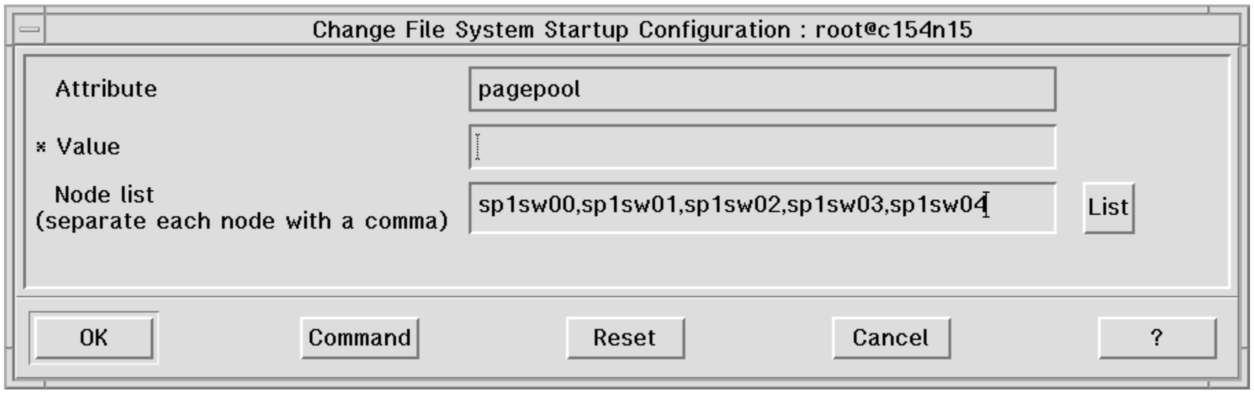
   The SMIT dialog shown in Figure 10 on page 38 is displayed.



pagepool

Figure 10. Select Attribute Dialog

2. Click on `List` to display the parameters that you can change. Select the target parameter and click on `OK`. A SMIT dialog similar to Figure 11 is displayed.



Attribute	pagepool
* Value	
Node list (separate each node with a comma)	sp1sw00,sp1sw01,sp1sw02,sp1sw03,sp1sw04

Figure 11. Change File System Startup Configuration Dialog

3. Enter the new value for the parameter and the hostnames of the target nodes for the configuration change. Figure 11 shows the nodes from “Planning a Sample GPFS Configuration” on page 19. Click on **OK**.

Changing Configuration Using mmchconfig

Specify the nodes you wish to target for change, and the attributes with their new values, in the **mmchconfig** command. For example, to change the priority of the GPFS daemon to 42 on all the nodes in the node list we created in “Planning a Sample GPFS Configuration” on page 19, we would enter:

```
mmchconfig priority=42
```

allowing the node list to default to all configured nodes.

Refer to “mmchconfig” on page 87 for syntax and usage information.

Managing File Systems

GPFS file system management tasks can be performed using either SMIT menus or by entering command strings. These tasks include:

1. “Creating a File System” on page 39
2. “Building Disk Descriptors” on page 39
3. “Deleting a File System” on page 47
4. “Modifying File System Attributes” on page 50

.

Creating a File System

You can use SMIT or the **mmcrfs** command to create a GPFS file system.

Before You Begin...

Some characteristics of a file system are not easily changed. Before you proceed, be sure you have read “File System Creation Considerations” on page 8.

Before you create your file system, you need to:

1. Decide which disks to use for the file system and how to use them.

   Have ready a list of all disks you want GPFS to use, as well as any existing IBM Virtual Shared Disks you plan to use in the file system. Note too, whether each disk will store data, metadata, or both (the default). See “IBM Virtual Shared Disks” on page 13.

2. Decide how to structure the file system.

   Write down the block size, i-node size, and indirect block size you plan to use. See “File System Sizing” on page 8.

3. Decide how to replicate your files.

   Write down the replication factors for data and metadata for the file system. The default is no replication.

4. Structure Failure Groups.

   Record a failure group number for each disk you plan to use. Default failure groups are organized by server. See “Recoverability” on page 15.

5. Be sure that GPFS has been started. See “Starting and Stopping GPFS” on page 36.

Building Disk Descriptors

Using the information gathered in “Before You Begin...,” create one disk descriptor for each IBM Virtual Shared Disk in your file system. You can use a SMIT dialog to enter and save your specifications in a disk descriptor file, or use any AIX editor to create such a file.

You must provide a descriptor for each GPFS IBM Virtual Shared Disk to be created or passed to the GPFS file system. Each descriptor contains the following positional parameters for its IBM Virtual Shared Disk.

Disk Name

The device name, for example, `hdisk1`, of any disk you wish to use to create an IBM Virtual Shared Disk, or the name of an existing IBM Virtual Shared Disk.

GPFS performance and recovery processes function best with one disk per IBM Virtual Shared Disk. If you want to create IBM Virtual Shared Disks with more than one disk, refer to Managing Shared Disks. Then pass the existing IBM Virtual Shared Disks to GPFS using the VSD names.

Server Name

The name of the IBM Virtual Shared Disk server node. This can be in any recognizable form and is unnecessary when specifying a predefined IBM Virtual Shared Disk.

Backup Server Name
: The backup server name. This can be in any recognizable form and is unnecessary when specifying a predefined IBM Virtual Shared Disk.

Disk Usage
: Specify one of the following or allow to default:

  - **dataAndMetadata** (default)
  - **dataOnly**
  - **metadataOnly**

  .

Failure Group
: A number identifying the failure group to which this disk belongs. All disks that have a common point of failure, such as all disks that are attached to the same VSD server node, should be placed in the same failure group. GPFS uses this information during data and metadata placement to assure that no two replicas of the same block are written in such a way as to become unavailable due to a single failure. You can specify any value from -1 (where -1 indicates that the disk has no point of failure in common with any other disk) to 4000. If you do not specify a failure group, the value defaults to the server node number plus 4000.

Notes:

1. To use an existing IBM Virtual Shared Disk volume group in the file system, only the *Disk Name* (the IBM Virtual Shared Disk name) need be specified in the disk descriptor. The *Disk Usage* and *Failure Group* parameters are optional and may be allowed to default.
2. To create an IBM Virtual Shared Disk with one disk and use it in a file system, you must specify the *Disk Name* and *Server Name* parameters in the descriptor. *Backup Server*, *Failure Group*, and *Disk Usage* are optional.

Examples: The following examples show disk descriptors defined in several different ways.

1. Start with a basic disk descriptor that takes advantage of GPFS defaults:

   ```
   hdisk5:sp1sw06:sp1sw07::
   ```

   This descriptor translates as follows:

   Disk Name hdisk5

   Server Name Switch node 6

   Backup Server Switch node 7

   Disk Usage Defaults to **dataAndMetadata**, allowing both

   Failure Group Defaults to 4006 (server node number + 4000)

   This descriptor would create an IBM Virtual Shared Disk with the name **gpfs1n6** on hdisk5.
2. If we add another descriptor to the file,

   ```
   hdisk6:sp1sw04::dataOnly:28
   ```

   which translates as follows:

Disk Name hdisk6

Server Name Switch node 4

Backup Server None

Disk Usage Data, not metadata

Failure Group 28

GPFS would also create an IBM Virtual Shared Disk with the name **gpfs2n4** on hdisk6.

3. This descriptor,

   ```
   hdisk9:sp1sw04::metadataOnly:−1
   ```

   translates to:

   Disk Name hdisk9

   Server Name Switch node 4

   Backup Server none

   Disk Usage Metadata, not data

   Failure Group Creates a unique failure group containing only this device

   This descriptor tells GPFS to also create an IBM Virtual Shared Disk with the name **gpfs3n4** on hdisk9.

4. One additional descriptor,

   ```
   vsdx3n12::::
   ```

   which could also be entered simply as

   ```
   vsdx3n12
   ```

   translates to:

   Disk Name vsdx3n12, the name of an existing IBM Virtual Shared Disk

   Server Name Predefined

   Backup Server Predefined

   Disk Usage Defaults to **dataAndMetadata**, allowing both

   Failure Group Defaults to server node number + 4000

   This descriptor specifies that an existing IBM Virtual Shared Disk with the name **vsdx3n12** be added to the GPFS file system.

Building a Disk Descriptor File Manually: If you create a disk descriptor file using an AIX editor, follow these rules:

1. Enter one descriptor to a line
2. Separate parameters within a descriptor with a colon (:)
3. Indicate an omitted parameter by skipping its position and entering two consecutive colons (::). For example, if you had no backup server and wanted to use your disk for both data and metadata (the default), you could create a disk descriptor that looked like this:

   ```
   hdisk1:sp1sw05:::5
   ```

   If you also wanted to allow the last parameter, Failure Group, to default, you could omit the last three delimiting colons:

```
hdisk1:sp1sw05
```

or leave them in if you prefer:

```
hdisk1:sp1sw05:::
```

Trailing delimiters are acceptable.

Sample Disk Descriptor Files: Using the information we gathered in “Planning Sample IBM Virtual Shared Disks” on page 21, we can create a disk descriptor file for each file system we planned.

fs1desc contains the following:

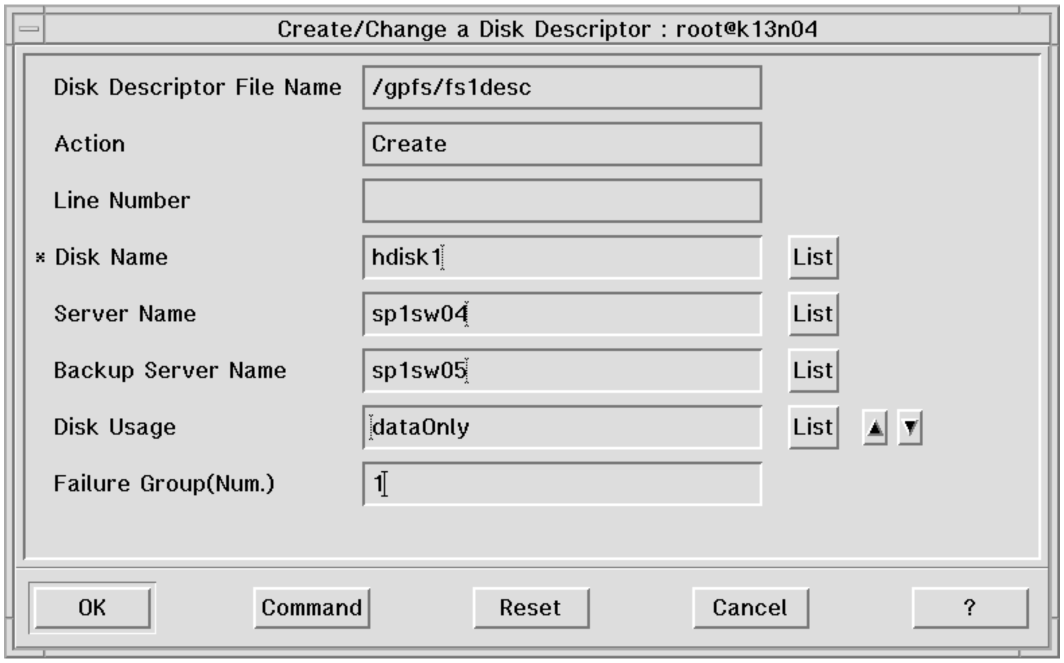
```
hdisk1:sp1sw04:sp1sw05:dataOnly:1
hdisk2:sp1sw05:sp1sw05:dataOnly:1
hdisk3:sp1sw04:sp1sw05:dataAndMetadata:1
hdisk5:sp1sw06:sp1sw07:dataOnly:2
hdisk6:sp1sw06:sp1sw07:dataOnly:2
hdisk7:sp1sw06:sp1sw07:dataAndMetadata:2
```

fs2desc contains the following:

```
pdisk1:sp1sw04:sp1sw05:dataOnly:3
pdisk2:sp1sw06:sp1sw07:dataOnly:4
hdisk4:sp1sw04:sp1sw05:metadataOnly:3
hdisk8:sp1sw06:sp1sw07:metadataOnly:4
```

Building Disk Descriptors Using SMIT: If you are creating a number of disk descriptors, use an editor such as **vi**. The SMIT dialog is better suited to creating or modifying a single descriptor.

1. On the SMIT GPFS Administration Menu (Figure 8 on page 34), select `Prepare Disk Descriptor File`. A dialog box asks if you are creating a descriptor file. Click on **OK** if you are starting a new file. The **List** button allows you to choose **Append**, if you are adding descriptors to an existing file, or **Modify**, to change an existing descriptor in a file. Enter a pathname for your disk descriptor file and click on **OK**. The Create/Change a Disk Descriptor dialog appears.


Create/Change a Disk Descriptor : root@k13n04

Disk Descriptor File Name	/gpfs/fs1desc
Action	Create
Line Number	
* Disk Name	hdisk1
Server Name	sp1sw04
Backup Server Name	sp1sw05
Disk Usage	dataOnly
Failure Group(Num.)	1

Figure 12. Create/Change a Disk Descriptor Dialog

Figure 12 shows the values we would enter for one of the disk descriptors we planned in "Planning Sample IBM Virtual Shared Disks" on page 21.

Create File System Using SMIT

Note: The following options cannot be specified when creating a file system using SMIT:

- Maximum data replication
- Default data replication
- Maximum metadata replication
- Default metadata replication

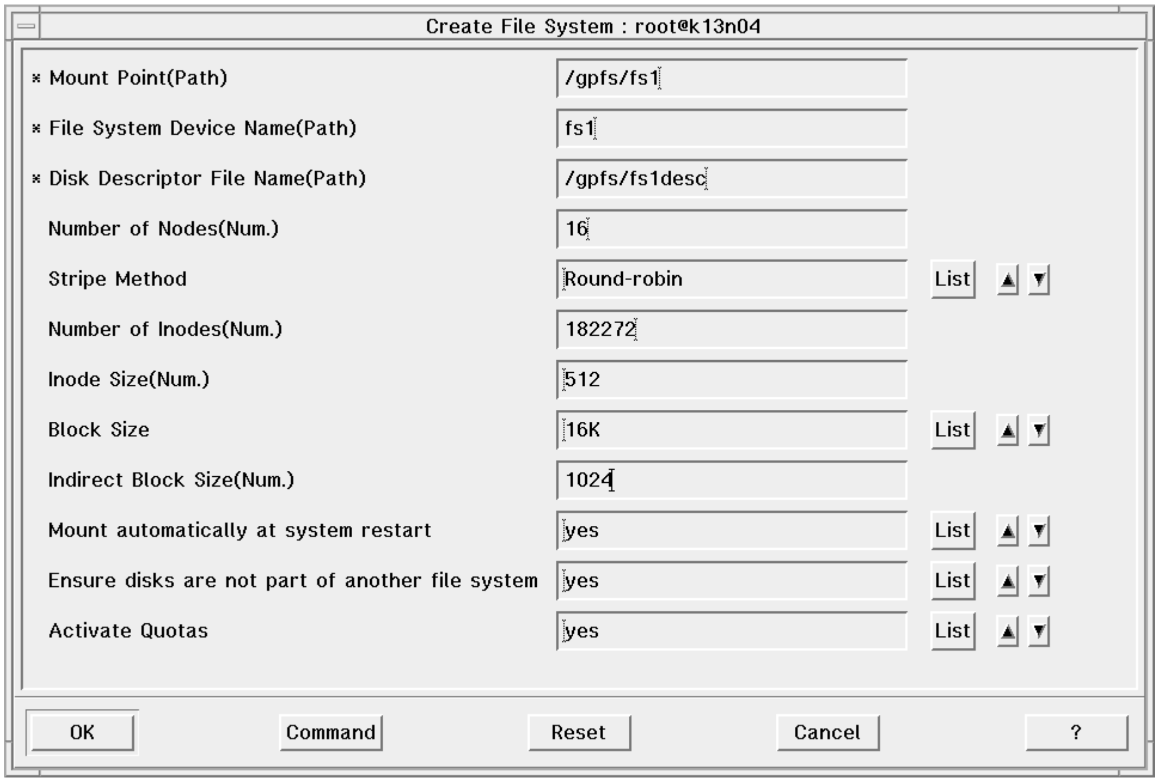
To specify replication factors (the default is no replication), see "Create File System Using mmcrfs" on page 44.

1. On the SMIT GPFS Administration Menu (Figure 8 on page 34), select `Create File System`, or enter the command,

   ```
   smit mmcrfs
   ```

   A dialog appears in which you choose `Descriptor File` or `Disk Descriptor List` as the disk descriptor source. To create **fs1** from "Planning a Sample GPFS File System" on page 20, we would select `Descriptor File`. Click on **OK**.

   The SMIT dialog shown in Figure 13 on page 44 is displayed.


Create File System : root@k13n04

* Mount Point(Path)	/gpfs/fs1
* File System Device Name(Path)	fs1
* Disk Descriptor File Name(Path)	/gpfs/fs1desc
Number of Nodes(Num.)	16
Stripe Method	Round-robin
Number of Inodes(Num.)	182272
Inode Size(Num.)	512
Block Size	16K
Indirect Block Size(Num.)	1024
Mount automatically at system restart	yes
Ensure disks are not part of another file system	yes
Activate Quotas	yes

Figure 13. Create File System Dialog

2. In the Create File System dialog, required parameters are indicated with an asterisk (*). Enter the file system name in the space provided for device name, and the mount point for the file system. Since we selected `Descriptor File` in the previous dialog, the third required parameter is the path name for our disk descriptor file. Had we specified `Disk Descriptor List` in the previous dialog, we would be prompted for our list of disk descriptors in this space. All other parameters in this dialog can be allowed to default. “File System Creation Considerations” on page 8 describes these parameters and explains their defaults.

   To create **fs1** from “Planning a Sample GPFS File System” on page 20, we have entered the path name of the disk descriptor file we created in “Sample Disk Descriptor Files” on page 42. We then entered the remaining values from “Sizing Sample File Systems” on page 20 and clicked on **OK**.

Create File System Using mmcrfs

Specify the file system name, mount point, and disk descriptor parameters with the **mmcrfs** command. For example, to create file system **fs1** from “Planning a Sample GPFS File System” on page 20 using the disk descriptor file named **/gpfs/fs1desc**, and have it automatically mounted at **/gpfs/fs1** when the system reboots, we could enter:

```
mmcrfs /gpfs/fs1 fs1 -F /gpfs/fs1desc -A yes -B 16K -i 512 -I 1K -M 2 -m 2 -n 16 -N 2600000 -Q yes -v yes
```

Likewise, the second file system we designed in “Planning a Sample GPFS File System” on page 20 could be created by entering:

```
mmcrfs /gpfs/fs2 fs2 -F /gpfs/fs2desc -A yes -B 256K -i 512 -I 32K -M 2 -m 2 -n 16 -N 6000 -Q yes -v yes
```

In “Planning a Sample GPFS File System” on page 20 we decided against replicating data for either **fs1** or **fs2** so we allowed the **-r** options to default to 1 when issuing the **mmcrfs** commands. We have, however, specified values of 2 for metadata replication and maximum metadata replication for both file systems. These options are not available when using SMIT.

See “mmcrfs” on page 102 for a detailed command description and usage information.

Mounting a File System

You must explicitly mount a GPFS file system if one or both of the following are true:

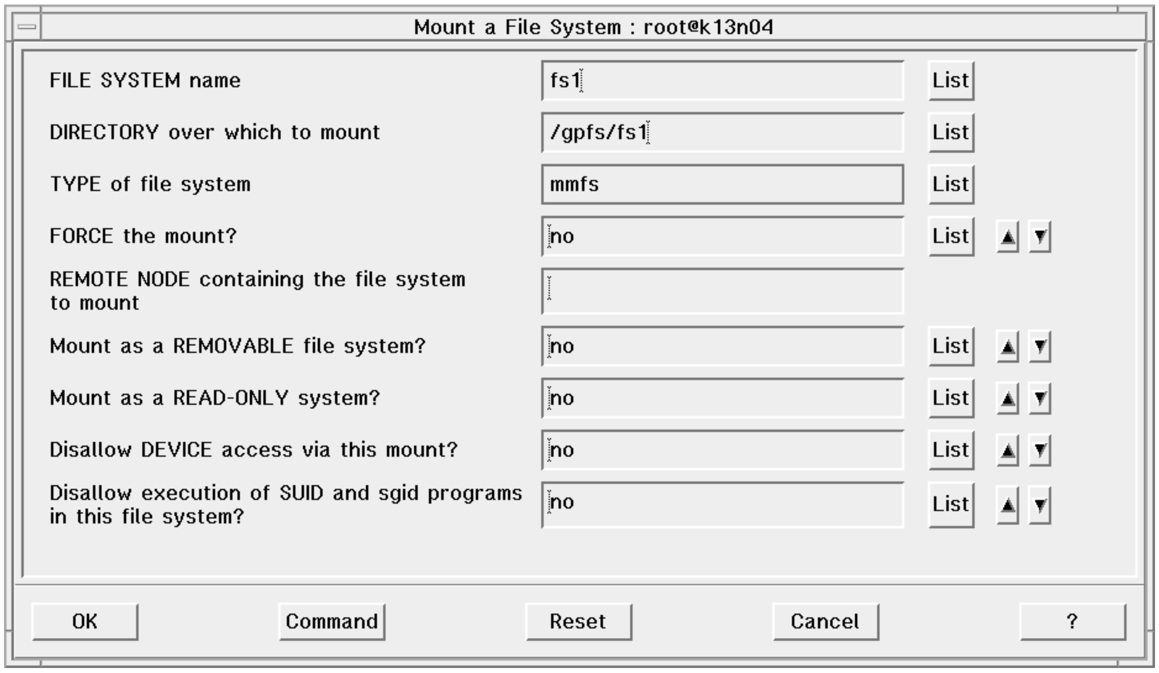
1. This is the first time the file system is being mounted after its creation
2. You did not specify the automatic mount option (**-A yes**) when you created the file system

If you specified the automatic mount (**-A yes**) option when you created the file system, then you need not use this procedure to mount it after restarting GPFS on the nodes.

You can mount a GPFS file system using SMIT or the AIX **mount** command.

Mount a GPFS File System Using SMIT

1. Enter `smit fs` and select `Mount File System`. The AIX Mount a File System dialog is displayed.


Mount a File System : root@k13n04

FILE SYSTEM name	fs1
DIRECTORY over which to mount	/gpfs/fs1
TYPE of file system	mmfs
FORCE the mount?	no
REMOTE NODE containing the file system to mount	
Mount as a REMOVABLE file system?	no
Mount as a READ-ONLY system?	no
Disallow DEVICE access via this mount?	no
Disallow execution of SUID and sgid programs in this file system?	no

Figure 14. Mount File System Dialog

2. Type the file system name and mount point in the prompt space. The file system type is **MMFS**. Enter additional values as you choose. Figure 14 shows the values we would enter to mount **fs1** from “Planning a Sample GPFS File System” on page 20. Click on **OK**.

Mount a GPFS File System Using AIX mount Command

To mount a GPFS file system using the mount command, enter:

```
mount directory
```

where *directory* is the file system mount point. For example, to mount the sample file systems from "Planning a Sample GPFS File System" on page 20, we would enter:

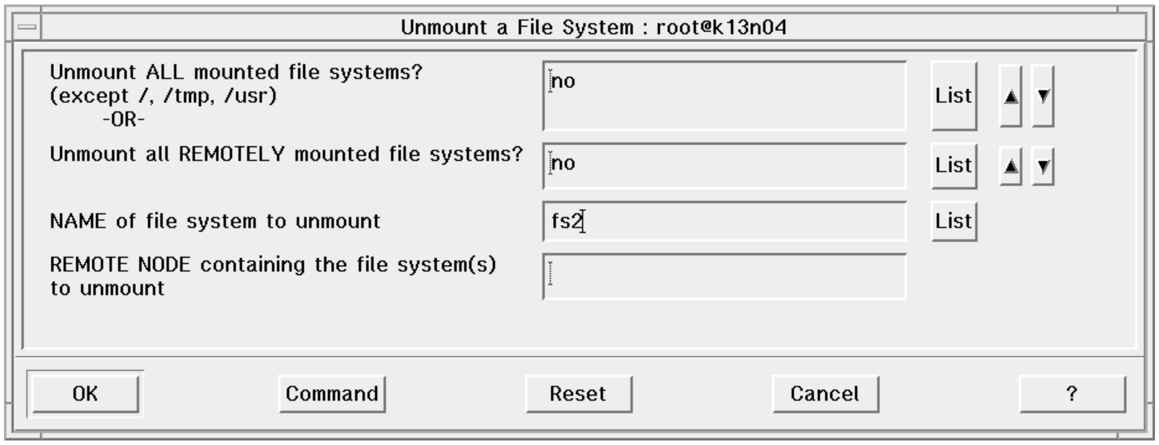
```
mount /gpfs/fs1
mount /gpfs/fs2
```

Unmounting a File System

Some GPFS administration tasks require you to unmount the file system before they can be performed. You can unmount a GPFS file system using SMIT or the AIX **unmount** command.

Unmount a GPFS File System Using SMIT

1. Enter `smit fs` and select `Unmount File System`. The Unmount a File System dialog is displayed.



Unmount ALL mounted file systems? (except /, /tmp, /usr) no
-OR-
Unmount all REMOTELY mounted file systems? no
NAME of file system to unmount fs2
REMOTE NODE containing the file system(s) to unmount

Figure 15. Unmount File System Dialog

2. Type the name the file system in the prompt space. Figure 15 shows the entry we would make to unmount **fs2** . Click on **OK**.

Unmount a GPFS File System Using the AIX unmount Command

To unmount a GPFS file system using the **unmount** command, enter:

```
unmount directory
```

where *directory* is the file system mount point. For example, to unmount the sample file systems from "Planning a Sample GPFS File System" on page 20, we would enter:

```
unmount /gpfs/fs1
unmount /gpfs/fs2
```

Deleting a File System

You can use SMIT or the **mmdelfs** command to delete a GPFS file system.

Before Deleting a File System

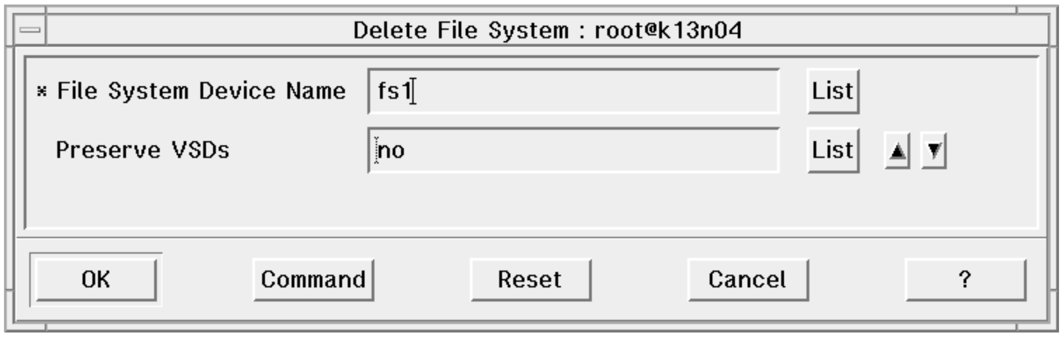
Unmount the file system on all nodes before deleting it. See “Unmounting a File System” on page 46.

Delete a File System Using SMIT

1. On the SMIT GPFS Administration Menu (Figure 8 on page 34), select `Delete File System` or enter the command:

   ```
   smit mmdelfs
   ```

   The Delete File System dialog is displayed:



* File System Device Name: fs1

Preserve VSDs: no

Figure 16. Delete File System Dialog

2. Type the file system name where prompted. Specify whether or not GPFS should preserve the IBM Virtual Shared Disks it created with the file system. Click on **OK**.

Delete a File System Using mmdelfs

Specify the file system you wish to remove with the **mmdelfs** command. For example, to delete the file systems from “Planning a Sample GPFS File System” on page 20, enter:

```
mmdelfs fs1
mmdelfs fs2
```

Refer to “mmdelfs” on page 113 for usage information.

Checking and Repairing a File System

The **mmfsck** command is useful for finding and repairing conditions that can cause problems in your file system.

If a file system will not mount or you receive messages to the effect that a file cannot be read, you can have GPFS check and repair the unmounted file system.

If a GPFS file operation fails due to an out of space condition, the cause may be disk blocks that have become unavailable after repeated node failures. You can check the mounted file system for unallocated blocks when using the **-o** option of the **mmfsck** command.

Use the **mmfsck** command to have GPFS check for the following file inconsistencies that might cause problems:

- Blocks marked allocated that do not belong to any file. These can be repaired while the file system is mounted. The corrective action is to mark the block free in the allocation map.
- Files for which an i-node is allocated and no directory entry exists (orphaned files). The corrective action is to create directory entries for these files in a **lost+found** subdirectory at the root of this file system. The index number of the i-node is assigned as the name. If you do not allow **mmfsck** to reattach an orphaned file, it asks for permission to destroy the file.
- Directory entries pointing to an i-node that is not allocated. The corrective action is to remove the directory entry.
- Ill-formed directory entries. The corrective action is to remove the directory entry.
- Incorrect link counts on files and directories. The corrective action is to update them with accurate counts.
- Cycles in the directory structure. The corrective action is to break any detected cycles. If the cycle was a disconnected cycle, the new top level directory is moved to the **lost+found** directory.

Before Repairing a File System

You must unmount the file system if you want repairs made. The only exception is the freeing of allocated blocks that do not belong to any file. Plan to make file system repairs when system demand is low. This is I/O intensive activity and it can affect system performance.

Checking and Repairing a File System Using mmfsck

Specify the file system you want to check and a repair option with the **mmfsck** command. For example, to check our sample **fs1** file system from “Planning a Sample GPFS File System” on page 20 and save the report in a file called **/mmfs/fs1_status** without making any changes to the file system, we would enter:

```
mmfsck fs1 -n > /mmfs/fs1_status
```

Output similar to the following is written to the **fs1_status** file:

```
Checking "fs1"
Checking inodes
Checking directories and files
Checking log files
Processing inodes

        7680 inodes
         907   allocated
           0   repairable
           0   repaired
           0   damaged
           0   deallocated
           0   orphaned
           0   attached

      823296 subblocks
       38211   allocated
           0   unreferenced
           0   deletable
           0   deallocated


File system is clean
```

For usage information and complete syntax, see “mmfsck” on page 123.

Listing File System Attributes

GPFS allows you to display the current values for many file system attributes.

Listing File System Attributes Using mmlsfs

Specify the file system and attributes to list with the **mmlsfs** command. Attributes are specified with the following flags:

-a	Display the estimated average file size, in bytes
-B	Display the block size, in bytes
-C	Display the configuration to which the file system belongs
-d	Display the names of all disks in the file system
-f	Display the fragment size, in bytes
-F	Display the maximum number of files currently supported
-i	Display i-node size, in bytes
-I	Display the indirect block size, in bytes
-m	Display the default number of replicas for metadata
-M	Display the maximum number of replicas for metadata
-n	Display the estimated number of nodes that will mount the file system
-Q	Display which quotas are currently enforced on the file system
-r	Display the default number of replicas for data
-R	Display the maximum number of replicas for data
-s	Display the stripe method for this file system

-V Display the current format version of the file system

If you specify no flags with the **mmlsfs** command, all file system attributes are listed.

For example, to list the expected average file size and current stripe method for our sample **fs1** file system from "Planning a Sample GPFS File System" on page 20, we would enter:

```
mmlsfs fs1 -a -s
```

or, to list all attributes for **fs0**, simply enter:

```
mmlsfs fs0
```

For output examples and more information, see "mmlsfs" on page 132.

Modifying File System Attributes

There are eight file system attributes that you can change for an existing file system:

1. Automatic Mount

   Change the specification that determines whether or not your file systems are automatically mounted when the GPFS daemon starts.

2. Maximum Number of Files

   If your file system has additional disks added or the number of i–nodes was insufficiently sized at file system creation, you may increase the number of i–nodes and hence the maximum number of files that can be created.

   The initial setting of the number of inodes at file system creation will be used as the minimum value. The new value, set by using the **mmchfs** command, will determine the maximum value. The i–node file will expand on demand, from the initial minimum value set up to the new maximum value as needed.

3. Default Metadata Replication

   If your file system availability requirements change, you may want to begin or cease replicating metadata for new files.

4. Quota Enforcement

   Activate/deactivate quota enforcement whenever the GPFS daemon starts.

5. Default Data Replication

   If your file system availability requirements change, you may want to begin or cease replicating data for new files.

6. Stripe Method

   You may want to determine whether your file system efficiency improves with another stripe method.

7. Mountpoint

   Change the mountpoint of your file system.

8. Migrate File System

   Change the file system to the latest format supported by the currently installed level of GPFS. This will cause the file system to become permanently incompatible with the prior release.

Note: Changes to the Default Data and Metadata Replication attributes, as well as to the Stripe Method attribute, apply only to new files created after the attributes change. If you want to change the replication of existing files, you must use the **mmchattr** command. See "Querying and Changing File Replication Attributes" on page 52. To change the stripe method of existing files, you must restripe the file system using the **mmrestripefs** command. See "Restriping a GPFS File System" on page 52.

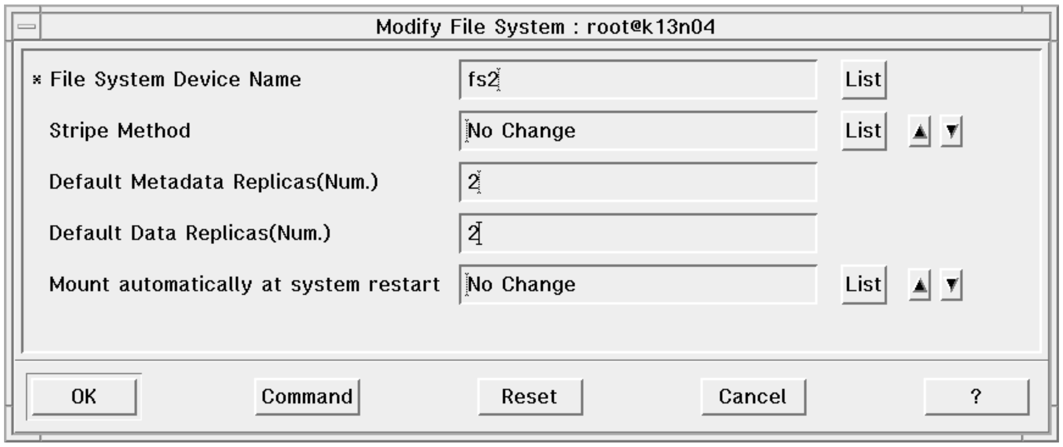
Specify the file system name and the target attribute with its new value using SMIT or the **mmchfs** command.

Change File System Attributes Using SMIT

1. Select `Modify File System` from the SMIT GPFS Administration Menu, Figure 8 on page 34, or enter:

   ```
   smit mmchfs
   ```

   The Modify File Systems dialog is displayed:



Modify File System : root@k13n04

* File System Device Name	fs2
Stripe Method	No Change
Default Metadata Replicas(Num.)	2
Default Data Replicas(Num.)	2
Mount automatically at system restart	No Change

Figure 17. Modify File System Dialog

2. Enter the new value for the target attribute(s). The Stripe Method and Automatic Mount attribute choices can be displayed for selection by clicking on **List**. Figure 17 shows how we would change the default data replication factor to 2 for sample file system **fs2** from "Planning a Sample GPFS File System" on page 20. Click on **OK**.

Change File System Attributes Using mmchfs

1. Specify the file system and target attribute with its new value, using the **mmchfs** command with one of the following options:

-A	Automatic Mount
-F	Maximum Number of Files
-m	Default Metadata Replication
-Q	Activate quota enforcement
-r	Default Data Replication
-s	Stripe Method
-T	Mountpoint

| **-V** Migrate File System

For example, to change the default data replication factor to 2 for sample file system **fs1** from “Planning a Sample GPFS File System” on page 20, we would enter:

```
mmchfs fs1 —r 2
```

See “mmchfs” on page 96 for complete syntax and usage information.

Querying and Changing File Replication Attributes

If you become concerned that your file system is using too much disk space, or if your availability requirements change, you can have GPFS display the current replication factors for one or more files by using the **mmlsattr** command. You might then decide to change replication for one or more files with the **mmchattr** command.

Querying File Replication Using mmlsattr

Specify one or more filenames with the **mmlsattr** command. For example, to display the replication factors for two files named **project4.sched** and **project4.resource** in sample file system **fs1** from “Planning a Sample GPFS File System” on page 20, we would enter:

```
mmlsattr /gpfs/fs1/project4.sched /gpfs/fs1/project4.resource
```

Refer to “mmlsattr” on page 128 for details about the information returned by this command.

Change File Replication Attributes Using mmchattr

Use the **mmchattr** command to change the replication attributes for one or more files.

You can only increase data and metadata replication as high as the maximum data and maximum metadata replication factors for that file system. You cannot change the maximum data and maximum metadata replication factors once the file system has been created.

Specify the filename, attribute, and new value with the **mmchattr** command. For example, to change the default metadata replication factor to 2 and the default data replication factor to 2 for the file named **project7.resource** in sample file system **fs1** from “Planning a Sample GPFS File System” on page 20, we would enter:

```
mmchattr —m 2 —r 2 /gpfs/fs1/project7.resource
```

Refer to “mmchattr” on page 85 for syntax and usage information.

Restriping a GPFS File System

If you have added disks to a GPFS file system that is seldom updated, you can restripe the file system to distribute data across all disks using the **mmrestripefs** command.

Note: Consider this operation carefully. Restriping involves a large amount of insert and delete activity and may affect system performance. A file system as large as a terabyte may take a long time to restripe.

Restriping offers the opportunity to specify useful options in addition to rebalancing (the **-b** option). Rereplicate (**-r** option) ensures that all data and metadata is properly replicated. If you use replication, this option is useful to protect against additional failures after losing a disk. For example, if you use a replication factor of 2 and one of your disks fails, only a single copy of the data on the failed disk would remain. If another disk then failed before the first failed disk was replaced, some data might be lost. If you expected delays in replacing the failed disk, you could protect against data loss by suspending the failed disk using the **mmchdisk** command and rereplicating. This would assure that all data existed in two copies on operational disks.

If you do not replicate all of your files, the migrate (**-m**) option is useful to protect against data loss when you have an advance warning that a disk may be about to fail, for example, when the AIX error log shows an excessive number of I/O errors on a disk. Suspending the disk and issuing the **mmrestripefs** command with the **-m** option is the quickest way to migrate only the data that would be lost if the disk failed.

If you do not use replication, the **-m** and **-r** options are equivalent; their behavior differs only on replicated files. After a successful rereplicate (**-r** option) all suspended disks are empty. A migrate operation, using the **-m** option, leaves data on a suspended disk as long as at least one other replica of the data remains on a disk that is not suspended. Restriping a file system includes rereplicating it; the **-b** option performs all the operations of the **-m** and **-r** options.

Before Restriping a File System

Consider the necessity of restriping and the current demands on the system. Files that are written with any regularity are automatically restriped. Restriping a large file system requires extensive insert and delete operations and may result in processing delays. Plan to perform this task when system demand is low.

If you are sure you want to proceed with the restripe operation:

1. Use the **mmchdisk** command to suspend any disks to which you DO NOT want the file system restriped. You may want to exclude disks from file system restriping because they are failing. (See “Changing GPFS Disk States and Parameters” on page 59.)
2. Use the **mmlsdisk** command to assure that all disk devices to which you DO WANT the file system restriped are in the up/normal state. (See “Displaying GPFS Disk States” on page 58.)

Restriping File System Using mmrestripefs

Specify the target file system with the **mmrestripefs** command. For example, to rebalance (**-b** option) sample file system **fs2** after adding an additional RAID device, we would enter:

```
mmrestripefs fs2 -b
```

Refer to “mmrestripefs” on page 146 for syntax and usage information.

Querying File System Space

Although you can use the AIX **df** command to summarize the amount of free space on all GPFS disks, the **mmdf** command is useful for determining how well-balanced the file system is across your disks. You can also use **mmdf** to diagnose space problems that might result from fragmentation.

Query Space Using mmdf

Specify the file system you want to query with the **mmdf** command. For example, to query available space on all disks in the sample file system **fs2** from “Planning a Sample GPFS File System” on page 20, we would enter:

```
mmdf fs2
```

Refer to “mmdf” on page 117 for usage and syntax information.

Managing Disks

There are five disk-related tasks you can perform on a GPFS file system:

1. “Adding Disks to a File System”
2. “Deleting Disks from a File System” on page 55
3. “Displaying GPFS Disk States” on page 58
4. “Changing GPFS Disk States and Parameters” on page 59
5. “Replacing Disks in a GPFS File System” on page 56

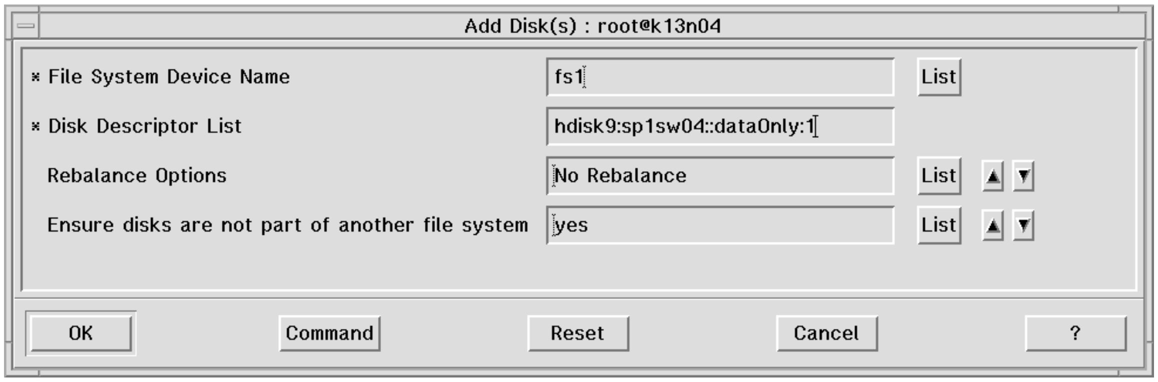
Most can be done through SMIT dialogues as well as through GPFS commands.

Adding Disks to a File System

Many files grow rapidly and you may decide that more disk space is required for your file system soon after creation. You can add disks to a GPFS file system using either SMIT or the **mmadddisk** command.

Add Disks Using SMIT

1. Select `Add Disk(s) to a File System` from the SMIT GPFS Administration Menu (Figure 8 on page 34) . A dialog window appears in which you choose `Descriptor File` or `Disk Descriptor List` as the disk descriptor source. To add a new 9GB disk to **fs1** from “Planning a Sample GPFS File System” on page 20, we would select `Disk Descriptor List`. Click on **OK**. The following SMIT dialog is displayed:



Add Disk(s) : root@k13n04

* File System Device Name	fs1
* Disk Descriptor List	hdisk9:sp1sw04::dataOnly:1
Rebalance Options	No Rebalance
Ensure disks are not part of another file system	yes

Figure 18. Add Disk(s) Dialog

2. Enter all information at the prompts, or click on **List** to display eligible parameters. In the disk descriptor list in Figure 18 we have specified that a new IBM Virtual Shared Disk be created in failure group 1 of our **fs1** from “Planning Sample IBM Virtual Shared Disks” on page 21. No metadata is to be written to hdisk9. Since this is not a twin-tailed disk, we have not named a

backup server. We specified that GPFS verify hdisk9 does not belong to any existing file system before adding it to **fs1**.

Add Disks Using mmadddisk

Specify the file system and descriptor data for the disks or IBM Virtual Shared Disks you want to add with the **mmadddisk** command. For example, to create a IBM Virtual Shared Disk for new disk hdisk9, and add it to sample failure group 1 in file system **fs1** from “Planning a Sample GPFS File System” on page 20 by entering disk descriptor parameters on the command line, we would enter:

```
mmadddisk fs1 "hdisk9:sp1sw04::dataOnly:1"
```

Wherever two consecutive colons appear, a positional parameter is either omitted or allowed to default. In this example, the two consecutive colons indicate that no backup server is specified, since hdisk9 is not a twin-tailed disk.

Refer to “mmadddisk” on page 78 for usage syntax and information. “IBM Virtual Shared Disks” on page 13 contains a more detailed explanation of the parameters required to define disks for GPFS.

Deleting Disks from a File System

If you detect a faulty disk, or decide to move disk resources out of the GPFS file system, you can delete a disk from a previously defined file system using either SMIT or the **mmdeldisk** command.

Before Deleting a Disk

Use the **mmdf** command to determine whether there is enough free space on the remaining disks to store the file system (see “Querying File System Space” on page 53). Consider how fragmentation may increase your storage requirements, especially when the file system contains a large number of small files. A margin of 20 percent of the file system size should be sufficient to allow for fragmentation when small files predominate.

If you replicate your file system data you should suspend the disk you intend to delete and then rereplicate the file system using the **mmrestripefs -r** command. This ensures that all data will still exist with correct replication after the disk is deleted. The **mmdeldisk** command only migrates data that would otherwise be lost, not data that will be left in a single copy.

| Do not delete stopped disks, if at all possible. Start any stopped disk before
| attempting to delete it from the file system. If the disk cannot be started you will
| have to consider it permanently damaged. You will need to delete the disk using
| the appropriate options. If metadata was stored on the disk, you will need to
| execute the offline version of **mmfsck**. See the *GPFS Problem Determination*
| *Guide* section on *Disk Media Failures* for further information on handling this.

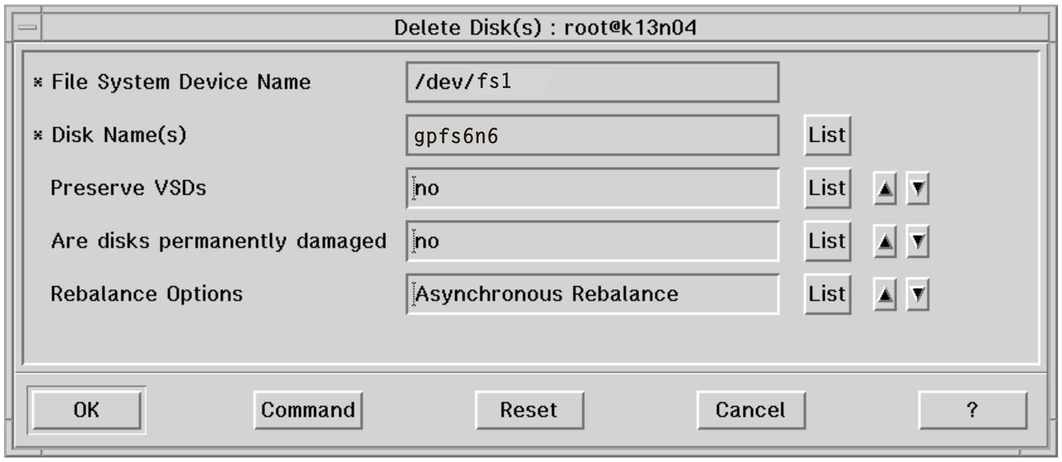
In order to delete gpfs6n6, a 4GB disk, from our sample file system, **fs1**, which contains user home directories with small files, we would first have to assure that the other disks in **fs1** contained a total of 5GB of free space.

Delete Disks Using SMIT

1. Select `Delete Disk(s) from a File System` from the SMIT GPFS Administration Menu (Figure 8 on page 34), or enter the command:

   ```
   smit mmdeldisk
   ```

   The Select File System dialog appears in which you enter the file system device name, or click on **List**, and select the device from the names displayed. Click on **OK**. The Delete Disk(s) dialog is displayed.



* File System Device Name	/dev/fs1
* Disk Name(s)	gpfs6n6
Preserve VSDs	no
Are disks permanently damaged	no
Rebalance Options	Asynchronous Rebalance

Figure 19. Delete Disk(s) Dialog

To delete the IBM Virtual Shared Disk created from hdisk6 in our sample **fs1** file system, we would select `gpfs6n6` and specify the rebalance option.

Delete Disks Using mmdeldisk

Specify the file system and the names of one or more IBM Virtual Shared Disks to delete, along with any instructions about how to handle the disk data, with the **mmdeldisk** command. For example, to delete the IBM Virtual Shared Disk named gpfs6n6 from file system **fs1** and rebalance the files across the remaining disks, we would enter:

```
mmdeldisk fs1 gpfs6n6 -r
```

| If the disk is permanently damaged, you will need to issue the **mmdeldisk**
| command with the **-p** option.

Refer to “mmdeldisk” on page 110 for syntax and usage information.

Replacing Disks in a GPFS File System

You can replace an existing disk in a GPFS file system with a new one using either SMIT or the **mmrpldisk** command. This is the same as performing a delete disk operation followed by an add disk, but this operation eliminates the need to restripe the file system following two separate delete disk and add disk operations.

| Under no circumstances should you replace a stopped disk. You need to start a
| stopped disk before replacing it. If a disk cannot be started, you will have to delete
| it using the **-p** option on the **mmdeldisk** command. See the *GPFS Probelm*
| *Determination Guide* section on *Disk Media Failures* for further information on
| handling this.

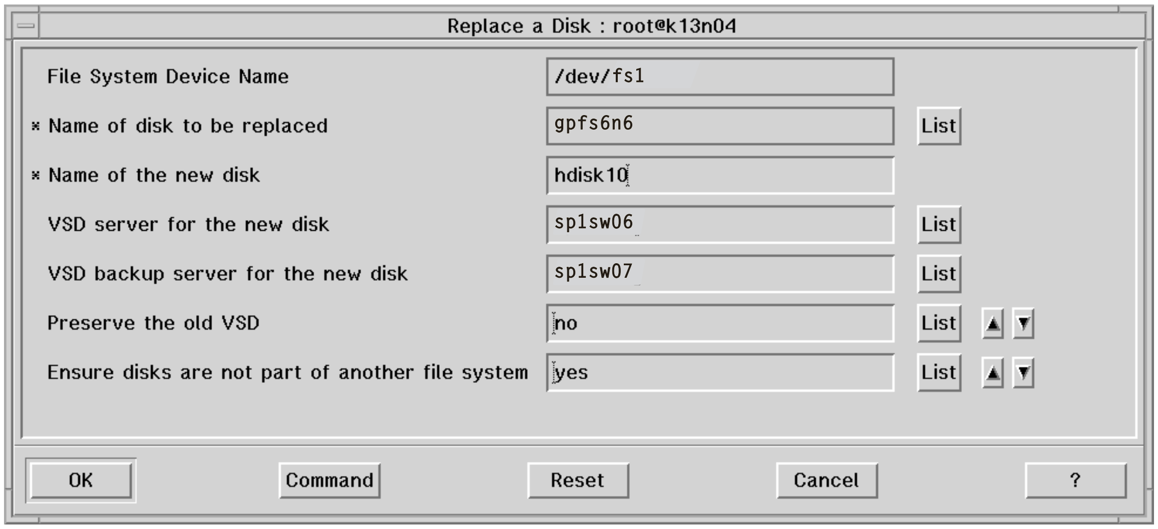
Replacing Disks Using SMIT

1. Select `Replace Disk in a File System` from the SMIT GPFS Administration Menu (Figure 8 on page 34) , or enter the command:

   ```
   smit mmrpldisk
   ```

   The Select File System dialog appears in which you enter the file system device name, or click on **List**, and select the file system from the device names displayed.

   To replace hdisk6 from our sample **fs1** file system, we would select `/dev/fs1` and click on **OK**. The Replace Disk dialog appears next.



File System Device Name	/dev/fs1
* Name of disk to be replaced	gpfs6n6
* Name of the new disk	hdisk10
VSD server for the new disk	sp1sw06
VSD backup server for the new disk	sp1sw07
Preserve the old VSD	no
Ensure disks are not part of another file system	yes

Figure 20. Replace Disk Dialog

2. Click on **List** and select the disk to be replaced. Enter the name of the new disk and the names of the primary and backup VSD servers. Specify whether the old disk should be preserved and the new disk should be verified as not yet belonging to a file system. Click on **OK**.

   To replace hdisk6 in sample file system **fs1**, we would click on **List** and select `gpfs6n6` from the IBM Virtual Shared Disk names displayed. Then we would enter the name of the replacement disk, hdisk10, along with the rest of the information in Figure 20. A new IBM Virtual Shared Disk would be created with sp1sw06 (switch node 6) as server and sp1sw07 (switch node 7) as backup.

Replacing Disks Using mmrpldisk

Specify the file system and old disk name, along with a set of disk description information for the new disk, with the **mmrpldisk** command. For example, to replace the **gpfs6n6** disk in file system **fs1** with a new IBM Virtual Shared Disk created from hdisk10, and specify that it have switch node 6 as the server and switch node 7 as the backup server, we would enter:

```
mmrpldisk fs1 gpfs6n6 hdisk10:sp1sw06:sp1sw07
```

Refer to “mmrpldisk” on page 148 for complete syntax and disk descriptor usage information.

Displaying GPFS Disk States

You can display the current state of one or more disks in your file system using either SMIT or the **mmlsdisk** command. This information includes parameters that were specified when the file system was created (see “Creating a File System” on page 39 for descriptions) and the current availability and status of the disks. Regardless of the method used, disk status will be display in the following format:

```
disk       driver    sector    failure    holds       holds     status    availability
name       type      size      group      metadata    data
hdisk1     disk      512       -1         yes         yes       ready     up
```

Availability

A disk's availability determines whether GPFS is able to read and write the disk. There are three possible values for availability:

up Disk is available to GPFS for normal read and write operations

down No read and write operations can be performed on this disk

recovering
An intermediate state for disks coming up, during which GPFS verifies and corrects data. Write operations can be performed while a disk is in this state but read operations cannot.

unrecovered
The disks was not successfully brought up.

Disk availability is automatically changed from `up` to `down` when GPFS detects repeated I/O errors. You can also make this change by issuing an **mmchdisk stop** command.

You can change a disk's availability from `down` to `recovering` by issuing the **mmchdisk start** command. When the **mmchdisk start** operation completes successfully on all disks, the disk availability automatically changes from `recovering` to `up`.

When disk availability remains `recovering` after **mmchdisk** has been issued, only partial recovery was achieved. It may be that another disk has an availability of `down` or an I/O error has occurred. Repair all disks and paths to disks before reissuing **mmchdisk** and specifying all `down` disks. If this is unsuccessful and some disks remain in `recovering`, run **mmfsck** to repair the data structure on those disks.

Status

Disk status controls data placement and migration. Status changes as a result of a pending delete operation, or when the **mmchdisk** is issued to allow file rebalancing or rereplicating prior to disk replacement or deletion.

Disk status has five possible values, but three are transitional:

ready Normal status

suspended Indicates that data is to be migrated off this disk

being emptied Transitional status in effect while a disk deletion is pending

replacing Transitional status in effect for old disk while replacement is pending

replacement Transitional status in effect for new disk while replacement is pending

GPFS allocates space only on disks with a status of `ready` or `replacement`. No space is allocated on disks being deleted or replaced, or on disks with status of `suspended`.

GPFS moves data off (migrates) disks that are being deleted, replaced, or disks with status of `suspended`, onto disks with a status of `ready` or `replacement`. During disk deletion or replacement, data is automatically migrated as part of the operation. The **mmrestripefs** command must be issued to initiate data migration from a suspended disk.

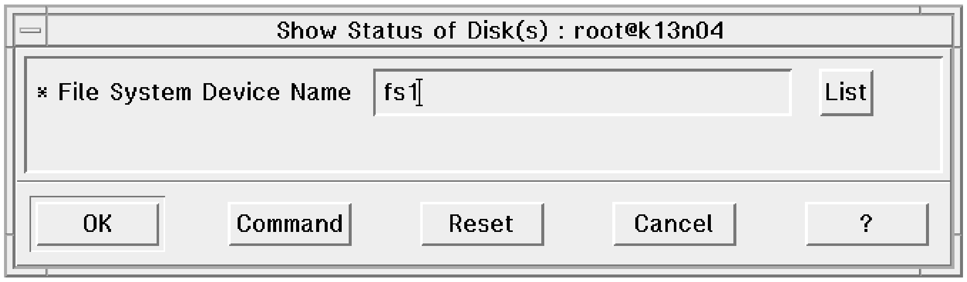
See “Deleting Disks from a File System” on page 55, “Replacing Disks in a GPFS File System” on page 56, and “Restriping a GPFS File System” on page 52.

Display Disk States Using SMIT

1. Select the `Display Status of Disks in a File System` dialog from the SMIT GPFS Administration Menu (Figure 8 on page 34), or enter the command:

   ```
   smit mmlsdisk
   ```

   The following SMIT dialog is displayed:



Show Status of Disk(s) : root@k13n04

* File System Device Name: fs1

Figure 21. Display Status of Disk(s) Dialog

   Enter the name of the files system to which the disks belong, or click on **List** and select the file system. Figure 21 shows what we would enter to display status of all disks in **fs1** from “Planning Sample IBM Virtual Shared Disks” on page 21. Click on **OK**.

Display Disk States Using mmlsdisk

Specify the file system and name of one or more disks with the **mmlsdisk** command. For example, to display the current status of IBM Virtual Shared Disks gpfs5n6 and gpfs6n6 in our **fs1** file system from “Planning Sample IBM Virtual Shared Disks” on page 21, enter:

```
mmlsdisk fs1 -d "gpfs5n6;gpfs6n6"
```

Refer to “mmlsdisk” on page 130 for syntax and usage information.

Changing GPFS Disk States and Parameters

You might find it necessary to change a disk's state if there is some indication of disk failure, or if you need to restripe the file system. Refer to “Displaying GPFS Disk States” on page 58 for a detailed description of disk states. You can change both the availability and status of a disk using the **mmchdisk** command:

- Change disk availability using the **mmchdisk** command and the **stop** and **start** options

- Change disk status using the **mmchdisk** command and the **suspend** and **resume** options. Suspend a disk to allow data to be migrated off prior to disk deletion or replacement. Resume a disk only when you've suspended it and decided not to delete or replace it.

Issue **mmchdisk** with one of the following four options to change disk state:

suspend Instructs GPFS to stop allocating space on the specified disk. Place a disk in this state when you are preparing to restripe the file system off this disk because of faulty performance. This is a user-initiated state that GPFS will never use without an explicit command to change disk state.

Note: A disk remains suspended until it is explicitly resumed. Restarting GPFS or rebooting nodes does not restore normal access to a suspended disk.

resume Informs GPFS that a disk previously suspended is now available for allocating new space. If the disk is currently in a stopped state, it remains stopped until you specify the **start** option. Otherwise, normal read and write access to the disk resumes.

stop Instructs GPFS to stop any attempts to access the specified disk. Use this option to inform GPFS that a disk has failed or is currently inaccessible because of maintenance. A disk remains stopped until it is explicitly started with the **start** option.

start Informs GPFS that a disk previously stopped is now accessible. GPFS does this by first changing the disk availability from `down` to `recovering`. The file system metadata is then scanned and any missing updates (replicated data that was changed while the disk was down) are repaired. If this operation is successful, the availability is then changed to `up`. If the metadata scan fails, availability is set to `unrecovered`. This could occur if other disks are down. The metadata scan can be reinitiated at a later time by issuing the **mmchdisk start** command again.

You can also use **mmchdisk** with the **change** option to change the *Disk Usage* and *Failure Group* parameters for one or more disks in a GPFS file system. This can be useful in situations where, for example, a file system that contains only RAID disks is being upgraded to add conventional disks that are better suited to storing metadata. After adding the disks using **mmadddisk**, the metadata currently stored on the RAID disks would have to be moved to the new disks to achieve the desired performance improvement. To accomplish this, first the **mmchdisk** change command would be issued to change the *Disk Usage* parameter for the RAID disks to **dataOnly**. Then the **mmrpldisk** command would be used to restripe the metadata off the RAID device and onto the conventional disks.

Change Disks Using mmchdisk

Specify the file system, the new state (option), and the disk name, using the **mmchdisk** command. For example, to suspend the gpfs1n4 IBM Virtual Shared Disk in our sample **fs1** file system (see “Planning Sample IBM Virtual Shared Disks” on page 21), we would enter this command:

```
mmchdisk fs1 suspend -d gpfs1n4
```

To change a disk's parameters, specify the **change** option with a disk descriptor containing the new parameter value. For example, to specify that metadata should no longer be stored on disk gpfs3n4, enter:

```
mmchdisk /dev/fs0 change -d "gpfs3n4:::dataOnly"
```

For complete usage and syntax information, refer to “mmchdisk” on page 90

Managing Nodes

If your processor requirements change, you can add or delete nodes in an existing GPFS configuration. These tasks can be performed using SMIT dialogues or GPFS commands.

Adding Nodes to the GPFS Configuration

You can add nodes to an existing GPFS configuration using either SMIT or the **mmaddnode** command.

Whenever you add nodes to the GPFS configuration, you must consider how this change affects the quorum. The number of original GPFS nodes that are *down* (not operational), added to the number of nodes being added, should not be equal or greater than the new quorum requirement. The safest way to add nodes is in small increments. The following examples illustrate the consequences of adding nodes to an existing configuration.

Adding Nodes - Example 1 (Successful)

GPFS is currently configured on eight nodes, all of which are up and running. Five nodes are required for a quorum. If two nodes are added for a total of ten nodes, the quorum changes to six. Since eight nodes are already running, the quorum requirement is met. All that remains to be done is to stop and restart GPFS on all existing nodes in order for the change to be propagated across the GPFS configuration. This can be done gradually, as the workload allows.

Adding Nodes - Example 2 (Successful)

GPFS is currently configured on eight nodes, five of which are up and running. Five nodes are required for a quorum. If two nodes are added for a total of ten nodes, the quorum changes to six. With only five nodes currently running, the quorum requirement is not met. The five running nodes automatically stop and restart the GPFS daemons to load the new node information. Then they enter and remain in a wait state until GPFS is started on another node, whether old or new, in order to meet quorum. The first time GPFS is started on the new nodes, it must be done manually. Until quorum is met, no file system operations can be performed.

Adding Nodes - Example 3 (Unsuccessful)

GPFS is currently configured on eight nodes, five of which are up and running. Five nodes are required for a quorum. If four nodes are added, the new total is twelve nodes and the quorum changes to seven. A problem can occur if the network partitions before the quorum changes, and if the original five nodes where GPFS is running are in one partition and the remaining seven nodes are in the other partition. You will then be able to start GPFS on the seven nodes, but the two partitions will not be able to communicate and file system corruption can result.

You can avoid this situation by assuring that the total of new nodes, when added to existing nodes where GPFS is not running, does not satisfy the new quorum. Alternatively, simply stop GPFS on all configured nodes before adding nodes.

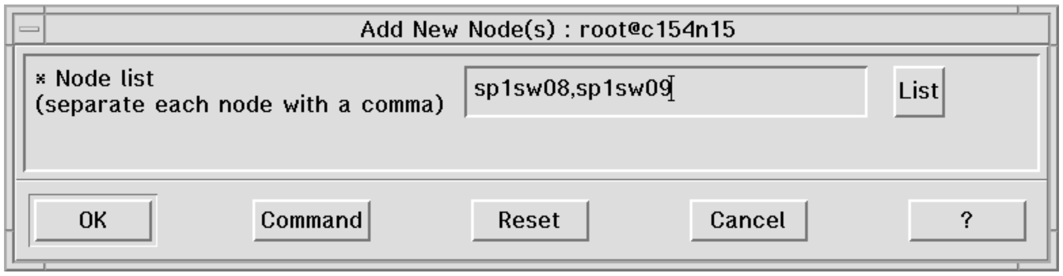
Note: When you add nodes, the original nodes in the configuration recognize new ones only after a GPFS restart. Until then, they do not allow the new nodes to become part of the configuration.

Adding Nodes Using SMIT

1. Select `Add Node(s) to a File System` from the SMIT GPFS Administration Menu (Figure 8 on page 34), or enter the command:

   ```
   smit mmaddnode
   ```

   The Add New Node(s) dialog appears, in which you can enter the node name, or click on **List**, and select the node from the names displayed. Then click on **OK**.



Add New Node(s) : root@c154n15

* Node list (separate each node with a comma): sp1sw08,sp1sw09

Figure 22. Add New Node(s) Dialog

Figure 22 shows the switch hostnames we would enter to add node8 and node9 to our sample **fs1** file system from "Planning a Sample GPFS Configuration" on page 19. Since there are eight nodes in the original configuration, we can add both new nodes at once without encountering a quorum problem. If, however, we added another eight nodes all at once, we would not be able to mount the file system because the quorum would immediately require that nine nodes be up and running in PSSP Group Services. In such a case, we would add the new nodes four at a time, provided at least seven of the original nodes were up and running GPFS.

Adding Nodes Using mmaddnode

Specify one or more nodes to add to your configuration with the **mmaddnode** command. For example, to add switch nodes 8 and 9 to the GPFS **fs1** file system, we would specify the following switch hostnames:

```
mmaddnode sp1sw08,sp1sw09
```

Refer to "mmaddnode" on page 82 for usage information.

Deleting Nodes from the GPFS Configuration

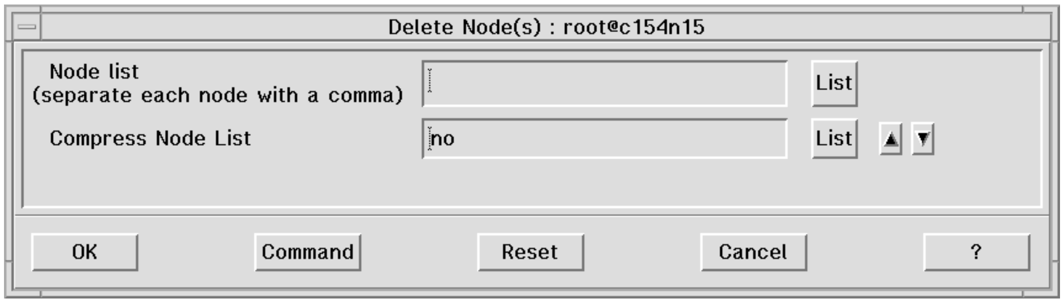
You can delete nodes from an existing GPFS configuration using either SMIT or the **mmdelnode** command.

Notes:

1. Before you can delete a node, you must unmount the file system and stop GPFS on the node to be deleted.
2. Exercise caution when deleting nodes from the GPFS configuration. If the number of remaining nodes falls below the requirement for a quorum, you will be unable to perform file system operations. See "Quorums" on page 6 for more information.
3. When a node is deleted from the GPFS configuration, its entry is not automatically deleted from the **/etc/cluster.nodes** file. Instead, a deleted hostname is replaced with `localhost` in the **/etc/cluster.nodes** file. This `localhost` entry is not a factor in calculating quorum. If you want to compress the **/etc/cluster.nodes** file by removing the entry altogether, specify the **-c** option with the **mmdelnode** command.

Deleting Nodes Using SMIT

1. Select `Delete Node(s) from a File System` from the SMIT GPFS Administration Menu (Figure 8 on page 34). The Delete Node(s) dialog appears, in which you can enter the node name, or click on **List**, and select the node from the names displayed. Then click on **OK**.


Delete Node(s) : root@c154n15

Node list
(separate each node with a comma)

Compress Node List: no

Figure 23. Delete Node(s) Dialog

Figure 23 shows the switch hostname we would enter to delete switch node 3 from our sample **fs1** file system from "Planning a Sample GPFS Configuration" on page 19.

Deleting Nodes Using mmdelnode

Specify one or more nodes to be deleted from the configuration with the **mmdelnode** command.

For example, to delete node03, we would specify the hostname used during configuration:

```
mmdelnode -c sp1sw03
```

The **-c** option tells GPFS to compress the **/etc/cluster.nodes** file by removing any `localhost` entries.

Refer to "mmdelnode" on page 115 for usage information.

Managing GPFS Quotas

The GPFS quota system helps you to control the allocation of files and data blocks in a file system. GPFS quotas can be defined for individual users or groups of users. Quota related tasks include:

1. "Installing and Uninstalling GPFS Quotas" on page 65
2. "Establishing and Changing Quotas" on page 65
3. "Checking Quotas" on page 66
4. "Listing Quotas" on page 67
5. "Activating Quota Enforcement" on page 68
6. "Deactivating Quota Enforcement" on page 68
7. "Creating File System Quota Reports" on page 69
8. "Recovering from Over-Quota Conditions" on page 69

In a quota-enabled configuration, one node is automatically nominated as the quota manager whenever GPFS is started. The quota manager allocates disk blocks to the other nodes writing to the file system, and compares the allocated space to quota limits at regular intervals. In order to reduce the need for frequent space requests from nodes writing to the file system, the quota manager allocates more disk blocks than requested.

Like JFS quotas, GPFS quotas operate with three parameters that you can set using the **mmedquota** command:

1. Soft limit
2. Hard limit
3. Grace period

The soft limits define levels of disk space and files below which the user or group can safely operate. The hard limits define the maximum disk space and files the user or group can accumulate. Specify hard and soft limits for disk space in multiples of the file system sub-block size (see "Fragments and Subblocks" on page 9).

The grace period allows the user or group to exceed the soft limit for a specified period of time (the default period is one week). If usage is not reduced to a level below the soft limit during that time, the quota manager interprets the soft limit as the hard limit and no further allocation is allowed. The user or group can reset this condition by reducing usage enough to fall below the soft limit.

The quota system maintains usage and limits data in the **quota.user** and **quota.group** files that reside in the root directories of GPFS file systems. These files are built with information input to the **mmedquota** command, and gathered during execution of the **mmcheckquota** command. **quota.user** and **quota.group** are readable by the **mmlsquota** and **mmrepquota** commands. The **mmquotaon** and **mmquotaoff** commands control activation of quota enforcement.

Quotas are typically used for file systems containing user home directories. Consider installing quotas on a GPFS file system if:

- Your system has limited disk space

- You need more file system security
- Your disk usage levels are high

If these conditions do not apply to your environment there may be no need to limit disk usage with quotas.

Installing and Uninstalling GPFS Quotas

To install quotas on your GPFS file system, follow this procedure:

1. Specify the **-Q yes** option when creating a new file system. This option automatically activates quota enforcement whenever the file system is mounted, and is also available when changing an existing file system with the **mmchfs** command (96).
2. Mount (or remount) the file system.
3. Set quota values. Refer to “Establishing and Changing Quotas.”
4. Compile i-node and disk block statistics using the **mmcheckquota** command (see “Checking Quotas” on page 66). Do this after creating a new file system, and whenever numerous node failures have occurred. This command reconciles quota information with actual disk allocation.
5. Activate quota enforcement. You must do this manually using the **mmquotaon** command if the file system has not yet been remounted, even when the **-Q yes** option (step 1) has been specified.

During normal operation, there is no need to deactivate quota enforcement (“Deactivating Quota Enforcement” on page 68) and doing so can affect quota accuracy. The only reason you might have to deactivate quota enforcement is when users are denied allocation that their quotas should allow, due to loss of quota information during node failure. If this occurs, use the **mmcheckquota** command after reactivating quotas to reconcile allocation data.

You may find it helpful to maintain a *quota prototype*, a set of limits that you can apply, by name, to any user or group, without entering the values manually. This makes it easy to set the same limits for all. The **mmedquota** command includes an option for naming a prototypical user or group upon which limits are to be based.

To uninstall quotas, edit the **/etc/filesystems** file to delete the following from the options line in the appropriate file system stanza on every node in the GPFS configuration:

```
quota=userquota;groupquota
```

Establishing and Changing Quotas

Use the **mmedquota** command to create file system quotas for individual users or groups of users. You can also change a quota once it has been created.

Establish/Change Quotas Using mmedquota

The **mmedquota** command allows you to establish or change quotas for one or more users or user groups. It opens a session using your default editor, and prompts you for soft and hard limits for i-nodes and blocks.

For example, to set user quotas for user `jesmith`, enter:

```
mmedquota -u jesmith
```

A prompt similar to the following appears in your default editor:

```
*** Edit quota limits for USR jesmith:
NOTE: block limits will be rounded up to the next multiple block size.
gpfs0: blocks in use (in KB): 24576, limits (soft = 0, hard = 0)
inodes in use: 3, limits (soft = 0, hard = 0)
```

Current (in use) i-node and block usage is for display only; it cannot be changed. When establishing a new quota, zeros appear as limits. Replace the zeros, or old values if you are changing existing limits, with values based on the user's needs and the resources available. When you close the editor, GPFS checks the values and applies them. If an erroneous value was specified, GPFS generates an error message. If this occurs, re-enter the **mmedquota** command.

To set group quotas, for example, for all users in a group named `blueteam`, to the prototypical values established for `prototeam`, specify the prototype option as follows:

```
mmedquota -g -p prototeam blueteam
```

When using the **-p** option, only a group prototype can be specified for group quotas, and only a user prototype can be specified for user quotas.

Refer to “mmedquota” on page 121 for syntax and usage information.

Checking Quotas

The **mmcheckquota** command counts i-node and space usage for a file system and writes the collected data into quota files.

Before activating quotas for the first time, you must use the **mmcheckquota** command to reconcile quota limits with current allocations. This must also be done in the event that quota information is lost due to node failure leaving users unable to open files or denying them disk space that their quotas should allow.

Check Quotas Using mmcheckquota

Specify the file system name with the **mmcheckquota** command. For example, to check quotas for file system **fs1** and report differences between calculated and recorded disk quotas, enter:

```
mmcheckquota -v fs1
```

Output similar to the following is displayed:

```
fs1: quota-check found following differences:
USR 0: 96 subblocks counted (was 0); 3 inodes counted (was 0)
```

This return says that the quota information for user 0 was corrected. Due to a system failure, this information was lost at the server, which recorded 0 sub-blocks and 0 files. **mmcheckquota** counted the current usage data, 96 subblocks and 3 files, and used it to update the quota.

Refer to “mmcheckquota” on page 94 for usage information.

Listing Quotas

Display file system quota limits and current usage information using the **mmlsquota** command.

List Quotas Using mmlsquota

Specify one user or user group with the **mmlsquota** command. For example, to display quota information about user `paul`, enter:

```
mmlsquota -u paul
```

Information similar to the following is returned:

```
                      Block Limits                          |              File Limits
Name type     KB        quota     limit in_doubt     grace |   files    quota     limit in_doubt     grace
paul USR      16384     17920     19968 16384        none  |   2        45        50    3            none
```

This output shows the quotas for user `paul` set to a soft limit of 17920KB and a hard limit of 19968KB. 16384KB is currently allocated to him. 16384KB is also *in doubt*, meaning that the quota manager allocated this space to other nodes writing the file system, but has not yet received updated information accounting for it. The quota manager, therefore, cannot yet report whether the space has been used by the nodes or is still available to them. This value may also represent a file that was open for a write operation when the quota manager was last updated.

If you issue the **mmlsquota** command with the **-e** option, the quota system collects updated information from all nodes before returning output. If the node to which *in-doubt* space was allocated should fail before updating the quota system about its actual usage, this space might be lost. Should the amount of space in doubt approach a significant percentage of the quota, run the **mmcheckquota** command to account for the lost space.

The soft limit for files (i-nodes) is set at 45 and the hard limit is 50. Two files are currently allocated to this user, and the three in doubt have been allocated to the nodes but the quota manager has not yet been updated as to whether they have been used or are still available.

No grace period appears because the user has not exceeded his quotas. Had he exceeded 17920KB or 45 files, the grace period, either explicitly set or allowed to default to one week, would be in effect and the user would have that time period to bring his usage below the soft limits. If he failed to do so, he would not be allocated any more space.

To collect and display updated quota information about a group named blueteam, specify the **-g** and **-e** options:

```
mmlsquota -g blueteam -e
```

Information is returned for groups and users in the same format.

Refer to “mmlsquota” on page 136 for syntax and usage information.

Activating Quota Enforcement

You can activate quota limit checking for users, groups, or both, using the **mmquotaon** command.

Note: Before activating quotas for the first time, you must run the **mmcheckquota** command to check file system quota consistency.

You can have quotas activated automatically whenever the file system is mounted by specifying the quota option when creating or changing a GPFS file system.

Activate Quotas Using mmquotaon

Specify the file system name, and whether user quotas or group quotas are to be activated, with the **mmquotaon** command. If you want both user and group quotas activated specify only the file system name.

For example, to activate user quotas on file system **fs1,** enter:

```
mmquotaon -u /gpfs/fs1
```

To activate group quotas on all GPFS file systems, enter:

```
mmquotaon -g -a
```

To activate both user and group quotas on **fs2**, enter:

```
mmquotaon fs2
```

Refer to “mmquotaon” on page 142 for syntax and usage information.

Deactivating Quota Enforcement

You can deactivate quota limit checking for users, groups, or both, using the **mmquotaoff** command. There is no need to deactivate quotas under normal conditions. Disk space and file allocations are made without regard to limits when quota enforcement is deactivated.

Deactivate Quotas Using mmquotaoff

Specify the file system name, and whether user or group quotas are to be deactivated, with the **mmquotaoff** command. If you want both types of quotas deactivated, specify only the file system name.

For example, to deactivate user quotas on file system **fs1,** enter:

```
mmquotaoff -u /gpfs/fs1
```

To deactivate group quotas on all GPFS file systems, enter:

```
mmquotaoff -g -a
```

To deactivate all quotas on **fs2,** enter:

```
mmquotaoff fs2
```

Refer to “mmquotaoff” on page 140 for syntax and usage information.

Creating File System Quota Reports

You can have GPFS prepare a quota report for a file system using the **mmrepquota** command. This lists:

1. Number of existing files
2. Amount of disk space used
3. Current quota limits
4. In doubt quotas (disk space allocated but currently unaccounted for)

for all users or all groups. If no options are specified, the report lists all users and all groups.

Create Quota Reports Using mmrepquota

Specify whether you want to list only user quota information or group quota information, along with the file system name, in the **mmrepquota** command. The default is to summarize both user quotas and group quotas.

To report on the group quotas for all file systems, enter:

```
mmrepquota -g -a
```

To report on user quotas for file system **fs1,** enter:

```
mmrepquota -u fs1
```

Refer to "mmrepquota" on page 144 for syntax and usage information.

Recovering from Over-Quota Conditions

Several methods of reducing file system usage are available to a user or group that has exceeded quota limits:

1. Abort the current process that caused the file system to reach its limit. Then remove surplus files to bring the limit below quota, and retry the failed program.
2. If an editor such as **vi** is in use, the shell escape key sequence can be used to check file space, remove surplus files, and return to the editor without losing the open file. The C and Korn shells allow the editor to be suspended with the **Ctrl-Z** key sequence so the file system commands can be issued. Return to the editor using the **fg** (foreground) command.
3. Temporarily write the file to a file system where limits have not been exceeded. Delete surplus files, then return the file to the correct file system.

Managing Access Control Lists

Access control protects directories and files by providing a means of specifying who should be granted access. GPFS access control lists (ACLs) give you added control over GPFS file access by allowing you to set permissions that extend the base AIX permissions assigned to individual users and groups.

The following administrative tasks are associated with GPFS ACLs:

1. "Setting Access Control Lists" on page 71
2. "Displaying Access Control Lists" on page 71
3. "Changing Access Control Lists" on page 72

4. “Deleting Access Control Lists” on page 72

GPFS ACLs extend the base AIX permissions, or traditional file access modes, of read (r), write (w), and execute (x) beyond the three categories of file owner, file group, and other users, to allow definition of additional users and user groups. In this way, an ACL can be created that might look like this:

```
#owner:jesmith
#group:team_A
user::rwx
group::rwx
other::--x
mask::rwx
user:alpha:r-x
group:audit:r-x
group:system:rwx
```

In the ACL above,

- The first two lines are comments showing the file's owner, jesmith, and group name, team_A
- The next three lines contain the base AIX permissions for the file:
  1. The permissions set for the file owner (**user**), jesmith
  2. The permissions set for the owner's **group**, team_A
  3. The permissions set for **other** groups or users outside the owner's group and not belonging to any named entry

  These three entries are the minimum necessary for a GPFS ACL.
- The next line, with an entry type of **mask**, contains the maximum permissions allowed for any entries other than the owner (the **user** entry) and those covered by **other** in the ACL.
- The last 3 lines contain additional entries for specific users and groups. These permissions are limited by those specified in the mask entry, but you may specify any number of additional entries up to a memory page (approximately 4KB) in size.

GPFS ACL s are fully compatible with the AIX permission set. Any change to the AIX permissions, using the **chmod** command, for example, modifies the corresponding ACL as well. Similarly, any change to the GPFS ACL is reflected in the output of AIX commands such as **ls -l**.

Each GPFS file or directory has an *access ACL* that determines its access privileges. These ACLs control who is allowed to read or write at the file or directory level.

In addition to an *access ACL*, a directory may also have a *default ACL*, which is assigned as an access ACL to every file created in that directory. This allows a user to protect all files in a directory without explicitly setting an ACL for each one. When a new subdirectory is created, both its access ACL and its default ACL are set to the default ACL of its parent directory.

Setting Access Control Lists

Use the **mmputacl** or **mmeditacl** command to set the access ACL of a file or subdirectory, or the default ACL of a directory. For example, to set the ACL for a file named **project2.history**, we might create a file named **project2.acl** that contains the following:

```
user::rwx
group::rwx
other::--x
mask::rwx
user:alpha:r-x
group:audit:rw-
group:system:rwx
```

In the **project2.acl** file above,

- The first three lines are the required ACL entries setting permissions for the file's owner, the owner's group, and for processes that are not covered by any other ACL entry.
- The last 3 lines contain named entries for specific users and groups.
- Because the ACL contains named entries for specific users and groups, it must also contain a mask entry, which is applied to all named entries (entries other than the **user** and **other**).

Once you are satisfied that the correct permissions are set in the ACL file, you can apply them to the target file with the **mmputacl** command:

```
mmputacl -i project2.acl project2.history
```

Although you can issue the **mmputacl** without using the **-i** option to specify an ACL input file, and make ACL entries through standard input instead, you will probably find the **-i** option more useful for avoiding errors when creating a new ACL.

See “mmputacl” on page 138 for syntax and usage information.

Displaying Access Control Lists

Use the **mmgetacl** command to display the access ACL of a file or subdirectory, or the default ACL of a directory. For example, to display the ACL created in the previous example for a file named **project2.history** , enter

```
mmgetacl project2.history
```

A display similar to the following is sent to standard output:

```
#owner:guest
#group:usr
user::rwx
group::rwx #effective:rw-
other::--x
mask::rw-
user:alpha:rwx #effective:rw-
group:audit:rwx #effective:rw-
group:system:-w-
```

The first two lines are comments displayed by the **mmgetacl** command, showing the owner and owning group. All entries containing permissions that are not allowed (because they are not set in the mask entry) display with a comment showing their effective permissions.

You can use the **-o** option to specify a file to which the ACL is written, for example,

```
mmgetacl -o old.acl project2.history
```

Then, if you want to assign the same permissions to another file, **project.notes**, for example, you could specify,

```
mmputacl -i old.acl project.notes
```

See “mmgetacl” on page 127 and “mmputacl” on page 138 for syntax and usage information.

Changing Access Control Lists

Use the **mmeditacl** command to change or create the access ACL of a file or directory, or the default ACL of a directory. For example, to edit the ACL for a file named **project2.history** interactively, enter

```
mmeditacl project2.history
```

The current ACL entries are displayed using the default editor, provided that the EDITOR environment variable specifies a complete path name.

See “mmeditacl” on page 119 for syntax and usage information.

Deleting Access Control Lists

Use the **mmdelacl** command to delete the extended entries in an access ACL of a file or directory, or the default ACL of a directory. For example, to delete the default ACL for a directory named **project2**, enter

```
mmdelacl -d project2
```

To delete the ACL for a file named **project2.history**, enter

```
mmdelacl project2.history
```

You cannot delete the base AIX permissions. These remain in effect after this command is executed. See “mmdelacl” on page 109 for syntax and usage information.

Chapter 6. Tuning GPFS Performance

GPFS performance depends on the correct specification of its parameters as well as the correct tuning of the functions that it uses. The following information describes the parameters that affect performance.

GPFS Tuning Parameters

For most work loads, the parameters that have the greatest impact on performance are the file system block size and the amount of memory allocated to GPFS. There are other parameters that affect specific work loads.

File System Block Size

GPFS offers three block sizes for file systems: 16KB, 64KB, and 256KB. Once you have set this parameter at file system creation, you cannot change it without recreating the file system.

The 256KB block size is the best choice for file systems that contain large files accessed in large reads and writes. This block size allows the most effective I/O operations.

The 16KB block size optimizes use of disk storage at the expense of large data transfers and should be used for other types of applications.

The 64KB block size offers a compromise. It makes more efficient use of disk space than 256KB while allowing faster I/O operations than 16KB.

You should choose the block size based on the application set that you plan to support.

GPFS Memory Parameters

GPFS pins an area of memory for its exclusive use. The memory allocated to GPFS is separated into two pools: the page pool and malloc pool. The size of these areas is controlled by GPFS configuration parameters.

Page Pool

The page pool is used primarily for storage of user data and indirect blocks. Increasing the size of the page pool allows GPFS to cache more data for access by applications. This provides two benefits. It reduces I/O operations by reusing previously fetched data, and it also gives GPFS the ability to overlap I/O and application execution through prefetch and deferred writes. If the applications you run have operational characteristics that would benefit from these features, an increase in page pool size might help performance. Examples of such characteristics are:

- Heavy use of writes that can be overlapped with application execution
- Heavy reuse of files and sequential reads of a size such that prefetch will benefit the application

Malloc Pool

The malloc pool is used for control structures. Applications that reuse files will benefit from increased malloc size because metadata can be cached.

Caching i–nodes

Storing a recently used file's i–node in the malloc pool permits faster access to the file the next time it must be opened. The **maxFilesToCache** parameter controls how many i–nodes are stored in cache. The default is 200 but increasing this number may improve throughput for workloads with high file reuse. Increasing it where file reuse is not great will waste kernel heap storage. Do not increase this parameter if you are in doubt.

Each cached file requires space in the mallocpool for an i–node plus approximately 800 bytes of metadata. GPFS will not use more than 50% of the mallocpool for this purpose. If you increase **maxFilesToCache**, you should also increase the **mallocsize** parameter to a value equal to 2 x (maximum i–node size for the file system + 800) x **maxFilesToCache**. For example, to set **maxFilesToCache** to 1000 for a file system with a maximum i–node size of 4096, **mallocsize** should be approximately 10MB.

Priority

Much of the GPFS code runs as a multi-threaded daemon. By default, the priority of the daemon is 40. You may wish to increase the priority of the daemon if your users execute a large number of time–critical I/O operations.

Switch Parameters and GPFS Performance

Two communication subsystem parameters affect GPFS performance: **rpoolsize** and **spoolsize**. Insufficient memory allocation to these switch pools can result in major performance degradation. Unless your nodes are very short of memory, we recommend that both of these pools be set at 16MB (the maximum allowed). See *Managing Shared Disks* for more information.

IBM Virtual Shared Disk Parameters and GPFS Performance

GPFS performance and recovery processes function best with one disk per IBM Virtual Shared Disk. If you want to create IBM Virtual Shared Disks with more than one disk, refer to *Managing Shared Disks*.

The IBM Virtual Shared Disk uses *buddy buffers* when it cannot hold sufficient switch buffers for the duration of an I/O operation. The number and size of these buffers is a function of the block sizes of the file systems and the number of disks. The optimal number of buddy buffers is different for IBM Virtual Shared Disk server nodes and IBM Virtual Shared Disk client nodes.

For your initial configuration, define buddy buffers at the largest block size of any GPFS file system you will create. If the block size of the largest file system is 16KB, define only 1 buddy buffer on IBM Virtual Shared Disk client nodes, but allow three or four on IBM Virtual Shared Disk servers because the IBM Virtual Shared Disk can use small buffers borrowed from the communication subsystem sendpool for blocks of this size.

You may find that you need more buddy buffers if you have a large number of disks attached to one IBM Virtual Shared Disk server. You can determine whether this is so by running the **statvsd** command and monitoring retries.

If the block size of any GPFS file system will be greater than 16KB, buddy buffers will be used for all I/O operations on the IBM Virtual Shared Disk servers. Only one buddy buffer may be needed on client nodes, but the number of buddy buffers required on a IBM Virtual Shared Disk server will be a function of the expected number of disk I/Os outstanding at any time. Start with an initial configuration of two buffers per spindle attached to a server. Again, monitoring the output of **statvsd** for buddy buffer retries will give you an indication of whether this initial value is too large or too small.

| The following is an example of a **vsdnode** command that could be used to initially
| setup IBM Virtual Shared Disk for GPFS on an eight-node SP:

```
| vsdnode 1 2 3 4 5 6 7 8 css0 64 256 256 48 4096 262144 33 61440
```

| On a system where IBM Virtual Shared Disk is already set up, these parameters
| could be changed using the **updatevsdnode** command instead.

To verify these values on the SP nodes, enter

```
vsdatalst -n
```

Output similar to the following is returned:

```
| VSD Node Information
|                                             Initial Maximum     VSD      rw      Buddy Buffer
|    node                VSD       IP packet   cache   cache request request minimum maximum size: #
|  number host_name      adapter     size    buffers buffers   count   count    size    size maxbufs
|  ------ -------------- -------- --------- ------- ------- ------- ------- ------- ------- -------
|       1 k13n01.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
|       2 k13n02.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
|       3 k13n03.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
|       4 k13n04.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
|       5 k13n05.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
|       6 k13n06.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
|       7 k13n07.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
|       8 k13n08.ppd.pok. css0         61440      64     256     256      48    4096  262144      33
```

See *Managing Shared Disks* for information on buddy buffers.

| Stripe Group Management

| When creating the stripe group manager preferences file, remember VSD buddy
| buffers compete for the same kernel memory, so avoid including VSD server nodes
| in the file. See “Creating a Preferences File” on page 6 for more information.

Chapter 7. GPFS Commands

mmadddisk

Purpose

Makes specified disk(s) available for GPFS use.

Syntax

mmadddisk *Device* {*DiskDescList* **| -F** *DescFile*} [**-a**] [**-r**] [**-v** <u>**yes**</u> **| no**]

Operands

Device
: The name of the file system device where the disk(s) are to be added. File system names need not be fully qualified. **fs0** and **/dev/fs0**, for example, are both acceptable.

DiskDescList
: A descriptor for each IBM Virtual Shared Disk to be added. Each descriptor (see "Disk Descriptors") is separated by a semicolon (;). The entire *DiskDescList* must be enclosed in quotation marks (' or ").

-F *DescFile*
: Points to a list of disk descriptors (see "Disk Descriptors") contained, one per line, in the specified file. This file eliminates the need for command line entry of these descriptors using the *DiskDescList* parameter. A sample file can be found in **/usr/lpp/mmfs/samples/diskdesc**.

Disk Descriptors

Whether you use a *DescFile* or *DiskDescList*, the positional parameters of the disk descriptor are the same. The only difference is how the disk descriptors are delimited. When entering them on the command line using a *DiskDescList*, each descriptor is separated by a semicolon. When entering them in a *DescFile*, each descriptor is on a separate line. No more than 1024 disk descriptors can be defined for a file system.

Each descriptor contains positional parameters that apply to the IBM Virtual Shared Disk, separated by colons (:).

You must provide a descriptor for each GPFS IBM Virtual Shared Disk to be created or passed to the GPFS file system. Each descriptor can contain the following positional parameters:

Disk Name
: The device name, for example, `hdisk1`, of any disk you wish to use to create an IBM Virtual Shared Disk, or the name of an existing IBM Virtual Shared Disk.

: GPFS performance and recovery processes function best with one disk per IBM Virtual Shared Disk. If you want to create IBM Virtual Shared Disks with more than one disk, refer to Managing Shared Disks. Then pass the existing IBM Virtual Shared Disks to GPFS using the VSD names.

Server Name
: The server name, when creating an IBM Virtual Shared Disk. This can be in any recognizable form.

Backup Server Name
: The backup server name, when creating an IBM Virtual Shared Disk. This can be in any recognizable form.

Disk Usage
: Specify one of the following or allow to default:

- **dataAndMetadata** (default)
- **dataOnly**
- **metadataOnly**

Failure Group
: A number identifying the failure group to which this disk belongs. All disks that have a common point of failure, such as all disks that are attached to the same VSD server node, should be placed in the same failure group. GPFS uses this information during data and metadata placement to assure that no two replicas of the same block are written in such a way as to become unavailable due to a single failure. You can specify any value from -1 (where -1 indicates that the disk has no point of failure in common with any other disk) to 4000. If you do not specify a failure group, the value defaults to the server node number plus 4000.

Any parameter that is intentionally omitted or allowed to default must be explicitly skipped. For example, if you had no backup server and wanted to use your disk for both data and metadata (the default), you could create a disk descriptor that looked like this:

```
hdisk1:sp1sw05:::5
```

If you also wanted to allow the last parameter, Failure Group, to default, you could omit the last three delimiting colons:

```
hdisk1:sp1sw05
```

or leave them in if you prefer:

```
hdisk1:sp1sw05:::
```

Trailing delimiters are acceptable.

Options

-a
: Specifies whether **mmadddisk** should wait for rebalancing to complete before returning. If this flag is specified, **mmadddisk** runs asynchronously and returns after the file system descriptor is updated and the rebalancing scan is started, but it does not wait for rebalancing to finish. If no rebalancing is requested (**-r** option not specified), this option has no effect.

-r
: Rebalance all existing files in the file system to make use of new disks.

-v <u>**yes**</u> **| no**
: Verify that specified disks do not belong to an existing file system. The default is **yes**. Specify **no** only when you want to reuse disks that are no longer part of an existing file system.

Description

Use the **mmadddisk** command to add disk(s) and logical volume groups to a GPFS file system. The current maximum number of disk descriptors that can be defined for any single file system is 1024.

This command optionally rebalances an existing file system after adding disks. **mmadddisk** does not require the file system to be unmounted; it can be run while the file system is in use.

Notes on specifying disk descriptor parameters:

Notes:

1. To use an existing IBM Virtual Shared Disk volume group in the file system, only the *Disk Name* (the IBM Virtual Shared Disk name) need be specified in the disk descriptor. The *Disk Usage* and *Failure Group* parameters are optional and may be allowed to default.
2. To create an IBM Virtual Shared Disk with one disk and use it in a file system, you must specify the *Disk Name* and *Server Name* parameters in the descriptor. *Backup Server*, *Failure Group*, and *Disk Usage* are optional.

Results

Upon successful completion of **mmadddisk** the following tasks are performed for each disk added to the GPFS file system:

- The volume group is created
- The IBM Virtual Shared Disk is configured and started
- New disks are added to the **/etc/filesystems** stanza

If **mmadddisk** is unsuccessful because a node is down, the added disk(s) will be propagated when that node comes up.

Files

- **/etc/filesystems**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmadddisk**.

Examples

To create a new IBM Virtual Shared Disk volume group for new disk, hdisk48 and add it to file system **fs0** by entering descriptor input on the command line, enter:

```
mmadddisk fs0 "hdisk48:sp1sw05:sp1sw06:dataOnly"
```

This command creates a new IBM Virtual Shared Disk with the default failure group of 4005. The IBM Virtual Shared Disk will store only data, not metadata.

Related Information

To add disks through SMIT panels, see “Add Disks Using SMIT” on page 54.

“mmchdisk” on page 90

“mmdeldisk” on page 110

“mmlsdisk” on page 130

mmaddnode

Purpose

Adds node(s) to GPFS configuration.

Syntax

mmaddnode *Newnodes*

Operands

Newnodes

List of nodes, delineated by commas. Nodes can be specified in any of the following hostname forms:

Format	**Example**
Short Hostname	k145s02
Long Hostname	k145s02.dpd.ibm.com
IP Address	9.119.19.102

Regardless which form you choose, specify the switch hostname.

Description

Use the **mmaddnode** command to add nodes to an existing GPFS configuration. **mmaddnode** must be run on an existing node in the GPFS subsystem.

Whenever you add nodes to the GPFS configuration, you must consider the impact to the quorum. The number of original nodes that are down (not operational), added to the number of new nodes, should not be equal to or greater than the new quorum requirement. The safest way to add nodes is in small increments. The following examples illustrate the consequences of adding nodes to an existing configuration.

- **Adding Nodes — Example 1 (Successful)**

  GPFS is currently configured on eight nodes, all of which are up and running. Five nodes are required for a quorum. If two nodes are added for a total of ten nodes, the quorum changes to six. Since eight nodes are already running, the quorum requirement is met. All that remains to be done is to stop and restart GPFS on all existing nodes in order for the change to be propagated across the GPFS configuration. This can be done gradually, as the workload allows.

- **Adding Nodes — Example 2 (Successful)**

  GPFS is currently configured on eight nodes, five of which are up and running. Five nodes are required for a quorum. If two nodes are added for a total of ten nodes, the quorum changes to six. With only five nodes currently running, the quorum requirement is not met. The five running nodes automatically stop and restart the GPFS daemons to load the new node information. Then they enter and remain in a wait state until GPFS is started on another node, whether old or new, in order to meet quorum. The first time GPFS is started on the new nodes, it must be done manually. Until quorum is met, no file system operations can be performed.

- **Adding Nodes — Example 3 (Unsuccessful)**

GPFS is currently configured on eight nodes, five of which are up and running. Five nodes are required for a quorum. If four nodes are added, the new total is twelve nodes and the quorum changes to seven. A problem can occur if the network partitions before the quorum changes, and if the original five nodes where GPFS is running are in one partition and the remaining seven nodes are in the other partition. You will then be able to start GPFS on the seven nodes, but the two partitions will not be able to communicate and file system corruption can result.

You can avoid this situation by assuring that the total of new nodes, when added to existing nodes where GPFS is not running, does not satisfy the new quorum. Alternatively, simply stop GPFS on all configured nodes before adding nodes.

Note: When you add nodes, the original nodes in the configuration recognize new ones only after a GPFS restart. Until then, they do not allow the new nodes to become part of the configuration.

Results

Upon successful completion of **mmaddnode** the following tasks are performed for each node added to the configuration:

- | Copy **/var/mmfs/etc/mmfs.cfg** and **/etc/cluster.nodes**.
- Create mount point directory and character mode device for each GPFS file system
- Update **/etc/filesystems** with stanzas for GPFS file systems

Upon successful completion of **mmaddnode** the following is performed for each pre-existing node in the configuration:

- Update **/etc/cluster.nodes** to reflect newly added nodes.
- Update quorum to reflect new requirement

If the **mmaddnode** command is unsuccessful because any existing nodes in the file system are down, the added node(s) will be propagated as each node comes up.

Files

- **/etc/filesystems**
- **/etc/cluster.nodes**
- **/var/mmfs/etc/mmfs.cfg**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

mmaddnode must be run on an existing node in the GPFS configuration where new node(s) are to be added.

You must have root authority to run **mmaddnode**.

Examples

To add node4 and node5 in the k145 system to the GPFS subsystem, enter:

```
k145n04,k145n05
```

Related Information

To add nodes through SMIT panels, see “Adding Nodes Using SMIT” on page 62.

“mmchconfig” on page 87

“mmconfig” on page 99

“mmdelnode” on page 115

| “mmlsnode” on page 134

mmchattr

Purpose

Changes attributes of one or more GPFS files.

Syntax

mmchattr [**-m** *MetadataReplicas*] [**-r** *DataReplicas*] *Filename* ...

Options

-m *MetadataReplicas*
: Specifies how many copies of the file system's metadata to create. Enter a value of 1 or 2, but no larger than the value of the *MaxMetadataReplicas* attribute of the file.

-r *DataReplicas*
: Specifies how many copies of the file data to create. Enter a value of 1 or 2, but no larger than the value of the *MaxDataReplicas* attribute of the file.

Operands

Filename
: The name of one or more files to be changed. Each filename should be delineated by a space. Wildcard characters are supported in filenames, for example, project*.sched.

Description

Use **mmchattr** to change the replication attributes of files in the GPFS file system. The replication factor must be less than or equal to the maximum replication factor for the file. If insufficient space is available in the file system to increase the number of replicas to the value requested, **mmchattr** ends. Some blocks of the file, however, may have their replication factor increased after **mmchattr** ends.

If additional free space becomes available in the file system at a later time (when, for example, you add another disk to the file system), you can then issue the **mmrestripefs** command with the **-r** or **-b** option to complete the replication of the file. You can then use the **mmlsattr** command to display the replication values.

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

Write permission for the specified files is required to run this command. The **mmchattr** command, however, does not require exclusive access to the file to run; the file can be in use.

Examples

1. To change the metadata replication factor to 2 and the data replication factor to 2 for the **project7.resource** file in file system fs1, enter:

   ```
   mmchattr -m 2 -r 2 /gpfs/fs1/project7.resource
   ```

Related Information

To change file attributes through SMIT panels, see "Change File System Attributes Using SMIT" on page 51.

"mmcrfs" on page 102

"mmlsattr" on page 128

"mmlsfs" on page 132

mmchconfig

Purpose

| Changes GPFS configuration parameters. Depending on the attribute, this may be
| done immediately, when the node is rebooted, or when the daemon is restarted.

Syntax

| **mmchconfig** *Attribute*=*value* [*node_list*] [**-i**]

Operands

Attribute
: The name of the attribute to be changed to the specified *value*.

| The **pagepool** attribute change will take effect immediately when used with the –**i**
| option, otherwise it will take effect when the nodes are rebooted:

pagepool
: The size of the cache on each node. It can range from a minimum of 4MB to a maximum of 512MB per node. This value should be specified with the character **M**, for example, `60M`.

The following attribute changes take effect when the GPFS daemon is restarted:

maxFilesToCache
: The number of i–nodes to cache for recently used files that have been closed. Storing a file's i–node in cache permits faster reaccess to the file. The default is 200 but increasing this number may improve throughput for workloads with high file reuse.

  Each cached file requires space in the mallocpool for an i–node plus approximately 800 bytes of metadata. GPFS will not use more than 50% of the mallocpool for this purpose. If you increase **maxFilesToCache**, you should also increase the **mallocsize** parameter to a value equal to 2 x (maximum i–node size for the file system + 800) x **maxFilesToCache**. For example, to set **maxFilesToCache** to 1000 for a file system with a maximum i–node size of 4096, **mallocsize** should be approximately 10MB.

dataStructureDump
: This specifies a path for the storage of dumps. The default is to store dumps in **/tmp/mmfs**. Specify **no** to store no dumps. This option sets two values in the **mmfs.cfg** file, **dataStructureDump** and **dataStructureDumpOnSGPanic**.

mallocsize
: This area is used exclusively for GPFS control structures. It can range from a minimum of 2MB to a maximum of 128MB. This value should be specified with the character **M**, for example, `8M`.

Note: The sum of **pagepool** and **mallocsize** must not exceed 80% of real memory.

priority
: Sets the UNIX dispatching priority of the daemon process to the specified value. The default is 40.

The following attribute change takes effect when the nodes are rebooted:

autoload
Starts GPFS automatically whenever the nodes are rebooted. Values are **yes** or **no**.

node_list
list of target nodes, delineated by commas, specified for customized configuration change. If *node_list* is not specified, the results are propagated to all GPFS nodes. If a list of target nodes is specified, the configuration changes affect only the GPFS nodes listed.

The list can cite nodes in any form of hostname shown in the following examples:

Format	**Example**
Short Hostname	k145s02
Long Hostname	k145s02.dpd.ibm.com
IP Address	9.119.19.102

Regardless which form you select, you should specify the switch hostname.

| ## Options

| **-i** Specifies for the **pagepool** attribute changes to take effect immediately
| as opposed to when the GPFS daemon is restarted.

Description

Use the **mmchconfig** command to change the GPFS configuration on a single node, a list of nodes, or to make global changes to all nodes in the configuration.

| Although the configuration may be changed at any time, only the **pagepool**
| attribute is valid with the **-i** option indicating changes to take effect immediately. All
| other changes take effect only when the daemons are restarted or the target nodes
| are rebooted, depending on the attributes changed. All target nodes need not be
| rebooted at the same time.

Results

| Upon successful completion of **mmchconfig**, the **mmfs.cfg** file is updated on all
| GPFS nodes to include the configuration changes made to the target nodes.

Files

- **/var/mmfs/etc/mmfs.cfg**

Return Codes

0 Successful completion.

1 A failure has occurred.

Restrictions

| **-i** is valid only for the **pagepool** attribute.

| **-i** must NOT come before *Attribute*=*value*.

You must have root authority to run **mmchconfig**.

Examples

1. To change the priority of the file system daemon to 42 on all nodes in the configuration, enter:

   ```
   mmchconfig priority=42
   ```

2. | To change pagepool only on node 6 and node 7 in the k145s system,
   | immediately, enter:

   ```
   | mmchconfig pagepool=380M k145sn6,k145sn7 -i
   ```

Related Information

To change configuration through SMIT panels, see “Changing Configuration Using SMIT” on page 37.

“mmconfig” on page 99

| “mmlsnode” on page 134

mmchdisk

Purpose

Changes state or parameters of one or more disks.

Syntax

mmchdisk *Device* {**suspend** | **resume** | **stop** | **start** | **change**} **-d** *DiskDescList*

Options

Device
: The name of the file system to which the disk(s) belong. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

suspend
: Instructs GPFS to stop allocating space on the specified disk. Place a disk in this state when you are preparing to restripe the file system off this disk because of faulty performance. This is a user-initiated state that GPFS will never use without an explicit command to change disk state.

  Note: A disk remains suspended until it is explicitly resumed. Restarting GPFS or rebooting nodes does not restore normal access to a suspended disk.

resume
: Informs GPFS that a disk previously suspended is now available for allocating new space. If the disk is currently in a stopped state, it remains stopped until you specify the **start** option. Otherwise, normal read and write access to the disk resumes.

stop
: Instructs GPFS to stop any attempts to access the specified disk(s). Use this option to tell the file manager that a disk has failed or is currently inaccessible because of maintenance.

  Note: A disk remains stopped until it is explicitly started by the **mmchdisk** command with the **start** option. Restarting the GPFS Server daemon or rebooting does not restore normal access to a stopped disk.

start
: Informs GPFS that disk(s) previously stopped are now accessible. This is accomplished by first changing the disk availability from `down` to `recovering`. The file system metadata is then scanned and any missing updates (replicated data that was changed while the disk was down) are repaired. If this operation is successful, the availability is then changed to `up`. If the metadata scan fails, availability is set to `unrecovered`. This could occur if too many other disks are down. The metadata scan can be reinitiated at a later time by issuing the **mmchdisk start** command again.

  Note: If you want to start more than one disk, specify them all in the same **mmchdisk start** command. If you start them separately while metadata is stored on any disk that remains down, the **mmchdisk start** command will fail.

change

Instructs GPFS to change the *Disk Usage* parameter, the *Failure Group* parameter, or both, according to the value(s) specified in *DiskDescList*.

-d *DiskDescList*

A descriptor for each disk to be changed.

Specify only disk names when using the **suspend**, **resume**, **stop**, or **start** options. Separate multiple disk names with semicolons and enclose list in quotation marks. For example, `"gpfs1n12;gpfs2n12"`

When using the **change** option, include the disk name and any new *Disk Usage* and *Failure Group* positional parameter values in the descriptor just as you would for the **mmadddisk** command, except leave the *Server Name* and *Backup Name* positional parameters unspecified. Separate descriptors with semicolons and enclose list in quotation marks, for example, `"gpfs1n12:::dataOnly;gpfs2n12:::metadataOnly:12"`. See "mmadddisk" on page 78 for more on disk descriptors.

Description

Use the **mmchdisk** command to change the state or parameters of one or more disks in a GPFS file system.

The state of a disk can be determined from its status and availability fields, displayable with the **mmlsdisk** command. A disk's state is a combination of its *availability* and *status*. Disk status is either ready or suspended. (Transitional status of replacing, replacement, or being emptied might also appear if a disk is being deleted or replaced.)

A suspended disk is one that the user has decided not to place any new data on. Existing data on a suspended disk may still be read or updated. Typically, a disk is suspended prior to restriping a file system. Suspending a disk tells the **mmrestripefs** command that data should be migrated off that disk. See "mmrestripefs" on page 146. Data may be read from a suspended disk.

Disk availability can be one of three values:

1. Up

   Normal read and write operations are possible
2. Down

   Normal read and write operations are not possible either due to a system-detected failure or an explicit user command that takes the disk offline. A disk with this status is not used.
3. Recovering

   Transitional availability between down and up, during which disk contents are validated.

   When disk availability remains `recovering` after **mmchdisk** has been issued, only partial recovery was achieved. It may be that another disk has an availability of `down` or an I/O error has occurred. Repair all disks and paths to disks before reissuing **mmchdisk** and specifying all `down` disks. If this is unsuccessful and some disks remain in `recovering`, run **mmfsck** to repair the data structure on those disks.

4. Unrecovered

   The disk was not successfully brought up.

You can use the **mmchdisk** command to change the status of a disk (suspend an active disk or resume a suspended disk), or to change its availability (start or stop a disk).

Be sure to use **stop** before you take a disk off-line for maintenance. You should also use **stop** when a disk has become temporarily inaccessible due to a disk failure that is repairable without loss of data on that disk (for example, an adapter failure or a failure of the disk electronics).

The **change** option operates on the *Disk Usage* (**dataOnly**, **metadataOnly**, **dataAndMetadata**) and *Failure Group* parameters of a disk. **mmchdisk change** does not move data or metadata that resides on the disk. After changing disk parameters, in particular, *Disk Usage*, you may have to issue the **mmrestripefs** command with the **-r** option to relocate data so that it conforms to the new disk parameters.

mmchdisk can be issued for a mounted or unmounted file system. When maintenance is complete or the failure has been repaired, use the **mmchdisk** command with the **start** option. If the failure cannot be repaired without loss of data, you can use the **mmdeldisk** command.

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

Root privileges are required to run this command.

Examples

1. To suspend active disk gpfs1n365, enter:
   ```
   mmchdisk /dev/fs0 suspend -d gpfs1n365
   ```
2. To stop suspended disk gpfs1n365, enter:
   ```
   mmchdisk /dev/fs0 stop -d gpfs1n365
   ```
3. To start stopped disk gpfs1n365, enter:
   ```
   mmchdisk /dev/fs0 start -d gpfs1n365
   ```
4. To resume allocation on started disk gpfs1n365, enter:
   ```
   mmchdisk /dev/fs0 resume -d gpfs1n365
   ```
5. To specify that metadata should no longer be stored on disk gpfs1n365, enter:
   ```
   mmchdisk /dev/fs0 change -d "gpfs1n365:::dataOnly"
   ```

Related Information

"mmadddisk" on page 78

"mmdeldisk" on page 110

"mmlsdisk" on page 130

"mmrpldisk" on page 148

mmcheckquota

Purpose

Checks file system i-node and space usage.

Syntax

mmcheckquota [**-v**] {**-a** | *Device*...}

Options

-a	Checks all GPFS file systems with disk quotas.
-v	Reports discrepancies between calculated and recorded disk quotas.

Operands

Device	Device name of the file system to be checked. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

Description

The **mmcheckquota** command counts i-node and space usage in a file system by user and group, and writes the collected data into quota files. This command need only be issued when quotas are first installed, after executing **mmedquota**, or when quota information is lost due to node failure and users are denied disk space that their quotas should allow.

mmcheckquota is an I/O-intensive command and should be run when the system load is light.

Files

- *filesystem_mountpoint***/user.quota**
- *filesystem_mountpoint***/group.quota**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmcheckquota**.

Examples

1. To check quotas for file system **fs0**, enter:
   ```
   mmcheckquota fs0
   ```
2. To check quotas for all file systems, enter:
   ```
   mmcheckquota -a
   ```

Related Information

“mmedquota” on page 121

“mmlsquota” on page 136

“mmquotaon” on page 142

“mmquotaoff” on page 140

“mmrepquota” on page 144

mmchfs

Purpose

Changes the attributes of a GPFS file system.

Syntax

| **mmchfs** *Device* [**-A yes | no**] [**-F** *MaxNumberOfInodes*] [**-m**
| *DefaultMetadataReplicas*] [**-Q yes | no**] [**-r** *DefaultDataReplicas*] [**-s** *StripeMethod*]
| [**-T** *mountpoint*] [**-V**]

| Or,

| **mmchfs** *Device* [**-C** *ConfigurationId*]

Options

-A yes | no
Change the automatic mount option for the file system. This specifies whether the file system should be automatically mounted when the GPFS daemons start.

| **-C**
| Change the name of the configuration for the file system.

| **-F** *MaxNumberOfInodes*
| Change the maximum number of files that can be created. Allowable
| values range from the current maximum number of files supported
| (determined at file system creation or by a previous invocation of this
| command), through the maximum number of files possibly supported
| according to the file system configuration.

-m *DefaultMetaDataReplicas*
Change the default number of replicas for metadata. Allowable values are 1 and 2 but cannot exceed the values of *MaxMetaDataReplicas* set when the file system was created.

-Q yes | no
Activate quotas automatically when the file system is mounted.

-r *DefaultDataReplicas*
Change the default number of replicas for data. Allowable values are 1 and 2 but cannot exceed the values of *MaxDataReplicas* set when the file system was created.

-s *StripeMethod*
Change the stripe method for this file system. Possible values are:

roundRobin
Places one block on all of the disks in the file system before repeating one, but uses the same permutation of disks repeatedly as the file grows.

random
Places the next block randomly, subject only to the constraint that no two replicas of a block be in the same failure group.

balancedRandom
Randomly places one block on all of the disks in the file system before repeating one.

-T
Change the mountpoint of the file system starting at the next mount of the file system.

-V
Change the file system format to the latest format supported by the currently installed level of GPFS.

Operands

Device
The name of the file system device to be changed. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

Description

This command need only be executed on one node in the GPFS configuration. The changes will be propagated through all nodes in the configuration.

Results

Upon successful completion of **mmchfs** the following tasks are performed:

- **/etc/filesystems** is updated, if any of the **-A**, **-Q**, or **-T** options are specified.
- Quotas are activated on subsequent starts of the GPFS daemons, if the **-Q** option is activated.
- All new file system functions are available after execution of **mmchfs**, if the **-V** option is specified. Once this option has been issued, the file system is no longer compatible with lower levels of GPFS.
- The maximum number of files supported by the file system is updated, if the **-F** option is specified with a value within the allowable range.
- All files created after execution of **mmchfs** take new attributes. Existing files are not affected. Use the **mmchattr** command to change the replication factor of existing files. To apply a new stripe method to existing files you must run the **mmrestripefs** command.

Files

- **/etc/filesystems**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must successfully execute the **-V** option before executing **mmchfs -F** or any application using the **gpfs_prealloc()** subroutine.

You must have root authority to run **mmchfs**.

Examples

To change the default replicas for metadata to 2 and the default replicas for data to 2 for new files created in the **fs0** file system, enter:

```
mmchfs fs0 -m 2 -r 2
```

Related Information

| Prior to issuing the **-V** option, read Chapter 4, “Migrating to the Latest Level of
| GPFS” on page 29.

To change file system attributes through SMIT panels, see “Change File System Attributes Using SMIT” on page 51.

“mmcrfs” on page 102

“mmdelfs” on page 113

“mmdf” on page 117

“mmfsck” on page 123

“mmlsfs” on page 132

mmconfig

Purpose

Configures GPFS prior to creating file system.

Syntax

mmconfig {-a **|** -n *node_file* } [**-A**] [**-c** *config_file*] [**-C** *configurationId*] [**-D** *dataStructureDump*] [**-i**] [**-m** *mallocsize*] [**-M** *maxFilesToCache*] [**-p** *pagepool*] [**-r** *priority*]

Options

-a
: Add all the nodes in the System Data Repository to the new configuration.

-n *node_file*
: Copies the list of nodes specified in *node_file* to the **/etc/cluster.nodes** file, which defines the cluster on all nodes. *node_file* consists of a list of hostnames, one per line. The list can cite nodes in any of the hostname forms shown in the following examples:

Format	**Example**
Short Hostname	k145s02
Long Hostname	k145s02.dpd.ibm.com
IP Address	9.119.19.102

Regardless which form you select, you should specify switch hostnames. If this option is not specified, all nodes in the System Data Repository are added to the **/etc/cluster.nodes** file.

-A
: Specifies that GPFS daemons are to be automatically started when nodes come up. The default is not to start daemons automatically.

-c *config_file*
: The name of a file containing global configuration information. GPFS copies the data specified in *config_file* to **/var/mmfs/etc/mmfs.cfg** on all nodes to be configured. If this option is not specified, the sample configuration file, **/usr/lpp/mmfs/samples/mmfs.cfg.sample** from the install package is used.

-C
: The identifier for the new configuration. It can be at most eight characters long and may not contain a period. If you do not provide an identifier, the system will assign one. The system assigns each configuration an integer identifier, beginning with 1 and increasing sequentially.

-D *dataStructureDump*
: This specifies a path for the storage of dumps. The default is to store dumps in **/tmp/mmfs**. Specify no to store no dumps.

| **-i**

| This specifies not to pin the file system manager in memory. However,
| the quality of service is degraded as the daemon is paged out. The
| default is to pin the file system manager in memory.

-m *mallocsize*

This area is used exclusively for GPFS control structures. It can range from a minimum of 2MB to a maximum of 128MB. This value should be specified with the character **M**. The default is 4M. If the **-c** option is specified, then **-m** is not allowed.

-M *maxFilesToCache*

This is the number of i–nodes to cache for recently used files that have been closed. Storing a file's i–node in cache permits faster reaccess to the file. The default is 200 but increasing this number may improve throughput for workloads with high file reuse. Increasing it where file reuse is not great will waste kernel heap storage. Do not increase this parameter if you are in doubt.

Each cached file requires space in the mallocpool for an i–node plus approximately 800 bytes of metadata. GPFS will not use more than 50% of the mallocpool for this purpose. If you increase **maxFilesToCache**, you should also increase the **mallocsize** parameter to a value equal to 2 x (maximum i–node size for the file system + 800) x **maxFilesToCache**. For example, to set **maxFilesToCache** to 1000 for a file system with a maximum i–node size of 4096, **mallocsize** should be approximately 10MB.

-p *pagepool*

This is the size of the cache on each node. It can range from a minimum of 4MB to a maximum of 512MB per node. This value should be specified with the character **M**. The default is 20M. If the **-c** option is specified, then **-p** is not allowed.

Note: The sum of **pagepool** and **mallocsize** must not exceed 80% of real memory.

-r *priority*

Sets the UNIX dispatching priority of the daemon process to the value specified. The default is 4. If the **-c** option is specified, then **-r** is not allowed.

Description

The **mmconfig** command allows you to specify configuration information on the command line or supply it in a *config_file* with the **-c** option. The use of a *config_file* provides you with a future reference and input should you decide to change the configuration at a later date. You might find it easier to input the specifications to a file, rather than in the more pressured situation that sometimes exists when entering long strings of data on the command line.

Results

Upon successful completion of **mmconfig** the following tasks are performed on all specified nodes:

- The configuration files are copied to**/var/mmfs/etc/mmfs.cfg**
- The **/etc/cluster.nodes** file is created and copied
- The GPFS vfs number is added to the **/etc/vfs** file

Files

- **/etc/cluster.nodes**
- **/var/mmfs/etc/mmfs.cfg**
- **/etc/vfs**

Return Codes

0	Successful completion.
1	A failure has occurred and an error message is printed to stdout.

Restrictions

You must have root authority to run **mmconfig**.

Examples

To configure all the nodes listed in the file called **system_1**, and have GPFS automatically started when the nodes come up, enter:

```
mmconfig -n system_1 -A
```

Related Information

To configure GPFS through SMIT panels, see “Configure Using SMIT” on page 35.

“mmaddnode” on page 82

“mmchconfig” on page 87

“mmdelnode” on page 115

“mmlsnode” on page 134

mmcrfs

Purpose

Creates GPFS file system.

Syntax

mmcrfs *Mountpoint Device* { *DiskDescList* **| -F** *DescFile*} [**-A** **yes** **| no**] [**-B** *BlockSize*] [**-i** *InodeSize*] [**-I** *IndirectSize*] [**-k yes |** **no**] [**-m** *DefaultMetadataReplicas*] [**-M** *MaxMetadataReplicas*] [**-n** *NumNodes*] [**-N** *NumInodes*] [**-Q yes |** **no**] [**-r** *DefaultDataReplicas*] [**-R** *MaxDataReplicas*] [**-s** *StripeMethod*] [**-v** **yes** **| no**]

Operands

Mountpoint
: The mountpoint directory of the GPFS file system.

Device
: The device name of the file system to be created. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

-F *DescFile*
: Points to a file containing a list of disk descriptors (see “Disk Descriptors”), one per line. This file eliminates the need for command line entry of these descriptors using the *DiskDescList* parameter. A sample file can be found in **/usr/lpp/mmfs/samples/diskdesc**.

DiskDescList
: A descriptor for each IBM Virtual Shared Disk to be added. Each descriptor (see “Disk Descriptors”) is separated by a semicolon (;). The entire *DiskDescList* must be enclosed in quotation marks (' or ").

Disk Descriptors

Whether you use a descriptor file or disk descriptor list, the positional parameters of the disk descriptor are the same. The only difference is how the disk descriptors are delimited. When entering them on the command line using a disk descriptor list, each descriptor is separated by a semicolon. When entering them in a descriptor
| file, specify each descriptor on a separate line. No more than 1024 disk descriptors
| can be defined for a single file system.

Each descriptor contains positional parameters that apply to the IBM Virtual Shared Disk, separated by colons (:).

You must provide a descriptor for each GPFS IBM Virtual Shared Disk to be created or passed to the GPFS file system. Each descriptor can contain the following positional parameters:

Disk Name
: The device name, for example, `hdisk1`, of any disk you wish to use to create an IBM Virtual Shared Disk, or the name of an existing IBM Virtual Shared Disk.

: GPFS performance and recovery processes function best with one disk per IBM Virtual Shared Disk. If you want to create IBM Virtual Shared

Disks with more than one disk, refer to Managing Shared Disks. Then pass the existing IBM Virtual Shared Disks to GPFS using the VSD names.

Server Name
The server name, when creating an IBM Virtual Shared Disk. This can be in any recognizable form and is unnecessary when specifying a predefined IBM Virtual Shared Disk.

Backup Server Name
The backup server name, when creating an IBM Virtual Shared Disk. This can be in any recognizable form and is unnecessary when specifying a predefined IBM Virtual Shared Disk.

Disk Usage
Specify one of the following or allow to default:

- **dataAndMetadata** (default)
- **dataOnly**
- **metadataOnly**

.

Failure Group
A number identifying the failure group to which this disk belongs. All disks that have a common point of failure, such as all disks that are attached to the same VSD server node, should be placed in the same failure group. GPFS uses this information during data and metadata placement to assure that no two replicas of the same block are written in such a way as to become unavailable due to a single failure. You can specify any value from -1 (where -1 indicates that the disk has no point of failure in common with any other disk) to 4000. If you do not specify a failure group, the value defaults to the server node number plus 4000.

Any parameter that is intentionally omitted or allowed to default must be explicitly skipped. For example, if you had no backup server and wanted to use your disk for both data and metadata (the default), you could create a disk descriptor that looked like this:

```
hdisk1:sp1sw05:::5
```

If you also wanted to allow the last parameter, *Failure Group*, to default, you could omit the last three delimiting colons:

```
hdisk1:sp1sw05
```

or leave them in if you prefer:

```
hdisk1:sp1sw05:::
```

Trailing delimiters are acceptable.

Options

-A yes | no
Automatic Mount option. Indicates whether the file system should automatically mount when the GPFS daemon starts. The default is **yes**.

-B *BlockSize*
Size of data blocks. Must be 16KB, 64KB, or 256KB (the default).

-i *InodeSize*
: The number of bytes in an i-node. The default is 512 bytes, the size of one logical sector. This can be as large as 4KB.

-I *IndirectSize*
: Number of bytes in an indirect block. This value must be a multiple of one subblock (*BlockSize*/32), and cannot exceed 32KB or *BlockSize*, whichever is smaller. Recommended values are *BlockSize*/*n*, where *n* is a power of 2. The default is *BlockSize*/16.

-k yes | <u>no</u>
: Keep the **restart.desc** file regardless of whether **mmcrfs** completes successfully. This file contains a list of all IBM Virtual Shared Disks in the file system, whether generated or not, and can be helpful in later attempts to create the file system and avoid recreating any IBM Virtual Shared Disks already completed. See “Error Recovery” on page 106.

-m *DefaultMetadataReplicas*
: Default number of copies of i-nodes and indirect blocks for a file. Allowable values are 1 and 2 but cannot exceed the value of *MaxMetadataReplicas*. The default is 1.

-M *MaxMetadataReplicas*
: Default maximum number of copies of i-nodes and indirect blocks for a file. Can only be overridden by a system call when the file has length 0. Determines the maximum possible file size, since space is reserved in the i-node for all possible copies of pointers to indirect blocks. Allowable values are 1 and 2 but cannot be lower than *DefaultMetadataReplicas*. The default is 1.

-n *NumNodes*
: The estimated number of nodes on which the file system will be mounted. This is used as a best guess for the initial size of some file system data structures. The default is 32.

-N *NumInodes*
: The estimated number of i-nodes to allocate in the file system. This value defaults to the size of the file system at creation, divided by 1MB, and can be specified with a suffix, for example 8K or 2M.

-Q yes | <u>no</u>
: Activate quotas automatically when the file system is mounted. The default is **no**.

-r *DefaultDataReplicas*
: Default number of copies of each data block for a file. Allowable values are 1 and 2 but cannot exceed *MaxDataReplicas*. The default is 1.

-R *MaxDataReplicas*
: Default maximum number of copies of data blocks for a file. Can only be overridden by a system call when the file has length 0. Determines the maximum possible file size, since space is reserved in the i-node and indirect blocks for all possible copies of pointers to data blocks. Allowable values are 1 and 2 but cannot be lower than *DefaultDataReplicas*. The default is 1.

-s *StripeMethod*
: Set the stripe method for this file system. Possible values are:

roundRobin
: Places one block on all of the disks in the file system before writing to the first disk again, repeating the same sequence of disks as the file grows. This provides the best performance if the file system never changes the number of disks, but requires more data movement when restriping. This is the default.

random
: Places the next block randomly, subject only to the constraint that no two replicas of a block be in the same failure group.

balancedRandom
: Randomly places one block on all of the disks in the file system before repeating one.

-v yes | no
: Verify that specified disks do not belong to an existing file system. The default is **yes**. Specify **no** only when you want to reuse disks that are no longer needed for an existing file system.

Description

Use the **mmcrfs** command to create a GPFS file system. The block size, indirect block size, i-node size, and replication factors affect file system performance as well as maximum potential file size. Refer to Table 1 on page 12 for details.

Notes on specifying disk descriptor parameters:

1. To use an existing IBM Virtual Shared Disk volume group in the file system, only the *Disk Name* (the IBM Virtual Shared Disk name) need be specified in the disk descriptor. The *Disk Usage* and *Failure Group* parameters are optional and may be allowed to default.
2. To create an IBM Virtual Shared Disk with one disk and use it in a file system, you must specify the *Disk Name* and *Server Name* parameters in the descriptor. *Backup Server*, *Failure Group*, and *Disk Usage* are optional.

When specifying the *DiscDescList* parameter, enclose the entire string in quotation marks so that the shell does not interpret the semicolon delimiters. The current maximum number of disk descriptors that can be defined for any file system is 1024.

When issuing the **mmcrfs** command, the size of the command must not exceed the shell limit. If the shell limit is insufficient to specify the file system on the command line, shorten the command string by using the **-F** option and specifying the disk descriptors in a file.

Although you can use SMIT to create the GPFS file system on each node, the following parameters can only be set using the **mmcrfs** command:

-m	*DefaultMetadataReplicas*
-r	*DefaultDataReplicas*
-M	*MaxMetadataReplicas*
-R	*MaxDataReplicas*

Results

Upon successful execution of **mmcrfs** the following tasks are completed on all GPFS nodes:

- IBM Virtual Shared Disks are created and configured.
- Mount point directory is created.
- File system is formatted.
- GPFS stanza is added to **/etc/filesystems** file.

If GPFS is not active on the node where **mmcrfs** is issued, the command fails.

If the node specified as either the server or backup server is down, the **mmcrfs** command fails because it will be unable to create IBM Virtual Shared Disks.

If any other node is down, the command executes, provided enough nodes are up to qualify as a quorum (see "Quorums" on page 6). The command completes the operation when the node comes back up.

Error Recovery: **mmcrfs** generates an error recovery disk descriptor file called **restart.desc**. If the creation of an IBM Virtual Shared Disk fails due to a system or user error, **mmcrfs** is designed to keep going rather than force a restart of the time-intensive process of IBM Virtual Shared Disk creation. The **restart.desc** file is stored in the directory where **mmcrfs** is issued. It contains a list of disk descriptors corresponding to those specified to the **mmcrfs** command. For IBM Virtual Shared Disk that are successfully created, the descriptor reflects the new VSD name. The only descriptors remaining in *disk* format are those that failed. If **mmcrfs** is successful, then the **restart.desc** file is deleted, unless **-k yes** is specified.

To use the **restart.desc** file, check the error messages for the IBM Virtual Shared Disks that failed. If the error is a user error, fix the problem in the disk, the descriptor, or wherever the problem occurred. If the failure was transient, such as failing to get a lock from IBM Recoverable Virtual Shared Disk, then the descriptor may be retried without modification. The subsequent **mmcrfs** command will generate a new **restart.desc** file, so rename the current one before using it. Use the renamed **restart.desc** file as the descriptor file in the **-F** option of **mmcrfs** in place of the original list of descriptors. If there is a problem with a descriptor that cannot be fixed, consider deleting that descriptor from the list. If the problem can be fixed later, the disk may be added using **mmadddisk**.

If the **mmcrfs** command is interrupted, the **restart.desc** file may not contain all descriptors. Append the missing lines to the file from the corresponding descriptors in the original list if you want to use the **restart.desc** file.

Files

- **/etc/filesystems**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmcrfs**.

| There is a maximum of 32 file systems that may exist within a GPFS configuration.

Examples

1. Start with a basic disk descriptor that takes advantage of GPFS defaults:

   ```
   hdisk5:sp1sw06:sp1sw07::
   ```

   This descriptor translates as follows:

   Disk Name hdisk5

   Server Name Switch node 6

   Backup Server Switch node 7

   Disk Usage Defaults to **dataAndMetadata**, allowing both

   Failure Group Defaults to 4006 (server node number + 4000)

   This descriptor would create an IBM Virtual Shared Disk with the name **gpfs1n6** on hdisk5.

2. If we add another descriptor to the file,

   ```
   hdisk6:sp1sw04::dataOnly:28
   ```

   which translates as follows:

   Disk Name hdisk6

   Server Name Switch node 4

   Backup Server None

   Disk Usage Data, not metadata

   Failure Group 28

   GPFS would also create an IBM Virtual Shared Disk with the name **gpfs2n4** on hdisk6.

3. This descriptor,

   ```
   hdisk9:sp1sw04::metadataOnly:−1
   ```

   translates to:

   Disk Name hdisk9

   Server Name Switch node 4

   Backup Server none

   Disk Usage Metadata, not data

   Failure Group Creates a unique failure group containing only this device

   This descriptor tells GPFS to also create an IBM Virtual Shared Disk with the name **gpfs3n4** on hdisk9.

4. One additional descriptor,

   ```
   vsdx3n12::::
   ```

   which could also be entered simply as

   ```
   vsdx3n12
   ```

   translates to:

   Disk Name vsdx3n12, the name of an existing IBM Virtual Shared Disk

   Server Name Predefined

   Backup Server Predefined

   Disk Usage Defaults to **dataAndMetadata**, allowing both

   Failure Group Defaults to server node number + 4000

   This descriptor specifies that an existing IBM Virtual Shared Disk with the name **vsdx3n12** be added to the GPFS file system.

To create a file system named **fs1** by entering the four disk descriptors on the command line and allowing all other parameters to default:

```
mmcrfs /gpfs/fs1 fs1 "hdisk4:sp1sw06:sp1sw07;hdisk5:sp1sw06::dataOnly:28;hdisk6:sp1sw04::metadataOnly:-1;vsdx3n12"
```

Instead of keying in the disk descriptors on the command line, we could enter them, one per line, in a file named **fs1disc.desc** and identify it with the **-F** option.

```
hdisk4:sp1sw06:sp1sw07
hdisk5:sp1sw06::dataOnly:28
hdisk6:sp1sw04::metadataOnly:-1
vsdx3n12
```

This example creates a file system called **fs1** with a block size of 16KB, an indirect block size 1KB, and an i-node size 1KB. The file system will be mounted on 16 nodes and accommodate an estimated 2500 files. It will be automatically mounted when the nodes boot up, with quota enforcement enabled. The maximum replication for data and metadata in this file system will be 2, although neither will be initially replicated by default.

```
mmcrfs /gpfs/fs1 fs1 -F fs1disc.desc -A yes -B 16K -I 1K -M 2 -n 16 -N 2500 -Q yes -R 2
```

Related Information

To create a GPFS file system through SMIT panels, see “Create File System Using SMIT” on page 43.

“mmchfs” on page 96

“mmdelfs” on page 113

“mmfsck” on page 123

“mmdf” on page 117

“mmlsfs” on page 132

mmdelacl

Purpose

Delete GPFS access control list.

Syntax

mmdelacl [**-d**] *File*

Operands

File
: The path name of the file or directory for which the ACL is to be deleted. If the -d option is specified, *file* must contain the name of a directory.

Options

-d
: Specifies that the default ACL of a directory is to be deleted.

Description

Use the **mmdelacl** command to delete the extended entries of an access ACL of a file or directory, or to delete the default ACL of a directory.

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

mmdelacl can only be executed by the file or directory owner.

Examples

1. To delete the default ACL for a directory named **project2**, enter:

```
mmdelacl -d project2
```

Related Information

"mmeditacl" on page 119

"mmgetacl" on page 127

"mmputacl" on page 138

mmdeldisk

Purpose

Removes a disk from GPFS file system.

Syntax

mmdeldisk *Device DiskNames* [**-a**] [**-n**] [**-p**] [**-r**]

Operands

Device
: The device name identifying the file system where the disk(s) are to be deleted. file system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

DiskNames
: The names of the IBM Virtual Shared Disks to be deleted. Specify the name generated when it was added. Use the **mmlsdisk** command ("mmlsdisk" on page 130) to display disk names. If there is more than one disk to be deleted, delineate each name with a semicolon (;) and enclose the list of disk names in quotation marks.

Options

-a
: Specifies that the **mmdeldisk** command should NOT wait for rebalancing to complete before returning. When this flag is specified, **mmdeldisk** runs asynchronously and returns after the file system descriptor is updated and the rebalancing scan is started, but it does not wait for rebalancing to finish. If no rebalancing is requested (**-r** option is not specified), this option has no effect.

-n
: | Do not delete the VSD. If this option is not specified, the VSD for a disk
| will be deleted after the disk is removed from the file system.

-p
: Indicates that the disk(s) are permanently damaged or no longer accessible, and instructs the **mmdeldisk** command not to attempt to read any data or metadata from the disk. Instead of migrating the data, **mmdeldisk** invalidates all references to the deleted disks in the i-nodes and indirect blocks. Run **mmfsck** after using this option.

  Any subsequent request to read data from a file that was stored on a deleted disk and not sufficiently replicated returns an I/O error (EIO).

-r
: Rebalance all existing files in the file system to make more efficient use of the remaining disks.

Description

The **mmdeldisk** command migrates all data that would otherwise be lost to the remaining disks in the file system. It then removes the disks from the file system descriptor. **mmdeldisk** optionally rebalances the file system after removing the disks.

Run **mmdeldisk** when system demand is low.

If a replacement for a failing disk is available, use the **mmrpldisk** command in order to keep the file system balanced. Otherwise, use one of the following procedures to delete a disk:

- If the disk is not failing and the GPFS Server can still read from it:
  1. Suspend the disk
  2. Restripe to rebalance all data onto other disks
  3. Delete the disk
- If the disk is permanently damaged and the data cannot be recovered, delete the disk if the file system is not replicated. If the file system is replicated:
  1. Suspend the disk
  2. Restripe and restore replication for the file system, if possible
  3. Delete the disk from the file system

  Later, when the disk is repaired or a replacement is available,

  4. Add the repaired or new disk back into the file system
  5. Restripe the file system

| **Note:** **mmdeldisk** will not delete a disk in a stopped state unless you specify the
| **-p** option. A stopped disk must be started before it can be deleted using
| **mmdeldisk**.

Results

Upon successful execution of **mmdeldisk** the following tasks are completed:

- Unreplicated data from the target disk(s) is migrated to other disks in the file system.
- Stanza with the deleted disks is updated in the **/etc/filesystems** file if the disk names appear on the options line. If the options line subsequently contains too few disk listings, more will be added from the full list in the SDR version of the stanza.
- Remaining disks are rebalanced, if specified.
- | The IBM Virtual Shared Disk is deleted, unless the **-n** option is specified.

Files

- **/etc/filesystems**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmdeldisk**.

Examples

To delete gpfs2n3 and gpfs3n4 from file system **fs0** and rebalance the files across the remaining disks, enter:

```
mmdeldisk fs0 "gpfs2n3;gpfs3n4" -r
```

Related Information

To delete disks through SMIT panels, see “Delete Disks Using SMIT” on page 56.

“mmadddisk” on page 78

“mmchdisk” on page 90

“mmlsdisk” on page 130

“mmrpldisk” on page 148

mmdelfs

Purpose

Removes a GPFS file system.

Syntax

mmdelfs *Device* [**-n**]

Operands

Device
Device name of the file system, as shown in **/etc/filesystems**. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

Options

-n
Do not delete IBM Virtual Shared Disks associated with the file system's disks. If this option is not specified, the IBM Virtual Shared Disks for the disks will be deleted after the file system is destroyed.

Description

The **mmdelfs** command removes all the structures for the specified file system from the nodes in the configuration.

Before you can delete a file system using **mmdelfs**, you must unmount it on all nodes.

Results

Upon successful execution of **mmdelfs** the following tasks are completed on all nodes:

- Removes the stripe group
- Removes all IBM Virtual Shared Disks used by the file system, unless the **-n** option was specified
- Removes the stanza for the file system from **/etc/filesystems** file
- Deletes the character device entry from **/dev**
- Removes the mount point directory where the file system had been mounted

Files

- **/etc/filesystems**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmdelfs**.

mmdelfs must be run on a node in the GPFS configuration.

Examples

1. To delete file system **fs0**, enter:

   ```
   mmdelfs fs0
   ```

Related Information

To delete a file system through SMIT panels, see “Delete a File System Using SMIT” on page 47.

“mmcrfs” on page 102

“mmchfs” on page 96

“mmdf” on page 117

“mmlsfs” on page 132

mmdelnode

Purpose

Removes one or more nodes from GPFS configuration.

Syntax

mmdelnode [**-c**] {*Delnodes* **|** **-a**}

Options

-a Delete all nodes.

-c Compress the node list contained in **/etc/cluster.nodes** file. This option removes `localhost` entries. The GPFS daemons must be stopped on all nodes (not only the ones specified in *Delnodes*) before you can run this option. Afterward, you must restart GPFS on all nodes at the same time in order for nodes with different versions of the **/etc/cluster.nodes** file to communicate.

Operands

Delnodes

| List of nodes to be deleted, delineated by commas. The nodes must all
| be members of the same GPFS configuration. The list can cite nodes in
| any of the hostname forms shown in the following examples:

Format	**Example**
Short Hostname	k145s02
Long Hostname	k145s02.dpd.ibm.com
IP Address	9.119.19.102

Description

| Use the **mmdelnode** command to delete one or more nodes from the same GPFS
| configuration. Issue **mmdelnode** on any GPFS node.

Before you can use **mmdelnode** to remove a node, you must unmount the file system and stop GPFS on the node to be deleted.

Note: Exercise caution when deleting nodes from the GPFS configuration. If the number of remaining nodes falls below the requirement for a quorum, you will be unable to perform GPFS file system operations. See “Quorums” on page 6 for more information.

Results

Upon successful execution of **mmdelnode** the following tasks are completed:

- Mount point directories and character mode devices are removed from the deleted nodes.
- **/etc/filesystems** is updated on deleted nodes by removing the GPFS stanzas.
- | **/etc/cluster.nodes** and **mmfs.cfg** are removed from deleted nodes.
- **/etc/cluster.nodes** updated on remaining nodes, to replace deleted nodes with `localhost` entries.

- The quorum requirement is updated

If the **mmdelnode** command is unsuccessful because one or more nodes are down, it will complete execution as the node(s) come up.

Files

- **/etc/cluster.nodes**
- **/etc/filesystems**
- **/var/mmfs/etc/mmfs.cfg**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmdelnode**.

Examples

1. To delete all nodes, enter:
   ```
   mmdelnode -a
   ```
2. To delete nodes k145s12, k145s13, and k145s14, enter:
   ```
   mmdelnode k145s12,k145s13,k145s14
   ```
3. To compress the **/etc/cluster.nodes** file by removing all `localhost` entries, enter:
   ```
   mmdelnode -c
   ```

Related Information

To delete a node through SMIT panels, see “Deleting Nodes Using SMIT” on page 63.

“mmaddnode” on page 82

“mmconfig” on page 99

“mmchconfig” on page 87

“mmlsfs” on page 132

| “mmlsnode” on page 134

mmdf

Purpose

Queries available file space on a GPFS file system.

| ### Syntax

| **mmdf** *Device* [**-d** | **-F** | **-m**]

Operands

Device
The name of the GPFS file system, for example, **/dev/fs0**. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

Options

	-d	List only disks that can hold data.
|	**-F**	List the number of i-nodes and how many of them are free.
	-m	List only disks that can hold metadata.

The default is to list all disks.

Description

Use the **mmdf** command to display the available space on each disk, as well as the total space available to the GPFS file system.

mmdf can be run against a mounted or unmounted file system.

Displayed values are rounded down to a multiple of 1024 bytes. If the fragment size used by the file system is not a multiple of 1024 bytes, then the displayed values may be lower than the actual values. This can result in the display of a total value that exceeds the sum of the rounded values displayed for individual disks. The individual values are accurate if the fragment size is a multiple of 1024 bytes.

Note: **mmdf** is only synchronized among nodes running the **xntpd** daemon and may therefore lag in reporting data.

Results

For each disk in the GPFS file system, **mmdf** displays:

- The size of the disk
- The failure group of the disk
- Whether the disk is used to hold data, metadata, or both
- Available space in full blocks
- Available space in fragments
- | The total number of i-nodes and the number available

mmdf displays the disks by failure group.

Return Codes

0 Successful completion.

1 A failure has occurred.

Examples

1. To query all disks in the **gpfssa** file system, enter:

   ```
   mmdf gpfssa
   ```

   Information is returned in the following format:

```
|                                                         free KB   free KB
|  disk            disk size  failure holds    holds    in full        in
|  name                in KB    group metadata data      blocks fragments
|  --------------- --------- -------- -------- ------ --------- ---------
|  g05ssa06vsd1n5    2097152      561 yes      yes      1774592      1312
|  g05ssa06vsd6n5    2097152      561 yes      yes      1775104       896
|  g05ssa06vsd2n5    2097152      561 yes      yes      1774080       856
|  g05ssa06vsd5n5    2097152      561 yes      yes      1773056       784
|  g05ssa06vsd3n5    2097152      561 yes      yes      1773312       680
|  g05ssa06vsd4n5    2097152      561 yes      yes      1773312      1064
|  g07ssa08vsd3n7    2097152      781 yes      yes      1772800       928
|  g07ssa08vsd4n7    2097152      781 yes      yes      1773056       624
|  g07ssa08vsd2n7    2097152      781 yes      yes      1775104       864
|  g07ssa08vsd5n7    2097152      781 yes      yes      1772544      1480
|  g07ssa08vsd1n7    2097152      781 yes      yes      1774336      1096
|  g07ssa08vsd6n7    2097152      781 yes      yes      1774848      1368
|                  ---------                            --------- ---------
|  (total)          25165824                             21286144     11952
|  nInodes:  23040
|  free inodes:  23014
```

Related Information

"mmchfs" on page 96

"mmcrfs" on page 102

"mmdelfs" on page 113

"mmlsfs" on page 132

mmeditacl

Purpose

Create or change GPFS access control list.

Syntax

mmeditacl [**-d**] *File*

Operands

File
: The path name of the file or directory for which the ACL is to be edited. If the -d option is specified, *file* must contain the name of a directory.

Options

-d
: Specifies that the default ACL of a directory is to be edited.

Description

Use the **mmeditacl** command for interactive editing of the ACL of a file or directory. This command uses the default editor, specified in the EDITOR environment variable, to display the current access control information, and allows the file owner to change it. The command verifies the change request with the user before making permanent changes.

The EDITOR environment variable must contain a complete path name, for example,

```
EDITOR=/usr/bin/vi
```

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

mmeditacl can be used to display an ACL by any user with access to the file or directory, but only the owner or root user can change an ACL.

Examples

1. To edit the ACL for a file named **project2.history** enter,

   ```
   mmeditacl project2.history
   ```

2. To edit the default ACL for a directory named **project2** enter,

   ```
   mmeditacl -d project2
   ```

Related Information

“mmdelacl” on page 109

“mmgetacl” on page 127

“mmputacl” on page 138

mmedquota

Purpose

Sets quota limits.

Syntax

mmedquota {**-u** [**-p** *ProtoUser*] *User*... **|** **-g** [**-p** *ProtoGroup*] *Group*... **|** **-t** {**-u** **|** **-g**}}

Operands

User	Name or user id of target user for quota editing.
Group	Name of target group for quota editing.

Options

-g Sets quota limits or grace times for groups.

-p When invoked with the **-u** option, uses *ProtoUser*, a set of limits that you can apply, by name, to any user without entering the values manually. This makes it easy to set the same limits for all users. When invoked with the **-g** option, **mmedquota** uses quotas established for prototypical group specified in *ProtoGroup* for each target group. You can specify any user as a prototype for another user, or any group as a prototype for another group.

-u Sets quota limits or grace times for users.

-t Sets grace period during which quotas can exceed the soft limit before it is imposed as a hard limit. The default grace period is one week.

Description

Use the **mmedquota** command to set or change quota limits for users and groups. **mmedquota** displays the current values for the following limits, if any, and prompts you to enter new values using your default editor:

- Current Block usage (display only)
- Current I-node usage (display only)
- I-node soft limit
- I-node hard limit
- Block soft limit
- Block hard limit

Note: A block or i–node limit of 0 indicates no limit.

The **mmedquota** command waits for the edit window to be closed before checking and applying new values. If an invalid entry is made, you must reissue the command and enter the correct values.

You can also use **mmedquota** to change the file system-specific grace periods for block and file usage if the default of one week is unsatisfactory. The grace period is the time during which users can exceed the soft limit. If the user or group does not reduce usage below the soft limit before the grace period expires, the soft limit becomes the new hard limit.

Files

- *filesystem_mountpoint*/**user.quota**
- *filesystem_mountpoint*/**group.quota**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

The file system must be mounted before **mmedquota** can be run.

You must have root authority to run **mmedquota**.

Examples

1. To set user quotas for user paul, enter:

   ```
   mmedquota -u paul
   ```

   You receive the following prompt in your default editor:

   ```
   *** Edit quota limits for USR paul:
   NOTE: block limits will be rounded up to the next multiple of the block size.
   gpfs0: blocks in use (in KB): 25600, limits (soft = 0, hard = 0)
   inodes in use: 3, limits (soft = 0, hard = 0)
   ```

2. To change the grace periods for all users, enter:

   ```
   mmedquota -t -u
   ```

   You receive the following prompt in your default editor:

   ```
   *** Edit grace times:
   Time units may be : days, hours, minutes, or seconds
   Grace period before enforcing soft limits for USRs:
   gpfs0: block grace period: 7 days, file grace period: 7 days
   ```

3. To set the quotas for the group, blueteam, to the prototype values in modelteam, enter:

   ```
   mmedquota -g -p modelteam blueteam
   ```

Related Information

"mmcheckquota" on page 94

"mmlsquota" on page 136

"mmquotaon" on page 142

"mmquotaoff" on page 140

"mmrepquota" on page 144

mmfsck

Purpose

Checks and repairs GPFS file system.

Syntax

mmfsck *Device* [**-n** | **-y**] [**-c**] [**-o**] [**-t** *Directory*]

The file system must be unmounted before you can run **mmfsck** with any option other than **-o**.

Operands

Device
: The name of the GPFS file system to be checked, for example, **fs0**. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

Note: The file system must be unmounted before **mmfsck** can repair file system inconsistencies.

Options

-c
: When the file system log has been lost and the file system is replicated, this option specifies that **mmfsck** attempt corrective action by comparing the replicas of metadata and data. If this error condition occurs, it is indicated by an error log entry.

-n
: Specifies a **no** response to all prompts from **mmfsck**. **-n** reports inconsistencies but it does not change the file system. To save this information, redirect it to an output file when you enter the **mmfsck** command. If neither **-n** nor **-y** is specified, **mmfsck** runs interactively, prompts you for permission to repair each consistency error as reported.

Recommendation: In all but the most severely damaged file systems, you should run interactively (the default).

-y
: Specifies a **yes** response to all prompts from **mmfsck**. Use this option only on severely damaged file systems. It allows **mmfsck** to take any action necessary for repairs. If you do not enter **-n** or **-y**, you are prompted for permission to repair each consistency error as reported.

-o
: Specifies that the file system can be mounted during the operation of the **mmfsck** command. Online mode does not perform a full file system consistency check, but blocks marked as allocated that do not belong to a file are recovered.

-t *Directory*
: Specifies the directory to be used for temporary storage during **mmfsck** processing. The default directory is **/tmp**. The minimum space required is equal to 8 bytes x the maximum number of i-nodes in the file system.

Description

The occurrence of input/output errors, or the appearance of a message telling you to run the **mmfsck** command, may indicate file system inconsistencies. Should either situation occur, use the **mmfsck** command to check file system consistency and interactively repair the file system.

mmfsck checks for the following inconsistencies:

- Blocks marked allocated that do not belong to any file. The corrective action is to mark the block free in the allocation map.
- Files for which an i-node is allocated and no directory entry exists (orphaned files). The corrective action is to create directory entries for these files in a **lost+found** subdirectory at the root of this file system. The index number of the i-node is assigned as the name. If you do not allow **mmfsck** to reattach an orphaned file, it asks for permission to destroy the file.
- Directory entries pointing to an i-node that is not allocated. The corrective action is to remove the directory entry.
- Ill-formed directory entries. A directory file contains the i-node number and the generation number of the file to which it refers. When the generation number in the directory does not match the generation number stored in the file's i-node, the corrective action is to remove the directory entry.
- Incorrect link counts on files and directories. The corrective action is to update them with accurate counts.
- Cycles in the directory structure. The corrective action is to break any detected cycles. If the cycle was a disconnected cycle, the new top level directory is moved to the **lost+found** directory.

Results

If the file system is inconsistent, **mmfsck** displays information about the inconsistencies and (depending on the option entered) may prompt you for permission to repair them. **mmfsck** tries to avoid actions that may result in loss of data. In some cases, however, it may recommend the destruction of a damaged file.

If there are no file system inconsistencies to detect, **mmfsck** reports the following information for the file system:

- Number of files
- Used blocks
- Free blocks

All corrective actions, with the exception of recovering lost disk blocks (blocks that are marked as allocated but do not belong to any file), require that the file system be unmounted on all nodes. If **mmfsck** is run on a mounted file system, it will recover lost blocks but any other inconsistencies will only be reported, not repaired.

If a bad disk is detected, **mmfsck** stops the disk and writes an entry to the error log. The operator must manually start and resume the disk when the problem is fixed.

Files

- **/etc/filesystems**
- **/etc/cluster.nodes**

Return Codes

0	Successful completion.
2	The command was interrupted before it complete checks or repairs.
4	The command changed the file system and it must now be restarted.
8	The file system contains unrepaired damage.

Restrictions

You must have root authority to run **mmfsck**.

Examples

1. To run **mmfsck** on the **fs1** file system, receive a report, but not fix inconsistencies, enter:

   ```
   mmfsck fs1 -n
   ```

   You receive information similar to the following:

   ```
   Checking "fs1"
   Checking inodes
   Checking directories and files
   Checking log files
   Processing inodes

           7680 inodes
            907   allocated
              0   repairable
              0   repaired
              0   damaged
              0   deallocated
              0   orphaned
              0   attached

         823296 subblocks
          38211   allocated
              0   unreferenced
              0   deletable
              0   deallocated


   File system is clean
   ```

   mmfsck found no inconsistencies in this file system.

2. To run **mmfsck** on the /dev/fs2 file system, receive a report, and fix inconsistencies, enter:

   ```
   mmfsck /dev/fs2 -y
   ```

   You receive information similar to the following:

```
Checking "/dev/fs2"
Checking inodes
block allocation map is modified.
         429 allocated subblocks (actual)
        1805 allocated subblocks (on disk)
Flush to disk? yes
Checking directory
Checking log files
Processing inodes
Freeing deallocated inodes
        2555 inodes
          65   allocated
           0   repairable
           0   repaired
           0   damaged
           0   deallocated
           0   orphaned
           0   attached

        46080 subblocks
         461   allocated
        4736   unreferenced
           0   deletable
           0   deallocated

          55 directory files
           0   deletable
           0   deleted
file system has been repaired
```

In this example, inconsistencies are identified and repaired.

Related Information

"mmcrfs" on page 102

"mmdelfs" on page 113

"mmdf" on page 117

"mmlsfs" on page 132

mmgetacl

Purpose

Display GPFS access control list.

Syntax

mmgetacl [**-d**] [**-o** *outfile*] *File*

Operands

File
: The path name of the file or directory for which the ACL is to be displayed. If the **-d** option is specified, *file* must contain the name of a directory.

Options

-d
: Specifies that the default ACL of a directory is to be displayed.

-o *outfile*
: The path name of a file to which the ACL is to be written.

Description

Use the **mmgetacl** command to display the ACL of a file or directory.

Return Codes

0	Successful completion.
1	A failure has occurred.

Examples

1. To display the ACL for a file named **project2.history** , enter

   ```
   mmgetacl project2.history
   ```

   Output similar to the following is returned:

   ```
   #owner:paul
   #group:design
   user::rwx
   group::r-x
   other::r-x
   ```

Related Information

"mmeditacl" on page 119

"mmdelacl" on page 109

"mmputacl" on page 138

mmlsattr

Purpose

Queries file attributes.

Syntax

mmlsattr *FileName...*

Operands

FileName
The name of the file to be queried. You must enter at least one filename. Wildcard characters are supported for filenames, for example, **project*.sched**.

Description

Use the **mmlsattr** command to display replication attributes of a file.

Results

mmlsattr lists the following attributes of the specified file:

- Current number of copies of data in a file and the maximum value
- Number of copies of the metadata for a file and the maximum value

Files

- **/etc/filesystems**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have read access to run **mmlsattr**.

Examples

1. To list the attributes of a file named **project4.sched**, enter:

   ```
   mmlsattr /mmfs/fs0/project4.sched
   ```

   The following information is returned:

   ```
   replication factors
   metadata(max) data(max)  file
   ------------- ---------  ----
         1 (  2)   1 (  2)  /mmfs/fs0/project4.sched
   ```

2. To show the attributes for all files in file system **fs0**, enter:

   ```
   mmlsattr /mmfs/fs0/*
   ```

   The following information is returned:

```
replication factors
metadata(max) data(max)   file
------------- ---------   ----
      1 (  2)   1 (  2)   /mmfs/fs0/project4.sched
      1 (  2)   1 (  2)   /mmfs/fs0/project4.hist
      1 (  2)   1 (  2)   /mmfs/fs0/project5.plan
```

3. To show the attributes for all files in file system **fs1**, enter:

   ```
   mmlsattr /mmfs/fs1/*
   ```

   The following information is returned:

   ```
   replication factors
   metadata(max) data(max)  file
   ------------- ---------  ----
         2 (  2)   1 (  2)  /mmfs/fs1/groupA.resource
         2 (  2)   1 (  2)  /mmfs/fs1/groupA.budget
         2 (  2)   1 (  2)  /mmfs/fs1/groupA.oview
   ```

Related Information

To query file replication attributes through SMIT panels, see “Querying File Replication Using mmlsattr” on page 52.

“mmchattr” on page 85

mmlsdisk

Purpose

Displays current state of disks in file system.

Syntax

mmlsdisk *Device* [**-d** *DiskName* ...]

Options

-d *DiskName*

The IBM Virtual Shared Disk name of the disk for which you want to display the state. When you enter multiple *DiskNames*, you must separate them with semicolons and enclose the entire string of disk names in quotation marks (for example "gpfs3n12;gpfs4n12;vsdx5n12").

Operands

Device

The name of the file system to which the disk(s) belong, for example, **fs0**. **fs0** and **/dev/fs0** are equally acceptable.

mmlsdisk can be run against a mounted or unmounted file system.

Description

Use the **mmlsdisk** command to display the current state of the disks in the file system.

For each disk in the list, **mmlsdisk** shows:

- Current Status (whether the disk is suspended or replaced, for example)
- Availability (whether the disk is stopped)

Return Codes

0	Successful completion.
1	A failure has occurred.

Examples

1. To display the current state of gpfs3n12, enter:

```
mmlsdisk /dev/fs0 -d gpfs3n12
```

Information similar to the following is displayed:

```
disk       driver    sector    failure    holds       holds     status    availability
name       type      size      group      metadata    data
gpfs3n12   disk      512       -1         yes         yes       ready     up
```

2. To display the current states of gpfs3n12, gpfs4n12, and vsdx5n12, enter:

```
mmlsdisk /dev/fs0 -d "gpfs3n12;gpfs4n12;vsdx5n12"
```

```
disk         driver      sector      failure      holds        holds       status      availability
name         type        size        group        metadata     data
gpfs3n12     disk        512         -1           yes          yes         ready       up
gpfs4n12     disk        512         -1           yes          yes         ready       up
vsdx5n12     disk        512         -1           yes          yes         ready       up
```

Related Information

To display the state of file system disks through SMIT panels, see “Display Disk States Using SMIT” on page 59.

“mmadddisk” on page 78

“mmchdisk” on page 90

“mmdeldisk” on page 110

“mmrpldisk” on page 148

mmlsfs

Purpose

Displays file system attributes.

Syntax

| **mmlsfs** *Device* [**-a**] [**-B**] [**-C**] [**-d**] [**-f**] [**-F**] [**-i**] [**-I**] [**-m**] [**-M**] [**-n**] [**-Q**] [**-r**] [**-R**] [**-s**] [**-V**]

Options

-a	Display the estimated average file size, in bytes
-B	Display the block size, in bytes
-C	Display the configuration identifier
-d	Display the names of all disks in the file system
-f	Display the minimum fragment size, in bytes
-F	Display the maximum number of files currently supported
-i	Display i-node size, in bytes
-I	Display the indirect block size, in bytes
-m	Display the default number of replicas for metadata
-M	Display the maximum number of replicas for metadata
-n	Display the estimated number of nodes that will mount file system
-Q	Display which quotas are currently enforced on the file system
-r	Display the default number of replicas for data
-R	Display the maximum number of replicas for data
-s	Display the stripe method for this file system
-V	Display the current format version of the file system

Operands

Device
The name of the file system, for example, **fs0**. **fs0** and **/dev/fs0** are equally acceptable.

Description

Use the **mmlsfs** command to list the attributes of a file system.

Results

If you do not specify any options, all attributes of the file system are listed. When you use options, only those attributes specified are listed, in the order issued in the command. Some parameters are preset for optimum performance and, although they display in **mmlsfs** output, you cannot change them.

Return Codes

0 Successful completion.

1 A failure has occurred.

Examples

1. If you issue the **mmlsfs** command with no options, for example:

   ```
   mmlsfs gpfssa
   ```

   The following information is returned:

```
| flag value          description
| ---- -------------- ---------------------------------------------------
|  -s  roundRobin     Stripe method
|  -f  8192           Minimum fragment size in bytes
|  -i  512            Inode size in bytes
|  -I  16384          Indirect block size in bytes
|  -m  2              Default number of metadata replicas
|  -M  2              Maximum number of metadata replicas
|  -r  1              Default number of data replicas
|  -R  1              Maximum number of data replicas
|  -a  102400         Estimated average file size
|  -n  8              Estimated number of nodes that will mount file system
|  -F  65536          Maximum number of files
|  -V  2              File system version.  Highest supported version
|  -B  262144         Block size
|  -Q  none           Quotas enforced
|  -C  1              Configuration identifier
|  -d  g05ssa06vsd1n5;g07ssa08vsd1n7;g05ssa06vsd2n5;g07ssa08vsd2n7;g05ssa06vsd3n5;
| g07ssa08vsd3n7;g05ssa06vsd4n5;g07ssa08vsd4n7;g05ssa06vsd5n5;g07ssa08vsd5n7;
| g05ssa06vsd6n5;g07ssa08vsd6n7  Disks in file system
```

Note: Output appears in the order specified in the command.

Related Information

“mmcrfs” on page 102

“mmchfs” on page 96

“mmdelfs” on page 113

mmlsnode

Purpose

Display the nodes for a GPFS configuration.

Syntax

mmlsnode{ *configId* **|** -a **|** -n *nodename*}

Options

-a Display all GPFS configurations.

-n *nodename* Display the GPFS configuration to which *nodename* belongs.

Operands

configId
The number of the GPFS configuration whose nodes are to be listed.

Description

The **mmlsnode** command displays the nodes contained in GPFS configurations. The configurations are listed in ascending order. Nodes which have been deleted are not displayed.

Files

Return Codes

0 Successful completion.

1 A failure has occurred.

Examples

1. To display the nodes in GPFS configuration 1, enter:

   ```
   mmlsnode 1
   ```

```
Configuration   Node list
-------------   -----------------------------------
1               k145sn06,9.119.19.102,k145sn08
```

2. To display the nodes for all GPFS configurations, enter:

   ```
   mmlsnode -a
   ```

   Information similar to the following is displayed:

```
Configuration   Node list
-------------   -----------------------------------
1               k145sn06,9.119.19.102,k145sn08
2               k145sn11,k145sn12
config3         k145sn01,k145sn02,k145sn03,k145sn04
```

3. To display the GPFS configurations to which **k145sn11** belongs to, enter:

```
mmlsnode -n k145sn11
```

Information similar to the following is displayed:

```
Configuration   Node list
-------------   -----------------------------------
2               k145sn11,k145sn12
```

Related Information

"mmaddnode" on page 82

"mmchconfig" on page 87

"mmconfig" on page 99

"mmdelnode" on page 115

mmlsquota

Purpose

Displays quota information for a user or group.

Syntax

mmlsquota [**-u** *User* **|** **-g** *Group*] [**-v** **|** **-q**] [**-e**]

Options

-g *Group*	Displays the quotas of the user group specified in the *Group* parameter.
-u *User*	Displays user quotas for name or user id specified in the *User* parameter.

If neither **-g** nor **-u** is specified, **mmlsquota** displays quota data for the user who entered the command.

-e	Specifies that **mmlsquota** is to collect updated quota usage data from all nodes before displaying results. If this option is not specified, the command displays the last quota data collected by the quota server.
-q	Prints a terse message containing only information about file systems with usage over quota.
-v	Displays quotas on file systems with no allocated storage.

Description

The **mmlsquota** command displays information about quota limits and current usage. The default is to display only user quotas for the user who issues the command.

Files

- *filesystem_mountpoint***/user.quota**
- *filesystem_mountpoint***/group.quota**

Return Codes

0	Successful completion.
1	A failure has occurred.

Examples

To display his own quota data, user paul enters:

```
mmlsquota
```

Information similar to the following is displayed:

```
|                  Block Limits                        |        File Limits
| Name type       KB    quota    limit in_doubt    grace |  files   quota    limit in_doubt    grace
| paul USR     16384    17920    19968 16384        none |      2      45       50        3     none
```

This output shows the quotas for user paul set to a soft limit of 17920KB, and a hard limit of 19968KB. 16384KB is currently allocated to him. 16384KB is also in doubt, meaning that the quota manager has not yet been updated as to whether this space has been used by the nodes, or whether it is still available.

The soft limit for files (i-nodes) is set at 45 and the hard limit is 50. Two files are currently allocated to this user, and the quota manager does not yet know whether the three in doubt have been used or are still available.

No grace period appears because the user has not exceeded his quotas. If he had exceeded 17920KB or 45 files, the grace period would be set and the user would have that amount of time to bring his usage below the quota values. If he failed to do so, he would not be allocated any more space.

Related Information

“mmcheckquota” on page 94

“mmedquota” on page 121

“mmrepquota” on page 144

“mmquotaon” on page 142

“mmquotaoff” on page 140

mmputacl

Purpose

Set GPFS access control list.

Syntax

mmputacl [**-d**] [**-i** *Infile*] *File*

Operands

File
: The path name of the file or directory for which the ACL is to be set. If the -d option is specified, *file* must contain the name of a directory.

Options

-d
: Specifies that the default ACL of a directory is to be set.

-i *Infile*
: The path name of a source file from which the ACL is to be read.

Description

Use the **mmputacl** command to set the ACL of a file or directory.

Note: If the **-i** option is not used, the command expects the input to be supplied through standard input, and will await your response to the prompt.

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must be the file or directory owner or have root authority to run **mmputacl**.

Examples

To use the entries in a file named **standard.acl** to set the ACL for a file named **project2.history**, enter:

```
mmputacl -i standard.acl project2.history
```

where **standard.acl** contains the following:

```
user::rwx
group::rwx
other::––x
mask::rw-
user:alpha:rwx
group:audit:rwx
group:system:-w-
```

Related Information

"mmeditacl" on page 119

"mmdelacl" on page 109

"mmgetacl" on page 127

mmquotaoff

Purpose

Deactivates quota limit checking.

Syntax

mmquotaoff [**-u** | **-g**] [**-v**] {**-a** | *Device* ...}

Options

-a	Deactivates all GPFS file system quotas, as indicated in the **/etc/filesystems** file. When used in combination with the **-g** option, only group quotas listed in **/etc/filesystems** are deactivated. When used in combination with the **-u** option, only user quotas listed in **/etc/filesystems** are deactivated.
-g	Specifies that only group quotas are to be deactivated.
-u	Specifies that only user quotas are to be deactivated.
-v	Prints a message for each file system in which quotas are deactivated.

Operands

Device	Specifies the device name of the file system. **fs0** is as acceptable as **/dev/fs0**.

Description

Before issuing the **mmquotaoff** command to turn quota checking off, the file system must be mounted.

If neither the **-u** nor the **-g** option is specified, **mmquotaoff** disables both.

If the **-a** option is not specified, *device* must be the last parameter entered.

Files

- *filesystem_mountpoint***/user.quota**
- *filesystem_mountpoint***/group.quota**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmquotaoff**.

Examples

1. To deactivate user quotas on file system **fs0**, enter:

   ```
   mmquotaoff -u /dev/fs0
   ```

2. To deactivate group quotas on all read-write file systems, enter:

   ```
   mmquotaoff -g -a
   ```

3. To deactivate all quotas on fs0, enter:

   ```
   mmquotaoff fs0
   ```

Related Information

“mmcheckquota” on page 94

“mmedquota” on page 121

“mmlsquota” on page 136

“mmquotaon” on page 142

“mmrepquota” on page 144

mmquotaon

Purpose

Activates quota limit checking.

Syntax

mmquotaon [**-u** | **-g**] [**-v**] {**-a** | *Device* ...}

Options

-a	Activates all GPFS file system quotas, as indicated in the **/etc/filesystems** file. When used in combination with the **-g** option, only group quotas listed in **/etc/filesystems** are activated. When used in combination with the **-u** option, only user quotas listed in **/etc/filesystems** are activated.
-g	Specifies that only group quotas are to be activated.
-u	Specifies that only user quotas are to be activated.
-v	Prints a message for each file system in which quotas are activated.

Operands

Device	Specifies the device name of the file system. **fs0** is as acceptable as **/dev/fs0**.

Description

Before issuing the **mmquotaon** command to turn quota checking on, the file system must be mounted.

If neither the **-u** nor the **-g** option is specified, **mmquotaon** enables both.

If the **-a** option is not used, *device* must be the last parameter specified.

Files

- *filesystem_mountpoint***/user.quota**
- *filesystem_mountpoint***/group.quota**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmquotaon**.

Examples

1. To activate user quotas on file system **fs0**, enter:

   ```
   mmquotaon -u /dev/fs0
   ```

2. To activate group quotas on all read-write file systems, enter:

   ```
   mmquotaon -g -a
   ```

3. To activate all quotas on fs0, enter:

   ```
   mmquotaon fs0
   ```

Related Information

“mmcheckquota” on page 94

“mmedquota” on page 121

“mmlsquota” on page 136

“mmquotaoff” on page 140

“mmrepquota” on page 144

mmrepquota

Purpose

Displays file system user and group reports.

Syntax

mmrepquota [**-e**] [**-g**] [**-q**] [**-u**] [**-v**] {**-a |** *Device*...}

Options

-a	Lists quotas for all file systems. A header line is printed automatically with this option.
-e	Specifies that **mmrepquota** is to collect updated quota usage data from all nodes before displaying results. If this option is not specified, the command displays the last quota data collected by the quota server.
-g	List only group quotas.
-q	Show whether quota enforcement is active.
-u	List only user quotas.
-v	Print a header line.

Operands

Device	Device name of the file system to be listed. **fs0** is as acceptable as **/dev/fs0**.

Description

The **mmrepquota** command lists (reports on) users and groups in a file system. If neither the **-g** nor the **-u** option is specified, then both user and group quotas are listed.

If the **-a** option is not specified, *device* must be the last parameter entered.

Files

- *filesystem_mountpoint***/user.quota**
- *filesystem_mountpoint***/group.quota**

Return Codes

0	Successful completion.
1	A failure has occurred.

Examples

1. To report on user quotas for file system **fs0**, enter:

   ```
   mmrepquota —u fs0
   ```

   Information similar to the following is displayed:

```
|                       Block Limits                    |       File Limits
|  Name   type    KB    quota    limit in_doubt    grace |  files   quota    limit in_doubt    grace
|  root   USR   7832        0        0        0     none |   277       0        0     0        none
|  alice  USR   9144    10240    12032     2888     none |   159    1000     1200     0        none
|  xzhong USR   7984     8192    10240     2256     none |   316    2000     2400     0        none
|  usr16  USR  65536        0        0        0     none |     1       0        0     0        none
```

| 2. To report on the group quotas for all file systems, enter:

```
| mmrepquota -g -a
```

| Information similar to the following is displayed:

```
|  fs2: no quota management installed
|  *** Report for GRP quotas on fs0
|                       Block Limits                     |       File Limits
|  Name   type     KB    quota    limit in_doubt    grace |  files   quota    limit in_doubt    grace
|  system GRP   23840        0        0   121944     none |   1072       0        0   666        none
|  staff  GRP  683664        0        0    99848     none |   6211       0        0   455        none
|  users  GRP 4194320 20971520 26214400    92160     none |  12973  100000   125000  1057        none
|  *** Report for GRP quotas on fs1
|                       Block Limits                     |       File Limits
|  Name   type     KB    quota    limit in_doubt    grace |  files   quota    limit in_doubt    grace
|  system GRP  284904        0        0   123144     none |    727       0        0     0        none
```

3. To report on quota enforcement for **fs2**, enter:

```
mmrepquota -q fs2
```

```
|  fs2: USR quota is on
|  fs2: GRP quota is on
```

Related Information

"mmcheckquota" on page 94

"mmedquota" on page 121

"mmlsquota" on page 136

"mmquotaoff" on page 140

"mmquotaon" on page 142

mmrestripefs

Purpose

Rebalances or restores the replication factor of all files in a file system.

Syntax

mmrestripefs *Device* {**-m | -r | -b**}

Options

-b
Rebalances all files across all disks that are not suspended, even if they are stopped. Although blocks are allocated on a stopped disk, they are not written to a stopped disk, nor are reads allowed from a stopped disk, until that disk is started and replicated data is copied onto it. **mmrestripefs** rebalances and restripes according to the stripe method for this file system. Use this option to rebalance the file system after adding, changing, or deleting disks in a file system.

-m
Migrates all critical data off any suspended disk in this file system. Critical data is all data that would be lost if currently suspended disks were removed.

-r
Migrates all data off suspended disks. It also restores all replicated files in the file system to their designated degree of replication when a previous disk failure or removal of a disk has made some replica data inaccessible. Use this parameter either immediately after a disk failure to protect replicated data against a subsequent failure, or before taking a disk off-line for maintenance to protect replicated data against failure of another disk during the maintenance process.

Operands

Device
Device name of the file system to be restriped. **fs0** is as acceptable as **/dev/fs0**.

Description

Use the **mmrestripefs** command to rebalance or restore the replication factor of all files in a file system. **mmrestripefs** moves existing file system data between different disks in the file system based on changes to the disk state made by the **mmchdisk**, **mmadddisk**, and **mmdeldisk** commands.

mmrestripefs attempts to restore the metadata or data replication factor of any file in the file system.

You must specify one of the three options (**-b**, **-m**, or **-r**) to indicate how much file system data to move. You can issue this command against a mounted or unmounted file system.

Files

/etc/filesystems

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmrestripefs**.

Examples

1. To restripe and move all critical data from any suspended disk in file system **fs0**, enter:

   ```
   mmrestripefs fs0 -m
   ```

   This command also rebalances the data in the file system.

   Messages similar to these are generated:

   ```
   MMFS: 6027-560 Scanning file system metadata ...
   MMFS: 6027-565 Scanning user file metadata ...
   3 % completed
       .
       .
       .
   100% completed
   MMFS: 6027-552 Scan completed successfully.
   ```

2. To rebalance all files in file system **fs0** across all defined, accessible disks that are not stopped or suspended, enter:

   ```
   mmrestripefs fs0 -b
   ```

   Messages are generated similar to those in the first example.

Related Information

“mmadddisk” on page 78

“mmchdisk” on page 90

“mmdeldisk” on page 110

“mmrpldisk” on page 148

mmrpldisk

Purpose

Replaces specified disk.

Syntax

mmrpldisk *Device OldDiskName DiskDesc* [**-n**] [**-v** **yes** | **no**]

Operands

Device
: The name of the file system device where the disk is to be replaced. File system names need not be fully qualified. **fs0** is as acceptable as **/dev/fs0**.

OldDiskName
: The name of the disk to be replaced. This can be a name previously generated by the **mmcrfs**, **mmadddisk**, **mmrpldisk** command, or one that was passed to one of these commands. You can have the entire list of disk names displayed using the **mmlsdisk** command.

DiskDesc
: A descriptor for the replacement IBM Virtual Shared Disk. The disk descriptor contains the following positional parameters that apply to the IBM Virtual Shared Disk, separated by colons (:)

Disk Name
: The device name, for example, `hdisk1`, of any disk you wish to use to create an IBM Virtual Shared Disk, or the name of an existing IBM Virtual Shared Disk.

GPFS performance and recovery processes function best with one disk per IBM Virtual Shared Disk. If you want to create IBM Virtual Shared Disks with more than one disk, refer to *Managing Shared Disks*. Then pass the existing IBM Virtual Shared Disks to GPFS using the VSD names.

Server Name
: The server name, when creating an IBM Virtual Shared Disk. This can be in any recognizable form.

Backup Server Name
: The backup server name, when creating an IBM Virtual Shared Disk. This can be in any recognizable form.

Disk Usage
: Specify the same as the disk being replaced or omit parameter and allow to default to the value of the original disk:

- **dataAndMetadata**
- **dataOnly**
- **metadataOnly**

.

Failure Group
A number identifying the failure group to which this disk belongs. Specify the same as the disk being replaced, or omit and allow to default to the value of the original disk.

Any parameter that is intentionally omitted or allowed to default must be explicitly skipped. Trailing delimiters are acceptable.

Options

| **-n** Do not delete the VSD for the replaced disk. If this option is not
| specified, the VSD will be deleted when the disk is replaced.

-v yes | no Verify that the new IBM Virtual Shared Disk does not belong to an existing file system. The default is **yes**. Specify **no** only when you want to reuse a disk that is no longer needed for an existing file system.

Description

Use the **mmrpldisk** command to replace an existing disk in the GPFS file system with a new one. All data on the old disk is migrated to the new one.

Notes:

1. To create a replacement IBM Virtual Shared Disk and add it to the file system, you must specify the Disk Name and Server Name parameters in the descriptor. The remaining positional parameters can be allowed to default.
2. You cannot replace a disk when it is the only remaining disk in the file system.
3. The replacement disk must have the same values for the Disk Usage and Failure Group parameters as the one it replaces. This means that if the old disk took the default failure group, the replacement disk must also take the default and have the same server.
4. Under no circumstances should you replace a stopped disk. You need to start a stopped disk before replacing it. If a disk cannot be started, you will have to delete it using the **-p** option on the **mmdeldisk** command. See the *GPFS Probelm Determination Guide* section on *Disk Media Failures* for further information on handling this.

The file system need not be unmounted before the **mmrpldisk** command can be run.

Results

Upon successful execution of **mmrpldisk** the following tasks are completed:

- IBM Virtual Shared Disk described in the descriptor is created and configured.
- **/etc/filesystems** is updated on all nodes in SP configuration to reflect disk replacement.
- The disk is replaced in the file system and data is copied to the new disk without restriping.
- SDR version of file systems stanza is updated with new **/etc/filesystems** data.
- The IBM Virtual Shared Disk of the disk being replaced is deleted, unless the **-n** option was specified.

Files

- **/etc/filesystems**

Return Codes

0	Successful completion.
1	A failure has occurred.

Restrictions

You must have root authority to run **mmrpldisk**.

Examples

1. To replace disk gpfs1n12 in **fs0** with a new IBM Virtual Shared Disk consisting of new disk hdisk48:

   ```
   mmrpldisk fs0 gpfs1n12 hdisk48:node12:::
   ```

   This command creates a new IBM Virtual Shared Disk with node12 as the server and no backup. The Disk Usage and the Failure Group parameters default to the corresponding values of gpfs1n12.

Related Information

To replace a disk through SMIT panels, see “Replacing Disks Using SMIT” on page 57.

“mmadddisk” on page 78

“mmchdisk” on page 90

“mmlsdisk” on page 130

“mmrestripefs” on page 146

Appendix A. GPFS Programming Interface

gpfs_prealloc

Purpose

Preallocate disk storage for a GPFS file

Library

GPFS Library (`libgpfs.a`)

Syntax

```
#include <gpfs.h>
int gpfs_prealloc(int fd, offset_t start, offset_t length)
```

Parameters

fd	An integer specifying the file descriptor returned by open(). The file for which preallocation is to be performed must be opened for writing.
start	The byte offset into the file at which preacllocation begins.
length	The number of bytes to preallocate.

Purpose

The **gpfs_prealloc** function is used to preallocate disk storage for a file that has already been opened, prior to writing data to the file. The preallocated disk storage is started at the requested offset, **start**, and covers at least the number of bytes requested, **length**. Allocations are rounded to GPFS subblock boundaries.

The preallocation of disk space for a file provides an efficient method for allocating storage without having to write any data. This can result in faster I/O compared to a file which gains disk space incrementally as it grows.

Existing data in the file will not be modified. Reading any of the preallocated blocks will return zeroes.

Note: Compile any program that uses this function from the **libgpfs.a** library with the **-lgpfs** flag.

Return Values

If the **gpfs_prealloc** subroutine is successful, it returns a value of 0.

If the **gpfs_prealloc** subroutine is unsuccessful, it returns a value of −1 and sets the global error variable **errno** to indicate the nature of the error. If **errno** is set to one of the following, some storage may have been preallocated:

- EDQUOT
- EFBIG

- ENOSPC
- ENOTREADY

The only way to tell how much space was actually preallocated is to **stat()** the file and compare the reported file size and number of blocks used with their values prior to preallocation.

Error Values

EACCES	The file is not opened for writing.
EBADF	The file descriptor is invalid.
EDQUOT	A disk quota has been exceeded
EFBIG	The file has become too large for the file system.
EINVAL	The file descriptor does not refer to a GPFS file or a regular file; a negative value was specified for **start** or **length**.
ENOTREADY	The file system on which the file resides has become unavailable.
ENOSPC	The file system has run out of disk space.
ENOSYS	**gpfs_prealloc** is not supported under the current file system format version.

Appendix B. Considerations for GPFS Applications

GPFS is designed so that most applications written to the X/Open standard for file system calls can access GPFS data with no modification, however, there are some exceptions.

Exceptions to X/Open Standards

The calls that provide the capability to use memory mapped files are not supported in this release. These include:

1. **mmap**
2. **munmap**
3. **msync**
4. **shmat**

IBM intends to support these calls in a future release of GPFS.

Applications that depend on exact reporting of changes to the following fields returned by the **stat** call may not work as expected:

1. **mtime**
2. **ctime**
3. **atime**

Providing exact support for these fields would require significant performance degradation to all applications executing on the system. These fields are guaranteed accurate when the file is closed.

| The delayed update of the information returned by the **stat** call also impacts system
| commands, such as **du** or **df** which display disk usage. The data reported by such
| commands may not reflect changes that have occured since the last sync of the file
| system. For a parallel file system, a sync does not occur until all nodes have
| individually synchronized their data. On a system with no activity, the correct values
| will be displayed after the sync daemon has run on all nodes.

| The **fsize** user process resource limit, as defined by **ulimit**, is not supported in this
| release and therefore not enforced. IBM intends to support this in a future release
| of GPFS.

Application Support

Applications access GPFS data through the use of standard AIX system calls and libraries. Support for larger files is provided through the use of AIX 64–bit forms of these libraries. See the AIX product documentation for details.

Glossary

F

failover. The assuming of server responsibilities by the node designated as backup server, when the primary server fails.

failure group. A collection of disks that share common access paths or adaptor connection, and could all become unavailable through a single hardware failure.

fragment. The space allocated an amount of data (usually the end of a file) too small to require a full block, consisting of one or more subblocks (one thirty-second of block size).

I

IBM Virtual Shared Disk. A subsystem that allows application programs executing on different nodes access a raw logical volume as if it were local at each node.

i-node. The internal structure that describes an individual file to AIX. An i-node contains file size and update information, as well as the addresses of data blocks, or in the case of large files, indirect blocks that, in turn, point to data blocks. One i-node is required for each file.

J

journaled file system. The local file system within a single instance of AIX.

L

Logical Volume Manager. Manages disk space at a logical level. It controls fixed-disk resources by mapping data between logical and physical storage, allowing data to be discontiguous, span multiple disks, replicated, and dynamically expanded.

M

metadata. Data structures that contain access information about file data. These might include i-nodes, indirect blocks, and directories. These data structures are used by GPFS but are not accessible to user applications.

mirroring. The creation of a mirror image of data to be preserved in the event of disk failure.

P

primary server. When physical disks are connected to two nodes (twin-tailed), this is the node that normally maintains and controls local access to the disk.

Q

quorum. The minimum number of nodes that must be running in order for the GPFS daemon to start. This is one plus half of the number of nodes in the GPFS configuration.

quota. The amount of disk space and number of i-nodes assigned as upper limits for a specified user or group of users.

R

RAID. Redundant Array of Independent Disks. A set of physical disks that are act as a single physical volume and use parity checking to protect against disk failure.

recovery. The process of restoring access to file system data when a failure has occurred. This may involve reconstructing data or providing alternative routing through a different server.

replication. The practice of creating and maintaining multiple file copies to ensure availability in the event of hardware failure.

S

SSA. Serial Storage Architecture. An expanded storage adapter for multi-processor data sharing in UNIX-based computing, allowing disk connection in a high-speed loop.

SCSI. Small Computer Systems Interface. An adapter supporting attachment of various direct-access storage devices.

secondary server. The second node connected to a twin-tailed disk. This node assumes control of local access if the primary server fails.

stripe group. A file system written across many disks, which are connected to multiple nodes.

striping. A method of writing a file system, in parallel, to multiple disks instead of to single disks in a serial operation.

sub-block. The smallest unit of data accessible in an I/O operation, equal to one thirty-second of a data block.

T

token management. A system for controlling file access in which each application performing a read or write operation is granted exclusive access to a specific block of file data. This ensures data consistency and controls conflicts.

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