

VERITAS Volume Manager™ 3.1 for Windows 2000

User's Guide

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VERITAS Software Corporation
350 Ellis St.
Mountain View, CA 94043
Phone 650-527-8000
Fax 650-527-2908

<http://www.veritas.com>



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This chapter presents a general introduction to Volume Manager™ 3.1 for Windows 2000 and has the following topics:

- ◆ Purpose of the Volume Manager 3.1 Release
- ◆ General Program Features
- ◆ Optional Advanced Features
- ◆ Features Introduced in Volume Manager 3.0
- ◆ Volume Manager Components
- ◆ VERITAS Enterprise Administrator Console
- ◆ Comparison of Volume Manager and Disk Management Features
- ◆ Interoperability with Other VERITAS Volume Manager for Windows Products
- ◆ Command Name Changes between Earlier Versions and Volume Manager 3.0

Purpose of the Volume Manager 3.1 Release

The primary purpose of the Volume Manager 3.1 release is to provide a Japanese version of the Volume Manager 3.0 release and to allow for bug fixes to the 3.0 release. Because there were minor changes to the VERITAS Enterprise Administrator (VEA) GUI, many of the screen captures have been updated and there is some change to the text in the documentation from the 3.0 release version of the documentation. There are also major GUI changes in the event notification feature in the Volume Manager program.



General Program Features

Volume Manager 3.1 for Windows 2000 provides a comprehensive solution to storage management in an integrated graphical view. Through the VERITAS Enterprise Administrator console, Volume Manager lets you configure and manage local and remote storage attached to your system while your system remains online.

With Volume Manager 3.1 for Windows 2000, you can do the following:

- ◆ Manage domain-wide storage from a single console.
- ◆ Create and configure software RAID while systems remain online and available.
- ◆ Optimize storage performance via online capacity monitoring and storage load balancing.

Centralized Storage Management across Entire Domain

Volume Manager provides a domain-wide view of disk storage resources for centralized storage management. The easy-to-use interface simplifies disk administration tasks, such as adding or moving storage resources or data while users are active online.

- ◆ Supports concurrent local and remote client connections to the server for browsing and update capabilities; thus, it's possible to administer online storage remotely.
- ◆ Provides asynchronous notification to all connected clients whenever any change to the storage configuration takes place.

The program also can be accessed through the Windows 2000 Computer Management window for both a local server and remote servers.

Volume Manager's Configuration Solutions

Many storage configuration tasks require taking the system offline and restarting the server, which interrupts system and data availability. Volume Manager provides a major improvement for system administrators and their users by allowing online configuration of dynamic volumes without requiring a system reboot. Volume Manager allows you to perform a wide variety of storage administration tasks while your systems remain online and your data remains available.

- ◆ Ability to configure and manage different volume layouts: concatenated, striped, mirrored, mirrored striped, and RAID-5 volumes. Supports up to 32-way mirrors on a mirrored volume.
- ◆ Automatic detection of failed disks and the ability to repair fault-tolerant volumes on those disks without interrupting applications using the volumes.

- ◆ Provides storage migration path with the ability to upgrade existing Windows NT 4 or “basic disk” partitions to the new “dynamic” volumes (volumes based on VERITAS Volume Manager technology).
- ◆ Supports and manages FT (fault-tolerant) disks and volumes previously created in a Windows NT system with Disk Administrator.
- ◆ Supports online extending of all volume types.
- ◆ Supports a cluster environment that runs under VERITAS Cluster Server software or Microsoft Cluster Service software.
- ◆ Supports mounting a volume without requiring the use of a drive letter.
- ◆ Supports moving of storage between computers with the **Import** and **Deport Dynamic Disk Group** functions.
- ◆ Command line support for administrators who prefer this method over a GUI.

Optimized System Performance Is a Priority with Volume Manager

Performance degradation occurs when a program or device uses too much disk I/O. By monitoring a system’s I/O, you can find the problem areas and eliminate areas of high activity (“hot spots”), thus ensuring smooth operation. Volume Manager’s performance monitoring utility allows you to continuously monitor and tune system performance, monitor I/O statistics, perform hot spot detection, and make adjustments.

Volume Manager can help improve overall disk and system performance in several ways:

- ◆ I/O statistics are used to identify high-traffic areas, known as “hot spots.” You can use the Volume Manager **Move Subdisk** command to resolve these hot spots online.
- ◆ Data is assigned to physical drives to evenly balance the I/O load among the disk drives. This is known as storage load balancing.
- ◆ Event logging of errors and important information is provided.



Optional Advanced Features

Volume Manager 3.1 for Windows 2000 offers the following optional advanced features:

- ◆ VERITAS FlashSnap
- ◆ Dynamic Multipathing Software
- ◆ VERITAS Volume Replicator (VVR) Support
- ◆ VERITAS Cluster Server (VCS) Support
- ◆ Microsoft Cluster Service (MSCS) Support

See the section “[Licensing for the Options](#)” on page 312 for details on which options are available with the different licensing levels of the Volume Manager product.

VERITAS FlashSnap

VERITAS FlashSnap™ is a multi-step process that allows you to create independently addressable multi-purpose volumes (MPVs) that are copies or mirrors of the volumes on your server. These MPVs can be easily moved to another server for backup or other purposes, such as loading or updating data warehouses or performing application testing with real production data while business continues. Thus, these activities can be performed without affecting the normal functions of mission-critical servers.

Even when FlashSnap is performed on the same server, its very efficient mirror breakoff and join process is much faster and takes less CPU availability than other mirror breakoff procedures that use ordinary mirroring.

FlashSnap is made possible by several new features that were first made available in Volume Manager 3.0 for Windows 2000. These features are FastResync, Snapshot commands, and Disk Group Split and Join. For details on FlashSnap, refer to “[VERITAS FlashSnap](#)” on page 313.

Dynamic Multipathing Software

The Dynamic Multipathing™ option adds fault tolerance to disk storage by making use of multiple paths between a computer and individual disks in an attached disk storage system. Disk transfers that would have failed because of a path failure are automatically rerouted to an alternate path. With Dynamic Multipathing, the VERITAS Enterprise Administrator console allows you to configure, manage, and obtain status information about these multiple paths. Dynamic Multipathing also improves performance by allowing load balancing between the multiple paths.

The major features of Dynamic Multipathing are:

- ◆ Fault tolerance

- ◆ Load balancing in Active/Active Dynamic Multipathing configurations
- ◆ Support for an unlimited number of input/output (I/O) paths
- ◆ Dynamic recovery
- ◆ Dynamic path recognition
- ◆ Selection capability for individual disks or an entire array
- ◆ Maintenance mode support

For more information about Dynamic Multipathing, refer to “[Dynamic Multipathing Software](#)” on page 347.

VERITAS Volume Replicator (VVR) Support

Volume Manager 3.1 for Windows 2000 enables dynamic volumes to work with VERITAS Volume Replicator™ (VVR). This feature was introduced in the Volume Manager 3.0 release. The Japanese version of Volume Manager 3.1 does not support VVR.

VVR is a data replication tool designed to maintain a consistent copy of application data at a remote site. It is built to contribute to an effective disaster recovery plan. In the event that the data center is down, the application data is immediately available at the remote site, and the application can be restarted at the remote site. VVR works as a fully integrated component of VERITAS Volume Manager for Windows 2000. If you choose to use this optional feature, you will not have to install it separately. It will be installed during the Volume Manager installation.

For more information on VERITAS Volume Replicator, see “[VERITAS Volume Replicator Support](#)” on page 378.

VERITAS Cluster Server (VCS) Support

Volume Manager 3.1 for Windows 2000 enables dynamic volumes to work with VERITAS Cluster Server™. This feature was introduced in the Volume Manager 3.0 release. The Japanese version of Volume Manager 3.1 does not support VCS.

With the VCS support option, VERITAS offers its Windows 2000 users an alternative to MSCS for implementing a cluster in a shared storage environment. VCS supports up to 32 interconnected servers, while MSCS supports 4 servers. VCS relies completely on network protocols to determine cluster membership. VCS can use, but does not require, a cluster quorum device, such as is used by MSCS. If you plan to use this option, the cluster hardware and the VCS software must be installed before installing Volume Manager.

For more information on VERITAS Cluster Server, see “[VERITAS Cluster Server Support](#)” on page 380.



Microsoft Cluster Service (MSCS) Support

Volume Manager 3.1 for Windows 2000 can support up to four nodes in a cluster environment set up under the Microsoft Cluster Service (MSCS) software. This optional feature requires that the cluster hardware and the MSCS software be installed before installing Volume Manager.

For more information about Microsoft Cluster Service support, refer to “[Microsoft Cluster Service Support](#)” on page 383.

Features Introduced in Volume Manager 3.0

This section describes features first introduced in VERITAS Volume Manager 3.0 for Windows 2000. These features, which are also in Volume Manager 3.1, are as follows:

◆ **New Heterogeneous GUI**

The new GUI, the VERITAS Enterprise Administrator™ console, is a heterogeneous GUI that will be used in the future by VERITAS programs on several platforms.

◆ **New Hot Spare, Hot Relocation, Undo Hot Relocation, and Hot Relocation Customization**

These features provide proactive storage management when disks fail.

- **Hot Spare**

If there are I/O errors anywhere on a disk, all healthy subdisks and subdisks of redundant volumes on that disk will automatically be moved to a designated spare disk.

- **Hot Relocation**

When a disk fails, hot relocation automatically moves all subdisks from redundant volumes on the failed disk to hot spare disks, or to free space on other disks if enough space is not available on hot spare disks.

- **Undo Hot Relocation**

This command relocates subdisks back to their repaired original disk or to a replacement disk and restores the previous volume configuration.

- **Customize Hot Relocation or Hot Spare Target Disks**

This feature allows you to specify or exclude specific disks as targets for hot spare and hot relocation operations.

◆ **Dirty Region Logging (DRL)**

The DRL feature uses a log-based recovery method to quickly resynchronize all the copies of a mirrored volume when a system is restarted following a system crash. A log can be created when a volume is created or can be added later.

◆ **RAID-5 Logging**

This feature ensures prompt recovery of a RAID-5 volume after a system crash. With RAID-5 logging, updates need to be made only to the data and parity portions of the volume that were in transit during the system crash. Thus, the entire volume does not have to be resynchronized. A log can be created when a volume is created or can be added later.



◆ **Disk Replacement**

Allows you to replace a failed disk with an empty basic disk. The volume configuration will be recreated on the new disk. The contents of non-redundant volumes are not guaranteed. Redundant volumes will be automatically resynchronized.

◆ **Disk Evacuation**

Moves the entire contents of a healthy disk to the free space on one or more dynamic disks. If the option to auto assign destination disks is selected and there is not enough space on any single disk, Volume Manager will automatically move the subdisks to any target disks with available free space. The user also has the option to manually assign destination disks. If there is a failed volume on the original disk, the volume cannot be moved and an error message will appear.

◆ **Subdisk Split, Move, and Join**

Splitting a subdisk and moving it to another location can help you make better use of disk storage. It also assists in load balancing because you can use the **Move Subdisk** command to distribute disk accesses more evenly across all disks to balance the load. The **Join Subdisk** command rejoins subdisks that were split.

◆ **Pager and Email Notification**

Several commands under the Tools menu allow you to set up and manage pager and email notification so that messages can be sent out when alerts of a certain severity occur.

◆ **FlashSnap**

VERITAS FlashSnap is a multi-step process that allows you to create independently addressable multi-purpose volumes (MPVs) that are copies or mirrors of the volumes on your server. These MPVs can be easily moved to another server for backup or other purposes, such as loading or updating data warehouses or performing application testing with real production data while business continues. Thus, these activities can be performed without affecting the normal functions of mission-critical servers.

FlashSnap is an option that can be purchased separately if you have a Volume Manager 3.0 or 3.1 Server or Advanced Server license. It is included with the Datacenter Server licensed product. FlashSnap is implemented through the following new commands:

- **FastResync (FR)**

Supports resynchronizing of mirrors by copying only changes for the temporarily split mirror by using FR logging. This will reduce the time it takes to rejoin a split mirror to the mirror set and also reduces the server CPU cycles needed to complete the resynchronization. This feature's added functionality makes the process of splitting a mirror off for tasks such as third mirror backup, data mining, and snapshots much easier to implement.

- **Snapshot Commands**

The snapshot feature enables quick and efficient online backup of volumes, with minimum disruption to the user. Snapshot automatically enables FR and creates a snapshot image of a volume, which can be detached from the volume. The detached snapshot image can be used for backup or other purposes, while the original volume remains in service. Later the snapshot image can be reattached to the original volume.

- **Dynamic Disk Group Split and Join (DGSJ)**

Supports the ability to split a dynamic disk group into two disk groups so that the newly formed disk group can be moved to another server. This allows splitting a mirror for backup and having a separate server handle the backup. After the backup is completed, the split-off disk group is moved back to the original server and joined to its former disk group, and the mirror is reassociated with its mirror set and resynchronized. DGSJ also can be done on the same server for the purposes of same-host backup or for reorganizing the disk groups on the server.

Note The FlashSnap process can be automated. VERITAS provides sample scripts to facilitate the process on the product CD.

- ◆ **SNMP Framework Support**

This feature enables Volume Manager alerts to be sent to a centralized network management framework, using SNMP.

- ◆ **VERITAS Cluster Server (VCS) Support**

Volume Manager 3.0 and 3.1 for Windows 2000 enable dynamic volumes to work with VERITAS Cluster Server. However, the Japanese version of Volume Manager 3.1 does not support VCS. With VCS, it is possible to have up to 32 interconnected servers in a shared storage environment. VCS support is an optional feature of Volume Manager.

- ◆ **VERITAS Volume Replicator (VVR) Support**

Volume Manager 3.0 and 3.1 for Windows 2000 enable dynamic volumes to work with VERITAS Volume Replicator. However, the Japanese version of Volume Manager 3.1 does not support VVR. VVR is a data replication tool designed to maintain a consistent copy of application data at a remote site. VVR support is an optional feature of Volume Manager.

- ◆ **Search and Reporting Capabilities**

The search function allows you to find specific volumes, disks, or disk groups on a large system or to get a list of volumes, disks, or disk groups meeting specified criteria. By using the search function, it is possible to generate a wide variety of reports that provide information on the disk groups, disks, and volumes on each server.



The results of these searches can be saved and imported into Microsoft Excel or any other spreadsheet application that accepts tab-delimited text files. The results can be sorted, displayed as graphs or charts, and imported into written reports or PowerPoint presentations.

Volume Manager Components

Volume Manager's software includes the following components:

Client Software

The client software includes the console and runs on Microsoft Windows 2000 Server, Advanced Server, Professional, and Datacenter Server, or XP Professional. The client enables you to configure and manage storage attached to both local and remote hosts.

Server Software

The server software, which runs on a managed node, is the common repository for all storage objects.

Providers

The providers run on a managed server. Providers are similar to drivers. Each provider manages a specific hardware or software storage component. For example, there is a disk provider that manages all disks that Windows 2000 sees as disks.

The providers discover the existing physical and logical entities and store that information in Volume Manager's distributed database. Providers update the database whenever there is a change in the physical or logical entities present in the hardware or software. For more information on providers, see the section "[Providers](#)" on page 215.



VERITAS Enterprise Administrator Console

The VERITAS Enterprise Administrator (VEA) console provides a common look-and-feel to manage and configure storage attached to local and remote servers. It communicates with the server framework to provide storage management functions.

The console contains these high-level features:

- ◆ Views to display physical and logical storage objects
- ◆ Context-sensitive menus to perform different operations related to each storage object
- ◆ Wizards and dialog boxes for ease of use
- ◆ A property page to display information related to each storage object
- ◆ An Events view to display alert notifications and system events
- ◆ A Statistics view that provides statistics on I/O activity

A full description of the console is given in “[The VEA Console](#),” Chapter 3.

Comparison of Volume Manager and Disk Management Features

The table below compares the features available in Disk Management, the disk and volume manager that comes with Windows 2000, and Volume Manager for Windows 2000. VERITAS developed Disk Management in cooperation with Microsoft. The fully featured VERITAS Volume Manager for Windows 2000 is an upgrade that replaces Disk Management, extending its capabilities.

Disk Management Features	Volume Manager Features
Basic disk partition functions: Creates, formats, and deletes primary and extended partitions, and logical drives for extended partitions.	Basic disk partition functions: Same as Disk Management.
Basic disk volume functions: Maintains basic volumes originally created in Windows NT Disk Administrator, but does not create or change them. Can repair basic mirrored and RAID-5 volumes. Also can break a mirror from a basic mirrored volume, but cannot add a mirror.	Basic disk volume functions: Same as Disk Management.
Dynamic volume functions: Creates, formats, and deletes five layout types: simple, spanned, mirrored, striped, and RAID-5.	Dynamic volume functions: Has the same five layout types plus mirrored striped volumes (RAID 1+0).
Volume limitations: Adds mirror to a simple volume only. Mirrored volume — 2 mirrors only. Spanned, striped, RAID-5 — up to 32 disks. Extends only a simple or spanned volume.	Volume limitations: Adds one or more mirrors to all volume types except RAID-5. Mirrored volume — up to 32 mirrors. Spanned, striped, RAID-5 — up to 256 disks. Extends all volume types online.



Disk Management Features

Only one dynamic disk group.

Advanced features:

MSCS support limited to having a dynamic quorum on a basic disk only.

Volume Manager Features

Multiple dynamic disk groups.

Advanced features:

MSCS support allows having a dynamic quorum on dynamic disks. It has support for up to four nodes.

VCS support allows similar features, but it includes more capabilities than MSCS support. It has support for up to 32 nodes.

Volume capacity monitoring.

Hot Spare, Hot Relocation, Undo Hot Relocation, and Hot Relocation Customization.

Dirty Region Logging.

RAID-5 Logging.

Disk Replacement.

Disk Evacuation.

Online I/O statistics monitoring and subdisk split, move, and join.

Preferred Mirror.

VERITAS FlashSnap feature.

SNMP Framework support.

VVR support.

Search and reporting capabilities.

Interoperability with Other VERITAS Volume Manager for Windows Products

This section describes the interoperability of the VERITAS Volume Manager products that run on Microsoft Windows 2000 and Windows NT 4.0. Interoperability refers to the ability of one product's client to connect over a LAN to another product's server and to what extent it can manage the disk and volume objects presented by the server.

There are four Windows products in the VERITAS Volume Manager family:

- ◆ Volume Manager for Windows 2000
- ◆ Volume Manager for Windows NT 4.0
- ◆ Windows 2000 Disk Management, or LDM (Logical Disk Manager)
- ◆ Dell OpenManage Array Manager

Windows 2000 Disk Management, which is also called LDM, is the disk and volume manager that comes with Windows 2000. VERITAS developed this product in cooperation with Microsoft. The fully featured VERITAS Volume Manager for Windows 2000 is an upgrade that replaces the LDM product, extending its capabilities. Topics in this section include:

- ◆ [Volume Manager for Windows 2000 and Volume Manager for Windows NT 4 Interoperability](#)
- ◆ [Disk and Volume Migration between VERITAS Volume Manager for Windows Products](#)



Volume Manager for Windows 2000 and Volume Manager for Windows NT 4 Interoperability

The table below indicates the interoperability of Volume Manager for Windows 2000 and Volume Manager for Windows NT.

Client	Can connect to and manage:	Cannot connect to:
Volume Manager for Windows 2000	- Dell OpenManage Array Manager 3.0, 3.1x, and 3.2 servers - Volume Manager for Windows NT server - Windows 2000 server with Disk Management (LDM)	
Volume Manager for Windows NT	- Dell OpenManage Array Manager 3.0, 3.1x, and 3.2 servers - Volume Manager for Windows 2000 server	Windows 2000 server with Disk Management (LDM)

Note If you upgrade from Dell OpenManage Array Manager to Volume Manager 3.0 or 3.1, the hardware array management capability will not be supported. Contact VERITAS Vsupport for further information on upgrading from Dell OpenManage Array Manager to Volume Manager 2.7, which supports array management.



Disk and Volume Migration between VERITAS Volume Manager for Windows Products

Disks and volumes configured on one product in the VERITAS Volume Manager for Windows product family can be migrated to another computer that is running another product in the family.

Migration from Other Products to Volume Manager 3.1 for Windows 2000

Dynamic volumes configured on all VERITAS Volume Manager for Windows products can be migrated to a system running Volume Manager 3.1 for Windows 2000. Dynamic disks with volumes on them can be migrated from systems with Dell OpenManage Array Manager 3.0, 3.1x, and 3.2, Volume Manager for Windows NT 4, and Disk Management (LDM), the default disk and volume manager in Windows 2000.

If you decide to migrate dynamic volumes from other VERITAS Volume Manager for Windows products, you may want to upgrade the version of the volumes' disk groups to the current disk group version in Volume Manager 3.0 or 3.1 for Windows 2000. The current-version disk groups in Volume Manager 3.0 or 3.1 for Windows 2000 have enhanced capabilities, such as RAID-5 logging, dirty region logging, VERITAS FlashSnap, and many other advanced features that are not available in disk groups in earlier versions of the Volume Manager for Windows 2000 and in other products in the Volume Manager for Windows family.

You do not have to upgrade the disk group version if you do not plan to use any of the new disk group features. Any disk groups upgraded to the Volume Manager 3.0 or 3.1 disk group version are not backward compatible; that is, once a disk group is upgraded to the new disk group type, it won't work properly if you try to move the disk group to another computer that is running an earlier version of Volume Manager for Windows 2000 or with another software product in the Volume Manager for Windows family.

Migration from Volume Manager for Windows 2000 and Volume Manager for Windows NT to Other Products

Volume Manager for Windows 2000 and Volume Manager for Windows NT 4 can produce and manage mirrored striped volumes, "n-way" mirrored volumes, and volumes with more than 32 columns, but the Dell OpenManage application and the Disk Management (LDM) function in Windows 2000 do not have these capabilities. Thus, it is NOT recommended that you attempt to migrate mirrored striped volumes, "n-way" mirrored volumes, or volumes with more than 32 columns to systems with the Dell OpenManage product or Windows 2000 systems that are running only Disk Management (LDM). Data corruption can occur.



As already mentioned, the disk groups in Volume Manager 3.0 or 3.1 for Windows 2000 can have a different version from those used in earlier Volume Manager for Windows products. It is not recommended that you migrate current-version Volume Manager 3.0 or 3.1 for Windows 2000 disk groups to other systems that are using earlier versions of Volume Manager for Windows products.

Command Name Changes between Earlier Versions and Volume Manager 3.0

If you have used an earlier version of Volume Manager for Windows (that is, before Volume Manager 3.0), you will notice that the names of several of the commands have changed. The table below summarizes the command name changes between earlier versions of Volume Manager for Windows programs and Volume Manager 3.0 and 3.1. The changes took effect in Volume Manager 3.0 and are carried forward in Volume Manager 3.1.

Changed Command Names in Volume Manager 3.0

Volume Manager Command from earlier versions	Volume Manager 3.0 Commands
Revert to Basic Disk	Remove Disk from Dynamic Disk Group
Upgrade to Dynamic Disk	New Dynamic Disk Group or Add Disk to Dynamic Disk Group
Upgrade to Cluster Disk	New Dynamic Disk Group or Add Disk to Dynamic Disk Group
Create Volume	New Volume or New Partition
Extend Volume	Resize Volume
Format	File System>New File System
Change Drive Letter and Path	File System>Change Drive Letter and Path
Repair RAID-5 Volume	Repair Volume
Add Mirror	Mirror>Add
Remove Mirror	Mirror>Remove
Break Mirror	Mirror>Break
Assign Preferred Plex	Set Volume Usage
Unassign Preferred Plex	Set Volume Usage





This chapter on installation covers the following topics:

- ◆ Volume Manager 3.1 Installation Requirements
- ◆ VVR Installation Requirements
- ◆ Licensing Requirements for Installation
- ◆ Access Rights
- ◆ Before Installing
- ◆ Initial Installation
- ◆ Modifying an Existing Installation
- ◆ Repairing the Installation
- ◆ Uninstalling the Product
- ◆ Upgrading from Previous Versions of the Program
- ◆ Installation Pointers for Volume Manager Options
- ◆ Starting and Exiting the Program
- ◆ Computer Management Window

Note In Volume Manager 3.1, VERITAS Cluster Server (VCS) and VERITAS Volume Replicator (VVR) are supported in the English version of the program but not in the Japanese version of the program.



Volume Manager 3.1 Installation Requirements

Installation requirements or recommendations are:

- ◆ To install the Volume Manager Client software, you must be running Windows 2000 Professional, Server, Advanced Server, or Datacenter Server, or Windows XP Professional.
- ◆ For the Volume Manager Server software, a Windows 2000 Server, Advanced Server, or Datacenter Server is required.
- ◆ Microsoft Windows 2000 Service Pack 2 or higher is required.
- ◆ 150 MB of disk space is required for the full installation if you include the optional programs. At least 10 MB of additional available disk space is needed for the proper operation of the software.

The program checks for sufficient disk space before installing.

- ◆ The minimum requirement for system memory size is 128 MB; 256 MB is recommended for optimal functioning. However, if you are using the VCS Support option, 256 MB is required.
- ◆ No minimum system processor speed.
400 MHz or faster Pentium is suggested.
- ◆ A minimum resolution of 800 x 600 pixels is required for the monitor, but a higher resolution, such as 1024 x 768 pixels, is recommended.

If you plan to use large fonts (such as those enabled by the High Contrast option in the Control Panel's Accessibility Options window), a 1024 x 768 pixels or higher screen resolution is needed to properly display the text.

- ◆ You must have administrator privileges to install this product.

VVR Installation Requirements

If you have purchased VERITAS Volume Replicator (VVR), it is installed along with Volume Manager. In addition to the Volume Manager installation requirements, the following are necessary for installation of VVR:

- ◆ 5 MB disk space is required for the full installation.
- ◆ 200 MHz or faster Pentium is required.
- ◆ For VVR, at least two systems running Volume Manager with VVR support are needed, one as Primary and the other as Secondary, with a network connection between them.



Licensing Requirements for Installation

If you install only the Volume Manager Client on a computer, no license is required. The Client can be freely used on any machine with a licensed version of either Windows 2000 or Windows XP Professional operating systems.

Note If you have a Windows 2000 Professional or a Windows XP Professional system, the Volume Manager Client is the only component of the Volume Manager software that you can install on that machine.

The Volume Manager licensing is based on the Microsoft Windows 2000 operating system in use on a specific server. The Volume Manager license you purchase—Server, Advanced Server, or Datacenter Server—allows installation on a machine with the matching version of the Windows 2000 operating system or a machine with a lower version of the Windows 2000 operating system.

For each Windows 2000 Server or Windows 2000 Advanced Server License authorized, you may install and use a single copy of the software for each instance of the operating system on a single server. For each Windows 2000 Datacenter Server License, you may install multiple instances of the software on a single server.

Note Licensing requirements are subject to change. Please refer to the Volume Manager 3.1 for Windows Readme file for the most updated licensing information at the time of product release.

For more information on what features are available in the different server versions, see the section “[Features Available for the Different License Levels](#)” on page 209.

Access Rights

Volume Manager uses the standard Microsoft Windows 2000 access rights. These govern the access rights of a user to the Volume Manager server and services. By default, an administrator has the right to load and unload device drivers; this access right is required to install and uninstall Volume Manager.

Administrator rights are required to access and use the program. Normal users are not given access, because they might inadvertently change a storage configuration and cause a loss of data on the system.

As an administrator, you will need to grant these same access rights to other Volume Manager users. You can grant these rights in the Local Users and Groups function under Computer Management in the Windows 2000 Administrative Tools. For more information, see the Microsoft Windows 2000 documentation.



Before proceeding, you should exit all Microsoft Windows 2000 programs and log on with administrator rights.

Before Installing

1. Read the Readme file and Release Notes. These contain important information about software versions, platforms, and compatibility, plus important information about Volume Manager.
2. Exit all running applications before running the Volume Manager Setup program.
3. Only one instance of Volume Manager should be running on a computer at a time. If you have a previous version of Volume Manager already installed, uninstall it before installing Volume Manager 3.1 for Windows 2000. The exceptions are Volume Manager 2.7 and 3.0, which can be upgraded without uninstalling.
4. If you are installing any options (such as DMP, MSCS support, VCS support, or VVR), see the section “[Installation Pointers for Volume Manager Options](#)” on page 33 before installing Volume Manager.
5. If you are upgrading from a previous version of a Volume Manager for Windows program, see the section “[Upgrading from Previous Versions of the Program](#)” on page 32 before installing.

Initial Installation

Note If you plan to use Volume Manager cluster disk groups with VCS or MSCS, make sure that VCS or MSCS is running on the target system when you install Volume Manager 3.1 for Windows 2000. The VCS or MSCS support can be installed later by using the Volume Manager Modify install procedure, but you still must install VCS or MSCS first before installing the desired support option.

1. To begin the installation, double-click on **launch.exe** in the root directory of the Volume Manager 3.1 for Windows 2000 program CD. After a short delay, the VERITAS Volume Manager 3.1 InstallShield wizard appears.
2. In the popup window that appears indicating that the VERITAS Enterprise Administrator will be installed before Volume Manager 3.1 is installed, click **Yes** to continue.
3. Click **Next** to continue in the installation wizard.
4. When a message appears about the VEA language pack being installed, click **OK** to remove the message from the screen.
The Setup Type screen appears.
5. Choose an installation setup type and click **Next**.
 - **Client**
Installs only the client. No license key is required for this type of installation.
 - **Client with Remote Cluster Support**
Installs the client and Remote Cluster Support. No license key is required for this type of installation.
 - **Server**
Installs the client, the server, and any additional features the license key will permit. A valid license key is required for this type of installation.
6. In the Customer Information screen that appears next, make sure that your name and company are entered.
If you chose the Server, enter your license key.
Click **Next**.



7. The window that appears next depends on the installation setup type you selected.
 - If you chose the Client, the Destination Folder screen comes up to give you the option to change the installation path. Click **Next** to confirm the default path or click the **Change** button and browse to the desired destination folder and click **OK** and then **Next**.
 - If you chose the Client with Remote Cluster Support, the next screen asks you to enter the name of the cluster to be remotely managed and click **Next**. Then the Destination Folder screen appears. After indicating the appropriate folder for the installation path, click **Next**.
 - If you chose the Server, the Custom Setup screen appears next. The server features available are dependent on the type of license purchased. Unavailable features will be designated by a red X in the box to the left of the feature name. The possible features are:
 - Volume Manager 3.1 DMP Support
 - Volume Manager 3.1 MSCS Support
 - Volume Manager 3.1 VVR Support
 - Volume Manager 3.1 VCS Support

Available features will be installed. To choose not to install an available feature, click the drop-down arrow to the left of its name, and select "This feature will not be available."

Note If you do not have a license for a feature that requires one, it will not be installed.

The Custom Setup screen also provides the option to change the installation path. Click on "Volume Manager Server," and then use the **Change** button to install to a different folder.

After you indicate the features to be installed, click the **Space** button to view the installation space requirements and the space available and remaining on each of the server's drives if the installation files were to be placed on that drive.

When you are finished selecting features and satisfied with the installation path, click **Next**.

8. The Ready to Install the Program screen appears. Click **Install** to install the program.
A screen appears indicating that the program is installing.
9. The Online Registration wizard starts. Click **Next** to continue with online registration, or **Cancel** to continue with the installation and register later.



10. When the installation finishes, a screen appears, indicating that the installation was successful. Click **Finish** to exit the installer.
11. At the dialog box asking you to reboot your computer, click **Yes** to reboot now. You will not have to reboot the computer when you install the client software.

You may be asked to reboot a second time if your computer already has dynamic boot or system volumes that were active in Disk Management, Microsoft's built-in disk and volume manager. Volume Manager for Windows can manage dynamic volumes that were created in the Disk Management program.

Note If you have a cluster system with VCS or MSCS installed but the VCS or MSCS program was not running at the time of Volume Manager installation, Volume Manager will not install the cluster support. You must make sure VCS or MSCS is running and then use the Modify installation procedure described in the next section. Be sure to select VCS or MSCS Support in the Custom Setup screen.



Modifying an Existing Installation

The Volume Manager 3.1 for Windows installation engine allows the user to add or remove specific components.

▼ **To modify an existing installation:**

1. Enter the system's Control Panel.

This can be done through the Start menu. Select **Start>Settings>Control Panel**.

2. Double-click **Add/Remove Programs**.

A list of installed products appears, one of which will be Volume Manager 3.1.

3. Click to select **VERITAS Volume Manager 3.1**.

4. Click the **Change** button corresponding to the Volume Manager 3.1 installation.

A dialog box comes up with three options:

- **Modify**
- **Repair**
- **Remove**

5. To modify the existing installation, select **Modify** and click **Next** to continue.

6. The Setup Type screen appears. Select an installation setup type and click **Next**.

- **Client**

Installs only the client. No license key is required for this type of installation.

- **Client with Remote Cluster Support**

Installs the client and Remote Cluster Support. No license key is required for this type of installation.

- **Server**

Installs the client, the server, and any additional features the license key will permit. A valid license key is required for this type of installation. You will need to enter this license key in a later screen.

7. In the Customer Information screen that appears next, do the following:

- a. Make sure that your name and company are entered.
- b. If you are installing the server or a server license option (like FlashSnap):



- Click the **License Upgrade** button.
 - Enter the license key (serial number) for the additional component in the screen that comes up.
- c. Click **Next** to continue.
8. If you chose the Client with Remote Cluster Support installation type, enter the cluster name in the screen that appears and click **Next**.
9. If you chose the Server installation type, the Custom Setup screen appears. Choose the features you wish to install. The features are:
- Volume Manager 3.1 DMP Support
 - Volume Manager 3.1 MSCS Support
 - Volume Manager 3.1 VVR Support
 - Volume Manager 3.1 VCS Support

To choose a feature, click the drop-down arrow to the left of its name, and then select "This feature will be installed on local hard drive."

To choose not to install a feature, click the drop-down arrow to the left of its name, then select "This feature will not be available."

Note If you do not have a license for a feature that requires one, it will not be installed.

When you are finished selecting features, click **Next**.

10. The Ready to Modify the Program screen appears. Click **Install** to modify the program.
11. A screen appears showing the progress of the program modification.
- When it is completed, a screen appears, indicating that the installation was successful. Click **Finish** to exit the wizard.
12. A dialog box appears, asking you to reboot your computer. Click **Yes** to reboot now.



Repairing the Installation

If the installation fails to properly install the product or there are errors when you start to use the product, a repair of the existing installation may resolve the situation.

▼ To repair your installation:

1. Enter the system's Control Panel, using the Start menu.
2. Double-click **Add/Remove Programs**.
A list of installed products appears, one of which will be Volume Manager 3.1.
3. Click to select **VERITAS Volume Manager 3.1**.
4. Click the **Change** button corresponding to the Volume Manager 3.1 installation.
A dialog box comes up with three options:
 - **Modify**
 - **Repair**
 - **Remove**

5. Select the **Repair** option and click **Next**.

6. Click **Install**.

The installer engine will now reinstall the product with the options that you selected during the initial install (such as install type and installation path).

7. Click **Finish**.

8. Reboot the system when prompted.

After the reboot, attempt to use the application again. If problems still persist, please contact VERITAS Support at:

<http://support.veritas.com>

Uninstalling the Product

▼ To uninstall Volume Manager 3.1 for Windows 2000:

1. Select **Start>Settings>Control Panel**.
2. Double-click **Add/Remove Programs**.
A list of installed products appears.
3. Select **VERITAS Volume Manager 3.1** and click the **Remove** button.
4. On the screen that appears, select the **Remove** option and click **Next** to continue.
5. A confirmation screen will appear; click **Remove** to remove the program.
6. When the uninstall process finishes, a screen appears, indicating that the program was successfully uninstalled. Click **Finish** to exit the installer.
7. After uninstalling Volume Manager, you will need to reboot so that the default Windows Disk Management utility will become active. Click **Yes** to reboot your computer.



Upgrading from Previous Versions of the Program

This section summarizes the instructions for upgrading to Volume Manager 3.1 for Windows 2000 from previous versions of the program, as well as from Volume Manager for Windows NT.

- ◆ If you have Volume Manager 2.7 or 3.0 for Windows 2000 installed, do not uninstall it. Run the Volume Manager 3.1 installation, which will upgrade the Volume Manager 2.7 or 3.0 program to the 3.1 version.
- ◆ If you have another version of Volume Manager for Windows installed, uninstall the older version of Volume Manager and then install Volume Manager 3.1. Your dynamic volumes will be preserved. However, if you have DMP set up on your computer, see the section [“Upgrading Volume Manager with a Previous DMP Installation”](#) on page 34 for steps that need to be done before uninstalling.
- ◆ Additional Pointers
 - If you are upgrading and have existing disk group names that are longer than the 18-character limit that was put in effect with Volume Manager 3.0, you will be asked to shorten the name when the disk group is used in a disk group command. It is possible that you will be asked to shorten the name to fewer than 18 characters if the disk group’s volumes also have very long names.
 - If you are upgrading from Volume Manager 2.7 or earlier versions of Volume Manager for Windows 2000 or Volume Manager for Windows NT and you have dynamic volumes already existing on your system, you may need to reboot twice because of a problem with Microsoft’s PNP mechanism. This happens only occasionally.
 - If you upgrade from Dell OpenManage Array Manager to Volume Manager 3.0 or 3.1, the hardware array management capability will not be supported. Contact VERITAS Vsupport for further information on upgrading from Dell OpenManage Array Manager to Volume Manager 2.7, which supports array management.



Installation Pointers for Volume Manager Options

This section describes installation pointers for installing DMP, MSCS support, VCS support, or VVR along with Volume Manager. Topics include:

- ◆ [DMP Installation](#)
- ◆ [MSCS or VCS Support Installation](#)
- ◆ [Cluster Setup with VCS or MSCS and DMP](#)
- ◆ [VVR Installation](#)

DMP Installation

This section on DMP installation pointers has these two topics:

- ◆ [General Setup for DMP](#)
- ◆ [Upgrading Volume Manager with a Previous DMP Installation](#)

General Setup for DMP

The Dynamic Multipathing option adds fault tolerance to disk storage by making use of multiple paths between a computer and the disks in a storage array. A path is the connection between the computer and the storage array's disks and consists of a host adapter and a SCSI bus connection to one or more SCSI disks or a fiber optic channel connected to a hub or switch. Thus, multiple paths are made possible by connecting two or more host bus adapters with either SCSI or fiber optic cabling to the storage array.

Make sure that your host is equipped with the following:

- ◆ One host bus adapter for each path to the disk array
For example, if the array has two paths to each disk, two host bus adapters are needed. If your array has three paths to each disk, three host bus adapters are needed.
- ◆ One SCSI or fiber cable for each host bus adapter

Each host bus adapter must have a unique SCSI ID assigned to it. You cannot change the cable connection order after Volume Manager has been installed. For example, if host bus adapter A is connected to port A on the array and host bus adapter B is connected to port B on the array, you cannot swap the connections between ports on the array (A to B and B to A).

It is recommended that you connect only one of the host adapters to the array before installing Volume Manager and DMP. Once DMP is installed, then you should include the array (see "Including an Entire Array under DMP Control" on page 355). Then you should connect any additional host adapters.



If you have any questions on how to install a specific hardware item, refer to the documentation for that disk, host adapter, or array.

Upgrading Volume Manager with a Previous DMP Installation

If you are upgrading to the current version of Volume Manager and you already have a previous installation of DMP set up on your computer system, you need to take certain steps before performing the upgrade. Uninstalling a Volume Manager program with DMP set up to manage dual paths can lead to data corruption if it is not done according to the steps given below:

- ◆ If you have Volume Manager 2.7 or 3.0 installed, do not uninstall it. Run the Volume Manager 3.1 installation, which will upgrade the Volume Manager 2.7 or 3.0 program to the 3.1 version. Be sure to select the DMP option during the install.
- ◆ If you have another version of Volume Manager for Windows and DMP installed, you must do the following steps to protect your data before uninstalling the older version of the program:
 - a. Using the VEA GUI, exclude each dual-path array from DMP management.
 - b. Physically remove one path from each dual-path array, so each array can be accessed by a single path.
 - c. Rescan.

Now you can uninstall the older version of Volume Manager and install Volume Manager 3.1.

Once the new program is installed, restore multipath protection to each dual-path array with the following steps:

- a. Include each array that will have a dual path under DMP management.
- b. Physically connect any second paths that were disconnected previously.
- c. Rescan.

MSCS or VCS Support Installation

MSCS or VCS has to be running for Volume Manager to install the cluster support option. If you want to add MSCS or VCS to your system at a later date, you can install it and then use the Modify option under the Volume Manager Installation to add the MSCS or VCS

support to the Volume Manager program. See the sections “Microsoft Cluster Service Support” on page 383 and “VERITAS Cluster Server Support” on page 380 for more information on how Volume Manager works with MSCS and VCS.

Cluster Setup with VCS or MSCS and DMP

To support VCS or MSCS and DMP simultaneously on a cluster, you must adhere to the following setup requirements.

Caution Failure to follow these requirements will result in disk signature discrepancies, causing MSCS or VCS or other applications to fail.

Installing MSCS or VCS and DMP for the First Time on a Cluster

1. Install MSCS or VCS with only one path to the disk array.
2. Do not create any new resources at this time.
3. Install Volume Manager, and then reboot the system.
4. Install DMP, and then reboot the system.
5. Using the DMP GUI, include the disk array.
6. Attach the additional paths to the disk array, and then do a rescan.
7. Repeat the above steps for other nodes.

Installing DMP on an Existing MSCS or VCS Cluster

1. Move resources to another node or take the resources offline.
2. Install additional hardware, but attach only one path to the disk array.
3. Install DMP, and then reboot the system.
4. Using the DMP GUI, include the disk array.
5. Attach the second path to the disk array, and then do a rescan.
6. Repeat the above procedure for other nodes.



Installing MSCS or VCS on an Existing DMP Setup

1. Using the DMP GUI, verify that the array is included.
2. Install MSCS or VCS.
3. Repeat the above steps for other nodes.

Caution Before connecting additional data paths to shared storage, make sure that you place the array under the control of DMP. Attaching a second path and using storage that is not under DMP control can lead to unpredictable operating system behavior and data corruption.

VVR Installation

If you have purchased the VVR program, it will be installed when Volume Manager is installed. You need to select it as an option during the Volume Manager installation. After Volume Manager is installed, configure VVR setup on your systems according to the directions in the VVR documentation. After setting up VVR on your systems, refer to the section “[VERITAS Volume Replicator Support](#)” on page 378 for the steps to integrate VVR with Volume Manager.

Starting and Exiting the Program

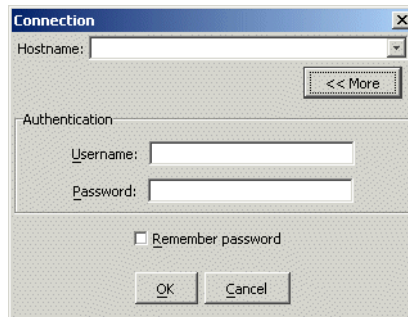
This section describes the procedures for starting and ending the program.

▼ To start the program:

1. Select **Start>Programs>VERITAS Enterprise Administrator**.

The VERITAS Enterprise Administrator console comes up, the Volume Manager program is activated, and the Connection dialog box is displayed.

2. Click the **More** button to expand the Connection dialog box.



3. Enter the name of the server you wish to connect to, or select it from the drop-down menu. Enter your user name and password.

Select the “Remember password” checkbox to save the user name and password you enter.

4. Click **OK** to connect.

Note The Connection dialog box is also used to connect to remote servers from within the VEA console. You can access the dialog box by selecting **Connect** from the File menu or by clicking on the first tool on the toolbar, the small computer icon with a green checkmark. For more on connecting to remote servers, see “[Remote System Management](#)” on page 218.

▼ To exit the program:

Select **Exit** from the File menu or click in the close box in the upper right corner of the VEA console.



Computer Management Window

If you prefer, you can access Volume Manager for Windows 2000 through the Windows 2000 Computer Management window. In this window, Volume Manager is available as one of the computer management programs or utilities provided in one convenient spot for system administrators.

▼ **To start Volume Manager and the VEA console through the Computer Management window:**

1. From the Start menu, select **Start>Programs>Administrative Tools>Computer Management**.

The Computer Management window appears.

2. In the tree view of the left pane of the window, click to select **VERITAS Enterprise Administrator**.

It is located under the Volume Management node, which is in the Storage folder.

The VERITAS Enterprise Administrator console comes up, and the Volume Manager program is activated with the Connection dialog box displayed.

3. Click the **More** button to expand the dialog box.
4. Enter the host name of the server you wish to connect to and your user name and password.
Select the “Remember password” checkbox to save the password on your computer.
Click **OK** to connect.

Note You can also access the Computer Management window by right-clicking the My Computer icon and selecting **Manage** from the context menu that appears.

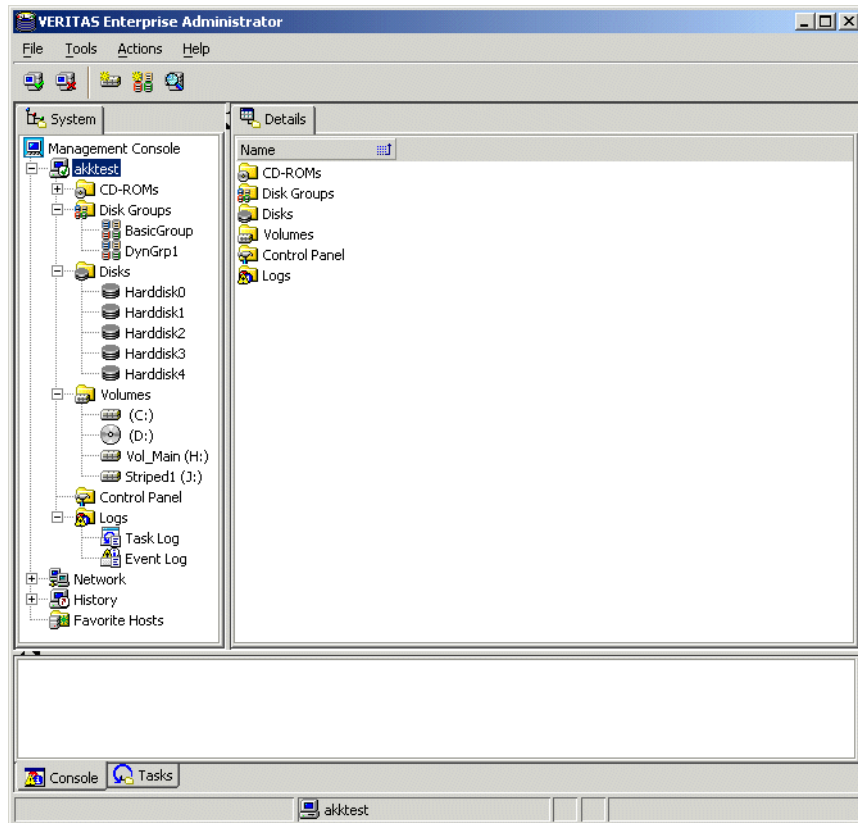
This chapter describes the features of the VERITAS Enterprise Administrator (VEA) console. The VEA console was first introduced in Volume Manager 3.0. The chapter's topics are:

- ◆ Overview of Console Features
- ◆ Viewing Disks and Volumes
- ◆ The Left Pane
- ◆ The Right Pane
- ◆ The Lower Pane
- ◆ The Toolbar
- ◆ Enhanced Disk View
- ◆ Control Panel
- ◆ Event Log
- ◆ Search
- ◆ Accessibility



Overview of Console Features

The VEA console provides a graphical way to view and manipulate all the storage objects in your system. You can customize the display to suit your preferences by customizing the table headers. The VEA console display for Volume Manager for Windows storage objects is shown in the sample screen that follows.



The VEA console display has the following features:

- ◆ A tree view displaying the storage objects in the left pane of the window
- ◆ Tabbed views in the right pane of the window containing additional information on the storage objects
- ◆ A menu bar and a toolbar
- ◆ A lower pane containing information on processes initiated by the program or a listing of alert messages

Viewing Disks and Volumes

You will use the VEA console primarily to view disks and volumes and their relationship with each other.

Viewing All Disks Associated with a Volume

1. In the left pane, click the desired volume icon.

If the volume icon is not displayed because the tree view is not fully expanded, click the plus sign in front of the computer icon at the top of the tree and/or the plus sign in front of the Volumes icon.

2. If necessary, in the right pane of the console window, select the Disks tab.

The Disks tab view will now show the disk or disks associated with that volume.

Viewing All Volumes Associated with a Disk

1. In the left pane, click the desired disk.

If the disk icon is not displayed because the tree view is not fully expanded, click the plus sign in front of the computer icon at the top of the tree and/or the plus sign in front of the Disks icon.

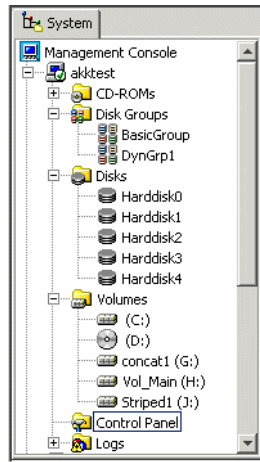
2. If necessary, in the right pane of the console window, select the Volumes tab.

The Volumes tab view will now show all the volumes that are on that disk.



The Left Pane

The left pane shows a tree view of the storage objects detected by the Volume Manager software. The tree view displays the hierarchical relationships of the storage objects. The Management Console node at the top of the tree represents Volume Manager's management console. The first level of objects under the Management Console node are the managed server objects for the servers the Volume Manager client is connected to and managing. You can have multiple server icons at this level. In the screen below, there is one managed server node, representing a server named "akktest."



Below each managed server icon are the following default object categories:

- ◆ CD-ROMs
- ◆ Disk Groups
- ◆ Disks
- ◆ Volumes
- ◆ Control Panel
- ◆ Logs

In addition, if the Volume Manager server software on a computer you are managing supports it, an **Arrays** permanent category is also shown. For your convenience, the tree view also displays:

- ◆ Network
- ◆ History
- ◆ Favorite Hosts

The tree view can be expanded by clicking on a plus sign (+) in front of an object icon. When the tree view is fully expanded, all the objects have a minus (-) sign in front of them. By clicking on a minus sign at any level, you can collapse an object down to that level. The fully collapsed tree shows only the top-level object, which is the computer icon.

Right-clicking on an object in the tree view brings up a context menu that is appropriate to that object.

The topics below give additional information on the storage object categories under each managed server node.

CD-ROMs

Any CD-ROM drives recognized by Volume Manager as existing on the computer you are managing.

Disk Groups

A disk group is a grouping of disks within Volume Manager. The two types of disk groups are basic and dynamic.

For more information, see “[Disk Groups](#)” on page 93.

Disks

Disks are physical disks or logical disks recognized by the Windows 2000 operating system.

Volumes

A volume is a logical entity that is made up of portions of one or more physical disks. A volume can be formatted with a file system and can be accessed by a drive letter or a mount point. Volume Manager works with basic and dynamic volumes.

For more information, see “[Basic and Dynamic Volumes](#)” on page 87.

Control Panel

The Control Panel allows you to access settings for Capacity Monitoring, the Event Log, Historical Statistics, Hot Relocation, Rule Management, the Task Log, and Task Throttling.

For more information, see “[Control Panel](#)” on page 61.



Logs

The Logs node on the tree contains two subordinate objects, the Task Log and the Event Log. When you select either Log object in the left pane, the corresponding log displays in the right pane.

- ◆ The Task Log is a listing of tasks, such as formatting a volume or resynchronization of a volume. In Volume Manager 3.1, the Task Log is not implemented.
- ◆ The Event Log list events pertaining to the Volume Manager activity.

For more on the Event Log, see “[Event Log](#)” on page 185.

Arrays

You will see the **Arrays** storage object in the tree view only when you remotely connect to a server that has the Dell OpenManage Array Manager product, which supports hardware RAID arrays. If you are running only Volume Manager 3.1 for Windows 2000 on your local or remote server, you will not see the Arrays storage object in the tree view.

Because the Dell OpenManage Array Manager product was codeveloped by VERITAS and Dell, the two products share a similar dynamic volume functionality; but Volume Manager for Windows has more advanced features. When you connect to a server running the Dell OpenManage Array Manager, a popup window appears, asking whether you want to use the Volume Manager 2.7 GUI to manage the server. In order to connect to the other server, you must click **Yes** in the popup window, and then the VEA GUI is replaced with the Volume Manager 2.7 GUI. The Volume Manager 2.7 GUI must be used to manage the server, because the Volume Manager 2.7 GUI commands are more compatible with the current versions of the Dell program.

The Arrays storage object and the subordinate objects beneath it represent the physical and logical aspects of a hardware RAID storage array. For details on the Arrays storage object, refer to the Dell OpenManage Array Manager documentation.

Currently, there is an upgrade from the Dell OpenManage Array Manager program to Volume Manager 2.7, but there is not a similar upgrade path to Volume Manager 3.0 or 3.1. An upgrade for the Dell product to the most current version of Volume Manager for Windows 2000 is expected in a future release.

Network

This node shows other computers in the network that are currently available. You can refresh this view by right-clicking on the Network icon to bring up the **Refresh** command.

History

Volume Manager uses **History** to list the most recent connections made. The default is to show the 10 most recent connections. Follow these steps to change the number of connections shown:

1. Select **Preferences** from the **Tools** menu.
2. Select the General tab.
3. In the “History settings” section, change the number of items in history to the desired number.
4. Click **Apply** and then **OK**.

Favorite Hosts

This node allows you to compile a list of frequently used hosts and to have them be automatically connected at Volume Manager startup. If you are not a domain administrator, you may be asked for a user name and password. To add a host to the Favorite Hosts list, right-click on the desired host from either the main node for that host or the host listing in the History list. Select **Add to Favorites** from the context menu.



The Right Pane

The right pane provides information on the various storage objects. The tabs available in this pane are determined by the object you have selected in the tree view in the left pane. In each tab view, you can right-click to get a context menu of commands available in that view. In every view, you can widen or narrow columns by placing the mouse pointer on the border between two columns in the header row and moving the mouse to the left or right while holding down the mouse button.

This section focuses on how information about disks and volumes managed by Volume Manager displays in the right pane. It contains these topics:

- ◆ [Right-Pane Display for Disks and Volumes](#)
- ◆ [Disk View Tab](#)
- ◆ [Right-Pane Legends](#)
- ◆ [Customizing the Table Headers](#)

For right-pane display of the Control Panel, the Event Log, and Search storage objects, see the following sections: “[Control Panel](#)” on page 61, “[Event Log](#)” on page 66, and “[Search](#)” on page 67.

Right-Pane Display for Disks and Volumes

This section describes how the tabbed views change, depending on the disk and volume storage objects you select.

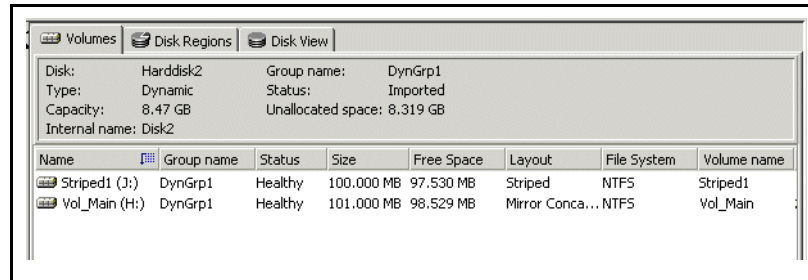
Selecting All Disks

In the tree view in the left pane of the VEA console, if you select all disks by clicking the Disks folder, the right-pane view will display tabbed views for Disks and Disk View. The Disks tab shows information about the disks available on the selected server, as shown in the sample screen below. The Disk View tab uses a graphical format to show information about the volumes contained on each disk. For more information on the Disk View tab, see the section “[Disk View Tab](#)” on page 49.

Device	Internal name	Group name	Status	Size	Type	% Used	Spare	Reserved
Harddisk0	-	-	Online	8.472 GB	Basic	47%	No	No
Harddisk1	Disk1	DynGrp1	Imported	8.472 GB	Dynamic	0%	No	No
Harddisk2	Disk2	DynGrp1	Imported	8.472 GB	Dynamic	1%	No	No
Harddisk3	Disk3	DynGrp1	Imported	4.236 GB	Dynamic	4%	No	No
Harddisk4	-	-	Online	4.236 GB	Basic	0%	No	No

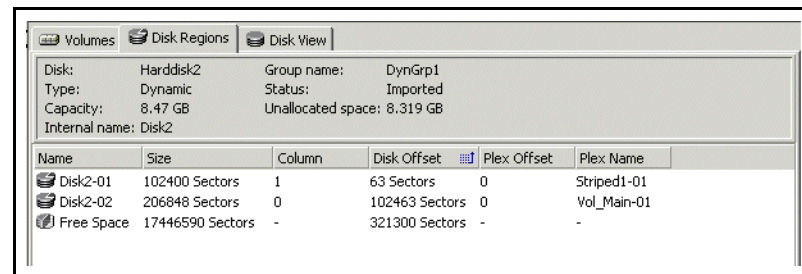
Selecting an Individual Disk

If you select an individual disk in the tree view, you will see a display similar to the sample screen below. Notice that the tabs have now changed to Volumes, Disk Regions, and Disk View. The Volumes tab gives information about the volumes on the selected disk.



Viewing Subdisks

If you click the Disk Regions tab, you will see all the subdisks or parts of a volume that reside on the disk, as well as any free regions on that disk. In the screen below, there are two subdisks.



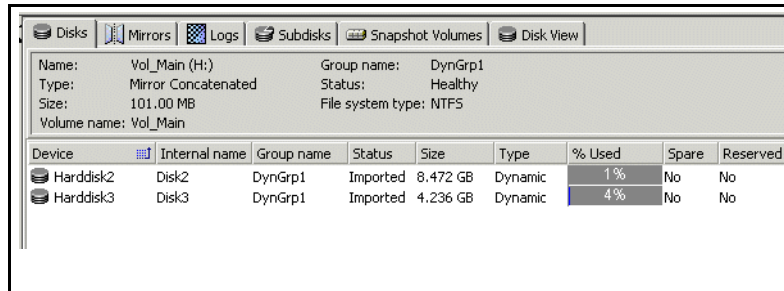
Every volume has at least one subdisk. A striped volume has a minimum of two subdisks. A RAID-5 volume has a minimum of three subdisks. A mirrored volume has as many subdisks as there are mirrors.

Note There are no subdisk storage objects in the left-pane tree view. You must access the subdisks through the right pane. You will have to click on an individual disk in the left pane to gain access to the Disk Regions tab.



Selecting Volumes

If you select all volumes by highlighting the Volumes folder in the tree view, the right pane has two tabs: Volumes and Disk View. When you select an individual dynamic volume in the tree view, you will see a right-pane view similar to the screen below. Notice how selecting an individual volume makes available many more tabbed views.



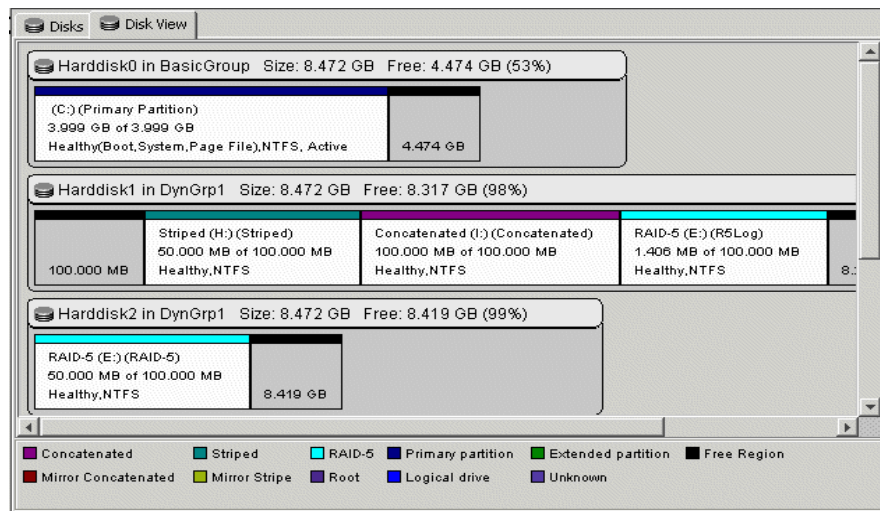
A dynamic volume has the following tabbed views:

Disks	Displays information about the disks in the volume.
Mirrors	Details the mirrors in the volume. For more information on mirroring, see “More on Mirrored Volumes” on page 154.
Logs	Shows any logs that are added to a volume to increase the speed of resynchronizing mirrored or RAID-5 volumes after disk failures. For more information on logging see “Dirty Region Logging (DRL) and RAID-5 Logging” on page 259.
Subdisks	Lists the subdisks associated with the volume. For more information on subdisks, see “Subdisks” on page 97.
Snapshot Volumes	Gives information on snapshots, which are mirrored volumes that have been broken off from their original volume for backup or other purposes. This tab appears only when you have created snapshot volumes. See “Snapshot Commands” on page 324.
Disk View	A detailed view of the disks associated with the volume. For more information, see “Disk View Tab” on page 49.
Alerts	Displays information about the alerts. This tab appears only when an event has occurred that generates an alert.

A volume that is not dynamic, such as a partition on your C drive, will not have multiple tabs. It will display only the Disks and Disk View tabs.

Disk View Tab

The **Disk View** tab displays a graphical layout of the disks on your system, including removable media. As with the tree view, right-clicking on an object or portion of the window relating to an object brings up a context menu that has commands related to the object.

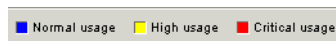


The Disk View is also available as a separate window. For a full explanation of all the features of the Disk View, see the section “[Enhanced Disk View](#)” on page 53.

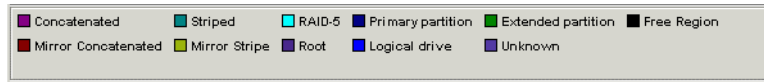
Right-Pane Legends

The legend, located at the bottom of the right pane, is context sensitive and will change depending on the tab selected in the right pane. The legend shows either disk usage or the volume type.

When the Disks, Subdisks, or Disk Regions tab is selected, the disk usage legend shows how to interpret symbols showing the level of I/O activity (Normal, High, or Critical) in each area. The usage legend is shown below:



The legend shown in the Disk View or with the Disk View tab selected shows the volume or partition type. The colors represent the following layout characteristics: concatenated, striped, RAID-5, primary partition, extended partition, free space, mirror concatenated, mirror stripe, root, logical drive, and unknown. The Disk View legend is shown below:

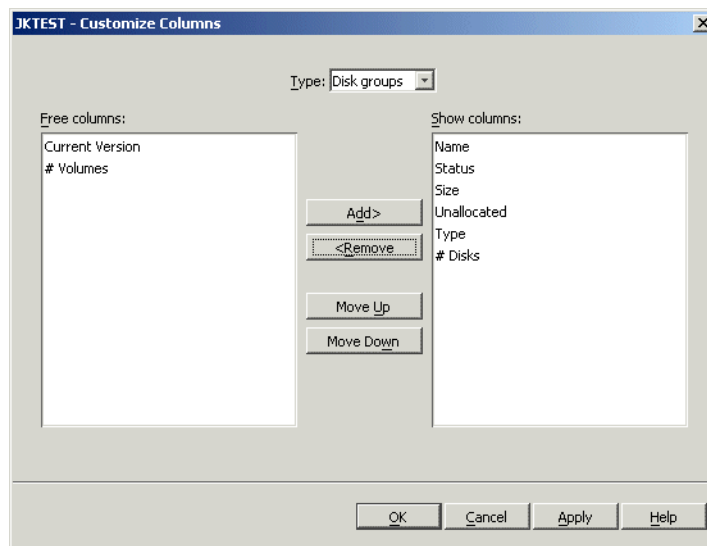


Customizing the Table Headers

The Customize Columns window allows you to customize the table headers by changing which columns are shown and in what order.

▼ To customize the table headers:

1. Either right-click on the column headers or click on the **Tools** menu.
2. Select **Customize Table Header**. The Customize Columns window appears.



3. Select the column type in the Type drop-down list. The available headers of that type will display in the dialog.

Columns shown in the “Free columns” box will not be displayed in the right pane of the console.

4. Make the desired changes to the column headers.
 - To add a column header, select it in the “Free columns” box and click the **Add** button.
 - To remove a column header, select it in the “Show columns” box and click the **Remove** button.
 - To rearrange the sequence of the headers, select the header you wish to move in the “Show columns” box and use the **Move Up** and **Move Down** buttons to move it within the list.
5. Click the **Apply** button to apply the settings. Only the headers you selected will display in the right pane. The column headers will display in the order you selected in the “Show columns” box.



The Lower Pane

In this new section, you can toggle the display by clicking on either the Console tab or the Tasks tab at the bottom left corner. The default Console tab display shows Volume Manager alerts. The Tasks tab shows progress on Volume Manager tasks, such as formatting a volume. The name of the selected managed server is displayed in the bottom center. This is helpful if you have connected to multiple servers with Volume Manager.

The Toolbar

The toolbar provides quick access for performing some of the program's most common tasks.



The toolbar has the following tools:

	Connect	Brings up the Connection dialog box.
	Disconnect	Disconnects from selected machine.
	New Volume	Brings up the New Volume Wizard.
	New Dynamic Disk Group	Brings up the New Dynamic Disk Group Wizard.
	Search Tool	Searches by specific criteria for volumes, disks or disk groups.

Enhanced Disk View

This section describes the Disk View. The section's topics are:

- ◆ Disk View Overview
- ◆ Refresh View
- ◆ Print
- ◆ Show Legend
- ◆ Options for Graphical Views
- ◆ Collapsed and Expanded Views
- ◆ Vol Details View
- ◆ Full Volume Display
- ◆ Projection
- ◆ Context Menu Available from Disk View

Disk View Overview

Volume Manager 3.0 for Windows 2000 introduced a new, expanded Disk View. It is the same Disk View that is used in the Volume Manager for UNIX GUI.

The Disk View can be accessed in two ways:

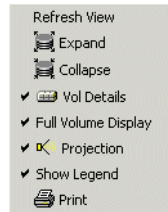
- ◆ Select the Disk View tab in the right pane.
- ◆ Right-click on an object (disk group, disk, or volume) in the tree view pane, and select **Disk View** from the context menu that appears.

The same commands are available in both views. The Disk View available from the tree view context menu opens a separate window that can remain open as you continue to work in Volume Manager. Additionally, you can use the Ctrl key to select only the specific objects (disks, volumes, or disk groups) you wish to include in the separate disk view. This feature is helpful if you have a very large number of disks or volumes.

The commands in Disk View include **Refresh View**, **Print**, **Show Legend**, and five options for different views of the selected disks: **Expand**, **Collapse**, **Vol Details**, **Full Volume Display**, and **Projection**. These commands are available from several different places.

From the Disk View tab in the right pane, right-click in an empty space (right-click on any area of the pane where there is not a graphical representation of a disk), and a context menu containing the commands will appear as shown in the screen that follows.





If you have created a separate window by selecting Disk View from the context menu, these commands can be accessed by right-clicking in an empty space (right-clicking on any area of the pane where there is not a graphical representation of a disk), by clicking the **Options** or **File** menu on the menu bar, or by clicking on icons on the toolbar.

Refresh View

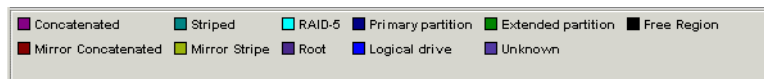
The **Refresh View** command found in the Disk View menu will update the Disk View only and ensure that any recent changes are represented accurately.

Print

The **Print** command sends your current Disk View display to a selected printer. It may be convenient to have a hard copy of your disk configuration, especially if you are working with a large number of disks.

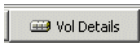
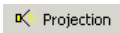
Show Legend

The legend is located at the bottom of the Disk View. The **Show Legend** command toggles the Disk View legend on and off. If you are working with a large number of disks, you may wish to turn the legend off to gain additional space in the window. Each volume type or partition type is assigned a color. The legend shows the color-coding scheme. When the **Vol Details** command is selected, there is a colored bar across the top of each subdisk that indicates its volume type.



Options for Graphical Views

There are five options for different views of the selected disks: **Collapse**, **Expand**, **Vol Details**, **Projection**, and **Full Volume Display**. The table below shows the buttons available for these commands and for the print function. The toolbar containing these buttons is displayed only in the separate Disk View window and not in the Disk View in the right pane. However, in both versions of the Disk View, you can right-click on an empty space (an area of the pane where there is not a graphical representation of a disk) to bring up a context menu with these options.

Icon	Meaning	Tasks
	Represents the Collapse disk function in the Disk View.	Allows you to hide the details of the disks displayed.
	Represents the Expand disk function in the Disk View.	Allows you to view detailed information about disks and the organization of the data on the disks.
	Represents the Vol Details function in the Disk View.	Displays subdisks as partial volumes.
	Represents the Projection function in the Disk View.	Highlights objects associated with the selected subdisk or volume.
	Represents the Print function in the Disk View.	Allows you to print the contents of the current view.

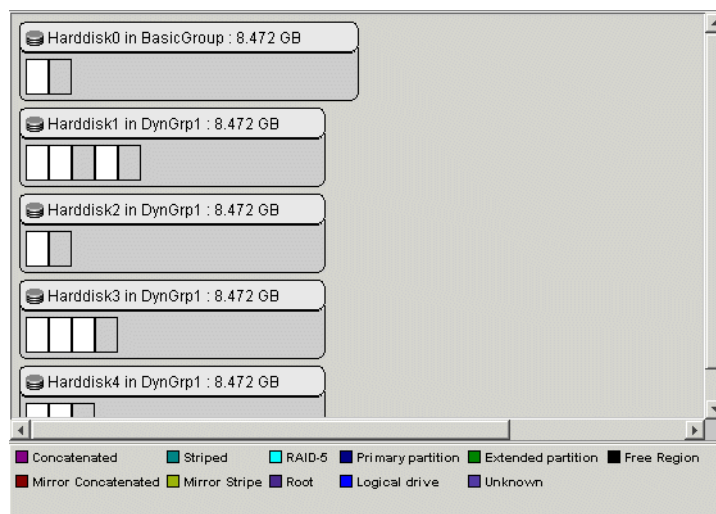


Collapsed and Expanded Views

The subdisks can be viewed in either the Collapsed or Expanded view. Each view gives different information.

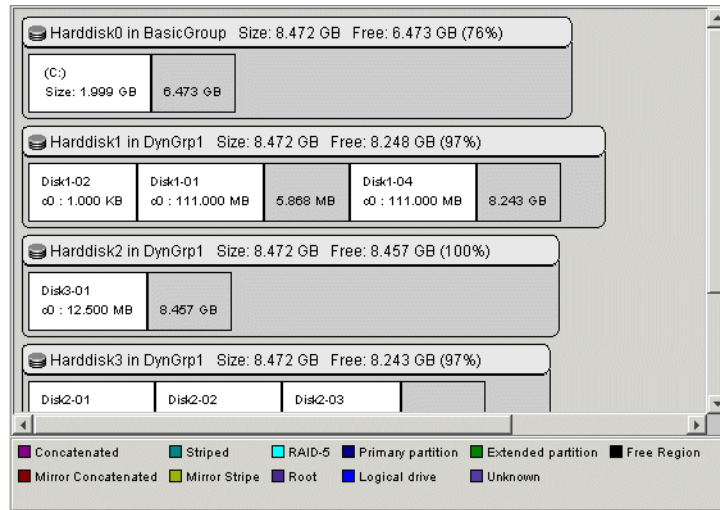
Collapsed View

The Collapsed view, shown below, allows you to easily see the number of subdisks on each disk.



Expanded View

The Expanded view, shown below, gives more information than the Collapsed view. It shows the subdisk names and sizes, as well as the amount of free space remaining on the disk.

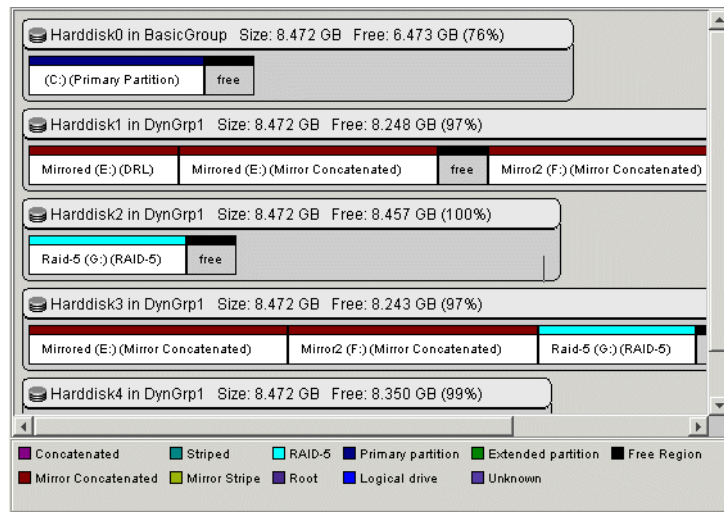


Vol Details View

The **Vol Details** view adds information to either the Collapsed or Expanded view. This view is useful if you are looking at a large number of disks, because each disk takes less space than in the full volume display, so more disks can be displayed on the screen at once.

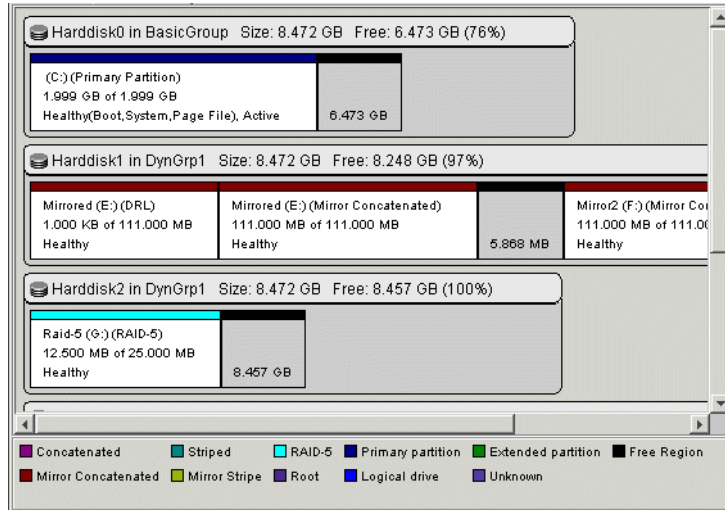
In the Collapsed view, Vol Details shows a colored bar at the top of each subdisk that indicates its volume type. The legend at the bottom of the pane shows the color-coding scheme. The legend can be toggled on and off with the **Show Legend** command.

Additionally, in the Expanded view, as shown below, Vol Details shows the volume name and drive letter associated with each subdisk.



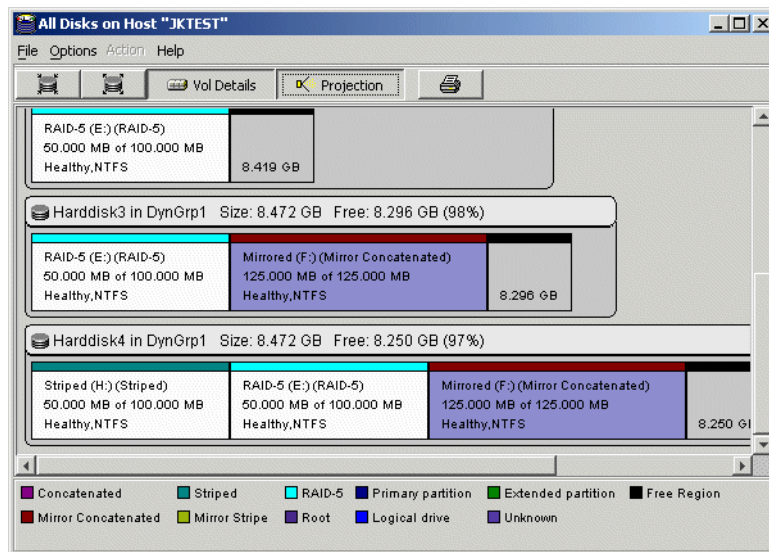
Full Volume Display

As shown below, **Full Volume Display** provides even more information about the subdisks. It is available only in the Expanded view and only when the Vol Details option is selected. In addition to the volume name and type, Full Volume Display shows the volume size and status.



Projection

Projection highlights all the subdisks associated with a selected volume. After the Projection command is selected, click on a subdisk. The selected subdisk becomes dark purple, and the other subdisks in that volume become a lighter purple. In the example below, the Projection feature was turned on, and the subdisk named Mirrored (F:) on Harddisk3 was selected. That subdisk became dark purple, and the other mirror that is part of the volume “Mirrored (F:)” (located on Harddisk4) became a lighter purple. This feature can be useful for viewing a volume that is spread across several disks.



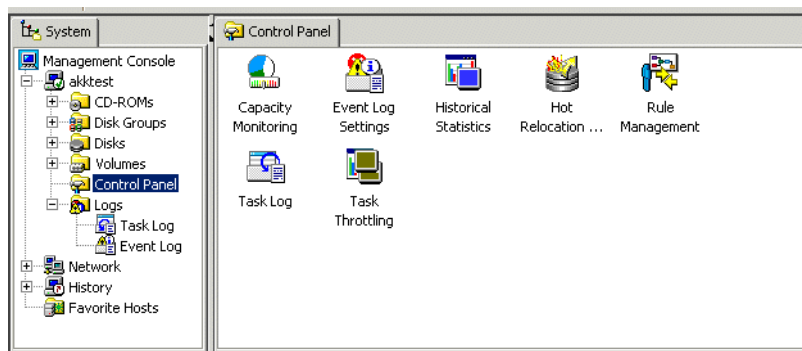
Context Menu Available from Disk View

The context-sensitive menu of commands that is available by right-clicking on a volume or disk in the tree view is also available by right-clicking a subdisk or disk in the Disk View. Additionally, in the separate Disk View window, the context-sensitive commands are available on the Action menu.

Also, in Disk View you can drag-and-drop subdisks instead of using the **Subdisk Move** command.

Control Panel

The Control Panel is a feature that was introduced in Volume Manager 3.0. To access the Control Panel, select the Control Panel folder in the tree view. The Control Panel tabbed view will display in the right pane.



Like the Control Panel in the Windows operating system, the VEA Control Panel has icons that open up into windows with settings for various functions within the program. The settings are for the following functions:

- ◆ Capacity Monitoring for All Volumes
- ◆ Event Log Settings
- ◆ Historical Statistics
- ◆ Hot Relocation
- ◆ Rule Management
- ◆ Task Log
- ◆ Task Throttling

To access any of these functions, double-click its icon in the Control Panel.

Capacity Monitoring for All Volumes

When you double-click the Capacity Monitoring icon, the Capacity Monitoring window comes up. Capacity monitoring is a feature that monitors the capacity of Volume Manager dynamic volumes so that when any volume reaches certain size thresholds, you are notified with an alert message. The purpose of capacity monitoring is to provide you with a warning when any dynamic volume has nearly reached full capacity.



When you select the Capacity Monitoring function through the Control Panel, you access a window that allows you to configure capacity monitoring settings for ALL dynamic volumes on the selected server. You can also configure capacity monitoring settings for a selected volume by right-clicking the volume and selecting the **Capacity Monitoring** command from the volume's context menu. For more information on setting up capacity monitoring on a specific volume, see "[Capacity Monitoring on a Volume](#)" on page 161.

Whether you select capacity monitoring for all volumes (through the Control Panel) or for an individual volume (by selecting **Capacity Monitoring** from the volume's context menu), the Capacity Monitoring window has the same setting options.

Note Enabling or changing the global settings (from the Control Panel) will replace any prior individual capacity monitoring settings.

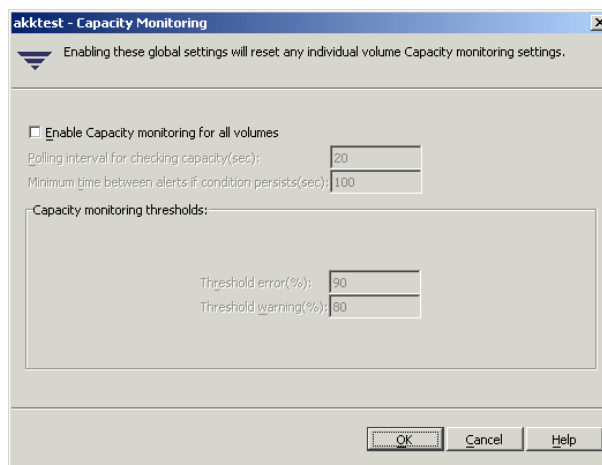
Capacity monitoring is off by default for all volumes and individual volumes. You turn it on through the Capacity Monitoring window. The Capacity Monitoring window allows you to set the time intervals for checking volume capacities and to set thresholds for sending out alert messages. You may want to temporarily change capacity monitoring settings to plan for volume cleanup and extension.

This section describes how to change global capacity monitoring settings through the Control Panel.

▼ **To change global capacity monitoring settings:**

1. In the tree view, click to select the Control Panel.
2. In the right pane, double-click the Capacity Monitoring icon.

The Capacity Monitoring window for all volumes appears, as shown in the sample screen that follows.



3. Set the capacity monitoring parameters as follows:

- Check or uncheck the “Enable Capacity monitoring for all volumes” checkbox.
Turns on and off Volume Manager’s monitoring of the capacity of the dynamic volumes. The default setting is off.

Note If capacity monitoring has been enabled for individual volumes, the default values shown for each parameter in the global capacity monitoring window will be the lowest value currently set for the individual volumes. Any changes made to these values on the global level will also change the previously set values for the individual volumes.

- Type in the polling interval for checking the capacity, in seconds.
The polling interval is the interval at which Volume Manager checks volume capacities. The minimum and default value is 20 seconds.
- Type in the minimum time between alerts if condition persists, in seconds.
To keep the event log file from getting full, you can limit how often an alert message is generated after a capacity threshold is reached for a volume. The default is 100 seconds between messages.
- Type in capacity monitoring thresholds, in percentages.
Threshold Error: the percentage of volume capacity at which Volume Manager reports an error. The default is 90%.
Threshold Warning: the percentage of volume capacity at which Volume Manager sends out a warning message. The default is 80%.



Event Log Settings

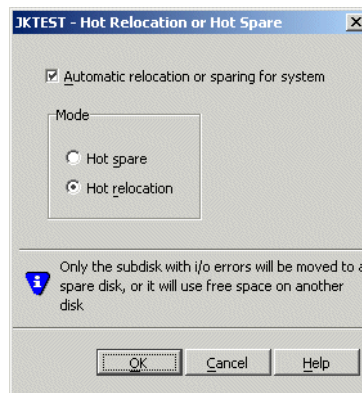
If you double-click the Event Log icon in the Control Panel, the Event Log Settings dialog box appears. This dialog box allows you to set the maximum size of the event log and to determine whether you want a single log or multiple logs. For full information on the Event Log Settings dialog box, see [“Event Log Configuration”](#) on page 187.

Historical Statistics

Double-clicking on the Historical Statistics icon brings up the Historical Statistics Settings dialog box. This dialog box lets you define the file size for the files that will be used for historical data collection. It also has a setting for the data collection rate. For full information on this window and its settings, see [“Configuring Settings in the Historical Statistics Settings Window”](#) on page 242.

Hot Relocation

Double-clicking on the Hot Relocation icon brings up the Hot Relocation or Hot Spare dialog box. When a subdisk containing a redundant volume fails, hot relocation automatically moves the redundant volume from the failed disk to hot spare disks, or to other free space if no space is available on hot spare disks.



For further information on hot relocation, see [“Hot Relocation and Hot Spare”](#) on page 262.

Rule Management

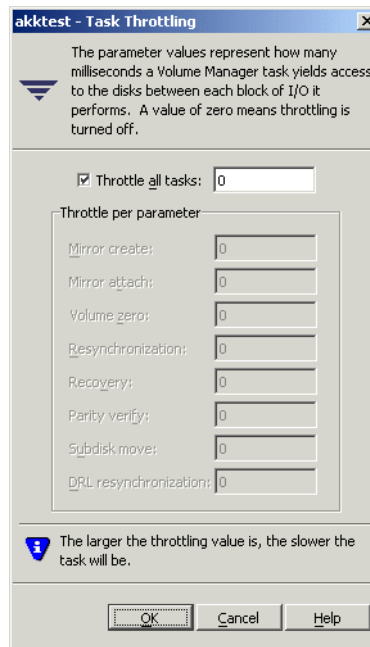
Double-clicking on this icon brings up the Rule Management window, which contains additional icons that provide access to various dialog boxes for configuring rules for event notification messages and actions. For more information on rule management for event notification, see “[Event Notification](#)” on page 189.

Task Log

Double-clicking this icon brings up the Task Log. The Task Log is a listing of tasks, such as formatting a volume or resynchronization of a volume. In Volume Manager 3.1, the Task Log is not implemented.

Task Throttling

The Task Throttling dialog allows you to determine the priority of certain tasks.

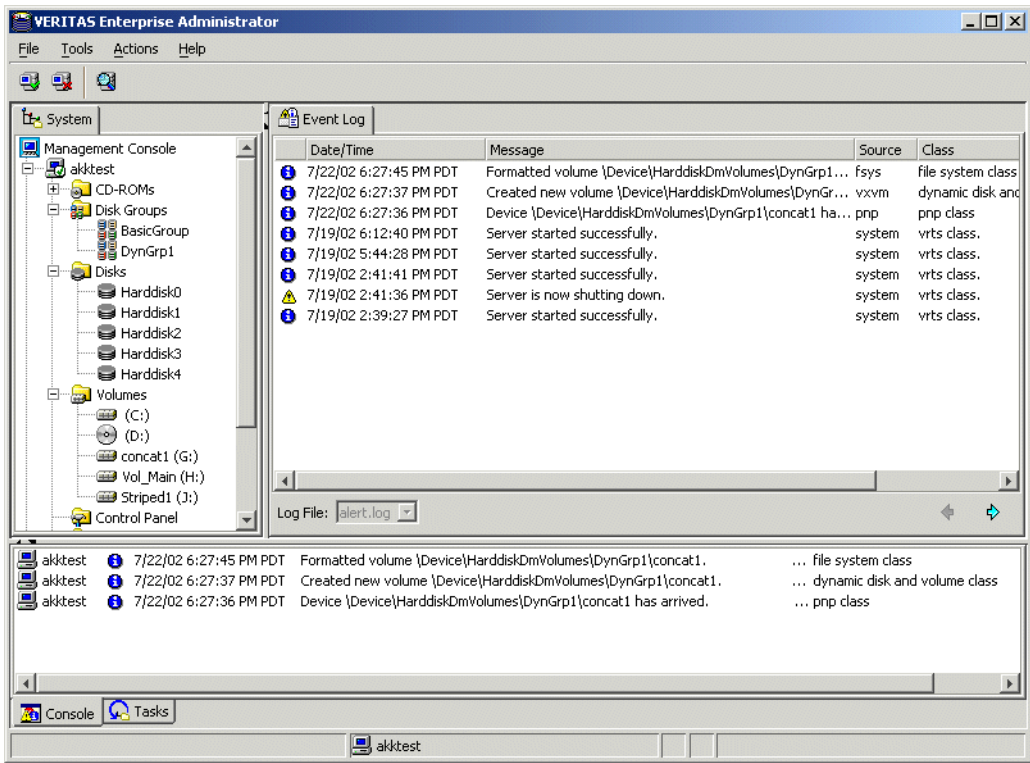


Using task throttling causes an operation to pause for the specified amount of time whenever a disk I/O is performed, allowing the CPU to perform other tasks. By selecting the “Throttle all tasks” checkbox, you apply the priority in the text field to all Volume Manager tasks. To apply a priority to a task, enter the number of milliseconds in the text field and click **OK**.

Event Log

The **Event Log** displays Event Log messages associated with the selected objects. To access the Event Log, select the Event Log folder in the tree view.

For detailed information on the Event Log, see the section “[Event Log](#)” on page 185.



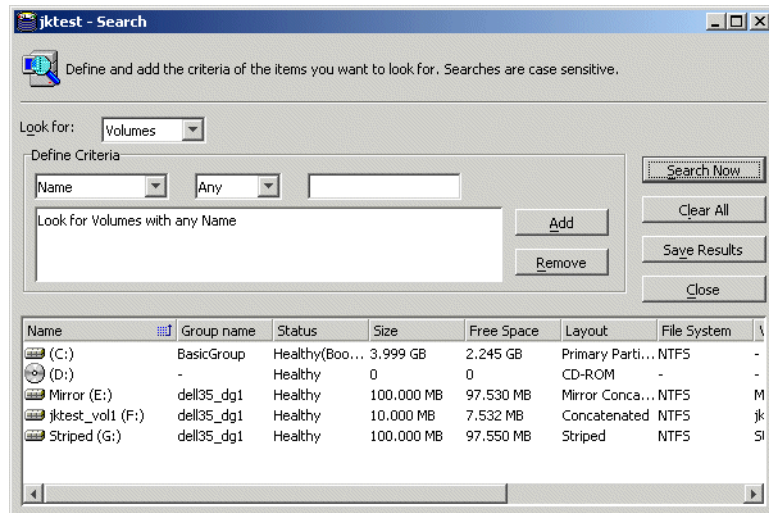
Search

Search was introduced as a new feature in Volume Manager 3.0. Search allows you to find specific volumes, disks, or disk groups on a large system or to find a list of volumes, disks, or disk groups meeting specified criteria.

Note Searches are case sensitive.

Conducting a Search

1. Click on the **Search** button on the toolbar, or select **Tools>Search** from the menu bar to open the Search window.



2. Select the object type from the drop-down list to the right of the words "Look for:" (near the top left corner of the window). The choices are Volumes, Disks, or Disk Groups.
3. Select the attribute you want to search for. The available attributes depend on the object type.

If you choose Volumes, the available attributes are:

- Name
- Disk Group Name
- Status



- Disk
- FS Capacity
- FS Free Space
- FS Type

If you choose Disks, the available attributes are:

- Name
- Disk Group Name
- Device Name
- Status
- Size
- Free Space

If you choose Disk Groups, the available attributes are:

- Name
- Imported
- Free Space
- Size

4. Define the limiter you want to use. Searches may be limited by the following: any, contains, is, is not.

- **Any** finds all instances of the selected attribute.

It is not necessary to enter information in the text box to the right. For example, searching Disk Groups for any Free Space will return all disk groups with free space available.

- **Contains** finds any of the selected attributes that contain the string that is entered in the text box to the right.

Contains acts as a wildcard (*) and will search for the string anywhere within a longer string. For example, searching Volumes for a name that contains "Stripe" will return all volumes that have the string "Stripe" anywhere in the volume name, including "Striped (H:)" and "JKStriped (J:)." Because searches are case sensitive, "Stripe" will not find "Astripedvolume (L:)."

- **Is** finds only an exact match with the string entered in the text box to the right.

It is useful for finding a specific volume, disk, or disk group on a very large system. For example, searching Disks for “Name is Harddisk1” will return Harddisk1. You must enter the exact information, including the drive letter or location for volumes.

- **Is not** excludes the specific information entered in the text box to the right.

For example, searching Volumes for “FS Type is not FAT32” will return all volumes that are not formatted as FAT32.

5. Enter the search string in the text box to the right. Searches are case sensitive, so the string must be entered exactly.

6. Click the **Add** button to create the search term.

If more than one search term is defined, they will be joined by a logical “and” operator; that is, the result will contain all of the search terms. For example, a search for the terms “Volumes with Free Space” and “any NTFS Volumes” will result in a list of all volumes that both are formatted as NTFS and contain free space.

The logical “or” operator is not provided in this search function.

The **Remove** button can be used to delete a highlighted search term.

7. Click the **Search Now** button to complete the search.

The search results will appear in the lower pane.

You can double-click on a specific storage object (disk, volume, or disk group) in the search results to bring up the information in the VEA console.

8. The **Clear All** button will delete all the search terms and allow you to begin a new search.

9. Clicking the **Save Results** button allows you to save the results.

- a. The Save dialog box appears. Select the folder you want to save the file to.
- b. Enter a name for the file into the File name field.
- c. Click **Save** to save the file and close the dialog box. The file will save as a text file with a .txt extension.

For information on creating reports generated from the Search function, see “[Creating Search Reports](#)” on page 418.



Accessibility

The GUI of the VERITAS Enterprise Administrator console is accessible through keyboard shortcuts and other navigation aids. In Windows 2000, accessibility options can be set through the Control Panel and through the Accessibility wizard located under Accessories on the Start menu. The topics in this section are:

- ◆ [MouseKeys Feature](#)
- ◆ [Keyboard Shortcuts](#)
- ◆ [Dialog Boxes](#)
- ◆ [Text Navigation and Editing Keys](#)
- ◆ [Accessibility Keys](#)

MouseKeys Feature

If you prefer not to use the mouse at all, Windows 2000 provides the MouseKeys feature, which lets you perform all mouse functions through the keypad on the keyboard. Activate this feature through the Accessibility wizard found under Accessories on the Start menu.

Keyboard Shortcuts

Mapping conventions describe ways to access commands using only the keyboard. A mapping convention can be either a mnemonic or an accelerator. An accelerator is a key combination that provides shortcut access to a GUI function. For example, **Ctrl+V** activates the **Paste** command. A mnemonic is a single-key equivalent for activating GUI components such as menu items. The mnemonic letter is underlined in the GUI. Often a mnemonic follows the use of an accelerator. For example, to activate the **Paste** command, you could first access the Edit menu using the accelerator **Alt+E** and then use the mnemonic **P**.

Exceptions to the Microsoft mapping conventions

Microsoft has standardized many of these mapping conventions. VEA has five notable exceptions to the Microsoft conventions. The following table describes the differences. It lists the specific command, followed by the conventions used in VEA and, for reference, the conventions used by Microsoft.

Differences between Microsoft conventions and VEA usage

Command	VEA Mnemonic	VEA Accelerator	Microsoft Mnemonic	Microsoft Accelerator
Cancel	C	Alt+C	None	Esc
OK	O	Alt+O	None	Enter, Spacebar
Refresh	E	None	R	F5
Yes	None	None	Y	Alt+Y
No	None	Esc	N	Alt+N



Conventions used only in VEA

Additionally, the following commands do not have Microsoft mapping conventions but are used in VEA.

Conventions used only in VEA

Command	Mnemonic	Accelerator
Actions	A	Alt+A
Add category	A	None
Add	D	Alt+D
Connect	C	None
Contents	C	None
Delete Now	None	None
Delete Temporary Files on Exit	E	Alt+E
Disconnect	D	None
Find in Topic	F	Ctrl+F
Find Next	N	F3
Find Previous	P	None
Hide Navigation Tabs	H	None
Index	I	None
Number of Items in History	N	Alt+N
Password	P	Alt+P
Previous	P	Alt+P
Print	P	None
Overwrite the Log File	W	Alt+W
Overwrite the Log File(s) After	A	Alt+A

Conventions used only in VEA

Command	Mnemonic	Accelerator
Overwrite the Log File(s) Older Than	O	Alt+O
Remove	E	Alt+E
Rescan	S	None
Reset	R	Alt+R
Set to Defaults	S	Alt+S
Search	S	None
Synchronize	N	None
Remember Password	R	Alt+R
User Name	U	Alt+U



Dialog Boxes

A dialog box is a window that appears temporarily on top of your application window to request information. Message boxes are simple dialog boxes that display additional information or warnings, or explain why a requested task could not be accomplished. Dialog boxes often contain groups of controls necessary to set options or settings for programs. A typical dialog box might contain some text, a set of radio buttons, and OK and Cancel buttons.

In an active dialog box, you can use the following keyboard navigation:

Keys	Action
Alt+underlined letter	Selects control containing the underlined letter.
Tab	Moves the keyboard focus between controls.
Shift+Tab	Reverses direction of the Tab key.
Arrow keys	Move within a list box, groups of option controls, or groups of page tabs.

Command buttons (also known as push buttons) initiate an immediate action. One command button in each dialog box carries out the command you've chosen, using the information supplied in the dialog box. This normally is labeled "OK." Other command buttons let you cancel the command or choose from additional options.

Command buttons marked with an ellipsis (...) open another dialog box so you can provide more information or confirm an action. Command buttons marked with a pair of greater-than symbols (>>) expand the current dialog box to show more controls.

Command buttons marked with an arrow display a menu.

A dark border initially indicates the default button. Press Enter at any time to choose the button with a dark border. Use Tab to move the keyboard focus to the next control, and add Shift to reverse the direction. When you move the keyboard focus to a command button, it temporarily takes the dark border, but when the keyboard focus is not on a command button, the dark border returns to the default button. Press Spacebar to choose the command button you selected with Tab. Use Esc to immediately choose the Cancel button if there is one. Typing the access key for a command button will immediately carry out the command.

Checkboxes may be selected or cleared to turn an option on or off. Checkboxes may have two states (checked and unchecked) or three states (checked, unchecked, and indeterminate). Checkboxes often are displayed in sets of related options; for example, in setting Font Effects in Microsoft Word, the checkboxes offer Strikethrough, Superscript, Subscript, Hidden, Small caps, and All caps.

Use Tab to move between boxes and the Spacebar to change the checkbox to the next state. Typing the access key for a checkbox also will move the focus to the box and change its state.

Option controls (also known as radio buttons) are used to select only one option from a group of options. (Like checkboxes, option buttons may represent two or three states.) Use the arrow keys to select the next or previous button within the group. In some applications, you can add Ctrl to move to the button without selecting it, then use Spacebar to choose the currently selected option button. Typing the access key for an option control will also move the focus to the control and select it.

Tabbed pages are used to fit many options into a single dialog box. They appear visually similar to dividers in a notebook. Each page contains separate groups of controls, such as checkboxes or option controls. Use Tab to move the focus to the tab for the currently visible page. Typing the access key for a page tab also will move the focus to the tab and display its page.

Keys	Action
Ctrl+Page Down or Ctrl+Tab	Switches to the next tab and displays the page.
Ctrl+Page Up	Switches to the previous tab and displays the page.
Right Arrow or Left Arrow	When the focus is on a tab selector, chooses the next or previous tab in the current row and displays the page.
Down Arrow or Up Arrow	Chooses the tab in the next or previous row and displays the page.



Sliders appear as an indicator on a vertical or horizontal gauge. The slider both displays and sets a value from a continuous range, such as speed, brightness, or volume. Use Tab or the appropriate access key to move the focus to the slider.

Keys	Action
Right Arrow or Down Arrow	Selects the next higher setting.
Left Arrow or Up Arrow	Selects the next lower setting.
Home or End	Selects the lowest or highest setting.
Page Down	Selects a somewhat lower or higher setting, depending on the application. (This is the equivalent of pressing an arrow key many times.)
Page Up	Moves in the reverse direction of Page Down.

Spin boxes appear as a text box with up and down arrows used to select from a list of fixed values. Use Tab to move the keyboard focus to the text box, and then enter a valid value in the box or use the Up Arrow or Down Arrow key to select the next higher or lower values.

List boxes display a column of available choices. If there are more choices than can fit in the open list box, moving the selection through the list will scroll more choices into view. Use Tab or type the appropriate access key to move the focus to the list box.

Single-selection list boxes allow only one item to be selected from the list at a time. Items are selected when navigating to them, and moving to a second item will automatically deselect all other items.

Drop-down list boxes by default show only the selected item. There is a small button to the right of the control that shows a downward-pointing arrow. You can click the arrow to display more items from the list. You also can show or hide the list using Alt+Down Arrow, Alt+Up Arrow, or F4. In all other respects, a drop-down list box behaves like a normal single-selection list box.

Extended-selection list boxes support selecting single items, blocks of items, or combinations of the two. After selecting an item as in a single-selection list box, hold down Shift+navigation keys to select or deselect more items.

Multiple-selection list boxes typically have comparatively long lists, and more of these items are expected to be chosen individually (not in blocks). Navigating to items does not automatically select them, nor does selecting an item change the status of other selections. Press the Spacebar to select or deselect an item.

Combo boxes and drop-down combo boxes are list boxes with attached edit boxes. You can make your selection by either typing in the edit box or using the standard commands to select from the list.

Keys	Action
Up Arrow or Down Arrow	Selects the previous or next item. In an extended-selection list box, add Shift to select additional items and add Ctrl to move to an item without selecting it. In a multiple-selection list box, moves without changing the selection.
Page Up or Page Down	Selects the item up or down one screen. In an extended-selection list box, add Shift to select additional items and add Ctrl to move to an item without selecting it. In a multiple-selection list box, moves without changing the selection.

Edit controls are rectangular boxes used for displaying or editing text. See the following section for more information. Use Tab or the appropriate access key to move the focus to the edit control and select the text.

Text Navigation and Editing Keys

When you open a document window in a word processing (or similar) program, a pointer appears in the upper-left corner of the window. The text you enter will appear at the pointer. In insertion mode, the new text is inserted into existing text and the existing text is automatically moved to follow the new text. In overwrite mode, the new text overwrites the existing text. The following keys automatically scroll the window to keep the pointer in view when it is necessary. These keys also work in the text boxes of dialog boxes and list boxes.

Keys	Action
Insert	Toggles between overtype and insertion modes. (Text boxes support only insertion mode.)



Keys	Action
Arrow Key	Moves the pointer one character in the direction of the Arrow Key. If text is selected, moves the pointer to the end of the selection and deselects the text.
Home or End	Moves the pointer to the beginning or end of the current line.
Page Up and Page Down	Moves the pointer up or down one screen or to the first or last line.
Ctrl+Right or Ctrl+Left	Moves the pointer to the beginning of the next or previous word.
Ctrl+Up or Ctrl+Down	Moves the pointer to the beginning of the preceding or next paragraph. (Not supported in text boxes.)
Ctrl+Home or Ctrl+End	Moves the pointer to the beginning or the end of the document. (Not supported in text boxes.)

Press Shift with the text navigation keys listed above to select blocks of text for editing. For example, press Shift+End to select text from the pointer to the end of the line. Shift toggles—you can use Shift plus the above navigation keys to both select and deselect text.

Keys	Action
Delete	Deletes the next character or the selected text.
Backspace	Deletes the previous character or the selected text.
Ctrl+Insert or Ctrl+C	Copies the selected text to the Clipboard.
Shift+Delete or Ctrl+X	Cuts the selected text to the Clipboard.
Shift+Insert or Ctrl+V	Pastes text from the Clipboard.

Accessibility Keys

Use the Accessibility Options setting in the Microsoft Windows 2000 Control Panel to turn on these keys.

Keys	Action
Five taps on Shift	Toggles the StickyKeys feature on and off. Use StickyKeys if you want to use the Shift, Ctrl, or Alt key one key at a time in combination with other keys (in other words, to use the keys sequentially, rather than simultaneously).
Left Alt+Left Shift+Num Lock	Toggles the MouseKeys feature on and off. Use MouseKeys if you want to control the mouse pointer with the numeric keypad.
Hold Num Lock for 5 seconds	Toggles the ToggleKeys feature on and off. Use ToggleKeys if you want to hear tones when pressing Caps Lock, Num Lock, and Scroll Lock.
Hold Right Shift for 8 seconds	Three beeps followed by a sliding beep signal 8 seconds. Toggles the FilterKeys features (SlowKeys, BounceKeys, and RepeatKeys) on and off. Use FilterKeys if you want Windows to ignore brief or repeated keystrokes or to slow the repeat rate. SlowKeys ignores keys that are pressed accidentally or for a short time. BounceKeys ignores keys that are pressed more than once too quickly. RepeatKeys adjusts or disables the keyboard repeat rate.
Hold Right Shift for 12 seconds	Three beeps followed by a sliding beep followed by a double beep signal 12 seconds. Turns on the BounceKeys feature with the most conservative settings.
Hold Right Shift for 16 seconds	Three beeps followed by a sliding beep followed by a double beep followed by a triple beep signal 16 seconds. Turns the SlowKeys feature on with the most conservative settings.





Volume Manager Concepts

4

This chapter provides a description of the concepts used in the Volume Manager program. Topics include:

- ◆ Basic and Dynamic Disks
- ◆ Basic and Dynamic Volumes
- ◆ Disk Groups
- ◆ Dynamic Volume Components
- ◆ RAID Terminology



Basic and Dynamic Disks

Volume Manager defines all physical disks that it manages as either *basic* or *dynamic* disks. This section defines these terms and describes the distinctions between these two types of physical disks. The section's topics are:

- ◆ [Basic and Dynamic Disk Definitions](#)
- ◆ [Advantages of Dynamic Disks](#)
- ◆ [Basic Disk Functions](#)
- ◆ [Dynamic Disk Functions](#)
- ◆ [General Disk Functions](#)
- ◆ [Basic and Dynamic Disk Limitations](#)

Basic and Dynamic Disk Definitions

When you install Windows 2000, your hard disks are automatically initialized as *basic*. You can upgrade them to *dynamic* after installation is complete.

◆ **Basic Disk**

A basic disk adheres to the partition-oriented scheme of Windows NT, Windows 95/98, and MS-DOS. Basic disks can also contain RAID volumes that were created in NT Disk Administrator, including spanned volumes (volume sets), mirrored volumes (mirror sets), striped volumes (stripe sets), and RAID-5 volumes (stripe sets with parity). In addition, CD-ROMs and removable-media disks are considered basic disks.

◆ **Dynamic Disk**

A dynamic disk is a physical disk that can contain dynamic volumes created with Volume Manager. A dynamic volume organizes space on one or more physical disks by using a specific type of volume layout. The dynamic volume layouts are simple, spanned, mirrored, striped, RAID-5, and mirrored striped (RAID 1+0).

On a dynamic disk, space is organized through volumes rather than partitions. Because a dynamic disk does not have the partitioning scheme used by Windows NT, Windows 95/98 and MS-DOS, you cannot access dynamic disks through those operating systems.

Advantages of Dynamic Disks

One of the main advantages of dynamic disks is that they support multi-disk volumes. You can get better use of your available disk space by combining areas of unallocated space in volumes that go across multiple disks. Multi-disk volumes also improve disk performance by letting more than one disk drive read and write data. Finally, multi-disk volumes let you use RAID technology to make volumes fault tolerant.

When you upgrade a disk, Volume Manager writes a small database onto the upgraded disk that contains volume management information about the disk and all other dynamic disks in its disk group. This database gives a dynamic disk additional advantages:

- ◆ Users can create dynamic volumes without restarting the system.
- ◆ Volumes can be accessed continuously, even across disk reconfiguration events.
- ◆ All dynamic volumes with an NTFS file system can be extended online. You can select where to extend the volume, or Volume Manager will assign space optimally on the available disks within the volume's dynamic disk group.
- ◆ Disk configuration information is contained on the disk, not in the registry. The disk configuration information is also replicated across all dynamic disks in the disk group so that the failure of one disk will not obstruct access to data on other disks.
- ◆ Dynamic disks provide volume migration, which is the ability to move a disk or disks containing a volume or volumes from one system to another system without loss of data.
- ◆ Dynamic disks allow you to move portions of volumes (subdisks) between disks on a single computer system to optimize performance.

Basic Disk Functions

These functions can be done only with basic disks:

- ◆ Create and delete primary and extended partitions.
- ◆ Create and delete basic logical drives within an extended partition.
- ◆ Format a primary partition and mark it as active.
- ◆ Format logical drives.
- ◆ View, repair, or delete volumes created by NT Disk Administrator.

These include simple partitions, simple and spanned volumes (volume sets), striped volumes (stripe sets), mirrored volumes (mirror sets), and RAID-5 volumes (stripe sets with parity). Thus, you can break a mirror set. You can also repair a mirror set or a stripe set with parity. However, you cannot add a mirror to another volume.



- ◆ Mark a partition active (the active partition is the partition from which the computer starts up).
- ◆ Upgrade a basic disk, including system and boot disks, to a dynamic disk.

For details on these functions, see [“Working with Basic Disks and Volumes”](#) on page 122.

Dynamic Disk Functions

These functions can be done only with dynamic disks:

- ◆ Create and delete simple, spanned, striped, mirrored, RAID-5, and mirrored striped (RAID 1+0) volumes.
- ◆ Online extending for all volume types.
- ◆ Support up to 32-way mirrors on a mirrored volume.
- ◆ Remove a mirror from a mirrored volume.
- ◆ Break a mirror on a mirrored volume.
- ◆ Repair mirrored or RAID-5 volumes.
- ◆ Bring a missing or offline disk back online.
- ◆ Move disks between computers with the Import and Deport Disk Group commands.
- ◆ Monitor performance and allow movement of subdisks.
- ◆ Provide dynamic volumes and disk groups that can be used with Microsoft Cluster Service software.
- ◆ Change a dynamic disk to a basic disk.
- ◆ Add a mirror to any kind of volume (except RAID-5).

For details on these functions, see [“Working with Dynamic Disks and Volumes”](#) on page 137.

General Disk Functions

These functions apply to both basic and dynamic disks:

- ◆ Check disk properties such as status, capacity, and unallocated space, as well as check which volumes exist on that disk.
- ◆ Make drive-letter assignments for volumes, partitions, CD-ROM, DVD, and removable devices.
- ◆ Mount a local drive at any empty folder on a local NTFS-formatted volume.

- ◆ Add a disk to the system.
- ◆ Remove a disk from the system.
- ◆ Update disk information with the Rescan command.
- ◆ Refresh the console with the Refresh command.
- ◆ Add a disk signature to a disk.

For detail on these functions, see “[General Disk Procedures](#)” on page 106.

Basic and Dynamic Disk Limitations

When are you limited to using only a basic disk or a dynamic disk? Normally, you would want to upgrade your physical disks to dynamic unless you have a dual-boot system where some disks need to be accessed by Windows NT, Windows 95/98, or MS-DOS. CD-ROM and removable-media disks must be basic disks.

Basic Disk Limitations

Certain functions are no longer available on basic disks because multiple-disk storage systems should use dynamic disks. On basic disks, Volume Manager supports NT Disk Administrator legacy volumes that exceed a single partition on more than one disk, but it does not allow you to create new ones. You CANNOT perform the following tasks on a basic disk:

- ◆ Create simple or spanned volumes (volume sets), striped volumes (stripe sets), mirrored volumes (mirror sets), and RAID-5 volumes (stripe sets with parity).
- ◆ Extend existing partitions or volumes (volume sets).
- ◆ Add mirrors to volumes.

Dynamic Disk Limitations

Dynamic disks have the following limitations:

- ◆ Dynamic disks can contain only volumes created with Volume Manager.
They cannot contain partitions or RAID volumes that were created in Windows NT Disk Administrator. If you want to upgrade a basic disk to a dynamic disk that has RAID volumes that were created in Disk Administrator, see the section “[Converting NT Disk Administrator Basic Volumes to Dynamic Volumes](#)” on page 135.
- ◆ After you upgrade a basic disk to a dynamic disk and create dynamic volumes on it, you cannot change the dynamic volumes back to partitions or basic volumes.
You can revert a dynamic disk to basic by deleting all dynamic volumes on the disk.



- ◆ Volumes on a dynamic disk cannot be accessed by MS-DOS, Windows 95/98, or Windows NT.

The exception is a dynamic volume that is created under a version of Volume Manager for Windows NT 4 and thus is accessible in Windows NT 4. See the section [“Interoperability with Other VERITAS Volume Manager for Windows Products”](#) on page 15 for information on how Volume Manager for Windows 2000 works with other members of the VERITAS Volume Manager for Windows family of products.

Basic and Dynamic Volumes

This section defines basic and dynamic volumes and describes the distinctions between these two types of volumes. The section's topics are:

- ◆ [Definition of Basic and Dynamic Volumes](#)
- ◆ [Basic and Dynamic Volume Functions](#)
- ◆ [General Volume Functions](#)
- ◆ [Dynamic Volume Types](#)

Definition of Basic and Dynamic Volumes

A volume is a logical entity that is made up of a portion or portions of one or more physical disks. A volume can be formatted with a file system and can be accessed by a drive letter or a mount path.

Like disks, volumes can be basic or dynamic.

Basic Volumes Definition

In Volume Manager, basic volumes refer to all the volumes that are on basic disks. Basic volumes can be primary or extended partitions, simple logical drives that reside on extended partitions, or RAID volumes that were originally created in Windows NT Disk Administrator. Volume Manager allows you to maintain and repair these NT Disk Administrator basic volumes but not to create new ones.

Dynamic Volumes Definition

Dynamic volumes are volumes created on dynamic disks using Volume Manager. On a dynamic disk, storage is divided into dynamic volumes instead of partitions. A dynamic volume consists of a portion or portions of one or more physical disks and is organized in one of six volume layouts. The six types of dynamic volumes—simple, spanned, mirrored, striped, RAID-5, and mirrored striped (RAID 1+0)—are described in the section [“Dynamic Volume Types”](#) later in this chapter.

You can create any number of dynamic volumes in the unallocated space on a disk or create volumes that span two or more disks. Each volume on a disk can have a different file system, such as the file allocation table (FAT or FAT32) file system or the Microsoft Windows NT file system (NTFS).



Remember that any changes you make to your disk are immediately available. You do not need to quit Volume Manager to save them or reboot your computer to implement them. The only exception to this rule is that if you upgrade a boot disk from basic to dynamic, you must reboot.

Basic and Dynamic Volume Functions

The lists in the previous sections “[Basic Disk Functions](#)” and “[Dynamic Disk Functions](#)” already include the basic and dynamic volume functions. This section gives further comments on the differences between the functions for the two types of volumes.

By design, Volume Manager limits the functions of basic volumes. Both basic and dynamic volumes use the same command, **Create Volume**, to create a volume. However, the basic volumes are limited to creating primary and extended partitions, while dynamic volumes allow for the choice of six volume types—simple, spanned, mirrored, striped, RAID-5, and mirrored striped (RAID 1+0).

With basic disks, you can also create new logical drives that reside on an extended partition. These logical drives are simple volumes that are limited to a contiguous disk area on the extended partition.

In contrast, all dynamic volume types can span across multiple disks to allow you to make optimal use of your disk space.

On basic disks, you can maintain and repair RAID volumes that were originally created in Windows NT Disk Administrator, but you cannot create new volumes of the same type. However, if you upgrade a disk that contains these NT Disk Administrator volumes to dynamic, Volume Manager will change the volumes to dynamic volumes of the corresponding type. For more information on basic NT Disk Administrator volumes, see the section “[Work with Basic Volumes Created in Windows NT Disk Administrator](#)” on page 132.

Dynamic volumes have additional advanced features. They can be moved between computers (with the **Import** and **Deport Dynamic Disk Group** and **Merge Foreign Disk** commands). Volume Manager also provides performance monitoring and allows the online movement of subdisks (portions of a volume) to another disk on the same computer to enhance performance. In addition, Volume Manager can create dynamic disks, volumes, and disk groups that work in a Microsoft Cluster Service environment.

General Volume Functions

Just as there are functions that are shared by both basic and dynamic disks, there are also general volume functions that apply to both basic and dynamic volumes.

You can do the following with partitions and volumes:

- ◆ Assign or change a drive letter
- ◆ Remove a drive letter
- ◆ Mount an NTFS volume at an empty folder
- ◆ Unmount a volume
- ◆ Add a file system to a partition or volume
- ◆ Refresh drive letter, file system, and partition or volume information
- ◆ View properties of a partition or volume
- ◆ Delete a partition or volume

For more information on these functions, see [“General Disk Procedures”](#) on page 106.

Dynamic Volume Types

This section provides detailed information on the six types of dynamic volumes it is possible to create and use in Volume Manager.

The types are:

- Simple
- Spanned
- Striped
- Mirrored
- RAID-5
- Mirrored striped (RAID 1+0)

For information on creating and using these volumes, see [“Working with Dynamic Disks and Volumes”](#) on page 137. Also, for more information about RAID strategies, see [“Choosing RAID Levels”](#) on page 99.

Note In Volume Manager’s **New Volume** command, simple and spanned volume types are both referred to as concatenated and often considered as one type.



Dynamic Simple Volumes

A dynamic simple volume consists of a single contiguous region (or subdisk) on a single physical disk. This definition of simple volume is different from the Windows 2000 Disk Management definition. In Disk Management, a simple volume can consist of one or more contiguous regions on the same disk. It is defined differently in Volume Manager because the performance of a single-subdisk volume is much better than that of a multiple-subdisk volume on the same disk or on multiple disks, so it was felt that a single-subdisk volume should be a category by itself.

Dynamic simple volumes can be extended or mirrored. When you extend a simple volume to a non-contiguous region within the same disk or onto additional disks, it becomes a spanned volume.

Dynamic Spanned Volumes

A dynamic spanned volume consists of two or more subdisks (single contiguous regions) on one or more disks.

With a spanned dynamic volume, you can combine sections of unallocated space from multiple dynamic disks into one large volume. The areas of unallocated space used to create spanned volumes can be different sizes. Spanned volumes are organized sequentially—that is, Volume Manager sequentially allocates space on each disk until that disk is full and then continues with the next disk until the volume size is reached. Up to 256 disks can be included in a spanned volume.

Existing spanned volumes can be extended by the amount of unallocated space on all the disks in the dynamic disk group. However, after a spanned volume is extended, no portion of it can be deleted without deleting the entire spanned volume.

The advantage of a spanned volume is that it allows you to create a large volume consisting of smaller pieces of disk space from several disks, thereby making more efficient use of the disk space than would be possible if you had to limit the volume to a single disk. The disadvantage of a spanned volume is that it is not fault tolerant. If one of the disks containing a spanned volume fails, the entire volume fails. However, a spanned volume can be mirrored.

Dynamic Striped Volumes

Striped volumes are created by combining areas of free space on two or more disks into one logical volume. Data is divided into blocks and spread in a fixed order among all the disks in the volume. With a striped volume, data is written to multiple disks, similar to spanned volumes. However, striping writes files across all disks so that data is added to all disks at the same rate. Up to 256 disks can be used in a striped volume.

Striped volumes offer the best performance of all the disk management strategies. However, as with spanned volumes, striped volumes do not provide fault tolerance. If a disk in a striped volume fails, the data in the entire volume is lost. However, a striped volume can be mirrored to provide data redundancy. In addition, Volume Manager allows you to extend a striped volume, either with or without a mirror.

Dynamic Mirrored Volumes

A mirrored volume is a fault-tolerant volume that duplicates your data on two or more physical disks. A mirror provides redundancy by simultaneously writing the same data onto two or more separate mirrors (or plexes) that reside on different disks. If one of the disks fails, data continues to be written to and read from the unaffected disk or disks.

Mirrored volumes protect the data on the disk from media failure. Mirroring reduces the chance of an unrecoverable error by providing duplicate sets of data, but it also multiplies the number of disks required for data storage and the input/output (I/O) operations when writing to the disk. However, some performance gains are achieved for reading data because of I/O load balancing of requests between the plexes. A mirrored volume is about the same as a RAID-5 volume in read operations but faster in write operations.

You can create a mirrored volume with the Create Volume Wizard, or you can add a mirror to an existing volume with the Add Mirror Wizard. To create a mirrored volume on two or more disks, each mirror or plex of the original volume requires space that is at least the same size as the original volume. When you create a mirror, the same drive letter is used for all plexes of the volume. If you have sufficient disks available, you can create multiple mirrors for extra redundancy (up to the limit of 32 mirrors). Then, you can break off a mirror to use for backup, data analysis, or testing without losing redundancy.

Breaking off a plex of the mirrored volume does not delete the information, but it does mean that the plex that is broken off will no longer mirror information from the other plex or plexes in the mirrored volume. The broken-off plex will be assigned a different drive letter than that of the original mirrored volume. It is no longer part of the mirrored volume, but it retains its other volume layout characteristics. For example, if you had a mirrored striped volume, the broken-off plex would become a striped volume.

In the case of an unrecoverable error on a plex on a disk within a mirrored volume, you need to remove the plex that is damaged with the **Remove Mirror** command. You then can use the **Add Mirror** command to create a new plex on another disk to take the place of the damaged plex.

When you want to use the space in a mirrored volume for other purposes, you can remove a plex and return the space it used to unallocated space.

Volume Manager lets you add a mirror to any kind of dynamic volume, except RAID-5. You can extend any mirrored volume.



Dynamic RAID-5 Volumes

A RAID-5 volume is a fault-tolerant volume with data and parity striped alternately across three or more physical disks. If one of the physical disks fails, data that was on the failed disk is recreated from the remaining data and parity on the other disks. RAID-5 volumes are a good solution for data redundancy in a computer environment in which most activity consists of reading data.

You need a minimum of three disks for a RAID-5 volume. Volume Manager can accommodate up to 256 disks in a RAID-5 volume. You can extend a RAID-5 volume, but it cannot be mirrored.

Dynamic Mirrored Striped Volumes (RAID 1+0)

RAID 1+0 volumes are mirrors of striped volumes. For example, a two-disk striped volume can be mirrored to two additional disks. This RAID type provides the advantages of both speed (from striping) and fault tolerance (from mirroring). You can add more mirrors to a mirrored striped volume, and you can extend this type of volume onto additional dynamic disks within the dynamic disk group.

Disk Groups

Volume Manager organizes disks into disk groups. Disk groups provide a way of organizing disks in a system and simplifying storage management for systems with large numbers of disks. They also allow you to move disks between computers so that you can easily transfer the storage between computers. Topics in this section are:

- ◆ [Basic and Dynamic Disk Groups](#)
- ◆ [Moving Disk Groups between Computers](#)
- ◆ [Primary and Secondary Dynamic Disk Groups](#)
- ◆ [Private Dynamic Disk Group Protection](#)
- ◆ [Cluster Disks and Cluster Dynamic Disk Groups](#)
- ◆ [Array Groups](#)

Basic and Dynamic Disk Groups

Volume Manager assigns one group for all basic disks, called the *Basic disk group* (shown as BasicGroup in the GUI). Dynamic disks, however, can have multiple disk groups, which are called *dynamic disk groups*. Disks within a dynamic disk group share a common configuration. Dynamic volumes are created within a dynamic disk group and are restricted to using disks within that group.

When Volume Manager is run for the first time on a server, all disks are in the Basic disk group. In order to upgrade basic disks to dynamic, one or more dynamic disk groups have to be created with the New Dynamic Disk Group command.

A dynamic disk is limited to one dynamic disk group; it cannot participate in multiple dynamic disk groups.

Moving Disk Groups between Computers

You can move a dynamic disk group between computers by deporting it on one computer, moving the disk or disks that contain the dynamic disk group to another computer, rescanning on the new computer, and then importing the dynamic disk group. You will be able to use the volumes from the imported dynamic disk group without having to reboot if you have hot-swappable disks.

Before moving the disks in a dynamic disk group, make sure that the disks are online and the volumes are healthy. You should move all disks that are part of the dynamic disk group; otherwise, the volumes will have Degraded status when the disks are moved to the other computer.

For more information, see [“Importing and Deporting Dynamic Disk Groups”](#) on page 170.



Primary and Secondary Dynamic Disk Groups

Volume Manager makes a distinction between primary and secondary dynamic disk groups. For versions of the program before Volume Manager 3.0, the first dynamic disk group that was created or imported became the primary dynamic disk group. In Volume Manager 3.0 and 3.1, the primary dynamic disk group is the disk group that contains the computer's boot or system disk. For Volume Manager 3.0 and 3.1, if you have not included a computer's boot or system disk in a dynamic disk group, you will not have a primary dynamic disk group. However, in all versions of Volume Manager, only one primary dynamic disk group can exist on a single host computer. Additional groups that are created or imported on that computer are secondary dynamic disk groups. In the user interface, the primary or secondary designation is shown in parentheses after each dynamic disk group name in the right pane.

The concept of importing dynamic disk groups is also used in Volume Manager in connection with a single computer. If a computer is rebooted, Volume Manager makes available or "auto-imports" the primary dynamic disk group and any secondary dynamic disk groups that previously existed on the computer before the reboot, provided these groups have not been deported to another computer.

The primary dynamic disk group with its system or boot disk cannot be deported because doing so would make the computer unbootable. A primary dynamic disk group should not be renamed.

Private Dynamic Disk Group Protection

This feature, which was introduced in Volume Manager 3.0, allows you to partition shared storage on a SAN or shared array for exclusive ownership by a single machine. The storage is partitioned by using a secondary dynamic disk group. The Private Dynamic Disk Group Protection provides hardware locking to the disks in the secondary dynamic disk group through a SCSI reservation thread. For details, see "[Partitioned Shared Storage with Private Dynamic Disk Group Protection](#)" on page 177.

Cluster Disks and Cluster Dynamic Disk Groups

Volume Manager has a special category of disk groups for disks involved in supporting Microsoft Cluster Service (MSCS) software and the VERITAS Cluster Server (VCS). In order for Volume Manager to work with MSCS or VCS, you have to have installed the Volume Manager MSCS or VCS support option and then you create a cluster dynamic disk group for the disks that are part of the cluster. To create a cluster dynamic disk group, you use the New Dynamic Disk Group command and click the "Create Cluster Dynamic Disk Group checkbox." For details, see "[Microsoft Cluster Service Support](#)" on page 383 and "[VERITAS Cluster Server Support](#)" on page 380 in Chapter 7.

Array Groups

If a computer you are managing has Volume Manager software that supports physical and logical arrays on a hardware array controller, you will see array disk groups in the tree view and the General tab view. These array disk groups are called *array groups*. For details, see “[Arrays](#)” on page 44.

For more information on working with disk groups, see the section “[Dealing with Disk Groups](#)” on page 164.



Dynamic Volume Components

A dynamic volume involves the following Volume Manager components:

- ◆ [Dynamic Disk](#)
- ◆ [Dynamic Disk Group](#)
- ◆ [Plexes](#)
- ◆ [Columns](#)
- ◆ [Subdisks](#)

Volume Manager uses these components to describe the characteristics of the volumes that are created within the program. Dynamic volumes and their components are sometimes referred to as “virtual storage objects” that Volume Manager uses to perform disk management tasks. This section describes these dynamic volume components and how they relate.

Volume Component Descriptions

This section describes the dynamic volume and its components.

Dynamic Volume

The dynamic volume is a virtual object that Volume Manager creates on top of physical disks. Volumes are accessed by the Windows 2000 and Windows NT operating systems in the same way that physical partitions are accessed. They are identified by a drive letter or mount point. Volume Manager’s volumes are internally organized according to established RAID levels. For more information on RAID and RAID levels, see the section “[RAID Terminology](#)” in this chapter.

Dynamic Disk

Every volume occupies space on one or more dynamic disks. When you upgrade a basic disk to dynamic, the physical disk can be used to create dynamic volumes.

Dynamic Disk Group

The disks in any volume all have to belong to the same dynamic disk group. All disks in a dynamic disk group share the same configuration. If you select a disk and then select the Create Volume command, the disk and its disk group will be automatically chosen for the volume.

Plexes

A plex refers to an instance of the volume. Mirrored volumes have two or more plexes. All other volumes have one plex.

Columns

A column refers to an area on the disk where all or a portion of the volume resides. Striped, RAID-5, and mirrored striped (RAID 1+0) volumes contain multiple columns. Other volume types contain one column.

Subdisks

Subdisks identify the disk location and size of each contiguous disk area in the volume. Subdisks are the basic units in which Volume Manager allocates disk space in a volume. A Volume Manager disk can be divided into one or more subdisks. Each subdisk represents a specific portion of a volume on a dynamic disk.

A Volume Manager disk may contain multiple subdisks, but subdisks cannot overlap or share the same portions of a Volume Manager disk. Any Volume Manager disk space that is not part of a subdisk is considered to be unallocated space, which can be used to create new volumes or to extend existing volumes.

You can move subdisks to improve disk performance. To move subdisks, see “[Moving Subdisks](#)” on page 251.

Note A volume that is spanned across two disks or across one disk with an intervening volume in between still has only one column. Only striped, RAID-5, and mirrored striped (RAID 1+0) volumes have multiple columns.



RAID Terminology

This section provides information on RAID, its features, and its levels. Volume Manager's dynamic volumes are organized according to the established RAID levels described in this section. Topics in this section are:

- ◆ [What Is RAID?](#)
- ◆ [RAID Features](#)
- ◆ [Choosing RAID Levels](#)
- ◆ [Hardware and Software RAID](#)

What Is RAID?

RAID (Redundant Array of Independent Disks) is a collection of specifications that describe a system for ensuring the reliability and stability of data stored on large disk subsystems.

RAID provides the following general benefits:

- ◆ Increased storage system reliability
- ◆ Improved I/O performance

Different RAID levels provide varying degrees of improved reliability and performance. See [“Choosing RAID Levels”](#) on page 99 for a description of RAID levels and their advantages and disadvantages.

RAID Features

RAID provides various features to ensure high availability of data in the event of drive failure. These features include data duplication and disk drive rebuilding.

- ◆ **Consistency Check** — Verifies the accuracy of redundant data in a RAID group. For example, in a system with parity, checking consistency computes the parity of the data drives and compares the results to the contents of the parity drive.
- ◆ **Disk Striping** — Storing data in stripes on two or more physical disks. Data is allocated alternately and evenly (in stripes) to the disks of the striped RAID group. Striped RAID groups are not fault tolerant.
- ◆ **Concatenation** — Storing data either on one disk (simple) or on disk space that spans more than one disk (spanned).
- ◆ **Disk Mirroring** — Duplicating data on two or more physical disks. Mirroring provides data redundancy by using one or more copies (mirrors) of the RAID group to duplicate the information contained in the RAID group. Each mirror is located on a

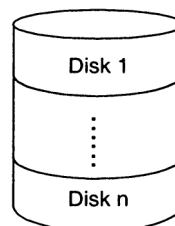
different disk. If one of the physical disks fails, the system can continue to operate with the unaffected disk(s). Because the mirrors on all drives contain the same data at all times, any drive with a mirror can act as the operational drive.

- ◆ Parity — Redundant information that is associated with a block of information. Parity is a calculated value used to reconstruct data after a failure. If a single disk drive fails, it can be rebuilt from the parity and the data on the remaining drives.
- ◆ Hot Spare — An extra, unused disk drive that is part of an array disk subsystem. A hot spare functions in standby mode. If a disk failure occurs, the hot spare replaces the failed drive without interrupting the system.
- ◆ Disk Rebuild — A rebuild is the recreating of data that existed on a drive before it failed. You can rebuild data only in arrays with data redundancy, such as RAID levels 1, 5, and 1+0. (See the next section, “[Choosing RAID Levels](#),” for more information about RAID levels.)
- ◆ Hot Swapping — A hot swap is the manual replacement of a defective physical disk unit while the computer is still running. When a new drive has been installed, you must issue a command to rebuild the drive.
- ◆ Fault Tolerance — Includes features like automatic failed-drive detection, rebuild, and hot swapping.

Choosing RAID Levels

RAID defines a collection of different configuration levels (RAID levels), which are used to configure an array of disks. The following illustrations show how RAID levels (RAID-0, RAID-1, RAID-5, and RAID 1+0) provide various levels of redundancy and performance, compared with a simple volume on a single disk. From these, you can decide what choices are applicable to your particular situation.

Concatenated

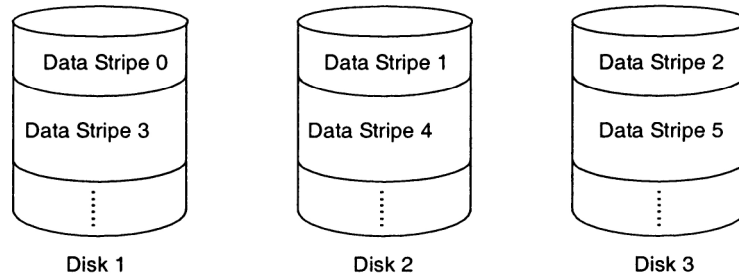


- ◆ Concatenates n disks as one large virtual disk with a capacity of n disks.
- ◆ Data fills up the first disk before it is written to the second disk.



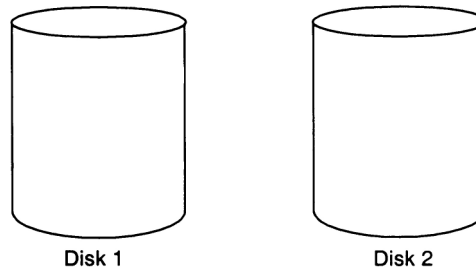
- ◆ Not fault tolerant. When a disk fails, the large virtual disk fails.
- ◆ No performance gain.

RAID Level 0 (Striping)



- ◆ Groups n disks as one large virtual disk with a capacity of n disks.
- ◆ Data is stored to the disks alternately.
- ◆ Not fault tolerant. When a disk fails, the large virtual disk fails.
- ◆ Better read and write performance than both simple volumes and all other RAID levels.

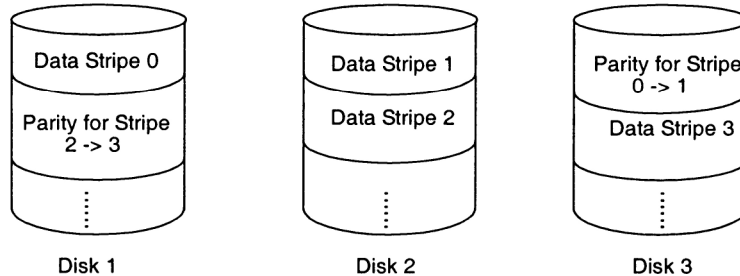
RAID Level 1 (Mirroring)



- ◆ Groups two or more disks as one virtual disk with the capacity of a single disk.
- ◆ Data is replicated on each disk, providing data redundancy.
- ◆ When a disk fails, the virtual disk still works. The data will be read from the surviving disk(s).

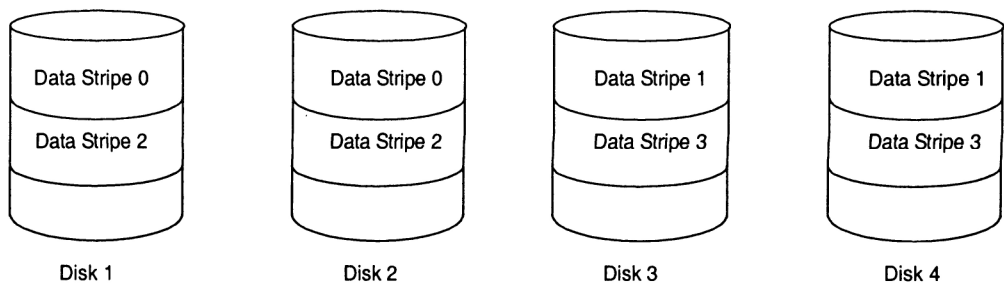
- ◆ Better read performance, but slightly slower write performance.
- ◆ Because data is duplicated on two or more disks, RAID-1 is more “expensive” in terms of disk space.

RAID Level 5 (Striping with Distributed Parity)



- ◆ Groups n disks as one large virtual disk with a capacity of $(n-1)$ disks.
- ◆ Redundant information (parity) is alternately stored on all disks.
- ◆ When a disk fails, the virtual disk still works. The data will be reconstructed from the surviving disks and the parity alternately stored on the disks. You will need to replace the failed disk to restore fault tolerance.
- ◆ Better read performance, but slower write performance.

RAID Level 1+0 (Mirrored Striped Volumes)



- ◆ Groups n disks as one large virtual disk with a capacity of $(n/2)$ disks.
- ◆ Data is striped across the replicated mirror-pair disks.



- ◆ When a disk fails, the virtual disk still works. The data will be read from the surviving mirror pair disk.
- ◆ Better read performance and write performance than RAID level 1 alone.
- ◆ Provides both redundancy (with mirroring) and performance (with striping).

Hardware and Software RAID

RAID functions can be implemented with either hardware RAID (a specific RAID controller) or software RAID (software without the specific hardware).

Software RAID can be configured on top of the hardware RAID volumes and provide a powerful variety of features.

This chapter describes Volume Manager's general procedures and has the following topics:

- ◆ [Function Overview](#)
- ◆ [General Disk Procedures](#)
- ◆ [General Volume Procedures](#)
- ◆ [Working with Basic Disks and Volumes](#)
- ◆ [Working with Dynamic Disks and Volumes](#)
- ◆ [Dealing with Disk Groups](#)
- ◆ [Event Monitoring and Notification](#)
- ◆ [License Procedures](#)
- ◆ [Help Menu Commands](#)
- ◆ [Providers](#)

Note [“Remote System Management,”](#) [“Performance Tuning,”](#) [“Dirty Region Logging \(DRL\) and RAID-5 Logging,”](#) and [“Command Line Interface”](#) are covered in Chapter 6, [“Additional Procedures.”](#) [“Microsoft Cluster Service Support,”](#) [“Dynamic Multipathing Software,”](#) [“VERITAS Cluster Server Support,”](#) [“VERITAS Volume Replicator Support,”](#) and [“VERITAS FlashSnap”](#) are covered in Chapter 7, [“Options.”](#)



Function Overview

This section gives an overview of Volume Manager's disk and volume functions. These topics are discussed in more detail in Chapter 4, "[Volume Manager Concepts](#)."

Basic and Dynamic Disks

Physical disks under Volume Manager's control are either basic or dynamic. When you install Volume Manager initially, all disks on a computer system are defined as basic disks. You can upgrade them to dynamic disks.

- ◆ Basic Disks

Basic disks adhere to the partition-oriented scheme of Windows NT, Windows 95/98, and MS-DOS. Basic disks can also contain RAID volumes that were created in NT Disk Administrator. In addition, CD-ROMs and removable media are considered basic disks.

- ◆ Dynamic Disks

Dynamic disks can contain dynamic volumes created with Volume Manager. The six types of dynamic volume layouts are simple, spanned, mirrored, striped, RAID-5, and mirrored striped (RAID 1+0). On a dynamic disk, space is organized through dynamic volumes rather than partitions.

Because a dynamic disk does not have the partitioning scheme used by Windows NT, Windows 95/98, and MS-DOS, you cannot access dynamic disks through those operating systems. If you have a dual-boot system with both Windows 2000 and an earlier Windows operating system or MS-DOS, you will need to retain some basic disks for use with the alternate operating system.

Basic and Dynamic Volumes

Volumes are defined as basic or dynamic, depending on whether they reside on a basic or dynamic disk.

- ◆ Basic Volumes

Basic volumes can be primary or extended partitions, simple logical drives that reside on extended partitions, or RAID volumes that were originally created in Windows NT Disk Administrator. Volume Manager allows you to maintain and repair these NT Disk Administrator basic volumes but not to create new ones.

- ◆ Dynamic Volumes

Dynamic volumes are volumes created on dynamic disks by using Volume Manager. You can create any number of dynamic volumes in unallocated space on one or more disks.

The volumes are created online without the need for rebooting (except a boot or system volume). Each volume can have a FAT, FAT32, or NTFS file system. You can do online extending of all dynamic volume types, and you can add up to 32 mirrors to any volume type, except RAID-5.

Although you cannot create new NT Disk Administrator-type volumes on a basic disk, you can upgrade them to dynamic. Then these volumes will have the full capabilities of other Volume Manager dynamic volumes. For more information, see the section [“Work with Basic Volumes Created in Windows NT Disk Administrator”](#) on page 132.

Disk Groups

All basic and dynamic volumes are required to be in a disk group. There is only one disk group for basic disks, known as the Basic disk group (or BasicGroup in the GUI). There can be one or more dynamic disk groups, which are known as dynamic disk groups. When you move disks between computers, you use the Import and Deport Dynamic Disk Group commands. When you use Microsoft Cluster Service software with Volume Manager, you upgrade a basic disk to a dynamic cluster disk instead of a dynamic disk. The disk group for clusters is called a cluster disk group. For more on disk groups and cluster disk groups, see [“Dealing with Disk Groups”](#) on page 164, [“Microsoft Cluster Service Support”](#) on page 383, and [“VERITAS Cluster Server Support”](#) on page 380.

Dynamic Volume Components

The components or virtual storage objects involved in a dynamic volume include its disk group, the dynamic disks it is associated with, and its plexes, columns, and subdisks. All of these items are discussed in more detail in the section [“Dynamic Volume Components”](#) on page 96.



General Disk Procedures

All physical disks—whether basic or dynamic—share some common procedures. This section describes disk functions that apply to all physical disks under Volume Manager’s control. It includes these topics:

- ◆ [Add a New Disk to Your System](#)
- ◆ [Add a Disk Signature to a Disk](#)
- ◆ [Remove a Disk from the Computer](#)
- ◆ [S.M.A.R.T. Monitoring](#)
- ◆ [Set Disk Usage](#)
- ◆ [Update Disk Information by Using Rescan](#)
- ◆ [Evacuate Disk](#)
- ◆ [Replace Disk](#)
- ◆ [Disk View](#)
- ◆ [Properties](#)

For the **Reactivate Disk** command, see “[Reactivate Disk Command](#)” on page 440. For the **Merge Disk** command, refer to the “[Merge Foreign Disk Command](#)” on page 174.

Add a New Disk to Your System

1. Install or attach the new physical disk or disks.
2. From the **Actions** menu, select **Rescan**.

A box displays the percentage completion for the rescan process. For more information on the **Rescan** command, see the topic “[Update Disk Information by Using Rescan](#)” in this section.

3. After the operation is finished, the VEA console displays current information.

If Volume Manager does not detect the new disk, you may need to reboot.

A brand new disk will have no signature. You can add a signature by using the **Write Signature** command described in the next section.

New disks are added to the computer as basic disks. You can upgrade new disks to dynamic disks at any time.

Add a Disk Signature to a Disk

A disk must have a signature on it before it can be used.

When you install a new disk and then do a **Rescan**, the new disk appears under the **Disks** icon. The disk will display with the message **No Disk Signature** in the tree view. The disk type is **No Disk Signature**. If left unsigned, the disk cannot be used.

▼ To add a signature to a disk:

1. Right-click on the unsigned disk.

The **Write Signature** command appears in the context menu. (The **Write Signature** command appears only if a disk does not have a signature on it.)

2. Select **Write Signature** from the context menu.

The Write Disk Signature dialog box will appear. Select the disks you wish to add a signature to.

To select a disk, click on it in the list of available disks and click the **Add** button. To select all the disks, click the **Add All** button.

To remove a disk from the Selected disks list, select the disk in the Selected disks list and click the **Remove** button. To remove all the disks from the Selected disks list, click the **Remove All** button.

3. Once you have selected the disks you wish to add a signature to, click the **OK** button. Click the **Cancel** button to exit without adding a signature to the disk or disks selected.

Once a signature appears on a disk, the disk will display as a basic disk. You can create partitions on the basic disk, or you can upgrade the disk to dynamic to create volumes on it.

Remove a Disk from the Computer

For information on removing a basic or dynamic disk from the computer, see the section [“Removing a Disk from the Computer”](#) on page 433.

S.M.A.R.T. Monitoring

Self-Monitoring, Analysis and Reporting Technology (S.M.A.R.T.) is available on many new SCSI disks. S.M.A.R.T. provides a way for disks to self-check certain physical conditions that are useful predictors of disk failure and send an alert when conditions indicate that a failure may occur soon. This allows the system administrator to take



preventive action to protect the data on the disk. In order to receive alerts in the Volume Manager Event Log, S.M.A.R.T. monitoring must be enabled for the global configuration and also on each disk you want checked. The default is to have S.M.A.R.T. monitoring disabled.

If S.M.A.R.T. predicts that a failure will occur, an alert is sent to the Event Log. See “[Event Notification](#)” on page 189 to learn how to also receive event notification by SMTP email, by pager, and through SNMP traps that can be displayed in HP OpenView, IBM Tivoli, and CA Unicenter.

▼ **To enable S.M.A.R.T. monitoring:**

1. Right-click on a disk for which you want to enable S.M.A.R.T. monitoring.
2. Select **S.M.A.R.T. Monitoring** from the context menu.

Note If the **S.M.A.R.T. Monitoring** command on the context menu is grayed out, then the S.M.A.R.T. monitoring technology is not available on that disk.

A S.M.A.R.T. monitoring dialog box will appear as shown below.



3. If it is not already checked, check the “Enable S.M.A.R.T. monitoring” checkbox in the global configuration.

The “Enable S.M.A.R.T. monitoring” checkbox acts as an on/off switch for the entire system and allows you to temporarily disable S.M.A.R.T. monitoring if desired.

4. Select the rate in hours for S.M.A.R.T. monitoring to occur.

Since this is a global configuration, the monitoring rate will be the same for all disks in the system. The default rate is one hour.

S.M.A.R.T. monitoring will use system resources as it checks the device.

5. Check the “Enable S.M.A.R.T. check on this device” checkbox at the bottom of the window to have S.M.A.R.T. monitoring be performed on the specific disk you selected.
6. Click **OK**.
7. Repeat steps 1, 2, 5, and 6 for each disk you want to monitor.

Set Disk Usage

This command is used to exclude a disk from certain operations by marking it as a spare, excluding it from Hot Relocation, or marking it as a reserved disk.

▼ To set disk usage:

1. Right-click on the disk you wish to modify.
2. Select **Set Disk Usage**.
3. The Set Disk Usage dialog will appear. Select any options you wish to implement.
4. Click **OK**.

For a complete explanation of this command, see “[Customize Target Disks with Set Disk Usage](#)” on page 266.

Update Disk Information by Using Rescan

When Volume Manager rescans disks, it scans all attached disks for disk configuration changes. It also updates information about removable media, CD-ROM drives, basic volumes, file systems, and drive letters.

Rescanning disks can take several minutes, depending on the number of hardware devices installed.

- You should rescan disks when you remove disks from or add disks to a computer.
- From the **Actions** menu, select **Rescan**.

If you click the Tasks button at the lower left corner of the VEA window, information on the progress of the rescan will display in the window’s lower pane.



See also the section “[Additional Important Information about the Rescan Command](#)” on page 439.

Evacuate Disk

The Evacuate Disk command moves the entire contents of a healthy disk to the free space on one or more dynamic disks. If there is a failed volume on the original disk, the volume cannot be moved, and an error message will appear.

▼ To evacuate a disk:

1. In the left pane, right-click on the disk you wish to evacuate.
2. Select **Evacuate Disk**.
3. The Evacuate Disk dialog will appear. Select either “Auto Assign destination disks” or “Manually assign destination disks.”
 - a. If you chose “Manually assign destination disks,” add the destination disks by clicking on each disk and clicking the **Add** button.
 - b. Remove disks from the selected destination disks by clicking on each disk and clicking the **Remove** button.
4. Click **OK** to evacuate the disk.

Replace Disk

Disks most often need replacing when they fail or start to behave strangely. A failed dynamic disk can be replaced by an empty basic disk. The volume configuration will be recreated on the new disk. Active redundant volumes (mirrored and RAID-5) on the replaced disk will be resynchronized automatically after disk replacement.

Failed volumes on the replaced disk, however, will stay failed after disk replacement because no valid data is available for copy.

The disk replacement procedure can only be performed on a disk that has failed. The VEA console identifies the disk by renaming it “Missing Disk.” If the disk replacement is successful, the replacement disk will take on the attributes of the failed disk, including the disk name.

Note This option is only available on Missing Disks.

▼ To replace a disk drive:

1. Right-click on the Missing Disk.
2. Select **Replace Disk**.
A dialog box appears containing a list of empty basic disks.
3. Select the disk you wish to use to replace the Missing Disk.
4. Click **OK** to perform the disk replacement.

If the original disk is returned to the system, it will show in the VEA console as a foreign disk and a disk group called Unknown Dg will be created. Use the **Merge Foreign Disk** command to return the disk to the same dynamic disk group it was in before. See “[Merge Foreign Disk Command](#)” on page 174 for information on this command.

Disk View

Right-click on a disk and select **Disk View** from the available options. Disk View provides detailed information about each disk and the organization of the data on the disks. For more information on the Disk View option, see “[Enhanced Disk View](#)” on page 53.

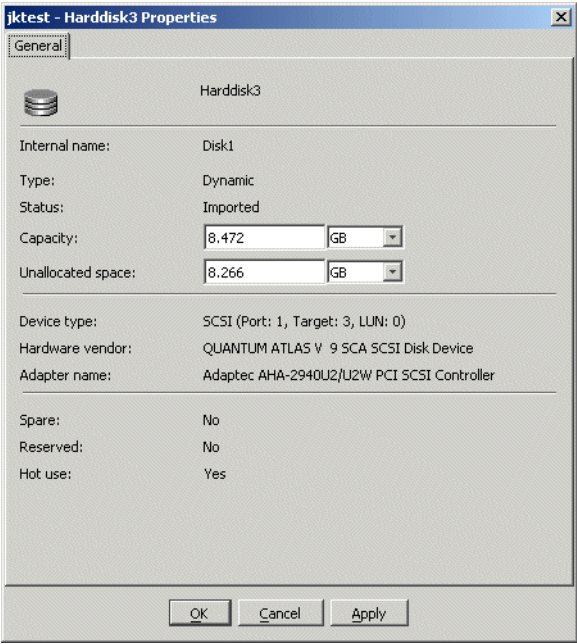
Properties

To check the properties of a disk:

1. Right-click the disk to be checked.
2. Select **Properties** from the context menu that appears.

The Properties window appears. The categories for the properties for a disk can differ, depending on whether the disk is basic or dynamic and whether it is direct-attached or a part of an array. The screen that follows shows an example of a Properties window for a dynamic disk.





The categories in the sample screen are as follows:

Category	Description
Name	The name of the hard disk is shown at the top of the window.
Type	Fields are Basic and Dynamic.
Status	Fields are Imported and Deported.
Capacity	Fields are Sectors, KB, MB, GB, TB.
Unallocated space	Amount of free space that is available to create a partition or volume.
Device type (Port, Target, LUN)	The Device type category includes SCSI, Fibre, and some other less commonly used types. Port refers to a controller card. A port has zero or more target IDs, and a target ID has one or more LUNs. LUN is the Logical Unit Number.
Hardware vendor	Vendor information from the disk itself.

Category	Description
Adapter Name	Gives information on the host bus adapter.
Spare	Indicates whether or not the disk has been designated as a hot spare.
Reserved	Indicates whether the disk is reserved—that is, excluded from use in automatic selection operations.
Hot use	Indicates whether the disk is to be used as a hot spare or to receive volumes from the Hot Relocation procedure.



General Volume Procedures

Just as basic and dynamic disks share some common disk procedures, basic and dynamic volumes also share common volume procedures. Those procedures are documented in this section. The section's topics are:

- ◆ [Add, Change, or Remove a Drive Letter or Path](#)
- ◆ [Mount a Volume at an Empty Folder](#)
- ◆ [Unmount a Volume](#)
- ◆ [View All Drive Paths](#)
- ◆ [Check Partition or Volume Properties](#)
- ◆ [Format a Partition or Volume with the File System Command](#)
- ◆ [Refresh Drive Letter, File System, and Partition or Volume Information](#)
- ◆ [Delete a Partition or Volume](#)

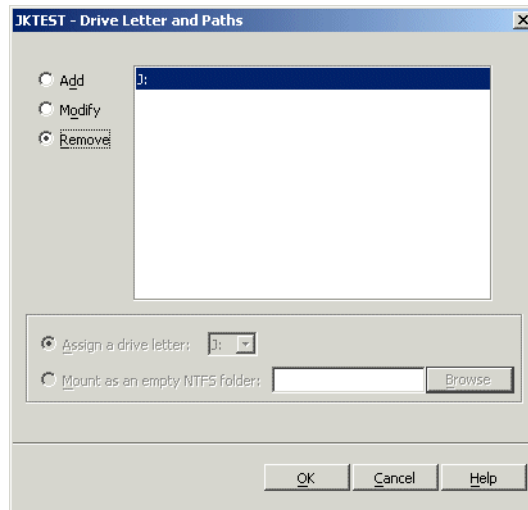
Add, Change, or Remove a Drive Letter or Path

You cannot change the drive letter or path on the active volume (the computer's boot volume). In previous versions of Volume Manager for Windows, the command **Change Drive Letter and Path** was on the context menu for a volume or partition. Now it is a subcommand under the **File System** command that is on the volume or partition context menu.

▼ To add, change, or remove a drive letter or path:

Caution Changing the drive letter or path of a partition or volume may cause programs installed on that partition or volume to no longer run.

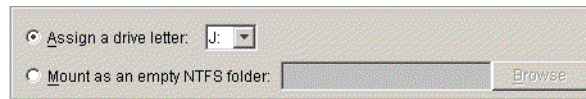
1. Right-click on the designated partition or volume, select **File System** from the context menu, and then select **Change Drive Letter and Path** from the File System submenu.
The Drive Letter and Paths screen appears.



2. Select **Add**, **Modify**, or **Remove** depending on what you want to do.

If a partition or volume does not have a drive letter, select **Add**. If you want to change an existing drive letter, select **Modify**. If you want to remove a drive letter or drive path, select **Remove**.

3. If you select **Add**, the “Assign a drive letter” box becomes available.



- a. Select the “Assign a drive letter” option and select a drive letter from the drop-down list.

Click **OK**.

Only drive letters that have not been assigned will be available.

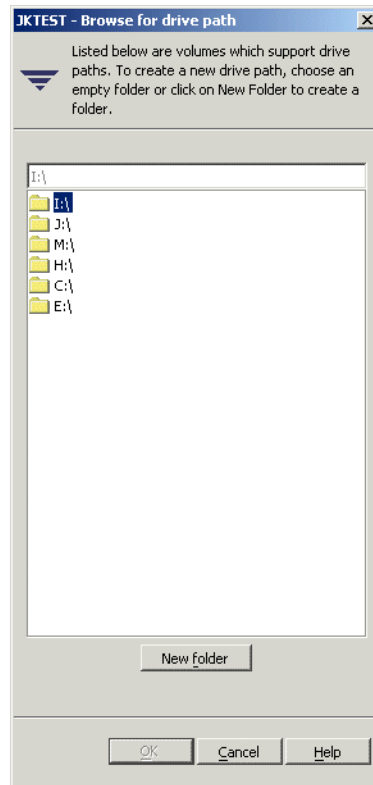
OR

- b. Select the “Mount as an empty NTFS folder” option.

Browse to select the empty folder by clicking the **Browse** button.

The Browse for drive path dialog appears:





Browse to the folder you wish to use, or create a new folder by using the **New folder** button. Once you have created and named the new folder, click **OK**. To exit the dialog without creating a new folder, click the **Cancel** button.

Click **OK** to mount the volume.

For details on mounting a volume at an empty folder, see “[Mount a Volume at an Empty Folder](#),” the next section in this chapter.

4. If you select the **Modify** option, the “Assign a drive letter” box becomes available.

Select a new drive letter from the drop-down list, and click **OK**. To exit the dialog without modifying the drive letter, click the **Cancel** button.

5. If you selected the **Remove** option, click **OK**.

Click **Yes** in the confirmation screen that appears.

Note If you try to assign a drive letter to a volume that is in use, a dialog box will ask you whether you want to forcibly reassign the drive letter. You can click **Yes** to do so.

If you want to modify an existing drive path, you will not be able to do so in this screen. You have to remove the drive path and recreate it. Select the **Remove** option. Then you have to invoke the command again to recreate the drive path with the **Add** button.

For details on mounting a volume at an empty folder, see “[Mount a Volume at an Empty Folder](#),” the next section in this chapter.

Mount a Volume at an Empty Folder

Volume Manager allows you to mount a volume at any empty folder on a local NTFS volume. Volume Manager assigns a drive path to the volume rather than a drive letter. Drive paths are useful because they eliminate the 24-drive-letter limit on hard-disk volume names. (Drive letters A and B are reserved for floppy drives.) The volume can be a partition, a logical drive that was created in Disk Administrator, or a dynamic volume.

For example, you can:

- ◆ Mount the C:\Temp folder as another drive to provide additional disk space for temporary files.
- ◆ Move the Program Files folder to a larger drive when space is low on drive C and mount it as C:\Program Files.

The only restrictions are that the folder you mount the volume to must be empty and it must be on an NTFS volume on a local computer. You cannot mount volumes to network-accessible drives. You can, however, assign multiple drive paths to a single volume.

Mounted drive folders are distinguished from ordinary folders by having a drive icon instead of the normal folder icon.

You can assign the drive path when you create the volume with the New Volume wizard at the Assign Drive Letter screen. You can also use the command **Change Drive Letter and Path** after the volume is created. A volume that already has a drive letter assigned can also have one or more drive paths. It does not have to be an unlabeled volume.

The **Change Drive Letter and Path** command is used to mount a volume. For more information, see “[Add, Change, or Remove a Drive Letter or Path](#)” on page 114. See also “[View All Drive Paths](#)” on page 118.

Unmount a Volume

To unmount a volume with a drive path, use the command **Change Drive Letter and Path**, select the drive path, and click **Remove**.



Note To modify a drive path, remove it, and then create a new drive path using the new location. You cannot modify the drive path directly.

View All Drive Paths

This command lets you view all volumes on a selected server that have a drive path.

▼ To view all mounted volumes:

1. Right-click the computer icon and select **View All Drive Paths**. In addition, if the computer icon is already selected, you can choose **View All Drive Paths** from the Actions menu.

The View All Drive Paths window appears.

2. If you want to unmount any volume listed in this window, select the drive path and click **Remove Drive Path**.

You can also use the **Change Drive Letter and Path** command to remove a drive path.

3. Click **OK**.

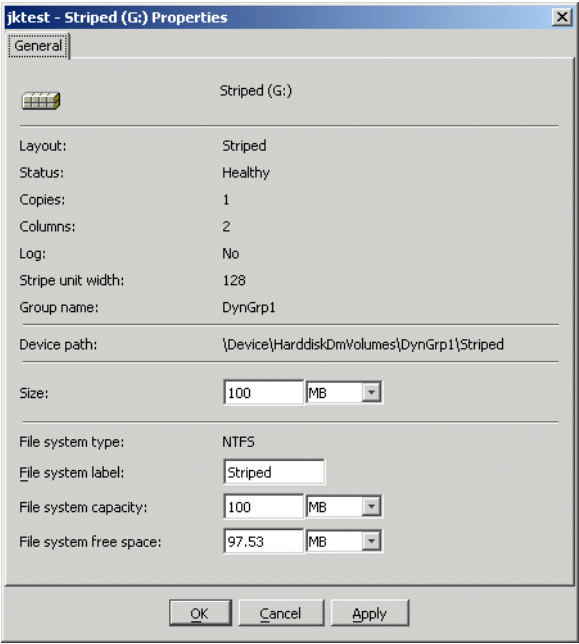
See also “[Mount a Volume at an Empty Folder](#)” on page 117 in this section.

Check Partition or Volume Properties

▼ To check the properties of a partition or volume:

1. Right-click the partition or volume to be checked.
2. Choose **Properties** from the context menu that appears.

The Properties window comes up. The categories for the properties for a volume differ, depending on the volume type. The screen that follows shows the Properties window for a striped volume.



The categories for the striped volume shown in the sample screen are as follows:

Category	Description
Name	The volume name is shown at the top of the window.
Layout	Indicates volume layout type. The layout categories are concatenated, striped, RAID-5, mirrored, mirrored striped.
Status	Status of the volume.
Copies	Number of mirrors the volume has.
Columns	Number of columns. It will be two or more for striped volumes.
Has log	Whether there is a DRL or RAID-5 log.
Stripe unit width	The amount of data in kilobytes that is striped across each physical drive in the striped volume.



Category	Description
Read policy	Applies if the volume is managed by a SCSI or Fibre Channel array controller and designates how the controller handles reads of the disk. Fields are read from the volume on the disk.
Group name	Basic or dynamic disk group the volume is associated with.
Device path	The path to the device.
Size	Size of the volume.
File system type	Fields are FAT, FAT 32, NTFS.
File system label	Optional label that you can designate when you create a volume. It also can be created through the operating system.
File system capacity	Total capacity of the file system on the disk.
File system free space	Free space on the file system for extending or creating dynamic volumes.

Format a Partition or Volume with the File System Command

In previous versions of Volume Manager for Windows, there was a **Format** command for formatting a partition or volume that was available from the partition or volume context menu. Now if you want to format a volume after it has been created, you select the command **File System** from the context menu and then choose the subcommand **New File System**.

▼ To format a partition or volume:

Caution All data in the partition or volume will be lost when you format it.

1. Right-click the volume or partition you want to format, click **File System** from the context menu, and then click the subcommand **New File System**.
2. Choose NTFS, FAT, or FAT32 as the file system to use.
3. Enter a label for the volume. This label appears on the VEA console. If a name has been selected, this name appears in this text box, but you can change it here.

4. Select an allocation size, or use the default, which is automatically selected.
5. If desired, select the formatting options:
 - Perform a quick format — Formats the volume or partition without scanning for bad sectors in the volume or partition.
 - Enable file and folder compression — Can be used only if you choose NTFS format.
6. Click **OK**.

A confirmation screen appears, warning that formatting will erase data.
7. Click **OK** in the confirmation screen to begin formatting.

You can view the percentage of completion for the formatting process in the bottom pane of the console, but the Tasks tab must be selected.

Refresh Drive Letter, File System, and Partition or Volume Information

To refresh, select **Refresh** from the Actions menu. The command refreshes drive letter, file system, volume, and removable-media information on the current computer. It also checks to see whether previously unreadable volumes are now readable. It may not pick up disk changes that occurred since the last reboot or rescan if there was no I/O occurring on the changed disk.

While the command runs, a progress bar displays the percentage of completion for the refresh process.

Delete a Partition or Volume

Caution All data in the volume or partition will be lost when you delete it. Make sure that the information has been backed up onto another storage medium and verified, or that it is no longer needed.

1. Right-click on the designated volume and select **Delete Volume**.
2. You are prompted for verification. Click **Yes** to delete or **No** to cancel. The volume is removed immediately if you click **Yes**.

Note You cannot delete the volume with the system files (the boot volume).



Working with Basic Disks and Volumes

This section describes the procedures for working with basic disks and volumes under Volume Manager's control. The topics are:

- ◆ [What Can You Do with a Basic Disk?](#)
- ◆ [Work with Removable Media](#)
- ◆ [Create Primary and Extended Partitions](#)
- ◆ [New Logical Drives](#)
- ◆ [Mark a Partition as Active](#)
- ◆ [Work with Basic Volumes Created in Windows NT Disk Administrator](#)
- ◆ [Restore Basic Disk Configuration](#)
- ◆ [Change a Basic Disk to Dynamic](#)
- ◆ [Troubleshoot Basic Disks and Volumes](#)

What Can You Do with a Basic Disk?

When you first install Volume Manager, all physical disks on your system are defined as basic. You can then upgrade them to dynamic disks.

A basic disk is managed with the standard partitioning scheme used by Windows NT, Windows 95/98, and MS-DOS, and may have partitions defined on it, but this is not required. A basic disk can contain up to four primary partitions or three primary partitions plus an extended partition. The extended partition may be further divided into logical drives.

You can create only primary and extended partitions on basic disks with Volume Manager. You should create partitions on basic disks if you want them to be accessible to computers running Windows NT 4.0, Windows 95/98, or MS-DOS.

You can also create new logical drives that reside in extended partitions. The logical drives are simple volumes that are limited to the space on the extended partitions. They cannot span multiple drives.

Basic disks can also contain RAID volumes that were originally created in Windows NT Disk Administrator, including simple and spanned volumes (volume sets), mirrored volumes (mirror sets), striped volumes (stripe sets), and RAID-5 volumes (stripe sets with parity). These volumes are also called "FT volumes" in Windows NT documentation. They are called "basic volumes" in the Windows 2000 Disk Management documentation.

Volume Manager allows you to maintain and repair these volumes but not to create new ones. Although you cannot create new NT Disk Administrator-type volumes on a basic disk, you can upgrade the existing volumes of this type to dynamic. Then these volumes

will have the full capabilities of other Volume Manager dynamic volumes. See “[Work with Basic Volumes Created in Windows NT Disk Administrator](#)” on page 132 in this section for more information.

Removable media are also considered basic disks by Volume Manager. You cannot upgrade these disks to dynamic.

Work with Removable Media

Volume Manager defines removable-media disks as Removable Disks and includes them in the Basic disk group. These include CD-ROM disks and other removable disks, such as Zip disks.

- ◆ You can create only one primary partition on removable-media devices. You cannot create extended partitions, logical drives, or dynamic volumes on removable-media devices. The primary partition must use up all unallocated space on the removable disk.
- ◆ You cannot upgrade removable-media devices to dynamic volumes.
- ◆ Removable-media devices can be formatted as FAT, FAT32, or NTFS.
- ◆ You cannot mark the primary partition on a removable-media device as active.
- ◆ You cannot delete the primary partition on a removable-media device.
- ◆ The **Eject** command allows you to eject a removable-media disk through the software rather than by a manual ejection mechanism.
- ◆ There is also a **Properties** command for the CD-ROM disk.



Create Primary and Extended Partitions

A partition is a portion of a physical disk that functions as if it were a physically separate disk. Partitions can be created only on basic disks. Partitions cannot span disks; they must be contiguous regions.

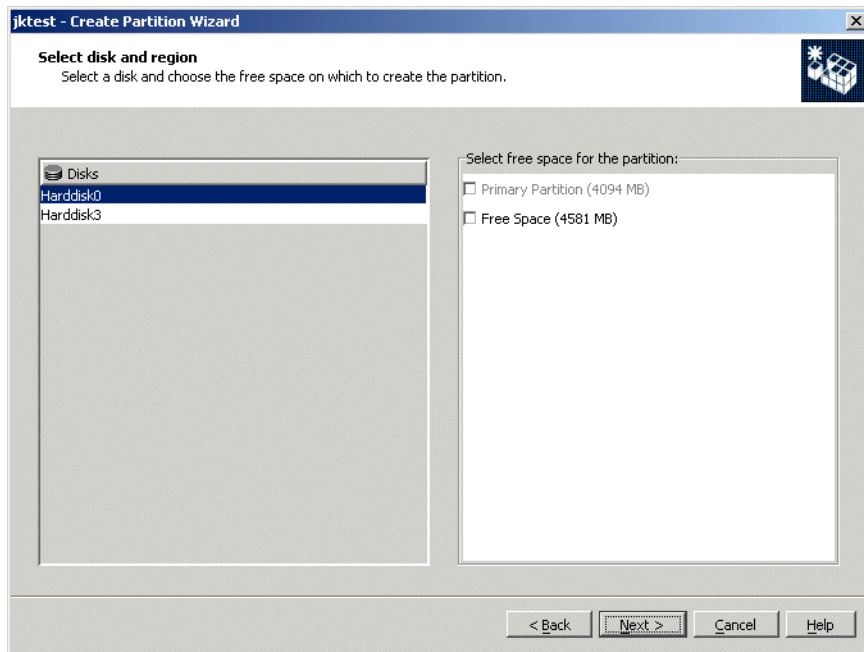
Use the Create Partition wizard to create primary partitions and extended partitions on a basic disk:

1. Select a basic disk, right-click to display the context menu, and select **New Partition**.

The Create Partition Wizard window appears.

2. Read the information on the first screen and then click **Next** to continue.

The Select disk and region window comes up.



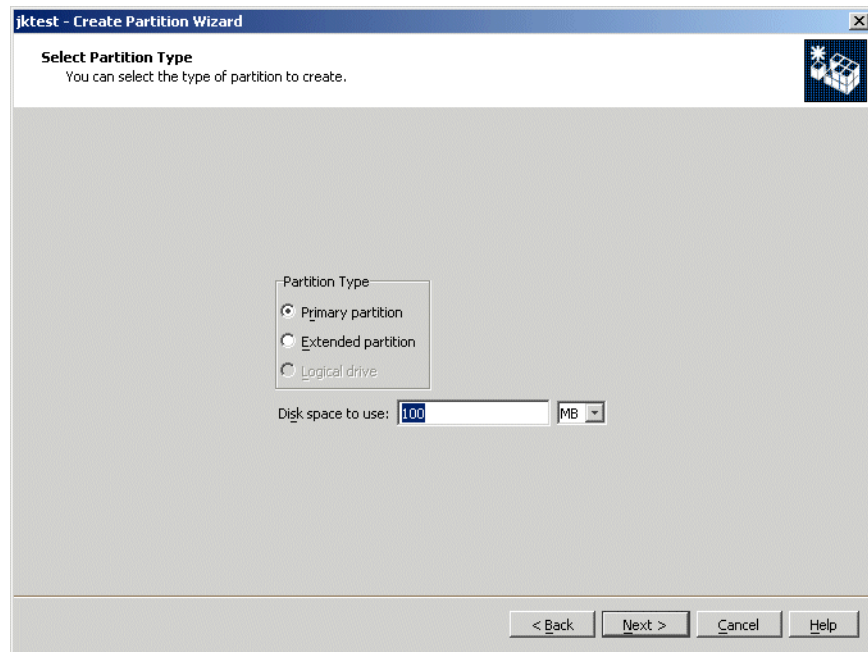
3. Select a disk and free space on which to create the partition.

The dialog box shows a list of available disks and free spaces. Check the box for the disk and free space you want to use, and click **Next** to continue.

If there is no free space on the selected disk, the free space selection and the **Next** button are grayed out. Click **Cancel** to exit the wizard.

Note If the free space selection is grayed out, you cannot continue. This can occur if the disk already has the maximum number of partitions (either four primary partitions or three primary partitions and one extended partition). It also can happen if the available free space is in an extended partition, because only logical drives (not partitions) can be created there.

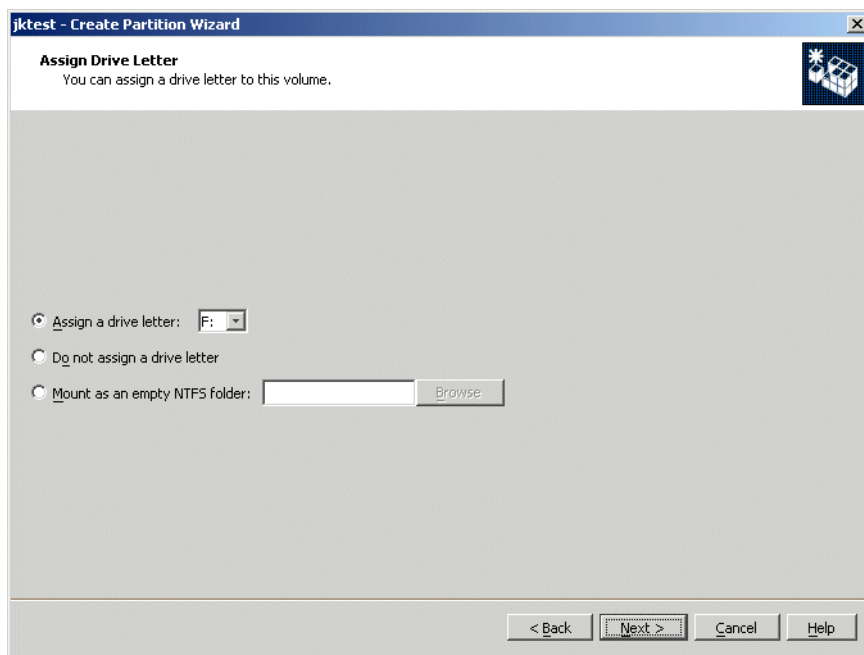
The Select Partition Type window comes up next.



4. Select a partition type (primary or extended) and indicate the size of the partition. The pull-down list to the right of the entry box for the disk space allows you to select either MB or GB. Click **Next** to continue.

The Assign Drive Letter screen comes up next.





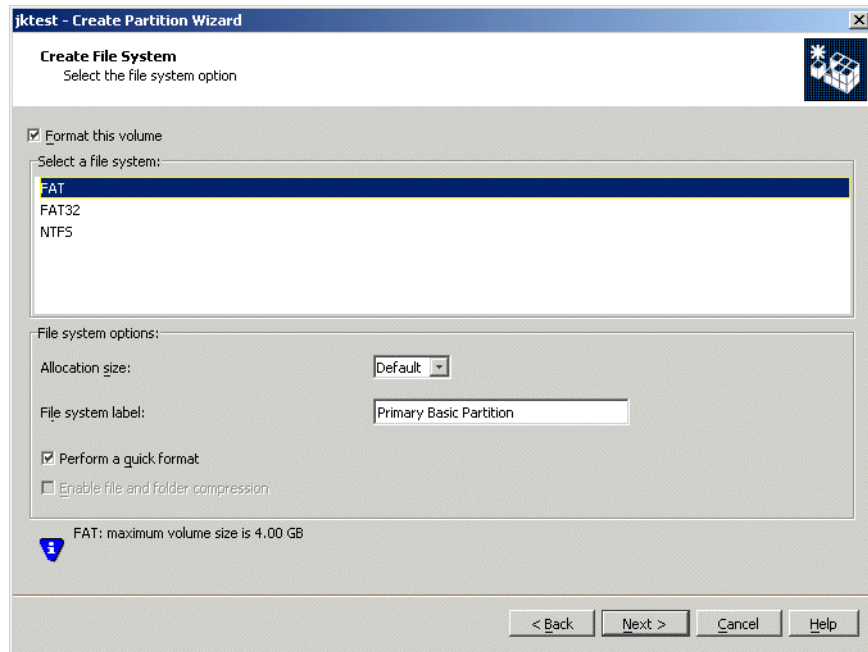
5. Assign a drive letter or drive path to this volume if you want to format the partition. You can also assign a drive letter after creating the partition. Click **Next** to continue.

When you mount a local drive as an empty folder on an NTFS volume, Windows 2000 assigns a drive path to the volume rather than a drive letter.

To mount a volume as an empty NTFS folder, click the radio button **Mount as an empty NTFS folder** and type the path to the empty folder, or click the **Browse** button to locate it.

For more information on mounting a volume as an empty NTFS folder, see the section [“Mount a Volume at an Empty Folder”](#) on page 117.

6. In the Create File System screen that appears next, select the “Format this volume” checkbox if you want to format the partition using NTFS, FAT, or FAT32.



- FAT (File Allocation Table) — A file system used by MS-DOS, Windows 3.x, and Windows 95/98. Microsoft Windows NT and Windows 2000 also can use the FAT file system. The operating system maintains a table to keep track of the status of various segments of disk space used for file storage.
- FAT32 (File Allocation Table) — An enhanced implementation of the FAT file system. FAT32 uses smaller cluster sizes; therefore, disk space is used more efficiently, disk performance is increased, and larger drives are supported.
- NTFS (NT File System) — An advanced file system designed for use specifically within the Windows NT and Windows 2000 operating systems. Use this format if you want to use file and folder compression. Note that NTFS cannot be used by MS-DOS, Windows 3.x, or Windows 95/98.

Note NTFS refers to NTFS 5. If you connect to an NTFS 4 machine, you will not have access to certain functionality, such as the quota tab.

7. Select an allocation unit size in bytes, if you want to use a size other than the default. Default settings are strongly recommended for general use.
8. To name the partition, type a label in the “File system label” entry box.
Give the volume a label that will be helpful to you in identifying it.



9. If desired, select the formatting options:

- Quick format — Use this method to skip scanning for bad sectors in the partition during formatting.
- Enable file and folder compression — Use this method to compress the folders and files that are added to the volume. This option is available only if the partition is being formatted with NTFS.

10. Click **Next** to continue.

The final screen displays the properties of the volume.

11. Click **Finish** in the final screen.

You can view the percentage of completion for the formatting process in the bottom pane of the console, but the Tasks tab must be selected.

New Logical Drives

An extended partition can be subdivided into as many as 32 logical drives. You can use all or part of the free space in an extended partition when creating logical drives. An extended partition or a logical drive cannot span multiple disks.

1. Right-click an extended partition from the left panel tree view, or click the Disk View tab in the right pane and right-click the extended partition in that view.

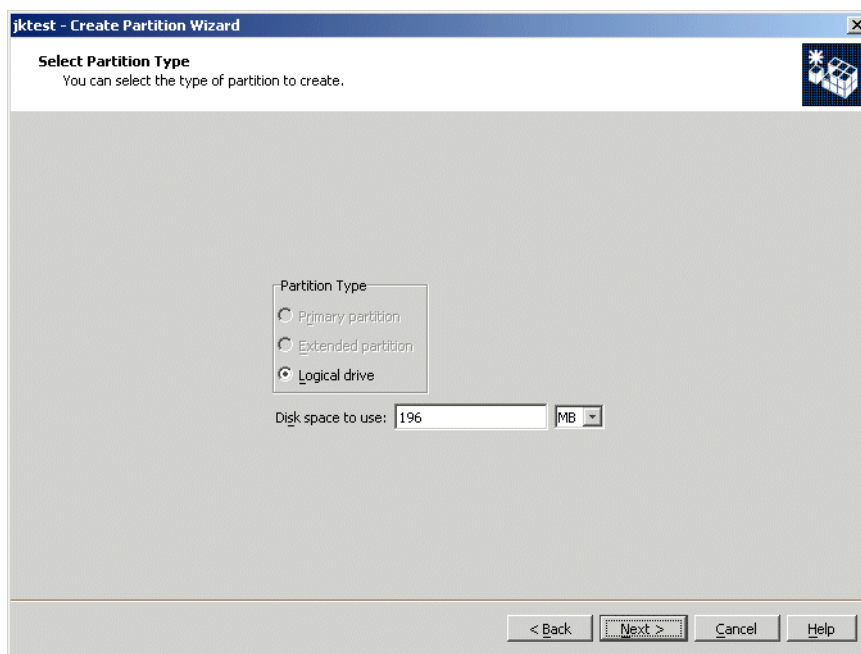
2. In the context menu that appears, click **New Logical Drive**.

The initial screen of the Create Partition wizard appears. Click **Next**.

3. Click the Free Space checkbox to select the free space to use for that logical drive. Click **Next**.

4. Click **Next** to move through the wizard's Select disk and region screen.

The Select Partition Type screen appears. The **Logical drive** radio button is automatically selected, and the screen displays the largest logical drive size that can be created in the extended partition. If desired, change the size of the disk space to use, or accept it as shown.



5. Type the size of the logical drive that you want to create, and then click **Next**.

The Assign Drive Letter screen appears.

6. Choose a drive letter, mount point, or neither (a drive letter can be assigned later). Click **Next** to continue.

The Create File System screen comes up next.

7. Select the file system type and options, and then click **Next** to continue.

8. Review your selections and click **Finish** to complete the process.

You can view the percentage of completion for the formatting process in the bottom pane of the console, but the Tasks tab must be selected.

Note You cannot mark a logical drive as active. An active volume or partition is the volume or partition from which the computer starts up.

Mark a Partition as Active

The **Mark Partition Active** command lets you designate a basic primary partition as active. An active partition is the partition from which the computer starts up. The system partition or volume must be a primary partition that has been marked as active for startup purposes and must be located on a disk that the computer accesses when starting up the system. There can be only one active system partition at a time, which displays as **Active** in the status field.

The **Mark Partition Active** command can be used only on a basic primary partition, not on a dynamic volume.

Note If you have a mirrored basic volume (a mirror set volume created in NT Disk Administrator), you must mark it as active with the separate command **Mark Volume Active**. For details, see “[Mark Volume Active](#)” on page 134.

1. Select the primary partition that contains the startup files for the operating system that you want to activate.
2. Right-click to display the partition’s context menu and click **Mark Partition Active** on that menu.

A message appears, advising you that the partition will be started when you reboot your computer.

3. Click **Yes** to proceed.

Note The names commonly used for partitions or volumes containing the startup and operating system files are the *system volume* and *boot volume*, respectively. The system volume refers to the partition or volume containing the startup files. The boot volume is a partition or volume that contains the operating system files. The boot volume can be (but does not have to be) the same as the system volume. The boot volume also cannot be part of a spanned, striped, or RAID-5 volume.



Work with Basic Volumes Created in Windows NT Disk Administrator

This section describes how you can work with basic volumes originally created in Windows NT Disk Administrator. You may have these legacy volumes if you upgraded to Windows 2000 from Windows NT 4.0 or earlier. In Windows NT documentation, these volumes are referred to as “FT volumes.” In Windows 2000 Disk Management documentation, they are known as “basic volumes.” They include spanned volumes (volume sets), mirrored volumes (mirror sets), striped volumes (stripe sets), and RAID-5 volumes (stripe sets with parity). The section’s topics are:

- ◆ [Choices with NT Disk Administrator Basic Volumes](#)
- ◆ [Retain NT Disk Administrator Basic Volumes](#)
- ◆ [Converting NT Disk Administrator Basic Volumes to Dynamic Volumes](#)

Choices with NT Disk Administrator Basic Volumes

You have two options with this type of volume:

- ◆ Continue to use the volumes as is on the basic disks.

Volume Manager allows you to maintain and repair NT Disk Administrator basic volumes but not to create new volumes. You would choose this option if you need to have these volumes accessed by other computers that are running Windows NT 4 or earlier.

- ◆ Upgrade the volumes to dynamic.

When you upgrade NT Disk Administrator volumes to dynamic, these volumes will have the full capabilities of other Volume Manager dynamic volumes. See the section “[Converting NT Disk Administrator Basic Volumes to Dynamic Volumes](#)” on page 135 for details on how Volume Manager converts these volumes to dynamic. However, once the volumes become dynamic, they can no longer be accessed by computers that are running Windows NT 4 or earlier.

Retain NT Disk Administrator Basic Volumes

If you choose to retain NT Disk Administrator basic volumes on basic disks, you need to be aware that Volume Manager has slightly different names for these volumes than the names used in NT Disk Administrator. This section describes Volume Manager’s naming convention and provides more information on the functions you can do with these volumes.

The following table shows the corresponding names used for these volumes in Volume Manager and in NT Disk Administrator:

Volume Manager Name	Windows NT Disk Administrator Name
Basic Primary Partition	Primary Partition
Basic Extended Partition	Extended Partition
Basic Logical Drive	Logical Drive
Basic Spanned Volume	Volume Set
Basic Striped Volume	Stripe Set
Basic Mirrored Volume	Mirror Set
Basic RAID-5 Volume	Stripe Set with Parity

With these partitions or volumes, you can do the general volume functions that Volume Manager provides for all volumes. These functions are:

- ◆ Add, change, or remove a drive letter
- ◆ Mount a volume at an empty folder
- ◆ Unmount a volume
- ◆ Check partition or volume properties
- ◆ Format a partition or volume, using the **File System** command
- ◆ Refresh drive letter, file system, or partition information
- ◆ Delete a partition or volume

See “[General Volume Procedures](#)” on page 114 for details on these functions.

In addition to these general volume functions, Volume Manager has four specialized commands for use with NT Disk Administrator basic volumes:

- ◆ **Resynchronize Volume** — Returns a basic RAID-5 or basic mirrored volume to a fault-tolerant state when there are minor errors on the disks that participate in these volumes or when disks have been removed and then replaced.
- ◆ **Repair Volume** — Repairs a basic RAID-5 or basic mirrored volume by creating a new portion of the volume on another disk.
- ◆ **Break Mirror** — Allows you to break off a mirror from a basic mirrored volume.
- ◆ **Mark Volume Active** — Allows you to mark a basic mirrored volume active.



For details on **Resynchronize Volume** and **Repair Volume**, see “[Resynchronize Volume \(FT Volume Only\)](#)” and “[Repair Volume \(FT Volume Only\)](#)” on page 443.

For details on **Break Mirror** and **Mark Volume Active**, see the following sections.

Break Mirror

Break Mirror allows you to break off a mirror from one of the disks of a basic mirrored volume that was originally created in Windows NT Disk Administrator.

1. Right-click the volume from which you want to break a mirror to bring up a context menu.
2. Click **Break Mirror**.

The following message appears: “If you break a mirror, your data may no longer be fault tolerant. Are you sure you want to break the mirror?”

3. Click **OK** to confirm.

The two portions of the mirror revert to basic primary partitions if they were mirrored primary partitions, or they become logical drives if they were mirrored logical drives. In either case, the two partitions or logical drives have different drive letters.

Note When you break off a basic mirror, you cannot add the mirror back again.

Mark Volume Active

Mark Volume Active allows you to mark a basic mirrored NT Disk Administrator volume active. An active volume is the volume that contains the system files that allow the computer to boot up. There can be only one active system volume at a time, which displays as **Active** in the status field.

1. Right-click the volume you want to make active to bring up a context menu.
2. Click **Mark Volume Active**.

The following message appears: “Marking a basic volume active will only mark underlying partitions active if they are primary partitions. Logical drives will not be marked active.”

3. Click **Yes** to enable the command.

Volume Manager marks the partition active.

Caution If you mark a basic mirrored volume active that does not contain the current system files, the computer will not be able to reboot. A basic disk that contains an unbootable active volume cannot be upgraded to dynamic.

Converting NT Disk Administrator Basic Volumes to Dynamic Volumes

You can upgrade basic disks containing these volumes to dynamic disks, and Volume Manager will convert the partitions into volumes of the appropriate type, preserving all data contained in them. This upgrade can be done on any basic disk, including those containing the system and/or boot partitions.

If you are upgrading a Disk Administrator basic volume that resides on multiple disks, you must upgrade all the basic disks that contain the multi-disk volume. You must upgrade all of these disks together. Each of the disks must have at least 1MB of unallocated space at the end of the disk or the upgrade will fail. This space is needed for the database information that Volume Manager uses to administer the volumes.

When you upgrade disks that contain partitions and NT Disk Administrator basic volumes, any existing partitions on the basic disk become simple volumes on the dynamic disks, and the other volumes become dynamic volumes of the corresponding type:

- ◆ A basic spanned volume (volume set) becomes a simple or spanned dynamic volume.
- ◆ A basic mirrored volume (mirror set) becomes a mirrored volume.
- ◆ A basic striped volume (stripe set) becomes a striped dynamic volume.
- ◆ A basic RAID-5 volume (stripe set with parity) becomes a dynamic RAID-5 volume.

For detailed instructions for converting a basic disk to a dynamic disk, see the section [“Change a Basic Disk to Dynamic”](#) on page 136.



Restore Basic Disk Configuration

The **Restore Basic Disk Configuration** command allows you to restore a disk configuration that was saved to a floppy disk through the Disk Administrator program in Windows NT 4.0 or earlier.

If you have installed Windows 2000 on a computer that also runs Windows NT 4.0 or earlier and want to restore a previous configuration, you can use this command. You must restore the configuration onto a basic disk.

Change a Basic Disk to Dynamic

In Volume Manager 2.7 and in earlier versions of the program, the command **Upgrade to Dynamic Disk** was used to change a basic disk to a dynamic disk. The command to change a dynamic disk back to basic was called **Revert to Basic Disk**.

In Volume Manager 3.0 and 3.1, the command to change a basic disk to dynamic is called **Add Disk to Dynamic Disk Group**, and the command to change a dynamic disk back to a basic disk is **Remove Disk from Dynamic Disk Group**. In Volume Manager 3.0 and 3.1, you need to create a dynamic disk group first with the command **New Dynamic Disk Group**. When you do create a dynamic disk group, you are able to specify basic disks for the group that become dynamic through the command. If you want to add more disks later, you use the **Add Disk to Dynamic Disk Group** command.

All of these commands are covered in the section “[Working with Dynamic Disks and Volumes](#)” on page 137.

Troubleshoot Basic Disks and Volumes

For more information on troubleshooting basic disks and volumes, see “[Troubleshooting](#),” Chapter 9. The following topics in that chapter will be especially helpful:

- ◆ [Bringing a Basic Volume Back to a Healthy State](#)
- ◆ [Resynchronize Volume \(FT Volume Only\)](#)
- ◆ [Repair Volume \(FT Volume Only\)](#)

Working with Dynamic Disks and Volumes

This section describes dynamic disk and volume procedures. The section's topics are:

- ◆ [Create Dynamic Disks](#)
- ◆ [Remove a Disk from a Dynamic Disk Group](#)
- ◆ [Create a Dynamic Volume](#)
- ◆ [Resize a Dynamic Volume](#)
- ◆ [More on Dynamic Boot and System Volumes](#)
- ◆ [More on Mirrored Volumes](#)
- ◆ [Capacity Monitoring on a Volume](#)
- ◆ [Merge Foreign Disk](#)
- ◆ [Troubleshoot Dynamic Disks and Volumes](#)

Create Dynamic Disks

In earlier versions of Volume Manager for Windows, the command **Upgrade to Dynamic Disk** was used to change a basic disk to a dynamic disk. The command to change a dynamic disk back to basic was called **Revert to Basic Disk**.

In Volume Manager 3.0 and 3.1, the command to change a basic disk to dynamic is called **Add Disk to Dynamic Disk Group**, and the command to change a dynamic disk back to a basic disk is **Remove Disk from Dynamic Disk Group**. In Volume Manager 3.0 and 3.1, you need to create a dynamic disk group first with the command **New Dynamic Disk Group**. When you create a dynamic disk group, you are able to specify basic disks for the group that become dynamic through the command. If you want to add more disks later, you use the **Add Disk to Dynamic Disk Group** command. This section on creating dynamic disks has three topics:

- ◆ [Considerations When Changing a Basic Disk to Dynamic](#)
- ◆ [Creating a Dynamic Disk Group](#)
- ◆ [Adding a Disk to a Dynamic Disk Group](#)

Considerations When Changing a Basic Disk to Dynamic

- ◆ You can change multiple basic disks to dynamic at one time when you use either the **New Dynamic Disk Group** command or the **Add Disk to Dynamic Disk Group** command.

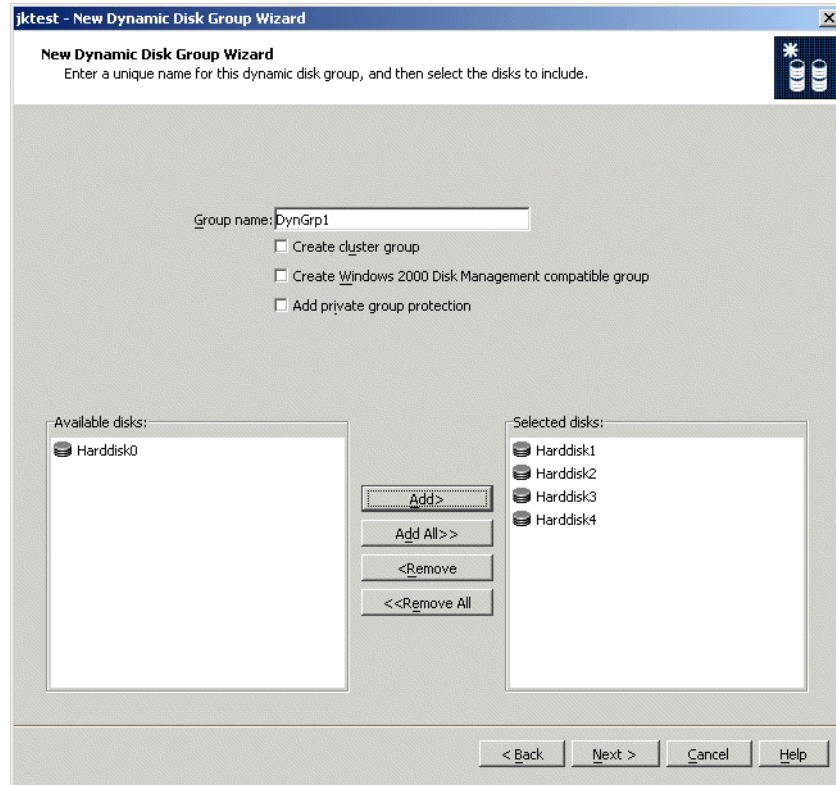


- ◆ Once you change a basic disk to a dynamic disk, the volumes on the disk cannot be accessed by MS-DOS, Windows 95/98, or Windows NT. The exception is a dynamic volume that is created under a version of Volume Manager for Windows NT 4 and thus is accessible in Windows NT 4.
- ◆ After you upgrade a basic disk to a dynamic disk and create dynamic volumes on it, you cannot change the dynamic volumes back to partitions or basic volumes. You can revert a dynamic disk to basic, but you must delete all dynamic volumes on the disk and then use the **Remove Disk from Dynamic Disk Group** command.
- ◆ If you are upgrading a disk that has multi-volume RAID sets that were created in Disk Administrator, see the section [“Converting NT Disk Administrator Basic Volumes to Dynamic Volumes”](#) on page 135.
- ◆ To create a bootable dynamic disk that can be mirrored, you must upgrade a basic disk that contains the system partition to a dynamic disk. For details, see the section [“More on Dynamic Boot and System Volumes”](#) on page 153.

Creating a Dynamic Disk Group

▼ To create a new dynamic disk group:

1. Right-click the Disk Groups folder or right-click a disk.
2. Select **New Dynamic Disk Group** from the context menu that comes up.
The New Dynamic Disk Group Wizard screen appears.
3. Click **Next** to continue.
A screen comes up for defining the attributes of the dynamic disk group.



4. Enter a name for the dynamic disk group, and indicate which disks you want to include in the group. Also consider whether you want the disks to be part of a regular disk group or one of the optional disk group types, which are defined in the table below. If you click none of the optional disk group type checkboxes, you will create a regular dynamic disk group.

If you already have disk groups on your computer that were created in Windows 2000 Disk Management or in Volume Manager 2.7 or earlier, you might want to consider the Disk Management compatible dynamic disk group type.

Make sure only the disks you want to include are listed in the right pane of the window (Selected disks), and click **Next**.

Note A dynamic disk group name is limited to 18 ASCII characters. It cannot contain spaces or forward or backward slashes. Also, a period cannot be the first character in the name.



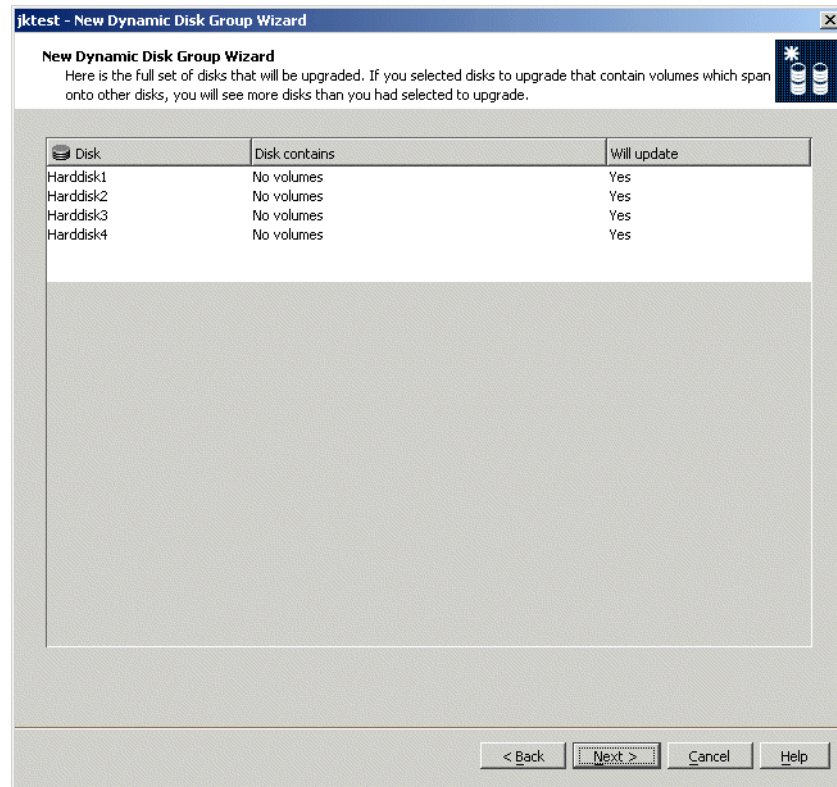
Optional Disk Group Types	Description
Cluster Dynamic Disk Group	Creates a cluster dynamic disk group that can be used with MSCS and VCS cluster manager programs.
Windows 2000 Disk Management Compatible Dynamic Disk Group	Creates a disk group that is compatible with the disk groups created in Windows 2000 Disk Management and in earlier versions of Volume Manager for Windows products. Because Volume Manager 3.0 and 3.1 disk groups have enhanced capabilities, they are not compatible with these earlier disk groups. You can upgrade the earlier-style disk groups by using the Upgrade Dynamic Disk Group Version command. For details, see the section “Upgrading a Dynamic Disk Group Version” on page 169.
Private Dynamic Disk Group Protection	The feature of private dynamic disk group protection makes it possible to partition shared storage with a regular dynamic disk group. For details, see “Partitioned Shared Storage with Private Dynamic Disk Group Protection” on page 177.

5. The next screen confirms the disks you have selected. Choose **Next** to continue if you are satisfied with the disk selection. If you are not satisfied, you can click the **Back** button to go back to the previous screen in order to modify your disk choices.

For each disk, information is provided on whether it contains volumes and whether it will be updated. If it is not going to be updated, you will want to modify the selection.

Normally, you would add all the disks you want in the group at this point. You can always add more disks later with the **Add Disk to Dynamic Disk Group** command.

Note If you selected disks that contain volumes that span disks, you will see more disks than you originally selected to upgrade. This would be the situation when you had FT volumes that were originally created in NT Disk Administrator. Those volumes will be converted to dynamic volumes.



6. Click **Finish** in the final screen.

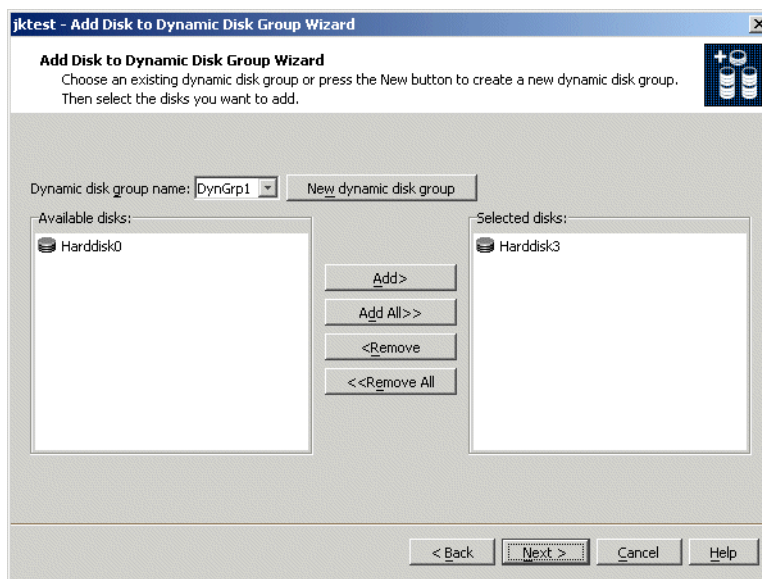
Adding a Disk to a Dynamic Disk Group

If you want to add more disks to a dynamic disk group after the group is created, use the **Add Disk to Dynamic Disk Group** command.

▼ To add a disk to a dynamic disk group:

1. Right-click a basic disk in the tree view or the Disk View tab in the right pane.
2. In the context menu that comes up, select **Add Disk to Dynamic Disk Group**.
3. The Add Disk to Dynamic Disk Group wizard appears. Click **Next** to continue.
4. In the next screen, select one or more disks and the dynamic disk group you want to add them to, and click **Next**.



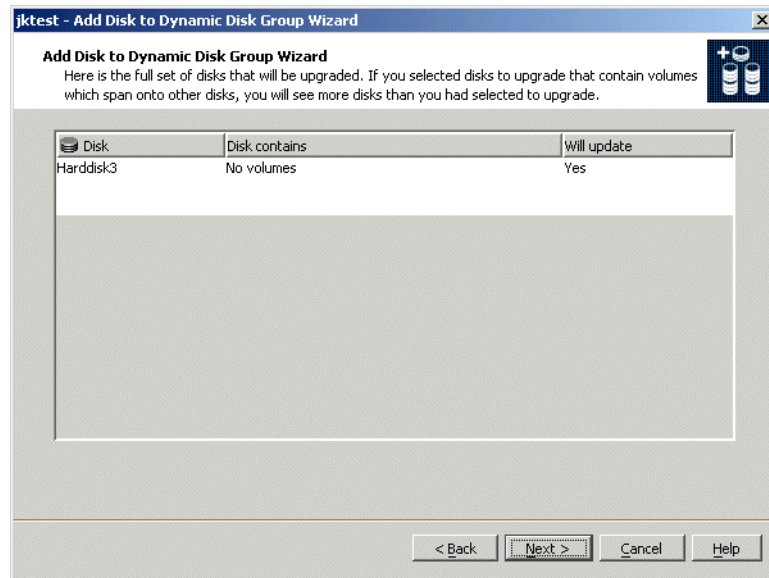


If you want to create a new dynamic disk group to add the disk to, click the New dynamic disk group button. The new dynamic disk group window appears to allow you to indicate the disk group name and characteristics.



For details on the options for creating a disk group, see [step 4](#) of the preceding procedure on creating a dynamic disk group.

5. A confirmation screen appears listing the selected disk or disks. Click **Next** to continue if you are satisfied with the selections, or choose **Back** to go back to modify your disk selection.



For each disk, information is provided on whether it contains volumes and whether it will be updated. If it is not going to be updated, you will want to modify the selection.

6. Click **Finish** in the final screen.

Remove a Disk from a Dynamic Disk Group

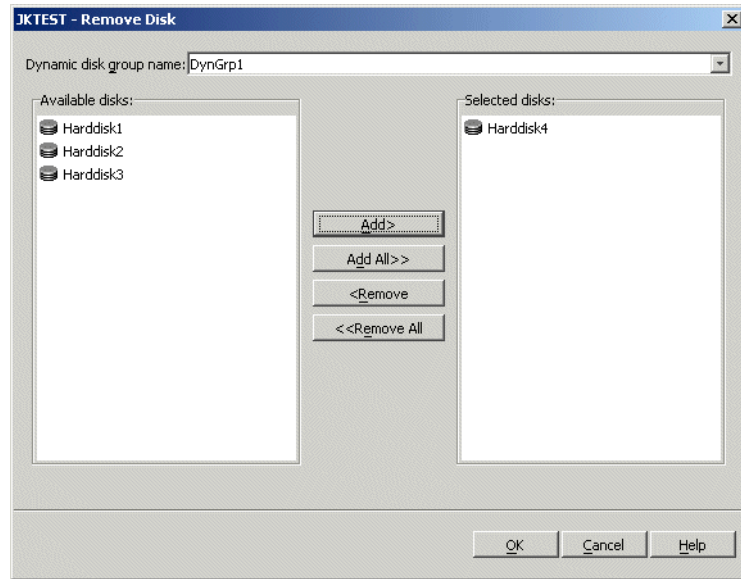
You can remove a dynamic disk from a dynamic disk group if there are no volumes on the disk. If volumes exist, you must delete them before you can remove the disk. Disks shown in Volume Manager to be Unreadable or Foreign can be removed, but doing so causes you to lose all existing data on the disk that is removed from the group. If a disk has failed and is marked as Missing, you can also remove it from the dynamic disk group. However, you cannot remove the last disk from a disk group that is an MSCS resource.

To remove a disk from a dynamic disk group, use the **Remove Disk from Dynamic Disk Group** command. Once you remove all the disks from a dynamic disk group, the disk group is removed from the GUI and the disk becomes a Basic disk.

▼ To remove a disk from a dynamic disk group:

1. Right-click on the selected disk or on the dynamic disk group and select **Remove Disk from Dynamic Disk Group**.
2. Make sure the proper disk or disks that you want to remove are showing in the right pane of the window, and click **OK**.





Create a Dynamic Volume

This section on creating a dynamic volume has some useful background information, as well as the detailed steps for successfully carrying out the procedure.

Background Information

Dynamic Volume Layouts or Types

There are five dynamic volume layouts or types—concatenated (simple or spanned), mirrored, striped, RAID-5, and mirrored striped (RAID 1+0). For a detailed description of the volume types, see “[Dynamic Volume Types](#)” on page 89.

Volume Size in the New Volume Wizard

It is important to understand that the total volume size you indicate for the volume in the New Volume wizard is the *usable* size for storing the data. Depending on the layout type, the volume can take more space on the disk. The size shown in the wizard for simple, striped, and spanned volumes is the actual volume size on the disk. A RAID-5 volume requires additional space for parity information, and a mirrored volume is a multiple of the space taken by the original plex of the volume.

The wizard provides a **Max Size** button to determine the size of the volume. Again, this is the usable size of the volume rather than the actual size taken by the volume on the disk.

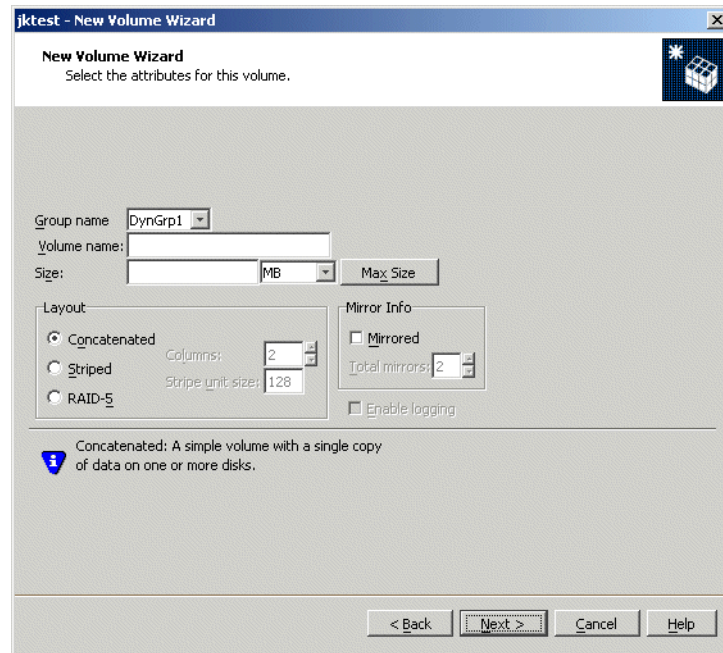
Steps for Creating a Dynamic Volume

1. Right-click a dynamic disk in the tree view, the right pane, or the Disk View tab, and select **New Volume** from the context menu that comes up.

You can also select the command from the Actions menu or click the New Volume tool on the toolbar (the third tool from the left side of the toolbar).

2. The New Volume wizard appears. Click **Next** to continue.





3. Select the attributes listed below for the volume, and click **Next** to continue.
 - a. A default dynamic disk group will appear in the Group name box. If you wish to create the volume in a different dynamic disk group, select it from the pull-down list.
 - b. The Volume name is a Volume Manager-specific name that is used in some Volume Manager commands. Enter a name in the “Volume name” text box.

A volume name is limited to 18 ASCII characters. It cannot contain spaces or forward or backward slashes. Also, a number or a period cannot be the first character in the name.

If you enter a volume name, Volume Manager will automatically assign the file system volume label the same name. If you later change the file system volume label through the **File System** command, the Volume Manager volume name and the file system volume label will be different. However, it will make little difference because the GUI identifies the volume by the file system label name except for the one entry that is listed as “Volume Name.” If you use the command line interface to create a volume, the file system name is not automatically changed to the name of the volume.

c. Select one of the following volume types:

- Concatenated
- Striped
- RAID-5
- Mirrored
- Mirrored Striped (RAID 1+0) — choose Striped and Mirrored

For a description of volume types, see “[Dynamic Volume Types](#)” on page 89. If you are creating striped or RAID-5 volumes, the Columns and Stripe unit size boxes need to have entries. Defaults are provided.

d. Provide a size for the volume. You can use the pull-down list to the right of the Size entry box to select Sectors, KB, MB, GB, or TB for indicating the volume size.

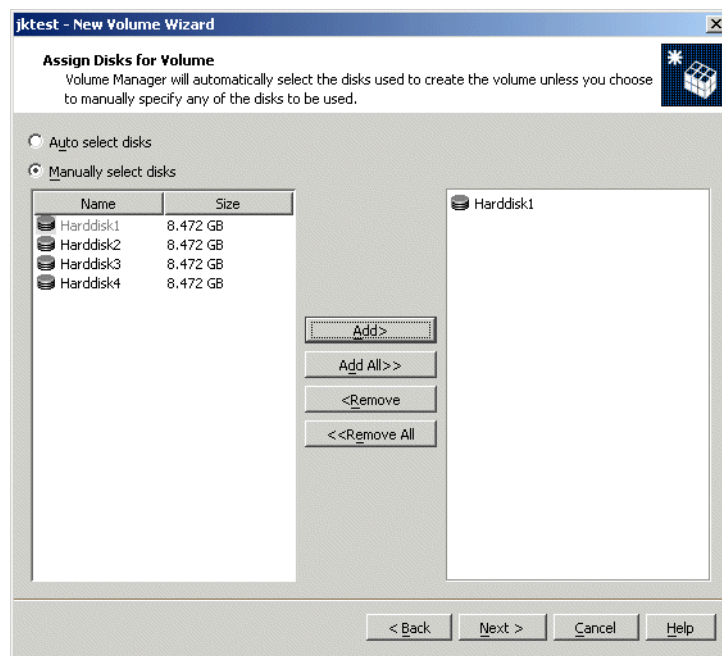
If you click on the **Max Size** button, a size appears in the Size box that represents the maximum possible volume size for that layout in the dynamic disk group. For a given dynamic disk group, the maximum volume size will depend on the type of layout selected.

4. Make your selections in the Assign Disks for Volume screen. Click **Next** to continue.

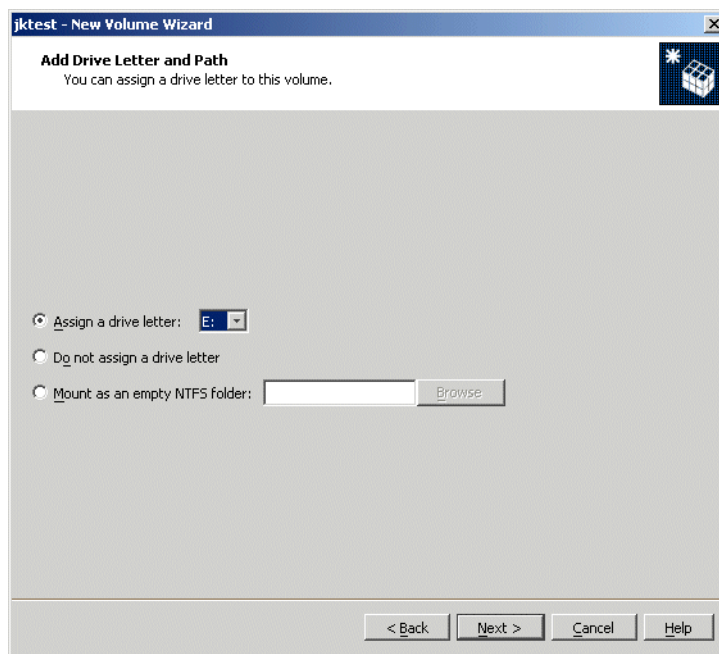
The default setting is for Volume Manager to assign the disks for you. To manually select the disks, click the “Manually select disks” radio button. The disks that you select should be in the right pane when you click **Next**.

The sample screen that follows indicates that Harddisk1 has been manually selected.

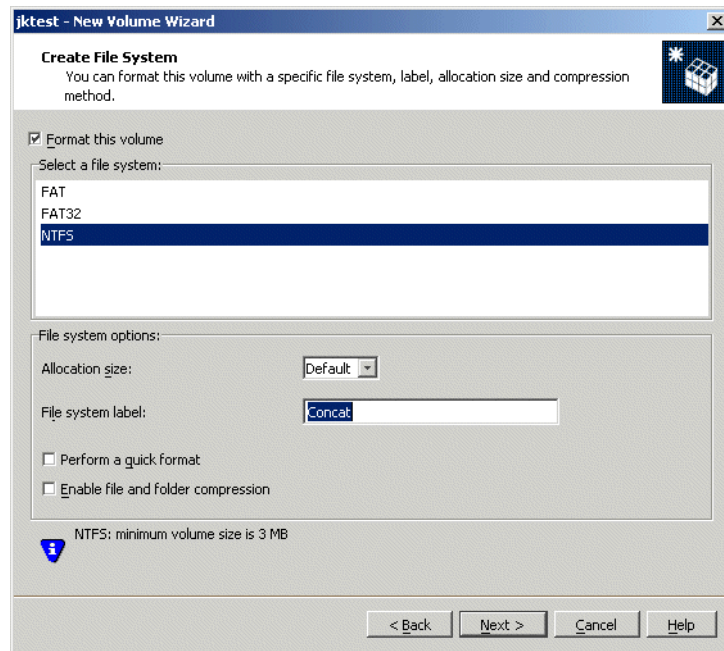




5. In the Add Drive Letter and Path screen, select one of the three choices described below, and click **Next**.
 - Assign a drive letter by using the pull-down list.
 - Do not assign a drive letter. You may prefer to do this task later.
 - Mount as an empty NTFS folder by clicking the option and then typing in a folder name or browsing to select the folder name. Volume Manager will create a new folder for you if you click the **New Folder** button in the Browse for Drive Path dialog box.



6. In the Create File System screen that appears next, indicate your choices for the file system selections that are described below, and click **Next**.
- Make sure that the “Format this volume” checkbox is checked if you want to format the volume using NTFS, FAT, or FAT32. You can uncheck the box if you want to format later.
 - Make sure the file system type that you want is highlighted if you want to format the volume now.
 - If desired, change the allocation size. The default size is recommended.
 - If desired, type a file system label. If you do not enter a label, no default label will be provided. You can enter a label for the file system later.
 - Decide if you want to perform a quick format. If the “Perform a quick format” box is not checked, the volume will be formatted with normal formatting.
 - If desired, check the “Enable file and folder compression” checkbox. This option is available only if the volume is being formatted with NTFS.



Note If you want to format the volume, create a file system label, or change any of the settings shown in the screen above after the volume is created, right-click the volume and select **File System** and the subcommand **New File System** from the volume context menu. You will be able to make your choices from a screen that has the same selections as the one above.

7. Check your selections in the final screen. When you are satisfied with your choices, click **Finish**.

By clicking the **Back** button, you can go back and make changes before you click **Finish**.

If you chose to format the volume, Volume Manager will begin the formatting process. Click the Tasks tab in the bottom left corner of the lower pane to see a text entry indicating the status and progress of the formatting process.

Resize a Dynamic Volume

The **Resize Volume** command allows you to increase a dynamic volume's size. You can have the program automatically assign destination disks, or you can manually assign these disks.

You can resize a volume only if:

- ◆ the volume is formatted with NTFS or is a raw dynamic volume
and
- ◆ there is unallocated space on a dynamic disk within the dynamic disk group onto which the volume can be extended.

You cannot resize a volume if either of the following is true:

- ◆ The volume is formatted with FAT or FAT32.
- ◆ There is not enough unallocated space available on the dynamic disks within the dynamic disk group to extend the volume.

You can extend volumes onto a maximum of 256 disks. No portion of an extended volume can be deleted without deleting the entire volume.

A system or boot volume is extended in increments of the disk's cylinder size and only into contiguous space at the end of the volume.

Note If a dynamic boot or system volume fails to extend, see the section "[Cannot extend a dynamic boot or system volume](#)" on page 447.

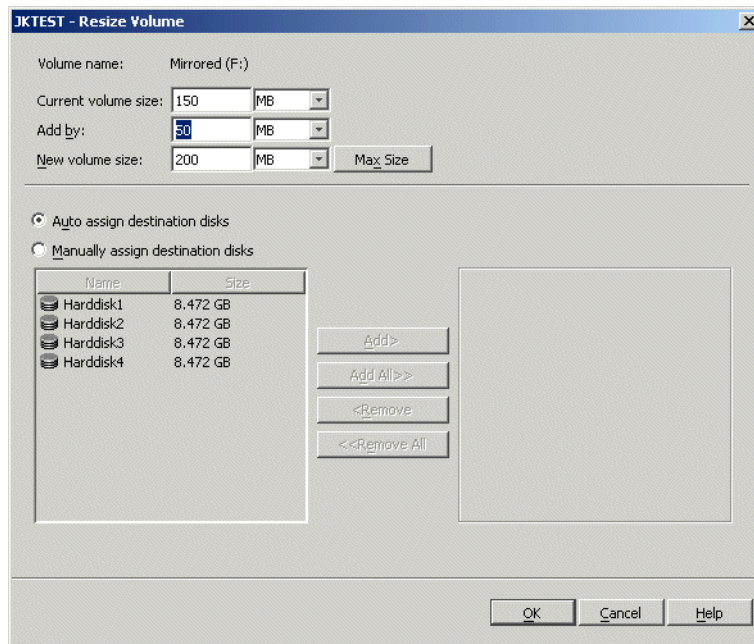


▼ **To resize a dynamic volume:**

1. Right-click the dynamic volume you want to resize, and then click **Resize Volume** in the context menu that appears.
2. Enter a number in either the “Add by” text box or the “New volume size” text box.
 - The “Add by” option allows you to add a specific amount to the volume by entering a number in the box.
 - The “New volume size” option allows you to specify the total volume size you want.

The drop-down lists next to the volume size text entry boxes allow you to indicate the size in Sectors, KB, MB, GB, or TB.

3. Choose to allow the default “Auto assign destination disks,” or click the “Manually assign destination disks” button to assign the disks manually. To assign the disk manually, use the buttons for adding and removing disks to move the disks you want assigned as destination disks to the right pane of the window.
4. Click **OK** to complete the command.



More on Dynamic Boot and System Volumes

This section includes additional important information on dynamic boot or system volumes. The topics are:

- ◆ [Making a Dynamic Volume Active](#)
- ◆ [Reinstalling Windows 2000 on a Dynamic Volume](#)
- ◆ [Mirroring the Boot and System Volumes](#)

Making a Dynamic Volume Active

In Volume Manager, you cannot mark a dynamic volume active directly. (The active volume is the volume from which the computer starts up.) However, you can upgrade a basic disk with a system partition that contains the Windows 2000 operating system to a dynamic disk. After the disk is upgraded and the computer is rebooted, the system partition becomes a system volume that remains active.

Upgrading a basic disk with a system partition to a dynamic disk preserves the partition table information, which is required when reinstalling Windows 2000.

Note After you upgrade a basic disk to a dynamic disk, you cannot change the dynamic volumes back to partitions. Instead, you must delete all the dynamic volumes on the disk and then use the **Remove Disk from Dynamic Disk Group** command.

Reinstalling Windows 2000 on a Dynamic Volume

You can perform a fresh installation of Windows 2000 on a dynamic volume only if that volume was upgraded from a basic volume, as described in the preceding paragraphs.

Mirroring the Boot and System Volumes

After you upgrade the disk or disks containing the boot and system partitions to a dynamic disk, you can mirror the boot and system volumes onto another dynamic disk. Then, if the disk containing the boot or system volume fails, you can start the computer from the disk containing the mirrors of the volume. For more information, see [“Mirroring a Dynamic Boot or System Volume”](#) in the next section, [“More on Mirrored Volumes.”](#)



More on Mirrored Volumes

The topics in this section are:

- ◆ [Two Methods for Creating a Mirror](#)
- ◆ [Adding a Mirror to a Volume](#)
- ◆ [Mirroring a Dynamic Boot or System Volume](#)
- ◆ [Breaking or Removing a Mirror](#)
- ◆ [Setting the Volume Read Policy](#)
- ◆ [Reactivating a Mirrored Volume](#)
- ◆ [Repairing a Mirrored Volume](#)

Two Methods for Creating a Mirror

- ◆ To create a mirror on an existing volume, use the **Add Mirror** command. See the next section, [“Adding a Mirror to a Volume.”](#)
- ◆ To create a new mirrored volume, use the New Volume wizard. You select a mirrored layout when you create the volume. See [“Create a Dynamic Volume”](#) on page 145.

Note The mirroring process is disabled if the volume cannot be mirrored or if there is no unallocated space on another dynamic disk large enough to mirror the volume. A RAID-5 volume cannot be mirrored.

Adding a Mirror to a Volume

1. Right-click on the volume you want to mirror.
2. Select **Mirror>Add** from the context menu.

The Add Mirror dialog box will appear.

3. Specify how many mirrors you want to add to the volume, and, if desired, manually assign the destination disks for the mirrors.

To assign the disks manually, click the “Manually select disks” radio button. Then use the buttons for adding and removing disks to move the disks you want assigned as destination disks to the right pane of the window.

4. A mirror will be created on each disk in the right pane. Click **OK** to add the mirror or **Cancel** to cancel the operation.

Note If you create more than one mirror at a time, you may see inconsistent information on the progress bar. Also, the generation of multiple mirrors does affect system resources. After creating a mirror, you may want to wait until it has finished generating before creating another mirror.

Caution Adding mirrors to a volume involves a certain amount of time for mirror resynchronization. Take care not to perform actions on the volume until the command is complete. Also, if you inadvertently shut down the server or deport the disk group containing the volume before mirror resynchronization completes, any mirrors that were being added to the volume will be deleted when the disk group with the volume comes online again.

Mirroring a Dynamic Boot or System Volume

This section presents items to consider when you plan to mirror a dynamic boot or system volume.

- ◆ If you plan to add a mirror to a dynamic system or boot volume, it is a good idea to create a boot floppy of the system partition. Then, if something goes wrong with the original system and boot volume or its mirror, you can boot your system from the floppy. Test the boot floppy while your system is in a known good state.

Note The boot floppy is called a “Windows 2000 startup floppy disk” in the Windows 2000 documentation. Search for this phrase on the Microsoft web site to locate instructions for creating this startup floppy disk. It must include the files **NTLDR**, **Ntdetect.com**, and **Boot.ini** from the Windows 2000 Setup CD.

- ◆ If you decide you want your system to boot from the mirror, make the necessary change to the **boot.ini** file.
- ◆ If a break-mirror operation is performed on a mirrored boot volume, the resulting new volume—the broken-off mirror—will not be usable as a boot volume.

Note If you are unable to create a mirror on a boot or system volume or get an error message during the process, see the section “[An attempt to mirror a boot or system volume fails or has an error message](#)” on page 448.

Breaking or Removing a Mirror

You can *break* or *remove* a mirror. It is important to understand the difference between these operations.



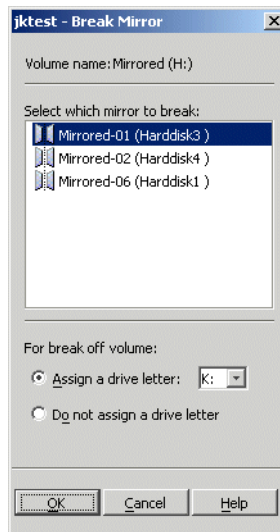
Breaking a mirror takes away a redundant mirror (or plex) of a volume and assigns it another drive letter. The data on the new volume is a snapshot of the original volume at the time of breaking. Breaking off a plex of the mirrored volume does not delete the information, but it does mean that the plex that is broken off will no longer mirror information from the other plex or plexes in the mirrored volume.

Removing a mirror from a volume “removes” or destroys the data from the selected mirror and leaves the other mirror or mirrors intact. After you remove a mirror, the space on the disk used by the removed mirror becomes unallocated free space.

Note Volume Manager does not allow you to remove the mirror of the volume that Windows 2000 is using to boot from. Also, if you break a mirrored boot volume, you cannot boot from the portion that was broken off.

▼ **To break a mirrored volume:**

1. Right-click on the volume from which you want to break a mirror. Click **Mirror** on the context menu that comes up, and then select **Break** from the submenu.



2. In the Break Mirror dialog box that appears, select the mirror you want to break off.

Choose whether or not to assign a drive letter to the broken-off volume. You may assign a specific letter from the drop-down list or accept the default.

When you are satisfied with your choices, click **OK**.

Once the command is completed, the broken-off plex is no longer part of the mirrored volume and is assigned a different drive letter than the original mirrored volume. The broken-off plex retains all other volume layout characteristics except the mirror. For example, if you had a mirrored striped volume, the broken plex would become a striped volume.

Note If you have a mirrored volume with two plexes and you break one off, the remaining plex is no longer a mirrored volume. It too assumes its other layout characteristics without the mirroring, but it does keep the drive letter of the original mirrored volume.

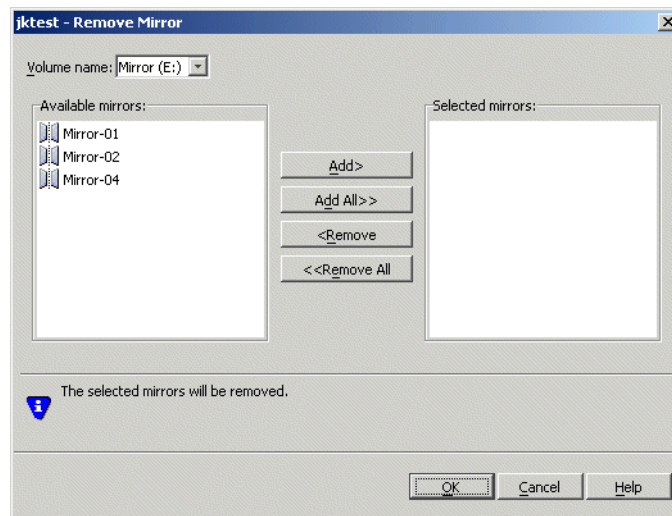
▼ **To remove a mirror from a mirrored volume:**

After a mirror is removed, the space formerly allocated to it reverts to free space.

Follow these steps to remove a mirror:

1. Right-click on the volume from which you want to delete the mirror.
2. Select **Mirror>Remove**.

The Remove Mirror dialog box will appear as shown below:



3. From the drop-down list next to the “Volume name” box, select the volume you wish to remove the mirror from. The name of the volume you right-clicked on will appear in this box by default.



4. The available mirrors will appear in the left pane. Use the **Add** or **Add All** button to move the desired mirrors to the list of mirrors selected to be removed in the right pane. To move mirrors from the Selected mirrors list to the Available mirrors list, select them in the right pane and click the **Remove** button. To move all of the mirrors from the selected mirrors list back to the available mirrors list, click the **Remove All** button.
5. Click **OK** to remove the mirror or mirrors.
6. Click **Yes** at the message warning you that removing mirrors will reduce the redundancy of the volume.

Caution When a mirror is removed, all of the data on the removed mirror is deleted.

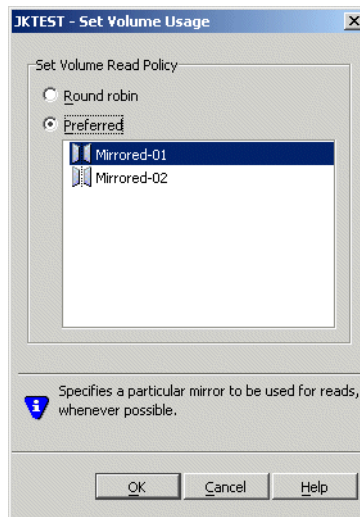
Setting the Volume Read Policy

Setting the read policy on a dynamic volume allows you to specify either that a particular mirror be used for reads or that all mirrors be read in turn in “round robin” fashion for each nonsequential I/O detected. The default is that mirrors be read “round robin.”

▼ To set the volume read policy:

1. Right-click on the volume you wish to set the read policy for.
2. Select **Set Volume Usage** in the context menu.

The Set Volume Usage dialog will appear.



3. Select either the Round robin or Preferred option.
 - a. The Round robin option reads each plex in turn in “round-robin” fashion for each nonsequential I/O detected. Sequential access causes only one plex to be accessed. This takes advantage of the drive or controller read-ahead caching policies.
 - b. If you select the Preferred option, you must select the mirror you wish to set as the preferred option from the list of mirrors shown. This mirror will be used for reads whenever possible.



This can improve your system's read performance, particularly if the drive used for the target mirror is a high-performance drive, or if the target mirror is located on a drive that is geographically closer.

If a mirror has already been set as preferred, you will see the text "(Preferred plex)" after the mirror's name in the dialog box.

Note When a preferred plex has an error, the read operation is completed by another plex. This happens automatically, as if there were no preferred plex.

4. Click **OK** to set the volume usage, or click the **Cancel** button to exit without setting the read policy.

Reactivating a Mirrored Volume

If there is a problem with one of the disks on which a mirrored volume resides, make sure that the disk is properly connected, and then try to bring that disk back online by first using **Rescan**. If **Rescan** does not work, then use the **Reactivate Disk** command. In most cases, **Reactivate Disk** will bring the disk online and all of the volumes will be healthy.

However, if any of the mirrors of the mirrored volume are still not healthy, you may need to resynchronize the degraded volume with the **Reactivate Volume** command. Resynchronizing makes the data consistent on all mirrors of a mirrored volume.

Right-click on the volume to bring up the context menu, and then click **Reactivate Volume**.

The mirrored volume should come back to a Healthy state unless there is a serious problem with the volume.

See also "[Rescan Command](#)" on page 438, and "[Reactivate Disk Command](#)" and "[Reactivate Volume Command](#)" on page 440.

Repairing a Mirrored Volume

When a disk on which a mirrored volume resides fails, the volume displays a Degraded status. The disk's name is changed to Missing, and an icon (X) appears on the Missing Disk icon. The status of the disk will be Offline.

For information on how to use the **Repair Volume** command to repair a mirrored volume, see the section "[Repair Volume Command for Dynamic Mirrored Volumes](#)" on page 442.

Capacity Monitoring on a Volume

Capacity monitoring is a feature that monitors the capacity of Volume Manager dynamic volumes so that when any volume reaches certain size thresholds, you are notified with an alert message. The purpose of capacity monitoring is to provide a warning when any dynamic volume has nearly reached full capacity.

You can select capacity monitoring for an individual volume by right-clicking the volume and selecting the **Capacity Monitoring** command from the volume's context menu, but you can also set capacity monitoring for all dynamic volumes on a selected server. This is done by through the Capacity Monitoring icon in the Control Panel of the tree view. For more information on setting up global capacity monitoring settings, see [“Capacity Monitoring for All Volumes”](#) on page 61.

Note Enabling or changing the global settings (from the Control Panel) will replace any prior individual capacity monitoring settings.

Whether you select capacity monitoring for an individual volume or for all volumes, a Capacity Monitoring window has the same setting options.

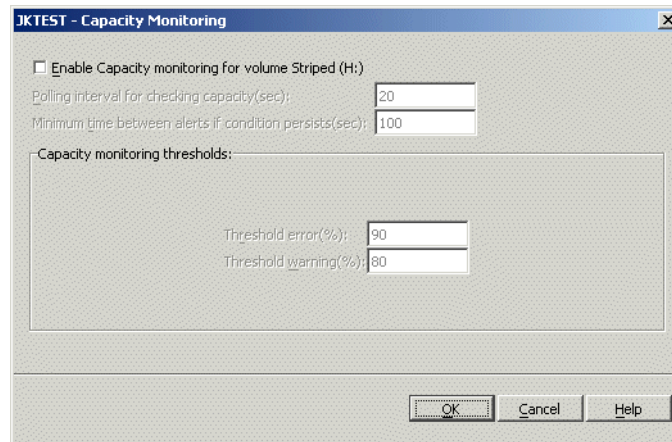
Capacity monitoring is off by default for all volumes and individual volumes. You turn it on through the Capacity Monitoring window. The Capacity Monitoring window also allows you to set the time intervals for checking volume capacities and to set thresholds for sending out alert messages. You may want to temporarily change capacity monitoring settings to plan for volume cleanup and extension.

▼ To change capacity monitoring settings for a volume:

1. Right-click the volume for which you wish to turn capacity monitoring on, and choose **Capacity Monitoring**.

The Capacity Monitoring window comes up.





2. Set the capacity monitoring parameters as follows.

- Check or uncheck the “Enable Capacity monitoring” checkbox.

Turns on and off Volume Manager’s monitoring of the capacity of the dynamic volume you have selected. The default setting is off.

- Type in the polling interval for checking the capacity, in seconds.

The polling interval is the interval at which Volume Manager checks volume capacities. The minimum and default value is 20 seconds.

- Type in the minimum time between alerts if condition persists, in seconds.

To keep the event log file from getting full, you can limit how often an alert message is generated after a capacity threshold is reached for a volume. The default is 100 seconds between messages.

- Type in capacity monitoring thresholds, in percentages.

Threshold Error: the percentage of volume capacity at which Volume Manager reports an error. The default is 90%.

Threshold Warning: the percentage of volume capacity at which Volume Manager sends out a warning message. The default is 80%.

Merge Foreign Disk

If you remove a disk from the server and delete it in Volume Manager and then decide to reattach it to the server as a member of the same dynamic disk group, you will need to use the **Merge Foreign Disk** command. This command will reinstate the disk to its old status as a member of its former dynamic disk group on that server. See “[Merge Foreign Disk Command](#)” on page 174 for more information.

Troubleshoot Dynamic Disks and Volumes

For more information on troubleshooting dynamic disks and volumes, see Chapter 9, “[Troubleshooting](#).” The following topics in that chapter will be especially helpful:

- ◆ [Bringing an Offline Dynamic Disk Back to an Imported State](#)
- ◆ [Bringing a Foreign Disk Back to an Online State](#)
- ◆ [Bringing a Dynamic Volume Back to a Healthy State](#)
- ◆ [Repair Volume Command for Dynamic RAID-5 Volumes](#)
- ◆ [Repair Volume Command for Dynamic Mirrored Volumes](#)



Dealing with Disk Groups

This section explains Volume Manager's disk groups and describes the procedures that are involved with dynamic disk groups. The section's topics are:

- ◆ [Disk Group Definition](#)
- ◆ [Creating and Deleting Dynamic Disk Groups](#)
- ◆ [Adding and Removing Disks from Dynamic Disk Groups](#)
- ◆ [Upgrading a Dynamic Disk Group Version](#)
- ◆ [Importing and Deporting Dynamic Disk Groups](#)
- ◆ [Merge Foreign Disk Command](#)
- ◆ [Partitioned Shared Storage with Private Dynamic Disk Group Protection](#)
- ◆ [Renaming Dynamic Disk Groups](#)
- ◆ [Dynamic Disk Group Properties](#)
- ◆ [Troubleshooting Problems with Dynamic Disk Groups](#)

Note The feature of Dynamic Disk Group Split and Join is covered in the section "[Dynamic Disk Group Split and Join](#)" on page 335.

Disk Group Definition

Volume Manager organizes disks into disk groups. Disk groups provide a way of organizing disks and simplifying storage management for systems with large numbers of disks. They also allow you to move disks between computers so that you can easily transfer the storage between computers. Topics in this section are:

- ◆ [Basic and Dynamic Disk Groups](#)
- ◆ [Moving Dynamic Disk Groups between Computers](#)
- ◆ [Primary and Secondary Dynamic Disk Groups](#)
- ◆ [Cluster Disks and Cluster Dynamic Disk Groups](#)
- ◆ [Array Groups](#)
- ◆ [Private Dynamic Disk Group Protection](#)

Basic and Dynamic Disk Groups

Volume Manager assigns one group for all basic disks, called the *Basic disk group*. Dynamic disks, however, can have multiple disk groups, which are called *dynamic disk groups*. Disks within a dynamic disk group share a common configuration. Dynamic volumes are created within a dynamic disk group and are restricted to using disks within that group.

When Volume Manager is run for the first time on a server, all disks are in the Basic disk group. In order to upgrade basic disks to dynamic, one or more dynamic disk groups have to be created with the New Dynamic Disk Group command.

Moving Dynamic Disk Groups between Computers

You can move a dynamic disk group between computers by deporting it on one computer, moving the disk or disks that contain the dynamic disk group to another computer, rescanning on the new computer, and then importing the dynamic disk group. You will be able to use the volumes from the imported dynamic disk group without having to reboot if you have hot-swappable disks.

Before moving the disks in a dynamic disk group, make sure that the disks are online and the volumes are healthy. You should move all disks that are part of the dynamic disk group; otherwise, the volumes will have Degraded status when the disks are moved to the other computer.

Primary and Secondary Dynamic Disk Groups

Volume Manager makes a distinction between primary and secondary dynamic disk groups. In the user interface, the primary or secondary designation is shown in parentheses after each dynamic disk group name.

For versions of the program before Volume Manager 3.0, the first dynamic disk group that was created or imported became the primary dynamic disk group. Any remaining disk groups were secondary dynamic disk groups. In Volume Manager 3.0 and 3.1, the primary dynamic disk group is the disk group that contains the computer's boot or system disk. Thus, in Volume Manager 3.0 and 3.1, if you have not included the computer's boot or system disk in any dynamic disk group, you will not have a primary dynamic disk group. The only exception is a primary dynamic disk group that was originally created in Windows 2000 Disk Management or an earlier version of Volume Manager and then the software for the storage that contained that disk group was upgraded to Volume Manager 3.0 or 3.1. In that situation, Volume Manager will retain the primary dynamic disk group label on this disk group. A primary disk group upgraded from Disk Management or an earlier version of Volume Manager software does not have to contain a boot or system disk.



In all versions of Volume Manager, only one primary dynamic disk group can exist on a single host computer. Additional groups that are created or imported on that computer are secondary dynamic disk groups.

You might wonder what happens in Volume Manager 3.0 or 3.1 if you have a primary dynamic disk group that was upgraded from Disk Management or earlier versions of Volume Manager and that has no boot or system disk and then you create another dynamic disk group that has the computer's boot or system disk. Once this second disk group is created, it becomes the primary dynamic disk group, and the other disk group that was upgraded from the earlier software becomes a secondary dynamic disk group.

The primary dynamic disk group that contains the computer's system or boot disk cannot be deported because doing so would make the computer unbootable.

Note A primary dynamic disk group should not be renamed.

The concept of importing dynamic disk groups is also used in Volume Manager in connection with a single computer. If a computer is rebooted, Volume Manager makes available or "auto-imports" the primary dynamic disk group and any secondary dynamic disk groups that previously existed on the computer before the reboot, providing these groups have not been deported to another computer.

Cluster Disks and Cluster Dynamic Disk Groups

Volume Manager has a special category of disk groups for disks involved in supporting Microsoft Cluster Service (MSCS) software and VERITAS Cluster Server (VCS) software. In order for Volume Manager to work with MSCS or VCS, you have to have installed the Volume Manager MSCS or VCS support option, and then you create a cluster dynamic disk group for the disks that are part of the cluster. To create a cluster dynamic disk group, you use the **New Dynamic Disk Group** command and click the Create Cluster Dynamic Disk Group checkbox. For details, see "[Microsoft Cluster Service Support](#)" on page 383 and "[VERITAS Cluster Server Support](#)" on page 380.

Array Groups

If a computer you are managing has Volume Manager software that supports physical and logical arrays on a hardware array controller, you will see array disk groups in the tree view and the General tab view. Array disk groups are called *Array Groups*. For details on arrays, see "[Arrays](#)" on page 44.

Private Dynamic Disk Group Protection

This feature, which was introduced in Volume Manager 3.0, allows you to partition shared storage on a SAN or shared array for exclusive ownership by a single machine. The storage is partitioned by using a secondary dynamic disk group. Private Dynamic Disk Group Protection provides hardware locking to the disks in the secondary dynamic disk group through a SCSI reservation thread. For details, see “[Partitioned Shared Storage with Private Dynamic Disk Group Protection](#)” on page 177.

Creating and Deleting Dynamic Disk Groups

Dynamic disk groups are created through the **New Dynamic Disk Group** command. For details about this command, see the section “[Creating a Dynamic Disk Group](#)” on page 138. Deleting a dynamic disk group can be done two ways. The recommended procedure is a two-part process. First, all the volumes in the dynamic disk group must be moved or deleted by using the **Delete Volume** command, then all the disks in the dynamic disk group must be removed from the disk group by using the **Remove Disk from Dynamic Disk Group** command. Once you remove all the disks from a dynamic disk group, the dynamic disk group will automatically be deleted. The alternative procedure is to use the **Destroy Dynamic Disk Group** command, which permanently removes the disk group and all its volumes in a one-step process.

Note All data in a volume will be lost when you delete the volume. Make sure that the information has been transferred elsewhere or that it is no longer needed.

Recommended Method for Deleting a Disk Group

▼ To delete a dynamic disk group by using the recommended method:

1. Delete each volume by right-clicking on the volume in the tree view or in the right-pane Disk View. Select **Delete Volume** from the context menu.
2. You are prompted for verification. Click **Yes** to delete the volume.
3. Repeat steps 1 and 2 until all volumes in the dynamic disk group have been deleted.
4. Right-click on the dynamic disk group to be deleted. Select **Remove Disk from Dynamic Disk Group** from the context menu.
5. In the Remove Disk window that appears, use the **Add** or **Add All** button to move all the disks in the dynamic disk group to the “Selected Disks” column in the right pane of the window.



6. Click **OK**. The dynamic disk group will be removed from the tree view automatically.

Alternative Method for Deleting a Disk Group

The alternative method for deleting a disk group is to use the **Destroy Dynamic Disk Group** command. Because this command permanently removes the disk group and all its volumes, please use caution in implementing this command.

▼ To delete a dynamic disk group with the alternative method:

1. Right-click the storage object representing the server being managed (the computer icon at the top of the tree for the server being managed).

2. Select **Destroy Dynamic Disk Group** from the context menu that appears.

Note that this command is not available from the context menu for the disk group itself. This is intentional because once this command is implemented, there is no way to undo the command and recover the data.

3. Enter the name of the dynamic disk group you want to delete in the dialog box that appears.

4. Click **OK**.

A confirmation box appears asking if you are sure you want to destroy the disk group.

5. Click **Yes** to delete the dynamic disk group or **No** to cancel the operation.

After the dynamic disk group is destroyed, the disks revert to basic disks and become part of the Basic disk group.

Caution This command permanently removes all volumes and disks within the disk group.

Adding and Removing Disks from Dynamic Disk Groups

Adding and removing disks from dynamic disk groups are covered earlier in this chapter. See [“Adding a Disk to a Dynamic Disk Group”](#) on page 141 and [“Remove a Disk from a Dynamic Disk Group”](#) on page 143.

Upgrading a Dynamic Disk Group Version

If you have upgraded to Volume Manager 3.0 or 3.1 from an earlier version of Volume Manager for Windows 2000 or another program in the Volume Manager for Windows product line and have existing dynamic disk groups that you created on your system, you most likely will want to upgrade those dynamic disk groups so that they are compatible with the dynamic disk group capabilities that were first introduced with Volume Manager 3.0.

If you don't plan to make changes to these existing disk groups, you do not have to upgrade them; upgrading them allows you to use additional disk group features, such as private disk group protection and disk group split and join.

If you upgrade a disk group, it will not be accessible from Disk Management or earlier versions of Volume Manager. Once a disk group is upgraded, it cannot be changed back to the Disk Management compatible disk group type.

▼ To upgrade a dynamic disk group version:

1. In the tree view, right-click the disk group you want to upgrade and select **Upgrade Dynamic Disk Group Version** from the disk group context menu.

A confirmation screen appears with the text “Are you sure you want to upgrade the dynamic disk group?”

2. Click **Yes** to upgrade the dynamic disk group.

Note In earlier versions of Volume Manager for Windows 2000 or Windows NT, it was possible to have a dynamic disk group name longer than the 18-character limit that was put into effect with Volume Manager 3.0. If you upgrade the dynamic group version of such a disk group, you will be asked to shorten the name. It is possible that you will be asked to shorten the name to fewer than 18 characters if the disk group's volumes also have very long names.



Importing and Deporting Dynamic Disk Groups

Volume Manager supports deporting and importing of dynamic disk groups. This feature allows you to move disks belonging to a dynamic disk group between computers and make their storage available for use. If you have hot-swappable disks, it is possible to move disks between systems without a system shutdown and reboot.

Note You must have administrator privileges on the source and destination computers to be able to move Volume Manager storage between computers.

Because you must deport a dynamic disk group on one computer before importing it on another, deporting is covered before importing.

The topics in this section are:

- ◆ [Deporting Dynamic Disk Groups](#)
- ◆ [Importing Dynamic Disk Groups](#)

Deporting Dynamic Disk Groups

The **Deport Dynamic Disk Group** command stops access to disks. If you are moving hot-swappable disks between computers, it is important to use the **Deport Dynamic Disk Group** command. Using the command ensures that the data has been preserved in a clean state before you move the disks to the other computer. The **Deport Dynamic Disk Group** command also clears the host ID of the computer on which the disk group is located, so that it can be imported on another computer.

▼ To deport a dynamic disk group:

1. Stop all processes using the volumes in the dynamic disk group, including all I/O to files.

If you do not stop volume processes, there is the possibility that data written to internal buffers may not get written to disk, resulting in data loss. It is also recommended that you back up all data on your volumes before you move disks to another computer.

2. Make sure the status of the volumes on the disks is Healthy.

If the status is not Healthy, you should repair the volumes before you move the disks.

Note Though it is possible to deport dynamic disk groups containing volumes that are actually in a Degraded state, this is not recommended. If a disk failed during transport between systems or during the import, it is possible that data would be lost for volumes running in the Degraded state.

3. Right-click on a disk name in the dynamic disk group or the dynamic disk group name in the tree view, and select **Deport Dynamic Disk Group** from the menu that appears.

A warning message asks if you are sure you want to deport the disk group.

4. Click **Yes** if you wish to deport the dynamic disk group or **No** if you decide not to deport the dynamic disk group.

The process of deporting a dynamic disk group puts the contained disks in the Offline state and all volumes in the Stopped state. This applies only while the dynamic disk group is deported. Once an **Import Dynamic Disk Group** command is issued, disks will come back online and volumes will return to the state they were in at the time of the deport (assuming that all the disks in the disk group are present).

5. Remove the disks from the current system.

If the disks are hot swappable, you can move disks between systems without performing a system shutdown. If the drives are NOT hot swappable, it is necessary to shut down and power off the computer to remove or install the drives.

You may need to prepare disks for removal in some cases. See your hardware manual for information.

Note Be sure to move all the disks that are members of the dynamic disk group at the same time.

Normally, you need to move all the disks in the dynamic disk group to the other computer. The only exception would be if you were moving disks temporarily to another computer to copy one or more of the volumes that resided on some of the disks. In that case, when you import the disks to the other computer, the volumes that are not complete because of missing disks will display a Missing status. If you reactivate the disks and the volumes, the true status of the volumes will appear, such as Failed or Degraded. Once you move the disks back to the original computer, rescan, and reimport the dynamic disk group, all the volumes in the dynamic disk group should come back in a Healthy state. You may need to use the Merge Foreign Disk command. For details, see [“Merge Foreign Disk Command”](#) on page 174.

Note Volume Manager does not allow you to deport a cluster disk group that is an MSCS Volume Manager disk group resource.



Importing Dynamic Disk Groups

Note Normally, you cannot import a dynamic disk group on a computer without having deported it on the computer where the disk group was located previously. However, the **Import Dynamic Disk Group** command has an option to clear the host ID of the previous computer, so that you can do an import operation. This option should be used with caution.

Once you have deported a dynamic disk group and disconnected the disks from the original machine, do the following to import the dynamic disk group:

1. Reinstall the hardware in the destination machine.
2. If the disks are hot swappable, open the VEA console on the destination machine and issue a **Rescan** command. If the system had to be shut down to install the disks, it will have done a rescan automatically during the reboot.

Once the rescan completes or the system reboots, the dynamic disk group and disks should be listed; but the dynamic disk group will be in a Deported state, and the disks will be in the Offline or Foreign state.

Note Occasionally, you may have to rescan a second time to get the disks showing as Offline or Foreign, particularly if you do the first rescan very quickly after installing the disks on the second computer system.

3. Right-click on a disk name in the dynamic disk group or the dynamic disk group name in the tree view, and select **Import Dynamic Disk Group** from the menu that appears.

4. If you want to change the dynamic disk group's name, type in a new name for the group in the screen that comes up.

The dynamic disk group name is limited to 18 characters. It cannot contain spaces or forward and backward slashes. Also, a period cannot be the first character of the name.

If the disk group you are importing has a name longer than 18 characters (as was possible in earlier versions of Volume Manager), you may be asked to shorten the disk group name at this point. It is possible that you will be asked to shorten the name to fewer than 18 characters if the disk group's volumes also have very long names.

Note Do not rename a dynamic disk group that contains a system or boot volume. See the section [“Error that the boot device is inaccessible, Bugcheck 7B”](#) on page 453 for details.

5. If you have not done a deport command on the computer where the disk group was located previously, click the checkbox to clear the host ID of the other computer.
6. Click **OK** to import the dynamic disk group.

If the volumes in the dynamic disk group come up as Failed or Degraded, see the section [“Repairing a Volume with Degraded Data after Moving Disks between Computers”](#) on page 436.



Merge Foreign Disk Command

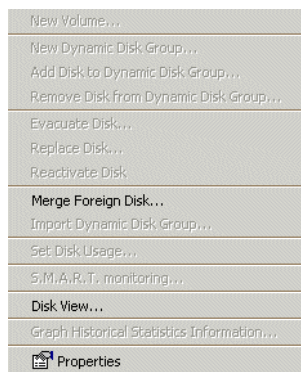
If you remove a disk from the server and also remove it in Volume Manager and then decide to reattach it to the server as a member of the same dynamic disk group, you will need to use the **Merge Foreign Disk** command. This command will reinstate the disk to its old status as a member of its former dynamic disk group on that server.

You will also need to use this command if you remove a disk without taking its disk group offline, move the disk to another server, and then attempt to reinstall it in the original server. The command is necessary in this case because the disk has the other server's disk group ID.

In Volume Manager 3.0 and 3.1, this command will probably not need to be used very often, because if a disk is removed from a computer that has subdisks from a redundant volume (such as a RAID-5 volume or a mirrored volume), the **Hot Relocation** command will automatically rebuild the missing subdisk on the volume. However, if the Hot Relocation feature is turned off, you may need this command. For more on Hot Relocation, see "[About Hot Relocation Mode](#)" on page 262.

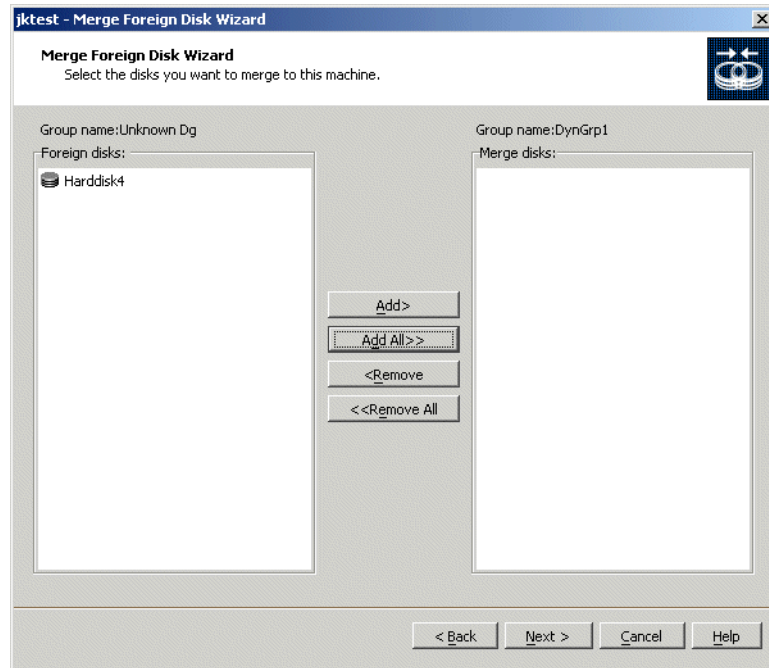
▼ To use the Merge Foreign Disk command:

1. Reattach the disk to the original server.
2. In the VEA console, do a rescan (select **Rescan** from the Actions menu). The disk will show up in the tree with a red X. Its dynamic disk group will display as "Unknown Group."
3. Right-click the disk label in the tree view to bring up the disk context menu.



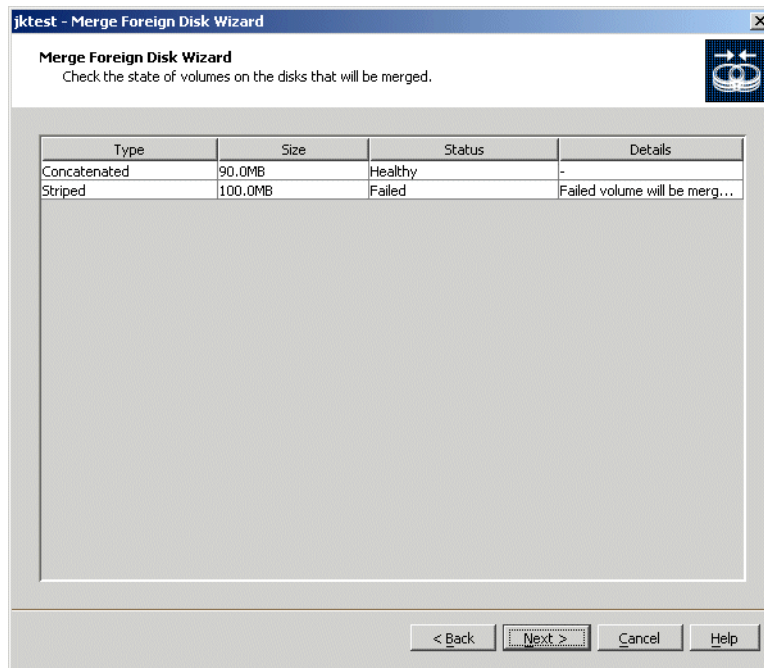
4. Select **Merge Foreign Disk** from the disk context menu.
5. After reading the first screen of the Merge Foreign Disk wizard, click **Next** to continue.

6. In the Merge Foreign Disk wizard screen that appears next, make sure that the disk that you want to merge is shown in the pane on the right side of the screen (using the **Add** button to move it from the left pane of the screen to the right pane), and then click **Next** to continue.



7. In the next screen, click **Next** to continue if the data condition on the disk is Healthy.





The final screen of the Merge Foreign Disk wizard appears. The volume condition types are shown below:

Volume Condition	Details

Failed	Volume is not functional. Volume will be merged, may be unusable.
Degraded	Volume contents will not be current. Volume will be merged.
Missing	Volume does not have a subdisk on merged disks.

If the volume condition type is Failed, there is no guarantee that the data will be intact (though it may be).

See the section [“Bringing a Dynamic Volume Back to a Healthy State”](#) on page 436. If the disk is Missing, make sure that it is properly connected.

8. Click **Finish** to complete the process of merging the foreign disk into the server.

The merged disk should now appear as it was before it was removed from the server. It should now be shown as being in its former dynamic disk group.

9. If the disk still has an error symbol, right-click the disk and click **Reactivate Disk** from the context menu that appears.

The disk now should appear as normal.

If you have a dynamic disk group with one disk marked as Missing and you revert the remaining disks in the group to basic, the dynamic disk group will no longer exist, and the disk marked as Missing will also disappear from Volume Manager's GUI. This happens because the information about a dynamic disk group is stored in a database on each of the disks that reside in the group. The dynamic disk group information is no longer available from the disks that were reverted to basic, and the Missing disk is not connected. If you reconnect the Missing disk and rescan, it will show up as Foreign. Now its database is available, but the remaining disks in the group are gone.

For more information on removing a dynamic disk from the computer, see the section [“Removing a Disk from the Computer”](#) on page 433.

Partitioned Shared Storage with Private Dynamic Disk Group Protection

Partitioned shared storage with private dynamic disk group protection allows administrators to partition storage and assign exclusive ownership in a SAN or shared disk array. In Volume Manager 2.7 for Windows 2000, partitioned shared storage was implemented through cluster disk groups without the use of a cluster application. In Volume Manager 3.0 and 3.1, the new feature of private dynamic disk group protection makes it possible to partition shared storage with a regular dynamic disk group.

Private dynamic disk group protection uses hardware locking techniques to protect secondary dynamic disk groups located on shared storage from access by other hosts connected to the shared storage pool. The hardware locking is implemented by using a SCSI reservation thread to maintain a current reservation for each disk in a protected group.

In Volume Manager 3.0 and 3.1, partitioned shared storage is available for secondary dynamic disk groups on shared storage. Private dynamic disk group protection can be assigned when a secondary dynamic disk group is created, or it can be added to an existing secondary dynamic disk group. The protection is in place as long as the disk group is imported; and since secondary dynamic disk groups are auto-imported, protected disk groups come online at system startup with a SCSI reservation thread started automatically.

If disks are being added to a dynamic disk group that has a SCSI reservation, they will get a reservation automatically. However, if a new disk group is being created, you must choose to add private group protection to the disk group.



Private dynamic disk group protection can be removed if the disk group no longer needs protection or is being reassigned to another Volume Manager host. If you deport the dynamic disk group and move it to another host, the protection will be removed and you will need to add it back again. Also, if you uninstall Volume Manager and then reinstall it, the group protection will have been removed and you will need to reapply the protection.

This section on partitioned shared storage with private dynamic disk group protection has the following topics:

- ◆ [Creating a New Dynamic Disk Group with Private Dynamic Disk Group Protection](#)
- ◆ [Adding Private Dynamic Disk Group Protection to an Existing Dynamic Disk Group](#)
- ◆ [Removing Private Dynamic Disk Group Protection from a Dynamic Disk Group](#)
- ◆ [Converting an Existing Cluster Disk Group to a Secondary Dynamic Disk Group with Private Dynamic Disk Group Protection](#)

Note If you uninstall Volume Manager and then reinstall it, the private dynamic disk group protection is removed during the uninstall process. If you then reinstall Volume Manager and want to continue the private dynamic disk group protection for the disk groups that had it previously, add the feature back to the disk groups through the **Add Dynamic Disk Group Protection** command.

Creating a New Dynamic Disk Group with Private Dynamic Disk Group Protection

The following steps describe how to use the VEA console to partition shared storage using private dynamic disk group protection.

Note If you are currently using cluster disk groups to partition shared storage, see the section [“Converting an Existing Cluster Disk Group to a Secondary Dynamic Disk Group with Private Dynamic Disk Group Protection”](#) on page 180.

1. Identify the set of shared basic disks you want to assign to a particular Volume Manager server.
2. Use the VEA console to connect to Volume Manager on that machine.
3. In the tree view or the right pane of the VEA console, right-click one of the basic disks you wish to upgrade, and select **New Dynamic Disk Group** from the context menu that comes up.
4. The initial screen of the New Dynamic Disk Group wizard appears. Click **Next** to continue.

5. The screen for entering the disk group attributes comes up. Do the following:
 - a. Type a name for the new group in the “Group Name” entry box.
 - b. Click the “Add private group protection” checkbox.
 - c. Move each of the basic disks that you want to include in the new disk group from the left pane of the wizard to the right pane by using the **Add** button.
 - d. Click **Next** to continue.
6. Click **Next** to confirm the group of disks to be included in the new dynamic disk group.
7. Select **Finish** on the next screen to create the new group.

The icon for the new disk group will include a lock icon superimposed on its lower right quadrant. The disk group Properties display will show that the group is of type “Dynamic(Secondary,Private).”

It is possible to perform the above operation by using the following command line command:

```
vxdg init -g<NewDynamicGroupName> -R <DiskName> ...
```

where <DiskName> is of the form **harddisk0**, **harddisk1**, etc.

Disks added to the group, either through the Add Disk to Dynamic Disk Group wizard or by a Join Dynamic Disk Group operation, will be automatically protected as soon as the add operation is complete. Disks that are removed from the group, using either the Remove Disk from Dynamic Disk Group or Split Dynamic Disk Group options, will no longer be protected.

Adding Private Dynamic Disk Group Protection to an Existing Dynamic Disk Group

Perform the following steps to add private dynamic disk group protection to an existing secondary disk group:

1. Right-click on the disk group in the tree view of the VEA console.

Note It must be a secondary dynamic disk group.

2. Select **Add Private Dynamic Disk Group Protection**.
3. A popup confirmation window will appear. Click **Yes**.



The disk group's icon will now include a lock icon superimposed on its lower right quadrant. The disk group properties display will show that the group is of the type `Dynamic(Secondary,Private)`.

It is possible to perform the above operation by using the following CLI command:

```
vxdg -g<DynamicDiskGroupName> protect
```

Removing Private Dynamic Disk Group Protection from a Dynamic Disk Group

▼ To remove Private Dynamic Disk Group Protection from a disk group:

1. Right-click on the disk group in the left pane of the VEA GUI.
2. Select **Remove Private Dynamic Disk Group Protection**.
3. A popup confirmation window will appear. Click **Yes**.

The lock icon previously superimposed on the disk group icon's lower right quadrant is removed. The disk group properties display will show that the group is of type `Dynamic(Secondary)`.

It is possible to perform the above operation by using the following CLI command:

```
vxdg -g<DynamicDiskGroupName> release
```

Converting an Existing Cluster Disk Group to a Secondary Dynamic Disk Group with Private Dynamic Disk Group Protection

If you have been using cluster disk groups in Volume Manager 2.7 to partition shared storage, VERITAS recommends that you convert these cluster disk groups to secondary dynamic disk groups with private dynamic disk group protection. The reason is that secondary dynamic disk groups are imported by Volume Manager at system startup, rather than requiring a manual or scripted import when a system is rebooted.

▼ Perform the following steps to complete the conversion:

1. Open a DOS command window. The convert option is not available via the VEA console.
2. Deport the disk group with the following command:

```
vxdg -g<DynamicDiskGroupName> deport
```

3. Import the group with the following command (do not use the `-s` option):


```
vxdg -g<DynamicDiskGroupName> import
```

This will accomplish the conversion from cluster to secondary dynamic disk group.

4. Add Private Dynamic Disk Group Protection.

```
vxdg -g<DynamicDiskGroupName> protect
```

5. Verify disk group status with the following command:

```
vxdg -g<DynamicDiskGroupName> dginfo
```

Sample output:

```
C:\>vxdg -g DG1 dginfo
```

Disk group information for the disk group DG1

```
Name                : DG1
DiskGroup ID         : eca6f21101c07-4e34-9f74-9ce8b
Disk Group Type      : Dynamic (Secondary)
Private Group Protection : Yes
Status               : Imported
Current Version      : Yes
Version Number       : 30
Number of Volumes    : 1
Number of Disks      : 3
```

Names of the Volumes are....

```
\Device\HarddiskDmVolumes\DG1\M1
```

Names of the Disk are....

```
Harddisk2
Harddisk1
Harddisk3
```

```
C:\>
```

From the VEA console, the disk group's icon will now include a lock icon superimposed on its lower right quadrant. The disk group properties display will show that the group is of type Dynamic (Secondary, Private).

Renaming Dynamic Disk Groups

You should not rename a primary dynamic disk group if it contains the boot or system volume.



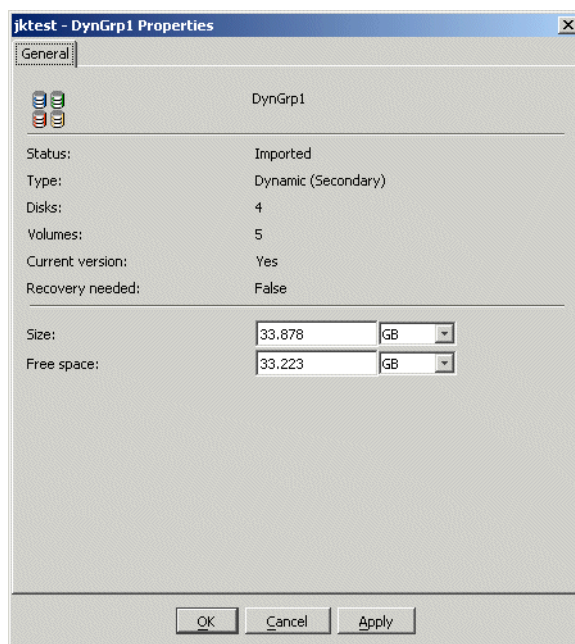
▼ To rename a dynamic disk group:

1. In the tree view, right-click the disk group and select the command **Rename Dynamic Disk Group** from the context menu.
2. The Rename Dynamic Disk Group dialog box comes up. Type the new name in the New Name text entry box, and click **OK**.

The dynamic disk group name is limited to 18 characters. It cannot contain spaces or forward and backward slashes. Also, a period cannot be the first character of the name.

Dynamic Disk Group Properties

If you right-click a dynamic disk group object in the tree view and then select the **Properties** command from the context menu that comes up, a Properties window for that dynamic disk group displays. The screen below is an example of the Dynamic Disk Group Properties screen. The status category is either Imported or Deported. “Current Version” refers to the disk group version that supports advanced disk group features (such as private disk group protection and disk group split and join) that were introduced in Volume Manager 3.0.



Troubleshooting Problems with Dynamic Disk Groups

For more information on troubleshooting problems with disk groups, see Chapter 9, “[Troubleshooting](#).” The following topics in that chapter will be especially helpful:

- ◆ [Repairing a Volume with Degraded Data after Moving Disks between Computers](#)
- ◆ [A disk Is marked as foreign](#)



Event Monitoring and Notification

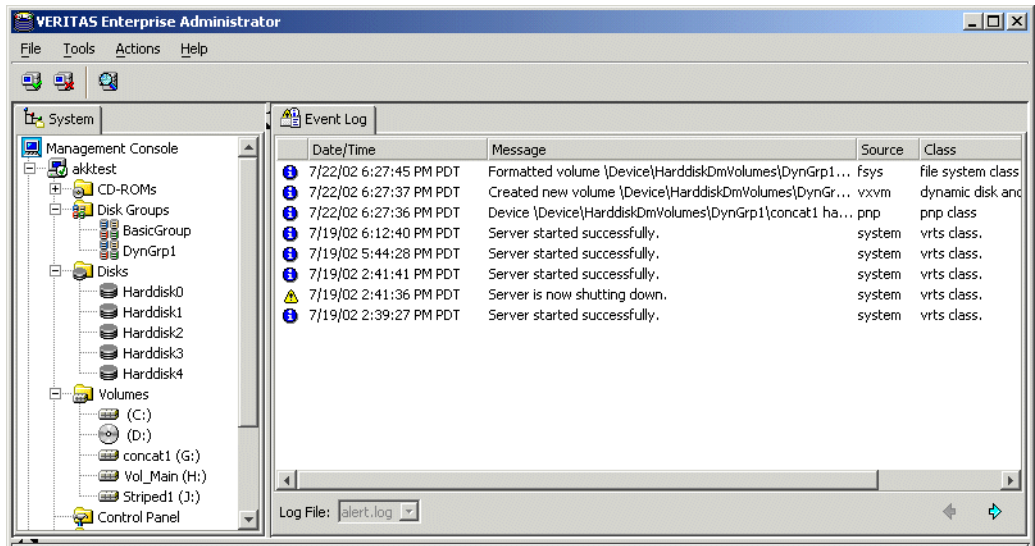
Volume Manager reports storage subsystem events that you can view in the Event Log. The log can provide information on significant incidents, such as a disk failure. Also, Volume Manager provides event notification by SMTP email, pager, and through SNMP traps that can be displayed in HP OpenView, IBM Tivoli, and CA Unicenter.

Topics in this section are:

- ◆ [Event Log](#)
- ◆ [Severity Levels](#)
- ◆ [Event Log Configuration](#)
- ◆ [Event Notification](#)

Event Log

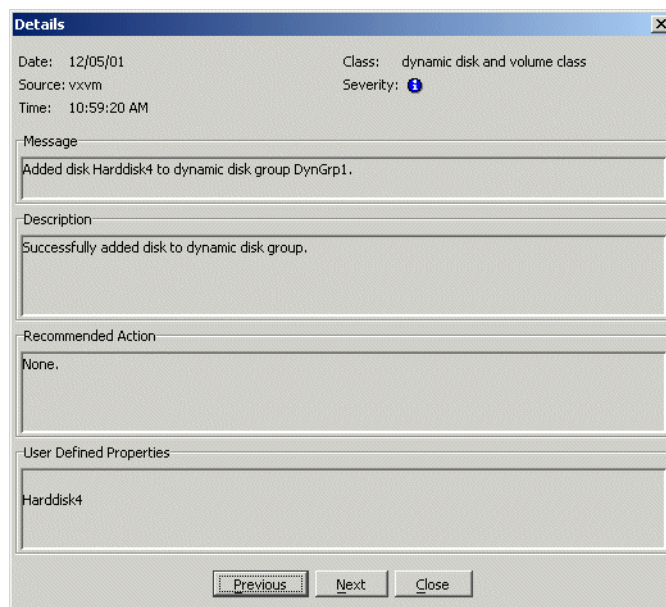
Click the Event Log folder in the left pane to display the Event Log, a listing of events or alerts that pertain to the Volume Manager program. For each event listing, you will see information on the severity of the event, the date and time that the event occurred, the event message, its source, and its class.



Starting in Volume Manager 3.0, the most recent event listings can also appear in the new section at the bottom of the window. This happens when the Console tab is selected at the bottom left corner of the window. If the Tasks tab is selected, text appears in the bottom section of the window that gives the progress of system tasks, such as format, refresh, and rescan.

When the Event Log is displayed in the right pane, the arrows that appear at the lower-right corner of the right pane can be used for scrolling in the events listing. There is a drop-down list at the lower-left corner of the right pane that allows you to select from multiple event logs if you have configured the Event Log function to have multiple logs. See [“Event Log Configuration”](#) on page 187 for details on configuring multiple event logs. The default setting is to have one event log.

You can view specific information on each event by double-clicking on it to display the Details dialog box. This shows, in addition to the information displayed in the Events tab, an event description, recommended action, and user-defined properties. The dialog box provides an easier way to read the description of the event.



The events in the Volume Manager Event Log also appear in the Windows 2000 Event Viewer, which is accessed through **Start>Settings>Control Panel>Administrative Tools>Event Viewer**. You can search for events in the Event Viewer, filter the list, save the list to a text file, print it out, or copy the data into a database program like Excel.

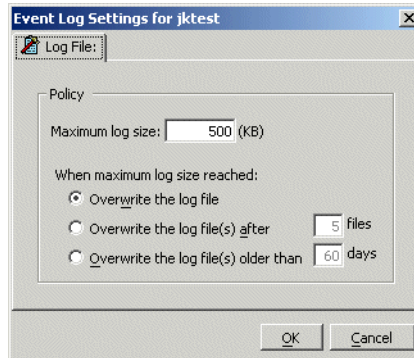
Severity Levels

Events listed in the Event Log have four severity levels:

- ◆ Critical — Indicates events of high importance involving a system crash or unrecoverable data loss.
- ◆ Error — Indicates a loss of functionality or data.
- ◆ Warning — Indicates recoverable errors and no data corruption.
- ◆ Information — Indicates an informational event, such as a new disk has been added to the system.

Event Log Configuration

You can configure the Event Log through the Event Log Settings dialog box. To access this dialog box, select the Control Panel icon in the Volume Manager tree view, and then double-click the **Event Log Settings** icon. The following configuration dialog box appears:



In this dialog box, you can make changes through the radio buttons and text entry boxes that are described below:

Maximum log size	This setting limits the Event Log file to the maximum size indicated.
Overwrite the log file	When the single log file reaches the specified maximum size, lines at the beginning of the file are removed one line at a time to maintain the specified size. With this option, you will always maintain one log file.
Overwrite the log file(s) after	You enter the number of files that you want to maintain for the event logs. When a file reaches the maximum log file size, another file is started. When the last numbered file reaches the maximum size, the sequence is started over again with the events being listed in the first file. For example, if you indicated 4 as the number of files, when the fourth file reaches its maximum size, the current events will start being compiled in the first log file again.
Overwrite the log file(s) older than	With this option, the log file compiles, and if it reaches its maximum size, an additional log file is started. When the number of days is reached, the current events will start being compiled in the first log file.



Note You can access the Event Log through the VEA console. If you have multiple logs, the drop-down list at the bottom left corner of the pane with the Event Log allows you to select another log from a list of logs.

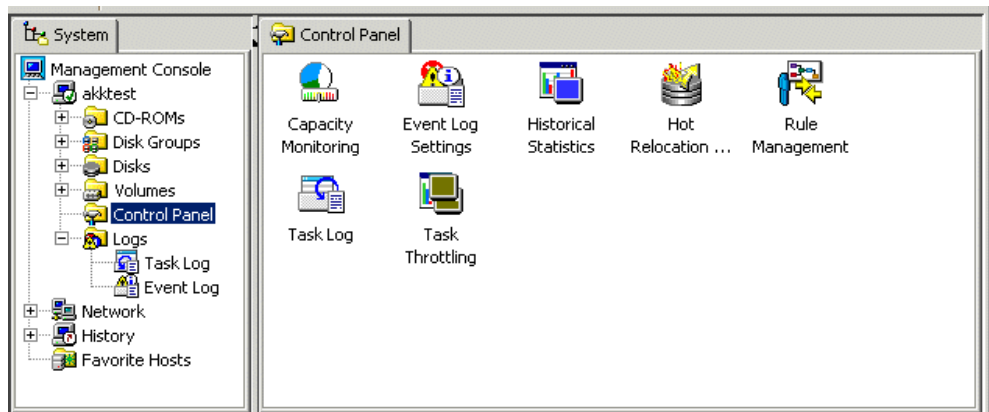
Event Notification

Volume Manager provides event notification by SMTP email, by pager, and through SNMP traps that can be displayed in HP OpenView, CA Unicenter, and IBM Tivoli. Additionally, Windows Management Instrumentation (WMI) can be set up to receive SNMP traps, which can then be viewed from the Microsoft Operations Manager (MOM) console. You can configure the notification service to send messages to specific individuals or groups and also set up rules for filtering the event messages. The event notification service is implemented through Volume Manager's Action Provider utility.

This section describes how to configure the event notification service and has the following topics:

- ◆ [Configuring the SMTP Mail Server](#)
- ◆ [Setting Up Notification Recipients](#)
- ◆ [Creating Rules to Enable Messages](#)
- ◆ [Exporting and Importing Rules, Recipients, and Notification Settings](#)
- ◆ [Accessing the Volume Manager SNMP MIB Files](#)
- ◆ [Setting Up Windows Management Instrumentation \(WMI\) to Receive Traps](#)

The commands for configuring the service are all accessed through the **Rule Management** icon in the VEA Control Panel. If you click the Control Panel node in the tree view, the Control Panel icons display in the right pane of the VEA window.



Double-click the **Rule Management** icon to bring up the Rule Management window, which has icons representing each of the commands for event notification configuration and management. To bring up a command, double-click its icon. The Rule Management window is shown in the screen that follows:





The commands in the Rule Management window are:

Command	Window or dialog box it accesses and its purpose
Rule Manager	Rule Manager window for defining and managing event notification rules.
Recipient Manager	Recipient Manager window for defining and managing recipients of messages sent out.
Notification Configuration	Notification Configuration dialog box for configuring the SMTP mail server.
Import	Import dialog box for importing a rule from another computer.
Export	Export dialog box for exporting a rule to another computer.

Configuring the SMTP Mail Server

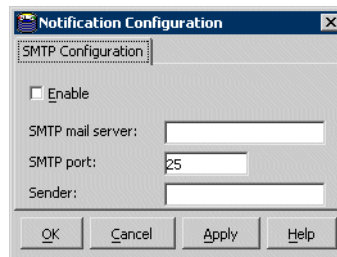
If you want to send notification messages by SMTP email or pager, your first step in configuring the notification service is to set up the SMTP mail server. The pager notification works by sending email directly to an individual's paging service.

Note You do not need to do this step if you want to send SNMP trap messages only.

▼ To set up the SMTP mail server:

1. From the VEA Control Panel, double-click the **Rule Management** icon, and then double-click the **Notification Configuration** icon in the Rule Management window that appears.

The Notification Configuration dialog box for SMTP configuration comes up.



2. Fill in the fields as follows:
 - Enable checkbox: Click to enable the SMTP email function. The checkbox gives you the flexibility of turning off the function to temporarily stop sending email to recipients. Then you can easily reactivate it when you want to start sending email again.
 - SMTP mail server: Enter the name or IP address of the SMTP mail server on your network.
 - Port: The default port for the SMTP mail server is usually 25. Check with your system administrator to determine the default port for the SMTP mail server that you plan to access on your network.
 - Sender: Enter the full SMTP email address for the sender. This must be a valid email address on your SMTP mail server. As a suggestion, you might create an SMTP mail profile specifically for these SMTP notifications.

If you don't supply a valid SMTP email address, recipients won't be able to reply to mail messages they receive from this sender.

3. Click **OK**.



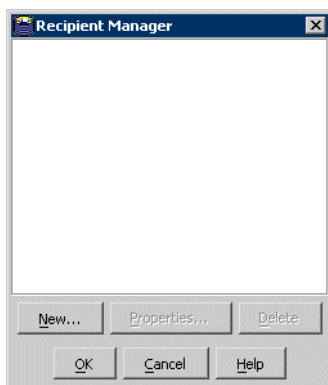
Setting Up Notification Recipients

There are three types of recipients: 1) an individual person, 2) a group, and 3) a management application (such as HP OpenView) that receives SNMP traps on a computer on your network. When you create a group, you have to configure the individual persons for the group before creating the group. You can also include a computer that is configured to receive SNMP traps in a group.

Note If you plan to receive Volume Manager SNMP traps through a management application, you will need to compile and load the VERITAS SNMP MIB files into your management application. You will also need the VERITAS SNMP mapping file. For details on locating these files, see “[Accessing the Volume Manager SNMP MIB Files](#)” on page 206.

1. To configure recipients, first, double-click the **Rule Management** icon in the VEA Control Panel, and then double-click the **Recipient Manager** icon in the Rule Management window that appears.

This command brings up the Recipient Manager dialog box.



2. To set up a new recipient, click **New**.

The Select New Recipient Type dialog box appears to allow you to select the type of recipient.

3. Select one of the three recipient types—Person, Group, or an SNMP trap—and click **OK**.
 - The SNMP trap category represents a management application, like HP OpenView, that has the capability of receiving Volume Manager alerts in the form of SNMP traps. The computer with the management application can be the same computer where Volume Manager is installed or another computer on the

network. The advantage of sending Volume Manager alerts to a management application is that an administrator can receive alerts from a large number of servers in one place. Volume Manager supports sending SNMP traps to HP OpenView, CA Unicenter, and IBM Tivoli.

- If you plan to set up a group, it is more efficient to set up all of the persons in the group before setting up the group. An SNMP trap recipient can also be a member of a group.
- 4. For setting up an individual person, see [step 5](#). For setting up a group, see [step 6](#); and for setting up an SNMP trap recipient, see [step 7](#).
- 5. If you selected “Person,” the Person Recipient Properties screen comes up. Fill in the attributes as follows:

- **Name:** Enter the individual’s name.
- **Enable:** Clicking in the upper “Enable” checkbox makes the person an active recipient. If the person is on vacation or is temporarily away so that messages don’t need to be sent, leave this box unchecked.
- **Address:** Put the person’s SMTP email address here.
- **Limit the number of notifications sent:** Allows you to limit the number of messages sent to a recipient within a certain time period. You might want to use this function if there is a problem on the system that would generate a larger number of notification messages than usual. For example, if you set the maximum number of messages to five messages in 10 minutes, if there are more than five messages in any 10-minute period, any remaining messages will be sent to a log file. The log file is a text file that is named with the recipient’s name (as specified



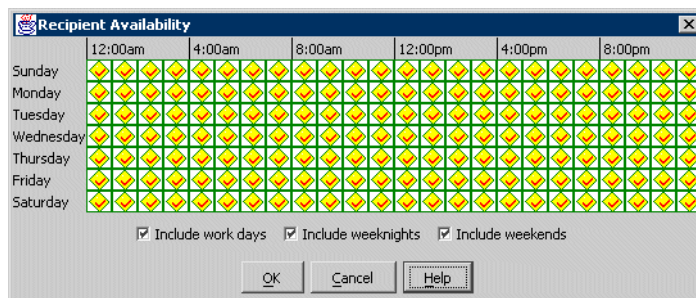
in the Name field above) followed by “_SMTP-Mail.txt,” such as “AK’s_email SMTP-Mail.txt,” and is located in the following directory on the drive where Volume Manager is installed:

\\Program Files\\VERITAS\\VERITAS Object Bus\\logs\\Notification

The **Enable** checkbox in this section enables and disables this feature.

The **Reset the notification limits after** field lets you specify in minutes the time period during which you want notification messages logged to a file.

- **Limit when notifications can be sent:** To limit the times when a notification can be sent, click the Enable checkbox for this function and then click the Schedule button. The Recipient Availability dialog box appears:



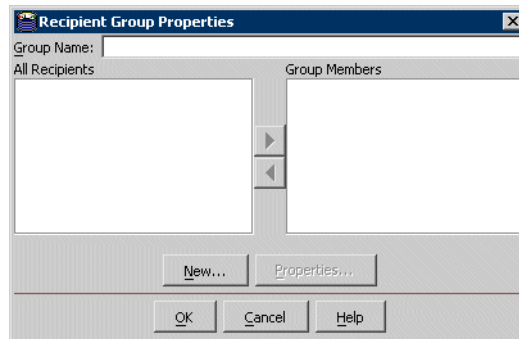
By default, all elements are checked in this dialog box. For any day of the week, uncheck the times when you do NOT want the recipient to receive notification. The time blocks at the bottom of the window are defined as follows:

- **Include work days:** Monday through Friday, 8 a.m. to 6 p.m.
- **Include weeknights:** Monday through Friday, 6 p.m. to 8 a.m.
- **Include weekends:** Saturday and Sunday

When you are finished entering the attributes, click **OK**.

You are returned to the Recipient Manager window. Enter additional recipients, or click **OK** to close the window.

6. If you selected “Group,” the Recipient Group Properties screen comes up. Fill in the attributes as follows:



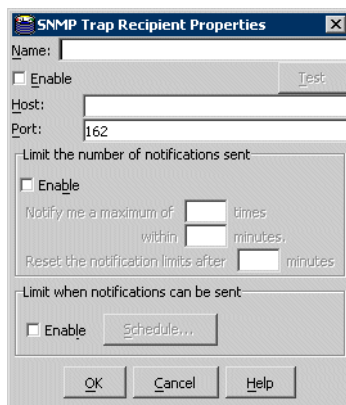
- **Name:** Enter a name for the group.
- **Group members:** Assign group members from available recipients. Select each desired recipient from the list in the left pane of the window and then use the right-pointing arrow to move the recipient to the Group Members list in the right pane of the window. If you change your mind about a recipient who was moved to the right pane, you can select the recipient name and move it back to the other list.
- **New:** If a recipient is not listed, you can define a new recipient by clicking **New** and then completing the required information.
- **Properties:** This button allows you to see and edit the properties of a highlighted recipient.

When you are finished entering the attributes, click **OK**.

You are returned to the Recipient Manager window. Enter additional recipients, or click **OK** to close the dialog box.

7. If you selected SNMP trap recipient, the SNMP Trap Recipient Properties screen comes up. An SNMP trap recipient refers to a management application (such as HP OpenView) that receives SNMP traps on a computer on your network. Fill in the attributes as follows:





- **Name:** Enter a name for the SNMP trap recipient, such as the name of the server or something like "Sales Servers Alerts" or "Sales Servers Management Console."
- **Enable:** Clicking to put a checkmark in the upper Enable box makes this recipient active. If you do not want this recipient to receive messages, temporarily leave this checkbox unchecked.
- **Host:** Actual host name or IP address of the host where the management program is installed.
- **Port:** Enter the number of the SNMP port that the management program uses to receive SNMP trap messages. The default port is 162.

For a description of the fields that limit the number of notifications sent and the time that they are sent, see the step on defining a Person recipient, [step 5](#) in this procedure.

When you are finished entering the attributes, click **OK**.

You are returned to the Notification Recipients dialog box. Enter additional recipients, or click **OK** to close the dialog box.

Note Once you have defined the recipients, you can always edit their attributes by bringing up the Recipient Manager window, clicking on the recipient, and then selecting **Properties**.

Creating Rules to Enable Messages

The final step in setting up the notification service is to create rules that determine the conditions under which messages will be sent and which recipients will receive which messages. The rules are categorized into two types:

◆ Rules based on alert name

Volume Manager has a specified number of alerts, which are named. You select the alert you want from a list. For example, you might want to pick the alert “Server is shutting down” as an alert you want to know about.

◆ Rules based on alert properties

There are two kinds of properties, alert severity and alert classification. The severities are Critical, Error, Warning, and Information. The classifications are taken from a defined list. They include, for example, disk class, which has all the alerts relating to disks, or vxvm class, which has alerts relating to dynamic volumes.

It is possible to specify both one or more severities and one or more classifications in a rule. If you create a rule with both severities and classifications, the rule will not be enabled unless one or more of the severity conditions are met and one or more of the classification conditions are met.

After defining the rule, you choose an action to perform when the conditions for the rule occur. The actions are:

◆ Notification of recipients

Recipients are notified through email, pager, or SNMP traps sent to a management platform, such as HP OpenView.

◆ Performing a command through a script you provide

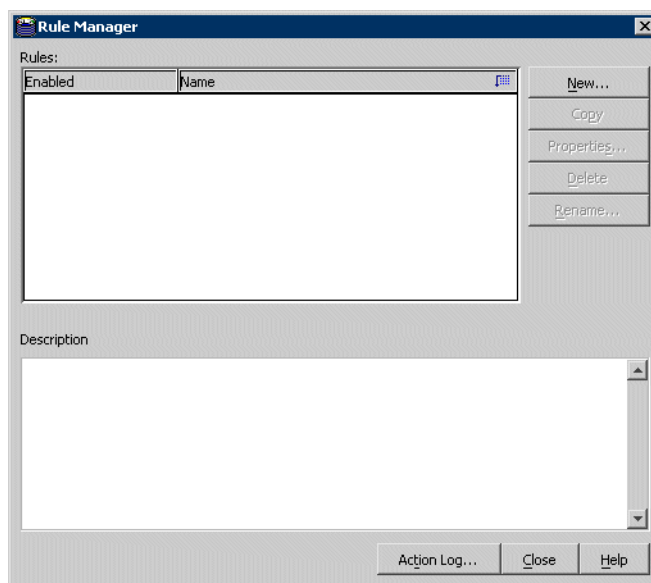
The scripts can be command prompt command files, batch files, Perl scripts, and executables. All commands are executed on the local system from a Windows service.

To create a rule:

1. From the VEA Control Panel, double-click the **Rule Management** icon, and then double-click the **Rule Manager** icon in the Rule Management window that comes up.

The Rule Manager window appears. This window is the main screen used for creating and maintaining rules.





Once you create a rule, it is listed in this screen. Using the buttons at the top right corner of the Rule Manager window, you can copy a rule, change its properties, delete it, or rename it. The **Action Log** button sets up the path to a log file that logs the status of any commands that are activated by defined rules. For more on the Action log, see [“Action Log”](#) on page 461.

2. Click the **New** button in the Rule Manager dialog box to start the Rule wizard.
3. The Rule wizard welcome screen appears. Read the screen that summarizes the rule creation process, and click **Next** to continue.
4. A screen appears for selecting the type of rule. Select the rule type by clicking its description line and then clicking **Next**.
 - “A rule based on the alert name” refers to a rule that consists of one or more alerts that you will select by name from a list of Volume Manager alerts.
 - “A rule based on alert properties” is a rule with attributes that consist of one or more severity levels and/or one or more alert classifications. You will select from a list of alert severities (Critical, Error, Warning, and Information) or alert classifications (such as the disk class, which has all the alerts for disks).

5. A screen comes up for selecting the attributes or conditions of the rule. To select the conditions of the rule, do the following:

If you selected a rule based on alert name:

- a. Click the underlined phrase “[\(click here to select names\).](#)”
A dialog box appears with a list of Volume Manager alerts.
- b. Select one or more alerts to include in the rule. To select multiple alerts, use the Shift or Ctrl key.
- c. When you are satisfied with your selection(s), click **OK** to close the dialog box, and then click **Next** to continue.

If you selected a rule based on alert properties:

- a. Choose the type of properties—classification, severity, or both.
Click the “Based on the classification” checkbox, the “Based on the message severity” checkbox, or both checkboxes. If you choose both types of properties, the defined conditions for both must be detected before a rule can execute.
- b. If you chose the classification type, select one or more Volume Manager alert classifications as follows:
 - Click the underlined phrase “[\(click here to select classifications\).](#)”
A dialog box comes up with a list of Volume Manager alert classifications.
 - Select one or more alert classifications to include in the rule. To select multiple classifications, use the Shift or Ctrl key.
 - When you are satisfied with your selection(s), click **OK** to close the dialog box.
A description of the rule appears in the Select Conditions screen.
- c. If you chose the severity type, select one or more severities as follows:
 - Click the underlined phrase “[\(click here to select severities\).](#)”
A dialog box comes up with a list of Volume Manager alert severities.
 - Select one or more severities to include in the rule. To select multiple severities, use the Shift or Ctrl key.
 - When you are satisfied with your selection(s), click **OK** to close the dialog box.
A description of the rule appears in the Select Conditions screen.



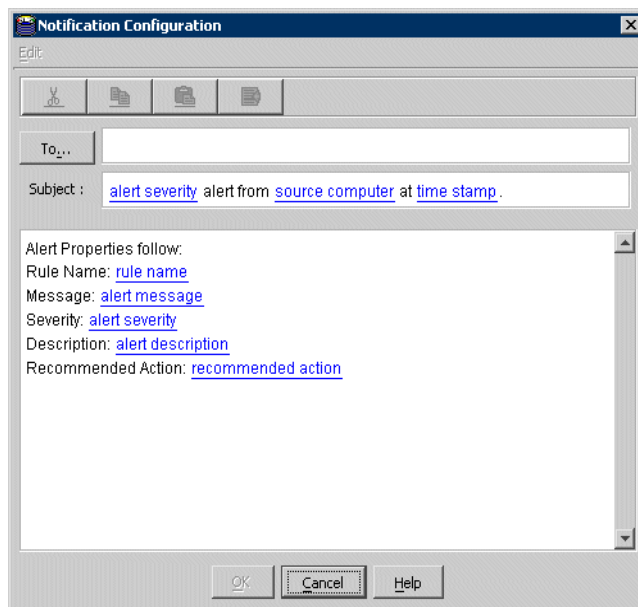
- d. Click **Next** to continue.
6. A screen comes up next for selecting the action(s) that will be performed when the conditions of the rule are met. Select the action(s) as follows:

There are two actions, sending a notification and executing a command. You can select one or both actions.

Sending a notification

- a. Click the “Send notifications” checkbox.
- b. Click on the text “(click here to select recipients).”

The Notification Configuration dialog box appears. This screen allows you to set up the subject of the message to be sent, the text of the message, and the list of recipients. Default subject, message text, and variables are provided for you, but you can change the text and the variables. Variables are the underlined items. They represent text that is derived from the information associated with each alert or with the rule properties you have defined. For example, “alert message” is the alert message associated with an alert or event that meets the conditions of the rule you have defined. You can also type text in the dialog box.



- c. Accept the default variables or, if desired, you can add other variables, delete variables, or even type in your own text.

- To add a variable, click to display a cursor where you want to enter a variable, and then click the Substitutions tool, the right-most tool at the top of the dialog box. A small window appears with a list of variables. Click to select the desired variable, and then click the **Insert** button to enter the variable in the Notification Configuration dialog box. The variables are:

Variable	Description
Alert description	Description provided for the alert by the Volume Manager program.
Alert message	Message defined for the alert by the Volume Manager program.
Alert name	Name of the alert associated with the message.
Alert severity	Alert severity associated with the message. The alert severities are Information, Warning, Error, and Critical.
Classification	Classification associated with the alert. Alerts are grouped by classification to make them easier to manage.
Recommended action	Recommended action established for the alert in the Volume Manager program.
Rule name	Name of the rule associated with the message.
Source computer	Name of the server on which the alert is raised.
Time stamp	Time when the alert is sent.

The toolbar also has the Cut, Copy, and Paste tools for cutting, copying, and pasting text or variables. To cut or copy, click to display a cursor to the right or left of the text or variable to be selected, select the text or variable, and then cut or copy it.

- You can delete text and variables by highlighting them and pressing the **Delete** key.
 - You type in new text by clicking in the window to position the cursor and then typing in the text.
- d. Add recipients by doing the following:
- Click the **To** button.



The Select Recipient dialog box appears.

- Type a recipient's name in the entry box, or use the right-arrow button to move selected recipients from the left pane of the window to the right pane. If a recipient has not been defined, click the **New** button, which brings up the screen for defining the recipient.

If you click on a recipient's name and click the **Properties** button, a dialog box appears that allows you to edit the recipient's properties.

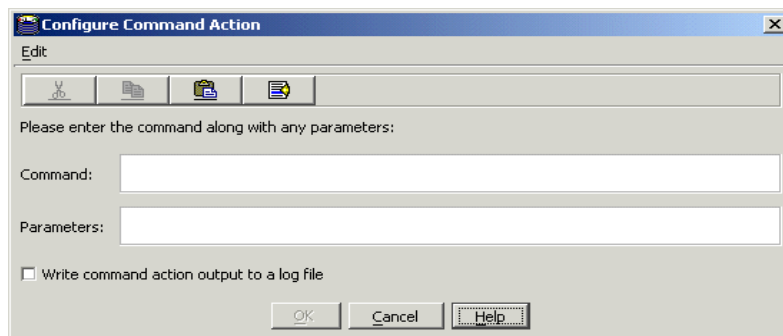
- When you are satisfied with the list of recipients, click **OK**.

Executing a command

Volume Manager can execute a command when the conditions for the rule occur. A command includes command prompt command files, batch files, Perl scripts, and executables. All commands are executed on the local system from a Windows service. Thus, if you want a specialized command to run, you must prepare the command file and place it on the local computer. The steps for setting up Volume Manager to access the command are:

- In the Select actions screen of the Rule wizard, click the "Execute a command at the command prompt" checkbox.
- Then at the bottom of the same screen, click the text "[\(click here to define a command\)](#)."

The Configure Command Action dialog box appears.



- Enter the name and path to the executable file for the command.
You will not need to set any parameters for this command.
- If desired, click the checkbox "Write command action output to a log file."

Clicking this checkbox sets up a log file that logs the status of the command action. You can check this log file to see whether the action was carried out. The default log path is **C:\Program Files\VERITAS\VERITAS Object Bus\logs**. You can change this path by clicking the **Action Log** button in the Rule Manager window.

- e. When you are satisfied with your settings, click **OK**.
7. Click **Next** to continue.
8. A screen comes up for entering a name for the rule. Enter the name for the rule, and click **Next**.
9. The final screen of the Rule wizard appears. Click **Finish**.

The Rule Manager screen appears with the new rule listed. Now that the rule has been defined, it will execute whenever the conditions of the rule are met.

Notice that the rule has an Enable checkbox that you can uncheck if you want to temporarily turn off the rule. In addition to the **New** button that is used for creating new rules, the Rule Manager window also has the following buttons that have functions related to rules:

- **Copy:** If you select an existing rule in the list of rules in the window and click this button, a copy of that rule is put in the list. You can then modify the copy and rename it.
- **Properties:** Brings up a window that allows you to modify an existing rule.
- **Delete:** Deletes a selected rule.
- **Rename:** Renames the selected rule.
- **Action Log:** Brings up a dialog box that lets you change the path to the log file that logs the status of a command that executes when the conditions of the rule are met. The log file has to be on the local machine. The default log file location is:

C:\Program Files\VERITAS\VERITAS Object Bus\logs

You can use the rules, recipients, and notification settings that you create on one computer on other computers. See the next topic, [“Exporting and Importing Rules, Recipients, and Notification Settings,”](#) for more information.



Exporting and Importing Rules, Recipients, and Notification Settings

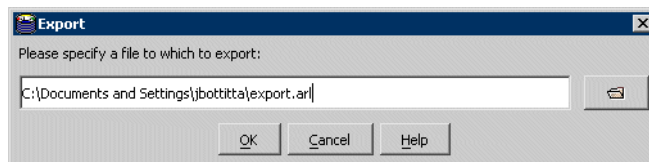
You can export the rules and notification data that have been defined on your system. The export/import feature provides an easy way to distribute this data among several systems, thus eliminating the need to create the same rules or notification recipients and settings over and over again. You might also want to export data to keep as a backup; in the event of a failure, you can easily import the rules and settings when restoring your system.

You must export rules and notification data to a file before the data can be imported elsewhere. When importing a file that has been exported, you have the option of importing rules, recipients, notification settings, or any combination of the three. You also have the option of discarding rules or recipients that have the same names as rules and recipients on the target machine. Editing the contents of an exported file will cause errors.

▼ To export rules, recipients, and notification settings:

1. From the VEA Control Panel, double-click the **Rule Management** icon, and then double-click the **Export** icon in the Rule Management window that appears.

The Export dialog box is displayed with the default path and name of an export file. The file specified here will be created to store the data that you export.



2. If desired, change the name of the file, as appropriate.

Select the **Browse** button to the right of the text box to choose another directory for the file. If you change the name of the export file, you can use any file name and extension you want for the file.

3. Select **OK**.

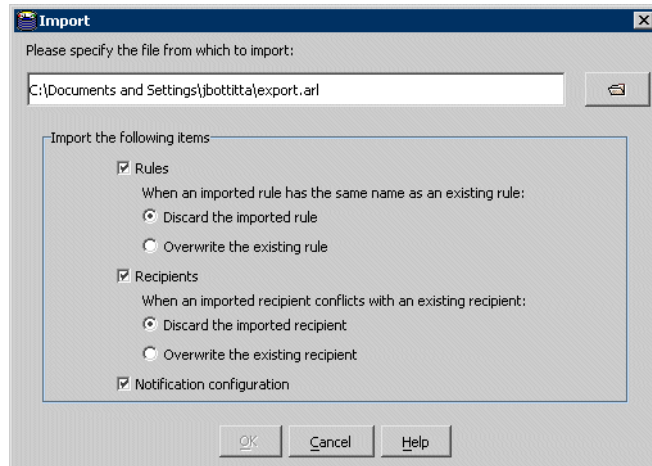
All existing rules, recipients, and notification settings are exported and stored in the specified file.

Caution After creating an export file, do not manually change the name or contents of the export file. Any changes you make to this file corrupt the file, and you will not be able to import its rules.

▼ **To import rules, recipients, and notification settings:**

1. From the VEA Control Panel, double-click the **Rule Management** icon, and then double-click the **Import** icon in the Rule Management window that appears.

The Import dialog box is displayed with a default export file.



2. If the default path and file name does not match the file you want to import, select the **Folder** tool. You can then locate and open the file from the Select File dialog box.

Tip In the Select File dialog box, if the file name you want does not have an extension of .arl, first select **All Files (*.*)** from the **Files of type** field, and then you can locate the file.

3. Deselect any of the checkboxes if you don't want to import the corresponding item.

For example, if you don't want to import notification configuration settings, deselect the **Notification Configuration** checkbox. If you leave this item checked, you will import any notification configurations that are defined in the export file.

If you are importing rules but not recipients, recipients contained in the rules you import are removed from those rules. This precautionary measure prevents errors that would arise when the imported rule contains a recipient that's not available on your system. Any recipients existing on your system before the importation remain unchanged.

4. For each selected checkbox with options, select the radio button that corresponds to the option you want enforced.



The options specify how you want to handle the case when the export file contains a recipient or rule that already exists on your system. You can do either of the following:

- Discard the rule or recipient and preserve your existing data.
- Import the rule or recipient, thereby overwriting the existing rule or recipient on your machine.

5. Select OK.

All specified rules, recipients, and notification settings are imported.

Accessing the Volume Manager SNMP MIB Files

If you want to receive Volume Manager SNMP traps on a management platform (such as HP OpenView), you will need to compile and load the VERITAS SNMP MIB files into your management platform, following the procedures outlined in the documentation for your specific platform.

When you install Volume Manager, the VERITAS MIB files are installed on a local hard drive along with the VERITAS Object Bus files and Volume Manager installation files. (The VERITAS Object Bus is associated with the VEA console and is needed to run Volume Manager.) The default path to the MIB files directory is:

C:\Program Files\VERITAS\VERITAS Object Bus\sigl\snmpmibfiles

The MIBs are: **VRTS-vip.mib** and **VRTS-vm.mib**.

Setting Up Windows Management Instrumentation (WMI) to Receive Traps

Windows Management Instrumentation (WMI) can be configured to receive traps by following these steps:

1. Download and install the latest versions of WMI SNMP Provider and Microsoft Operations Manager (MOM) from the Microsoft web site.

WMI SNMP is currently available at:

<http://www.microsoft.com/downloads/release.asp?ReleaseID=19775>

Refer to the WMI tutorial for more information on using WMI. The WMI tutorial is currently located at:

<http://msdn.microsoft.com/downloads/default.asp?url=/code/sample.asp?url=/MSDN-FILES/027/001/574/msdncompositedoc.xml>

Microsoft Operations Manager is currently available at:

<http://www.microsoft.com/mom/>



These URLs are accurate as of this writing, but may be subject to change in the future.

2. Locate the SNMP MIB files directory. The default path to the MIB files directory is:

C:\Program Files\VERITAS\VERITAS Object Bus\sig\snmpmibfiles

3. Execute the SNMP compiler at the command prompt to compile and register the MIBs:

smi2smir /a/t/ext VRTS-vip.mib

smi2smir /a/t/ext VRTS-vm.mib

4. View the WMI events from the MOM console.



License Procedures

This section describes the licensing for Volume Manager 3.1 for Windows 2000. The topics are:

- ◆ [Volume Manager 3.1 Licensing Overview](#)
- ◆ [Features Available for the Different License Levels](#)
- ◆ [Using the System License Command](#)
- ◆ [Modifying the Volume Manager Installation for License Changes](#)

Volume Manager 3.1 Licensing Overview

If you install only the Volume Manager Client on a computer, no license is required. The Client can be freely used on any machine with a licensed version of either Windows 2000 or Windows XP Professional operating systems.

Note If you have a Windows 2000 Professional or a Windows XP Professional system, the Volume Manager Client is the only component of the Volume Manager software that you can install on that machine.

The Volume Manager licensing is based on the Microsoft Windows 2000 operating system in use on a specific server. The Volume Manager license you purchase—Server, Advanced Server, or Datacenter Server—allows installation on a machine with the matching version of the Windows 2000 operating system or a machine with a lower version of the Windows 2000 operating system.

For each Windows 2000 Server or Windows 2000 Advanced Server License authorized, you may install and use a single copy of the software for each instance of the operating system on a single server. For each Windows 2000 Datacenter Server License, you may install multiple instances of the software on a single server.

Note Licensing requirements are subject to change. Please refer to the Volume Manager 3.1 for Windows Readme file for the most updated licensing information at the time of product release.

Features Available for the Different License Levels

Some features and options in Volume Manager 3.1 for Windows 2000 are available only with certain server license levels (or platforms), as shown in the chart below:

Features for different server versions	Server	Advanced Server	Datacenter Server
Number of mirrors for mirrored volumes	4	32	32
Number of disks supported per volume	128	256	256
Multiple dynamic disk groups	4	128	128
Disk replacement	-	Included	Included
Hot Spares	-	Included	Included
Hot Relocation/Undo Hot Relocation	-	Included	Included
DMP	-	Included	Included
VERITAS Volume Replicator	Included with all server versions of Volume Manager 3.1 for Windows 2000 if you purchase a VVR license. 32-node support.*		
VERITAS Cluster Server support	-	Included. 32-node support.*	Included. 32-node support.*
MSCS support	-	2-node	4-node
FlashSnap	**	**	Included

*Requires the purchase of the VERITAS Volume Replicator or VERITAS Cluster Server software. In Volume Manager 3.1, VERITAS Volume Replicator (VVR) and VERITAS Cluster Server (VCS) are supported in the English version of the program only.

**FlashSnap is available with Volume Manager Server and Advanced Server as a separate add-on license. It is included with Datacenter Server.



Using the System License Command

The **System License** command on the Tools menu brings up the System License window. Use this window to find out information about your current software license(s) for the program or to add to or replace your current software license(s). The section's topics are:

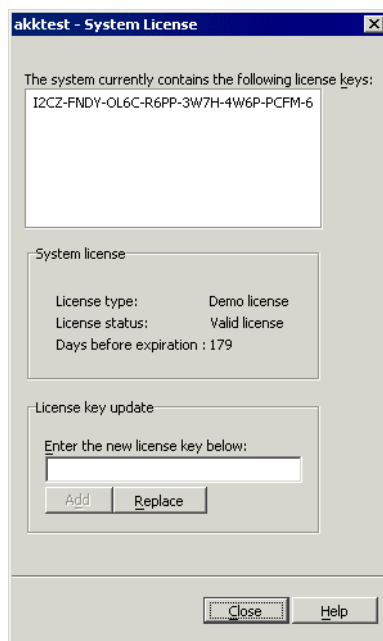
- ◆ What Is a License Key?
- ◆ Displaying License Keys
- ◆ Adding or Replacing a License Key

What Is a License Key?

The license key is the product serial number. When you purchase a new or replacement license, VERITAS provides you with a serial number for the license. When you purchase the product initially, this number is included with the software.

Displaying License Keys

To display the current license keys present on your system, select **System License** from the Tools menu to bring up the System License window.



The licenses currently running on the system are displayed in the text field under the header “The system currently contains the following license keys.”

The **License type** and **License status** are displayed in the **System license** section of the window.

Possible license types include:

- Permanent
- 60-Day Evaluation
- 30-Day Evaluation Extender
- 180-Day Not-For-Resale (NFR)

Possible license statuses include:

- Valid
- Invalid
- Duplication

In addition, a third field is displayed based on the license type.

- If you have a Permanent license, the third field displays as “License platform” to indicate what platform type the license key was issued for. The three license platforms (or levels) are Server, Advanced Server, and Datacenter Server.
- For the 60-Day Evaluation, 30-Day Evaluation Extender, and NFR licenses, the third field displays as “Days before expiration: numeric” if the license is still valid and indicates the number of days until the license expires.

If the license has expired, it displays as “Days after expiration” and indicates the number of days since the license expired.

Note When a license expires, the functionality of the Windows 2000 built-in disk and volume manager, Disk Management, is reactivated. Although Disk Management and Volume Manager have a compatible dynamic volume management functionality, Volume Manager’s advanced features will no longer be available.

Adding or Replacing a License Key

The **License key update** section of the System License window allows you to enter a new license key. To add or replace a license key:

1. Type the new key into the text field.
2. Select either **Add** or **Replace**.



The **Add** button will only appear when a valid, permanent license already exists on the system.

A confirmation message will appear.

3. Click **OK** to update the license key.

Note If your new or changed license key involves software components that require installation, you will receive a message recommending that you run the Modify install procedure to add the new components to the Volume Manager installation. MSCS support, VCS support, DMP, and VVR are components that require installation. FlashSnap does not require installation.

Modifying the Volume Manager Installation for License Changes

You add new licensed components to the Volume Manager installation by running the Modify procedure under Add/Remove Programs in the Windows 2000 Control Panel. You need to install only the components you actually plan to use.

Note If you have a new license that enables certain components (such as DMP or MSCS support) but you do not plan to use these components, then you do not have to run the Modify install procedure (if you have already registered the license through the System License command described above).

In the Modify procedure:

- ◆ Be sure to select the Server option for the installation type in the Setup Type screen.
- ◆ Click the License Upgrade button in the Customer Information screen, and then enter the license key for the component in the screen that comes up.
- ◆ If you are installing new licensed components, they should already be selected for you in the screen that lists the Server component and its options.

For a detailed, step-by-step description of the Modify install procedure, see [“Modifying an Existing Installation”](#) on page 28.

If you select a license and do not choose to install some or all of the optional components, you can install optional components later through the Modify install procedure. During the later install, you do not have to register your license again.

Note If you are using a demo license to try out DMP, please refer to the section [“When a DMP license is no longer valid”](#) on page 458.

Help Menu Commands

This section describes the Help menu commands, which are:

- ◆ [Help Contents](#)
- ◆ [Help About](#)
- ◆ [Register Online](#)
- ◆ [Get Support](#)
- ◆ [About VERITAS Software](#)

Help Contents

Selecting **Contents** from the Help menu brings up the VERITAS Enterprise Administrator online help. The Volume Manager 3.1 for Windows 2000 online help is included in the tree structure. The content of Volume Manager 3.1 for Windows 2000 online help is the same as the printed *Volume Manager 3.1 for Windows 2000 User's Guide*, except that it is in an online format.

Help About

The **About** command, located on the Help menu, gives version information about the software.

Register Online

The **Register Online** command, located on the Help menu, allows you to register Volume Manager for Windows online via an Online Registration wizard.

Get Support

The **Get Support** command, available on the Help menu, allows you to install the software for the SupportNow service at the VERITAS Technical Services web site.

SupportNow lets a VERITAS Technical Services representative take control of your desktop and do online troubleshooting while you remain on the line. Each connected session can be established only at your request and approval. SupportNow does not compromise your corporate firewall, because it cannot be established by VERITAS software independently.



▼ **To load the SupportNow software:**

1. Click the **Help** menu and select **Get Support** from the available options.
2. In the window that appears, choose either the “North America Install” or “European Install” option.
3. Click **Next** to continue.
SupportNow will launch the SupportNow Setup Program.
4. Click **Next** to continue.
5. The License Agreement Screen appears. Read through the agreement and click **Yes** to continue.
6. The Choose Program Destination Location screen appears. This displays the default location the program will install to. To change this location, click the **Browse** button.
Click **Next** to continue.
7. SupportNow will install on your computer. When it is finished installing, the Setup Complete screen appears. By default, the “Yes, I want to view the README file” option is selected. If you do not wish to view the README file, deselect this option.
8. Click **Finish** to complete the setup.
9. The first screen of the wizard will redisplay. Click **Cancel** to close it. The SupportNow software is now installed on your computer and can be accessed through the Start menu.

For more information on how the service works, access the VERITAS Support web site at:

<http://support.veritas.com>

About VERITAS Software

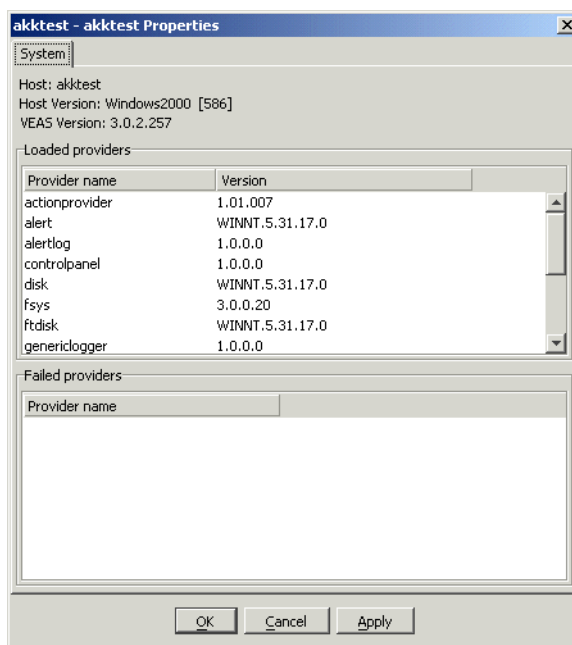
The **About VERITAS Software** command, located on the Help menu, launches the VERITAS Software web site at:

<http://www.veritas.com>

Providers

In Volume Manager, providers are similar to drivers. Each provider manages a specific hardware or software storage component. For example, there is a disk provider that manages all disks that Windows 2000 sees as disks. The providers discover the existing physical and logical entities and store that information in Volume Manager's distributed database.

If you receive an error at Volume Manager startup that a provider failed to load, you can check the provider status by right-clicking the managed server node in the VERITAS Enterprise Administrator tree view and selecting **Properties** from the context menu that appears. An example of the Properties window is shown in the screen below.



The top section of the window displays the loaded providers. The bottom section of the window displays any providers that failed to load. Normally, the bottom section is blank.

If a certain provider failed to load at Volume Manager startup, the features that the provider supplies will not work in Volume Manager. It is necessary to determine why the provider did not load and start the application again. For assistance, contact VERITAS Vsupport for technical support services at the following web site:

<http://support.veritas.com>





This chapter contains information on additional Volume Manager for Windows 2000 procedures and has the following topics:

- ◆ Remote System Management
- ◆ Performance Tuning
- ◆ Dirty Region Logging (DRL) and RAID-5 Logging
- ◆ Hot Relocation and Hot Spare
- ◆ Command Line Interface



Remote System Management

This section on remote system management has the following topics:

- ◆ Understanding the Conditions for Remote Connection
- ◆ Accessing Remote Servers Managed by Earlier Versions of Volume Manager for Windows Products
- ◆ Connecting to a Remote Computer
- ◆ Disconnecting from a Remote Computer
- ◆ Using History and Favorites

Understanding the Conditions for Remote Connection

This section describes the conditions for connecting to a remote computer.

You are able to connect to a remote computer if it is established that your user name and password match that of an account with any of the following:

1. Local Administrator rights of the remote server
2. Domain Administrator rights of the domain of the remote server and you have logged on from that domain or a trusted domain
3. Domain Administrator rights of a trusted domain to the remote server's domain and you have logged on from that domain or the remote server's domain

When you initiate the command to connect to a remote computer, Volume Manager checks to see whether you have already met one of the three conditions above when you logged on initially to the local client computer. If you have, then you will be connected directly to the remote computer without being asked to supply a user name and password.

You will not be connected automatically if you have logged onto the local computer with an account that does not have administrator privileges on the remote machine you want to connect to. However, with the **Connect** command in the VEA GUI, you will always be given the opportunity to enter a user name and password. Click the **More** button in the Connection dialog box to expand the dialog box and display the Authentication section. If you then enter a user name and password for an administrator account on the remote machine, you will be connected to the remote computer.

Note The first time you enter a user name and password, you can click the "Remember password" checkbox, so that you do not have to enter the password every time.

Accessing Remote Servers Managed by Earlier Versions of Volume Manager for Windows Products

From Volume Manager for Windows 2000, you can connect to and manage servers running earlier versions of Volume Manager for Windows 2000 as well as other Volume Manager for Windows products. There are four Windows products in the VERITAS Volume Manager family:

- ◆ Volume Manager for Windows 2000
- ◆ Volume Manager for Windows NT 4.0
- ◆ Windows 2000 Disk Management, or LDM (Logical Disk Manager)
- ◆ Dell OpenManage Array Manager

Windows 2000 Disk Management, which is also called LDM, is the disk and volume manager that comes with Windows 2000. VERITAS developed this product in cooperation with Microsoft. Volume Manager for Windows 2000 is an upgrade that replaces the LDM product, extending its capabilities.

Volume Manager for Windows 2000 supports interoperability with the other Volume Manager for Windows products. For more on interoperability between Volume Manager for Windows products, see the section [“Interoperability with Other VERITAS Volume Manager for Windows Products”](#) on page 15.

The process for connecting to earlier versions of Volume Manager or to other Volume Manager for Windows products differs, depending on the products you want to connect to. The remainder of this section describes the differences.

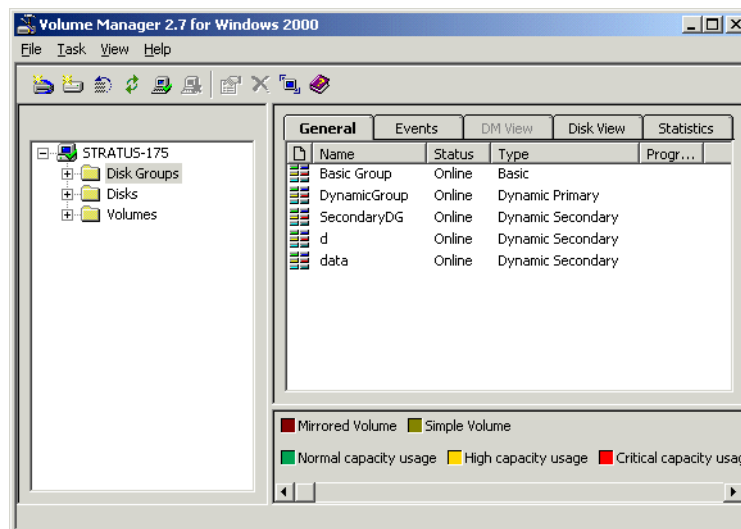
Connecting to a Server Running Another Version of Volume Manager for Windows or Dell OpenManage Array Manager

When you attempt to connect remotely to a server that is running Volume Manager 2.7 for Windows 2000 or earlier, Volume Manager for Windows NT 4.0, or Dell OpenManage Array Manager, a popup window appears, asking whether you want to use the Volume Manager 2.7 GUI to manage the server. To connect to the other server, you must click **Yes** in the popup window, and then the VEA GUI is replaced with the Volume Manager 2.7 GUI.

The Volume Manager 2.7 GUI must be used to manage the server because its commands are consistent with the earlier versions of Volume Manager for Windows 2000, Volume Manager for Windows NT 4.0, and Dell OpenManage Array Manager. Volume Manager 3.0 and 3.1 for Windows 2000 have an entirely different command structure, even though many of the commands have similar functions.

The screen that follows shows an example of the Volume Manager 2.7 GUI.





Connecting to a Server Running Disk Management

Connecting to a machine running Windows 2000 Disk Management requires that you connect through the Computer Management window of the Windows 2000 GUI. You cannot connect directly through the VERITAS Enterprise Administrator GUI. The instructions for using Computer Management to connect to a remote computer are given in the section [“Connecting through the Computer Management Window in Windows 2000”](#) on page 222.

When the connection is made to a server running Disk Management, you will see the GUI that comes with Disk Management.

Connecting to a Remote Computer

This section describes two methods for connecting to a remote computer. You can connect to a remote computer by two methods:

- ◆ [Connecting through the VEA Console](#)
- ◆ [Connecting through the Computer Management Window in Windows 2000](#)

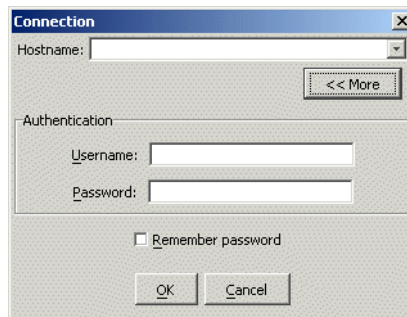
Connecting through the VEA Console

These steps assume that you have accessed the VEA console and the Volume Manager program is running.

▼ To connect to a remote computer through the VEA console:

Note You will not be able to connect to a computer running Disk Management, Microsoft's built-in disk and volume manager, using this method. You must make the connection through the Computer Management window in the Windows 2000 GUI. See the section "[Connecting through the Computer Management Window in Windows 2000](#)" on page 222 for details.

1. Select **Connect** from the File menu, or click the **Connection** icon on the toolbar, the first icon at the left of the toolbar (a computer icon with a green checkmark).
2. When the Connection dialog box appears, click the **More** button to expand the dialog box.



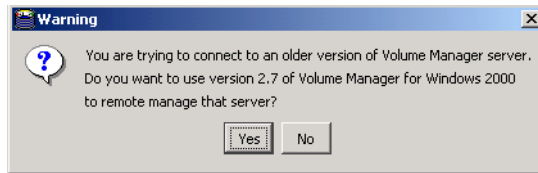
3. Enter the host name of the server you wish to connect to and, if necessary, your user name and password.

Select the "Remember password" checkbox to save the password on your computer.

Click **OK** to connect.

When you connect remotely to a server that is running an earlier version of Volume Manager for Windows 2000, Volume Manager for Windows NT 4.0, or Dell OpenManage Array Manager, a popup window comes up, as shown in the screen that follows.





In this situation, you must click **Yes** to activate the Volume Manager 2.7 GUI.

The GUI will change from the VEA GUI to the Volume Manager 2.7 GUI because that GUI's commands are consistent with the earlier versions of Volume Manager for Windows 2000 and the other products in the Volume Manager for Windows family.

If you click **No**, you will not be able to connect to the other computer.

Connecting through the Computer Management Window in Windows 2000

This alternative method of connecting to a remote computer is preferred by many system administrators. You use the Computer Management window in Windows 2000 to access the remote computer and to bring up the VEA console Connection dialog box. To connect to a remote computer running Disk Management, you must use this method.

▼ To connect to a remote computer through the Computer Management window in Windows 2000:

1. Right-click the My Computer icon and select **Manage** from the context menu that appears.

The Computer Management window comes up. The window's display can represent a local computer or a remote computer.

If the window is representing the local computer, "(Local)" will appear after the words "Computer Management" in the top node of the window's tree view. If a remote computer is being represented, the name of the computer appears in place of the word "Local."

2. Right-click the top node on the Computer Management tree view, and select **Connect to another computer** from the context menu.

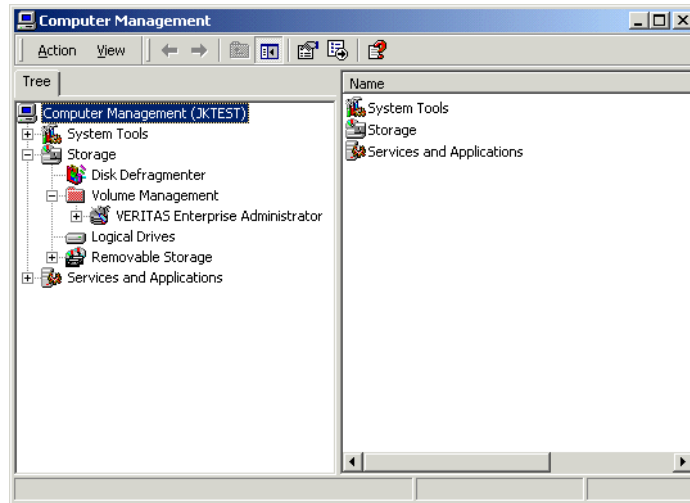
The Select Computer dialog box comes up.

3. Browse in the Select Computer dialog box to find the name of the computer you want to connect to, click to select it and click **OK**, or just double-click on the computer name.

You may be asked to enter a user name and password.

If Windows can connect to the remote computer, that computer's name is now displayed in the top node of the Computer Management tree in place of the name of the local computer.

The screen that follows is an example.

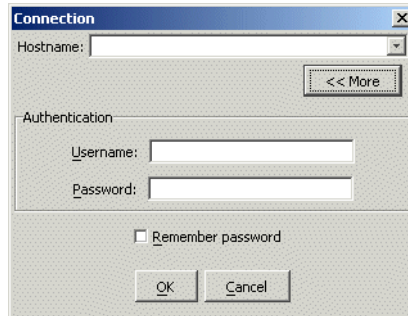


4. Fully expand the Storage node, and the Volume Management node under it.
 - If the remote computer is running a version of Volume Manager for Windows 2000, Volume Manager for Windows NT, or Dell OpenManage Array Manager, **VERITAS Enterprise Administrator** will appear under the Volume Management node.
 - If the remote computer does not have a version of Volume Manager installed, you will see **Disk Management**, the Windows 2000 built-in disk and volume manager, listed under the Volume Management node.
5. To connect to a remote computer running Disk Management, click **Disk Management** under the Volume Management node.
 You will be connected to the computer with Disk Management, and you will see the Disk Management GUI.
6. If you want to connect to a computer running Volume Manager for Windows 2000, Volume Manager for Windows NT, or Dell OpenManage Array Manager, click **VERITAS Enterprise Administrator**.

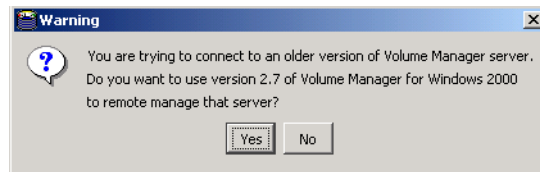


The VERITAS Enterprise Administrator GUI comes up with the Connection dialog box displayed.

7. Enter the name of the remote computer in the Connection dialog box, and click **OK**.
If necessary, enter your user name and password.



When you connect remotely to a server that is running an earlier version of Volume Manager for Windows 2000, Volume Manager for Windows NT 4.0, or Dell OpenManage Array Manager, a popup window comes up, as shown in the screen that follows.



In this situation, you must click **Yes** to activate the Volume Manager 2.7 GUI.

The GUI will change from the VEA GUI to the Volume Manager 2.7 GUI because that GUI's commands are consistent with the earlier versions of Volume Manager for Windows 2000 and the other products in the Volume Manager for Windows family.

If you click **No**, you will not be able to connect to the other computer.

Disconnecting from a Remote Computer

1. Right-click the computer icon you want to disconnect from, and select **Disconnect** from the computer context menu. Alternatively, you can select **Disconnect** from the File menu or click the **Disconnect** tool on the toolbar, the second tool from the left, the small computer with a red checkmark.
2. A confirmation dialog will appear; click **Yes** to end the remote connection.

The computer icon disappears from the tree view.

If the connection is lost for any other reason, a message appears that indicates the connection has been terminated. Volume Manager removes the icon for that computer from the tree view. You need to click **OK** to close the message box.

Using History and Favorites

The History and Favorites folders in the tree view can be helpful when you want to connect regularly to remote computers. The History folder displays the recent computers you have connected to. You can click on a computer in the History list, and Volume Manager will connect to the computer automatically. However, if authorization is needed, the Connection dialog box will come up first.

The Favorites folder lets you define computers that you want Volume Manager to connect to at the startup of the program. If you have a managed server in the tree or in the History list, you can right-click its icon and select **Add to Favorites**.

Note Please see the section “[Connection Issues](#)” on page 450 for a description of common problems when attempting to connect to a remote computer.



Performance Tuning

This section describes the statistics functions that Volume Manager provides for storage objects on dynamic disks. Topics covered include:

- ◆ [Statistics Overview](#)
- ◆ [Real-time Statistics Collection and Display](#)
- ◆ [Historical Statistics Collection and Graphing](#)
- ◆ [Subdisk Move, Split, and Join](#)
- ◆ [Displaying Volume Manager Storage Objects with Microsoft System Monitor \(Perfmon\) through WMI](#)
- ◆ [Command Line Commands for Statistics](#)

Statistics Overview

Volume Manager's statistics feature provides I/O statistics to allow you to do performance tuning to improve overall disk and system performance. Volume Manager provides the following statistics parameters:

- **Read Requests/Second**

The number of read requests per second for selected storage objects.

- **Write Requests/Second**

The number of write requests per second for selected storage objects.

- **Read Blocks/Second**

The amount of read request data (in blocks per second) that is processed for selected storage objects. It is the throughput on the read requests made.

- **Write Blocks/Second**

The amount of write request data (in blocks per second) that is processed for selected storage objects. It is the throughput on the write requests made.

- **Average Time/Read Block**

The average time in microseconds that it takes to process a read block from the time a request is made until the data is returned.

- **Average Time/Write Block**

The average time in microseconds that it takes to process a write block from the time a request is made until the data is returned.

- **Read and Write Requests/second**

The number of read and write requests per second for selected storage objects.

- **Read and Write Blocks/second**

The number of read and write blocks per second for selected storage objects.

- **Queue Depth**

The current number of read and write requests in the queue for selected disks. It does not apply to volumes and subdisks.

With these statistical tools, you will be able to improve disk and system performance by:

- ◆ Identifying high I/O areas, known as “hot spots.”
- ◆ Moving data among physical drives to evenly balance the I/O load among the disk drives. This is known as “load balancing.”

Bottlenecks occur when a program or device uses too much disk I/O, creating a hot spot and degrading performance. By monitoring a system’s I/O, you can find the problem areas and prevent bottlenecks, thus ensuring smooth operation. Volume Manager’s performance monitoring utility allows you to continuously monitor and tune system performance. You can make adjustments by moving subdisks from an area of high I/O usage to another disk that has lower usage. Starting with Volume Manager 3.0 for Windows 2000, you also have the feature of splitting subdisks and joining them back together again. This gives you added flexibility of breaking subdisks down to smaller parts and then moving them.

You can view the statistics in a real-time format in the Online Monitoring window. You can also set up the statistics collection so that you can do an analysis of the statistics over time with the historical statistics collection and graphing functions. The table below summarizes the similarities and differences between the two types of statistics.

Comparison of Real-time and Historical Statistics

	Real-time	Historical
Displays in	The Online Monitoring window that shows real-time statistical values in a tabular format for selected storage objects.	A graph that represents historical statistics for one storage object. You can select multiple storage objects to track, but each object is graphed individually.
Statistical Parameters	You can select one or more of seven statistical parameters to display in the Online Data Display Options window.	All seven statistical parameters are included in the data collection, but you select one parameter at a time for graphing from the graphing window.



	Real-time	Historical
Storage Objects	When you select Online Monitoring, the Select Objects for Online Monitoring window comes up first to allow you to select the storage objects to monitor.	You select storage objects to monitor in the Start Historical Data Collection window.
Time Frame	Current values since last refresh. Data is not saved. Online monitoring data is available only when the Online Monitoring window is open.	Data is accumulated over time and saved in a file. You indicate the file size. You can start and stop data collection. You view the data only through a graph.

For details on these two types of statistics formats, see the next two sections, “[Real-time Statistics Collection and Display](#)” and “[Historical Statistics Collection and Graphing](#).”

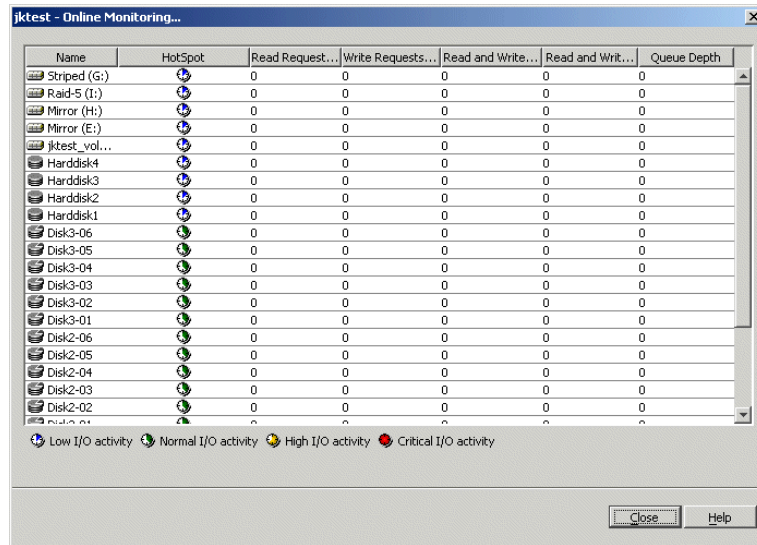
Real-time Statistics Collection and Display

This section describes real-time statistics collection and its display, which is done in the Online Monitoring window. The section has the following topics:

- ◆ [Online Monitoring Window Features](#)
- ◆ [Setup Steps for Real-time Statistics](#)
- ◆ [Volume to Disk Mapping](#)

Online Monitoring Window Features

The Online Monitoring window displays real-time statistics for storage objects you select. It can include disks, subdisks, and volumes. To access the Online Monitoring window, select **Statistics/Online Monitoring** from the Tools menu, then select the storage objects to monitor in a preliminary window that comes up, and click **OK**.



The screenshot shows a window titled "jktest - Online Monitoring...". It contains a table with the following columns: Name, HotSpot, Read Request..., Write Requests..., Read and Write..., Read and Writ..., and Queue Depth. The table lists various storage objects including Striped (G:), Raid-5 (I:), Mirror (H:), Mirror (E:), jktest_vol..., Harddisk4, Harddisk3, Harddisk2, Harddisk1, Disk3-06, Disk3-05, Disk3-04, Disk3-03, Disk3-02, Disk3-01, Disk2-06, Disk2-05, Disk2-04, Disk2-03, and Disk2-02. Each row has a pie chart icon in the HotSpot column and numerical values in the other columns. At the bottom, there is a legend for I/O activity: Low I/O activity (blue), Normal I/O activity (green), High I/O activity (yellow), and Critical I/O activity (red). Buttons for "Close" and "Help" are at the bottom right.

Name	HotSpot	Read Request...	Write Requests...	Read and Write...	Read and Writ...	Queue Depth
Striped (G:)		0	0	0	0	0
Raid-5 (I:)		0	0	0	0	0
Mirror (H:)		0	0	0	0	0
Mirror (E:)		0	0	0	0	0
jktest_vol...		0	0	0	0	0
Harddisk4		0	0	0	0	0
Harddisk3		0	0	0	0	0
Harddisk2		0	0	0	0	0
Harddisk1		0	0	0	0	0
Disk3-06		0	0	0	0	0
Disk3-05		0	0	0	0	0
Disk3-04		0	0	0	0	0
Disk3-03		0	0	0	0	0
Disk3-02		0	0	0	0	0
Disk3-01		0	0	0	0	0
Disk2-06		0	0	0	0	0
Disk2-05		0	0	0	0	0
Disk2-04		0	0	0	0	0
Disk2-03		0	0	0	0	0
Disk2-02		0	0	0	0	0

The Online Monitoring window collects statistics as long as you have it open. The window operates in the foreground. You will not be able to perform other operations while it is open. When you set up the real-time statistics, you can change the refresh rate, the time interval of the refresh of the screen display. The default is 5 seconds. The statistics are actually being computed continuously in the background.

The Online Monitoring window is organized as follows:

◆ Name

The first column contains the names of the storage objects that have been selected for monitoring. Thus, each row contains the statistical data on a selected storage object.

◆ Hot Spot

The second column has a pie symbol that is designed to be used as an indicator for hot spot detection. A hot spot is an area of high I/O activity that may cause bottlenecks in I/O throughput. The color and shading of each pie symbol indicate the current state of I/O activity for the associated storage object. The pie symbol for the highest amount of I/O activity, Critical activity, is red and fully shaded, making it easy to notice on the screen. You can select the statistical parameters you want to use for hot spot detection.

◆ Statistical Parameters

The remaining columns represent the different statistical parameters available in the program. By default, Read requests per second, Write requests per second, and Queue depth are selected, but you can select any of the seven statistical parameters. For a definition of each parameter, see [“Statistics Overview”](#) on page 226.



◆ Legend for the Hot Spot Indicator

The legend at the bottom of the window describes the four pie symbol categories for the hot spot indicator. The table below gives more detail on these categories. If the pie symbol indicator displays the High or Critical category, it signals the fact that you have a hot spot—that is, an area of high I/O activity.

Explanation of the Pie Symbol Categories for Hot Spot Indicator

I/O Activity	Pie Symbol	Subdisk I/O	Dynamic Disk I/O
Low	Blue Small section in pie	Does not apply	More than 30% below average if it is not below minimum I/O threshold
Normal	Green Section less than half of pie	80% or less of parent disk I/O	30% below average up to 30% above average
High	Yellow Section more than half of pie	81% to 90% of parent disk I/O	31% to 50% above average
Critical	Red Color in all of pie	More than 90% of parent disk I/O	More than 50% above average

◆ Context Menu

If you right-click any row in the Online Monitoring window, a context menu appears with two menu choices relating to the storage object being monitored:

- Graph Historical Statistics Information
- Remove Object from Online Monitoring

The first menu choice is grayed out unless you have previously selected that storage object for historical statistics monitoring.

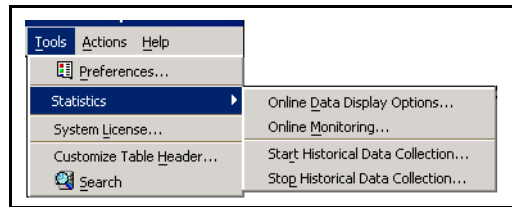
Setup Steps for Real-time Statistics

This section describes what is involved in setting up the real-time statistics, so that you can view them in the Online Monitoring window. The topics are:

- ◆ [Getting Acquainted with the Statistics Submenu](#)
- ◆ [Selecting Online Display Options](#)
- ◆ [Selecting Storage Objects to Monitor](#)

Getting Acquainted with the Statistics Submenu

The commands for setting up the real-time statistics are located on the Statistics submenu on the Tools menu.



The table below summarizes the available commands:

Command	Description
Online Data Display Options	Sets display options for real-time statistics.
Online Monitoring	Brings up the Select Objects to Monitor window to allow you to select objects to monitor for a real-time statistics session. Once you have selected objects to monitor, the Online Monitoring window appears.
Start Historical Data Collection	Starts the data collection for historical statistics.
Stop Historical Data Collection	Stops the data collection for historical statistics.

For information on historical statistics, which are displayed as graphs of individual storage objects that you select, see the section [“Historical Statistics Collection and Graphing”](#) on page 240.

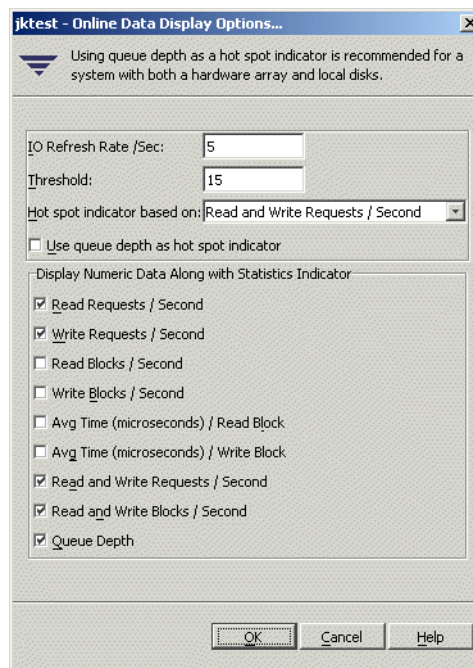


Selecting Online Display Options

The first task in the setup process is to set the display options. This task is not absolutely necessary. If you do not use this window, the default settings, which are shown in this window the first time you bring it up, will apply. The default settings are shown in the sample screen below.

▼ To select the online data display options:

1. Choose **Statistics/Online Data Display Options** from the Tools menu to bring up the Online Display Options window.



2. If desired, change the **I/O Refresh Rate/Sec** setting.

This is the time interval of the refresh of the screen display. The program continuously runs the actual statistics in the background but changes the display of them in the Online Monitoring window according to the refresh rate you set. The default and minimum I/O refresh rate is 5 seconds.

3. If desired, change the **Threshold** setting.

The threshold is the minimum amount of I/O per second that a disk or subdisk has to have to display a color other than blue. Blue is the lowest state, Low I/O activity. The default threshold is 15.

4. Determine which statistical parameter or parameters to use for the **hot spot indicator.**

See “[Hot Spot](#)” on page 468 in the Glossary for an explanation of the hot spot indicator.

The dialog box provides two places to enter a hot spot indicator:

- The drop-down list that is labeled “Hot spot indicator based on.”
- The checkbox labeled “Use queue depth as hot spot indicator.”

Queue depth applies only to disks. The other six statistical parameters that are in the “Hot spot indicator based on” drop-down list apply to disks, volumes, and subdisks.

If you select the checkbox to use queue depth as a hot spot indicator, queue depth will be used to calculate the hot spot statistic for disks only. The hot spot indicator that is used to calculate the hot spot statistic for volumes and subdisks will be the statistical parameter shown in the “Hot spot indicator based on” drop-down list.

If you don’t select queue depth as a hot spot indicator, then the hot spot indicator that is used to calculate the hot spot statistic for volumes, subdisks, and disks will be the statistical parameter shown in the “Hot spot indicator based on” drop-down list.

Why Use Queue Depth?

It is recommended that you select queue depth when you have both disks that are directly connected to your computer and disks that are in a hardware disk array. Because a disk in a disk array can have a much higher level of reads or writes and still function well, reads or writes per second are not really a good way to compare directly connected disks and array disks. Queue depth is the current number of read and write requests in the queue for selected disks. It is a better indicator of how well a disk in an array is working, and it also works for disks that are directly attached to the computer.

5. Select the statistics parameters you wish to monitor by clicking the checkbox in front of each parameter. The statistics parameters are described as follows:

- Read Requests/Second

The number of read requests per second for selected storage objects.

- Write Requests/Second

The number of write requests per second for selected storage objects.

- Read Blocks/Second



The amount of read request data (in blocks per second) that is processed for selected storage objects. It is the throughput on the read requests made.

- **Write Blocks/Second**

The amount of write request data (in blocks per second) that is processed for selected storage objects. It is the throughput on the write requests made.

- **Average Time/Read Block**

The average time in microseconds that it takes to process a read block from the time a request is made until the data is returned.

- **Average Time/Write Block**

The average time in microseconds that it takes to process a write block from the time a request is made until the data is returned.

- **Read and Write Requests/second**

The number of read and write requests per second for selected storage objects.

- **Read and Write Blocks/second**

The number of read and write blocks per second for selected storage objects.

- **Queue Depth**

The current number of read and write requests in the queue for selected disks. It does not apply to volumes and subdisks.

Note By default, Read Requests/Second, Write Requests/Second, and Queue Depth are the selected parameters.

6. When you are finished with your changes, click **OK**.

Selecting Storage Objects to Monitor

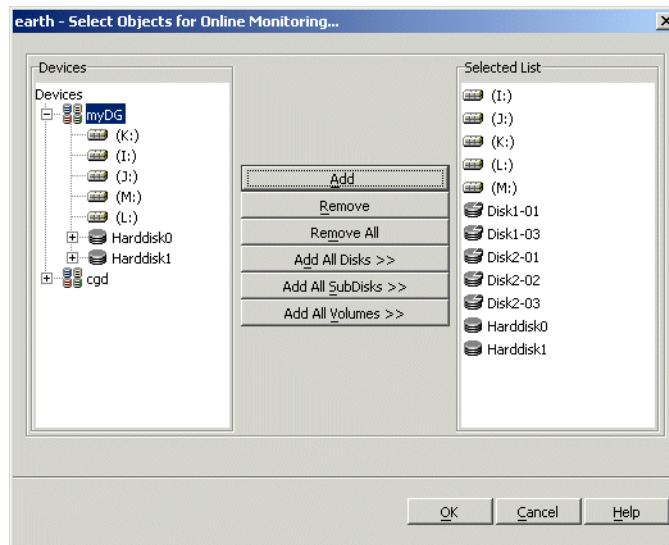
When you select the **Online Monitoring** command, the Select Objects for Online Monitoring window appears to allow you to select the storage objects to monitor. The detailed steps are given in the procedure that follows.

▼ **To select objects for online monitoring:**

1. Choose **Statistics>Online Monitoring** from the Tools menu.

The Select Objects for Online Monitoring window appears. You can select an entire disk group or its individual disks, subdisks, and volumes.

You may need to click on the plus symbol next to a disk group icon to display the disks, subdisks, and volumes.

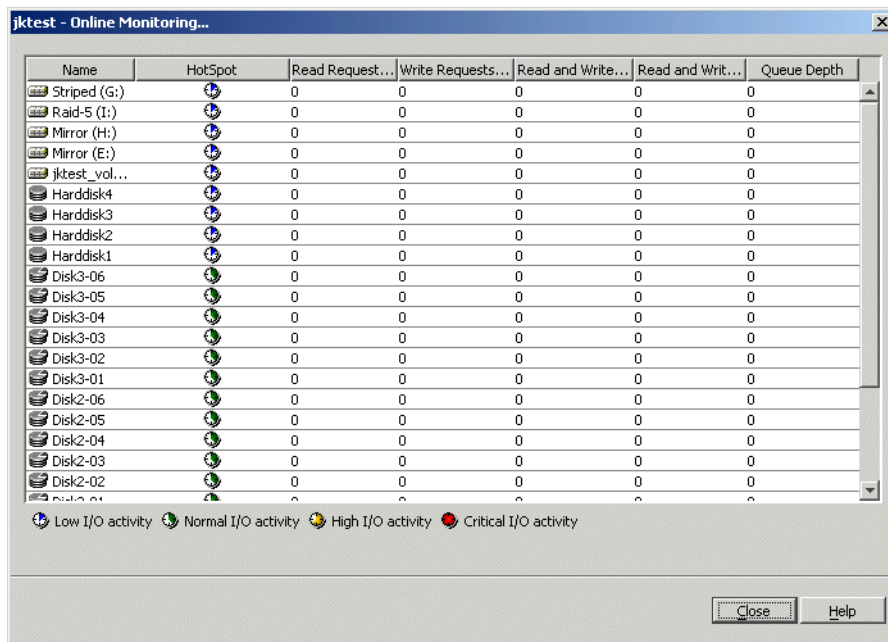


2. Select the storage objects you want to display by using the following options:
 - **Add:** Adds one or more selected objects in the left pane of the window to the Selected List in the right pane of the window. If you select a dynamic disk group and click **Add**, all associated objects (disks, subdisks, and volumes) will be added to the Selected List in the right pane.
 - **Remove:** Removes any objects that are selected from the Selected List in the right pane.
 - **Remove All:** Removes all available objects from the Selected List in the right pane.
 - **Add All Disks:** Adds all available disks in the left pane to the Selected List in the right pane.
 - **Add All SubDisks:** Adds all available subdisks and parent disks in the left pane to the Selected List in the right pane.
 - **Add All Volumes:** Adds all available volumes in the left pane to the Selected List in the right pane.
3. Click **OK** to view the statistics.

The Online Monitoring window is displayed. When there is I/O activity on the selected storage objects, you will see that activity in the window. The window operates only in the foreground. You cannot leave the window open and perform



other Volume Manager commands. Once you close the window, the settings for the storage objects selected are not retained. When you select Online Monitoring again, you reselect the storage objects.



The screenshot shows a window titled "jktest - Online Monitoring...". It contains a table with the following columns: Name, HotSpot, Read Request..., Write Requests..., Read and Write..., Read and Writ..., and Queue Depth. The table lists various storage objects, including Striped (G:), Raid-5 (I:), Mirror (H:), Mirror (E:), jktest_vol..., Harddisk4, Harddisk3, Harddisk2, Harddisk1, Disk3-06, Disk3-05, Disk3-04, Disk3-03, Disk3-02, Disk3-01, Disk2-06, Disk2-05, Disk2-04, Disk2-03, and Disk2-02. Each row has a corresponding icon in the HotSpot column and numerical values in the other columns. At the bottom of the window, there is a legend for I/O activity: Low I/O activity (blue circle), Normal I/O activity (green circle), High I/O activity (yellow circle), and Critical I/O activity (red circle). The legend shows that all objects in the table have Normal I/O activity. The window also has "Close" and "Help" buttons at the bottom right.

Name	HotSpot	Read Request...	Write Requests...	Read and Write...	Read and Writ...	Queue Depth
Striped (G:)	Normal I/O activity	0	0	0	0	0
Raid-5 (I:)	Normal I/O activity	0	0	0	0	0
Mirror (H:)	Normal I/O activity	0	0	0	0	0
Mirror (E:)	Normal I/O activity	0	0	0	0	0
jktest_vol...	Normal I/O activity	0	0	0	0	0
Harddisk4	Normal I/O activity	0	0	0	0	0
Harddisk3	Normal I/O activity	0	0	0	0	0
Harddisk2	Normal I/O activity	0	0	0	0	0
Harddisk1	Normal I/O activity	0	0	0	0	0
Disk3-06	Normal I/O activity	0	0	0	0	0
Disk3-05	Normal I/O activity	0	0	0	0	0
Disk3-04	Normal I/O activity	0	0	0	0	0
Disk3-03	Normal I/O activity	0	0	0	0	0
Disk3-02	Normal I/O activity	0	0	0	0	0
Disk3-01	Normal I/O activity	0	0	0	0	0
Disk2-06	Normal I/O activity	0	0	0	0	0
Disk2-05	Normal I/O activity	0	0	0	0	0
Disk2-04	Normal I/O activity	0	0	0	0	0
Disk2-03	Normal I/O activity	0	0	0	0	0
Disk2-02	Normal I/O activity	0	0	0	0	0

For information on the features of the Online Monitoring window, see [“Online Monitoring Window Features”](#) on page 228.

Volume to Disk Mapping

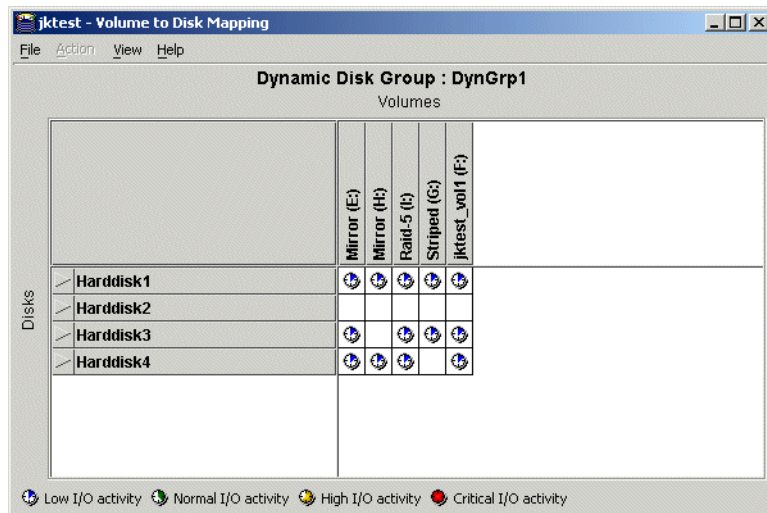
Volume to Disk Mapping tracks the I/O activity level for disks and subdisks within a selected disk group. The **Disk/Volume Map** command provides a graphical display that shows the I/O activity level of each volume on its associated disks and subdisks and allows you to see at a glance any areas with High or Critical activity levels. The advantage of this window is that it can run in the background. You can leave it open to do online monitoring while you do other commands. This section's topics are:

- ◆ [Displaying the Disk/Volume Map](#)
- ◆ [Available Menus](#)
- ◆ [Expanded View and Subdisk Move, Split, and Join](#)
- ◆ [I/O Activity Criteria](#)

Displaying the Disk/Volume Map

1. Right-click on the desired disk group.
2. Select **Disk/Volume Map** from the context menu.

The normal or collapsed view appears. This view shows the I/O activity for all disks and volumes in the disk group. There is also an expanded view that shows subdisks. The expanded view is discussed in a following section.



Available Menus

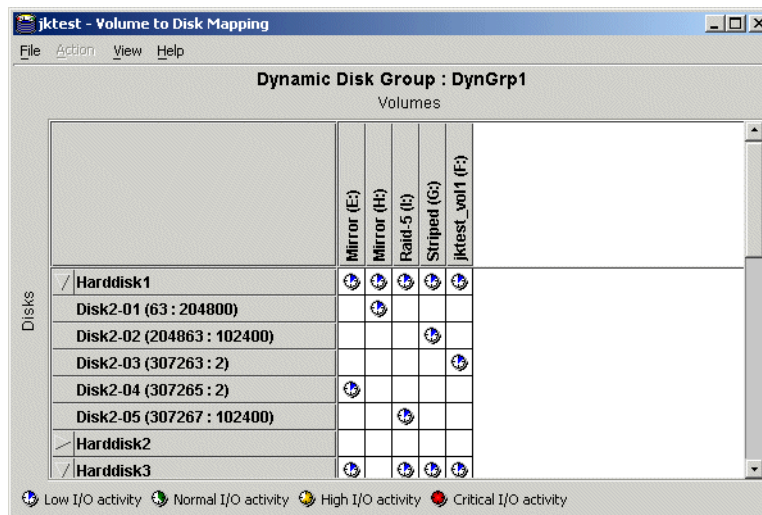
The menu bar at the top of the window has the following menus:

- The File menu has commands relating to printing and a **Close** command.
- The Action menu is active only when a specific storage object is selected and has commands that apply to that object.
- The View menu contains the **Expand All** and **Collapse All** commands. These two commands cycle back and forth between a normal view and an expanded view that displays the subdisks.
- The Help menu provides access to online help on the window.

There are also context menus available in the window. If you right-click a disk in the disks row, the disk context menu appears, allowing you access to the various disk commands. Likewise, you can right-click a volume in the columns at the top of the screen to access the volume context menu.

Expanded View and Subdisk Move, Split, and Join

To display the associated subdisks, either click on the arrow icon to the left of each disk or select **View>Expand All** from the menu bar. The expanded view shows the I/O activity for all the disks, subdisks, and volumes in the disk group.

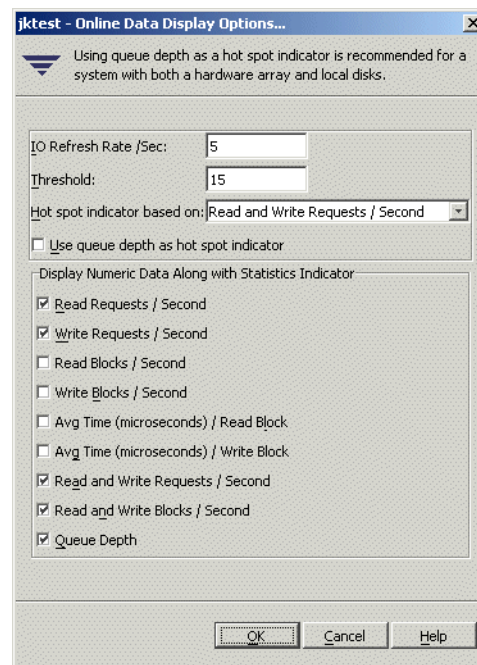


The most important feature of the expanded view is that it gives you access to subdisks so that you can do subdisk commands through the window. By selecting the appropriate command from the Action menu or right-clicking on the desired subdisk, you can move, split, or join subdisks. For more information on these commands see [“Subdisk Move, Split, and Join”](#) on page 247.

I/O Activity Criteria

The criteria for the I/O activity levels are based on the display options selected for Online Monitoring. By default the Disk/Volume Map will be based on the Read Requests/Second parameter. To base the activity level on another parameter, follow these steps:

1. Select **Statistics** from the **Tools** menu on the main menu bar. The Online Data Display Options dialog box will open as shown below
2. Select **Online Data Display Options** from the submenu.



3. If desired, change the I/O Refresh Rate/Sec to a longer interval.
4. Select a different parameter from the “Hot spot indicator based on” drop-down list, and click **OK**. See [“Setup Steps for Real-time Statistics”](#) on page 231 for more information.



Historical Statistics Collection and Graphing

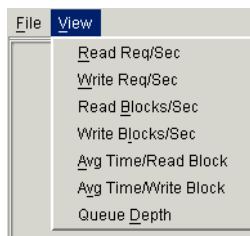
The historical statistics collection and graphing function allows you to monitor one or more storage objects (disks, subdisks, or volumes) over time and to create individual graphs for these storage objects. You invoke the graphing function by right-clicking a storage object and then selecting the command **Graph Historical Statistics Information** from the context menu that appears. However, the command will not be available on the context menu without certain setup steps having been done first.

This section first describes the graphing window and then details the setup functions that are necessary before you can do the graphing. The topics are:

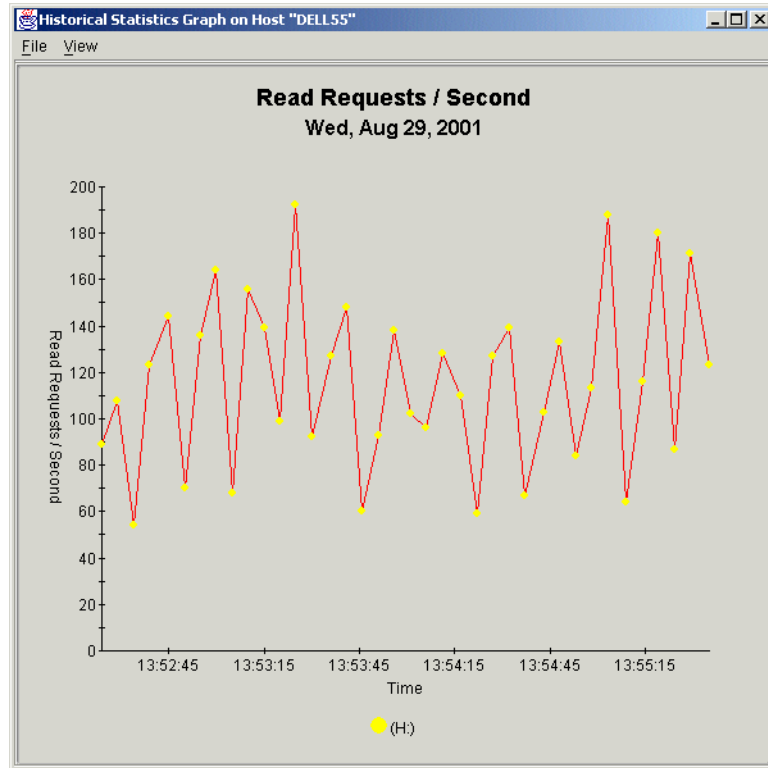
- ◆ [Features of the Graphing Window](#)
- ◆ [Setup Steps for Historical Statistics](#)
- ◆ [Stopping Historical Data Collection](#)

Features of the Graphing Window

After you select the **Graph Historical Statistics Information** command from a storage object's context menu, a graphing window comes up, but it does not display a graph because no statistical parameter has been selected. To display the statistics, you select the View Menu at the top left corner of the graph and click to choose one of the seven statistical parameters to graph.



The graph then generates and displays, as shown in the sample graph that follows:



The features of the graph include:

- ◆ The vertical axis on the graph displays a scale for the statistical parameter being graphed, and the name of the statistical parameter is also displayed vertically next to the axis.
- ◆ The horizontal axis shows time, which is determined by the data collection rate setting. The name of the storage object being graphed is displayed under the axis.
- ◆ The View menu, as mentioned previously, has the various statistical parameters, allowing you to change the graph to show a different parameter.
- ◆ The File menu has an **Exit** command, but you can also close the graph window by clicking the close box in the top right corner.

A graph can be saved and printed by copying it to the Clipboard with Alt+PrintScreen and then pasting it into a program, such as Microsoft Word.



Setup Steps for Historical Statistics

This section describes how to configure and graph historical statistics. The topics are:

- ◆ [Configuring Settings in the Historical Statistics Settings Window](#)
- ◆ [Selecting Storage Objects and Starting the Data Collection for Historical Statistics](#)
- ◆ [Graphing Steps](#)

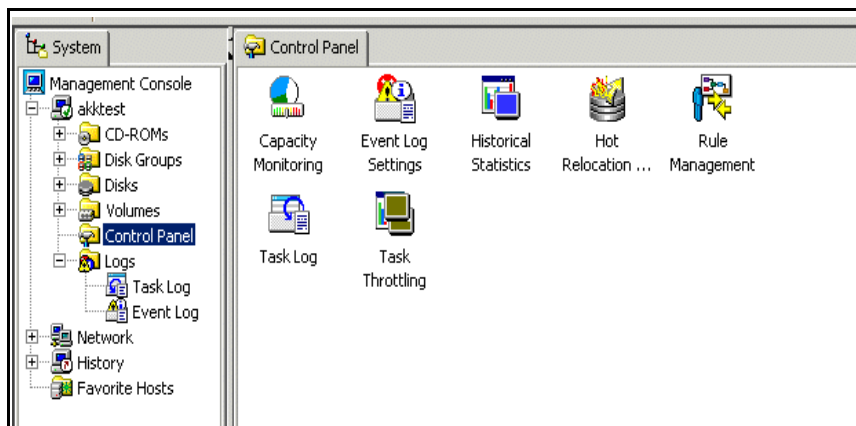
Configuring Settings in the Historical Statistics Settings Window

The first task in the setup process is to configure the settings in the Historical Statistics Settings window. This window is accessed through the Volume Manager Control Panel. This task is not absolutely necessary. You can just accept the default settings, which are settings that are appropriate for most data collection purposes.

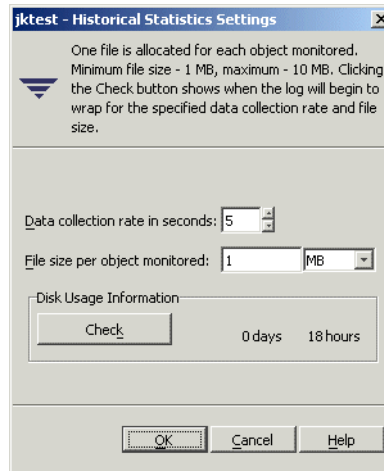
▼ To access the Historical Statistics Settings window to view and adjust settings:

1. In the Volume Manager tree view, click the Control Panel folder.

The Control Panel icons appear in the right pane of the window, including the **Historical Statistics** icon.



2. Double-click the **Historical Statistics** icon to bring up the Historical Statistics Settings window, as shown in the screen below.



3. Check the settings in the Historical Statistics Settings window (as described below), and make changes if desired. Click **OK** to confirm the settings and close the window.

Historical Statistics Window Settings

- **Data collection rate in seconds**

This is the rate at which the data is collected. It is the time interval between data samples. The default is every 5 seconds. You may prefer the data to be collected every hour (3,600 seconds). This setting establishes the point when the data is graphed. If you plan to run the statistics for several days, it is easier to read the graph with a longer data collection rate.

- **File size per object monitored**

Volume Manager collects the data in a file. You set the desired size of the file. Once the file reaches the specified size, the older statistics information is deleted as new information is added. This feature allows you to continuously monitor the statistics without taking up increasing file space.

- **Disk Usage Information section**

The numbers at the bottom of this window are an estimate of how long (in days and hours) it would take to compile statistics per storage object monitored to fill up the file size indicated. If you change either the data collection rate or the file size per object monitored, click the **Check** button to update the estimate.

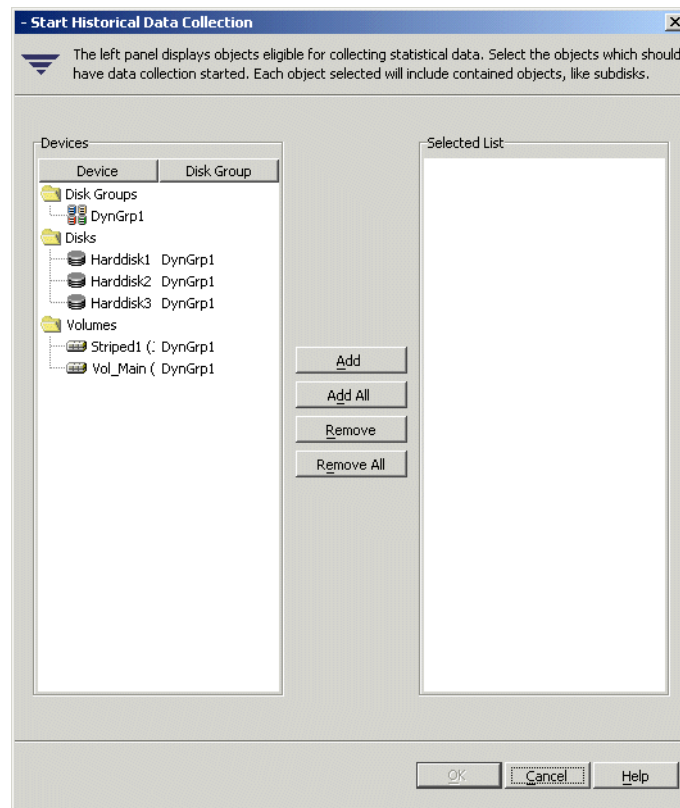


Selecting Storage Objects and Starting the Data Collection for Historical Statistics

The next task in the setup for the historical statistics is to select the storage objects you want to monitor and start the historical statistics data collection. These functions are available through the **Start Historical Statistics** command. This task is not optional.

▼ To select storage objects and start the historical data collection:

1. Select **Tools>Statistics>Start Historical Data Collection** to bring up the Start Historical Data Collection window, as shown in the sample screen below.



This window allows you to select the storage objects for historical data collection. Once you have made your selection and clicked **OK**, the historical data collection begins. The data collection continues in the background until you stop it with the **Stop Historical Data Collection** command or until Volume Manager is stopped or the computer is rebooted.

2. Select the storage object or objects you want to monitor for historical statistics data collection by highlighting the object or objects and using the **Add** or **Add All** button to move the objects to the Selected List.

You can also move the objects to the right pane by double-clicking them or by dragging them to the right pane. Use the **Remove** or **Remove All** button to move items on the Selected List in the right pane back to the Devices list in the left pane.

3. Click **OK** when you have made your selection.

The data collection begins in the background. You now have the necessary settings for invoking the graphing function. If you select a storage object that was one of the selected objects or that is included under a selected object (for example, if you selected an entire disk group), the **Graph Historical Statistics Information** command will be available on that storage object's context menu.

Graphing Steps

This section covers the specific steps for creating a graph.

Note You must have selected one or more storage objects and have started the historical data collection for the graph to be displayed. Refer to the previous section [“Selecting Storage Objects and Starting the Data Collection for Historical Statistics”](#) for details.

▼ To create a graph:

1. Right-click the storage object you want to graph, and select **Graph Historical Statistics Information** from the context menu that appears.

A graphing window appears, but no graph is generated until you select a statistical parameter.

2. Choose View from the menu bar at the top of the screen, and then click one of the statistical parameters from the View menu.

For a description of each statistical parameter, see [“Statistics Overview”](#) on page 226.

Once you click a parameter, the View menu closes and the graph is generated.

For a description of the graph, see the section [“Features of the Graphing Window”](#) on page 240.

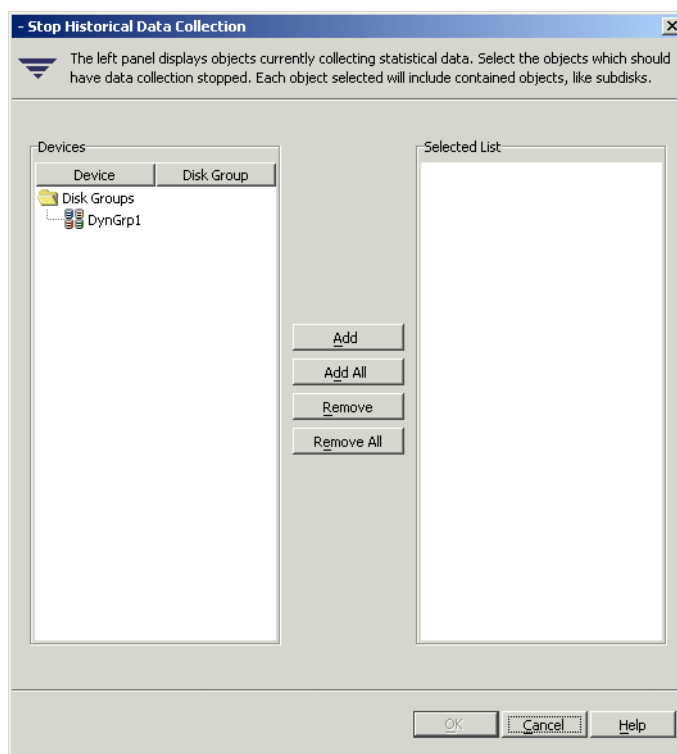


Stopping Historical Data Collection

You can stop the collection of historical data by using the **Stop Historical Data Collection** command. The historical data collection is also stopped when Volume Manager is stopped or when the computer is rebooted. In those cases, you will need to restart the historical data collection, using the steps outlined in the section [“Selecting Storage Objects and Starting the Data Collection for Historical Statistics”](#) on page 244.

▼ To stop the historical data collection:

1. Select **Tools/Statistics/Stop Historical Data Collection** to bring up the Stop Historical Data Collection window, as shown in the sample screen that follows.



2. In the left pane of the window, highlight the storage objects for which you no longer want to have data collection and use the **Add** or **Add All** button to move the objects to the right pane. You can also move the objects to the right pane by double-clicking them or by dragging them to the right pane.
3. Click **OK** when you are satisfied with your selections.

Subdisk Move, Split, and Join

This section describes the **Subdisk Move**, **Split**, and **Join** commands. Topics include:

- ◆ [Purpose of the Subdisk Commands](#)
- ◆ [Subdisk Context Menu](#)
- ◆ [Subdisk Properties](#)
- ◆ [Moving Subdisks](#)
- ◆ [Splitting Subdisks](#)
- ◆ [Joining Subdisks](#)

Purpose of the Subdisk Commands

With the commands **Move Subdisk**, **Split Subdisk**, and **Join Subdisk**, you can move subdisks to other locations within the dynamic disk group, split subdisks, and join them back together. The flexibility of moving subdisks, splitting them, and joining them lets you make best use of your disk space.

There are three main purposes for moving and splitting your subdisks:

- ◆ [Load Balancing](#)
- ◆ [Disk Failure or Removal](#)
- ◆ [Disk Phaseout](#)

Load Balancing

If disk activities are heavily concentrated on one or a small number of disks in the storage subsystem, it may create bottlenecks. You can use the **Move Subdisk** and possibly the **Split Subdisk** command to spread out disk accesses more evenly across all the disks.

If a disk has High or Critical I/O activity (shown by a yellow or red pie symbol), you may consider moving one or more of its subdisks to another disk that shows below-average I/O activity (shown by a blue pie symbol). The idea is to move just enough activity to achieve balance. A careful study of the statistics for the disk with Critical activity may identify the best subdisks to move. You should move subdisks only when a disk has High or Critical I/O activity over a prolonged period of time and performance is affected. Moving a subdisk to another disk has an effect on I/O as well, but it should be compensated for by the other disk's having much lower I/O activity. You would need to look at the statistics after the subdisk move to see whether the move was effective in balancing the load.



Disk Failure or Removal

The **Move Subdisk** command can also be used to move the part of a volume that is on a failed or missing disk to a healthy one. Moving a subdisk for redundant volumes (mirrored or RAID-5) will use the redundant data to recreate the subdisk on the healthy disk. However, for nonredundant volumes (concatenated or striped), the data cannot be recreated, and doing subdisk move will therefore lose data, which could be recovered if the disk can be repaired. Thus, when you attempt to move a subdisk from a failed or missing disk that has nonredundant data, a dialog box appears that asks if you want to force the move. You may want to force the move if you don't need the data anymore or you can no longer recover the data. By doing so, you will retain the volume structure, but there is no guarantee that the data will be recoverable.

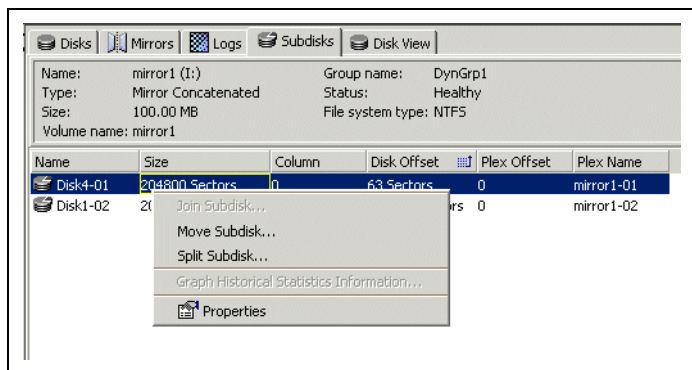
Disk Phaseout

When a disk starts getting intermittent I/O errors and shows signs of hardware fatigue, you can use the **Move Subdisk** command to move all its subdisks to healthier disks. The benefit of moving subdisks instead of copying the volumes is that you need only enough space on the receiving disks for the subdisks on the one failed disk, not for entire volumes that may span multiple disks. Another advantage is that there is no interruption in I/O.

Moving subdisks provides you a flexible means of making adjustments in your storage system while it is up and running.

Subdisk Context Menu

The subdisk commands are available from the subdisk context menu, which is shown below:

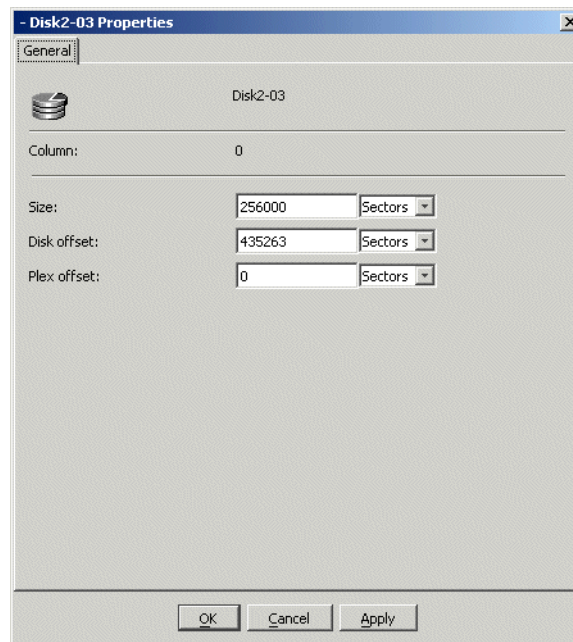


To access this menu, display the subdisk you want to work with by first clicking on its volume in the tree view and then clicking the Subdisks tab above the right pane. Once the subdisk is displayed, right-click the subdisk to bring up this menu.

Note The subdisk context menu is also available from the expanded view in the Volume to Disk Mapping window. This window allows you to monitor the activity of the various subdisks on your system. For more information, see “[Volume to Disk Mapping](#)” on page 237.

Subdisk Properties

When you select Subdisk Properties from the subdisk context menu, the following screen displays the properties of the selected subdisk:



Note The Size, Disk offset, and Plex offset fields have pull-down lists that allow you to select the units you want the number to be displayed in (Sectors, KB, MB, GB, or TB).

Name

In the screen captures showing subdisks in this chapter, you may have noticed that the subdisks on a disk are assigned numbers in a sequence, such as 1-01, 1-02, 1-03 or 12-01, 12-02, 12-03. The subdisk number is an internal number generated by the program. There is no particular significance to the one or two digits before the dash except that for any one



disk, the first one or two numbers identifying its subdisks must be the same. The numbers after the dash represent a number for the subdisk within the disk. Thus, if the subdisk was the first one created for a particular disk, it would have a 01 after the dash, the second disk created would have a 02 after the dash, and so on.

Column

Column displays the column that the subdisk occupies in the volume. Striped and RAID-5 volumes have multiple columns.

Size

This field displays the size of the subdisk.

Disk Offset

This is the offset where the subdisk starts on the disk. This is included in the Properties window because for a subdisk to be split, it must be contiguous to the subdisk next to it. By looking at the offsets, you can determine which subdisks are contiguous.

Plex Offset

This is the offset of a subdisk within a plex. It shows the distance from the start of a plex to the start of a specific subdisk. The first subdisk within a plex will have an offset of 0. The second subdisk will be offset by the size of the first subdisk.

Moving Subdisks

The purpose of moving a subdisk is discussed in the section “[Purpose of the Subdisk Commands](#)” on page 247.

Note You are not allowed to move a subdisk that is part of a boot or system volume.

▼ **To move a subdisk:**

1. In the tree view, select the volume that contains the subdisk you want to move.
2. In the right pane, click the Subdisks tab to display the volume’s subdisks.
3. Right-click on a subdisk you want to move to bring up its context menu.
4. Identify the subdisk that you want to move, and display it in the right pane of the VEA console.

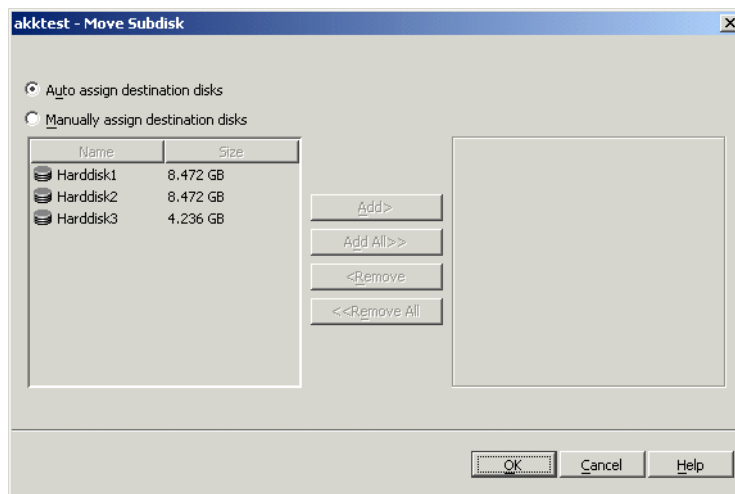
If you are concerned about load balancing, look for a disk with High or Critical I/O activity. It will have a yellow or red pie symbol in the cell to the right of its name in the Statistics tabular view. You may also be aware that a disk has had difficulties because of minor disk errors that have occurred. Such a disk may display an Online (Errors) state from time to time.

To display the subdisk in the right pane, click on its volume in the tree view, and then click on the Subdisks tab in the right pane. The subdisks for that volume will display. You can use the subdisks’ **Properties** command to further identify the characteristics of a volume’s subdisks.

5. Right-click on the subdisk you want to move to bring up its context menu.
6. Select **Move Subdisk** from the context menu.

The Move Subdisk window appears.





- a. Choose either automatic or manual selection of the destination disk or disks for the subdisk to be moved to.

Leave the default value of “Auto assign destination disks” if you want the program to assign the destination disk or disks.

- b. If you want to select the destination disk(s), click “Manually assign destination disks.” In the left panel of the window, highlight the disk(s) you want to assign as the destination disk or disks and use the **Add** or **Add All** button to move the disk(s) to the right pane of the window.

7. Click **OK** when you are satisfied with the changes.

Note Volume Manager automatically checks the state of the data before beginning the subdisk move. If the data is degraded, the subdisk can still be moved. After moving, you will need to reactivate the disk to clear the Degraded state.

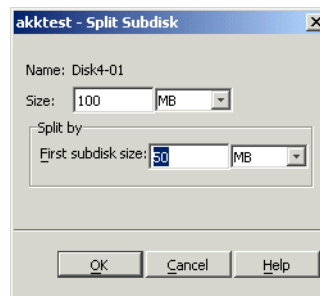
Splitting Subdisks

The **Split Subdisk** command allows you to split a subdisk. After the subdisk is split, the resulting two subdisks will reside on the same sections of the same disk. You can then use the **Move Subdisk** command to move one or both subdisks to other disks. You may want to split and move a subdisk to make the best use of your disk space. A split subdisk can be joined back together with the **Join Subdisk** command.

▼ To split a subdisk:

1. In the tree view, select the volume that contains the subdisks you want to split.
2. In the right pane, click the Subdisks tab to display the volume's subdisks.
3. Right-click on the subdisk you want to split to bring up its context menu.
4. Select **Split Subdisk** from the context menu.
5. In the window that comes up, specify the subdisk size for the first of the two subdisks.
The remaining space will be assigned to the second subdisk. For example, if the original subdisk was 100 MB and you assigned 40 MB to the first subdisk, the other subdisk will be 60 MB.

The drop-down list to the right of the "Size" and "First subdisk size" text entry boxes allow you to select sectors, KB, MB, GB, or TB.



6. Click **OK** to complete the command.

After a few moments, two subdisks will appear in the right pane of the VEA console.

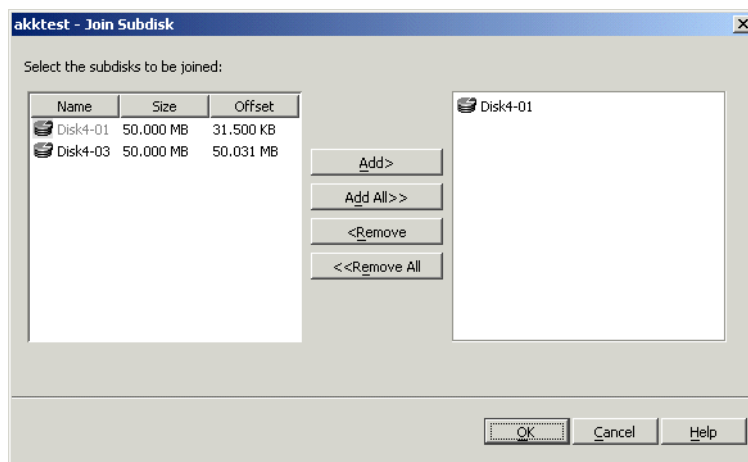
Joining Subdisks

The **Subdisk Join** command allows you to join subdisks. You can join two subdisks that had been one subdisk but that were split by the **Subdisk Split** command. You cannot split a subdisk and join it back to another subdisk that it was not split from. There also has to be room on the disk for the two subdisks.



▼ **To join subdisks:**

1. In the tree view, select the volume that contains the subdisks you want to join.
2. In the right pane, click the Subdisks tab to display the volume's subdisks.
3. Right-click on a subdisk you want to join to bring up its context menu.
4. Select **Join Subdisk** from the context menu.
5. In the window that appears, select the subdisks to be joined.



6. Click **OK** to complete the command.

Within a short time, the two subdisks in the right pane of the VEA GUI will be replaced with one subdisk.

Displaying Volume Manager Storage Objects with Microsoft System Monitor (Perfmon) through WMI

Volume Manager storage objects are available for use with Windows Management Instrumentation (WMI). They can be accessed through programs that use WMI. The Volume Manager performance objects are published under the **root\CIMV2\WMI namespace**. The Class names are **Win32_PerfRawData_vxio_DynamicDisk** and **Win32_PerfRawData_vxio_DynamicVolume**.

One Microsoft program that uses WMI is Microsoft System Monitor, which is also known as Perfmon. This program provides an alternative way to view Volume Manager performance data. With the Microsoft System Monitor, the statistics types, which are called counters, are the same as those included in Volume Manager (except Volume Manager has a few more statistics types). In Microsoft's System Monitor, you can set up the statistics to display a graph of the current statistics. You can also save the data to a log (called the performance log) and graph the saved data or import it into a spreadsheet, such as Excel, for printing and reporting. You can specify the time and duration of data to be collected for the log.

This section gives a step-by-step example of how to use the Microsoft System Monitor with Volume Manager storage objects.

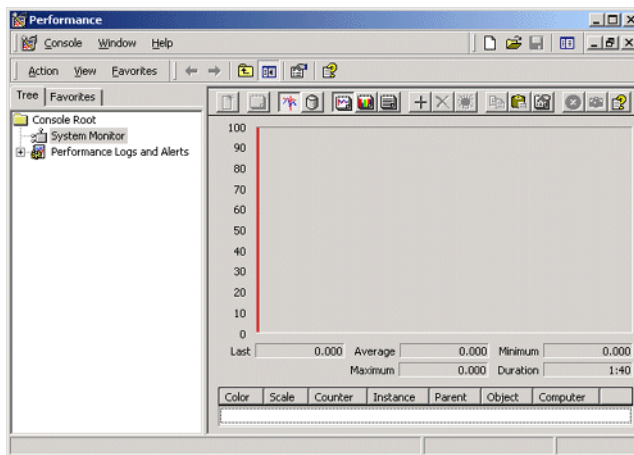
▼ To use Microsoft System Monitor to create a graph with Volume Manager storage objects:

1. Bring up the Microsoft command window (**Start>Run**). Type at the command window:

```
perfmon /wmi
```

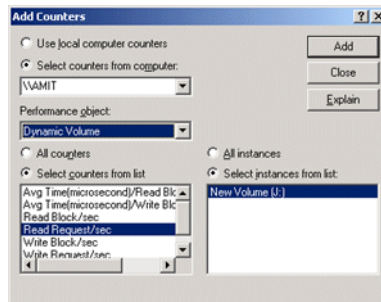
The main System Monitor screen appears.





2. Click the **Add** button, the button with a plus sign that is located in the middle of the toolbar above the graphing window.

The Add Counters screen appears as shown.



3. Select **Dynamic Disk** or **Dynamic Volume** from the “Performance object” pull-down list.

The Dynamic Disk object and Dynamic Volume object are created by VERITAS Volume Manager.

4. Select the specific instance—a specific disk or volume—in the section on the right side of the Add Counters screen, if it is not already selected.

You can also select all instances by clicking the “All instances” radio button above the list of instances.

5. Select the counter or statistics type from the list on the left side of the Add Counters screen, and then click **Add** to add this counter for monitoring. The counters are described in the table below.

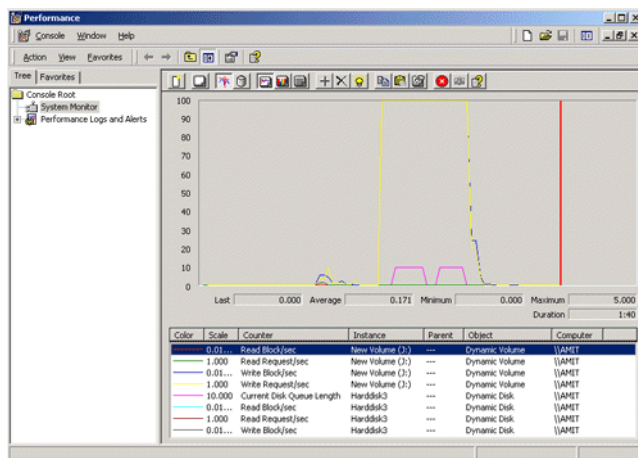
Counters	Description
Read Request/sec	Read Request/sec is the rate of I/O read requests to this object.
Write Request/sec	Write Request/sec is the rate of I/O write requests to this object.
Read Block/sec	Read Block/sec is the rate at which blocks are read from this object. A block is 512 bytes.
Write Block/sec	Write Block/sec is the rate at which blocks are written to this object. A block is 512 bytes.
Avg Time(microsecond) /Read Block	Avg Time(microsecond)/Read Block is the average time required to read a block from this object. A block is 512 bytes.
Avg Time(microsecond) /Write Block	Avg Time(microsecond)/Write Block is the average time required to write a block to this object. A block is 512 bytes.
Current Disk Queue Length	Current Disk Queue Length is the number of requests outstanding on the disk at the time the performance data is collected. It includes requests in service at the time of the snapshot. This is an instantaneous length, not an average over the time interval. This counter might reflect a transitory high or low queue length, but if there is a sustained load on the disk drive, it is likely that this will be consistently high.

You can also select all counters by clicking the “All counters” radio button above the list of counters.

6. Click **Close** to close the window.

The performance screen returns with a real-time graph that graphs the selected counter or counters for the selected dynamics disk(s) or volume(s). You can add more counters to the graph by repeating steps 2 through 5. When you want the display of the counters to stop, click the first button on the left above the graphing window, the **New Counter Set** button.





If you right-click in the graph area, a context menu appears. If you select **Properties** from that menu, the **System Monitor Properties** screen comes up. This screen, which has multiple tabs, allows you to customize the appearance of the graph. From this screen, you can choose to have the statistics output as a text report. You can also save the graph as an htm file.

Note For more information on the Microsoft System Monitor, refer to the program's online help, which has a good explanation of the program's features, as well as tips on using the statistics to analyze the various aspects of your system and network performance.

Command Line Commands for Statistics

Statistics commands can be done through the command line interface. See "[vxstat](#)" on page 308 in the "[Command Line Interface](#)" section at the end of this chapter.

Dirty Region Logging (DRL) and RAID-5 Logging

This section describes the dirty region logging (DRL) and RAID-5 logging features that were introduced in Volume Manager 3.0 for Windows 2000. The topics are:

- ◆ Dirty Region Logging for Mirrored Volumes
- ◆ RAID-5 Logging
- ◆ Adding Logs
- ◆ Removing Logs

Dirty Region Logging for Mirrored Volumes

DRL uses a log-based recovery method to quickly resynchronize all the copies of a mirrored volume when a system is restarted following a crash. If DRL is not used and a system failure occurs, all mirrors of the volume must be restored to a consistent state by copying the full contents of the volume between its mirrors. This process can be lengthy and I/O intensive.

A log can be created when the volume is created or can be added later.

Caution Although DRL makes sure that the mirror copies of the mirrored volumes are in sync following a system crash, it does not guarantee data integrity. The data integrity will be preserved by the file system, for example, NTFS.

When a dirty region log is created, a log subdisk is added to the volume. Multiple logs can be associated with a single mirrored volume as a fault tolerant measure. Depending on the number of logs configured, this may result in degraded performance.

RAID-5 Logging

The primary purpose of RAID-5 logging is to quickly reactivate a RAID-5 volume when a system is restarted following a crash. Without RAID-5 logging enabled, a time-consuming reactivation of the entire RAID-5 volume is necessary.

If a RAID-5 log is available, updates need to be made only to the data and parity portions of the volume that were in transit during a system crash. The entire volume does not have to be resynchronized.

A log can be created when the volume is created or can be added later.

When a RAID-5 log is created, a log subdisk is added to the volume. Multiple RAID-5 logs can be associated with a single RAID-5 volume as a fault tolerant measure. Depending on the number of logs configured, this may result in degraded performance.



Adding Logs

This operation adds a log plex containing a log subdisk to a volume. For mirrored volumes, a dirty region log will be added. For RAID-5 volumes, a RAID-5 log will be added.

Note Logs are only used for mirrored volumes or RAID-5 volumes.

▼ To add logs to a mirrored or RAID- 5 volume:

1. Right-click on the volume you wish to add the logs to.
2. Select **Log > Add** from the context menu.
The Add Log dialog box will appear.
3. Choose either the default setting “Auto assign destination disks” or the option to manually assign the destination disks. Click **OK** to create the logs.

Auto assign destination disks

This option will add one log to the selected volume.

Manually assign destination disks

You can create multiple logs with this option.

Click the “Manually assign destination disks” radio button. Available disks will appear in the left window. To add destination disks for the logs, select them in the left window and click the **Add** button. To add logs to all available disks, click the **Add All** button.

To remove destination disks, select them in the right window and click the **Remove** button. To remove all of the destination disks, click the **Remove All** button.

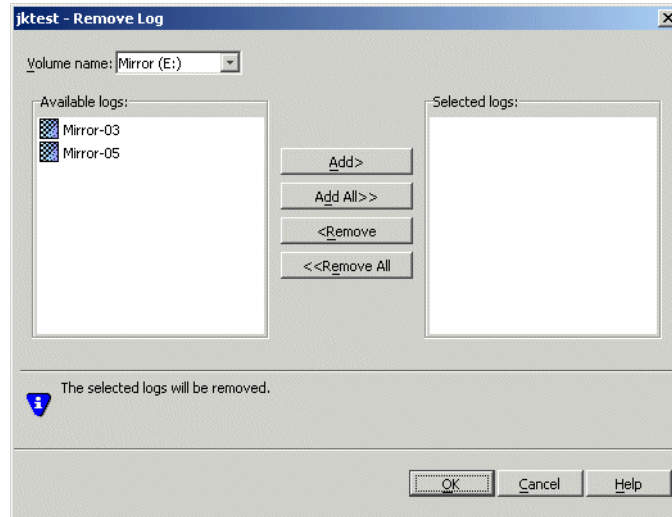
Removing Logs

After a log is removed, the space formerly allocated to it reverts to free space.

▼ To remove a log:

1. Right-click on the volume you wish to delete the log from.
2. Select **Log>Remove**.

The Remove Log dialog box will appear as shown in the sample screen below:



3. From the drop-down list next to the "Volume name" box, select the volume you wish to remove the log from. The name of the volume on which you right-clicked will appear in this box by default.
4. The available logs will appear in the left pane. Use the **Add** or **Add All** button to move the desired logs to the list of logs selected to be removed in the right pane. To move the logs from the Selected logs list to the Available logs list, select them in the right pane and click the **Remove** button. To move all of the logs from the Selected logs list back to the Available logs list, click the **Remove All** button.
5. Click **OK** to remove the log or logs.
6. Click **Yes** at the message warning you that removing logs will potentially increase recovery time.



Hot Relocation and Hot Spare

This section describes the Hot Spare and Hot Relocation features that were introduced in Volume Manager 3.0 for Windows 2000. Hot Spare and Hot Relocation describe the ability of a system to automatically react to I/O failures. The topics are:

- ◆ [About Hot Spare Mode](#)
- ◆ [About Hot Relocation Mode](#)
- ◆ [Enable Hot Spare or Hot Relocation Mode](#)
- ◆ [Undo Hot Relocation](#)
- ◆ [Clear Hot Relocation Information](#)
- ◆ [Customize Target Disks with Set Disk Usage](#)

About Hot Spare Mode

In Hot Spare mode, if there are I/O errors anywhere on a disk, all healthy and degraded subdisks from that disk will automatically be moved to a spare disk. If an entire disk fails, only the redundant volumes (RAID-5 or mirrored) will have a Healthy or Degraded status and will be moved to a spare disk. The redundant volumes can only be moved if there are healthy plexes of the volume available elsewhere within the dynamic disk group. For the hot spare operation to occur, there must be enough free space on the spare disk for all the subdisks from the original disk. If there is not enough free space on the spare disk, the hot spare operation will fail and an alert message will be sent to the Event Log.

The **Undo Hot Relocation** command can be used to move the subdisks back to their original location after the failed disk has been repaired or replaced.

One or more disks in each dynamic disk group can be designated as hot spare targets by using the **Set Disk Usage** command. These hot spare disks provide a location for data to be moved to. See [“Customize Target Disks with Set Disk Usage”](#) on page 266 for more information.

About Hot Relocation Mode

In Hot Relocation mode, if there are I/O errors on a subdisk containing a redundant volume (RAID-5 or mirrored), the redundant volume's subdisks are moved from the failed subdisk to a hot spare disk. If there is not enough free space on designated hot spare disks, then free space on any available disk will be used. Depending on available disk space, the subdisks will not always be moved to the same disk, but may be scattered within the dynamic disk group. The **Undo Hot Relocation** command can be used to move the subdisks back to their original location after the failed disk has been repaired or replaced.

Note The hot relocation operation is performed only for redundant subdisks with I/O errors if there are healthy plexes of the volume available elsewhere within the dynamic disk group. Non-redundant subdisks with I/O errors are not relocated; the volume fails, and an alert message is sent to the Event Log.

When selecting space for relocation, hot relocation preserves the redundancy characteristics of the dynamic volume that the relocated subdisk belongs to. For example, hot relocation ensures that a failed subdisk is not relocated to a disk containing its mirror. If redundancy cannot be preserved using any available spare disks or free space, hot relocation does not take place. If relocation is not possible, the system administrator is notified and no further action is taken.

When hot relocation takes place, the failed subdisk is removed from the configuration database, and Volume Manager takes precautions to ensure that the disk space used by the failed subdisk is not recycled as free space.

The default is to have all disks available as targets for hot relocated subdisks. Using the **Set Disk Usage** command you can choose to designate specific disks as not available. See “[Customize Target Disks with Set Disk Usage](#)” on page 266 for more information.

Enable Hot Spare or Hot Relocation Mode

The default for Volume Manager is to have automatic Hot Relocation mode active. This means that if an I/O error occurs in a redundant subdisk, the subdisk will automatically be relocated to another disk.

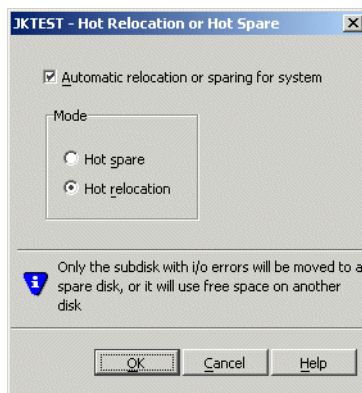
The option to disable automatic Hot Relocation mode or to choose Hot Spare mode instead is available from the Control Panel.

▼ To change the option:

1. Select Control Panel from the tree view.
2. Double-click on the **Hot Relocation** icon.

The Hot Relocation or Hot Spare window shown below will open.





3. Choose the mode you desire—either Hot Spare or Hot Relocation.

Hot Spare

Select the Hot Spare mode if you prefer to automatically relocate any healthy and degraded subdisks from a disk with I/O errors to a designated spare disk.

Caution In order for the Hot Spare operation to occur, there must be enough free space on the targeted spare disk for ALL the healthy and degraded subdisks from the original disk.

Hot Relocation

Select the Hot Relocation mode if you prefer to automatically relocate any redundant subdisks containing I/O errors to a hot spare disk or to free space on another available disk.

4. If you want to disable both the Hot Relocation and Hot Spare modes, uncheck the checkbox next to the phrase “Automatic relocation or sparing for system” to turn off this feature. If automatic relocation or sparing is disabled and an I/O failure occurs, an alert will be sent to the Event Log, but no further action will take place.
5. When you are satisfied with your selections, click **OK**.

Undo Hot Relocation

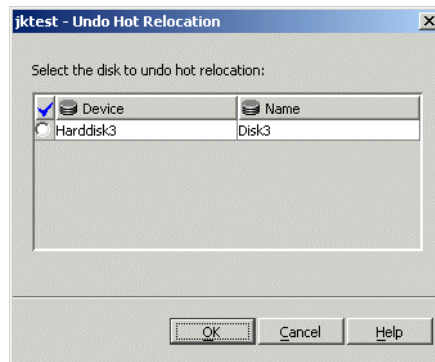
The command **Undo Hot Relocation** relocates subdisks back to their repaired original disk or replacement disk and restores a system to its original configuration, less any failed volumes. If hot relocation scattered subdisks from a failed disk to several disks within a dynamic disk group, the **Undo Hot Relocation** command will move all of them back to a single disk without the user having to find and move each one individually.

Note This command is available only after a hot relocation or hot sparing procedure has occurred.

▼ To undo a hot relocation or hot spare:

1. Right-click on the dynamic disk group that contains the hot-relocated volumes.
2. Select **Undo Hot Relocation** from the context menu.

A window appears showing the disks that had I/O errors and from which subdisks were moved.



3. Click on the corresponding circles in the column under the checkmark to select the disks you wish to restore. The hot relocated or hot spared subdisks will return to this disk.
4. Click **OK**.



Clear Hot Relocation Information

The **Clear Hot Relocation Information** command deletes the information that describes the original location of any subdisks that have been moved through the hot relocation or hot spare processes. Use this command only if you do not plan to move the hot relocated subdisks back to their original configuration.

▼ To clear hot relocation information:

1. Right-click on a disk group that contains hot relocated subdisks.
2. Select **Clear Hot Relocation Information** from the context menu.
3. A dialog box will appear asking if you are sure you want to clear the relocation information for the dynamic disk group. Click **Yes** if you want to clear the hot relocation information.

Caution Once you clear the hot relocation information, you will not be able to perform an **Undo Hot Relocation** command for that dynamic disk group.

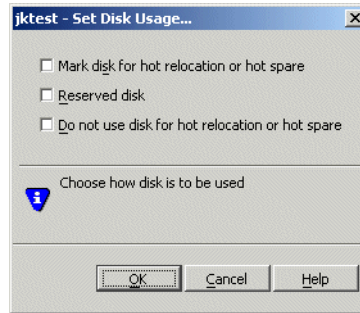
Customize Target Disks with Set Disk Usage

The **Set Disk Usage** command allows you to specify how individual disks within a dynamic disk group will be used. You can select a disk to act as hot spare target, prevent a disk from being used as a hot relocation or hot spare target, and/or mark a disk as reserved. Each disk must be customized individually; you cannot set disk usage for a group of disks.

▼ To set disk usage:

1. Right-click on the desired disk.
2. Select **Set Disk Usage** from the context menu.

A window appears offering three options. By default, no options are selected.



Reserved disk option

The middle option, Reserved disk, allows a disk to be marked so that it will not be used in automatic selection operations. For example, during the Create New Volume wizard, the default option is to auto-select disks for the new volume; the volume would not be created on a reserved disk. However, if you wish to create a volume on that specific disk, you could choose the option to manually select the disks for the new volume and then select that disk.

Mark Disk and Do not use disk for hot relocation or hot spare options

A disk can be marked for use for hot relocation only, for both hot spare and hot relocation, or for neither hot spare nor hot relocation. Use the table below as a guide in making your choice.

Set Disk Usage selection	Disk will be used as a hot spare target	Disk will be used as a hot relocation target
Neither choice checked	No	Yes
Mark disk for hot relocation or hot spare	Yes	Yes
Do not use disk for hot relocation or hot spare	No	No

- When you are satisfied with your selection, click **OK**.

Note You can review the settings for all your disks by selecting the Disks folder in the tree view and then viewing the Disks tab in the right pane. The settings for each disk are listed in the Spare, Reserved, and Hot Use columns.



For an unused disk, if you choose both the “Mark disk for hot relocation or hot spare” and “Reserved disk” options, the disk will be saved as a target for hot spare or hot relocation operations only, unless it is manually selected for use during a procedure such as create volume, add mirror, etc.

For an unused disk, if you choose both the “Do not use disk for hot relocation or hot spare” and “Reserved disk” options, nothing will automatically be written to the disk. If the disk already contains volumes, then data will continue to be written to those volumes, but no new subdisks will be added automatically.

Command Line Interface

This section describes the command line interface (CLI) commands available with Volume Manager 3.1 for Windows 2000. The key Volume Manager commands can be executed from the command line as well as from the GUI.

The utilities are available in the Volume Manager installation directory, typically **C:\Program Files\VERITAS\Volume Manager 3.1**. You can invoke the commands from any directory in the command prompt window.

Note The CLI commands run only on the server. They will not run on the Volume Manager client.

The available commands are:

- ◆ **vxvol**
Displays volume information, repairs a RAID-5 or mirrored volume, turns Fast Resynchronization on and off, and reactivates a volume.
- ◆ **vxdbg**
Allows you to create a dynamic disk group and perform other functions related to dynamic disk groups.
- ◆ **vxclus**
Enables and disables the capability of forcing the import of a disk group on an MSCS cluster.
- ◆ **vxdisk**
Provides information on dynamic disks and allows you to reactivate a dynamic disk.
- ◆ **vxassist**
Allows you to create a dynamic volume and perform other operations related to dynamic volumes.
- ◆ **vxevac**
Moves subdisks from the disk specified to a specified destination disk.
- ◆ **vxunreloc**
Reverses the process of hot relocation.
- ◆ **vxsd**
Provides commands for moving and splitting a subdisk and joining two subdisks.
- ◆ **vxstat**
Provides commands for displaying statistics for disks, volumes, and subdisks.



Conventions for Command Line Syntax

This topic describes the typographical conventions used for the command line syntax in this CLI section.

1. Any parameter that is optional for the command syntax has a square bracket ([]) around it. For example:

[-b] or **[-o keepplex]**

2. Required command words and parameters for the command do not have square brackets around them. For example:

vxvol volinfo or <VolumeName>

3. Command words and parameters that are typed as shown in the command syntax are displayed in the Courier bold font. For example:

vxvol volinfo or [-b]

4. Parameters that require the user to enter something in their place are displayed in Helvetica Italic font and have angle brackets around them. They are placeholders for information the user enters. For example:

<VolumeName>

If a parameter is enclosed by both angle brackets and square brackets, it is an optional parameter for the command. For example:

[<DiskName>]

5. The | character is a separator that allows two or more choices for a given parameter. The user can use any one of the choices for the command. For example:

<VolumeName | DriveLetter>

[volume | mirror | log]

6. Ellipses (...) after a parameter indicate more items. For example, the parameter *<DiskName>...* means to enter one or more disk names. The parameter **[DriveLetter={A | B | ... | Z}]** means to enter **DriveLetter=** and a drive letter in the range of A to Z.

7. The parameter **!<DiskName>** is used with three commands—**vxassist break**, **vxassist remove**, and **vxassist snapshot**. The exclamation mark is needed to make these commands consistent with the Volume Manager for UNIX versions of these commands.

8. In all commands relating to an existing dynamic volume, the *<VolumeName>* parameter for the command line interface is the path name of the volume and has the following syntax:

\Device\HarddiskDmVolumes\<DynamicDiskGroupName>\<VolumeName>

For example:

\Device\HarddiskDmVolumes\DynDskGrp1\volume1

When you are creating a volume with **vxassist make**, the *<VolumeName>* parameter is a name you assign to the volume. A volume name is limited to 18 characters. It cannot contain spaces or forward or backward slashes. Also, a period cannot be the first character in the name.

Note The name you assign for the *<VolumeName>* parameter when creating a volume in the CLI is equivalent to the volume name that is specified in creating a volume with the **New Volume** command in the VEA GUI.

9. A disk that is involved in a command line command is identified by its *<DiskName>*, such as **Harddisk4**. For disk and dynamic disk group names, no spaces are supported. A disk can be specified in two ways: either as **"Harddisk"** with a number, such as **Harddisk2**, or with a path name, such as **\Device\Harddisk2**.



vxvol

The **vxvol** utility has commands relating to dynamic volumes. These are the keywords:

volinfo	Displays information on a dynamic volume.
repair	Repairs a RAID-5 volume.
set fastresync=on off	Turns Fast Resynchronization on and off.
reactivate	Reactivates the volume (restarts the volume).
rdpol prefer	Sets the volume read policy on a volume with multiple mirrors to designate one specific plex to be used whenever possible for reading from the volume.
rdpol round	Sets the volume read policy on a volume with multiple mirrors so that plexes are read sequentially in a “round-robin” fashion.

Each keyword is followed by the volume name or drive letter. Typing the following sequence for each keyword brings up a description of its syntax:

vxvol <Keyword> -?

Keywords or Operands

vxvol volinfo

vxvol [-v] **volinfo** <VolumeName | DriveLetter>

Returns information on the volume. The possible information categories are name, dynamic disk group name, size, volume type, whether it is a boot or system volume, whether it contains the page file (pagefile.sys), and volume status. If the volume is a dynamic volume, the command can return additional information on any mirror plexes or DCO volumes associated with the volume. The verbose [-v] option displays the size and offset of the subdisks as well as the other information provided by the main command.

Example

vxvol volinfo E:

This returns a list with specified information as described above for volume E.

vxvol repair**vxvol repair** <VolumeName | DriveLetter>

Repairs a RAID-5 or mirrored volume if its status is Degraded and there is unallocated space on another dynamic disk. The command repairs the damaged part of the volume by placing a functional replacement of that subdisk on another disk.

Example**vxvol repair J:**

This command repairs a RAID-5 volume (designated as J:) after a disk that belongs to the RAID set has failed.

vxvol set fastresync=on|off**vxvol set fastresync=on|off** <VolumeName | DriveLetter>

Turns FastResync on or off for the specified mirrored volume. FastResync is not supported on RAID-5 volumes. If you have initiated a snapshot operation on a volume, you cannot turn FastResync off for that volume. If you try to do so, the command line interface returns an error message.

When you turn FastResync on, a DCO (disk change object) log volume is created. When you turn FastResync off, the DCO log volume is deleted. You can perform a limited number of operations on a DCO log volume. For more information, see “FastResync” on page 317 and “Disk Change Object (DCO) Volume” on page 319.

Examples**vxvol set fastresync=on J:**

This command turns on the FastResync feature on the volume with drive letter J.

vxvol set fastresync=on \Device\HarddiskDMVolumes\DynDskGrp1\Volume1

This command turns on the FastResync feature for Volume 1, which belongs to DynDskGrp1.

vxvol reactivate**vxvol reactivate** <VolumeName | DriveLetter>

Manually restarts the volume. You need to rescan and then reactivate the disk before attempting to reactivate the volume. For information on the CLI version of the **Rescan** and **Reactivate** commands, see “[vxassist rescan](#)” on page 301 and “[vxdisk reactivate](#)” on page 288.



Example**vxvol reactivate J:**

This command reactivates the volume with drive letter J.

vxvol rdpol prefer**vxvol rdpol prefer** *<VolumeName|DriveLetter>* *<PlexName>*

Sets the volume read policy on a volume with multiple mirrors to designate a specific plex to be used for reads. This plex is referred to the “preferred plex.” Designating a plex as preferred can improve your system’s read performance if the drive used for the target mirror is a high-performance drive or if the target mirror is located on a drive that is physically closer.

Note When a preferred plex has an error, the read operation is completed by another plex. This happens automatically, as if there were no preferred plex.

Example**vxvol rdpol prefer J: Volume1-01**

This command designates plex **Volume1-01** as the preferred plex on mirrored volume **J**.

vxvol rdpol round**vxvol rdpol round** *<VolumeName|DriveLetter>*

Sets the volume read policy on a volume with multiple mirrors to read from each plex sequentially in a “round-robin” fashion. Sequential access causes only one plex to be accessed at a time. This takes advantage of the drive or controller read-ahead caching.

Example**vxvol rdpol round J:**

This command sets up the mirrors of volume **J** to be read in a round-robin fashion.

vxchg

The **vxchg** utility performs operations relating to dynamic disk groups. The keywords are:

list	Displays a list of the dynamic disk groups on the computer.
dginfo	Displays information about a specified dynamic disk group.
init	Creates a dynamic disk group.
adddisk	Adds a basic disk to a dynamic disk group.
rmdisk	Removes a disk from a dynamic disk group and reverts it back to a basic disk.
import	Imports the specified dynamic disk group on the computer.
deport	Deports the specified dynamic disk group on the computer.
protect	Adds private dynamic disk group protection.
release	Removes private dynamic disk group protection.
upgrade	Upgrades the dynamic disk group to the current version.
repldisk	Replaces the specified disk by moving all the subdisks to a spare disk.
split	Splits the specified dynamic disk group into two dynamic disk groups.
recover	Recovers a dynamic disk group that fails because of a system crash or other problem during a dynamic disk group split operation.
join	Joins two dynamic disk groups into one larger dynamic disk group.

A dynamic disk group is identified by *<DynamicDiskGroupName>*, such as **DynDskGrp1** or by its dynamic disk group ID (DgID). The DgID is an internal number assigned to the disk group. It can be viewed through the **vxchg list** or **vxchg dginfo** command.

A disk that is being added or removed is identified by its *<DiskName>*, such as **Harddisk4**. For disk and dynamic disk group names, no spaces are supported. A disk can be specified in two ways: either as **"Harddisk"** with a number, such as **Harddisk2**, or a with a path name, such as **\Device\Harddisk2**.

In earlier versions of Volume Manager for Windows, using **vxchg adddisk** to add the first basic disk to a dynamic disk group automatically created the first dynamic disk group (known as the primary dynamic disk group). If you then used **vxchg adddisk** to specify adding a disk to a dynamic disk group with a new name, a secondary dynamic disk group



was formed. Starting with Volume Manager 3.0 for Windows 2000, the **vx dg adddisk** command does not automatically create a dynamic disk group by adding a disk. You must use the **vx dg init** command to create a dynamic disk group. The **vx dg adddisk** command now only adds disks to dynamic disk groups that have already been created.

Note In Volume Manager 3.0 and 3.1, the primary dynamic disk group is the dynamic disk group that contains the boot or system disk. It is not necessarily the first dynamic disk group that is created.

Typing the following sequence for each keyword brings up a description of its syntax:

vx dg <keyword> - ?

Keywords or Operands

vx dg list

vx dg list

Returns a list of the dynamic disk groups that are on the current computer. The list includes the disk groups' names, their types, whether each disk group is imported or deported, and the DgID. The dynamic disk group ID (DgID) is an internal number assigned to the disk group. It can be used in place of the dynamic disk group name.

vx dg dginfo

vx dg -g<DynamicDiskGroupName> dginfo

Returns information about the dynamic disk group that is referenced in -g<DynamicDiskGroupName>. Gives the names and numbers of the volumes and the disks in the dynamic disk group. It also includes the dynamic disk group name, its state (either Imported or Deported), and its dynamic disk group ID. The dynamic disk group ID (DgID) is an internal number assigned to the disk group. It can be used in place of the dynamic disk group name.

Example

vx dg -gSalesDynDskGrp dginfo

Lists the names and numbers of the volumes and disks in SalesDynDskGrp.

vxdg init

vxdg -g<DynamicDiskGroupName> [-s | -R] [-TLDM] init <DiskName>...

Creates a new dynamic disk group with the specified disks.

-g<DynamicDiskGroupName>	Identifies the dynamic disk group name. A dynamic disk group name is limited to 18 ASCII characters.
-s	Creates a cluster dynamic disk group.
-R	Creates a private dynamic disk group, that is a disk group with private dynamic disk group protection.
-TLDM	Creates a Windows 2000 Disk Management compatible dynamic disk group.
<DiskName>...	Name of the disk or disks, for example, Harddisk2, or the path to a disk, such as \Device\Harddisk2.

There can be one or more disks in a dynamic disk group. Disks within a dynamic disk group share a common configuration. Dynamic volumes are created within a dynamic disk group and are restricted to using disks within that group.

For definitions of cluster dynamic disk group, private dynamic disk group, and Windows 2000 Disk Management compatible dynamic disk group, see the section [“Creating a Dynamic Disk Group”](#) on page 138.

Examples

vxdg -gSharedDg1 init -s -TLDM Harddisk0 Harddisk1

This command creates a new cluster dynamic disk group called “SharedDg1,” which is compatible with Windows 2000 Disk Management dynamic disk groups. The dynamic disk group includes Harddisk0 and Harddisk1.

vxdg -gProtectedDg init -R -TLDM Harddisk0 Harddisk1

This command creates a new private dynamic disk group called “ProtectedDg,” which is compatible with Windows 2000 Disk Management dynamic disk groups. The dynamic disk group includes Harddisk0 and Harddisk1.

vxdg adddisk

vxdg -g<DynamicDiskGroupName> adddisk <DiskName>...



Adds one or more basic disks that are referenced in *<DiskName>...* to the dynamic disk group referenced in **-g<DynamicDiskGroupName>**. *<DiskName>...* is the disk name or path name of the device, such as **Harddisk2** or **\Device\Harddisk2**. The ellipses indicate that you can specify more than one disk.

You can no longer create a dynamic disk group implicitly by using a different dynamic disk group name. Dynamic disk group creation and all the options associated with the operation are now done through **vxdg init** instead.

Examples

```
vxdg -gSalesDynDskGrp adddisk Harddisk4
```

Adds Harddisk4 to SalesDynDskGrp.

```
vxdg -gclustr_dyndskgrp1 adddisk Harddisk5
```

Adds Harddisk5 to the cluster dynamic disk group clustr_dyndskgrp1.

vxdg rmdisk

```
vxdg rmdisk <DiskName>
```

Reverts a disk that is referenced in *<DiskName>* from a dynamic disk to a basic disk. *<DiskName>* can be the disk name or path name of the device, such as **Harddisk2** or **\Device\Harddisk2**. The disk must not contain any volumes when it is reverted.

Example

```
vxdg rmdisk Harddisk2
```

Reverts Harddisk2 to a basic disk.

vxdg import

```
vxdg -g<DynamicDiskGroupName> [-n<NewDynamicDiskGroupName>] [-s] [-f] [-C] import
```

Imports the dynamic disk group referenced in **-g<DynamicDiskGroupName>** for use on this computer. You can use its name from the original computer or rename it with **-n<NewDynamicDiskGroupName>**. The optional parameter **-s** is used if you want to import the dynamic disk group as a cluster dynamic disk group. Using this command with the **-s** option is the only way you can convert a regular secondary disk group to a cluster disk group. The **-f** option forces the import of a cluster disk group when a minority of disks in the disk group are available. For more on the **-f** option, see [“Unable to bring a cluster disk group online when a minority of the disks in the disk group are available”](#) on page 455. The **-C** option is explained in the paragraphs that follow.

When a dynamic disk group is created or imported, all disks in the dynamic disk group are stamped with the computer's host ID. Typically, a dynamic disk group cannot be imported if any of its disks are stamped with a non-matching host ID. This mechanism provides a check in cases when disks can be accessed from more than one host.

In Volume Manager 3.0 and 3.1, if a dynamic disk group is in use by one machine when another machine attempts to import this dynamic disk group again, the import will fail because the host IDs of these two machines are different.

If a dynamic disk group is successfully deported, the host ID is cleared and the group can be safely imported to another machine. By default, it will be imported as a regular dynamic disk group, regardless of whether the group was originally created as a cluster dynamic disk group or not. You must use the **-s** option to import it as a cluster dynamic disk group. However, if you use the GUI to do the import, the group will be imported as a cluster dynamic disk group if it was already a cluster dynamic disk group.

To move a dynamic disk group from one machine to another when the dynamic disk group was not cleanly deported (for example, if the host computer crashed), you must specify the **-C** option to clear the original host ID and stamp a new host ID onto the dynamic disk group.

Example

```
vxdg -gDynDskGrp1 -nAcctgDynDskGrp import
```

Imports the dynamic disk group previously known as "DynDskGrp1" and renames it "AcctgDynDskGrp."

vxdg deport

```
vxdg -g<DynamicDiskGroupName> [-f] deport
```

Deports the dynamic disk group referenced in **-g<DynamicDiskGroupName>** in preparation for its being imported to another computer. Disks and volumes cannot be accessed until the dynamic disk group is imported. The **-f** option forces the deport of the disk group if one or more of its volumes are still in use. Volume Manager does not allow you to deport a cluster disk group that is an MSCS Volume Manager disk group resource.

Example

```
vxdg -gDynDskGrp1 deport
```

Deports the dynamic disk group named "DynDskGrp1."



vxdg protect**vxdg -g<DynamicDiskGroupName> protect**

Adds private dynamic disk group protection to a secondary dynamic disk group on the current host. Private dynamic disk group protection allows administrators to partition storage and assign exclusive ownership in a SAN or shared disk array.

Private dynamic disk group protection uses hardware locking techniques to protect a secondary dynamic disk group located on shared storage from access by other hosts connected to the shared storage pool. The hardware locking is implemented by using a SCSI reservation thread to maintain a current reservation for each disk in a protected group.

If disks are being added to a dynamic disk group that has a SCSI reservation, they will get a reservation automatically.

As long as the dynamic disk group remains on the same host, the protection will be enabled, even through reboots. If the dynamic disk group is deported and imported on another host, the private dynamic disk group protection is removed and the command must be redone to restore the protection.

Also, if you uninstall Volume Manager, the dynamic disk group protection information is removed. If you then reinstall Volume Manager and want to restore the dynamic disk group protection, you must redo the command. For more information on private dynamic disk group protection, see [“Partitioned Shared Storage with Private Dynamic Disk Group Protection”](#) on page 177.

Example**vxdg -gDynDskGrp2 protect**

Adds private dynamic disk group protection to DynDskGrp2.

vxdg release**vxdg -g<DynamicDiskGroupName> release**

Removes private dynamic disk group protection.

Example**vxdg -gDynDskGrp2 release**

Removes private dynamic disk group protection from DynDskGrp2.

vxldg upgrade

vxldg -g<DynamicDiskGroupName> upgrade

Upgrades the dynamic disk group to the current dynamic disk group version. If you have upgraded to Volume Manager 3.1 from Volume Manager 2.7 or earlier or another program in the Volume Manager for Windows product line and have existing dynamic disk groups that you created on your system, you most likely will want to upgrade those dynamic disk groups so that they are compatible with the advanced Windows dynamic disk group capabilities that were first introduced in Volume Manager 3.0. The “current version” refers to a disk group version that supports those capabilities, such as FastResync and Dynamic Disk Group Split and Join.

If you don’t plan to make changes to these existing dynamic disk groups, you do not have to upgrade them.

For more information on Fast Resync, see “[vxvol set fastresync=on|off](#)” on page 273. Dynamic Disk Group Split and Join are implemented through the **vxldg split** and **vxldg join** commands, which are covered later in this section. See also “[Upgrading a Dynamic Disk Group Version](#)” on page 169.

Note You cannot upgrade a dynamic disk group that contains a boot or system volume. Also, upgrading a dynamic disk group is not reversible. If you do upgrade a disk group, it will not work properly if you try to move it to another computer that is running an earlier version of Volume Manager for Windows 2000 or another product in the Volume Manager for Windows product family.

Example

vxldg -gDynDskGrp2 upgrade

Upgrades DynDskGrp2 to the most current Volume Manager for Windows dynamic disk group version.

vxldg repldisk

vxldg repldisk “Missing Disk (disk#)”=<SpareDiskName>

Replaces a missing disk specified by “**Missing Disk (disk#)**”, moving all the subdisks to the disk specified by <SpareDiskName>. The disk specified by <SpareDiskName> must be a basic blank disk.

This command is listed under dynamic disk group commands because it applies only to dynamic disks. Because the string “**Missing Disk (disk#)**” has spaces, you must use quotation marks around it. The program specifies the (disk#), such as (disk2).

Example

vxldg repldisk “Missing Disk (disk2)”=Harddisk3



This command moves the contents of a missing dynamic disk designated as **"Missing Disk (disk2)"** to a basic disk, which in this case is Harddisk3. In the process, Harddisk3 becomes a dynamic disk. Active redundant volumes (mirrored and RAID-5) on the replaced disk will be resynchronized automatically after disk replacement.

vxdg split

vxdg -g<SourceDynamicDiskGroupName> **-n**<TargetDynamicDiskGroupName> **[-i] [-s] [-y] [-v] split** [<Object>...]

Splits a dynamic disk group into two dynamic disk groups. The disks and volumes that will be in the split-off disk group must be healthy. Also, the volumes that will be in the new disk group must be complete for the command to succeed.

-g<SourceDynamicDiskGroupName> Name of the current dynamic disk group.

-n<TargetDynamicDiskGroupName> Name of the new dynamic disk group.

-i Makes the new dynamic disk group to be in the Imported state.

-s Makes the new dynamic disk group a cluster dynamic disk group.

-y Query for the split closure. See the first example below.

-v Splits all disks in the dynamic disk group that contain snapshot volumes.

<Object>... Name of a disk or volume, or a drive letter. You can split either by disks or volumes. This option is not needed when using the **-v** option.

A primary dynamic disk group created in Volume Manager 3.0 or 3.1 for Windows 2000 cannot be split because it contains a boot or system drive. If you have dynamic disk groups created in Volume Manager 2.7 or earlier, you will need to upgrade them to be compatible with Volume Manager 3.0 and 3.1 dynamic disk groups before you can use the **vxdg split** and **join** commands. See the **vxdg upgrade** command in this section.

By default, the new dynamic disk group is in the Deported state after the split. You can use the **-i** option to have it be in the Imported state. The source dynamic disk group remains in the Imported state.

With the GUI split command, if the source disk group is a cluster disk group or a disk group with private dynamic disk group protection, the resulting target disk group will be of the same disk group type. With a CLI split command for either of these two disk group types, you must use additional parameters to ensure that the target disk group after the split retains the same disk group type. A cluster disk group requires the **-s** switch and the **-i** switch. A disk group with private dynamic disk group protection requires the **-i** switch. In a CLI split operation with either of these disk group types, the target disk group does not assume the disk group type of the source disk group until after the target disk group is imported. See also “[Dynamic Disk Group Split and Join](#)” on page 335. For considerations in using VCS or MSCS with dynamic disk group split and join commands, see “[Using Dynamic Disk Group Split and Join with a Cluster on Shared Storage](#)” on page 343.

Examples

```
vxdg -gDynDskGrp1 -y -nDynDskGrp2 split Harddisk5 Harddisk7
```

This command makes a query to determine whether **Harddisk5** and **Harddisk7** in a dynamic disk group named **DynDskGrp1** comprise the total disks that are needed to have a dynamic disk group split where all the volumes in the split-off dynamic disk group are complete. Here is the output from the command:

Following is the Closure for the requested Split operation.

Names of the Disks are....

```
Harddisk7  
Harddisk5  
Harddisk6
```

Names of the Volumes are....

```
\Device\HarddiskDmVolumes\DynDskGrp1\Volume1  
\Device\HarddiskDmVolumes\DynDskGrp1\Stripe1
```

The output indicates that in order to have a successful split, or what is called “split closure,” **Harddisk6** must also be added. The example of the command to perform the actual split is as follows:

```
vxdg -gDynDskGrp1 -i -nDynDskGrp2 split Harddisk5 Harddisk6  
Harddisk7
```

This command results in successfully splitting the dynamic disk group **DynDskGrp1** with the target dynamic disk group **DynDskGrp2** in the Imported state. The new dynamic disk group has the disks **Harddisk5**, **Harddisk6**, and **Harddisk7**.

The example that follows designates the volumes to be included in a new target disk group. Note the path name that is needed for volumes.

```
vxdg -gDynDskGrp1 -i -nDynDskGrp2 split  
\Device\HarddiskDmVolumes\DynDskGrp1\mirrorvol1  
\Device\HarddiskDmVolumes\DynDskGrp1\mirrorvol2
```



This command results in successfully splitting the dynamic disk group **DynDskGrp1** with the target dynamic disk group **-nDynDskGrp2** in the Imported state. The new dynamic disk group contains the volumes **\Device\HarddiskDmVolumes \DynDskGrp2\mirrorvol1** and **\Device\HarddiskDmVolumes \DynDskGrp2\mirrorvol2**.

vxdg recover

vxdg -g<DynamicDiskGroupName> [-s] recover

Recovers a dynamic disk group that fails because of a system crash or other problem during a dynamic disk group split operation. This command is used for manual recovery of a disk group when the disk group requires such recovery. The **-s** option recovers the disk group as a cluster disk group in the Imported state. See [“Recovery for the Split Command”](#) on page 340 for an extended explanation of automatic and manual recovery.

Example

vxdg -gDynDskGrp2 recover

Recovers DynDskGrp2 after it failed because of a system crash during a dynamic disk group split operation.

vxdg join

vxdg -g<SourceDynamicDiskGroupName> -n<TargetDynamicDiskGroupName> join

Joins two dynamic disk groups together. If some disks are missing or are non-functioning, the join command will fail.

-g<SourceDynamicDiskGroupName> Name of the source dynamic disk group, the dynamic disk group that will be added to the target dynamic disk group. The source dynamic disk group ceases to exist after the join.

-n<TargetDynamicDiskGroupName> Name of the target dynamic disk group, the dynamic disk group that will exist after the join.

The disk group type after the join will be the type of the target disk group. For example, if the target disk group before the join had private dynamic disk group protection, the resulting disk group will have private dynamic disk group protection after the join. Also, a cluster dynamic disk group will not be allowed to be the source

group for a join command if the disk group is being monitored by cluster software, such as MSCS or VCS. However, a cluster disk group can be a target dynamic disk group in a join command. See also “[Dynamic Disk Group Split and Join](#)” on page 335.

Example**`vxdg -gDynDskGrp2 -nDynDskGrp1 join`**

This command will join DynDskGrp2 back into DynDskGrp1. You can also join dynamic disk groups together that were not originally split apart.



vxclus

The **vxclus** utility makes it possible to bring an MSCS cluster disk group online on a node with a minority of the disks in the disk group. The **vxclus** utility creates an entry in the Registry that enables the cluster resource to be brought online. Once **vxclus enable** is executed, you can bring the resource online in Cluster Administrator.

Note The **vxclus** commands are needed only with an MSCS cluster. For further information on bringing cluster disk groups online on a node with a minority of the disk group's disks, see [“Unable to bring a cluster disk group online when a minority of the disks in the disk group are available”](#) on page 455.

The **vxclus** keywords or operands are:

enable	Allows a cluster disk group to be brought online when a minority of disks in the disk group are available.
disable	Disables the capability to bring a cluster disk group online when a minority of disks in the disk group are available.
cleanup	Disables for all cluster disk groups on a node the capability to bring the disk group online when a minority of disks in the disk group are available.

Typing the following sequence for each keyword brings up a description of its syntax:

vxclus <Keyword> -?

Caution To avoid possible data corruption, make sure that a majority of a disk group's disks do not become available and online on one node while another node with a minority of the disk group's disks also has the disk group online.

Keywords or Operands

vxclus enable

vxclus enable -g<DynamicDiskGroupName>

Allows a designated cluster disk group to be brought online when a minority of disks in the disk group are available. The **vxclus** utility creates an entry in the Registry that enables the cluster resource to be brought online. Once **vxclus enable** is executed, you can bring the resource online in Cluster Administrator. After you have done that, the **vxclus** functionality is disabled.

Example

vxclus enable -gDG2

Makes the DG2 cluster disk group able to be brought online on a node when a minority of disks in the disk group are available.

vxclus disable

vxclus disable -g<DynamicDiskGroupName>

Disables the capability to bring the designated cluster disk group online on a node when a minority of disks in the disk group are available. This command is necessary only if you have executed the **vxclus enable** command but have not yet brought the disk group online with Cluster Administrator, and then you decide that you do not want to bring the disk group online.

Example

vxclus disable -gDG2

Removes from the DG2 cluster disk group the capability to be brought online when a minority of disks in the disk group are available.

vxclus cleanup

vxclus cleanup

Disables for all cluster disk groups on a node the capability to bring a disk group online when a minority of disks in the disk group are available. This command is necessary only if you have executed the **vxclus enable** command on multiple cluster disk groups but you have not yet brought the cluster disk groups online with Cluster Administrator, and you decide that you do not want to bring these disk groups online.

Example

vxclus cleanup

On the current cluster node, this command turns off the **vxclus** capability for any cluster disk groups that had this capability enabled.



vxdisk

The **vxdisk** utility has commands relating to disks. Its keywords or operands are:

diskinfo	Gives information about a disk.
reactivate	Reactivates a disk (restarts a disk).
sig	Places a disk signature on a disk.

Each keyword is followed by *<DiskName>*, which is the disk name or path name of the device, such as **Harddisk2** or **\Device\Harddisk2**.

Typing the following sequence for each keyword brings up a description of its syntax:

vxdisk <Keyword> -?

Keywords or Operands

vxdisk diskinfo

vxdisk diskinfo <DiskName>

Provides information on the disk referenced in *<DiskName>*. The information includes the disk name, the dynamic disk group with which the disk is associated, capacity (indicated as *Length*), free space, device type, port, channel, target ID, LUN, and the disk signature. If the disk has subdisks associated with it, they will be listed.

Example

vxdisk diskinfo Harddisk2

Gives information on Harddisk2.

vxdisk reactivate

vxdisk reactivate "Missing Disk (disk#)"

Reactivates a disk that has gone offline. The string **"Missing Disk (disk#)"** represents how the missing disk is identified by the program. See the example below. Because the string **"Missing Disk (disk#)"** has spaces, you must use quotation marks around it.

Example

vxdisk reactivate "Missing Disk (disk2)"

Reactivates a disk shown as **"Missing Disk (disk2)"** that has gone offline. This assumes that the disk was offline and has now come back online.

vxdisk sig**vxdisk sig "<DiskName> (no signature)"**

Adds a disk signature to a new disk. Because the string "<DiskName> (no signature)" has spaces, you must use quotation marks around it.

Example**vxdisk sig "Harddisk5 (no signature)"**

Adds a signature to Harddisk5.



vxassist

The **vxassist** utility has keywords or operands for creating and changing a volume and for doing operations related to a volume. The keywords are:

make	Creates a dynamic volume.
growby	Extends an NTFS dynamic volume or an unformatted dynamic volume.
mirror	Adds a mirror to an existing volume.
break	Breaks a mirror from an existing volume.
remove	Removes a volume, a mirror, or a log.
delete	Deletes a partition or volume.
addlog	Adds a log plex to a volume.
snapstart	Adds a snapshot mirror to a volume.
snapshot	Creates a separate volume from the snapshot mirror.
snapback	Joins the snapshot mirror back to the original volume.
snapclear	Clears the association between the original volume and the snapshot volume, making them separate volumes.
snapabort	Aborts the snapstart operation on the original volume.
rescan	Rescans all the storage objects on the computer.
refresh	Refreshes volume, drive letter, and system information.
resetbus	Performs a SCSI bus reset on all SCSI buses.

Windows-Specific Commands

assign	Assigns or changes a drive letter or drive path.
unassign	Removes a drive letter or drive path.
create_part	Creates a primary partition.
create_ext	Creates an extended partition.
create_drive	Creates a logical drive.
delete_ext	Deletes an extended partition.

Typing the following sequence for each keyword brings up a description of its syntax.

vxassist <Keyword> -?

Keywords or Operands

vxassist make

```
vxassist [-b] -g<DynamicDiskGroupName> make [<VolumeName>] <Length>
[type={mirror | raid5 | stripe} [, log] [Mirror=<M>] [Column=<N>]
[StripeUnit=<Width>] [DriveLetter={A | B | ... | Z} | DrivePath=<DrivePath>]
[<DiskName>...]
```

Creates a volume. The following attributes apply:

-b	Option to run the command in the background. This option is useful for operations that take an extended amount of time, such as adding a mirror or extending a volume.
-g <DynamicDiskGroupName>	Name of the dynamic disk group.
<VolumeName>	Name of the volume. This is a Volume Manager-specific name that is used for internal processing. The name is limited to 18 ASCII characters. It cannot contain spaces or forward or backward slashes. A number or a period cannot be the first character in the name.
<Length>	Size of the volume in megabytes.
type ={ mirror raid5 stripe } [, log]	Type of volume to be created. Default is a spanned volume. The [, log] argument in type will add a RAID-5 log for a RAID-5 volume or a dirty region logging (DRL) log for a mirrored volume during volume creation.
Mirror =<M>	Number of mirrors to be created for mirrored volumes. The default is 2.
Column =<N>	Number of columns. Required for RAID-5 and striped volumes.
StripeUnit =<Width>	Stripe width of RAID-5/striped volumes in blocks (512 Kbytes). Allows the user to specify the stripe unit for RAID-5 and striped volumes.
DriveLetter ={ A B ... Z }	The default is no assignment of a drive letter to the volume.
DrivePath =<DrivePath>	Used when you want to mount the new volume at an empty folder on a local NTFS volume. You can use this attribute as an alternative to the drive letter.



<DiskName>...

Name of disk, such as Harddisk2. Parameters will be used to specify disks for volume creation, mirroring, and extension.

If disks are not specified, Volume Manager will pick the disks automatically within the specified disk group.

Note The default volume type is a concatenated volume. The created volume is not formatted (no file system is created on the volume). You need to use the operating system **format** command to format the volume.

Examples

vxassist -gDG2 make 100 DriveLetter=E Harddisk1

The above command line sequence creates a simple 100-MB volume in dynamic disk group DG2. The volume's drive letter is E. The volume would be created on Harddisk1.

vxassist -gDG2 make 100 type=mirror,log DriveLetter=F

The above command line sequence makes a mirrored 100-MB volume with a DRL log. The volume is assigned the drive letter F.

**vxassist -gDG2 make 120 type=raid5 DriveLetter=X Column=3
Harddisk2 Harddisk3 Harddisk5**

The above command line sequence creates a 120-MB RAID-5 volume with the drive letter X. The volume is striped across Harddisk2, Harddisk3, and Harddisk5. All RAID-5 volumes require at least three columns. If you do not indicate a column number for a RAID-5 volume, the command will fail.

vxassist -b -gDG2 make 100 type=stripe DriveLetter=X Column=3

The above command line sequence makes a striped volume that is assigned drive letter X. The **-b** option allows the command to run in the background.

vxassist -gDG2 make DbVolume 100

The resulting path name for the volume is:

\Device\HarddiskDmVolumes\DG2\DbVolume.

vxassist growby

vxassist [-b] growby <VolumeName | DriveLetter> <Length> [<DiskName>...]

Extends the usable space of an NTFS or unformatted volume by the amount specified in <Length> in MB. <VolumeName> is the volume's name. The **-b** option runs the command in the background. The option [<DiskName>...] lets you specify the disk or disks for growing the volume. If you do not use this option, the program assigns the disk usage.

Example

vxassist growby J: 100

The above command extends volume J by 100 MB. Only NTFS or unformatted volumes can be extended. An unformatted volume's file system type is shown as "RAW."

vxassist mirror

vxassist [-b] mirror <VolumeName | DriveLetter> [**Mirror**=<M>] [<DiskName>...]

Adds a mirror to an existing volume. The following attributes apply:

-b	Runs the command in the background.
<VolumeName>	the path name of the volume, such as \Device\HarddiskDmVolumes\DynDskGrp1\volume1.
<DriveLetter>	The drive letter of the volume.
Mirror =<M>	The number of mirrors to be added.
<DiskName>...	The name of the disk or disks (such as Harddisk2) on which the mirror or mirrors are to be created.

Example

vxassist mirror -b Z: Mirror=2 Harddisk4 Harddisk5

The above command line sequence adds two mirrors to volume Z. Harddisk4 and Harddisk 5 will be used to create the mirrors. The process of adding the two mirrors will run in the background. Instead of using the drive letter Z, you could provide a path name, such as:

\Device\HarddiskDmVolumes\DynDskGrp1\volume1



vxassist break

```
vxassist break <VolumeName | DriveLetter>  
<plex=PlexName> | <!DiskName>  
[DriveLetter={A | B | ... | Z} | DrivePath=<DrivePath>]
```

Breaks a mirror from an existing volume. When a mirror is broken, it becomes a separate volume and you will lose the fault tolerance that mirroring provides.

The following attributes apply:

<VolumeName>	The path name of the existing volume, such as \Device\HarddiskDmVolumes\DynDskGrp1\volume1 .
<DriveLetter>	The drive letter of the volume.
plex =<PlexName>	The mirror or plex to be broken off. It can be the plex name (such as Volume2-01) or the GUID of the mirror plex. A GUID is a unique internal number assigned to the plex. To determine the GUID for a given plex, use the command vxvol volinfo for the mirrored volume that contains the plex. If you are using a script and have multiple snapshot plexes, then the GUID can distinguish the different snapshot plexes.
<!DiskName>	The name of the disk, such as Harddisk2 . You can use this attribute as an alternative to the plex name. See the note below on the exclamation mark.
DriveLetter ={A B ... Z}	Used to assign a specific drive letter to the new volume that is created from the broken-off plex. The drive letter is not automatically assigned.
DrivePath =<DrivePath>	Used when you want to mount the new volume that is created from the broken-off plex at an empty folder on a local NTFS volume. You can use this attribute as an alternative to the drive letter.

Note The exclamation mark in front of the *DiskName* attribute is necessary to make the command compatible with the Volume Manager for UNIX version of the command. The use of the exclamation mark applies only to the **vxassist break**, **vxassist remove**, and **vxassist snapshot** commands.

If you do not remember the plex name, you can determine what it is by using the **vxvol volinfo** command. Alternatively, if you know which disk the plex resides on, you can use the <!DiskName> syntax, for example, **!Harddisk2**, to specify the plex.

Note If you want to remove the mirror rather than break it off, see the command “**vxassist remove**” in the next topic.

Examples

vxassist break H: plex=Volume1-01 DriveLetter=Z

The above command line sequence will break a mirror from a volume that has been assigned the drive letter H. The specified plex will become a new volume and receive the drive letter Z. The drive letter H will be retained by the original volume.

**vxassist break \Device\HarddiskDmVolumes\DynDskGrp1\Volume1
plex=Volume1-01 DriveLetter=Z**

The above command line sequence is the same as the previous command sequence except that a path name, instead of a drive letter, is used to indicate the volume from which the mirror will be broken.

vxassist break L: !Harddisk3 DriveLetter=M

This will break off the mirror that resides on Harddisk3 from volume L and assign drive letter M to the newly created volume.

vxassist remove

vxassist remove [**volume** | **mirror** | **log**] <VolumeName | DriveLetter>
[**plex**=<PlexName> | <!Diskname>]

Removes either a volume, a mirror from an existing volume, or a DRL or RAID-5 log from an existing volume. When you specify removing a volume, the command works the same as **vxassist delete**. If no volume, mirror, or log is specified, the command assumes a mirror plex for backward compatibility because the command formerly removed only a mirror plex. The following subcommands or attributes apply:

volume mirror log	Specifies what is to be removed from an existing volume. If you do not use this parameter, a mirror will be removed. If you want to remove a volume or a log, you will have to put the volume or log keyword in.
<VolumeName>	the path name of the volume, such as \Device\HarddiskDmVolumes\DynDskGrp1\volume1.
<DriveLetter>	The drive letter of the volume to be operated on.



plex=<PlexName>

The mirror or plex to be removed. It can be the plex name (such as **Volume2-01**) or the GUID of the mirror plex. A GUID is a unique internal number assigned to the plex. To determine the GUID for a given plex, use the command **vxvol volinfo** for the mirrored volume that contains the plex. If you are using a script and have multiple snapshot plexes, then the GUID can distinguish the different snapshot plexes.

<!DiskName>

The name of the disk, such as **Harddisk2**. See the note below on the exclamation mark. You can use this as an alternative to the *PlexName*. If there is more than one mirror or log associated with the volume, you need to indicate either the mirror plex name or log plex name or the disk name.

Note The exclamation mark in front of the *DiskName* attribute is necessary to make the command compatible with the Volume Manager for UNIX version of the command. The use of the exclamation mark applies only to the **vxassist break**, **vxassist remove**, and **vxassist snapshot** commands.

If you do not remember the plex name, you can determine what it is by using the **vxvol volinfo** command. Alternatively, if you know which disk the plex resides on, you can use the **<!DiskName>** syntax, for example, **!Harddisk2**, to specify the plex.

The logs can be either DRL or RAID-5 logs. If you have more than one log, you will need to identify the log plex. You cannot remove a DCO log with this command. A DCO log is added with the command **vxvol set fastresync=on** and deleted with the command **vxvol set fastresync=off**. See “**vxvol**” on page 272 for details.

Examples

vxassist remove Z: plex=Volume1-01

The above command line sequence removes a mirror from volume Z. The data on the specified plex will be destroyed and is not recoverable.

vxassist remove volume F:

The above command line sequence removes volume F. The data on the volume will be destroyed and is not recoverable.

vxassist remove log H:

The above command line sequence removes a log from volume H.

vxassist delete

vxassist delete <VolumeName | DriveLetter>

Deletes a volume or partition. The volume or partition can be identified by a drive letter or by a volume name.

Example

vxassist delete J:

The above command deletes volume J. The command will destroy all data on the volume.

vxassist delete \Device\HarddiskDmVolumes\DynDskGrp1\volume1

The above command deletes a volume with the path name:

\Device\HarddiskDmVolumes\DynDskGrp1\volume1.

vxassist addlog

vxassist addlog <VolumeName | DriveLetter> [<DiskName>...]

Adds a DRL or RAID-5 log plex to the volume. For descriptions of the advanced features of DRL and RAID-5 logging, see [“Dirty Region Logging \(DRL\) and RAID-5 Logging”](#) on page 259.

Example

vxassist addlog J:

Adds the appropriate log to the volume with drive letter J.

vxassist snapstart

vxassist [-b] snapstart <VolumeName | DriveLetter>
[plex=<MirrorPlexName> | <DiskName>...]

Adds a snapshot mirror to the volume. It is a mirrored plex of the original volume that will be broken off in the snapshot process. You can either add a new snapshot mirror or convert a mirror of the volume that already exists. A snapshot mirror is also referred to as a “snap plex.” The following attributes apply:

-b	Runs the command in the background.
<VolumeName>	The path name of the volume, such as \Device\HarddiskDmVolumes\DynDskGrp1\volume1.
<DriveLetter>	The drive letter of the existing volume.



plex=<MirrorPlexName> Converts a specified mirror plex to a snap plex. It can be the plex name (such as **Volume2-01**) or the GUID of the mirror plex. A GUID is a unique internal number assigned to the plex. To determine the GUID for a given plex, use the command **vxvol -v volinfo** for the mirrored volume that contains the plex.

<DiskName>... The name of the disk, such as **Harddisk2**, that a new snapshot mirror will be created on.

If you do not remember the plex name, you can determine what it is by using the **vxvol volinfo** command.

When the snapshot mirror is synchronized with the volume, its state changes to Snap Ready and the snapstart task exits. For more information on the snap commands, see “[Snapshot Commands](#)” on page 324.

Examples

vxassist -b snapstart E:

Runs the snapstart process on volume E in the background.

vxassist snapstart E: plex=Volume2-01

Runs the snapstart process on volume E, converting the existing mirror plex, Volume2-01, to a snap plex.

Note You should not use the **vxassist break** command to break off a snapshot mirror from its associated volume or the **vxassist remove** command to delete a snapshot mirror. Instead use **vxassist snapshot** to break off a snapshot mirror from the associated volume or use **vxassist snapabort** to delete it.

vxassist snapshot

vxassist snapshot<VolumeName | DriveLetter>
[plex=<SnapPlexName> | <!DiskName>]
[DriveLetter={A | B | ... | Z}] [DrivePath=<DrivePath>] [<NewVolumeName>]

Detaches the snapshot mirror (also called the “snap plex”) and creates a separate volume that is associated with the snapshot mirror. The following attributes apply:

<VolumeName> The path name of the original volume, such as **\Device\HarddiskDmVolumes\DynDskGrp1\volume1**.

<DriveLetter> The drive letter of the volume.

plex =<SnapPlexName>	Name of the snapshot mirror. It can be the plex name (such as Volume2-01) or the GUID of the mirror plex. A GUID is a unique internal number assigned to the plex. To determine the GUID for a given plex, use the command vxvol -v volinfo for the mirrored volume that contains the plex. You need to specify this attribute only when there is more than one snap plex.
<!DiskName>	The name of the disk, such as Harddisk2 . See the note below on the exclamation mark. You can use !DiskName as an alternative to the plex name.
DriveLetter = {A B ... Z}	Used to assign a specific drive letter to the new volume.
DrivePath =<DrivePath>	As an alternative to a drive letter, you can assign a drive path to the volume. The drive path must reference an empty NTFS folder.
<NewVolumeName>	Use this parameter if you want to specify the name of the volume that is created when the snapshot mirror is broken off. This can also be referred to as the <i>SnapVolumeName</i> parameter.

Note The exclamation mark in front of the *DiskName* attribute is necessary to make the command compatible with the Volume Manager for UNIX version of the command. The use of the exclamation mark applies only to the **vxassist break**, **vxassist remove**, and **vxassist snapshot** commands.

Examples

vxassist snapshot E: DriveLetter=H

This command detaches a snapshot mirror from volume E. The snapshot volume will be volume H.

vxassist snapshot E: plex=volume1-02 DrivePath=C:\ABC BackupVolume

This command detaches the snapshot mirror, **volume1-02**, from volume E, and mounts the new volume called "BackupVolume" to an empty folder called "ABC" on the C drive. The device path of the new volume is:

\Device\HarddiskDMVolumes\DynDskGrp1\BackupVolume.



vxassist snapback

vxassist [-o **resyncfromreplica**] **snapback** <SnapVolumeName | DriveLetter>

Joins the broken plex back to the original volume and resynchronizes the two volumes. By default, the synchronization is done from the original volume to the snapshot mirror. The optional parameter, [-o **resyncfromreplica**], reverses the resynchronization, copying data from the snapshot mirror to the original volume. *SnapVolumeName* is the name of the volume associated with the snapshot plex, the volume that is broken off through the **vxassist snapshot** command.

Example

vxassist snapback H:

This command joins the snapshot volume H back to the original volume.

vxassist snapclear

vxassist snapclear <SnapVolumeName | DriveLetter>
[plex=<SnapPlexName>]

Clears the association between the original volume and the snapshot volume and makes the snapshot volume and original volume two independent volumes. The **vxassist snapclear** command can be specified only after the **vxassist snapshot** command has been issued. After the **vxassist snapclear** command runs, the snapshot volume becomes an ordinary volume and cannot be snapped back to the original volume. The following attributes apply:

<SnapVolumeName>	The name of the volume associated with the snapshot plex, the volume that is broken off through the vxassist snapshot command.
<DriveLetter>	The drive letter of the snapshot volume.
plex=<SnapPlexName>	This parameter is not used. It may be used in a future release.

Example

vxassist snapclear H:

This command clears the association between the snapshot volume H and the original volume.

vxassist snapabort

vxassist [-o keepplex] snapabort *<VolumeName | DriveLetter>*
[plex=<SnapPlexName>]

Aborts a snapshot mirror plex that has been attached to a volume through a snapstart operation or a snapback operation by either deleting it or converting it to an ordinary mirror. In cases where the deleted snap plex is the last snap plex and the resulting volume is simple or striped, the **vxassist snapabort** command deletes the DCO log volume also.

The following attributes apply:

[-o keepplex]	Converts the snap plex to a mirror plex instead of deleting it.
<i><VolumeName></i>	The path name of the original volume, such as \Device\HarddiskDmVolumes\DynDskGrp1\volume1 .
<i><DriveLetter></i>	The drive letter of the volume.
plex=<SnapPlexName>	Name of a mirror plex that was created when a snapstart process began. You would need this only if you already snapstarted the volume previously and you snapstart it again, and thus you have multiple snap plexes and want to abort one of them. A SnapPlexName can be the plex name (such as Volume2-01) or the GUID of the mirror plex. A GUID is a unique internal number assigned to the plex. To determine the GUID for a given plex, use the command vxvol -v volinfo for the mirrored volume that contains the plex.

Examples

vxassist snapabort E:

This command aborts the snapstart operation on volume E.

vxassist -o keepplex snapabort H: plex=Concatvol1-03

This command aborts the snapstart operation on volume H, but it converts the plex **Concatvol1-03** to a volume of the same type as the original volume. The reason the *SnapPlexName* had to be specified is that there were two snap plexes, because the **vxassist snapstart** command had been invoked twice on volume H.

vxassist rescan

vxassist [-b] rescan



Rescans all the storage system objects on the computer, including disks, volumes, and file systems. The **-b** option runs the command in the background.

vxassist refresh

vxassist [-b] refresh

Refreshes volume, drive letter, and system information. The **-b** option runs the command in the background.

vxassist resetbus

vxassist resetbus

Performs a SCSI bus reset on all SCSI buses.

Windows-Specific vxassist Commands

vxassist assign

vxassist [-f] assign <VolumeName | DriveLetter>
DriveLetter={A | B | ... | Z} | DrivePath=<DrivePath>

Assigns or changes a drive letter or drive path for a volume. The **-f** parameter forces the operation if the volume is in use. In the command line interface, if you want a drive letter, you must always assign it. For more information on assigning a drive letter or drive path, see the sections [“Add, Change, or Remove a Drive Letter or Path”](#) on page 114 and [“Mount a Volume at an Empty Folder”](#) on page 117.

If the volume already has a drive letter, assigning a drive letter will replace the existing drive letter. In addition, if you assign a drive path to a volume that already has an existing drive letter, the existing drive letter will remain.

Example

**vxassist assign \Device\HarddiskDmVolumes\DynDskGrp2\
volume1 DriveLetter=E:**

This command assigns drive letter E to \Device\HarddiskDmVolumes\DynDskGrp2\volume1.

vxassist unassign

vxassist [-f] unassign <VolumeName | DriveLetter>
[DrivePath=<DrivePath>]

Removes a drive letter or drive path for a volume. The **-f** parameter forces the operation. For more information on unassigning a drive letter or drive path, see the sections [“Add, Change, or Remove a Drive Letter or Path”](#) on page 114 and [“Unmount a Volume”](#) on page 117. If a drive path and a drive letter are not specified, the command will remove the drive letter. If you want to remove the drive path, you must specify it.

Example

vxassist unassign E:

This command removes drive letter E from the volume.

vxassist create_part

vxassist create_part *<DiskName>* *<Length>*
[DriveLetter={A|B|...|Z}] DrivePath=<DrivePath>]

Creates a primary partition of *<Length>* megabytes on *<DiskName>* and optionally assigns either a drive letter or drive path to it. See also [“Create Primary and Extended Partitions”](#) on page 124.

Example

vxassist create_part Harddisk0 100 DriveLetter=E

Creates a primary partition of 100 MB with drive letter E on Harddisk0.

vxassist create_ext

vxassist create_ext *<DiskName>* *<Length>*

Creates an extended partition of *<Length>* megabytes on *<DiskName>*. See also [“Create Primary and Extended Partitions”](#) on page 124.

Example

vxassist create_ext Harddisk0 100

Creates an extended partition of 100 MB on Harddisk0.

vxassist delete_ext

vxassist delete_ext *<DiskName>*

Deletes the extended partition on *<DiskName>*.

Example

vxassist delete_ext Harddisk0

Deletes the extended partition on Harddisk0.



vxassist create_drive

vxassist create_drive <DiskName> <Length> [DriveLetter={A|B|...|Z}]

Creates a logical drive of <Length> megabytes in the extended partition on <DiskName>. The extended partition must have been created first. See also “[New Logical Drives](#)” on page 129.

Example

vxassist create_drive Harddisk0 100 DriveLetter=E

Creates a logical drive of 100 MB on Harddisk0. The logical drive has the drive letter E.

There is no separate **delete_part** command. The **vxassist delete** command, which removes a volume, can be used to delete primary partitions or logical drives. The **delete_ext** command is needed since an extended partition does not have a name to be used in the **vxassist delete** command.

vxevac

vxevac <DiskName> [<NewDiskName>]

The **vxevac** utility moves subdisks from the disk specified by <DiskName> to the specified destination disk <NewDiskName>. If no <NewDiskName> argument is specified, any non-volatile, non-reserved disks in the same dynamic disk group can be used as destination disks. The disks must be in the same dynamic disk group.

Example

vxevac Harddisk0 Harddisk3

Moves all the subdisks from Harddisk 0 to Harddisk 3.

vxunreloc

vxunreloc [-f] [-n<NewDiskName>] <DiskName>

Reverses the process of hot relocation or evacuation and moves the hot-relocated subdisks back onto the disk that was replaced after a disk failure or onto a new disk.

- n<NewDiskName>** Specifies a new disk to unrelocate to. All the subdisks originally belonging to <DiskName> will be unrelocated to <NewDiskName>.
- f** Unrelocates a subdisk to a different offset if unrelocating to the original offset is not possible.

All disks involved in the process must be in the same dynamic disk group.

Example

vxunreloc Harddisk0

This command unrelocates Harddisk0, which had been previously relocated to another hard disk.

Note There is no **Relocate** command for the command line. The hot relocation capability is on by default in the program. For more about information about hot relocation, see the section “[Hot Relocation and Hot Spare](#)” on page 262.



vxsd

These are commands for moving, splitting, and joining a subdisk. The keywords are:

mv	Moves a subdisk.
split	Splits a subdisk.
join	Joins a subdisk.

Typing the following sequence for each keyword brings up a description of its syntax.

vxsd <Keyword> -?

Use **vxvol volinfo** to display the subdisk names. Use **vxvol -v volinfo** to display the size and offset of the subdisks. The parameter **-g**<DynamicDiskGroupName> specifies the dynamic disk group for the operation. This needs to be specified since <SubDiskName> is not distinct among different dynamic disk groups.

vxsd mv

vxsd -g<DynamicDiskGroupName> [**-f**] **mv** <SubDiskName> [<DiskName>]

This will move the named subdisk to <DiskName>. If <DiskName> is not specified, the move operation tries to find free space within the dynamic disk group. The Move Subdisk function can be used for load balancing by moving a subdisk from a heavily accessed disk to a more lightly loaded one.

This command can also be used to move the part of a volume that is on a failed or missing disk to a healthy one. Moving a subdisk for redundant volumes (mirrored or RAID-5) will use the redundant data to recreate the subdisk on the healthy disk. However, for nonredundant volumes (concatenated or striped), the data cannot be recreated and doing a subdisk move will therefore lose data, which could be recovered if the disk can be repaired. Because of this possibility of data loss, Volume Manager normally does not allow you to move the subdisk for nonredundant volumes.

You can force the operation by using the **-f** option if you don't need the data anymore or you can no longer recover the data. By doing so, you will retain the volume structure, but there is no guarantee that the data will be recoverable.

Example

vxsd -gDynDskGrp1 mv Disk1-01 Harddisk2

This command moves subdisk Disk1-01 to Harddisk 2 (belonging to the DynDskGrp1 dynamic disk group).

vxsd -gDynDskGrp1 -f mv Disk1-01

This command forces the move of subdisk Disk1-01 (which is on a failed disk) to another disk.

vxsd split

vxsd -g<DynamicDiskGroupName> -s<Size> split <SubDiskName>

Splits a subdisk into two separate subdisks.

The **-s** option is required to specify the <Size> in MB of the first of the two subdisks to be created. The second subdisk occupies the remaining space used by the original subdisk.

Example

vxsd -gDynDskGrp1 -s100 split Disk3-03

This command will split subdisk Disk3-03 into two subdisks, the first of which is 100 MB.

vxsd join

vxsd -g<DynamicDiskGroupName> join <SubDiskName>...

Combines two or more existing subdisks into one subdisk. To join subdisks, the subdisks must be contiguous on the same disk.

Example

vxsd -gDynDskGrp1 join Disk3-03 Disk3-04

In this example, the command joins the two subdisks Disk3-03 and Disk3-04 into a new subdisk called Disk3-05.



vxstat

The **vxstat** utility has keywords and operands for displaying statistics for dynamic disks, dynamic volumes, and subdisks of dynamic volumes. It can also display statistics at specified intervals and for specified numbers of times.

Typing the following sequence brings up a description of its syntax:

vxstat <Keyword> -?

Keywords or Operands

vxstat [-g<DynamicDiskGroupName>] [-s] [-d] [-v][-i<Interval>] [-c<Count>]
[<Object>...]

The following attributes can apply:

-g<DynamicDiskGroupName>	Name of the dynamic disk group from which the records will be selected. For example, -gDynDskGrp1 .
[<Object>...]	An object can be a disk or a volume (specified by the volume name or drive letter). If no object is specified, the statistics apply to all the volumes on the managed server. Multiple objects are separated by a space.
[-s]	Displays statistics for subdisks on the objects specified. If the object specified is a disk, all subdisks on that disk will be selected. If the object specified is a volume, all subdisks on that volume will be selected.
[-d]	Displays statistics for disks on the objects specified.
[-v]	Displays statistics for volumes on the objects specified.
[-i<Interval>]	Displays statistics every <Interval> seconds. The default and minimum interval is 5 seconds between instances that the statistics are displayed.
[-c<Count>]	Stops displaying interval statistics after <Count> times.

If the **-i<Interval>** option is specified without the **-c<Count>** option, the statistics will run continuously with the interval specified. If neither the **-i<Interval>** option nor the **-c<Count>** option is specified, the statistics display once.

Summary statistics for each object are displayed in one-line output records, preceded by two header lines. The output line consists of blank-separated fields for the object type and object name.

Statistics Types

The statistics types are as follows:

- **Read Requests/Second**

The number of read requests per second for selected storage objects.

- **Write Requests/Second**

The number of write requests per second for selected storage objects.

- **Read Blocks/Second**

The amount of read request data (in blocks per second) that is processed for selected storage objects. It is the throughput on the read requests made.

- **Write Blocks/Second**

The amount of write request data (in blocks per second) that is processed for selected storage objects. It is the throughput on the write requests made.

- **Average Time/Read Block**

The average time in microseconds that it takes to process a read block from the time a request is made until the data is returned.

- **Average Time/Write Block**

The average time in microseconds that it takes to process a write block from the time a request is made until the data is returned.

- **Queue Depth**

The current number of read and write requests in the queue for selected disks. It does not apply to volumes and subdisks.

For more information on how you can use these statistics to improve performance on your system, see [“Performance Tuning”](#) on page 226.

Examples

vxstat -s

Displays statistics for all subdisks on a managed server.

vxstat -s E:

Displays statistics for the subdisks of volume E.

vxstat -i 10 -c 5 -d



Displays 5 sets of statistics at 10-second intervals for all the disks on the managed server.

vxstat -d F:

Displays statistics for the disks that are associated with volume F.

vxstat -v Harddisk5

Displays statistics for the volumes that are associated with Harddisk5.

vxstat -gDynDskGrp1 -v

Displays statistics for all volumes in DynDskGrp1.

vxstat -s F: G: H: Harddisk7

Displays subdisk statistics for volumes F, G, H, and for Harddisk7.

Volume Manager 3.1 for Windows 2000 offers the following optional advanced features:

- ◆ VERITAS FlashSnap
- ◆ Dynamic Multipathing Software
- ◆ VERITAS Volume Replicator Support
- ◆ VERITAS Cluster Server Support
- ◆ Microsoft Cluster Service Support

The chapter begins with a summary of the licensing required for each of these options. The remainder of the chapter is organized into five sections, one for each option.



Licensing for the Options

The various options are available with different levels of Volume Manager 3.1 for Windows 2000 licenses, as shown in the chart below:

Options for different server versions	Server	Advanced Server	Datacenter Server
FlashSnap	*	*	Included
Dynamic Multipathing	-	Included	Included
VERITAS Volume Replicator support	Included with all server versions of Volume Manager 3.1 for Windows 2000 if you purchase a VVR license. 32-node support.**		
VERITAS Cluster Server support	-	Included. Provides 32-node support.**	Included. Provides 32-node support.**
MSCS support	-	2-node support	4-node support

*FlashSnap is available with Volume Manager Server and Advanced Server as a separate add-on license. It is included with Datacenter Server.

**Requires the purchase of the VERITAS Volume Replicator or VERITAS Cluster Server software. In Volume Manager 3.1, VERITAS Volume Replicator (VVR) and VERITAS Cluster Server (VCS) are supported in the English version of the program only.

VERITAS FlashSnap

This section on VERITAS FlashSnap has the following topics:

- ◆ [FlashSnap Overview](#)
- ◆ [Summary of the FlashSnap Procedure](#)
- ◆ [FastResync](#)
- ◆ [Snapshot Commands](#)
- ◆ [Dynamic Disk Group Split and Join](#)

FlashSnap Overview

VERITAS FlashSnap is a multi-step process that allows you to create independently addressable multi-purpose volumes (MPVs) that are copies or mirrors of the volumes on your server. When these MPVs are moved to a remote server, they can be used for backup and other activities, such as uploading or updating data warehouses or performing application testing while business continues. Thus, these activities can be performed without affecting mission-critical applications on the original working server.

Even when FlashSnap is performed on the same server, its very efficient mirror breakoff and join process is much faster and takes less CPU availability than other mirror breakoff procedures that use ordinary mirroring. FlashSnap is made possible by several features that were introduced in Volume Manager 3.0 for Windows 2000. These features are:

- ◆ [FastResync](#)

FastResync (FR) supports resynchronizing of mirrors by copying only changes for the temporarily split mirror by using FR logging. This will reduce the time it takes to rejoin a split mirror with the mirror set and also reduces the server CPU cycles needed to complete the resynchronization.

- ◆ [Snapshot Commands](#)

The Snapshot commands are used to create the mirrored volumes or MPVs that are useful for backup or other resource-intensive processing purposes.

- ◆ [Dynamic Disk Group Split and Join](#)

Dynamic Disk Group Split and Join (DGSJ) supports the ability to split a dynamic disk group into two disk groups so that the newly formed disk group can be moved to another server. This allows splitting a mirror for backup and having a separate server handle the backup. After the backup is completed, the split-off disk group is moved back to the original server and joined to its former disk group, and the mirror is reassociated with its mirror set and resynchronized. DGSJ also can be done on the same server for same-host backup or for reorganizing the disk groups on the server.



These new features are necessary for the FlashSnap procedure, but they can also be used for other, more general purposes. The descriptions of these features in this section contain complete information about each feature, not just the part of the feature used in the FlashSnap procedure. However, to make use of these commands, you have to purchase the license that enables FlashSnap. For licensing details, see the section “[Licensing for the Options](#)” on page 312.

Summary of the FlashSnap Procedure

You can use the FlashSnap procedure with two servers (using a remote server to do the processing of the backup or other resource-intensive activities), or you may prefer to have the processing done on the same server. This section includes a summary for both situations. These steps can be implemented through the VEA GUI or through the command line.

Off-Host FlashSnap Procedure (Two Servers)

1. Use the **Snap Start** command to attach a snapshot mirror to a volume on the working server.

This step of creating the snapshot mirror of the volume and resynchronizing it to the volume does take considerable time, but it has to be done only one time for the initial setup.

2. Use the **Snap Shot** command to automatically detach the snapshot mirror and create a new volume that is associated with the snapshot mirror.

This new volume, which is also called an MPV, can be used for backup or other purposes. The snapshot process typically takes less than 20 seconds.

3. Split the new volume from its dynamic disk group with the **Split Dynamic Disk Group** command, creating a new dynamic disk group on the server.

4. Deport the new dynamic disk group from the original server.

When using the command line, a separate deport command is not necessary. It is needed only for the GUI.

If you do not have a SAN where you can access the deported dynamic disk group from the second server, move the split-off dynamic disk group by physically moving its disks and connecting them to the second server.

5. Rescan on the second server so that the computer recognizes the split-off dynamic disk group.

6. Import the dynamic disk group on the second server where the backup or other off-host processing will occur.
7. Perform the backup or other off-host processing activity, using the snapshot volume or MPV.

If you are backing up the server, VERITAS NetBackup or VERITAS Backup Exec is recommended for the backup software.

8. Deport the dynamic disk group from the second server.
If you do not have a SAN where you can access the deported dynamic disk group from the original server, physically move the split-off disk group's disks back to the original server.
9. Rescan on the original server, so that the server recognizes the split-off dynamic disk group.

Note You do not need to import the dynamic disk group back to the original server.

10. Use the **Join Dynamic Disk Group** command to join the split-off dynamic disk group back to its original dynamic disk group.
11. Join the mirrored volume (or MPV) back to its original volume, using the **Snap Back** command.

The mirrored volume will now be resynched to the data source and continually updated. Because FR is used in resynchronizing the mirrors, the time for the resynchronization is greatly reduced.

The next time the sequence of commands is run again, the snapshot mirror will be ready for the snapshot step. The **Snap Start** step, step 1, does not have to be done again.

Same-Host FlashSnap Procedure (One Server)

Steps 1 and 2 are the same as in the two-server procedure: 1) using **Snap Start** to attach a snapshot mirror to the original volume, and 2) detaching the snapshot mirror and creating a new volume that is associated with it.

Because no remote host is involved, you do not need to use Disk Group Split and Join to do any deporting or importing of the disk group. The backup or other resource-intensive processing is done on the same server.

In both the off-host and same-host procedures, the final step is to join the mirrored volume back to its original volume, using the **Snap Back** command. In this step, as already mentioned, the time for synchronizing the mirrors is greatly reduced.



Note For a description and diagrams of both an off-host and a same-host FlashSnap procedure for backups, see the section “[Custom Scripts to Automate Backup with FlashSnap](#)” on page 400. That section summarizes the FlashSnap steps for backup and describes how you can use the sample scripts provided by VERITAS to create your own script for backing up your servers with either VERITAS NetBackup or VERITAS Backup Exec and a choice of three applications—Exchange Server 5.5, Oracle Server, and Microsoft SQL Server. The scripts are on the Volume Manager 3.1 for Windows 2000 CD.

FastResync

FastResync is a feature that was introduced in Volume Manager 3.0 for Windows 2000. It provides two fundamental enhancements to Volume Manager.

- ◆ Resynchronization

Optimizes the resynchronization of a mirror that is detached from and then returned to a volume.

- ◆ Reconnection

Extends the snapshot model by providing the ability to refresh and reuse a snapshot, rather than discarding it.

FR increases the efficiency of the Volume Manager snapshot mechanism and improves the performance of operations, such as backup and decision support (that is, organized methods of collecting data that are designed to facilitate decision-making). Typically, these operations require that a volume is quiescent and that they are not impeded by updates to the volume by other activities in the system. FR reduces the amount of time that a volume must be out of service during such operations.

FR can be enabled or disabled by the user on a per-volume basis. When you enable FR for a volume, a DCO (disk change object) volume is created to track the regions on a volume that are changed while a mirror is detached.

Note Only a limited subset of operations is permitted on a DCO volume. You can perform a subdisk move, or add and remove a mirror.

FR is automatically enabled for a volume when the snap start operation is performed on the volume through the command line interface **vxassist snapstart** command or through the VEA GUI **Snap Start** command.

FR Limitations

FastResync cannot be used with software RAID-5 volumes.

Resynchronization

FR keeps track of data store updates missed by mirrors that are unavailable at the time that the updates are applied to a volume. When a mirror returns to service, FR resynchronizes the mirror with the volume by applying only the updates missed by that mirror while it was detached. This generally takes less time than the traditional method of copying the entire data store to the returning mirror.



If you want FR to resynchronize a mirror, FR must be enabled for the volume before the mirror is detached and continue to be enabled until after the mirror is reattached and resynchronized. However, if you are using any of the snapshot commands, FR is automatically turned on.

FR does not alter the traditional mirror failure and repair administrative model. The only visible effect is that typical mirror repair operations conclude more quickly.

Note Although both FR and dirty region logging (DRL) keep track of regions on a volume where the mirrors are not synchronized, they perform different functions. FR keeps track of data store updates missed by a detached mirror, while DRL keeps track of whether a write to a mirrored volume has been completed on all mirrors. The write region on the volume is considered “dirty” because the mirrors are out of sync until the write to all mirrors is completed. DRL is used to resynchronize mirrors following a system crash. For more on DRL, see “[Dirty Region Logging \(DRL\) and RAID-5 Logging](#)” on page 259.

Reconnection

Reconnection extends the snapshot model by providing the ability to refresh and reuse a snapshot mirror, rather than discarding it. FR is automatically enabled when you take a snapshot of a volume. FR retains the association between the snapshot mirror and the volume, as described in the “[Resynchronization](#)” section, when the snapshot mirror is detached from the volume. FR reattaches and resynchronizes the snapshot mirror with the volume when the **Snap Back** command is issued, either through the **vxassist** command line command (see “[vxassist snapback](#)” on page 300) or the GUI (see “[Snapshot Commands](#)” on page 324).

Enabling and Disabling FR

FastResync can be enabled and disabled on a per-volume basis. For FR to be active when a mirror is reattached and resynchronized with its associated volume, FR must be enabled before the mirror is detached and remain enabled until the mirror has been reattached and resynchronized with the volume.

FR commands can be accessed from the command line or from the GUI. The procedure for enabling FR from the VEA GUI is described below. See “[vxvol set fastresync=on|off](#)” on page 273 for instructions on enabling and disabling FR from the command line.

Note You cannot enable FR on RAID-5 volumes.

▼ To enable FR for a volume:

Note If you are using snapshot commands, you do not need to use the following steps, because FR is automatically enabled for snapshot commands. These steps are needed only when you want to enable FR on a volume that will not be used with any snapshot commands.

1. Right-click on the mirrored volume that you want to enable FR for.
The volume context menu is displayed.
2. Select **FastResync>Add**.
A dialog box is displayed, asking you to confirm adding FR for the volume.
3. Click **Yes**.
FR is now enabled for the volume.

▼ To disable FR for a volume:

1. Right-click on the mirrored volume that you want to disable FR for.
The volume context menu is displayed.
2. Select **FastResync>Remove**.
A dialog box is displayed asking you to confirm removal of FR.
3. Click **OK**.
FR is now disabled for the volume.

Disk Change Object (DCO) Volume

The DCO volume is created when you enable FR or when a snapshot operation is started. The DCO volume keeps track of the changes made to a volume while a mirror is detached. The DCO volume is not visible in the tree view in the left pane of the VEA console. It is visible in the Disk View (when Volume Details is not selected).

You can perform two optional operations on a DCO volume:

- ◆ Add or remove a mirror — you can add a mirror to the DCO volume and remove a mirror from it.
- ◆ Move a subdisk — you can move the DCO volume and the mirrored subdisk associated with it to another disk with the **Subdisk Move** command.

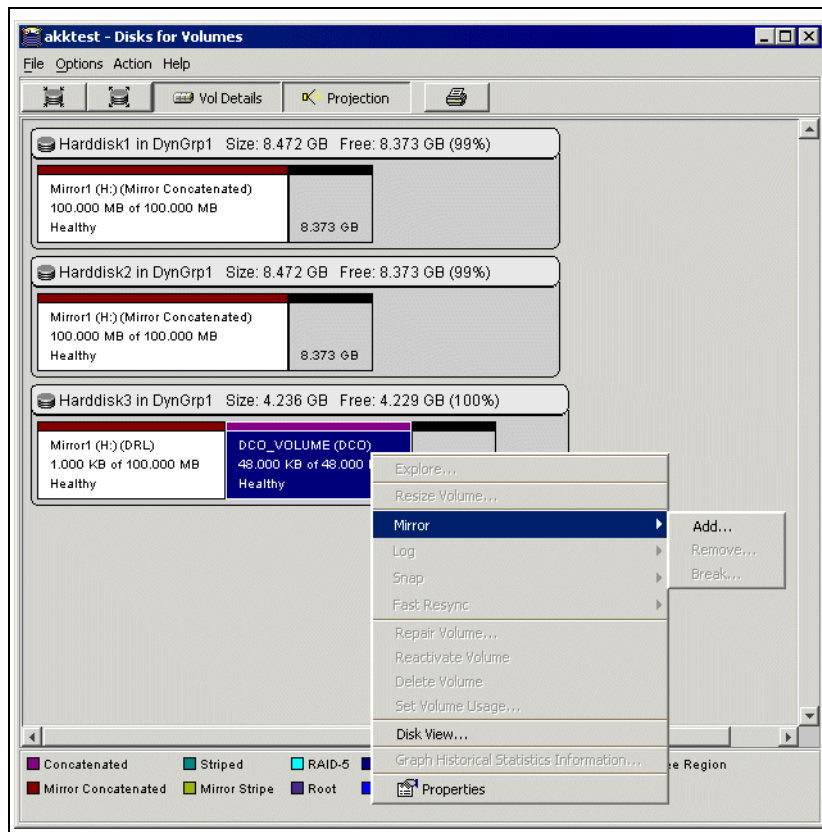


Adding a Mirror to a DCO Volume

You might want to add a mirror to a DCO volume to have a backup copy of the DCO volume.

▼ To add a mirror to a DCO volume:

1. Under the Volumes folder, right-click the volume whose DCO volume you want to add a mirror to.
2. From the volume's context menu, select **Disk View** to get a separate Disk View window. You can also select the Disk View tab to have the Disk View display in the right pane.
3. Right-click the DCO volume to bring up a context menu, as shown in the sample screen.



4. Select **Mirror>Add**.

The Add Mirror window is displayed.

5. If you want to add the mirror to a specific disk, click the radio button “Manually select disks,” select the desired disk, and then click the **Add** button to move the disk to the right pane. If you want the disk to be selected automatically, leave the default setting of “Auto assign destination disks” selected.

6. Click **OK** to add the mirror.

For more information about adding a mirror to a volume, see “[Adding a Mirror to a Volume](#)” on page 154.

Removing a Mirror from a DCO Volume

▼ **To remove a mirror from a DCO volume:**

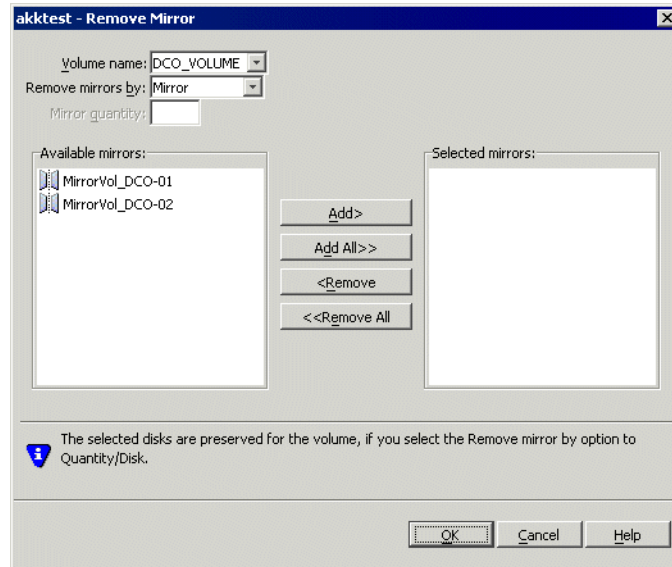
1. Under the Volumes folder, select the volume whose DCO volume you want to remove a mirror from.

2. Select the Disk View tab in the right-hand pane, and right-click on the DCO volume.
A context menu is displayed.

3. Select **Mirror>Remove**.

A dialog box is displayed, asking you to select the mirror to remove.





4. Select the mirror and click the **Add** button to move it to the right pane.
5. Click **OK**.

The mirror is removed from the DCO volume.

Moving the DCO Volume Subdisk

▼ To move a DCO volume subdisk:

You might want to move a DCO volume and the mirrored subdisk associated with it to another disk if something happens to the original disk or you may prefer to have this subdisk on another disk to split the disk group differently. The DCO volume and the mirrored subdisk associated with it have to be moved to a disk in the same disk group.

1. Under the Volumes folder, select the volume whose DCO volume subdisk you want to move.
2. Right-click in the empty space on the Disk View tab in the right-hand pane.
A context menu is displayed.
3. Select **Vol Details**.

The display changes. The Disk View tab now displays the subdisk names for the volumes.

4. Right-click on the subdisk containing the DCO volume.
A context menu is displayed.
5. Select **Move Subdisk**.
The Subdisk Move window appears.
6. Click the radio button “Manually assign destination disks.”
7. Highlight the disk you want to move the mirrored volume subdisk with the DCO volume to and click the **Add** button. The selected disk is moved to the right pane of the window.
8. Click **OK** to complete the command.
The mirrored volume subdisk with the DCO volume is moved to the other disk.
For more information about subdisk move, see “[Subdisk Move, Split, and Join](#)” on page 247.



Snapshot Commands

Snapshot is a feature first made available in Volume Manager 3.0 for Windows 2000. Snapshot can be accessed through the VEA GUI or through the command line interface (see “[vxassist](#)” on page 290). You can take a snapshot of a mirrored or an unmirrored volume, but snapshot is not supported for RAID-5 volumes. This section describes the Snapshot feature and how to use the VEA console to take a snapshot of a volume.

Note To take a snapshot of a volume, you must have an empty dynamic disk in the volume’s disk group.

The snapshot feature enables quick and efficient online backup of volumes, with minimum disruption to the user. Snapshot automatically enables FR and creates a snapshot image of a volume, which can be detached from the volume. The detached snapshot image can be used for backup or other purposes, while the original volume remains in service. The snapshot can then be quickly reattached and resynchronized with the volume through the FR reconnection capability (see “[Reconnection](#)” on page 318). The snapshot volume can also be permanently disconnected from the original volume.

You can attach more than one snapshot plex to a volume by issuing successive **Snap Start** commands on the volume. This enables you to take multiple snapshots of a single volume.

You can attach a snapshot to either the original volume or the snapshot volume.

The following five snapshot commands are supported by the VEA console and are accessed through the volume context menu:

- ◆ **Snap Start**

Creates the snapshot mirror and attaches it to the original volume.

- ◆ **Snap Shot**

Detaches the snapshot mirror from the original volume and creates a snapshot volume that is associated with the snapshot mirror.

- ◆ **Snap Back**

Reattaches the snapshot mirror to the original volume.

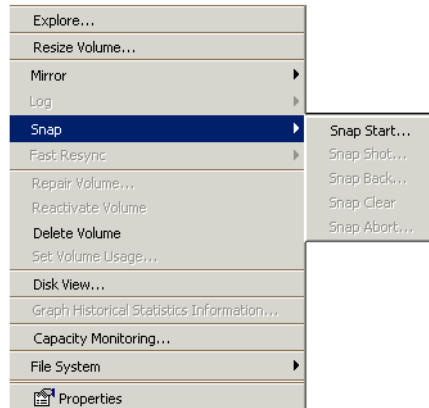
- ◆ **Snap Clear**

Permanently removes the snapshot mirror from the original volume.

- ◆ **Snap Abort**

Aborts the snapshot operation after a **Snap Start** or **Snap Back** command is issued. **Snap Abort** permanently removes the snapshot mirror from the volume and releases its space.

The five snapshot commands are subcommands of the **Snap** command on the volume context menu.



Using the Snapshot Procedure

In summary, the snapshot procedure consists of three steps:

1. Attaching a snapshot mirror to a volume, using **Snap Start**.
2. Detaching the snapshot mirror and creating the snapshot volume that is associated with the snapshot mirror. The **Snap Shot** command is used for this step.
3. Either reattaching the snapshot to the volume after you are done using it, or permanently disconnecting it from the volume. **Snap Back** reattaches the snapshot mirror; **Snap Clear** permanently disconnects the snapshot mirror from the volume, removing the association between the snapshot volume and the original volume.

The **Snap Start** procedure takes considerable time because it involves creating a mirror, but it has to be done only the first time you perform the snap commands sequence. After that, you use the commands **Snap Shot** to break off the mirror for backup (or other purposes) and then **Snap Back** to reattach the snapshot mirror to the original volume. Both of those are very quick procedures (two minutes or less for each one).

Snap Abort aborts the snapshot operation after the **Snap Start** or **Snap Back** command is issued.



Snap Start

Snap Start creates a snapshot mirror or plex, which is attached to and synchronized with a volume. Alternatively, if you are applying the command to a volume that already has one or more normal mirrors, you can designate an existing mirror to be used for the snapshot mirror. The advantage of selecting an existing mirror is that it saves time, since it is not necessary to resynchronize the mirror to the volume.

When the snap start process is complete, the status of the snapshot mirror displays as Snap Ready on the Mirrors tab in the right pane of the GUI. At this point, the snapshot mirror can be associated with a snapshot volume by using the **Snap Shot** command.

The mirror synchronization process can take a while, but it does not interfere with use of the volume. If the snap start process fails, the snapshot mirror is deleted if it was created from scratch, and its space is released. If you selected a normal mirror to be used for the snapshot mirror, that mirror reverts to its normal state if the snap start process fails.

Once the snapshot mirror is created, it continues to be updated until it is detached.

▼ To create a snapshot mirror:

1. Right-click on the volume that you want to take a snapshot of.

A context menu is displayed.

2. Select **Snap>Snap Start**.

The dialog box that comes up initially for the command varies, depending on whether you already have a mirrored volume or not.

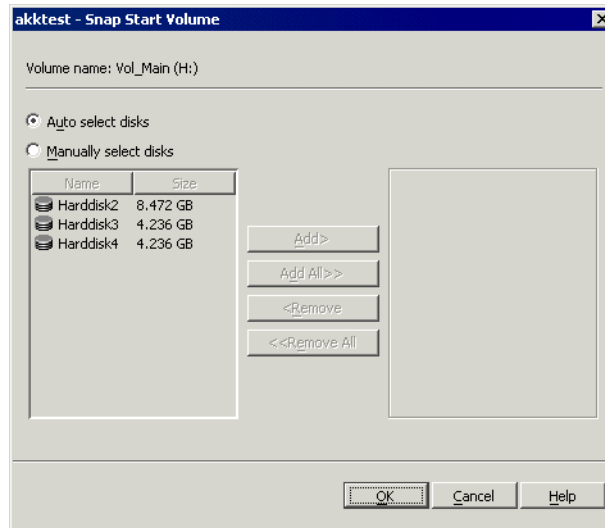
- a. If you have a mirrored volume, a dialog box appears to allow you to select an existing mirror to be used for the snapshot mirror.

- If you have a mirrored volume and there is also a disk available on your system to create an additional mirror, the dialog box allows you to choose either to use an existing mirror for the snapshot or to have a new mirror created.
- If you have a mirrored volume and there is no disk available for creating a new snapshot mirror, the dialog box allows you to select from existing mirrors in the volume.

If you select an existing mirror to be used for the snapshot mirror, the command completes at this point. Skip [step b](#).

If you have a mirrored volume but you have chosen the option “Do not use existing mirror for snap,” a dialog box to select disks will appear next. Continue with [step b](#).

- b. If you have an unmirrored volume or you have not selected an existing mirror to use for the snapshot mirror, select the disk to be used for the snapshot mirror from the window for disk selection, as shown in the sample screen that follows.



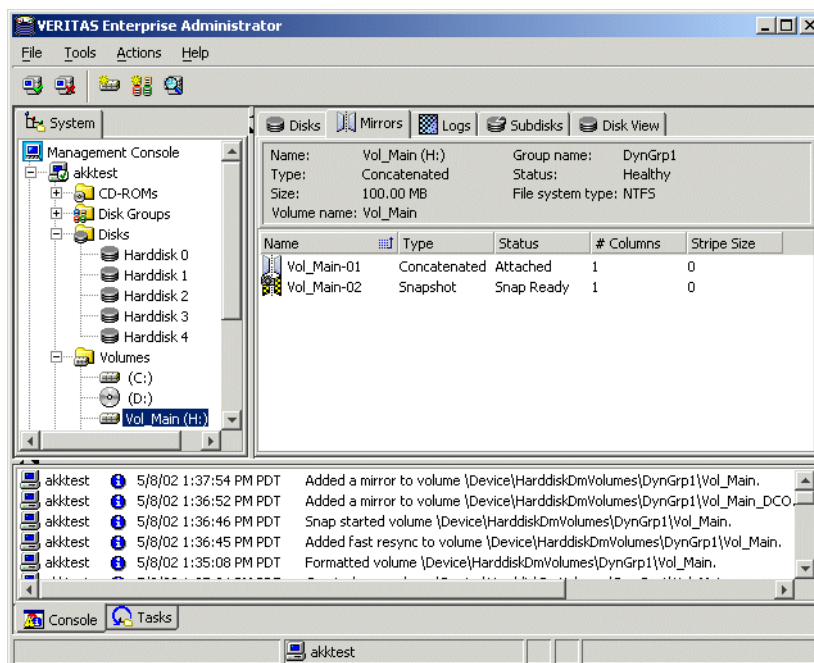
The default setting is to have the program select the disks where the snapshot mirror will be created. If you choose this default setting, click **OK** to have the program start creating the snapshot mirror.

You can also click the “Manually select disks” radio button to specify the disks that can be used to create the snapshot mirror. If you select the manual setting, use the **Add** or **Add All** button to move the selected disks to the right pane of the window. The **Remove** and **Remove All** buttons allow you to move selected disks back to the left pane. When you are satisfied with your disk selection, click **OK** to complete the command.

After the **Snap Start** command completes, a new snapshot mirror is attached to the volume. See the sample screen below. In that screen, Vol_Main (H:) has a snapshot mirror attached to it.

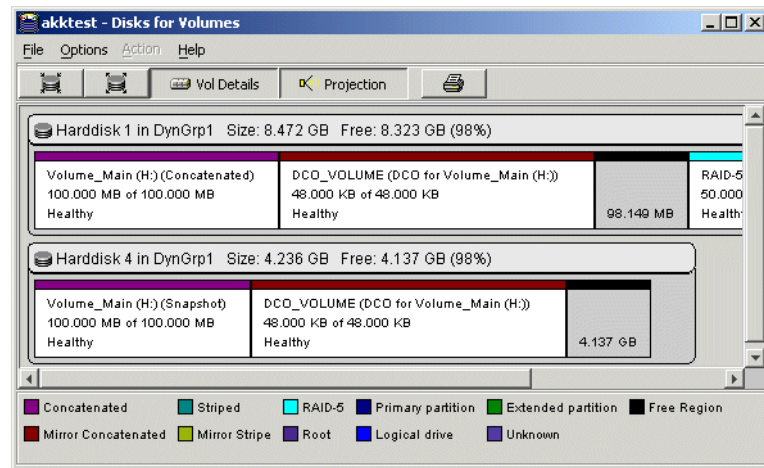
The new mirror is added to the Mirrors tab for the volume. In the sample screen, the mirror is identified as a snapshot mirror and has the Snapshot icon. After the snapshot mirror is synchronized with the volume, its status becomes Snap Ready.





Note It is important to make sure that the snapshot mirror (or snap plex) has completed its resynchronization and displays the status of Snap Ready before continuing with the **Snap Shot** command or doing any other operations on the snapshot mirror. Also, if you shut down the server or deport the disk group containing the volume being snap started before resynchronization completes, the snapshot mirror will be deleted when the disk group with the original volume comes online again.

The sample Disk View screen that follows shows the DCO log that is created by the **Snap Start** command. The DCO (disk change object) volume is created to track the regions on a volume that are changed while a mirror is detached. The DCO volume is not included in the tree view of the VEA GUI. To view the DCO volume, you must use the Disk View. To access the Disk View, click the Disk View tab in the right pane or select Disk View from a disk's or volume's context menu. For more on DCO volumes, see the section "[Disk Change Object \(DCO\) Volume](#)" on page 319.



Note The **Break Mirror** and **Remove Mirror** commands do not work with the snapshot mirror.

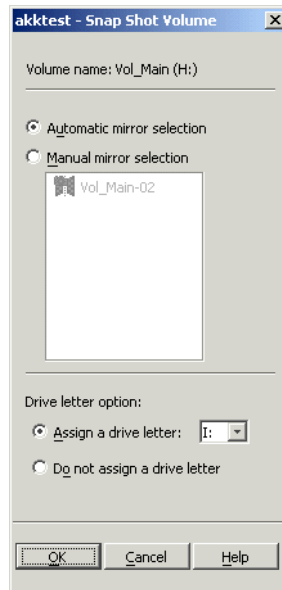
Snap Shot

Snap Shot detaches the snapshot mirror and creates a new volume that is associated with that mirror. This process takes a relatively short time, typically less than a minute, during which users can be requested not to access the original volume. After the snapshot volume is created, it can be used for backup or other purposes.

▼ To take a snapshot:

1. Right-click on the volume with the snapshot mirror.
A context menu is displayed.
2. Select **Snap>Snap Shot**.
3. In the Snap Shot Volume window that appears, choose the snapshot mirror that will be associated with the snapshot volume that will be created.





When there is only one snapshot mirror, “Automatic mirror selection” will be selected. If there are multiple mirrors and you want to select the mirror to be used, click to select “Manual mirror selection.” You then can select the mirror from the list on the screen.

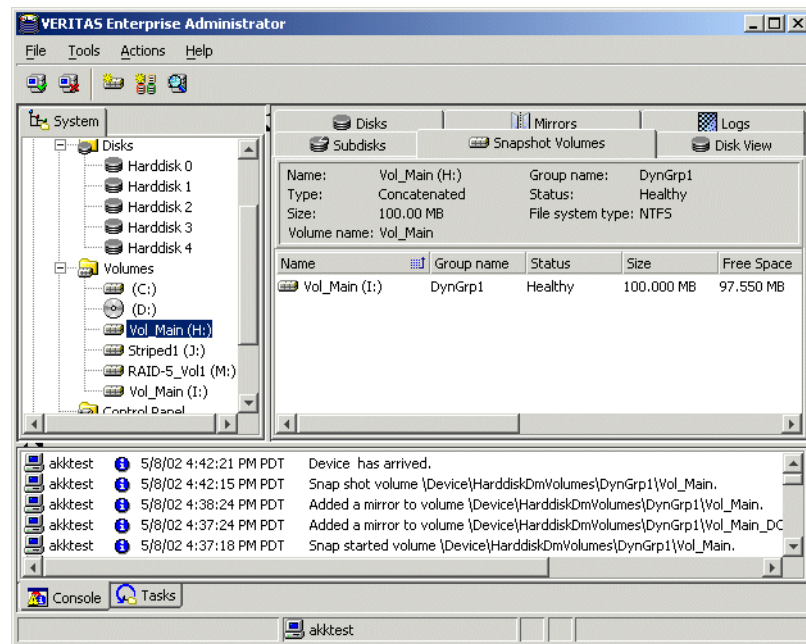
You have three options relating to drive letter selection:

- Accept the program’s assignment of the drive letter.
- Use the pull-down list to choose another drive letter.
- Click the radio button “Do not assign a drive letter.”

When you are satisfied with your selections in the window, click **OK**.

The snapshot mirror is detached from the original volume, and a new volume is created that is associated with the snapshot mirror. This process usually takes less than a minute (normally about 20 seconds).

The snapshot mirror is no longer displayed on the Mirrors tab for the original volume. The new snapshot volume is displayed under the Volumes folder in the tree view. The program assigns it the next available drive letter. It is shown as drive letter I in the following sample screen, both in the tree view and in the Snapshot volumes tab of the right pane of the GUI.



You can now use the snapshot volume for backup or other purposes.

Snap Back

Snap Back reattaches a detached snapshot mirror to its original volume.

After you are done using the snapshot, you can reattach it to the volume, where it would be resynchronized to the data store and continually updated. You can get a current copy of the original volume, with minimal disruption to users, by issuing **Snap Shot** again.

▼ To reattach a snapshot mirror to the original volume:

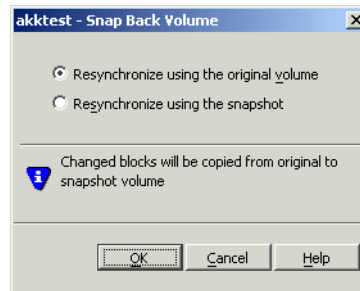
1. Right-click the snapshot volume whose snapshot mirror you want to reattach to its original volume.

A context menu is displayed.

2. Select **Snap>Snap Back**.

A dialog box appears with two options for resynching the snapshot, as shown in the screen that follows:





3. Specify whether the snapshot volume is to be resynchronized to the original volume or the original volume is to be resynchronized to the snapshot volume, and click **OK**.

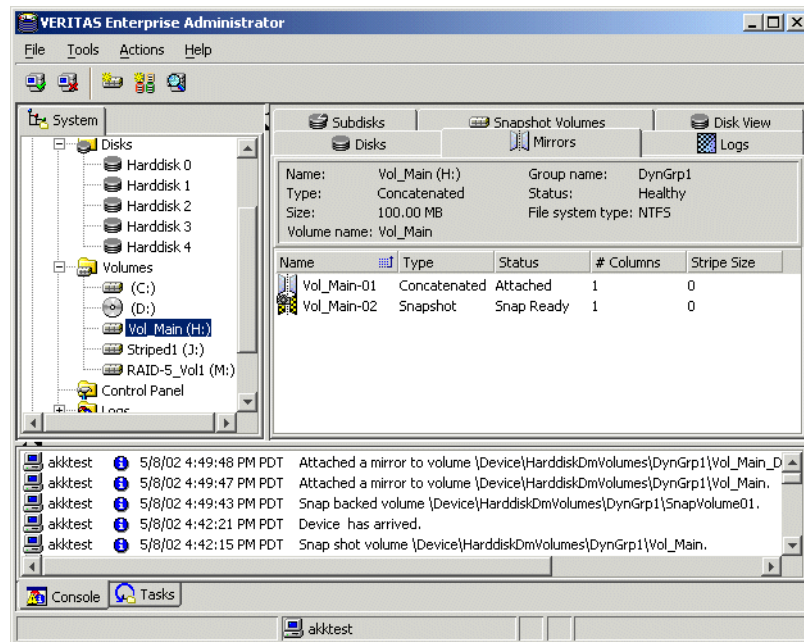
The middle of the screen displays a further explanation of the selected option.

Note One situation where you might want to resynchronize to the snapshot volume rather than the original volume if something has happened to the original volume so that its data integrity is no longer sound.

The snapshot mirror is reattached to the original volume, and the snapshot volume is deleted if it is the last plex of the volume. (If the snapshot volume has other mirrors associated with it, it is not deleted.) As shown in the following figure, the snapshot volume, identified as I in the previous figure, is removed from the Volumes folder in the tree view, and the snapshot mirror is now shown on the Mirrors tab for the original volume. After the resynchronization, the original volume is now in a similar situation as it was after the first **Snap Start** command but any changes to it have been updated on the snapshot mirror.

Now it is possible to do another **Snap Shot** command on the volume and repeat the process. If you are resynchronizing to the original volume, the resynchronization should take very little time because that volume was being constantly updated all the time.

Only the original synchronizing of the mirror in the original **Snap Start** command takes the normal amount of time to create the snapshot mirror. Once you have completed the original **Snap Start** command, the repeat procedure for **Snap Shot** and **Snap Back** are very quick. You only have to do the **Snap Start** command once.



Snap Clear

Snap Clear permanently removes the link between a snapshot volume and its original volume. **Snap Clear** can be specified only after the **Snap Shot** command has been issued. After a **Snap Clear**, the snapshot volume becomes an ordinary volume.

▼ To change a snapshot volume to an ordinary volume:

1. Right-click on the snapshot volume that you want to change to an ordinary volume. After the **Snap Clear** command is completed, the volume will no longer be linked to its original volume.

2. Select **Snap>Snap Clear**.

A message box is displayed asking you to confirm the **Snap Clear** operation for the specified volume.

3. Click **Yes**.

The snapshot mirror becomes an ordinary volume. The original volume goes back to the state that it was before a **Snap Start** command.



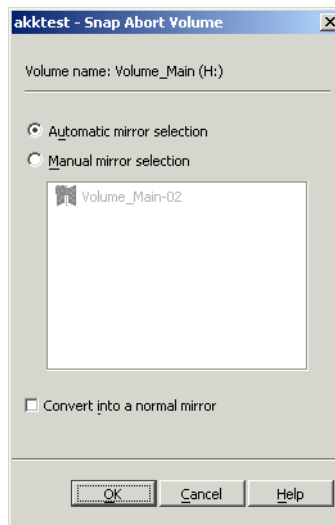
Snap Abort

Snap Abort aborts the changes made by the **Snap Start** command or the **Snap Back** command. In both these commands, a snapshot mirror plex is attached to a volume. **Snap Abort** either deletes this snapshot mirror plex or converts the snapshot mirror plex to an ordinary mirror. In cases where the deleted snap plex is the last snap plex and the resulting volume is simple or striped, the Snap Abort command deletes the DCO log volume also.

The command cannot be done directly after a **Snap Shot** command.

▼ **To delete a snapshot mirror or change it into an ordinary mirror:**

1. Right-click the volume on which you want to abort the **Snap Start** operation.
2. Select **Snap>Snap Abort** from the context menu that comes up.
3. Select the options in the Snap Abort Volume window that appears.



If you have only one mirror, you can leave the default setting of “Automatic mirror selection.” If there are multiple mirrors, you can manually select the mirrors to snap abort. If you click the checkbox “Convert into a normal mirror,” the selected mirror or mirrors will become normal mirrors.

Click **OK** when you are satisfied with your selections.

4. Respond to the message box asking you to confirm the **Snap Abort** operation for the specified volume. The snapshot mirror is aborted. The DCO volumes are removed.

Dynamic Disk Group Split and Join

This section on Dynamic Disk Group Split and Join has the following topics:

- ◆ [About Dynamic Disk Group Split and Join](#)
- ◆ [Dynamic Disk Group Split](#)
- ◆ [Recovery for the Split Command](#)
- ◆ [Dynamic Disk Group Join](#)
- ◆ [Using Dynamic Disk Group Split and Join with a Cluster on Shared Storage](#)
- ◆ [Limitations When Using Dynamic Disk Group Split and Join with VVR](#)
- ◆ [DGSJ Troubleshooting Tips](#)

About Dynamic Disk Group Split and Join

Dynamic Disk Group Split and Join (DGSJ) refers to two related commands—**Split Dynamic Disk Group** and **Join Dynamic Disk Group**. **Split Dynamic Disk Group** splits a dynamic disk group into two dynamic disk groups. **Join Dynamic Disk Group** joins two dynamic disk groups into one merged disk group. You can join two disk groups that were originally split apart with the **Split Dynamic Disk Group** command, but you can also join two dynamic disk groups that started out as separate disk groups.

DGSJ can be used for the FlashSnap process and to reorganize dynamic disk groups. DGSJ can be implemented through the VEA console or through the command line by using the **vxdg split** and **vxdg join** commands.

With the **Split Dynamic Disk Group** command, you can take some but not all disks from one dynamic disk group to another. The source dynamic disk group retains its identity as the original, while the other dynamic disk group, called the target disk group, becomes a new dynamic disk group. After the split operation, the target dynamic disk group is in the Imported state if you used the GUI to implement the command. If you used the command line to do the split, the target dynamic disk group is by default in the Deported state (though you can use the **-i** switch to have it remain in the Imported state). In both the GUI and the command line, the source dynamic disk group continues to remain online after the split operation.

Primary dynamic disk groups cannot be split because in Volume Manager 3.0 or 3.1 primary dynamic disk groups usually contain the computer's boot and system disks. Also, only healthy dynamic volumes can be transferred in the split operation. If you have dynamic disk groups created in Volume Manager 2.7 or earlier, you will need to upgrade these disk groups to be compatible with Volume Manager 3.0 and 3.1 dynamic disk groups before you can use the DGSJ commands. See "[Upgrading a Dynamic Disk Group Version](#)" on page 169 for the GUI command or "[vxdg upgrade](#)" on page 281 for the command line usage.



The **Split Dynamic Disk Group** command works on the premise that the split-off disk group should contain all disks that are needed to make the volumes in the new disk group complete. If the disks that you select to split the disk group will result in incomplete volumes, the logic built into the command will add the remaining disk or disks needed to split the disk group with complete volumes. A screen is presented to you that lists the disks needed for the split. You can decide at that time whether you want to go ahead with the dynamic disk group split.

Thus, you are not able to split a dynamic disk group into two disk groups if any of the volumes allocated to either split disk group are incomplete.

The **Join Dynamic Disk Group** command allows you to join dynamic disk groups. It does not require that the dynamic disk groups to be joined were previously split. When you join two dynamic disk groups, the dynamic disk group you designate as the source will be the one that loses its identity in the merge. The target dynamic disk group is the one that remains after the join.

With the join command all disks, of the source dynamic disk group are joined with all the disks of the target dynamic disk group. If some disks are missing or nonfunctioning in the source dynamic disk group, the join command will not work.

The procedures in this section focus on the GUI commands related to Dynamic Disk Group Split and Join. For the command line procedures, see “[vxdg](#)” on page 275.

Dynamic Disk Group Split

After a dynamic disk group is split with the GUI command, the target disk group is in an Imported state. If you want the dynamic disk group to be in a Deported state, use the CLI version of the command, **vxdg split**, in which the default state of the target disk group is Deported. However, you can also use the **-i** switch with **vxdg split** to have the target disk group be Imported.

With the GUI dynamic disk group split command, if the source disk group is a cluster disk group or a disk group with private dynamic disk group protection, the resulting target disk group will be of the same disk group type. With the CLI disk group split command, these disk group types need additional parameters to ensure that they retain their respective disk group type. See “[vxdg split](#)” on page 282 for details.

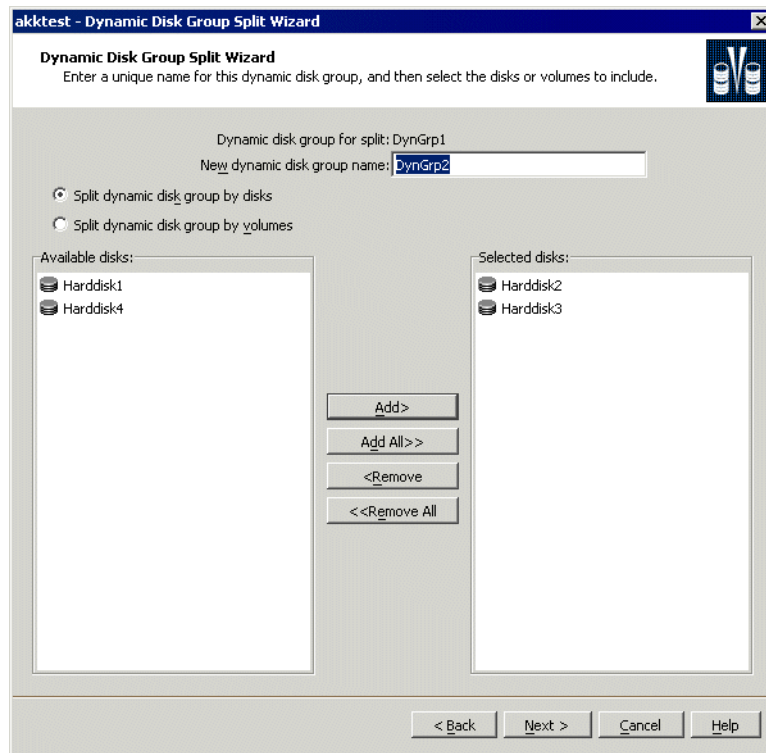
▼ To split a dynamic disk group:

1. Make sure that the volumes to be split are not in use and that they are healthy. Similarly, make sure that any disks that will be split do not have a Missing status.

It is a good idea to use the Disk View to look at the disk group’s volumes and subdisks, so you can see which disks are appropriate to split. The disks in the new split-off disk group have to contain complete volumes.

Note If a volume is in use, an error message comes up, asking if you want to force the split operation. For details, see “[Error message about forcing a split or join operation](#)” on page 346.

2. Right-click the dynamic disk group object in the tree view of the VEA console, and click **Split Dynamic Disk Group** from the context menu. If the dynamic disk group is highlighted, you can also select the command from the Actions menu on the VEA console menu bar.
3. The Dynamic Disk Group Split wizard appears. Click **Next** to continue.
4. In the screen that appears next, specify the information needed for splitting the disk group as follows:



- a. Enter the new dynamic disk group name.

The disk group name should be unique. The dynamic disk group name is limited to 18 characters. It cannot contain spaces or forward and backward slashes. Also, a period cannot be the first character of the name.

- b. Choose either the “Split dynamic disk group by disks” option or the “Split dynamic disk group by volumes” option.

When you choose to split by disks, disks appear in the panes in the lower section of the window. If you choose to split by volumes, volumes will appear instead of disks.

- c. Select disks or volumes that you wish to split.

The currently available disks or volumes in the specified disk group are displayed in the left pane, which is labeled “Available disks” or “Available volumes.” You select disks or volumes in the left pane and then click the **Add** or **Add All** button to move them to the right pane, which is labeled “Selected disks” or “Selected volumes.”

The **Add All** button is provided for convenience in moving many disks at once. After the disks are moved, you would need to move at least one of them back to the left pane, because you cannot split a dynamic disk group if you include all the disks in the target disk group.

- d. Click **Next** to continue.

Note The volumes and disks that belong to the source dynamic disk group and that are not being split remain accessible during the entire dynamic disk group split operation.

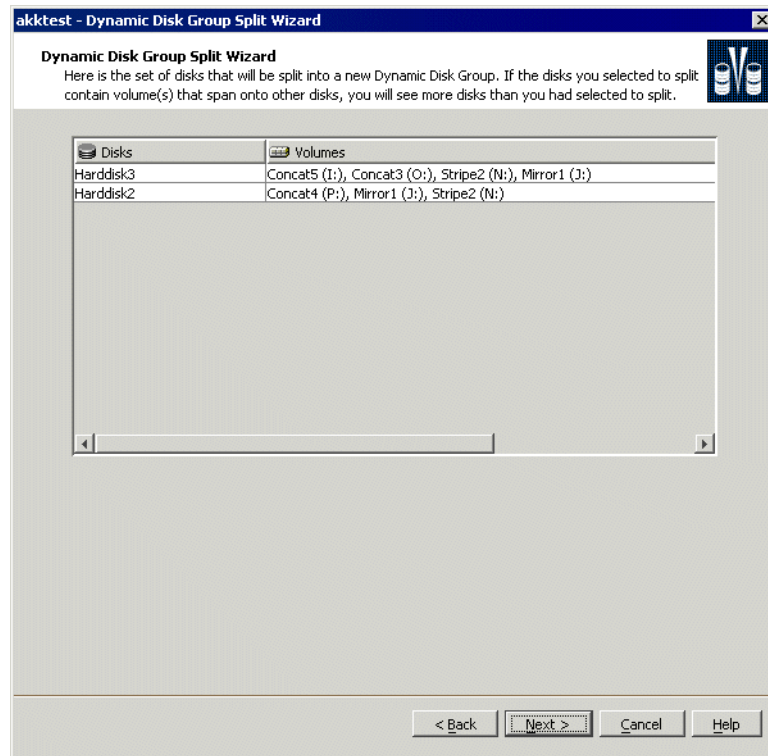
5. Verify the information for the dynamic disk group split.

The screen that follows shows the type of information you will see. The purpose of this screen is to allow you to confirm the disk group split.

The wizard shows the disks selected for the split in the left column and the volumes that will be split in the right column. In this screen, you may see more disks than what you selected for the split. If the disks you have selected would result in a disk group with partial volumes, the program will supply the disks needed to ensure that the split-off dynamic disk group will have complete volumes.

If you want to make the split-off dynamic disk group larger, you can click **Back** to go back and add more disks.

When you are satisfied that the information is correct, click **Next**.



6. Click **Finish** to confirm the dynamic disk group split.

If the dynamic disk group split is successful, you'll be able to view the new target dynamic disk group in the tree view and in the right pane of the console. By default, the new target disk group is in the Imported state if you are using the GUI to perform the split. If you use the command line to execute the split, the new target disk group will be in the Deported state by default, because it assumes you want to deport the disk group and then import it on another computer. However, with the command line, you can use the **-i** switch with the **vx dg split** command to have the disk group remain in the Imported state.

If the **Split Dynamic Disk Group** command fails, an error dialog box is displayed showing the reason for failure. The **Dynamic Disk Group Split** operation fails if the target disk group already exists or if a problem occurs when the split operation is taking place.

If the computer fails during the split operation, Volume Manager provides a recovery process. The next section has the details on the recovery process.



Recovery for the Split Command

If disk and/or system failures occur during the disk group split operation, Volume Manager generally performs any necessary recovery operations automatically. The recovery procedure performs any necessary operations to restore the disk group to a consistent state. On successful recovery, the disk groups are again available for use.

For example, if there is a power outage during the split operation, it will result in incomplete information on the disk and in the disk group. The recovery mechanism ensures that when the host boots up the next time or if the disk group is imported on a host (the same host or another host), the inconsistencies in the information will be removed. Depending on the amount of processing completed by the split operation at the time of the failure, the recovered disk group will either be in the state it was before the split operation or be successfully split into two disk groups.

There are two modes for recovery: automatic and manual.

◆ Automatic recovery

If it is possible to reboot the system, Volume Manager will attempt automatic recovery after the reboot. If the automatic recovery process is able to detect sufficient information to perform the recovery, the recovery will be successful and the disk group will appear to be in a normal state after the automatic recovery process.

◆ Manual recovery

There are several situations where it is necessary to do manual recovery:

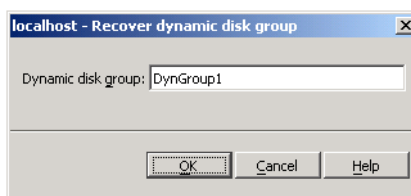
- If the automatic recovery runs after the reboot and there is not sufficient information for recovery, the disk group will be in a Deported state and will display an alert icon (a yellow caution icon).
- If you cannot reboot the system because it has failed completely, then you must move the disk group's disks to another system and then do a manual recovery. In this situation, it is recommended that you move the entire source disk group to another computer, rescan, and implement the recovery manually.
- It will also be clear that a disk group needs manual recovery after a split command when Volume Manager does not allow imports of the disk group to succeed or it blocks the join of a disk group. You will receive an error message indicating that the disk group needs recovery.

Recovery should be done as soon as possible to preserve the integrity of the data.

You can perform the manual recovery by using the command line (see “[vxdg](#)” on page 275) or the GUI. The GUI process is described in the section that follows.

▼ To manually recover the dynamic disk group:

1. Right-click the disk group icon in the VEA GUI and select **Recover Dynamic Disk Group** from the context menu that appears.
2. In the dialog box that appears, make sure the proper disk group name is showing, and click **OK** to have Volume Manager start the recovery process.



On the successful completion of the manual recovery operation, the user can perform all Volume Manager operations. The only exception is that if a host crashes during a particular stage of the split operation, one or more of the disk group's disks and volumes may come up in an unhealthy state after recovery. In that situation, use the **Reactivate Disk** command on the unhealthy disks and then the **Reactivate Volume** command on each of the unhealthy volumes involved in the split command. After running these commands, the disk group's disks and volumes should be healthy. See [“Reactivate Disk Command”](#) and [“Reactivate Volume Command”](#) on page 440 for details on these commands.

Dynamic Disk Group Join

This section describes the procedures for a dynamic disk group join operation.

When you join two dynamic disk groups, the disk group you designate as the source will be the one that loses its identity in the merge. The target dynamic disk group is the one that remains after the merge. Volume Manager requires that the volumes transferred to another disk group must be complete; that is, the source disk group cannot have missing disks. The disk group type after the join will be the type of the target disk group. For example, if the target disk group before the join had private dynamic disk group protection, it will have private dynamic disk group protection after the join.

Note A cluster dynamic disk group that is part of the cluster resources cannot be a source disk group for a join command. However, it can be a target disk group for the command.



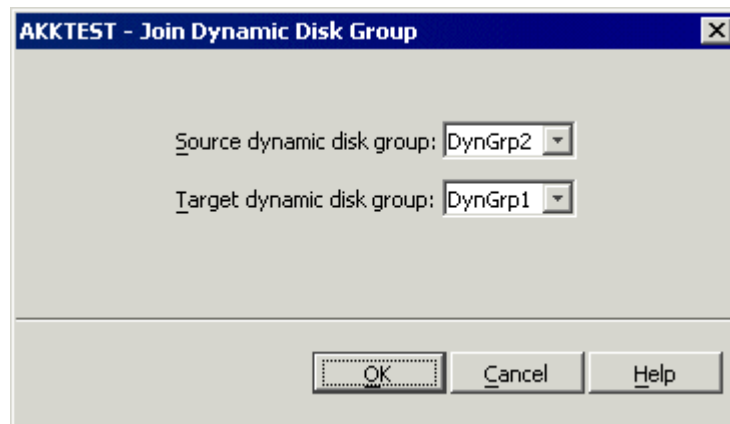
To join two disk groups into one disk group:

1. Make sure that the volumes in the source dynamic disk group are not in use and are healthy.

Note If a volume is in use, an error message comes up, asking if you want to force the join operation. For details, see [“Error message about forcing a split or join operation”](#) on page 346.

2. Right-click the disk group object in the left pane of the VEA console, and then click the **Join Dynamic Disk Group** command, or select the **Join Dynamic Disk Group** command from the Actions menu on the VEA console menu bar.

The **Join Dynamic Disk Group** dialog box appears as shown:



3. In the Join Dynamic Disk Group dialog box, make sure the correct source and target disk group are indicated. If necessary, use the drop-down lists to change the disk group names.

The source dynamic disk group is the disk group that will be merged with the target dynamic disk group. The source disk group will cease to exist after the join.

The target dynamic disk group is the disk group that remains after the join. It retains its identity and becomes larger with the addition of the disks from the source disk group.

4. Click **OK**.

If the join operation is successful, the source dynamic disk group merges into the target dynamic disk group. The changes in the target dynamic disk group will be reflected in the VEA console tree view and right pane.

If the join operation fails, an error dialog box is displayed, showing the reason for the failure.

The new dynamic disk group after the join command will be of the same type as the target dynamic disk group. For example, if a cluster dynamic disk group is joined with a normal dynamic disk group, then the new dynamic disk group will be a normal dynamic disk group.

Using Dynamic Disk Group Split and Join with a Cluster on Shared Storage

This section describes the use of the Dynamic Disk Group Split and Join operations with Volume Manager cluster disk groups on shared storage. Volume Manager supports cluster dynamic disk groups with either VERITAS Cluster Server (VCS) or Microsoft Cluster Service (MSCS) software. The section's topics are:

- ◆ Using DGSJ with VCS or MSCS
- ◆ Example of an Off-Host Backup Procedure Using Volume Manager and VCS or MSCS

Using DGSJ with VCS or MSCS

If a disk group is under VCS or MSCS control, Volume Manager imposes certain conditions on the functioning of the Dynamic Disk Group Split and Join operations. These conditions are:

1. If a shared dynamic cluster disk group is joined to another (possibly shared) dynamic disk group and the source disk group is configured as a VCS or MSCS resource, then the join operation will fail.
2. If a dynamic disk group (possibly shared) is joined to another shared cluster dynamic disk group and the target disk group is configured as a VCS or MSCS resource, then the join operation is allowed to proceed.
3. (VCS only) If a shared dynamic cluster disk group is split into another (possibly shared) disk group and the source disk group is configured as a VCS resource, then the split operation will not be allowed to proceed, with one exception. The exception is that the split operation can proceed when the volumes selected to be split off are NOT configured under VCS.

Thus, in this situation, if users want to split any volumes that are configured under VCS, they should remove the volumes from VCS monitoring and retry the split operation.

4. (MSCS only) If a shared dynamic cluster disk group is split into another (possibly shared) disk group and the source disk group is configured as an MSCS resource, the split operation is allowed to proceed. However, before the command completes, a



confirmation window appears to remind you that if you split a disk group resource so that a volume on which other cluster resources depend is moved to a new Volume Manager cluster disk group, it is necessary to define the new cluster disk group as an MSCS resource and to modify the properties of dependent resources to reflect the change.

If necessary, use Cluster Administrator to check and modify resource dependency fields as follows:

- a. Define the new cluster disk group as an MSCS Volume Manager cluster disk group resource.
- b. If the new disk group resource is in a different MSCS group than the original cluster disk group resource, move all resources that depend on the new cluster disk group resource to the MSCS group where it resides.
- c. For each dependent resource, do the following:
 - Offline the resource.
 - Right-click on the resource and select **Properties**.
 - Select the Dependencies tab in the resource's Properties window.
 - If the resource lists the disk group that was the source of the split operation as a dependency, click the **Modify** button.
 - Move the new disk group from the Available Resources pane of the Modify Dependencies window to the Dependencies pane, and move the old disk group from the Dependencies pane to the Available Resources pane, if it appears in the Dependencies pane.
 - Online the resource.
5. (VCS only) If there is a hardware failure or a power failure during an ongoing disk group split operation and the disk group being split is configured under VCS, then VCS will attempt to failover that disk group to another node in the cluster and to bring the disk group online.

At that time, appropriate disk group split recovery will be carried out as required to bring the disk group online. For more about the dynamic disk group recovery process, see ["Recovery for the Split Command"](#) on page 340. Manual intervention may or may not be required to recover the disk group.
6. If you are splitting a dynamic cluster disk group that contains the quorum volume, make sure that the quorum volume is not part of the target disk group after the split operation. If you fail to do so, the quorum volume will not be able to function and the cluster will fail.

Example of an Off-Host Backup Procedure Using Volume Manager and VCS or MSCS

This section describes how to use VCS or MSCS and Volume Manager in a typical off-host backup procedure.

In the example, a disk group named “SQL” has volume “V” on which a SQL Server database is under heavy use by clients. This disk group is imported on one node of a cluster running VCS or MSCS. VCS or MSCS monitors the disk group as well as the volume, ensuring high availability. To implement off-host backup, a user would typically do the following:

1. Create a snapshot “V1” of the volume V with the snap commands in the VEA GUI or the CLI. For procedure details, see [“Snapshot Commands”](#) on page 324.
2. Split the dynamic disk group SQL into another dynamic disk group “Temp” so that V1 resides on the disks in the Temp disk group. Since VCS or MSCS is monitoring V (and not V1), the split operation will succeed. Refer to [“Dynamic Disk Group Split”](#) on page 336 for procedure details.
3. Deport the Temp disk group and import it on another node in the cluster. For details, see [“Importing and Deporting Dynamic Disk Groups”](#) on page 170.
4. Back up volume V1 on the second node, using the backup software.
5. After backup is complete, deport the Temp disk group on the second node.
6. Join the Temp disk group to the SQL disk group on the first node. Since the SQL disk group is a VCS or MSCS resource (and the Temp disk group is not monitored), the join operation will succeed. Refer to [“Dynamic Disk Group Join”](#) on page 341 for procedure details.
7. The snapshot volume V1 can then be snapped back to its parent volume V. For procedure details, see [“Snap Back”](#) on page 331.

In the off-host backup solution outlined above, the high availability of the volume V is not affected at all. While the successful backup is taking place, the SQL server provides uninterrupted service to its clients with minimum configuration changes on both nodes in the cluster.

The above procedure is fully scriptable and thus can be automated to provide a backup on a hourly, daily, weekly, or monthly basis.

Limitations When Using Dynamic Disk Group Split and Join with VVR

If you are using the Dynamic Disk Group Split and Join commands with volumes that are under VERITAS Volume Replicator (VVR) control, the following limitations apply:



- ◆ A volume under replication cannot be part of the volumes split off to the target disk group. It can remain in the source disk group.
- ◆ A join operation will not be allowed if the source disk group has any VVR objects.

DGSJ Troubleshooting Tips

This section provides information and workarounds for problems that might arise when using the Dynamic Disk Group Split and Join commands.

Error message, “The disk group requires recovery. Please recover...”

This message can occur when you attempt to import a disk group or do a join command. The message indicates that the disk group needs recovery because of a problem that occurred during a disk group split operation. See the section [“Recovery for the Split Command”](#) on page 340 for details on the recovery procedure.

Error message, “The disk is not ready or usable.”

This message can occur when you attempt a disk group split or join operation and a disk in the disk group is no longer functioning or has gone offline. It is recommended that you rescan and then retry the disk operation. However, if one or more disks in the disk group has failed, the split or join operation will fail even after a rescan operation. You cannot do a disk group split or join operation when any of the disks involved are offline.

Error message about forcing a split or join operation

If you attempt a dynamic disk group split or join command when a volume is in use, Volume Manager will put up a message asking whether you want to force the split or join. If the volume is in use because it is selected in Windows Explorer, then you can force the split or join safely. However, if the volume is actually in use within an application, it is not recommended that you attempt to complete the command. If a volume is regenerating, resynching, or recovering, then even if you force the split or join, the operation will not be successful. The command line interface does not have a force option and will fail the join whenever a volume is in use.

Dynamic Multipathing Software

This section describes the Dynamic Multipathing (DMP) software option and its use. The following topics are covered:

- ◆ [Dynamic Multipathing Overview](#)
- ◆ [Dynamic Multipathing Menus](#)
- ◆ [Including and Excluding an Entire Array from DMP Control](#)
- ◆ [Including and Excluding One or More Disks from DMP Control](#)
- ◆ [Adding and Removing Paths](#)
- ◆ [Specifying Active/Active and Active/Passive Load Balancing Settings and the Preferred Path](#)
- ◆ [Viewing Array, Disk, and Path Status](#)
- ◆ [Disabling and Enabling a Path to a Disk for Maintenance](#)
- ◆ [Setting the Monitor Interval Option](#)
- ◆ [Using the Purge Disks Command](#)

For information on installing DMP, see the sections “[DMP Installation](#)” on page 33 and “[Cluster Setup with VCS or MSCS and DMP](#)” on page 35.



Dynamic Multipathing Overview

This section provides a general overview of the Dynamic Multipathing software option. Its topics are:

- ◆ [About Dynamic Multipathing](#)
- ◆ [Major Features of Dynamic Multipathing](#)
- ◆ [Active/Active and Active/Passive Load Balancing Settings](#)

About Dynamic Multipathing

The Dynamic Multipathing option adds fault tolerance to disk storage by making use of multiple paths between a computer and a disk in a storage array. A path is the connection between the computer and the storage array's disks and consists of a host adapter and a SCSI bus connection to one or more SCSI disks or a fiber optic channel connected to a hub or switch. Thus, multiple paths are made possible by connecting two or more host bus adapters with either SCSI or fiber optic cabling to the storage array. The DMP software manages the multiple paths so that only one path to the data on each of the array's disks is accessible at a time to the host computer. If a path to a disk fails, DMP will automatically transmit data to and from the disk over an alternate path.

When Volume Manager is first installed, Dynamic Multipathing control is not in effect. All arrays attached to the system come up as excluded. You must include the array to enable the Dynamic Multipathing control functions. See [“Including an Entire Array under DMP Control”](#) on page 355 for detailed instructions.

The paths on an array are set up to work in two ways—either an Active/Active mode, which provides load balancing of the data between multiple paths, or an Active/Passive mode, in which only one path is active and any remaining paths are backups.

Major Features of Dynamic Multipathing

The major features of Dynamic Multipathing are:

- ◆ **Fault tolerance**

Provides fault tolerance to a disk system by using multiple paths to each disk. If the primary path fails, either at the card level or in the cabling from the card to the disk, a secondary path automatically activates.

- ◆ **Load balancing in Active/Active configurations**

When a system is configured as Active/Active, Dynamic Multipathing switches between the active paths to a disk for each successive transfer to or from the disk.

- ◆ **Support for an unlimited number of paths**

You can set up as many I/O paths as your system box can accommodate. You are limited only by the number of SCSI cards or fiber optic channels you can install in your system.

- ◆ **Dynamic recovery**

If an active path to a disk fails, Dynamic Multipathing automatically flags the failed path and no longer attempts to transfer data on it. The failed path is monitored and is automatically restored to service when DMP detects that the path is functioning correctly. DMP automatically updates path status on the user display when a path fails or is restored to service.

- ◆ **Dynamic path recognition**

If you add a new path to your Dynamic Multipathing configuration, running a rescan or rebooting your system causes Dynamic Multipathing to detect the new path and display its status. If a failed or disabled path is restored to service, DMP automatically detects the status change and updates the display.

- ◆ **Selection capability for individual disks or an entire array**

Dynamic Multipathing can be selectively enabled or disabled for an entire array or for individual disks in the array.

- ◆ **Maintenance mode support**

A user can disable a given path or paths to a storage array temporarily for maintenance purposes.

Active/Active and Active/Passive Load Balancing Settings

This section describes DMP's two modes of operation for an array's paths, Active/Active and Active/Passive. These modes also apply to the array's disks and are defined as follows:

- ◆ **Active/Active**

The mode in which DMP allocates the data transfer across the possible paths, thus enabling the desirable feature of load balancing. With this mode, DMP implements a round-robin algorithm, selecting each path in sequence for each successive data transfer to or from a disk. For example, if you have two paths active, A and B, the first disk transfer occurs on path A, the next on path B, and the next on path A again.

- ◆ **Active/Passive**

A mode in which a path designated as the "Preferred Path" is always active and the other path or paths act as backups that are called into service if the current operating path fails.



The two settings—Active/Active and Active/Passive—are shown as options under the Load Balancing section in the program's Array Settings and Device Settings windows. The Active/Active setting enables load balancing, but the Active/Passive setting does not provide load balancing.

Note If a storage array cannot transfer data on one of the path configurations, the Load Balancing options will appear grayed out on the screen and you will not be able to access these settings.

You first configure these settings for the paths on an array level through the Array Settings screen, or you can accept the default setting. Generally the default setting is Active/Passive if the storage array supports both Active/Active and Active/Passive. Consult the documentation for your storage array to determine which setting it will support. If you are using DMP in a cluster environment, make sure the Active/Passive setting is selected.

After the appropriate array setting is made, all the disks in an array have the same load balancing setting as that on the array. If the array is set to Active/Active, you can use the Device Settings screen to change the setting on an individual disk so that it has a different load balancing setting than the one on its array; you cannot change it if the array is set to Active/Passive. In that situation, the Active/Active option is grayed out. When an array has no load balancing (Active/Passive), data transfer is limited to one path only; thus, a disk on such an array cannot use Active/Active because load balancing requires two or more available paths to work.

When you set a disk on an Active/Active array to Active/Passive, that disk will be a backup disk and will not be included with the other disks in round-robin data transmission. If one of the other disks fails, this backup disk will take its place.

Note If you plan to use DMP on an external array that contains the system's boot disk, please see "[Possible problem on a system that has a boot disk and Volume Manager with DMP on an external array](#)" on page 458.

Note If you are using a demo license to try out DMP, please refer to the section "[When a DMP license is no longer valid](#)" on page 458.

Dynamic Multipathing Menus

This section describes the Dynamic Multipathing menus. The section's topics are:

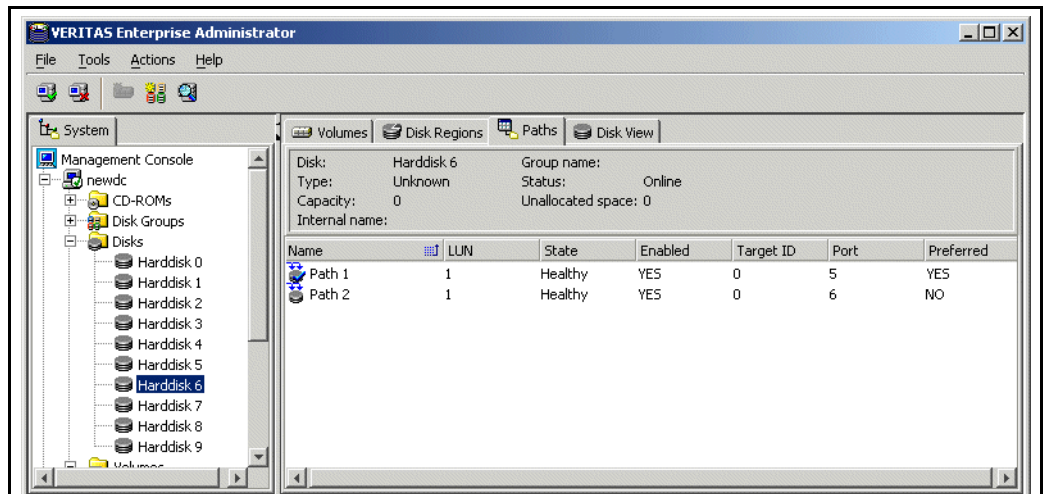
- ◆ [Displaying the DMP Menu](#)
- ◆ [DMP Menu Commands](#)

Displaying the DMP Menu

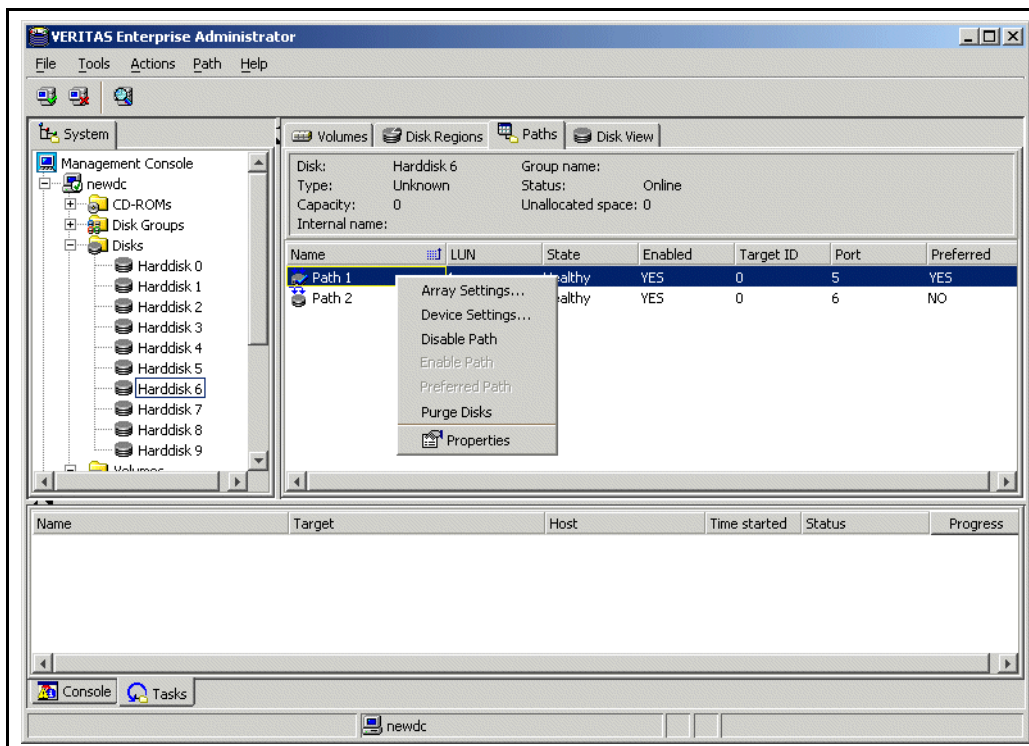
There are two menus for DMP—a context menu that is available when you select a path and a Path menu that appears on the VERITAS Enterprise Administrator GUI menu bar. Both menus require the Paths tab to be active.

▼ To display the DMP path context menu:

1. Open the Disks folder in the tree view.
2. Select the disk that you are interested in.
3. Select the Paths tab in the right pane. This tab displays the paths to the selected disk.

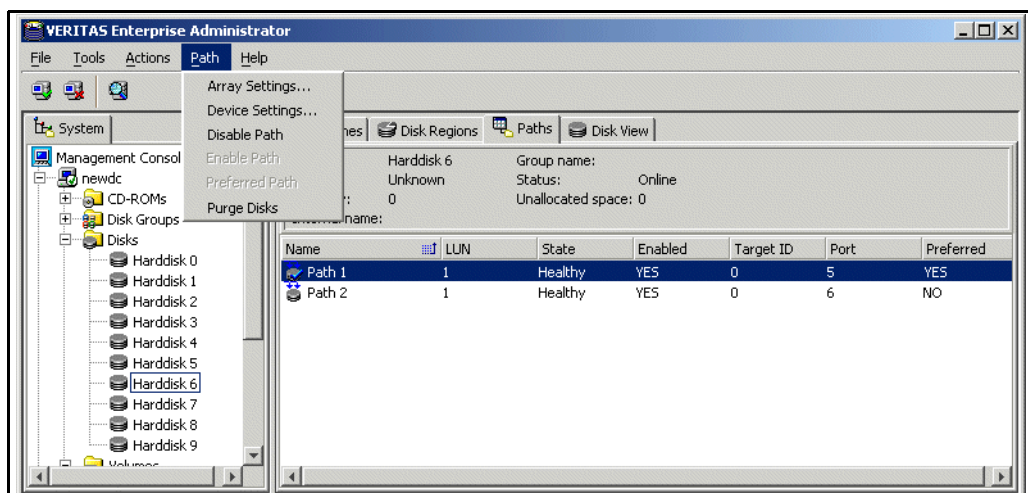


4. Right-click on the path that you are interested in, and the path context menu appears.



▼ To display the DMP Path menu from the menu bar:

1. Make the Paths tab active by first selecting a disk that has a DMP path and then selecting the Paths tab in the right pane.
2. Select the path you are interested in on the Paths tab. The Path menu option appears on the menu bar. Click it and select from the drop-down menu. The options that are accessible through the Path menu are the same as those on the path context menu except for the **Properties** command, which can be accessed through the File menu.



DMP Menu Commands

This section describes the DMP menu commands. As described in the preceding section, there are two DMP menus—the path context menu and a Path menu available from the menu bar. Both menus contain the same commands, except for the **Properties** command. The **Properties** command is not on the Path menu on the menu bar because it is included on the File menu. The DMP menu commands are:

- ◆ [Array Settings](#)
- ◆ [Device Settings](#)
- ◆ [Disable Path](#)
- ◆ [Enable Path](#)
- ◆ [Preferred Path](#)
- ◆ [Purge Disks](#)
- ◆ [Properties](#)

Array Settings

The **Array Settings** command brings up the Array Settings screen, which displays characteristics of the array whose path is selected on the Paths tab in Volume Manager. It lists the devices in the array and has the settings for excluding the array from DMP control or including it under DMP control. It also has the settings for the operational modes for the array's paths (either Active/Active or Active/Passive) under the Load Balancing section and an option at the bottom of the screen for setting the interval for monitoring the array. For further information, including a sample screen, see "[Array Status](#)" on page 369.



Device Settings

The **Device Settings** command brings up the Device Settings screen, which displays the DMP characteristics of the disk whose path is selected on the Paths tab in Volume Manager. It has settings for excluding the disk from DMP control or including it under DMP control. It also has a Load Balancing section with the Active/Active and Active/Passive options to indicate the operational mode that applies to the selected disk. For further information, including a sample screen, see [“Device Status”](#) on page 371.

Disable Path

The **Disable Path** command on the DMP menu is used to disable the selected path to the disk for maintenance purposes. No data is transferred to a disk over a disabled path. For step-by-step details on how to use this command, see [“Disabling a Path”](#) on page 374.

Enable Path

The **Enable Path** command on the DMP menu is used to enable a previously disabled path to a disk. For step-by-step details on how to use this command, see [“Enabling a Path”](#) on page 374.

Preferred Path

The **Preferred Path** command on the DMP menu is used to specify the currently selected path as the Preferred Path to the disk. This menu option is available only when the operational mode for the array’s paths to the disks is specified as Active/Passive. The Preferred Path is the path that is used to transfer data to and from the disks. For the specific steps in selecting the Preferred Path, see [“Specifying the Preferred Path”](#) on page 368.

Purge Disks

The **Purge Disks** command allows you to remove failed paths from the GUI display when all the paths on an array fail. The command also removes all disk objects associated with the array from the GUI. The command does not disconnect the failed path hardware. For more information about this command, see [“Using the Purge Disks Command”](#) on page 376.

Properties

The **Properties** command brings up the Properties screen, which displays information about the selected path, including path name, state, and SCSI address. For full details, including a sample screen, see [“Path Status”](#) on page 372.

Including and Excluding an Entire Array from DMP Control

This section describes how to include and exclude arrays from DMP control. It is presented early in this DMP section because one of the first steps you must do after installing DMP is to include arrays under DMP control. The section's topics are:

- ◆ Including an Entire Array under DMP Control
- ◆ Excluding an Entire Array from DMP Control

Including an Entire Array under DMP Control

When Volume Manager is first installed, any arrays it detects are NOT placed under Dynamic Multipathing control. All arrays are defined as excluded as the default condition. You must perform the "Include" procedure to place any new array under DMP control.

Caution It is strongly recommended that you not connect more than one path to an array until after you have installed Volume Manager and the DMP software AND after you have included the array.

If you have multiple paths connected before an array is included, the operating system interprets each path to a disk as a separate disk; for example, if there are two paths to an array and the array is not yet included under DMP control, the VEA console will display twice the number of actual disks in the array under the Disks folder in the tree view. If you see more disks under the Disks folder than you actually have, then you probably have multiple paths connected. In such circumstances, it is important that you include the array under DMP control as soon as possible.

Caution Do not use the storage on an excluded array with multiple paths. Data corruption and unpredictable system behavior can occur because the operating system interprets multiple paths to a single disk in the array as paths to separate disks.

▼ To include an array under DMP control:

1. Display the Array Settings screen for the array you are including by doing the following:
 - a. In the tree view under the Disks folder, select a disk from the storage array.
 - b. In the right pane, click the Paths tab for the disk.

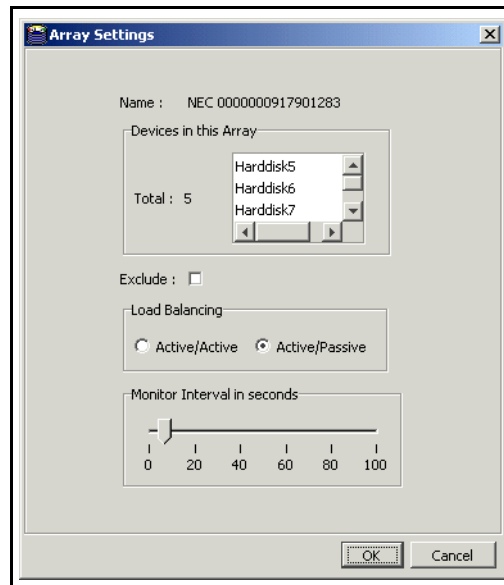
Only one path should display in the Paths tab, since the disk is not yet under DMP control.



- c. Right-click the path and select **Array Settings** from the path context menu that comes up. You can also select **Array Settings** from the Path menu on the menu bar.

The Array Settings window comes up. The Exclude checkbox is checked.

2. Uncheck the Exclude checkbox.



3. If the Load Balancing options are available (not grayed out), make sure that the settings you want are selected.
 - Active/Active option (has load balancing)
 - Active/Passive option (no load balancing).

If necessary, click the appropriate option. For more information on these options, see [“Active/Active and Active/Passive Load Balancing Settings”](#) on page 349.

Note If the Load Balancing options are grayed out, you probably have a single path connected to the array. You can complete the settings for these options after including the array. See [“Specifying Active/Active and Active/Passive Load Balancing Settings and the Preferred Path”](#) on page 365.

4. Click **OK**.

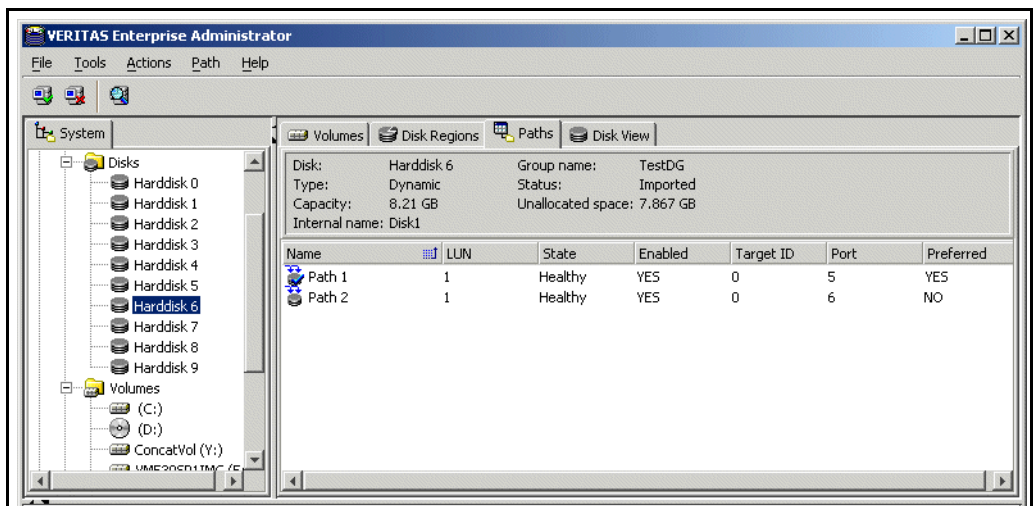
The entire array is now included under Dynamic Multipathing control.

5. Select **Actions>Rescan** from the VEA menu bar.

Volume Manager rescans the array and updates the display.

Note If you include an entire array that has previously had one or more individual disks excluded, these disks are still excluded. You must include them individually after including the array as a unit. See the section [“Including One or More Disks under DMP Control”](#) on page 359.

The sample screen that follows shows an array that has been included under DMP control. The Paths tab displays the two paths to each selected disk in the array.



Excluding an Entire Array from DMP Control

You can remove Dynamic Multipathing control from an entire array. You probably will never need to do this unless you want to use the array under another third-party DMP software program. It is strongly recommended that you disconnect multiple paths before excluding an array from DMP control.

Caution Do not use the storage on an excluded array with multiple paths. Data corruption and unpredictable system behavior can occur because the operating system interprets multiple paths to a single disk in the array as paths to separate disks.

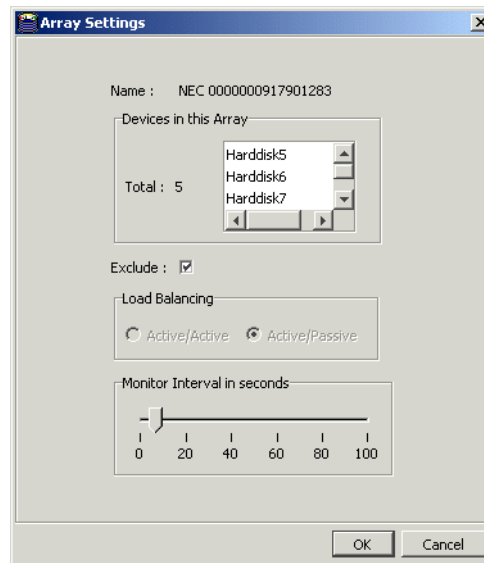


▼ **To exclude an entire array from DMP control:**

1. Display the Array Settings screen for the array you are excluding by doing the following:
 - a. In the tree view under the Disks folder, select a disk from the storage array.
 - b. In the right pane, click the Paths tab for the disk.
 - c. Right-click a path and select **Array Settings** from the path context menu that comes up. You can also select **Array Settings** from the Path menu on the menu bar.

The Array Settings screen appears.

2. Check the Exclude checkbox.



3. Click **OK**.

The entire array is now excluded from Dynamic Multipathing control.

4. Select **Actions>Rescan** from the VEA menu bar.

Volume Manager rescans the array and updates the display.

Note After an array is excluded from DMP monitoring, the status of its paths in the Paths tab does not update. Thus, if a path fails after the array is excluded, its state may be displayed as Healthy in the Paths tab.

Including and Excluding One or More Disks from DMP Control

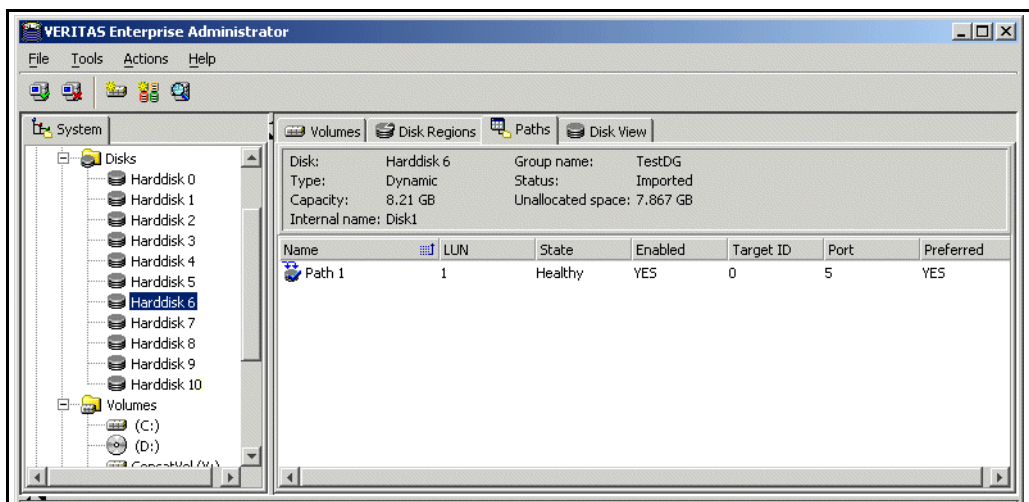
This section describes how to include individual disks under DMP control and how to exclude individual disks from DMP control. You cannot include or exclude a disk without having an array included first. You would include a disk under DMP control after adding a new disk to an array and exclude a disk from DMP control if you were planning to remove a disk from an array. The section's topics are:

- ◆ Including One or More Disks under DMP Control
- ◆ Excluding a Disk from DMP Control

Including One or More Disks under DMP Control

You can include one or more disks under Dynamic Multipathing control. However, you cannot include a disk that is in an array that is excluded as a unit. You must first include that array and then include any previously excluded disks.

The sample screen that follows shows an array with two paths, where Harddisk 6 is excluded from DMP control. In the tree view, Volume Manager added Harddisk 10 to the display to represent the second path to the excluded disk. In this situation, Harddisk 6 was previously included in the array and then was excluded. If it were a new disk added to the array, two new disks would show up at the end of the list of disks under the Disks folder.

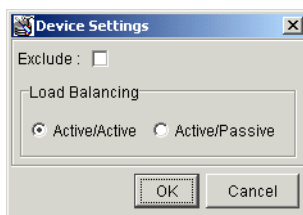


▼ **To include one or more disks in an array under DMP control:**

1. Display the Device Settings screen for the disk you want to include by doing the following:
 - a. In the tree view under the Disks folder, select a disk that you want to include under DMP control.
 - b. In the right pane, click the Paths tab for the disk.
 - c. Right-click the path and select **Device Settings** from the path context menu that comes up. You can also select **Device Settings** from the Path menu on the menu bar.

The Device Settings screen appears.

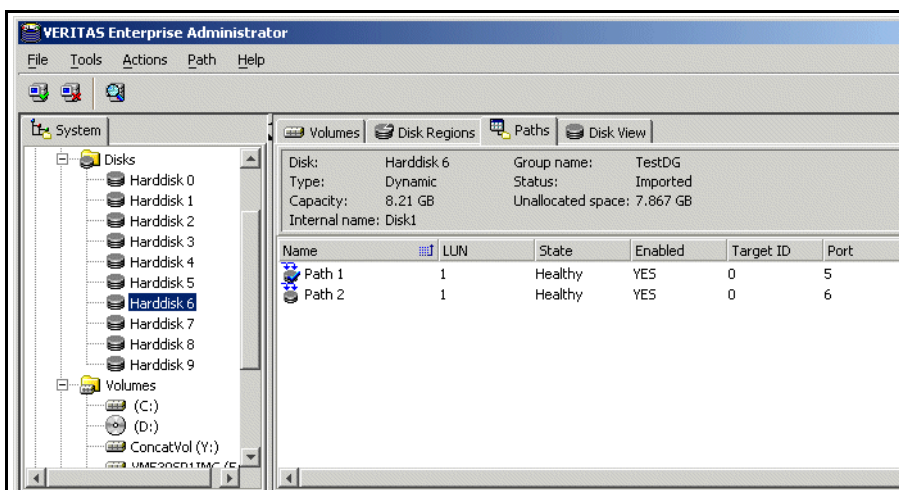
2. Uncheck the Exclude checkbox.



Notice that the Load Balancing option is enabled if there is more than one path to the disk, and the array is not excluded from DMP control.

3. Click **OK**.
4. If you want to include another disk, repeat steps 1 to 3.
5. Select **Actions>Rescan** from the VEA menu bar.

The following screen shows that Harddisk 6 is now included in the array because it has two paths, and Harddisk 10 is no longer displayed.



Note If the array has the Active/Active option, which indicates load balancing, you can choose to have certain disks in the array be Active/Passive (or have no load balancing). See the section [“Specifying Load Balancing Settings for a Disk”](#) on page 367 for details.

Excluding a Disk from DMP Control

This procedure removes Dynamic Multipathing control from the specified disk in an array. Other disks in the array are not affected. To exclude more than one disk, repeat this procedure for each disk you want to exclude. The only reason you might want to exclude a disk from DMP control is that you may want it to be used under another third-party DMP software program.

If there are multiple paths to a disk, excluding the disk disables the Load Balancing and Preferred Path functions for that disk. See [“Specifying Load Balancing Settings for a Disk”](#) on page 367 and [“Specifying the Preferred Path”](#) on page 368 for more information about these functions.

▼ To exclude a disk in an array from DMP control:

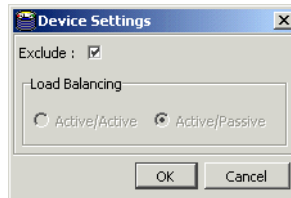
1. Display the Device Settings screen for the disk you want to exclude by doing the following:
 - a. In the tree view under the Disks folder, select a disk that you want to remove from DMP control.
 - b. In the right pane, click the Paths tab for the disk.



- c. Right-click the path and select **Device Settings** from the path context menu that comes up. You can also select **Device Settings** from the Path menu on the menu bar.

The Device Settings screen appears.

2. Check the Exclude checkbox.

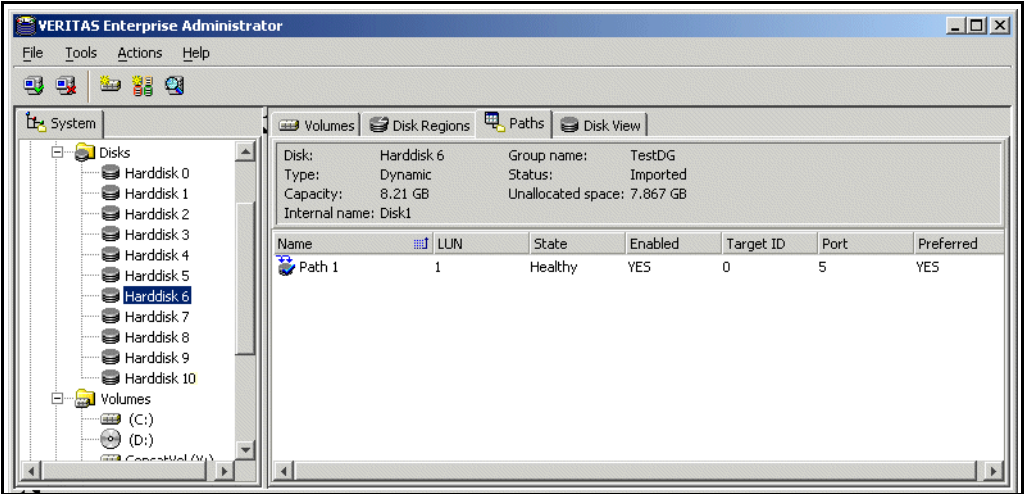


Notice that when the Exclude option is specified, the Load Balancing options are no longer available.

3. Click **OK**.
4. If you want to exclude another disk, repeat steps 1 to 3.
5. Select **Actions>Rescan** from the VEA menu bar.

Volume Manager rescans the disk array and updates the display.

When a disk is excluded from Dynamic Multipathing control, each path to the disk is displayed under the Disks folder in the tree view as a separate disk. Only one path is displayed on the Paths tab for the excluded disk. In the sample screen below, Harddisk 6 has been excluded. The second path is represented by Harddisk 10.



Caution Do not use the storage on an excluded disk. Data corruption and unpredictable system behavior can occur because the operating system interprets multiple paths to a single disk as paths to separate disks.



Adding and Removing Paths

This section describes how to add and remove paths. When DMP is being set up initially, it is necessary to add one or more paths after Volume Manager and DMP are installed. The installation of the software is done with only one path installed. Then it is recommended that you include the array under DMP and add any other paths that are available.

After you have been using DMP for a while, you might want to add a path to an array if you are adding more disks to an array or if you want additional fault tolerance for the array by having another path. You may want to remove a path if you are reconfiguring your system.

The section's topics are:

- ◆ [Adding a Path](#)
- ◆ [Removing a Path](#)

Adding a Path

▼ To add a path to an array:

1. Add the path by physically connecting a new cable.
2. To view the screen changes caused by the additional path, open the Disks folder in the tree view and select a disk. Then select the Paths tab in the right-hand pane.
3. Select **Actions>Rescan** from the VEA menu.

Dynamic Multipathing scans for paths and updates the screen, reflecting any changes you have made in the physical installation.

Removing a Path

Remove a path by physically disconnecting the cable. Dynamic Multipathing monitors existing paths and detects that the disconnected path is no longer functioning properly. The display is updated to indicate this, and data transfers failover to the next path in the sequence.

Specifying Active/Active and Active/Passive Load Balancing Settings and the Preferred Path

This section gives the step-by-step directions for specifying the Active/Active and Active/Passive load balancing settings for the paths in an array and for individual disks. For a general discussion of the two load balancing settings, see “[Active/Active and Active/Passive Load Balancing Settings](#)” on page 349. The Preferred Path is an additional setting that is necessary when you select the Active/Passive load balancing setting for an array.

When you first set up an array under DMP, you will need to make sure you have the load balancing setting you want for the paths in the array. After that is done, all of the disks in the array by default have the same load balancing setting. Then, if desired, you can change this setting for individual disks. The Active/Active and Active/Passive load balancing settings are located in the Load Balancing section of the Array Settings and Device Settings screens in the program.

The topics in this section are:

- ◆ [Specifying Load Balancing Settings for an Array](#)
- ◆ [Specifying Load Balancing Settings for a Disk](#)
- ◆ [Specifying the Preferred Path](#)

Specifying Load Balancing Settings for an Array

Note The load balancing settings are not available for an array with a single path or for an array that is excluded from DMP control. If a storage array cannot transfer data on one of the path configurations, the Load Balancing options will appear grayed out on the screen and you will not be able access these settings.

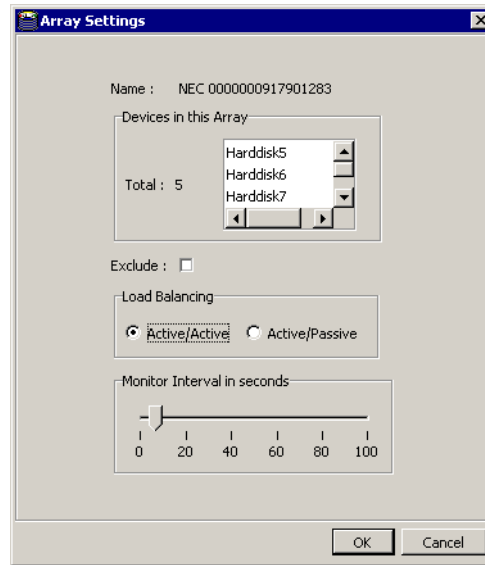
▼ To specify load balancing settings for an array:

1. Display the Array Settings screen by doing the following:
 - a. Make sure the Paths tab is selected in the right pane.

To display the Paths tab, use the tree view in the left pane to select a disk under the Disks folder that has DMP enabled, and then click the Paths tab that appears in the right pane.
 - b. In the Paths tab, right-click one of the paths for the array, and then select **Array Settings** from the path context menu that comes up. You can also select **Array Settings** from the Path menu on the menu bar.



The Array Settings screen appears. In the sample screen shown below, the Active/Active setting is selected.



2. Select either the Active/Active or Active/Passive load balancing option by clicking the appropriate radio button.
 - Active/Active ensures that load balancing is used for data transfers to and from an array. With this setting, DMP configures *all paths* to the array as active and enables round-robin path selection during data transmission.
 - Active/Passive has one Preferred Path with the remaining path or paths as backups when the current primary path fails. This option does not provide load balancing.

Note Generally the default setting is Active/Passive if the storage array supports both Active/Active and Active/Passive. Consult the documentation for your storage array to determine which setting it will support. If you are using DMP in a cluster environment, make sure the Active/Passive setting is selected.

3. Click **OK**.

Note If you selected the Active/Passive load balancing option, Path 1 is the default Preferred Path. See the section [“Specifying the Preferred Path”](#) on page 368 if you need to change that setting to another path.

Specifying Load Balancing Settings for a Disk

If a setting has not been specified for an individual disk, the disk assumes the same load balancing setting as the one used for the paths of the entire array.

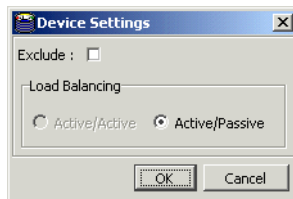
Note The load balancing settings are not available for a disk with a single path or for a disk that is excluded from DMP control or that is in an array that is excluded from DMP control. If a storage array cannot transfer data on one of the path configurations, the Load Balancing options will appear grayed out on the screen and you will not be able access these settings.

You can change the load balancing option on an individual disk if the array is set to Active/Active, but you cannot change it if the array is set to Active/Passive. In that situation, the Active/Active option is grayed out. When an array has no load balancing (Active/Passive), data transfer is limited to one path only; thus, a disk on that array cannot use Active/Active because load balancing requires two or more available paths to work.

▼ To specify load balancing settings for a disk:

1. In the VEA console's tree view, select the disk that has the load balancing settings you want to change.
2. Make sure the Paths tab is selected in the right pane, right-click one of the displayed paths, and then select **Device Settings** from the path context menu that comes up. You can also select **Device Settings** from the Path menu on the menu bar.

The Device Settings screen appears.



3. Select either the Active/Active or Active/Passive load balancing option.
 - If an array is set to Active/Active, you can set one or more of its disks to Active/Passive. In that situation, an Active/Passive disk will be a backup disk and not be included with the other disks in data transmission. If one of the other disks fails, a backup disk will take its place.
 - If an array is set to Active/Passive, you cannot change any of its disks to Active/Active.



- If an array is set to Active/Active and one or more of its disks has already been set to Active/Passive, you can change that disk or disks back to Active/Active.

4. Click **OK**.

Specifying the Preferred Path

Note This function is not available for disks with a single path or for disks that have been excluded from Dynamic Multipathing control.

When an array or disk is configured for Active/Passive operation, the user specifies the path that is used for data transfer. The specified path, called the Preferred Path, is the *only* path used for data transfer.

▼ To specify the Preferred Path:

1. Under the Disks folder on the tree view, click on any disk in the array.
2. Make sure the Paths tab is selected, right-click on the path you want to be the Preferred Path for the array, and select **Preferred Path** from the path context menu that comes up. You can also select **Preferred Path** from the Path menu on the menu bar.

The selected path is now the Preferred Path and is used for data transmission to the disk. The other paths to the disk are available for failover.

The Preferred Path is identified as Path 1 on the Paths tab and has a blue checkmark on the icon.

Viewing Array, Disk, and Path Status

Dynamic Multipathing provides status information for arrays, disks, and paths to the disks. Status displays are accessed through the path context menu or the Path menu on the VEA console menu bar. Topics in this section are:

- ◆ [Array Status](#)
- ◆ [Device Status](#)
- ◆ [Path Status](#)

Array Status

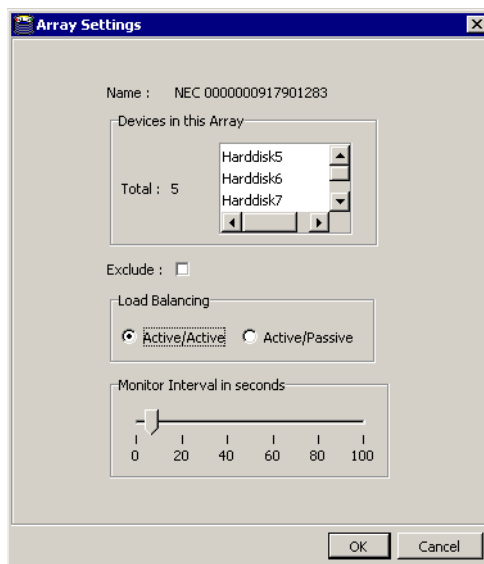
▼ To view array status:

1. Make sure that the Paths tab for one of the array's disks is selected in the right pane of the VEA console.

If the Paths tab is not showing, select one of the array's disks in the tree view under the Disks folder. Then, in the right pane, click the Paths tab for the disk.

2. Right-click one of the paths in the Paths tab, and select **Array Settings** from the path context menu that comes up. You can also select **Array Settings** from the Path menu on the menu bar.

The Array Settings screen appears.



The Array Settings screen contains the following fields:

- Name — displays the name of the array. The name is not user definable.
- Devices in this Array — displays the number of disks in the array and lists them by name. Disks that have been excluded from DMP control are shown at the bottom of the list.

When an array is excluded from DMP control, the disks in the array are displayed multiple times, because each path to a disk is displayed as an individual disk. If an individual disk is excluded from DMP, its paths will each show up as individual disks as well.

- Exclude — indicates whether the *entire* array is excluded from Dynamic Multipathing control. The default value, which is set at time of installation, is excluded. You must include any arrays you want under DMP control after installing the software. If the Exclude checkbox is unchecked, the array is under DMP control.

If an array is excluded, none of its individual disks can be placed under DMP control.

Caution Do not use the storage on an excluded array. Data corruption and unpredictable system behavior can occur because the operating system interprets multiple paths to a single disk in the array as paths to separate disks. Include arrays before creating volumes or partitions on them to prevent data corruption and provide fault tolerance.

- Load Balancing — applies when the selected array is under DMP control and there is more than one path to the array. There are two options—Active/Active, which represents load balancing, and Active/Passive, which represents a state of no load balancing. See the section “[Active/Active and Active/Passive Load Balancing Settings](#)” on page 349 for the definitions of Active/Active and Active/Passive.

If the array is excluded from DMP control or there is only one path to the array, the Load Balancing options are not available.

Note If a storage array cannot transfer data on one of the path configurations, the Load Balancing options will appear grayed out on the screen and you will not be able access these settings.

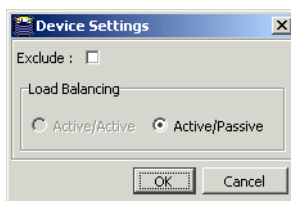
- Monitor Interval — DMP monitors the paths to an array to determine whether they are functioning properly. The monitor interval specifies the time interval for the monitoring of that array. Adjust the monitoring interval by sliding the marker on the scale.

Device Status

▼ To view device status:

1. In the tree view under the Disks folder, select a disk whose status you want to view.
2. In the right pane, click the Paths tab for the disk.
3. Right-click the path and select **Device Settings** from the path context menu that comes up. You can also select **Device Settings** from the Path menu on the menu bar.

The Device Settings screen appears.



The Device Settings screen contains the following fields:

- **Exclude** — indicates whether the individual disk is excluded from DMP control. If the Exclude checkbox is unchecked, the disk is under DMP control.
If the array is not under DMP control, the selected disk cannot be placed under DMP control.

Caution Do not use the storage on an excluded disk. Data corruption and unpredictable system behavior can occur because the operating system interprets multiple paths to a single disk as paths to separate disks. Include arrays and disks before creating volumes or partitions on them to prevent data corruption and provide fault tolerance.

- **Load Balancing** — indicates whether the individual disk is configured for load balancing. The Active/Active option represents load balancing. The Active/Passive option represents no load balancing. See the section [“Active/Active and Active/Passive Load Balancing Settings”](#) on page 349 for more information on Active/Active and Active/Passive.

You can change the load balancing options on an individual disk if the array is set to Active/Active, but you cannot change it if the array is set to Active/Passive. In that situation, the Active/Active option is grayed out. When an array has no load balancing (Active/Passive), data transfer is limited to one path only; thus, a disk on that array cannot use Active/Active because load balancing requires two or more available paths to work.



If an array is set to Active/Active and you set one of its disks to Active/Passive, that disk becomes a backup disk that is not included with the other disks in data transmission. If one of the other disks in the array fails, this backup disk will take its place.

Note If a storage array cannot transfer data on one of the path configurations, the Load Balancing options will appear grayed out on the screen and you will not be able access these settings.

Path Status

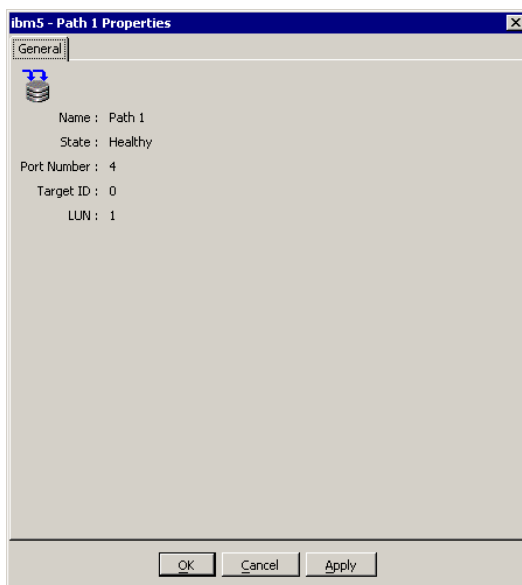
▼ To view path status:

1. Make sure that the path you want to view the status for is displayed in the Paths tab in the right pane of the VEA console.

If the Paths tab is not showing, select an array disk that uses that path in the tree view under the Disks folder. Then, in the right pane, click the Paths tab for the disk.

2. Right-click the path in the Paths tab, and select **Properties** from the path context menu that comes up. You can also select **Properties** from the File menu on the menu bar.

The Properties screen appears.



The Properties screen displays the following information for the selected path:

- **Name** — the name of the selected path.
- **State**

Dynamic Multipathing has two path state indicators:

Healthy — the path is operational.

Not Healthy — the path has failed more than one status check and is not operational, or the path has been disabled with the **Disable Path** command.

- **Port Number** — the number of the physical port on the storage array that the selected path is connected to.
- **Target ID** — the number that, when combined with the LUN, uniquely identifies a disk on the port.
- **LUN** — Logical Unit Number, the number that, when combined with the Target ID, uniquely identifies a disk on the port.



Disabling and Enabling a Path to a Disk for Maintenance

Caution Do not disable all of the paths to the disk where Volume Manager is installed. If you do so, you will not be able to access Volume Manager.

Disabling a path allows you to temporarily remove a path from service for individual disk maintenance. The section's topics are:

- ◆ [Disabling a Path](#)
- ◆ [Enabling a Path](#)

Disabling a Path

▼ To disable a path:

1. Under the Disks folder in the tree view, select the disk for which you want to disable the path.
2. In the right pane, click the Paths tab to make it active.
3. Right-click the desired path in the Paths tab, and select **Disable Path** from the path context menu that comes up. You can also select **Disable Path** from the Path menu on the menu bar.

Volume Manager updates the display, showing a red "X" icon on the path you disabled. No data is transmitted to or from the disk on this path.

Note Disabling a path to a disk stops only the data transfer to that disk. To stop data transmission on a path to an entire array, individually disable the path to each disk in the array.

Enabling a Path

Enabling a path makes the path functional again.

▼ To enable a path:

1. Under the Disks folder in the tree view, select the disk for which you want to enable the path.
2. In the right pane, click the Paths tab to make it active.

3. Right-click the desired path in the Paths tab, and select **Enable Path** from the path context menu that comes up. You can also select **Enable Path** from the Path menu on the menu bar.

Volume Manager updates the screen, removing the red “X” icon. The path is now available for data transfers to or from the disk.

Setting the Monitor Interval Option

Dynamic Multipathing periodically monitors the paths to an array to determine whether they are functioning correctly. Set the monitoring interval for the array by using this option. The range is from 10 to 100 seconds.

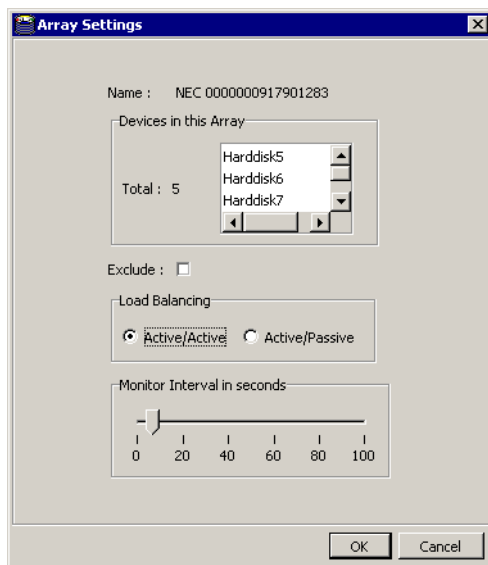
▼ To set the Monitor Interval parameter:

1. Display the Array Settings screen by doing the following:
 - a. Make sure that the Paths tab for one of the array’s disks is selected in the right pane of the VEA console.

If the Paths tab is not showing, select one of the array’s disks in the tree view under the Disks folder. Then, in the right pane, click the Paths tab for the disk.
 - b. Right-click one of the paths in the Paths tab and select **Array Settings** from the path context menu that comes up. You can also select **Array Settings** from the Path menu on the menu bar.

The Array Settings screen appears, as shown in the sample screen that follows.





2. Drag the Monitor Interval marker to set the time parameter.
3. Click **OK**.

Using the Purge Disks Command

The **Purge Disks** command allows you to remove the failed paths from the GUI display when all paths fail to the disks in an array. The command also removes all disk objects associated with the array from the GUI.

▼ To use the Purge Disks command:

1. Make sure that the failed paths that you want to remove from the GUI are displayed in the Paths tab in the right pane of the VEA console.

If the Paths tab is not showing, select one of the array's disks that uses that path in the tree view under the Disks folder. Then, in the right pane, click the Paths tab for the disk.

2. Right-click the path in the Paths tab and select **Purge Disks** from the path context menu that comes up. You can also select **Purge Disks** from the Path menu on the menu bar.

The **Purge Disks** command will be available only when all the paths on the array have failed.

Volume Manager permanently removes the failed paths from the right pane of the GUI. In addition, all disk objects associated with that array are removed from the Disks folder in the tree view.

Note The command does not disconnect the failed path hardware.



VERITAS Volume Replicator Support

VERITAS Volume Replicator (VVR) is a data replication tool designed to maintain a consistent copy of application data at a remote site. It is built to contribute to an effective disaster recovery plan. In the event that the data center is down, the application data is immediately available at the remote site, and the application can be restarted at the remote site.

VVR works as a fully integrated component of VERITAS Volume Manager 3.1 for Windows 2000. VVR benefits from the robustness, ease of use, and high performance of Volume Manager and, at the same time, adds replication capability to Volume Manager. VVR can use existing Volume Manager configurations, with some restrictions. Any application, even with existing data, can be configured to use VVR transparently.

Highlights of VVR

- ◆ Support for up to 32 secondary nodes.
- ◆ Independent of any specific storage hardware platform.
- ◆ Provides complete data integrity for commercial database management systems, such as Oracle and Sybase.
- ◆ Can replicate over any IP network, LAN or WAN.
- ◆ Provides multipurpose volume-level replication.
- ◆ Easily accommodates growth and large configurations.
- ◆ Provides an In-band Control (IBC) facility for application-defined control messages.

Installation Requirements

For VVR, at least two systems running Volume Manager with VVR support are needed, one as primary and the other as secondary, with a network connection between them. For more on installation requirements, see the section “[VVR Installation](#)” on page 36.

Integration Steps

1. Create one or more disk groups in Volume Manager on your primary system.
2. On your secondary system, create a duplicate of each disk group that is on the primary system.

Make sure the name of each duplicate disk group on the secondary system is the same as the name of the disk group on the primary system.

3. In Volume Manager, create a one or more dynamic volumes for each disk group on the primary and secondary systems.

Refer to [“Create a Dynamic Volume”](#) on page 145 for details on creating a dynamic volume.

Make sure that the volumes in any disk groups on the secondary system are exact duplicates of those on the primary system. The names and sizes have to be the same.

4. Refer to the VVR documentation for further steps.

Other Integration Considerations

For volumes under replication, there are certain limitations when using the Dynamic Disk Group Split and Join commands. See the section [“Limitations When Using Dynamic Disk Group Split and Join with VVR”](#) on page 345 for details.



VERITAS Cluster Server Support

VERITAS Cluster Server (VCS) support was introduced in Volume Manager 3.0. If you select this option, you will use Volume Manager to set up cluster disk groups for a VCS cluster on a Windows 2000 system.

With this option, VERITAS offers its Windows 2000 users an alternative to MSCS for implementing a cluster in a shared storage environment. VCS has the following features that are similar to MSCS:

- ◆ Manages cluster membership using heartbeat message exchange protocols over network links connecting clustered servers.
- ◆ Organizes resources into bundles called *service groups* that are similar to MSCS resource groups.
- ◆ Performs the failover of a service group by restarting the group on an alternative server when its primary server fails.

The main differences between VCS and MSCS are:

- ◆ VCS supports up to 32 interconnected servers, while MSCS supports 4 servers.
- ◆ VCS relies completely on network protocols to determine cluster membership. VCS can use, but does not require, a cluster quorum device, such as is used by MSCS.

With the exception of the MSCS quorum device support, usage of host-based volumes in the VCS environment is very similar to the usage within MSCS. In order to be VCS cluster resources, volumes must be part of Volume Manager cluster disk groups. You first set up the cluster disk group(s) with one or more dynamic volumes in Volume Manager and then use the Veritas Cluster Manager to assign the newly created storage as resources in a VCS service group.

This section contains a summary of the process for integrating Volume Manager with VCS. Refer to the VCS documentation for detailed information on VCS.

Prerequisites

- ◆ VERITAS Volume Manager must be installed on all nodes used in the cluster.
- ◆ Set up the cluster hardware according to the recommendations in the VCS documentation.
- ◆ At least one basic disk must be available for shared storage.
- ◆ VERITAS Cluster Server must be installed on at least two nodes of the cluster, accessing the same shared storage device.
- ◆ VERITAS Cluster Manager must be installed on at least one node of the cluster.

Integration Steps

1. Create one or more cluster disk groups in Volume Manager.

A separate cluster disk group with a unique name should be created for each application to be clustered. Refer to [“Creating a Dynamic Disk Group”](#) on page 138 for details on creating a cluster disk group. In step 4, defining the attributes, be sure to click the radio button “Create cluster group.”

Note When creating a cluster disk group for use as a Volume Manager disk group resource, make sure that the disk group name is unique across the cluster. If the cluster software attempts to fail over a disk group to another node that has a disk group with the same name or if you move a disk group to another node that has a disk group with the same name, unpredictable results can occur.

2. In Volume Manager, create one or more dynamic volumes for each cluster disk group.

Refer to [“Create a Dynamic Volume”](#) on page 145 for details on creating a dynamic volume.

Make sure the device path to each disk group is recognized by all systems sharing the disk.

3. Make the volumes of each cluster disk group part of the VCS configuration and of the same service group.

Refer to the VCS documentation for details.

Other Integration Considerations

- ◆ When using VERITAS Volume Manager, use the MountV agent in place of the Mount agent and the Volume Manager agent in place of the Disk Reservation agent in VCS.
 - In VCS, the MountV agent mounts, monitors, and unmounts volumes on cluster disk groups imported with VERITAS Volume Manager. When a cluster disk group fails over to another system, the MountV agent ensures that the new system accesses the disk group in the same way it was accessed before the failover.
 - The Volume Manager agent imports, monitors, and depots a cluster disk group configured with VERITAS Volume Manager 3.0 or 3.1. The agent makes the disk group highly available. The VM agent supports Dynamic Multipathing (DMP) and works in a SAN environment.



- ◆ A cluster dynamic disk group that is part of the cluster resources cannot be a source disk group for a join command. However, it can be a target disk group for the command.
- ◆ For more about using Volume Manager and VCS in a shared cluster environment with the FlashSnap off-host backup procedure, see [“Using Dynamic Disk Group Split and Join with a Cluster on Shared Storage”](#) on page 343.
- ◆ Connecting to a Cluster Node

If you connect to a machine, using the cluster name or cluster IP address, the GUI will display the machine name of the cluster node that currently owns the cluster name and IP resources. Therefore, we do not recommend using the cluster name or IP address when connecting and administering a cluster node through Volume Manager.

Microsoft Cluster Service Support

This section describes how you can use Volume Manager 3.1 for Windows 2000 to manage storage for a cluster set up with Microsoft Cluster Service (MSCS) software. The topics are:

- ◆ [Overview](#)
- ◆ [How Volume Manager Works with MSCS](#)
- ◆ [Creating a Cluster Dynamic Disk Group](#)
- ◆ [Making the Cluster Disk Group a Cluster Resource](#)
- ◆ [Displaying Cluster Disk Group Resource Properties](#)
- ◆ [Creating a Dynamic Mirrored Quorum Resource](#)
- ◆ [Additional Considerations for Volume Manager MSCS Support](#)

Note You can install Volume Manager MSCS cluster support on a machine that is not a member of an MSCS cluster to allow the target system to function as a remote cluster administrator. In this case, the installer will prompt you for the name of the remote cluster you wish to administer.



Overview

Volume Manager 3.1 for Windows 2000 supports a cluster environment set up under the Microsoft Cluster Service (MSCS) software for up to four nodes. A cluster consists of two or more nodes, which are linked servers that support a set of common resources and provide an image of a single system to the client. MSCS has failover functionality so that if one of the nodes fails or is taken offline, another node gains access to all resources held by the failed node, thus providing minimum downtime for applications using these resources.

With Volume Manager, you can create mirrored, RAID-5, and other advanced dynamic volumes on MSCS clustered storage. To use Volume Manager with MSCS, there are three main tasks you need to do:

- ◆ Set up the cluster environment.

The minimum requirements are two servers connected by a network. The servers must be on a shared SCSI or Fibre Channel bus. You install and configure MSCS on each machine that is to be a member of the new cluster.

- ◆ Create one or more cluster disk groups in Volume Manager.

The process is almost identical to creating a regular dynamic disk group in Volume Manager, except that when you create a cluster disk group, Volume Manager sets up the group so that it can be accessed by MSCS and be used as a resource in the cluster. You create the desired dynamic volumes in the cluster disk group in exactly the same way as a regular dynamic disk group. See the section “[Creating a Cluster Dynamic Disk Group](#)” on page 387 for details.

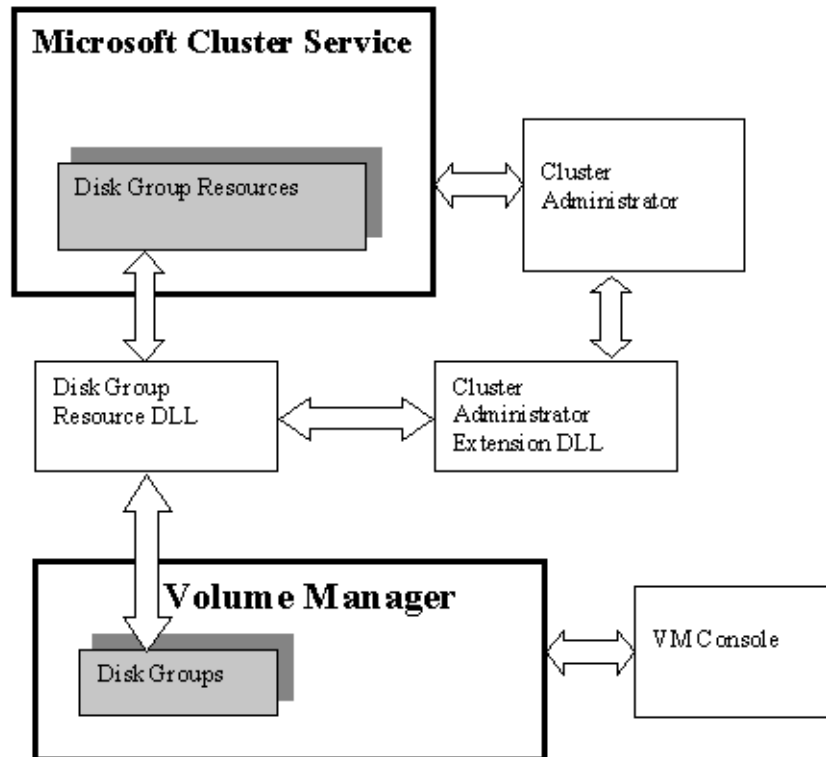
- ◆ Use the MSCS Cluster Administrator to add the cluster disk group as a resource to the cluster.

After this step is done, the storage is a part of the cluster and is associated with a specific node of the cluster. If the node fails or goes offline, the clustered storage on the node is transferred to another node in the cluster. See the section “[Making the Cluster Disk Group a Cluster Resource](#)” on page 388 for details.

How Volume Manager Works with MSCS

MSCS provides a set of standard resources, such as physical disks, file and print shares, and network addresses and names. Each resource is accessed using a resource DLL and an extension DLL. The resource DLL provides communication between MSCS and the resource. The extension DLL allows the user to set the resource properties.

Microsoft also allows vendors to integrate product-specific resources into MSCS through the use of custom resource and extension DLLs. Volume Manager's product-specific resource is the Volume Manager Disk Group resource with its two DLLs, Disk Group resource DLL and Cluster Administrator extension DLL. The block diagram below shows the relationship between Volume Manager cluster components and the Microsoft Cluster Service.



The initial install program for Volume Manager will install both the Volume Manager Disk Group resource DLL and the Cluster Administrator extension DLL, provided that you select the Volume Manager 3.1 MSCS support option and the install program detects that MSCS is already installed and running on the server. In the situation where you want to add MSCS and Volume Manager MSCS support after Volume Manager has already been



installed, you must install these resource and the extension DLLs by using the steps shown in the section that follows, “[Installing MSCS Support after Volume Manager Is Already Installed.](#)”

If you are installing a client version of Volume Manager, you can choose the Volume Manager install option “Client with Remote Cluster Support.” This option installs remote cluster support on the client machine and does not require MSCS to be installed on that machine. However, MSCS, Volume Manager, and Volume Manager MSCS support must be installed on any servers that the client manages.

Installing MSCS Support after Volume Manager Is Already Installed

This section describes the steps needed to install MSCS support on a server if Volume Manager is already installed.

▼ To install MSCS support when Volume Manager is installed:

1. First, you must install MSCS and have it running on the server where you want to install the Volume Manager MSCS support.
MSCS and Volume Manager have to be installed on each node of the cluster.
2. From the server’s Windows 2000 Control Panel, double-click **Add/Remove Programs**.
3. Select the Volume Manager program and click its **Change** button.
4. Click the **Modify** option in the Application Maintenance screen that comes up.
5. Enter the required information in the User Information Verification screen that appears. Click **Next** to continue.
6. In the Application Maintenance - Select Features screen, click the **Volume Manager 3.1 MSCS Support** option, and then choose “Entire feature will be installed on the local hard drive” from the drop-down list. Click **Next**.
7. Choose a location on your target system to install the product, and click **Next**.
8. Click **Next** again to start the modification process.
9. A screen appears with the message that the program has been successfully installed. Click **Finish**.
10. An additional screen comes up to inform you that the system must be rebooted. Click **Yes** to restart now or **No** to restart later.

Creating a Cluster Dynamic Disk Group

Note Volume Manager does not allow you to create a cluster dynamic disk group with disks that are on the same bus as the computer's system or boot disk or disks that have been defined by MSCS as physical disk resources. In the New Dynamic Disk Group Wizard, you may see ineligible disks listed as available for upgrade to a cluster disk group, but if any are selected to be members of the new group, an error message will be displayed and the operation will be blocked.

Volume Manager 2.7 and earlier required a separate wizard for creating a Cluster Dynamic Disk Group. In Volume Manager 3.0 and 3.1, creating a cluster disk group that can be used as a cluster resource in an MSCS cluster environment is an option included in the New Dynamic Disk Group wizard.

To create a cluster disk group, follow the steps for creating a new dynamic disk group described in “[Creating a Dynamic Disk Group](#)” on page 138. In step 4, defining the attributes, be sure to turn on the radio button “Create cluster group.”

Note When creating a cluster disk group for use as a Volume Manager disk group resource, make sure that the disk group name is unique across the cluster. If the cluster software attempts to fail over a disk group to another node that has a disk group with the same name or if you move a disk group to another node that has a disk group with the same name, unpredictable results can occur.

After creating the cluster disk group, create the necessary dynamic volumes on the cluster disks.

Caution When assigning a drive letter to a new volume that is going to be part of a Volume Manager disk group resource, make sure the drive letter assigned is available on all other nodes. Failure to do so may result in drive letter changes when the resource is moved or failed over to another node.

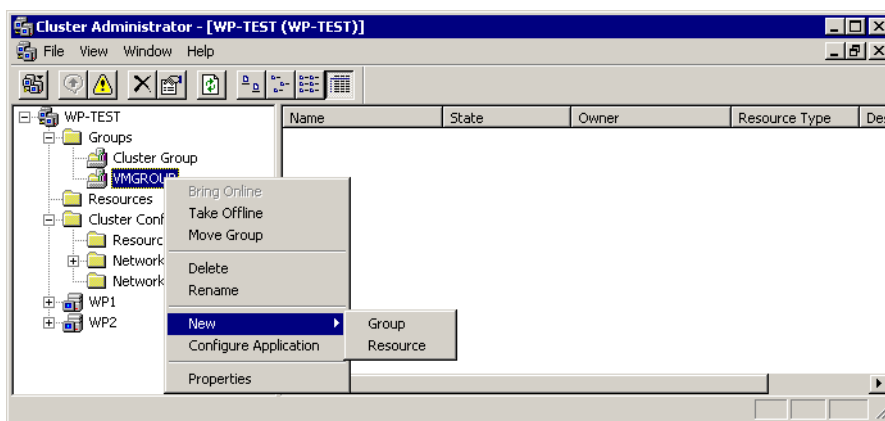


Making the Cluster Disk Group a Cluster Resource

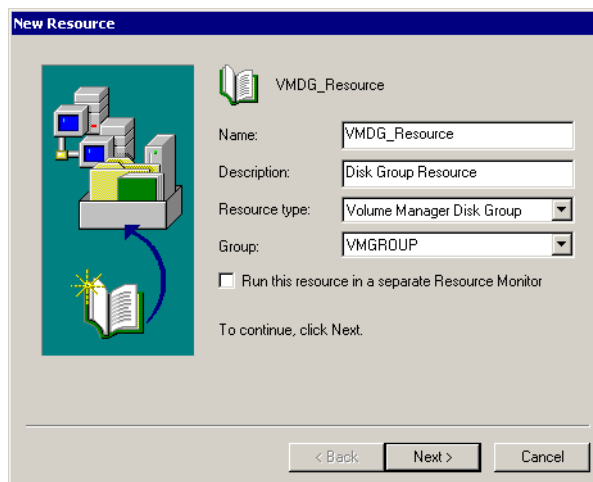
The following steps describe how to use the MSCS Cluster Administrator to make a Volume Manager cluster disk group a resource in a cluster.

1. Start Cluster Administrator.
2. Right-click the label of the MSCS cluster group for which you want to create the resource.

The cluster group context menu appears.



3. Select **New** and then **Resource**, which brings up the New Resource screen.

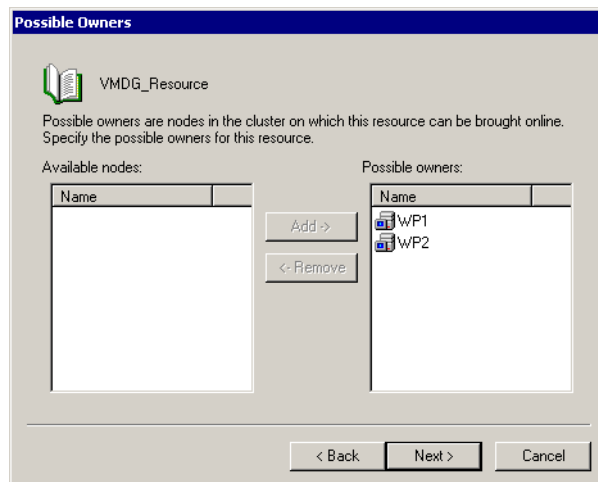


4. Fill in the fields for the New Resource screen as follows:
 - a. Name — Designate a useful name.
 - b. Description — “Disk Group Resource” is an appropriate description.
 - c. Resource type — Use the drop-down list to select **Volume Manager Disk Group**.
 - d. Group — Use the drop-down list to select the appropriate MSCS cluster group.
The MSCS group you chose in [step 2](#) should already be selected.
 - e. Run this resource in a separate Resource Monitor — Generally, make sure that this is NOT checked.

Check this box if you wish to run the resource in a separate resource monitor, which can be useful for troubleshooting, but it is typically not necessary.

Click **Next** to go to the next screen.

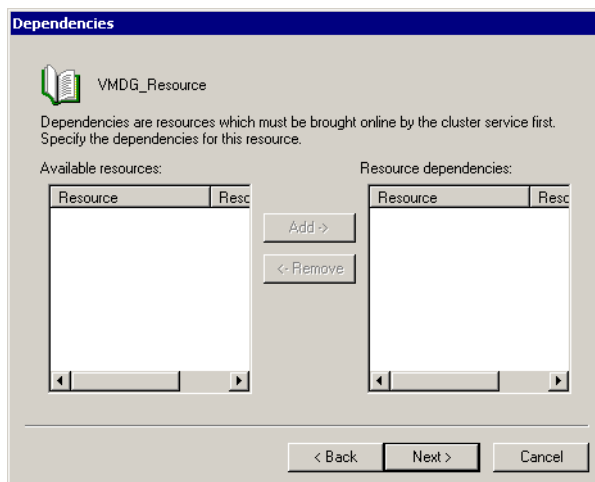
The Possible Owners screen appears.



5. Use the **Add** button to add all possible owners of the new resource to the “Possible owners” list, and click **Next** to continue.

The Dependencies screen appears.

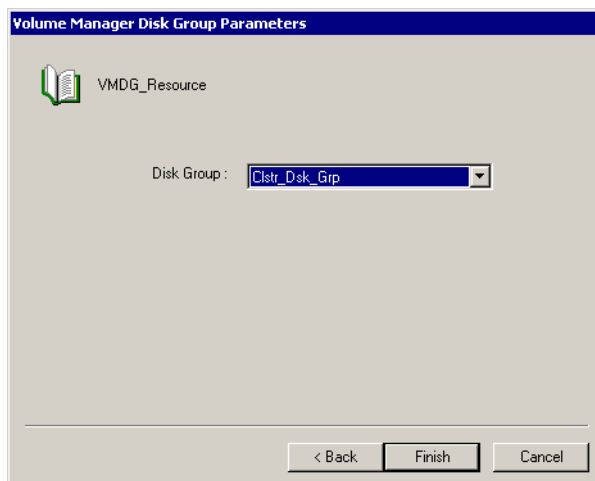




6. In the Dependencies screen, click **Next** to continue.

The disk group resource does not depend on any other resources.

The final screen for creating a resource in Cluster Administrator appears.



7. Make sure that the appropriate Volume Manager cluster disk group is selected from the drop-down list for the resource, and then click **Finish** to complete the operation.

If the cluster disk group you want doesn't appear, exit the Cluster Administrator New Resource wizard and do the following:

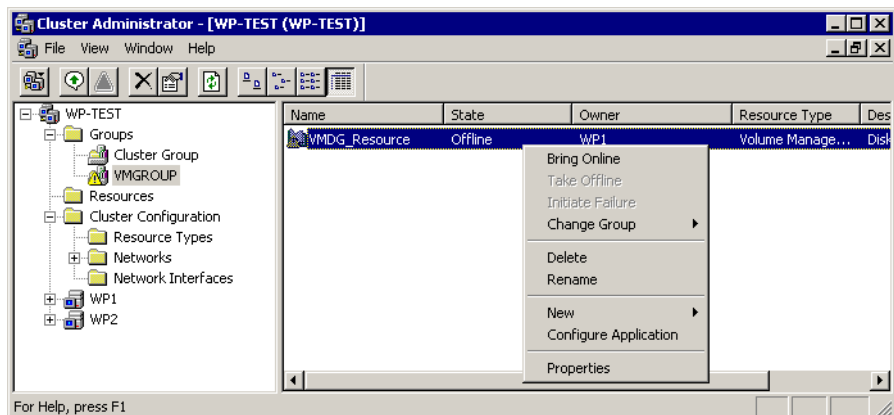
- Make sure the cluster disk group you want as an MSCS resource is imported and note which node it is imported on.
- Move the MSCS group to the same node where the cluster disk group is imported.
- Invoke the Cluster Administrator New Resource wizard and attempt to add the cluster disk group again (step 1 to step 7 in this procedure). This time, you should be able to add the desired cluster disk group as a resource.

8. In the final dialog box that appears, click **OK** to confirm.



9. Bring the disk group resource online by doing the following:

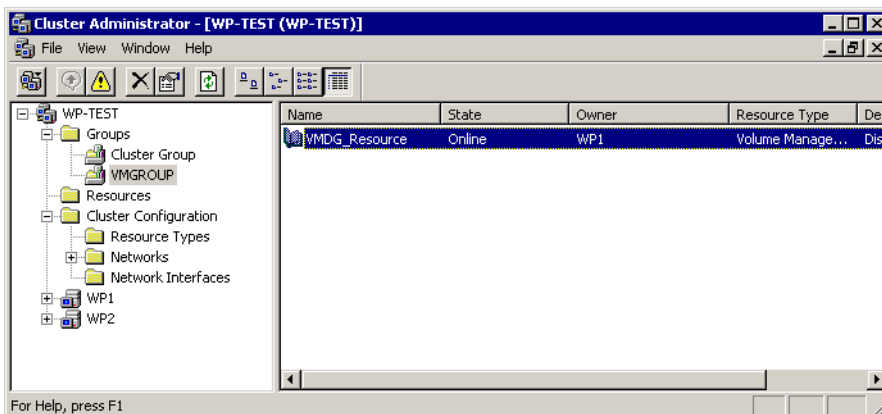
- a. Right-click the name of the resource to bring up a context menu as shown:



- b. Select **Bring Online** on the context menu.

The sample screen that follows shows the VMDG resource in an Online state.

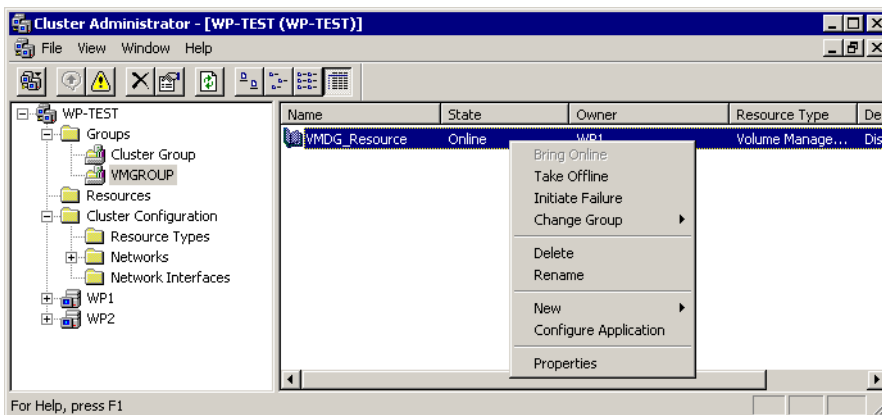




Displaying Cluster Disk Group Resource Properties

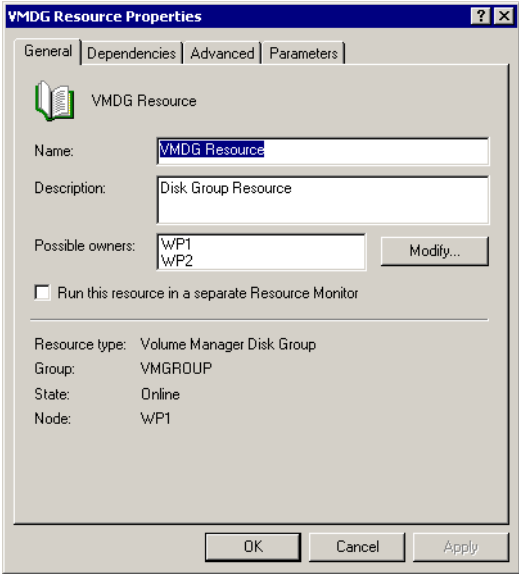
The following steps describe how to display cluster disk group resource properties, using Cluster Administrator.

1. Start Cluster Administrator.
2. Right-click the resource label to bring up the cluster resource context menu.

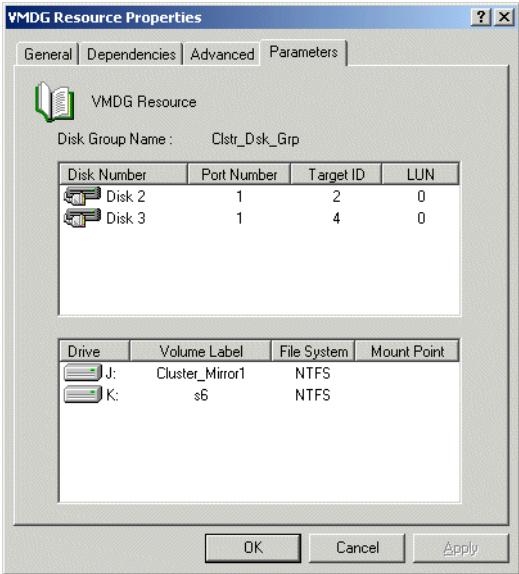


3. Select **Properties** from the context menu.

The Properties window for the disk group comes up.



4. Click the Parameters tab to display the disk and volume information for the disk group, as shown in the sample screen. Clicking **OK** returns you to the Cluster Administrator main window.



Creating a Dynamic Mirrored Quorum Resource

When you install the first node of a cluster, you specify a basic disk volume for a physical disk resource known as the quorum resource. This resource contains the cluster log and is also used for determining which node in a cluster has control over the cluster. If the physical disk quorum resource fails or becomes corrupted, the cluster becomes unusable.

A quorum resource failure can be avoided by using a dynamic mirrored quorum resource instead of a physical disk quorum resource. Unlike a physical disk quorum resource, which contains a single disk, a dynamic mirrored quorum resource will provide a high level of redundancy by allowing the mirroring of the quorum disk. It is strongly recommended that a dynamic mirrored quorum contain three disks because a cluster disk resource cannot be brought online unless a majority of disks are available. With the quorum volume in a two-disk group, loss of one disk will prevent the quorum volume from coming online and make the cluster unavailable.

▼ To create a dynamic mirrored quorum resource:

1. Create a Volume Manager cluster disk group that contains three disks.

If possible, use small disks, since the disk group will be used only for the quorum volume, which is recommended by Microsoft to be a size of 250 to 500 MB.

Note If other volumes are added to this disk group, any failures related to their operation can cause disruptive failovers of the quorum volume; or if another volume in the group experiences a high volume of read/write activity, failovers may result from delays in access to the quorum volume by MSCS.

For details on creating a cluster disk group, see [“Creating a Cluster Dynamic Disk Group”](#) on page 387.

2. Create a mirrored volume with all three disks in the cluster disk group.

It is strongly recommend that you maximize redundancy by using all three disks to create a three-way mirrored quorum.

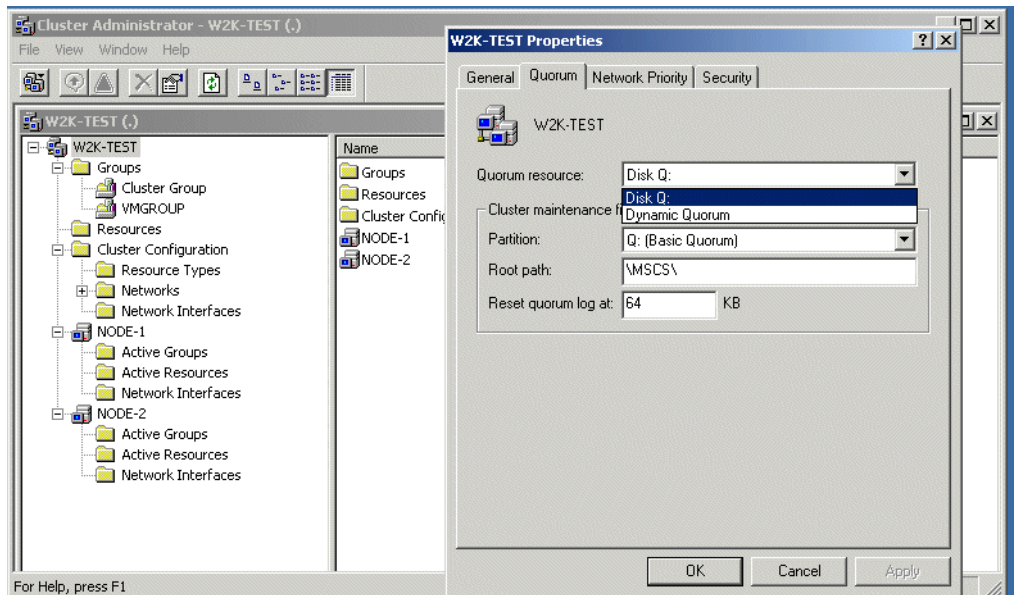
See the section [“More on Mirrored Volumes”](#) on page 154.

3. Make the cluster disk group a cluster resource.

See the section [“Making the Cluster Disk Group a Cluster Resource”](#) on page 388.

4. Use the Cluster Administrator to change the quorum resource from a physical disk resource to a dynamic disk resource by doing the following:

- a. Right-click on the cluster name in the tree to bring up a context menu.
For example, in the screen shown below, the cluster name is “**W2K-TEST**,” and the dynamic quorum disk group resource has been named “**Dynamic Quorum**.”
- b. In the menu that comes up, click **Properties**, which displays the Cluster Properties window.
- c. Select the Quorum tab of the Properties window.
- d. Select **Dynamic Quorum** from the list of possible quorum resources, as shown in the screen below.



- e. Click **OK** to complete the operation.

Note If you are using a system running SQL Server, see the section “[Problem on a SQL Server system with an MSCS cluster when migrating to a dynamic mirrored quorum volume on a Volume Manager disk group resource](#)” on page 457.



Additional Considerations for Volume Manager MSCS Support

This section contains additional information that is important in working with MSCS and Volume Manager 3.1 for Windows 2000.

- ◆ Before installing Volume Manager on a cluster node, make sure the cluster service is running on that node. If the service is not running, the Volume Manager install program will not install the Volume Manager MSCS cluster components.
- ◆ When an MSCS cluster disk group resource is offline, or a cluster disk group that is not an MSCS resource is in a Deported state, it is not protected from access by other machines. For maximum data protection, keep Volume Manager disk group resources online.
- ◆ When using Cluster Administrator to create a Volume Manager disk group resource, the Volume Manager Disk Group Parameters screen might not list all the available Volume Manager cluster disk groups in the drop-down list. If this happens, exit the New Resource Wizard and use Cluster Administrator to select the MSCS cluster group to which the resource is to be assigned. Next, move the MSCS cluster group to the cluster node where the Volume Manager cluster disk group is currently online. Then create the Volume Manager disk group resource.
- ◆ Under the following circumstances, the VEA Disk View may not reflect the latest state of the disk(s) until a refresh is performed:
 - If you change the state of an MSCS cluster disk resource on one node and try to view the disks under this resource from another node on the same cluster.
 - If you change the state of an MSCS cluster disk resource on one node and try to view the disks under this resource from a remote computer.
- ◆ DMP does not support load balancing in the MSCS cluster environment. You will need to select the Active/Passive load balancing setting if you are using DMP.
- ◆ A cluster dynamic disk group that is a part of the cluster resources cannot be a source disk group for a join command. However, it can be a target disk group for the command.
- ◆ Change in Bringing a Two-Disk Cluster Group Online

In earlier versions of Volume Manager for Windows 2000, it was possible to bring a two-disk cluster disk group online when only one disk was available. If an MSCS cluster were to lose all network communication, this allowed the disk group to be brought online on two cluster nodes simultaneously, with each node owning a single disk, possibly resulting in data loss or a partitioned cluster. Though the likelihood of this situation occurring is slim for most customers, the consequences if it does happen may be severe. Accordingly, in Volume Manager 3.0 and 3.1, it is no longer possible to bring a two-disk cluster disk group online unless it complies with the normal majority algorithm ($n/2 + 1$), which means both disks must be available.

- ◆ You are not allowed to deport a cluster disk group that is an MSCS Volume Manager disk group resource.
- ◆ For information about using Volume Manager and MSCS in a shared cluster environment with the FlashSnap off-host backup procedure, see [“Using Dynamic Disk Group Split and Join with a Cluster on Shared Storage”](#) on page 343.
- ◆ Connecting to a Cluster Node

If you connect to a machine, using the cluster name or cluster IP address, the GUI will display the machine name of the cluster node that currently owns the cluster name and IP resources. Therefore, we do not recommend using the cluster name or IP address when connecting and administering a cluster node through Volume Manager.





This chapter describes the following special procedures that you can implement to enhance the functions of Volume Manager 3.1 for Windows 2000:

- ◆ **Custom Scripts to Automate Backup with FlashSnap**

The procedure provides sample scripts that you can use as a model to create your own scripts to automate backup with FlashSnap by using Backup Exec or NetBackup on a Microsoft Exchange server, a Microsoft SQL server, or an Oracle server. The sample scripts are included on the Volume Manager 3.1 for Windows 2000 CD.

- ◆ **Adding a Beep for Notification**

You can add a beep to the notification process for important alerts to make it easier to identify servers that require attention in a computer room with many servers.

- ◆ **Creating a Hardware Failure Report**

This topic describes how to use the Computer Management Event Viewer in Windows 2000 and Microsoft Excel to create a log file of specified alerts on the server.

- ◆ **Automatic Volume Growth Based on Capacity**

This procedure describes how to use a script that will automatically grow a volume when it reaches a certain capacity threshold. With this procedure, you can conserve disk space on your servers because space is distributed to users on an as-needed basis, and you do not have to be available to allocate the new disk space.

- ◆ **Creating Search Reports**

You can create custom reports based on the Search feature that provide a snapshot of a system at a particular point in time.



Custom Scripts to Automate Backup with FlashSnap

VERITAS FlashSnap is an option that was first made available in Volume Manager 3.0. It is a highly efficient procedure involving multiple commands that lets you detach a mirrored volume for backup and do the backup either on the same host or on a different host. After the backup is completed, the mirrored volume can be very quickly reattached to the original volume.

This section summarizes the FlashSnap steps for backup and describes how you can use the sample scripts provided by VERITAS to create your own scripts for backing up your servers with either VERITAS NetBackup or VERITAS Backup Exec and a choice of three applications—Exchange Server 5.5, Microsoft SQL Server, and Oracle Server. The scripts are on the Volume Manager 3.1 for Windows 2000 CD.

This section's topics are:

- ◆ [Advantages of Off-Host Backup and Same-Host Backup with FlashSnap](#)
- ◆ [Summary of Steps for Off-Host and Same-Host Backup](#)
- ◆ [Description of FlashSnap Scripts](#)

Note It is important that you understand all aspects of your backup and restore operations and that you test the script before implementing it in a production environment.

Advantages of Off-Host Backup and Same-Host Backup with FlashSnap

Using FlashSnap for backup offers these key advantages:

Off-Host Backup Advantages

- **Off-Host Processing of the Backup**

The applications on the working server can be maintained at a consistently higher performance level because the backup is performed on another machine.

- **Dynamic Disk Group Split and Join (DGSJ)**

DGSJ splits the dynamic disk group so that the snapshot mirror or MPV can be moved to another server, allowing the application volumes to remain in operation on the original server. Backup or other processing can be done on the snapshot mirror, which then can be moved back the original server through the use of the join command.

Off-Host and Same-Host Backup Advantages

- **Fast and Efficient Mirror Resynchronization**

The FastResync (FR) feature greatly speeds up mirror resynchronizing by copying only changes for the temporarily split mirror. This reduces the time it takes to rejoin a split mirror to the mirror set and reduces the server CPU cycles needed to complete the resynchronization.

- **Quick Mirror Breakoff Step**

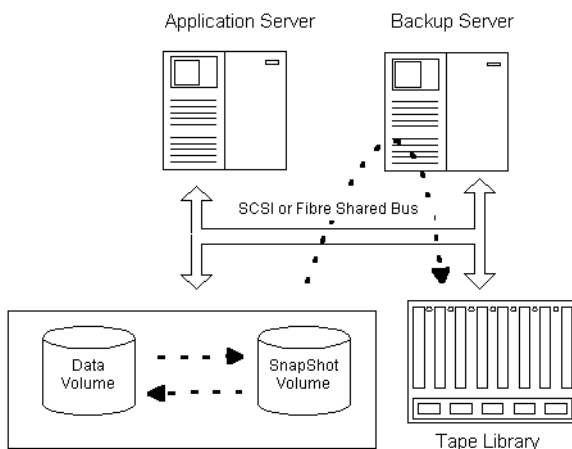
The snapshot step in which the copy of the snapshot mirror is broken off generally takes less than 20 seconds. During this time, the application must be quiescent.

Summary of Steps for Off-Host and Same-Host Backup

This section summarizes the steps for using the FlashSnap procedure with off-host and same-host backup.



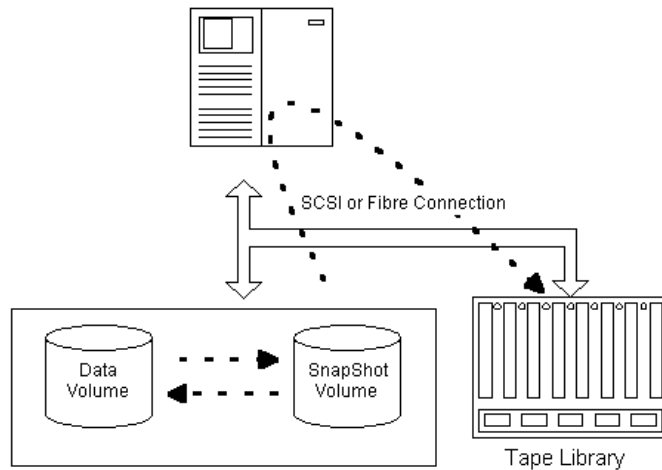
1) Off-Host Backup Steps



	Application Server Steps		Backup Server Steps
1	Snap Start — add a snapshot mirror to the existing data volume.	7	Rescan — recognize the new disk group deported from the application server.
2	Freeze Application — suspend the application to flush a consistent data state to disk.	8	Import — import the disk group for backup.
3	Snap Shot — break the mirror for backup.	9	Mount the Volume — mount the volume for backup.
4	Restart Application — resume the application.	10	Backup — back up the snapshot volume (also known as an MPV—multi-purpose volume).
5	Split Disk Group — split the snapshot volume as a separate disk group for deport.	11	Deport Disk Group — deport the disk group.
6	Deport Disk Group — deport the disk group. With the command line, the disk group split command automatically deports the disk group. With the GUI, you must do this step.		
12	Rescan — recognize the new disk group deported from the backup server.		
13	Join Disk Group — join the disk group to the original disk group.		
14	Snap Back — merge and resync the snapshot volume to the data volume.		

2) Same-Host Backup Steps

Single Server for Application and Backup Tasks



	Single-Server Steps
1	Snap Start — add a snapshot mirror to the existing data volume.
2	Freeze Application — suspend the application to flush a consistent data state to disk.
3	Snap Shot — break the mirror for backup.
4	Restart Application — resume the application.
5	Backup — back up the snapshot volume (also known as an MPV—multi-purpose volume).
6	Snap Back — merge and resync the snapshot volume to the data volume.



Description of FlashSnap Scripts

The topics in this section are:

- ◆ [Scripts Summary Description and File Name Listing](#)
- ◆ [Scripts Requirements](#)
- ◆ [Scripts Location](#)
- ◆ [Additional Files Needed to Implement the Scripts](#)
- ◆ [More on the Application Scripts](#)

Scripts Summary Description and File Name Listing

The scripts include:

1. NetBackup and Backup Exec backup scripts

You select the script for the backup application you are using. These two scripts are designed for off-host backup with two hosts. They cover the backup steps that are done on the backup server (steps 7 through 11 under the off-host backup diagram in the preceding section). The scripts are designed to run on the backup server. You can modify the scripts to run on the same server by removing the commands related to the second server. It is important to understand that the backup script is the main script.

2. Custom application scripts for Microsoft Exchange Server 5.5, Microsoft SQL Server, and Oracle Server

The purpose of the application scripts is to provide code for suspending the application and resuming the application before and after the snapshot. As already mentioned, the application needs to be suspended to flush a consistent data state to disk. (These scripts are for steps 2 and 4 under the diagrams on off-host and same-host backup in the preceding section.) The code from these scripts should be inserted before and after the snapshot step in the “Split” script below or called from that script.

3. “Split” script and “Join” script

Note Step 1 under both the off-host and same-host backup diagrams, the Snap Start step, is not included in the “Split” script, because the Snap Start step is done only once, the first time you run the series of snap commands.

For an off-host backup situation, the “Split” covers application server steps 2 through 6 under the off-host diagram in the preceding section. The “Join” script covers steps 12 through 14 under the off-host diagram. The scripts can be modified for a single server by removing the dynamic disk group commands. The “Split” and “Join” scripts run on the application server and are called from the backup script that is run on the backup server. If you are running the scripts on a single server, you can integrate the code from these two scripts into the main backup script.

The table that follows provides a list of scripts with their file names:

Script	File Name
NetBackup script	NetBackup.cmd
Backup Exec script	BackupExec.cmd
Microsoft Exchange script	exchange.presnapshot.cmd exchange.postsnapshot.cmd
SQL Server scripts	sql.pre_snapshot.cmd sql.post_snapshot.cmd
Oracle scripts	oracle.pre_snapshot.sql oracle.post_snapshot.sql
Split script	split.cmd
Join script	join.cmd

Scripts Requirements

The scripts assume that you are using a secondary dynamic disk group that is on a shared bus (or at least the snapshot mirrored volume must be on a shared bus). The disk group must be of the current Volume Manager dynamic disk group version. See [“Upgrading a Dynamic Disk Group Version”](#) on page 169 for details on upgrading to the current disk group version.



Scripts Location

The scripts are on the Volume Manager 3.1 for Windows 2000 CD in a directory called “FlashSnap Scripts.” The scripts themselves are annotated with comments, but a readme file is also provided with them.

Additional Files Needed to Implement the Scripts

1. Sleep.exe

You need to place the file **sleep.exe** on both the application server and the backup server so that it can be called by the scripts that run on both servers. The purpose of this file is to allow time for various commands to process. The file is available with the script files.

2. rcmd and rcmdsvc

If you are using two servers, you will need to install these two files for remote command processing. These files are available with the Windows 2000 resource kit.

In order to install Remote Command Service (**rcmdsvc.exe**), run the following command in the command window:

```
rcmdsvc -install
```

Run **rcmdsvc /?** for more options about **rcmdsvc.exe**

Run **rcmd /?** for more options about **rcmd.exe**

More on the Application Scripts

The remainder of this section gives more information on the application scripts.

1. Microsoft Exchange Server Script

To perform a backup of an Exchange database using Volume Manager 3.0 or 3.1 for Windows 2000 and the backup program, it is necessary to stop the Exchange services when creating a snapshot and restart the services when the snapshot is completed. This disruption is directly related to Microsoft’s application design and the APIs it provides.

To shut down Exchange services, you need to “net stop” the following services (as applicable):

```
MSExchangeMSMI  
MSExchangePCMTA  
MSExchangeFB  
MSExchangeDX
```

MSExchangeMTA
MSExchangeIMC
MSExchangeIS
MSExchangeDS
"PC MTA - HUB"
MSExchangeSA

After the snapshot, you need to restart the services. The sample script for Microsoft Exchange (exchange.cmd) provides the code for shutting down these services and starting them up again.

2. SQL Server Scripts

The sample SQL Server scripts provide the code for stopping the SQL services before the snapshot and restarting these services after the snapshot.

There are several services in SQL Server (version 2000); you may not need to stop and start all of them.

MSDTC Distributed Transaction Coordinator
MSSEARCH Microsoft Search
MSSQLSERVER Microsoft SQL Server
SQLSERVERAGENT SQL Server Agent

The SQL "pre" sample script (sql.pre_snapshot.cmd) stops the SQL services. The SQL "post" sample script (sql.post_snapshot.cmd) starts the services.

3. Oracle Server Scripts

Oracle provides the capability of performing a "hot backup" of the database. This "hot backup" mode allows the database to run during the backup procedure. The sample "pre" script for Oracle (oracle.pre_snapshot.sql) places the Oracle database into "hot backup" mode before the snapshot, and the "post" script (oracle.post_snapshot.sql) turns off the "hot backup" mode after the snapshot.



Adding a Beep for Notification

This section describes how to add a beep to the notification process for important alerts to make it easier to identify servers that require attention in a computer room with many servers. The “Event Notification” section of Chapter 5 describes how you can set up rules that determine the conditions under which messages will be sent and the recipients of those messages. In addition, Volume Manager can execute a command when the conditions for a rule occur. A command includes command prompt command files, batch files, Perl scripts, and executables. All commands are executed on the local system from a Windows service. Thus, if you want a specialized command to run, you must prepare the command file and place it on the local computer. One possibility for a command file is one that causes a beep to sound when the conditions of a specific rule are met.

To enable you to easily set up a beep for any desired rule, an executable file, **beep.exe**, is included with other Volume Manager files. Beep.exe is normally found in the following path:

C:\Program Files\VERITAS\Volume Manager 3.1

Example of Adding a Beep When a Drive Is Failed or Removed

The following example may be useful for your system procedures. The example sets up a rule for creating a beep when a drive is failed or removed. After the alert condition occurs, the beep sounds continuously and a dialog box comes up that allows you to turn off the beep.

Note This example sets up a beep for drive failure or removal, but you can set up the beep for any error condition that you want. You simply select a different alert name for the rule in [step 3](#) of the procedure that follows.

▼ To add a beep for notification for a drive failure or removal:

1. If you have not already done so, refer to “[Event Notification](#)” on page 189 to set up the recipient or recipients that will receive the alert messages about the drive failure or removal.
2. Access the Rules wizard.
 - Select the Control Panel icon in the left pane of the VEA GUI.
 - Double-click the **Rule Management** icon in the Control Panel icon group that now appears in the right pane of the window, and double-click the **Rule Manager** icon from the window that comes up.
 - Select **New** in the Rule Manager window that appears, and the first screen of the Rules wizard comes up. Click **Next** to continue.

3. Select a rule based on the alert name **Device Removed**.

- In the second screen of the Rules wizard, highlight **a rule based on alert name** and click **Next**.
- In the next screen, click on the text **click here to select names**, select **Device Removed** from the pull-down list in the Select Alert Names dialog box, and click **OK**. Then click **Next** to continue.

It is easier to select from the Select Alert Names dialog box if you drag down with the mouse on the bottom of the dialog box to make it longer, allowing you to see more names at one time.

4. Select the actions associated with the rule.

- a. In the Select Actions screen that comes up next, click *both* checkboxes, the **Send Notifications** checkbox and the **Execute a command at the command prompt** checkbox.

b. **Defining Recipients**

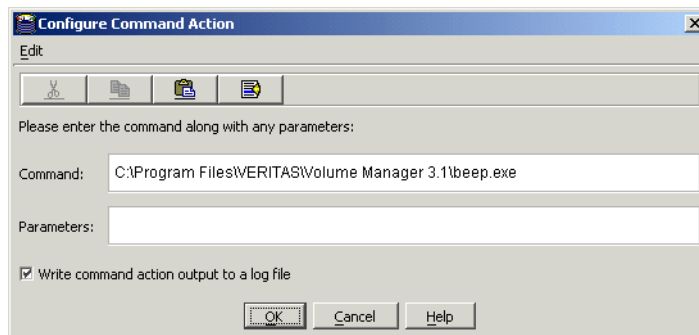
- Click the text **click here to select recipients**.
- The Notification Configuration window appears. Click the **To** button at the top left corner.
- The Select Recipient window appears. Select each recipient you want from the list in the left pane of the screen, and then use the right arrow to move the name to the list in the right pane of the screen.
- Click **OK** when you have finished adding the recipients who will receive the messages.
- You are returned to the Notification Configuration window. It has a list of fields that will appear in the message sent out for the alert. The program supplies default values for these fields. It is recommended that you accept the default values by clicking **OK**. If you want to change the values, refer to “[Event Notification](#)” on page 189 for details on how to modify the fields.



c. Defining the Command

- Click the text **click here to define a command**.
- In the Configure Command Action window that appears, type in the path for the command file. It is located on the drive where the Volume Manager files are installed. The typical path is:

C:\Program Files\VERITAS\Volume Manager 3.1\beep.exe.



- No parameters are necessary for this command.
- If you want to record this alert in a log file, check the checkbox next to “Write command action output to a log file.” The log file will be found with other Volume Manager files; normally it is in:

C:\Program Files\VERITAS\VERITAS Object Buslogs.

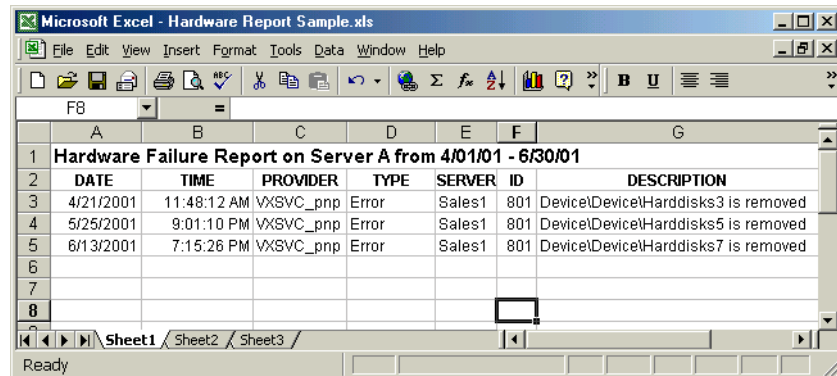
The file name will be “CommandPrompt_date_time.out.” For example, the file name for an alert sent on January 30, 2002, at 10:04:12 a.m. would be “CommandPrompt_Jan-30-2002_10-04-12.out.”

- Click **OK** to accept the command.
- 5.** Click **Next** to continue to display the Set rule properties screen. Enter a name for the rule in the entry box provided near the top of the window. Check the description of the rule to verify that it is correct, and then click **Finish**.
- The Rule Manager window comes up. The new rule should be listed. Once the conditions for the new rule occur, a continuous beep will occur and a dialog box will come up that allows you to click **OK** to stop the beep and close the dialog box.
- 6.** Click **Close** to close the Rule Manager window.

Creating a Hardware Failure Report

This section describes the steps for creating a report that details hardware failures. You use the Computer Management Event Viewer in Windows 2000 to create a log file of all the alerts on the server. Next, you import the file into Excel, filter and sort the events, and then customize your report. You will need to do these steps on each server. If desired, a script or Excel macro could be created to automate the process.

Here is an example of a hardware failure report created using the procedure outlined below.



	A	B	C	D	E	F	G
1	Hardware Failure Report on Server A from 4/01/01 - 6/30/01						
2	DATE	TIME	PROVIDER	TYPE	SERVER	ID	DESCRIPTION
3	4/21/2001	11:48:12 AM	VXSVC_pnp	Error	Sales1	801	Device\Device\Harddisks3 is removed
4	5/25/2001	9:01:10 PM	VXSVC_pnp	Error	Sales1	801	Device\Device\Harddisks5 is removed
5	6/13/2001	7:15:26 PM	VXSVC_pnp	Error	Sales1	801	Device\Device\Harddisks7 is removed
6							
7							
8							

Follow these steps for creating the report:

1. Right-click the **My Computer** icon and select **Manage** from the context menu that comes up.
The Computer Management window appears.
2. In the left pane of the Computer Management window, click **Event Viewer**, and then click to select **Application** under the Event Viewer folder.
3. Select **Action>Save Log File As**. The Save Application As window appears.
 - a. Navigate to the location where you want to save the file.
 - b. Type a file name in the text entry box.
 - c. Select "CSV (Comma delimited)" from the "Save as type" drop-down menu.
 - d. Click **Save**.
4. Open the Excel application.



5. Choose **File>Open**. Open the log file you saved in Computer Management.
6. Add headings by following these steps:
 - a. Insert an empty row at the top of the spreadsheet by highlighting the entire top row and then selecting **Insert>Rows**.
 - b. Type the following headings horizontally across the columns:

Column	Heading
A	Date
B	Time
C	Source
D	Type
E	Category
F	Event
G	User
H	Computer
I	Description

- c. Format the headings as desired.
7. Follow these steps to filter the information by source:
 - a. Highlight the "Source" column.
 - b. Select **Data>Filter>AutoFilter**. A drop-down arrow appears to the right of the "Source" heading.
 - c. Select **VxSvc_pnp** from the drop-down menu to filter out the hardware failure alerts from the alerts generated by all other sources.
8. Next, sort by alert type by following these steps:

- a. Highlight the “Type” column.
 - b. Select **Data>Sort**.
A Sort Warning window will appear.
 - c. Make sure the “Expand the Selection” radio button is selected, and click **Sort**.
A Sort window will appear.
 - d. Sort by “type” with the “ascending” radio button selected. Make sure the radio button default “My list has a header row” is also selected and click **OK**.
The resulting file will be organized by alert type and will list the most recent alerts appearing first within each alert type group.
9. Format the report as desired, perhaps renaming the categories, changing their order, or adding a title to the report.

Note Another way to create this report is by filtering the data in Computer Management first and then using the **Export List** command to bring the reduced file into Excel or another spreadsheet program. Unfortunately, this method does not allow a description field in the resulting filtered list. The description field is highly desirable, so in the above procedure the **Save Log File As** command is used instead and the filtering is performed in Excel.



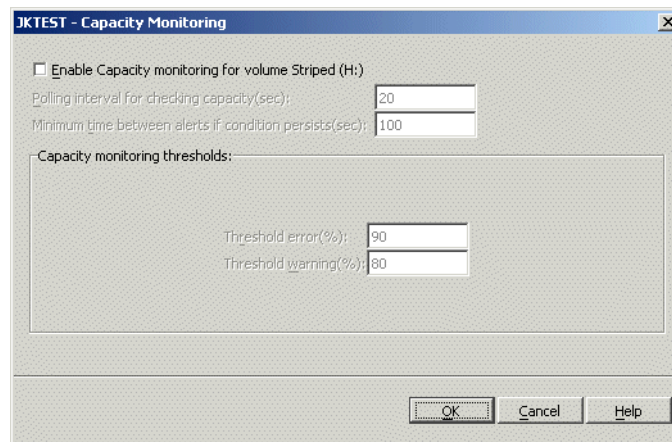
Automatic Volume Growth Based on Capacity

This procedure describes how to use a script that will automatically grow a volume when it reaches a certain percentage of capacity. With this procedure, you can conserve disk space on your servers because space is distributed to users on an as-needed basis, and you do not have to be available to allocate the new disk space.

The example sets up a rule for growing the volume when the Capacity Monitoring Threshold error occurs. Volume Manager's Capacity Monitoring function monitors the capacities of the volumes on your system; it has two thresholds—a Warning Threshold with a default setting of 80% of capacity and an Error Threshold with a default setting of 90% of capacity. These are the points at which the Capacity Monitoring function sends out an alert. The rule that the following example is based on executes when the Error Threshold is passed. The rule has an executable file, **volgrow.cmd**, associated with it that grows the volume.

▼ To set up automatic volume growth based on capacity:

1. Make sure that the Capacity Monitoring function is turned on for the volume you want to monitor and that the thresholds are set to the desired percentages. Capacity Monitoring is off by default.
 - a. Right-click the volume, and select **Capacity Monitoring**. In the Capacity Monitoring screen that comes up, click the checkbox to enable Capacity Monitoring for the volume, and change any other default settings, if desired, and then click **OK**.



Note You may want to set the **Minimum time between alerts if the condition persists** to a large number so that you won't get so many messages while the volume is being enlarged, such as 3600 seconds (equivalent to one hour).

2. If you have not already done so, refer to “[Event Notification](#)” on page 189 to set up the recipient or recipients that will receive the alert messages about the capacity threshold.
3. Access the Rules wizard.
 - Select the Control Panel icon in the left pane of the VEA GUI.
 - Double-click the **Rule Management** icon in the Control Panel icon group that now appears in the right pane of the window, and double-click the **Rule Manager** icon from the window that comes up.
 - Select **New** in the Rule Manager window that appears, and the first screen of the Rules wizard comes up. Click **Next** to continue.
4. Select a rule based on the alert name **Volume capacity reached error condition**.
 - In the second screen of the Rules wizard, highlight **a rule based on alert name** and click **Next**.
 - In the next screen, click on the text **click here to select names**, select **Volume capacity reached error condition** from the pull-down list in the Select Alert Names dialog box, and click **OK**. Then click **Next** to continue.

It is easier to select from the Select Alert Names dialog box if you drag down with the mouse on the bottom of the dialog box to make it longer, allowing you to see more names at one time.
5. Select the actions associated with the rule.
 - a. In the Select Actions screen that comes up next, click *both* checkboxes, the **Send Notifications** checkbox and the **Execute a command at the command prompt** checkbox.
 - b. **Defining Recipients**
 - Click the text **click here to select recipients**.
 - The Notification Configuration window appears. Click the **To** button at the top left corner.
 - The Select Recipient window appears. Select each recipient you want from the list in the left pane of the screen, and then use the right arrow to move the name to the list in the right pane of the screen.



- Click **OK** when you have finished adding the recipients who will receive the messages.
- You are returned to the Notification Configuration window. It has a list of fields that will appear in the message sent out for the alert. The program supplies default values for these fields. It is recommended that you accept the default values by clicking **OK**. If you want to change the values, refer to “[Event Notification](#)” on page 189 for details on how to modify the fields.

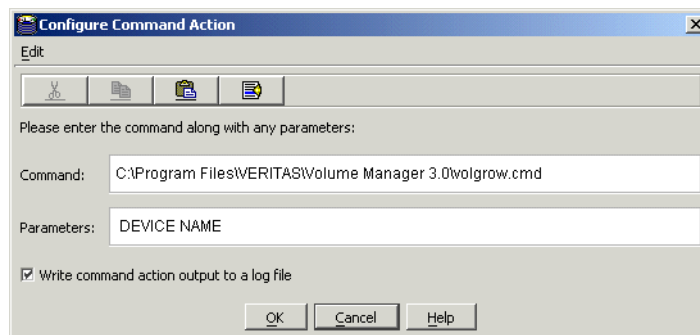
c. Defining the Command

- Click the text **click here to define a command**.
- In the Configure Command Action window that appears, type the path for the command file. The typical path is:
C:\Program Files\VERITAS\Volume Manager 3.1\Sig\volgrow.cmd.
- Select **Edit>Insert** or click on the Insert button on the far right of the four buttons. From the pop-up window that appears, select **DEVICE NAME** and click **Insert**.
- If you want to record the capacity monitoring alert in a log file, click the checkbox next to “Write command action output to a log file.” The log file will be found with other Volume Manager files; normally it is in:

C:\Program Files\VERITAS\VERITAS Object Buslogs

The file name will be “CommandPrompt_date_time.out.” For example, the file name for an alert sent on January 30, 2002, at 10:04:12 a.m. would be “CommandPrompt_Jan-30-2002_10-04-12.out.”

- The Configure Command Action dialog box now will look similar to the example below.



- Click **OK** to accept the command.

6. Click **Next** to continue to display the Set rule properties screen. Enter a name for the rule in the entry box provided near the top of the window. Check the description of the rule to verify that it is correct, and then click **Finish**.

The Rule Manager window comes up. The new rule should be listed. With the new rule, once the amount of data in the volume reaches the point where the error threshold is reached, the rule activates, a warning message goes out that the error threshold has passed, and immediately the command to grow the volume is implemented. Once the process for growing the volume is complete, you will stop receiving error messages about the volume capacity.

Note The included `volgrow.cmd` script is set to grow a volume by 150 MB. The growby size can be changed by modifying the `volgrow.cmd` script to a desired number. Please read the comments in the script for more information. The script can be found on the drive where the Volume Manager files are installed. It is normally in **C:\Program Files\VERITAS\Volume Manager 3.1\Sig**.



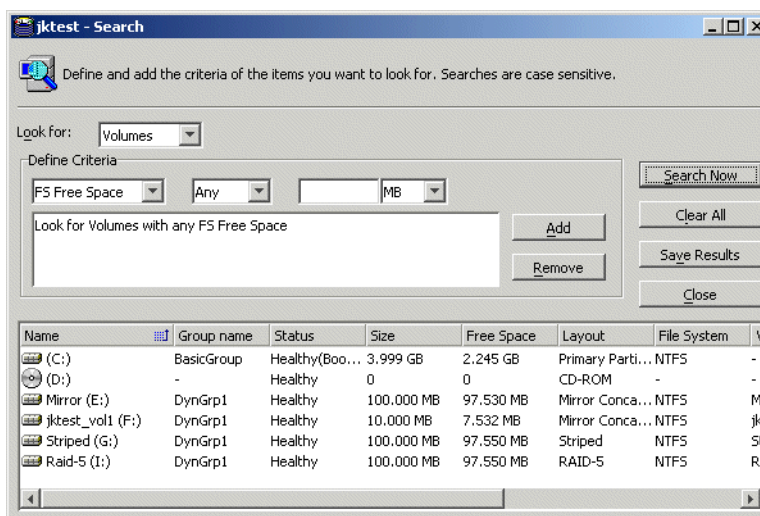
Creating Search Reports

This section describes how to create reports from the results of the Search feature. For information on how to conduct a search, see “[Search](#)” on page 67. Using the **Search** command, it is possible to generate a wide variety of reports that provide information on the disk groups, disks, and volumes on each server. The results of these searches can be saved and imported into Microsoft Excel or any other spreadsheet application that accepts tab-delimited text files. The results can be sorted, displayed as graphs or charts, and imported into written reports or PowerPoint presentations.

Search reports provide a snapshot of a system at a particular point in time. By running the same search on a regular schedule (monthly, annually, etc.), information can be collected, evaluated, and used to better manage the system.

The following sample report was created by using the Search feature and Microsoft Excel.

1. Determine the categories you want to include in your report, and use the Search feature to output the results to a text file.



This search lists the free space available on all the volumes located on the accessed server. After the search results are saved by using the **Save Results** button, a Microsoft Excel report can be generated similar to the one shown below.

	A	B	C	D	E	F	G	H
	Name	Group name	Status	Size	Free Space	Layout	File System	Volume
1	(C:)	BasicGroup	Healthy	3.999 GB	2.245 GB	Primary Partition	NTFS	-
2	(D:)	-	Healthy	0	0	CD-ROM	-	-
3	Mirror (E:)	DynGrp1	Healthy	100.000 MB	97.530 MB	Mirror Concatenated	NTFS	Mirror
4	jktest_vol1	DynGrp1	Healthy	10.000 MB	7.532 MB	Mirror Concatenated	NTFS	jktest_vol1
5	Striped (G:)	DynGrp1	Healthy	100.000 MB	97.550 MB	Striped	NTFS	Striped
6	Raid-5 (I:)	DynGrp1	Healthy	100.000 MB	97.550 MB	RAID-5	NTFS	Raid-5

Follow these steps to generate the search report:

2. Open the Excel application.
3. Click **File>Open** to open the .txt file saved by the Volume Manager search.
4. You will have to select "All Files (*.*)" from the "Files of type" drop-down menu. Navigate to the correct file and click the **Open** button.
5. In the Text Import wizard that appears, do the following:
 - a. In step 1 you are asked to choose the file type that best describes your data. Select the **Delimited** radio button and click **Next**.
 - b. In step 2 you are asked to choose a delimiter. Select the **Tab** radio button and click **Next**.
 - c. In step 3 you are asked to choose the data format. Select the **General** radio button and click **Next**.
 - d. Click **Finish**, and your report will appear in Excel.

Refer to the Microsoft Excel help for instructions on using the commands and features available in Excel.

Types of Search Reports

The type of search and search report you generate depends on the object type you base your search on.

If you choose to search for volumes, you can search by the following attributes:



- Name
- Disk Group Name
- Status
- Disk
- FS Capacity
- FS Free Space
- FS Type

If you choose to search for disks, you can search by the following attributes:

- Name
- Disk Group Name
- Device Name
- Status
- Size
- Free Space

If you choose to search for disk groups, you can search by the following attributes:

- Name
- Imported
- Free Space
- Size

Each search is run only on the specific server selected. For convenience, you could write a macro to automate the Excel steps in the report. By opening the search text files from multiple servers in Excel and running the macro, you can generate a combined report for a group of servers. The table that follows lists some sample searches and the types of report that would be generated:



Search	Criteria	Report shows:
Volume	FS Free Space, any	All volumes that contain free space
Volume	FS type is NTFS	All volumes that are formatted NTFS
Volume	Status is degraded	Volumes whose state is degraded and that might fail soon
Disk	Size greater than 10 GB	All disks larger than 10 GB
Disk	Free Space greater than 1 GB	All disks with more than 1 GB of free space
Disk	Disk Group is DynGrp1	All disks in DynGrp1
Disk Group	Name, any	All disk groups. Useful to run the search on multiple servers



Troubleshooting

This chapter contains troubleshooting information and has the following topics:

- ◆ [Using Disk and Volume Status Information](#)
- ◆ [Volume Manager Error Symbols](#)
- ◆ [Resolving Common Problem Situations](#)
- ◆ [Commands or Procedures Used in Troubleshooting](#)
- ◆ [Additional Troubleshooting Issues](#)

Using Disk and Volume Status Information

If a disk or volume fails, it is important to repair the disk or volume as quickly as possible to avoid data loss. Because time is critical, Volume Manager makes it easy for you to locate problems quickly. In the Status column of the Disks tab view or Volumes tab view, you can view the status of a disk or volume. You can also see indications of abnormal status in the tree view or the Disk View tab. If the status is not Healthy for volumes, Imported for dynamic disks, or Online for basic disks, use this section to determine the problem and then fix it. The topics are:

- ◆ [Disk Status Descriptions](#)
- ◆ [Volume Status Descriptions](#)

Note When there is a problem with a disk or volume, you can also look at the Events tab view for messages about problems that may have occurred.



Disk Status Descriptions

One of the following disk status descriptions will always appear in the Status column of the disk in the right pane of the console window. If there is a problem with a disk, you can use this troubleshooting chart to diagnose and correct the problem.

Caution The suggested actions may bring the disks to an Imported status, but they do not guarantee data integrity.

Disk Status Descriptions

Status	Meaning	Action Required
Imported	The disk is accessible and has no known problems. This is the normal disk status for dynamic disks.	No user action is required.
Online	The disk is accessible and has no known problems. This is the normal disk status for basic disks.	No user action is required.
No Media	No media has been inserted into the CD-ROM or removable drive. Only CD-ROM or removable disk types display the No Media status.	Insert the appropriate media into the CD-ROM or removable drive, and the disk status will become Online. If you do not see the disk status change immediately, use the Refresh command to refresh the GUI.
Foreign	Only dynamic disks display this status. There are three situations where a disk may be marked as Foreign: <i>Situation 1</i> The disk was created as a dynamic disk on another computer and has been moved to your computer and has not been set up for use.	For details on these actions, see “Bringing a Foreign Disk Back to an Online State” on page 434. <i>Situation 1</i> Use Import Dynamic Disk Group to make the disk group available for use. In the Import Dynamic Disk Group dialog box, be sure to click the checkbox to clear the host ID of the other system.



Disk Status Descriptions

Status	Meaning	Action Required
	<i>Situation 2</i> The disk contains a secondary disk group (that is, a disk group other than the first disk group created on the server) and you have a dual-boot system. When you switch between operating systems, the disk with a secondary disk group is marked as Foreign and does not auto-import.	<i>Situation 2</i> Use Import Dynamic Disk Group to make the secondary disk group available for use. The primary disk group will import automatically when you switch between operating systems. In the Import Dynamic Disk Group dialog box, be sure to click the checkbox to clear the host ID of the other system.
	<i>Situation 3</i> The disk was originally created on this computer. It was moved or deleted. Now you want to bring it back to this computer as a member of the disk group in which it was originally created.	<i>Situation 3</i> Use the Merge Foreign Disk command to restore the disk as a member of its former disk group.
No Disk Signature	Displays for new disks. The disk cannot be used because it has no signature.	Right-click on the disk and select Write Signature from the menu. The disk type will change to Basic Disk and the disk can be accessed or upgraded.
Offline	Only dynamic disks display this status. There are two situations where a disk may be show a status of Offline:	
	<i>Situation 1</i> The disk was part of the system's disk configuration but currently cannot be found.	<i>Situation 1</i> Make sure the disk is connected to the computer. Then use Rescan to bring the disk online. See also "Bringing an Offline Dynamic Disk Back to an Imported State" on page 431.



Disk Status Descriptions

Status	Meaning	Action Required
	<i>Situation 2</i> The disk is not accessible. The disk may be corrupted or intermittently unavailable. An error icon appears on the offline disk. If the disk status is Offline and the disk's name changes to Missing Disk (#), the disk was recently available on the system but can no longer be located or identified.	<i>Situation 2</i> Make sure the disk is connected to the computer. Then use Rescan to bring the disk online. See the section "Bringing an Offline Dynamic Disk Back to an Imported State" on page 431.
Disconnected	Displays for dynamic disks when the system can no longer find the disk. The name of the disk becomes "Missing Disk."	Reconnect the disk.
Import Failed	The import of the dynamic disk group containing the disk failed. All disks in a dynamic disk group that failed to import will show this status.	Examine your configuration to determine what the problem might be.
Failing	Failing is a secondary message shown in parentheses after a disk status. This status indicates that I/O errors have been detected on a region of the disk. All the volumes on the disk will display Failed, Degraded, or Failing status, and you may not be able to create new volumes on the disk. Only dynamic disks display this status.	Right-click on the failing disk and select Reactivate Disk to bring the disk to Online status and all its volumes to Healthy status.

Volume Status Descriptions

One of the following volume status descriptions will always appear in the graphical view of the volume and in the Status column of the volume in list view. If there is a problem with a volume, you can use this troubleshooting chart to diagnose and correct the problem.

Caution The suggested actions may bring the volumes to a Healthy status, but they do not guarantee data integrity.

Volume Status Descriptions

Status	Meaning	Action Required
Healthy	The volume is accessible and has no known problems. This is the normal volume status. Both dynamic volumes and basic volumes display the Healthy status.	No user action is required.
Resynching	The volume's mirrors are being resynchronized so that both mirrors contain identical data. Both dynamic and basic mirrored volumes display the Resynching status. When resynchronization is complete, the mirrored volume's status returns to Healthy. Resynchronization may take some time, depending on the size of the mirrored volume.	No user action is required. Although you can safely access a mirrored volume while resynchronization is in progress, you should avoid making configuration changes (such as breaking a mirror) during resynchronization.
Regenerating	Data and parity are being regenerated for a RAID-5 volume. Both dynamic and basic RAID-5 volumes display the Regenerating status. When regeneration is complete, the RAID-5 volume's status returns to Healthy.	No user action is required. You can safely access a RAID-5 volume while data and parity regeneration is in progress.
Degraded	The Degraded status applies only to mirrored or RAID-5 volumes on basic or dynamic disks. There are three situations where Degraded status can occur:	Take the following actions to resolve these situations:



Volume Status Descriptions

Status	Meaning	Action Required
	<i>Situation 1</i> The data on the volume may no longer be fault tolerant because one of the underlying disks is not online. A RAID-5 volume loses redundancy if one disk is offline or failed. A mirrored volume can lose redundancy if one of the disks containing one of its subdisks fails.	<i>Situation 1</i> You can continue to access the volume using the remaining online disks, but you should repair the volume as soon as possible. It is important to repair the volume because if another disk that contains the volume fails, you will lose the volume and its data. For details, see the sections “Bringing a Dynamic Volume Back to a Healthy State” on page 436 and “Bringing a Basic Volume Back to a Healthy State” on page 435.
	<i>Situation 2</i> A Degraded status will also display if a disk involving a RAID-5 or mirrored volume was physically moved.	<i>Situation 2</i> To correct the problem, you must move all the disks that contain the volume to the new location or return the moved disk or disks to the original location.
	<i>Situation 3</i> The data on the volume is no longer fault tolerant, and I/O errors have been detected on the underlying disk. If an I/O error is detected on any part of a disk, all volumes on the disk display the (At Risk) status. Only dynamic mirrored or RAID-5 volumes display the Degraded (At Risk) status.	<i>Situation 3</i> To return the underlying disk to the Online status, reactivate the disk (using the Reactivate Disk command). Once the disk is returned to the Online status, the volume status should change to Degraded. See the volume status description Degraded for further action.
Failed	A failed volume will be started automatically. An error icon appears on the failed volume. Both dynamic and basic volumes display the Failed status. There are two situations where Failed status can occur:	Take the following actions to resolve these situations:



Volume Status Descriptions

Status	Meaning	Action Required
	<i>Situation 1</i> A volume that spans two or more disks has one or more disks fail. A striped volume, simple volume, spanned volume, or extended partition will fail with one disk failure. A RAID-5 volume will fail with two disk failures. A mirrored or mirrored-striped volume will fail when the disks containing all the mirrors in the volume fail.	<i>Situation 1</i> Replace or repair the failed or malfunctioning disk or disks.
	<i>Situation 2</i> A disk or disks involving a volume that spans multiple disks is moved to another computer.	<i>Situation 2</i> Move all the disks that contain subdisks of the volume, or return the moved disk or disks to the original location.
Formatting	The volume is being formatted using the specifications you chose for formatting.	No user action is required.
Stopped	A volume that is in a dynamic disk group that is not imported.	Import the dynamic disk group containing the volume.
Missing	The volume status will be Missing if any of the subdisks of the volume are on disks that show an Offline status.	Reactivate the offline disks and Rescan . If the volume status changes to Stopped or Failed, reactivate the volume.
Failing	Failing is a secondary message shown in parentheses after a volume status. Failing means Volume Manager encountered some I/O errors on at least one disk that contains subdisks of the volume; however, these errors did not compromise the data on the specific volume. Failing sends the message that the disk integrity is deteriorating. When the volume status is Degraded (At Risk), the underlying disk's status is usually Online (Failing).	Determine which disk is failing, and take corrective action as described in " Disk Status Descriptions " on page 424.



Volume Manager Error Symbols

When a problem occurs in a computer's storage subsystem, Volume Manager will alert the user with error messages and error symbols placed on top of the disk or volume icons to show the source of the problem.

The table below lists these error symbols, explains their meaning, and gives examples of their usage.

Symbol	Meaning	Example
 Disk 4  Disk 5	Warning. The yellow caution symbol indicates there is a potential problem but the system can still function normally.	Capacity warning, Degraded warning.
	Informational. The blue information symbol indicates the object is not accessible. This state is often caused by a user operation. No degradation or loss of data; the system can still function normally.	Server started, Device arrival, Write disk signature.
 Dynamic Mirrored  Dynamic Spanned	Failure. The X symbol on a red circle indicates that a serious storage failure has occurred. Users need to look at the source of the problem and fix it as soon as possible. Any attempt to access the object will result in an error.	Failed volume, Missing disk.

Resolving Common Problem Situations

This section provides information on how to resolve the most common problem situations that users encounter when managing their storage with Volume Manager. The topics are:

- ◆ [Bringing an Offline Dynamic Disk Back to an Imported State](#)
- ◆ [Bringing a Basic Disk Back to an Online State](#)
- ◆ [Removing a Disk from the Computer](#)
- ◆ [Bringing a Foreign Disk Back to an Online State](#)
- ◆ [Bringing a Basic Volume Back to a Healthy State](#)
- ◆ [Bringing a Dynamic Volume Back to a Healthy State](#)
- ◆ [Repairing a Volume with Degraded Data after Moving Disks between Computers](#)

Bringing an Offline Dynamic Disk Back to an Imported State

An Offline dynamic disk may be corrupted or intermittently unavailable.

1. Repair any disk or controller problems, and make sure that the disk is turned on, plugged in, and attached to the computer.
2. Use the **Rescan** command to rescan all the devices on the SCSI bus to bring the disk back online.

Select **Rescan** from the Task menu, or right-click the computer icon in the tree view to get a context menu and select **Rescan** from that menu. If you have a lot of devices on the computer's SCSI bus, the rescan of the bus may take some time.

For more information on the **Rescan** command, see the section "[Rescan Command](#)" on page 438.

If one of the disks has failed and you have a mirrored or RAID-5 volume, see the section "[Repair Volume Command for Dynamic Mirrored Volumes](#)" or "[Repair Volume Command for Dynamic RAID-5 Volumes](#)" on page 441 for further instructions. The repair involves recreating part of the volume in a different location.

3. If the disk does not come back after doing a rescan, select the disk and use the **Reactivate Disk** command to manually bring the disk back online.

Right-click the disk's label in the tree view or the Disk View tab view to bring up the disk's context menu and select the **Reactivate Disk** command from the menu.

For more on the **Reactivate Disk** command, see the section "[Reactivate Disk Command](#)" on page 440.



If reactivating the disk does not change its status, something must be wrong with the disk or its connections.

4. If a disk comes back online after reactivating, check to see whether its volumes are healthy. If not, try the **Reactivate Volume** command on its volumes. See the section [“Reactivate Volume Command”](#) on page 440 for more information.
5. Run **Chkdsk.exe** to make sure that the underlying data on the disk is not corrupted. Even if the disk and volumes come back online, it is important to check whether the underlying data is intact.

To run **Chkdsk**, open a command prompt window and enter the following command:

chkdsk x: /f

where *x* is the drive letter of the volume you want to check. The **/f** option tells **Chkdsk** to fix any errors it finds. If the **/f** option is omitted, **Chkdsk** will operate in a read-only mode.

If the data is corrupted, you will need to replace it with data from backup storage.

Bringing a Basic Disk Back to an Online State

If a basic disk is corrupted or unavailable, it will not show in the GUI.

1. Repair any disk or controller problems, and make sure that the disk is turned on, plugged in, and attached to the computer.
2. Use the **Rescan** command to rescan all the devices on the SCSI bus to bring the disk back online.

Select **Rescan** from the Task menu, or right-click the computer icon in the tree view to get a context menu and select **Rescan** from that menu. If you have a lot of devices on the computer's SCSI bus, the rescan of the bus may take some time.

For more information on the **Rescan** command, see the section [“Rescan Command”](#) on page 438

3. If a disk comes back online after rescanning, check to see whether its volumes are healthy. If they are not, see the section [“Bringing a Basic Volume Back to a Healthy State”](#) on page 435 for more information.
4. Run **Chkdsk.exe** to make sure that the underlying data on the disk is not corrupted. Even if the disk and volumes come back online, it is important to check whether the underlying data is intact.

To run **Chkdsk**, open a command prompt window and enter the following command:

chkdsk x: /f

where *x* is the drive letter of the volume you want to check. The **/f** option tells **Chkdsk** to fix any errors it finds. If the **/f** option is omitted, **Chkdsk** will operate in a read-only mode.

If the data is corrupted, you will need to replace it with data from backup storage.

Removing a Disk from the Computer

This section has information on removing a basic or dynamic disk from a computer.

Basic Disk

If you remove a basic disk from the computer and then do a rescan, the disk and its volumes will no longer show up in the VEA GUI.

Dynamic Disk

If the dynamic disk's status remains Offline and Missing and you determine that the disk has a problem that cannot be repaired, you can remove the disk from the system by using the **Remove Disk from Dynamic Disk Group** command.

However, before you can remove the disk, you must delete all volumes on the disk. You can save any mirrored volumes on the disk by removing the mirror that is on the Missing disk instead of the entire volume. Deleting a volume destroys the data in the volume, so you should remove a disk only if you are absolutely certain that the disk is permanently damaged and unusable.

If a disk is marked Missing and is not connected to the computer, you can use the **Remove Disk from Dynamic Disk Group** command without worrying about the data.

To use the **Remove Disk from Dynamic Disk Group** command:

1. Right-click the disk to bring up its context menu.
2. Select **Remove Disk from Dynamic Disk Group** from the menu.

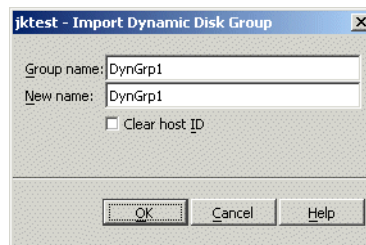
Note If you have a disk that appears to be deteriorating because it has many errors, you can easily move the data from that disk to another disk by using Volume Manager's **Move Subdisk** command. See "[Moving Subdisks](#)" on page 251.



Bringing a Foreign Disk Back to an Online State

1. Use **Import Dynamic Disk Group** to bring a Foreign disk online if the disk was part of a dynamic disk that was created on another computer and moved to the current computer.
 - a. To add the disk so that it can be used, right-click on the disk and select **Import Dynamic Disk Group**.

A dialog box comes up that displays the name of the dynamic disk group.



- b. Indicate the name for the dynamic disk group as follows:
 - If you want to leave the name as is, just click **OK**.
 - If you want a new name for the dynamic disk group, type in a new name for the group in the “New name” entry box and then click **OK**.
 - c. If you are importing a dynamic disk group from a different system, then click the checkbox to clear the host ID of the other system.

The disk group then imports. All existing volumes on the disk will be visible and accessible. For more information on importing and deporting dynamic disk groups, see “[Importing and Deporting Dynamic Disk Groups](#)” on page 170.

Note Because a volume can span more than one disk (such as with a mirrored or RAID-5 volume), it is important that you first verify your disk configurations and then move all the disks that are part of the volume. If you do not move all the disks, the volume will have a Degraded or a Failed error condition.

2. Use **Import Dynamic Disk Group** if the Foreign disk has a secondary dynamic disk group (that is, a dynamic disk group other than the first dynamic disk group created on the server) and you have switched between operating systems on a dual-boot machine (booting both Windows NT 4.0 and Windows 2000).

When you have one or more secondary dynamic disk groups on a disk in a dual-boot environment, the disk will be marked as Foreign when you switch between operating systems, because the secondary disk groups are not automatically imported. A shared primary dynamic disk group on a disk in that situation is automatically imported.

Note The note under [step 1](#) also applies here.

3. Use **Merge Foreign Disk** if the disk was originally created on the current computer but was removed and now you have reattached it to the current computer and want to restore it to its status as a member its original dynamic disk group.

For full details on this command, see “[Merge Foreign Disk Command](#)” on page 174.

Note The note under [step 1](#) also applies here.

Bringing a Basic Volume Back to a Healthy State

1. Repair any disk or controller problems, and make sure that the disk is turned on, plugged in, and attached to the computer.
2. Use the **Rescan** command to rescan all the devices on the SCSI bus to bring the disk that the volume belongs to back online.

Select **Rescan** from the Task menu, or right-click the computer icon in the tree view and select **Rescan** from the context menu. If you have a lot of devices on the computer’s SCSI bus, the rescan of the bus may take some time.

For more information on the **Rescan** command, see the section “[Rescan Command](#)” on page 438.

3. If the disk comes back online but the volume still shows the Degraded status and it is a RAID-5 or mirrored volume, you can resynchronize the volume. See the section “[Resynchronize Volume \(FT Volume Only\)](#)” on page 443 for details.
4. If the volume shows Failed status, you can attempt to repair it by using the **Repair Volume** command. See the section “[Repair Volume \(FT Volume Only\)](#)” on page 443.



Bringing a Dynamic Volume Back to a Healthy State

1. First you need to attempt to bring the disk or disks to which the volume belongs to Online status by doing a **Rescan** and, if necessary, a **Reactivate Disk**.

See the sections “[Rescan Command](#)” on page 438 and “[Reactivate Disk Command](#)” on page 440 for details.

If one of the disks has failed and you have a mirrored or RAID-5 volume, see the section “[Repair Volume Command for Dynamic Mirrored Volumes](#)” or “[Repair Volume Command for Dynamic RAID-5 Volumes](#)” on page 441 for further instructions. The repair involves recreating part of the volume in a different location.

2. If a disk comes back online after reactivating, check to see whether its volumes are healthy. If not, try the **Reactivate Volume** command on its volumes. See the section “[Reactivate Volume Command](#)” on page 440 for more information.

3. Run **Chkdsk.exe** to make sure that the underlying file system structure is intact.

To run **Chkdsk**, open a command prompt window and enter the following command:

chkdsk x: /f

where *x* is the drive letter of the volume you want to check. The **/f** option tells **Chkdsk** to fix any errors it finds. If the **/f** option is omitted, **Chkdsk** will operate in a read-only mode.

Although **Chkdsk** will clean up the file system structure, there may still be invalid data on the disk if users were working when a problem occurred on the disk. It is highly recommended that you run utilities to check the integrity of the data. If the data is corrupted, you will need to replace it from backup storage.

Repairing a Volume with Degraded Data after Moving Disks between Computers

This section gives steps you can take if you used the **Deport Dynamic Disk Group** and **Import Dynamic Disk Group** commands to move disks between computers that contain mirrored or RAID-5 dynamic volumes with degraded data.

To resolve the problem:

1. Deport the disks on the computer they were moved to and then physically move the disks back to the computer where they originated.
2. Use **Rescan** to make sure all the disks are installed correctly.

If the volume showed Degraded status before the disks were moved, the volume will still show Degraded status when the disks are moved back.

3. Make sure the status of the disk that contained the degraded mirror or parity information is not Offline.

If the status is Offline, check for any hardware problems, and reconnect the disk, if necessary.

4. Use the **Reactivate Disk** command to bring the disk back online.

If the hardware problem is corrected, the disk will show Healthy status, and any mirrored volumes on the disk will be resynchronized and any RAID-5 volume will regenerate parity.

5. If any volume still shows Degraded status, use the **Reactivate Volume** command on that volume.

Volume Manager will attempt to bring the volume back online. You may see a warning message indicating that Volume Manager may not be able to bring back all of the data on the volume.

If Volume Manager successfully brings the volume back online, the status of the volume becomes Healthy.

6. Now you can deport the dynamic disk group and move all the dynamic disk group's disks to the second computer.

Be sure to move all the disks involved in the disk group at the same time to ensure that your volumes will have the Healthy status on the second computer.



Commands or Procedures Used in Troubleshooting

The section's topics are:

- ◆ Refresh Command
- ◆ Rescan Command
- ◆ Reactivate Disk Command
- ◆ Reactivate Volume Command
- ◆ Repair Volume Command for Dynamic RAID-5 Volumes
- ◆ Repair Volume Command for Dynamic Mirrored Volumes
- ◆ Resynchronize Volume (FT Volume Only)
- ◆ Repair Volume (FT Volume Only)
- ◆ Starting and Stopping the Volume Manager Service

Refresh Command

If you do not believe that anything is wrong with the disks or volumes but the GUI has not updated a recent change, try the **Refresh** command. **Refresh** refreshes drive letter, file system, volume, and removable-media information on the current computer. It also checks to see whether previously unreadable volumes are now readable. It may not pick up disk changes that occurred since the last reboot or rescan if there was no I/O occurring on the changed disk.

Select **Refresh** from the Task or View menu, or right-click the computer icon in the tree view to get a context menu and select **Refresh** from that menu. During the refresh process, a dialog box comes up with a progress bar showing percentage of completion.

Rescan Command

The **Rescan** command rescans the SCSI bus for disk changes. It also does the equivalent of the **Refresh** command, updating information on drive letter, file system, volume, and removable media.

It is recommended that you use **Rescan** every time you make disk changes, such as removing or adding a disk. Rescanning can take several minutes, depending on the number of devices on the SCSI bus.

Select **Actions**, then **Rescan**. Alternatively, from the toolbar, click the **Rescan** icon, the second icon from the left.

A progress bar showing the percentage of completion for the rescan process is available by clicking on the Tasks tab located in the lower pane. When **Rescan** is finished, you should see accurate information about your system.

If error flags remain, you may need to reactivate the disks or volumes.

Additional Important Information about the Rescan Command

This section gives additional information on how a rescan affects redundant and non-redundant volumes.

Redundant Volumes (Mirrored and RAID-5)

If a RAID-5 or a mirrored volume is in a Degraded state, doing a rescan also will automatically trigger an attempt to reactivate the disks and resynchronize the volume on the disk. This is done in the background and is the reason why it is not always necessary to invoke the **Reactivate Disk** and **Reactivate Volume** commands.

Non-Redundant Volumes (Simple, Spanned, and Striped)

If you have a simple, spanned, or striped volume that has failed, a rescan will NOT automatically attempt to reactivate the disk and the volumes. The data on these failed volumes may already be corrupted.

For a failed simple, spanned, or striped volume, you must manually reactivate the disk(s) and the volume. The error messages you receive may give you a hint of the reason for the problem. After manually reactivating the disk(s) and volume, the disks may come back as Online and the volume as Healthy, but you cannot assume that the underlying data has not been affected.

In this situation, you should also run **Chkdsk**. Although **Chkdsk** will clean up the file system structure, there may still be invalid data on the disk if users were working when a problem occurred on the disk. It is highly recommended that you run utilities to check the integrity of the data. If the data is corrupted, you will need to replace it from backup storage.

Note If you have mirrored or RAID-5 volumes with a Failed state, a rescan will not automatically reactivate the disks and resynchronize the volumes on the disks. Once a redundant volume has failed, it is subject to the same conditions as a failed non-redundant volume.

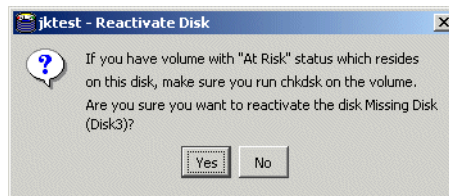


Reactivate Disk Command

Occasionally, **Rescan** will not clear error flags on a dynamic disk. When this happens, you can use **Reactivate Disk** to clear these flags. This command does a manual restart on a disk. Dynamic Disks that are marked as Missing or Offline can be reactivated. After reactivating, disks should be marked as Online if they are attached and are not in a Failed condition.

1. Right-click the disk with the error flags and select **Reactivate Disk** from the context menu that appears.

A dialog box appears with a confirmation message.



2. Click **Yes** to reactivate the disk.

The disk should be marked Online after the disk is reactivated unless there is a mechanical or other serious problem with the disk.

See also [“Additional Important Information about the Rescan Command”](#) in the section above.

Reactivate Volume Command

If you have errors on a dynamic volume, you must try to bring any disks on which it resides back online by first using **Rescan** and then, if that does not work, **Reactivate Disk**.

Once the disk or disks come back online, if the volume does not return to a Healthy state, use the **Reactivate Volume** command.

Right-click on the volume to bring up the context menu, and then click **Reactivate Volume**.

This can be necessary if any of the mirrors or plexes of a mirrored volume are still not healthy. The same situation applies to a RAID-5 volume; you may need to use **Reactivate Volume** to allow the volume to regenerate.

If the underlying disks for a volume are sound, the volume most likely will come back to a Healthy state, but the data on it may be corrupted or stale. It is recommended that you run **Chkdsk.exe** before using the volume. If chkdsk fails or finds an excessive number of errors, you may need to reformat the volume and restore its contents from backup.

The difference between the **Reactivate Volume** and **Repair Volume** commands is that **Reactivate Volume** resynchronizes the volume to bring it to a Healthy state in its existing location, while **Repair Volume** removes the damaged section of the volume and recreates it in another location on a healthy dynamic disk.

See also “[Additional Important Information about the Rescan Command](#)” on page 439.

Repair Volume Command for Dynamic RAID-5 Volumes

You can repair a RAID-5 volume if its status is Degraded and if there is enough unallocated space available on other dynamic disks to recreate the degraded subdisks of the volume. To avoid data loss, you should attempt to repair the volume as soon as possible.

Note After a disk fails, you may need to rescan before this menu option is available.

▼ Follow these steps to repair a dynamic RAID-5 volume using the Repair Volume command:

1. Right-click the degraded volume. Select **Repair Volume** from the context menu that appears.

The Repair Volume dialog box appears.

2. The default setting is for Volume Manager to automatically assign the destination disks. To manually select the disks, click the “Manually assign destination disks” radio button and then select the disks you want assigned as destination disks.
3. When you are satisfied with your selection, click **OK**.

The difference between the **Reactivate Volume** and **Repair Volume** commands is that **Reactivate Volume** resynchronizes the volume to bring it to a Healthy state in its existing location, while **Repair Volume** removes the damaged section of the volume and recreates it in another location on a healthy dynamic disk.



Repair Volume Command for Dynamic Mirrored Volumes

When a disk on which a mirrored volume resides fails, the volume displays a Degraded status. The disk's name is changed to Missing Disk, and an icon (X) appears on the Missing disk icon. The status of the disk will be Offline.

▼ Follow these steps to repair a mirrored volume using the **Repair Volume** command:

1. Right-click the degraded volume. Select **Repair Volume** from the context menu that appears.

The Repair Volume dialog box appears.

2. Select the mirror or mirrors to repair by clicking in the corresponding checkboxes.
3. Click **OK**.

New mirrors will be created on available disk space on other dynamic disks.

▼ Follow these steps to repair a volume and manually select the target disks for the new mirrors:

1. Right-click the degraded volume. Select **Mirror** from the context menu, then **Remove** from the submenu.

The **Remove Mirror** dialog box appears.

2. Remove the degraded mirror.

See “[To remove a mirror from a mirrored volume:](#)” on page 157 for a complete description of this operation. Note that the mirrors on preserved disks (in the right pane) will not be removed.

3. Right-click the volume again. Select **Mirror** from the context menu, then **Add** from the submenu.
4. Manually select the target disk to add the mirror to and then click **OK**. See “[Adding a Mirror to a Volume](#)” on page 154 for a complete description of this operation.

The difference between the **Reactivate Volume** and **Repair Volume** commands is that **Reactivate Volume** resynchronizes the volume to bring it to a Healthy state in its existing location, while **Repair Volume** removes the damaged section of the volume and recreates it in another location on a healthy dynamic disk.

Resynchronize Volume (FT Volume Only)

This command applies only to volumes previously created in NT Disk Administrator. These volumes are sometimes called FT volumes. **Resynchronize Volume** returns a basic RAID-5 or basic mirrored volume to a fault-tolerant state when there are minor errors on the disks that participate in these volumes or in a situation where disks have been removed and then replaced.

1. To do the command, right-click on the volume to bring up the context menu.
2. Select **Resynchronize Volume**.

The command runs immediately. The volume should be brought back to a Healthy state.

The difference between resynchronizing and repairing a basic volume is that resynchronizing regenerates the volume and brings it to a normal state in its existing location, while repairing involves removing the damaged section of the volume and recreating it in another location on a healthy basic disk.

Repair Volume (FT Volume Only)

This command applies only to volumes previously created in NT Disk Administrator. These volumes are sometimes called FT volumes. **Repair Volume** repairs a basic RAID-5 or basic mirrored volume by recreating the failed part of the volume on another disk.

1. Right-click on the volume, then click **Repair Volume** on the context menu that appears.

A dialog box appears with the possible disks that can be used for creating a new portion of the volume.
2. Click the disk you want to use for the new portion of the volume, and then click **OK**.

The volume should be brought back to a Healthy state.

The difference between resynchronizing and repairing a basic volume is that resynchronizing regenerates the volume and brings it to a normal state in its existing location, while repairing involves removing the damaged section of the volume and recreating it in another location on a healthy basic disk.



Starting and Stopping the Volume Manager Service

It is useful to know how to start and stop the Volume Manager service when you are troubleshooting. For example, if Volume Manager stops running on the server, you can try restarting the service instead of rebooting. Sometimes stopping the service and restarting it again can resolve temporary problems. The Volume Manager service is also referred to as the VERITAS Object Bus or vxob.

▼ To start the Volume Manager service

Bring up the command window and enter the following command:

```
net start vxob
```

Note If you reboot, the service is automatically restarted.

▼ To stop the Volume Manager service

Bring up the command window and enter the following command:

```
net stop vxob
```


Additional Troubleshooting Issues

This section contains additional troubleshooting issues. The topics are organized in the following areas:

- ◆ [Disk Issues](#)
- ◆ [Volume Issues](#)
- ◆ [Disk Group Issues](#)
- ◆ [Connection Issues](#)
- ◆ [Issues Related to Boot or Reboot](#)
- ◆ [Cluster Issues](#)
- ◆ [DMP Issues](#)
- ◆ [Other Issues](#)

Disk Issues

This section has the following issues:

- ◆ [Disk type shows no signature](#)
- ◆ [A disk is marked as foreign](#)
- ◆ [Error when upgrading a basic disk to dynamic](#)

Disk type shows no signature

If the type of disk shows No Signature, you need to write a signature to the disk. When installing a new disk, the software must write a signature to the disk that prepares it for use. This signature is not written automatically, in case that disk has been imported from another operating system and the configuration information needs to be kept intact.

Check:

- ◆ To write the configuration data to the disk, right-click on the disk under the **Disks** node and choose **Write Signature**.

A disk is marked as foreign

For more information, see the section [“Bringing a Foreign Disk Back to an Online State”](#) on page 434 and the status definition of Foreign disk in the section [“Disk Status Descriptions”](#) on page 424.



Error when upgrading a basic disk to dynamic

This topic describes known problems when upgrading a basic disk to dynamic.

Basic Disk Has More Than 32 Logical Drives

If you attempt to upgrade a basic disk that has more than 32 logical drives in its extended partition, it will not upgrade to a dynamic disk. You will get the error message “Disk cannot be partitioned after it has been upgraded.” There is a limit of 16 logical drives for a basic disk to be upgraded to a dynamic disk.

Basic Disk Has an “Active” Volume with No System Files

If you mark a basic mirrored volume active that does not contain the current system files, the computer will not be able to reboot. A basic disk that contains an unbootable active volume cannot be upgraded to dynamic.

You Receive an Error about Disk Geometry

If you receive an error about disk geometry when you are trying to upgrade a basic disk to a dynamic disk and the disk does not upgrade, the geometry on the disk is inconsistent with the disk geometry used on Windows 2000 systems. If the disk is not upgraded, Volume Manager maintains the disk with its current partition structure; but if the partition structure is changed in any way, the disk partitions and their data become inaccessible.

The fix for the situation, which is described in the error message, is:

1. Back up all your data from the affected disk.
2. Delete all partitions on the disk.
3. Upgrade the disk to dynamic.
4. Create volumes on the disk.
5. Restore your data to the disk.

It is very likely that you have a disk that was created under NT 4.0 with partitions on it and this disk has a different geometry because it was attached to a secondary host bus adapter with the BIOS turned off and mapping features turned off.

Once you have done the above steps, the disk will have the proper geometry and can still be connected to the secondary host adapter with the BIOS and mapping features turned off. The geometry problem was the result of the change from NT 4.0 to Windows 2000. It is a known problem and is discussed in more detail on the Microsoft web site.

Volume Issues

This section has the following issues:

- ◆ Cannot create a RAID-5 volume
- ◆ Cannot create a mirror
- ◆ Cannot extend a volume
- ◆ Cannot extend a dynamic boot or system volume
- ◆ When creating a spanned volume over multiple disks within a disk group, you are unable to customize the size of subdisks on each disk
- ◆ An attempt to mirror a boot or system volume fails or has an error message

Cannot create a RAID-5 volume

Check:

- ◆ Adequate unallocated space on three or more disks? You must have at least three disks to create a RAID-5 volume or four disks to create a RAID-5 volume with a log.

Cannot create a mirror

Check:

- ◆ Adequate unallocated space on two or more dynamic disks? You must have two or more disks to create a mirrored volume.

Also see the section “[An attempt to mirror a boot or system volume fails or has an error message](#)” on page 448.

Cannot extend a volume

One possible reason for not being able to extend a volume is that the RAID-5 or DRL log that was associated with the volume cannot be found, possibly because a disk has failed or is offline. The workaround is to delete the log from the failed disk or bring the missing disk back online, and then you should be able to extend the volume. If your volume has a boot or system disk, see the next section.

Cannot extend a dynamic boot or system volume

- ◆ A boot or system volume cannot be extended unless there is enough contiguous space after the volume for the desired extension. If you have another volume on the disk, you cannot use space before that volume and after that volume for the extension.



- ◆ If the extension of a dynamic boot or system volume requires adjustment of an extended partition boundary, then the extension will not be allowed. The error message “Requested operation not supported” will be returned.
- ◆ A boot or system disk volume that was originally created on a logical drive and later upgraded to a Volume Manager dynamic volume cannot be extended in Volume Manager.

When creating a spanned volume over multiple disks within a disk group, you are unable to customize the size of subdisks on each disk

When you create a spanned volume over multiple disks, Volume Manager does not allow you to use the Custom mode to create subdisks of a specified size on the disks in the volume. Volume Manager automatically uses all the available disk space in the first disk before moving to the second disk, and likewise does the same with the second disk before moving to the third, and so on.

To work around this problem, create a simple volume on the first disk with a specified size (the size will be a fraction of the total size needed). Once this is created, use the Extend Volume command with the Custom mode to specify additional space on another disk. Repeat for the total number of disks being used.

This technique will allow you to create a spanned volume with specific subdisk sizes on each disk in the group.

An attempt to mirror a boot or system volume fails or has an error message

There are several causes for this problem.

1. The Only Available Dynamic Disk Large Enough for the Mirror Has More than Two Retained Partitions

If you try to add a mirror to a system or boot disk but the only dynamic disks that have enough space contain more than two retained partitions, the Add Mirror operation will fail. The error message will say “insufficient disk space,” even though there is plenty of space on the disk.

2. No Available Dynamic Disk Has the Same Offset as the Original Boot or System Disk

In order to boot from a mirrored system volume, its offset from the beginning of the disk must be in the same location as that of the original system volume’s offset. If you try to add a mirror to a system volume where there are no dynamic disks that can have the offset in the same location, you will receive a message to that effect and be

asked whether you wish to continue. You can choose to continue, so that a mirror at a different offset will be created. The mirror will correctly mirror the data, but you cannot boot from the mirror.

Disk Group Issues

This section has the following issues:

- ◆ Unknown group appears after upgrading a basic disk to dynamic and immediately deporting its dynamic disk group
- ◆ Cannot use Volume Manager disk groups in Disk Management after uninstalling Volume Manager
- ◆ After uninstalling and reinstalling Volume Manager, the private dynamic disk group protection is removed

Note If you are having a problem with the dynamic disk group split and join commands, see the section “[DGSJ Troubleshooting Tips](#)” on page 346.

Unknown group appears after upgrading a basic disk to dynamic and immediately deporting its dynamic disk group

Upgrading a basic disk and immediately deporting its dynamic disk group will occasionally result in the appearance of a dynamic disk group named “Unknown.” Refreshing the display or trying to import the deported dynamic disk group will remove the original group from the display and, in the case of import, generate an error that the disk could not be found.

This problem occurs when the basic disk that was upgraded already contained partitions or basic volumes (such as NT Disk Administrator volume sets) and had one or more disks that were connected to a SCSI HBA that had its BIOS disabled.

DO NOT attempt any other operations on these disks from within Volume Manager. Doing so can result in a loss of data. To recover the dynamic disk group and its contents requires a reboot of the computer. After rebooting, the dynamic disk group will display correctly as a deported group as “Offline, Foreign.” Then you can import it without any problems.

Cannot use Volume Manager disk groups in Disk Management after uninstalling Volume Manager

After uninstalling Volume Manager 3.0 or 3.1 for Windows 2000, the existing disk group may not be able to be imported and used in Disk Management.



When you uninstall Volume Manager, Disk Management will automatically import only primary disk groups.

If, in Volume Manager 3.0 or 3.1 for Windows 2000, you do not have a primary disk group because your system or boot disk is not encapsulated, and then you uninstall Volume Manager, Disk Management will be unable to import the disk group or groups, because it cannot import a secondary disk group as a primary disk group. Without a primary disk group, you cannot merge the foreign disk group.

The workaround is to create a new dynamic disk in Disk Management and then the foreign disk group(s) can be merged into the dynamic disk group.

After uninstalling and reinstalling Volume Manager, the private dynamic disk group protection is removed

If you uninstall Volume Manager and then reinstall it again (either through an upgrade or for other purposes), the Private Dynamic Disk Group Protection is removed during the uninstall process. If you then reinstall Volume Manager and want to continue the Private Dynamic Disk Group protection for the disk groups that had it previously, add the feature back to the disk groups through the **Add Dynamic Disk Group Protection** command. Private Dynamic Disk Group information is stored in the registry; and, by necessity, the registry entries are removed during an uninstall.

Connection Issues

This section has the following issues:

- ◆ When attempting to connect to a remote computer, you are denied access or get an error message
- ◆ Error message: "Unable to add extension..."

When attempting to connect to a remote computer, you are denied access or get an error message

This topic describes situations where you are unable to connect to a remote computer.

Most Common Situation

If, from within Volume Manager, you attempt to connect to a remote computer but are denied access, your situation probably falls under one of the two following conditions:

- ◆ You are logged on to a local server that is not in any domain.

- ◆ You are logged on to a domain, but that domain does not contain the remote server. Also your domain does not have a trust relationship with the domain that the remote server is in.

The workaround in this situation is to create an account on the local machine that has the name and password that are the same as the administrator name and password of the remote computer and then use that account to log on to the local machine.

Client-Only Installation

Another situation where you may get an error message is when you have just done a client-only installation of Volume Manager for Windows 2000 and you bring up the Volume Manager client and attempt to connect to a remote server that has Windows 2000 Disk Management.

Volume Manager for Windows 2000 assumes that its client will connect first to a remote server running Volume Manager for Windows 2000 or Windows NT before connecting to a system running Windows 2000 Disk Management.

Once you connect to a server with Volume Manager for Windows 2000 or Windows NT, you will then be able to connect successfully to a remote system running Disk Management.

Note Windows 2000 Disk Management is the disk and volume management program that comes with Windows 2000. Volume Manager can connect to a remote server with Disk Management because the Disk Management software was jointly developed by VERITAS and Microsoft.

Error message: “The connection to *RemoteComputer* has terminated. *RemoteComputer* will be removed from view.”

The remote computer that you were connected to has been disconnected from your console. Most often there is a problem with the network connection and the transmissions timed out. This can also occur if the remote machine was restarted or the Volume Manager service on the remote machine was stopped. You can also get the message “Connection Failed” instead.

Check:

- ◆ Make sure that the remote machine is turned on and available to the network and that the service is started.
- ◆ Reconnect to the remote computer.



Error message: “Unable to add extension...”

If you are running a Volume Manager 3.0 or 3.1 client and attempt to connect to a server running Volume Manager 2.7, the Volume Manager 3.0 or 3.1 client recognizes this and automatically launches a Volume Manager 2.7 client to make the connection. Thus, the GUI you see and work with is the Volume Manager 2.7 GUI. The following error message appears if client extensions are not able to load when you connect from a Volume Manager 2.7 client machine to a remote server running Array Manager, another product in the Volume Manager family of products:

“Unable to add extension. You should make sure you are logged on to an account with local administrator rights on this client machine. If you don’t have administrator privileges, please log on to an account with this privilege and try connecting again.”

The problem is due to the account the user is logged on to locally, not the account on the remote machine that the user is trying to connect to. To remedy the situation, you need to log off, and then either add your user account to the local machine’s administrator group or log on to an account that has administrator privileges on the client machine. Then try connecting to the remote server running Array Manager again.

Issues Related to Boot or Reboot

This section has the following issues:

- ◆ During reboot, a message may appear about a “Corrupt Drive” and suggests that you run autocheck
- ◆ Error that the boot device is inaccessible, Bugcheck 7B
- ◆ Error message “vxboot- failed to auto-import disk group repltest_dg. All volumes of the disk group are not available.”
- ◆ Error message that a system file is corrupted after rebooting

See also the issue “[Cannot extend a dynamic boot or system volume](#)” on page 447.

During reboot, a message may appear about a “Corrupt Drive” and suggests that you run autocheck

Let autocheck run, but do not worry about the message. Autocheck will finish and the reboot will be complete. Depending on the size of the system, this may take quite a while.

Error that the boot device is inaccessible, Bugcheck 7B

There are two known situations that can result in this message:

After a Dynamic Disk Group with a Boot Device Has Been Renamed

A dynamic disk group that contains a boot volume should not be renamed when the dynamic disk group is imported. Normally, Volume Manager does not allow you to deport a dynamic disk group that contains the current boot volume. However, if you move a disk to another system or boot from another boot volume in a different dynamic disk group on the same system, you will then be able to deport the dynamic disk group that contains the boot volume.

Booting from a boot volume contained in a renamed dynamic disk group can, under certain circumstances, cause the error message “Bugcheck 7B, Inaccessible Boot Device.”

When Attempting to Boot from a Stale or Damaged Boot Plex

If you get the error message “Bugcheck 7B, Inaccessible Boot Device” and the boot volume is mirrored, try booting off one of the other mirrors. You are not allowed to boot from a stale mirror. A stale mirror is one that was detached because it was missing at some point or because it had errors.



Error message “vxboot- failed to auto-import disk group repltest_dg. All volumes of the disk group are not available.”

The situation that causes the error message is that disks from a dynamic disk group in Volume Manager have been removed without being deported, deleted, or converted to basic disks. The next time the computer is rebooted, Volume Manager expects to find these disks so that the disk group can be autoimported and when the disks are not there, the error message is generated.

Even when you have uninstalled Volume Manager and reinstalled it again, information about the disk group is retained in the registry because it is needed in upgrading from one version of Volume Manager for Windows software to another.

If you are not planning to use the disk group again, you need to remove the record of that disk group from the registry; otherwise, you will continue to get this message on reboot. Here are the steps to do so:

1. Run the command **Regedit** to bring up the Registry Editor window.
2. Locate the reference to the disk group in the registry. It is under the following key:
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\vxio\
Boot Info\Disk Group 1, Disk Group 2, and so on
3. The disk groups are not listed by the actual name, only by a general name of Disk Group 1, Disk Group 2, and so on. To determine which disk group to delete, click the general name to see a further listing that includes the actual name of the disk group.
4. Once you have determined which disk group to delete, highlight its general name (such as Disk Group 2) and hit the **Delete** key.

Error message that a system file is corrupted after rebooting

Depending on your situation, you may get either of the following error messages:

Windows 2000 could not start because the following file is missing or corrupt:

\WINNT\SYSTEM32\CONFIG\SYSTEMecd startup options for Windows 2000

Press F8.

Or

Windows 2000 could not start because the following file is missing or corrupt:

\WINNT\SYSTEM32\DRIVERS\ntfs.sys

Press F8.

This problem is a known Microsoft bug. It occurs when there is a large number of volumes and you have reconfigured your system by deleting and removing some volumes and then added new volumes. The Windows 2000 PNP registry retains information about the volumes in the system registry hive and does not remove this information, even when the volumes are deleted. Because the system registry hive is limited to 16 MB, the system fails to reboot when the system registry hive exceeds 16 MB. The repair procedure modifies the system registry hive.

Microsoft has a description of the repair procedure in a document labeled “q277222.” This document is not generally available to the public. Please see the VERITAS Technical Support database for a tech note that outlines the steps in the repair procedure.

Cluster Issues

This section has the following issues:

- ◆ Unable to bring a cluster disk group online when a minority of the disks in the disk group are available
- ◆ Problem on a SQL Server system with an MSCS cluster when migrating to a dynamic mirrored quorum volume on a Volume Manager disk group resource

Unable to bring a cluster disk group online when a minority of the disks in the disk group are available

Safeguards are put into effect so that normally you cannot bring a cluster disk group online on a node when a minority of disks in the disk group are available. However, in certain situations, you may want to force the import of the disk group or find some other way to bring the disk group online. One example is a campus cluster situation with a two-node cluster, where each node of the cluster is located in a separate physical location and each node has an even number of disks, with the disks evenly distributed between the two sites. In such a situation, if one site goes down, the remaining site will not be able to access the cluster data because it cannot reserve a majority of the disks in the disk groups.

With both MSCS clusters and other cluster types, there are methods to allow a site with a minority of the disks to bring disk groups online, if necessary, until the site with failed equipment can be repaired. The following section describes these methods.



Steps to Bring a Cluster Online That Has a Minority of the Disks in the Cluster

Caution When bringing a cluster disk group online with a minority of cluster disks, make sure that a majority of the disk group disks are NOT online on any other cluster node before (and after) onlining the disk group. If a majority of disk group disks are online on another node, data corruption can occur.

1. If you have an MSCS cluster, use the following **vxclus** command for each disk group on your cluster node:

vxclus enable -g<DynamicDiskGroupName>

You will be asked to confirm the use of this command.

If necessary, start the cluster service (**clussvc**) if the cluster service has stopped because of a dynamic quorum resource failure.

Then, using the Cluster Administrator, bring the cluster disk groups online.

Note For more on the **vxclus** utility, see “**vxclus**” on page 286.

2. If you have any other cluster type, enter the following command at the command line to receive further information on how to force an import of a cluster disk group when the cluster disk group does not have a majority of disks available.

vxdbg -g<DynamicDiskGroupName> -s import

A message comes up describing the command for forcing the import and giving cautions about the use of the command.

Enter the command to force the import as follows:

vxdbg -g<DynamicDiskGroupName> -s -f import

You will be asked to confirm the use of this command.

For more information about campus clusters, see the white paper “Campus Clustering: Using VERITAS Volume Manager for Windows with Microsoft Cluster Server (MSCS)” at:

<http://www.veritas.com/products/listing/ProductDownloadList.jhtml?productId=volu memanagerwin#whitepapers>

Problem on a SQL Server system with an MSCS cluster when migrating to a dynamic mirrored quorum volume on a Volume Manager disk group resource

If you have a system running SQL server with an MSCS cluster and decide to migrate the quorum volume from a non-fault-tolerant physical disk resource to a dynamic mirrored volume on a Volume Manager disk group resource, you should be aware that the cluster may have a Microsoft Distributed Transaction Coordinator (MSDTC) resource that has a dependency on the physical disk resource. If this is the case, you may need to take special steps to move the MSDTC resource to the new mirrored quorum volume.

MSDTC is a component used by SQL Server to manage distributed transactions and some replication functions. To determine whether MSDTC has a dependency on the physical disk resource, use Cluster Administrator to view the resources in Cluster Group. If there is a resource named MSDTC, right-click on it and select Properties. Select the Dependencies tab. If the MSDTC resource has a dependency on the physical disk quorum volume, you can create the dynamic mirrored quorum, but you cannot remove the physical disk resource that contained the old quorum volume from Cluster Group until you have reassigned the MSDTC resource to a fault tolerant volume.

You can leave the MSDTC resource on the physical disk resource that formerly held the quorum volume. However, since the log file contains critical transaction data, Microsoft recommends that it be located on a mirrored volume for maximum reliability. For more information about MSDTC, refer to Microsoft's SQL Server and COM+ (Component Services) documentation.

If you decide to move the MSDTC resource to the new quorum volume, it must be done with care to avoid the loss of any information related to unresolved transactions. Instructions on how to move the MSDTC resource can be found on the Microsoft Support web site in the article "HOWTO: Rebuild or Move MSDTC Used With a SQL Fail-Over Cluster" (Q294209) at:

<http://support.microsoft.com/default.aspx?scid=kb;en-us;Q294209>

This link was accurate when this manual was written, but the link may change in the future.



DMP Issues

This section has the following issues:

- ◆ Possible problem on a system that has a boot disk and Volume Manager with DMP on an external array
- ◆ When a DMP license is no longer valid

Note Look in the Volume Manager 3.1 Readme file for documentation of additional issues relating to DMP. Also, refer to the Hardware Compliance list on the Vsupport technical support web site for the list of equipment that has been tested to work with DMP.

Possible problem on a system that has a boot disk and Volume Manager with DMP on an external array

DMP does not failover a disk with multiple paths that contains the boot disk because DMP cannot manage the operating system. If the BIOS is enabled on the second host adapter path (so that the boot disk can be identified), you can reboot and the operating system will be able to bring up the boot disk on the second path (if the first path no longer exists). If you do not reboot and instead try to exclude the array under DMP, a bugcheck occurs. To correct the problem, fix the hardware that caused the path failure on path 1, and then reboot the system. The bugcheck does not cause data corruption.

When a DMP license is no longer valid

If you have a demo license and have DMP installed on an array with two or more paths and your demo license expires or you replace the demo license key with a permanent license key that does not include DMP, the DMP program will disable all paths except the primary path. This action ensures that all I/O will run on the primary path and there will be no corruption of your data. In addition, the various DMP options will no longer be available. You need to purchase a license that enables DMP. After you add the new license key, you must enable the paths that were previously disabled when the license was found to be not valid for DMP. To do this, use the Enable Paths command under DMP.

Other Issues

This section has the following issues:

- ◆ [An option is grayed out](#)
- ◆ [Disk View on a mirrored volume does not display the DCO volume](#)

An option is grayed out

When an option is grayed out in a menu, the task cannot be performed on the object at this time. Certain operations are valid only for certain types of objects. If there is a task currently running on that object, wait until it has finished and try again. Otherwise, the operation may not be appropriate at this time.

Disk View on a mirrored volume does not display the DCO volume

The Disk View for a selected mirrored volume will not show the DCO volume if that DCO volume was moved to a disk that does not contain any of the other plexes of the mirrored volume. A DCO volume can be moved manually by the user through a subdisk move or it can also be moved automatically with the hot relocation function when the subdisk has an I/O error.

If you select the Disk View for all disks (by selecting the Disks folder and clicking the Disk View tab in the right pane or by selecting Disk View from the Disk folder context menu), you can see the DCO volume. However, finding the DCO volume on all disks may not be practical if you have a large number of disks.





Glossary

Use this glossary to find explanations of terms that relate to the Volume Manager for Windows 2000 software.

Action Log

If you set up an event notification rule that runs a script when a certain event occurs, the running of the script will be noted in a log file referred to as the Event Log. The default log path is **C:\Program Files\VERITAS\VERITAS Object Bus\logs**. You can change this path by clicking the Action Log button in the Rule Manager window. You have to provide the script and place it on the local computer. For more about setting up event notification rules, see [“Creating Rules to Enable Messages”](#) on page 197.

Active/Active

The mode in which DMP allocates the data transfer across the possible paths to and from an array, thus enabling the desirable feature of load balancing. With this mode, DMP implements a round-robin algorithm, selecting each path in sequence for each successive data transfer to or from a disk. For example, if you have two paths active, A and B, the first disk transfer occurs on path A, the next on path B, and the next on path A again.

See also the [“Active/Passive”](#) and [“Load Balancing”](#) glossary entries.

Active Partition or Volume

The partition or volume from which the computer starts up. On a basic disk, the active partition must be a primary partition. For a dynamic disk, a dynamic volume cannot be marked active directly. However, you can upgrade a basic disk with a system partition to dynamic. After the disk is upgraded and the computer is rebooted, the system partition becomes a system volume, which retains its active status.

Upgrading a basic disk with a system partition to a dynamic disk preserves the partition table information, which is required when reinstalling Windows 2000.

See also the [“Boot Partition or Volume”](#) and the [“System Partition or Volume”](#) glossary entries and the sections [“Mark a Partition as Active”](#) on page 131 and [“Mark Volume Active”](#) on page 134.



Active/Passive

The mode in which DMP allocates data transfer to and from an array across a path designated as the “Preferred Path.” The Preferred Path is always active, and the other path or paths act as backups that are called into service if the current operating path fails. This option does not provide load balancing.

See also the “[Active/Passive](#)” and “[Load Balancing](#)” glossary entries.

Automatic Volume Growth Based on Capacity

This procedure uses a script that will automatically grow a volume when it reaches a certain percentage of capacity. With automatic volume growth, you can conserve disk space on your servers because space is distributed to users on an as-needed basis, and you do not have to be available to allocate the new disk space.

See also “[Automatic Volume Growth Based on Capacity](#)” on page 414.

Basic Disk

A basic disk adheres to the partition-oriented scheme of Windows NT, Windows 95/98, and MS-DOS. Basic disks can also contain RAID volumes that were created in NT Disk Administrator, including spanned volumes (volume sets), mirrored volumes (mirror sets), striped volumes (stripe sets), and RAID-5 volumes (stripe sets with parity). In addition, CD-ROMs and removable-media disks are considered basic disks.

See also the section “[What Can You Do with a Basic Disk?](#)” on page 122.

Basic Group

A disk group that contains all the basic disks on a server.

See also the “[Dynamic Disk Group](#)” and “[Disk Group](#)” glossary entries.

Basic Volume

In Volume Manager, basic volumes refer to all the volumes that are on basic disks. Basic volumes can be primary or extended partitions, simple logical drives that reside on extended partitions, or RAID volumes that were originally created in Windows NT Disk Administrator. Volume Manager allows you to maintain and repair these NT Disk Administrator basic volumes but not to create new ones.

Boot Disk

A user-created floppy disk that can be used to access a drive with a faulty startup sequence. This disk can access a drive that has the NTFS, FAT, or FAT32 file system installed.

The boot floppy is called a “Windows 2000 startup floppy disk” in the Windows 2000 documentation. Search on this phrase on the Microsoft web site to locate instructions for creating this startup floppy disk. It has to include the files NTLDR, Ntdetect.com, and Boot.ini from the Windows 2000 Setup CD.

See also the section “[Mirroring a Dynamic Boot or System Volume](#)” on page 155.

Boot Partition or Volume

The volume, formatted with an NTFS, FAT, or FAT32 file system, that contains the Windows 2000 operating system and its support files. The boot volume can be in the same location as the system volume. In Windows NT and in Windows 2000, the system partition or volume is the one the computer starts from, while the boot volume is the one that has the operating system and support files.

See also the “[System Partition or Volume](#)” glossary entry.

Capacity Monitoring

Refers to Volume Manager’s capability of monitoring dynamic volume capacities, so that when any volume reaches preset size thresholds, the user is notified with an alert message.

See the section “[Capacity Monitoring for All Volumes](#)” on page 61.

Column

A column refers to an area on the disk where all or a portion of the volume resides. Striped volumes, RAID-5, and mirrored striped (RAID 1+0) volumes contain multiple columns. Other volume types contain one column.

Plexes, columns, and subdisks are the constituent parts of the volume. You will see them displayed in the Verify Disks screen in the Create Volume wizard. This screen appears near the end of the volume creation process, so that you can verify the volume characteristics.

Concatenation

Storing data either on one disk (simple) or on disk space that spans more than one disk (spanned).

Dirty Region Logging (DRL)

Dirty region logging (DRL) uses a log-based recovery method to quickly resynchronize all the copies of a mirrored volume when a system is restarted following a system crash. A log can be created when a volume is created, or it can be added later.

See also “[Dirty Region Logging for Mirrored Volumes](#)” on page 259.



Disk

A physical data storage device attached to a computer.

See also the “[Basic Disk](#)” and “[Dynamic Disk](#)” glossary entries.

Disk Evacuation

The Evacuate Disk command moves the entire contents of a healthy disk to the free space on one or more dynamic disks. If there is a failed volume on the original disk, the volume cannot be moved and an error message will appear.

See also “[Evacuate Disk](#)” on page 110.

Disk Group

Volume Manager organizes disks into disk groups. Disk groups provide a way of organizing disks in a system and simplifying storage management for systems with large numbers of disks. They also allow you to move disks between computers so that you can easily transfer the storage between computers.

All basic and dynamic volumes are required to be in a disk group. There is only one disk group for basic disks, known as the Basic Group. There can be one or more dynamic disk groups, which are known as dynamic groups. Disks within a dynamic group share a common configuration. Dynamic volumes are created within a dynamic group and are restricted to using disks within that group.

See also “[Disk Groups](#)” on page 93.

Disk Replacement

The Replace Disk command allows you to replace a failed disk with an empty basic disk. The volume configuration will be recreated on the new disk. The contents of non-redundant volumes are not guaranteed. Redundant volumes will be automatically resynchronized.

See also “[Replace Disk](#)” on page 110.

Disk Signature

The disk signature identifies the disk to the operating system. Windows 2000 requires that a disk have a signature before it can be used. Once a signature is written on a disk, the disk will display as a basic disk.

See also “[Disk type shows no signature](#)” on page 445 and “[Add a Disk Signature to a Disk](#)” on page 107.

Disk Striping

Disk striping writes data across multiple disk drives instead of just one disk. Disk striping involves partitioning each drive storage space into stripes that can vary in size. These stripes are interleaved in a repeated sequential manner. The combined storage space is composed of stripes from each drive.

See also [“RAID Level 0 \(Striping\)”](#) on page 100.

Dynamic Disk

A dynamic disk is a physical disk that can contain dynamic volumes created with Volume Manager. A dynamic volume organizes space on one or more physical disks by using a specific type of volume layout. The six types of dynamic volume layouts are simple, spanned, mirrored, striped, RAID-5, and mirrored striped (RAID 1+0).

On a dynamic disk, space is organized through volumes rather than partitions. Because a dynamic disk does not have the partitioning scheme used by Windows NT, Windows 95/98, and MS-DOS, you cannot access dynamic disks through those operating systems.

See also the [“Basic Disk”](#) glossary entry.

Dynamic Disk Group

A dynamic disk group contains dynamic disks and dynamic volumes. In Volume Manager for Windows 2000, you can have multiple dynamic disk groups.

See also [“Disk Groups”](#) on page 93.

Dynamic Volume

Dynamic volumes are volumes created on dynamic disks by using Volume Manager. On a dynamic disk, storage is divided into dynamic volumes instead of partitions. A dynamic volume consists of a portion or portions of one or more physical disks and is organized in one of six volume layouts. The six types of dynamic volumes—simple, spanned, mirrored, striped, RAID-5, and mirrored striped (RAID 1+0)—are described in the section [“Dynamic Volume Types”](#) on page 89. The size of a dynamic volume can be increased if the volume is formatted with NTFS and there is unallocated space on a dynamic disk within the dynamic disk group onto which the volume can be extended. See [“Resize a Dynamic Volume”](#) on page 151 for further information.

You can create any number of dynamic volumes in the unallocated space on a disk or create volumes that span two or more disks. Each volume on a disk can have a different file system, such as the file allocation table (FAT or FAT32) file system or the Microsoft Windows NT file system (NTFS).



Extended Partition

A portion of a basic disk that can contain logical drives. Use an extended partition if you want to have more than four volumes on your basic disk. A basic disk can contain up to four primary partitions or three primary partitions plus an extended partition. The extended partition can be further divided into up to 32 logical drives.

See also the “[Basic Disk](#),” “[Logical Drive](#),” “[Partition](#),” and “[Primary Partition](#)” glossary entries.

FastResync (FR)

FastResync is a part of the VERITAS FlashSnap feature. FR supports resynchronization of mirrors by copying only changes to the temporarily split mirror by using FR logging. This reduces the time it takes to rejoin a split mirror to the mirror set and also reduces the server CPU cycles needed to complete the resynchronization. This feature’s added functionality makes the process of splitting a mirror off for tasks such as third mirror backup, data mining, and snapshots much easier to implement. FastResync can also be used on ordinary mirrored volumes to speed up resynchronization.

See also “[FastResync](#)” on page 317.

FAT and FAT32

FAT and FAT32 are file systems that are defined as follows:

- ◆ FAT (File Allocation Table) — A file system used by MS-DOS, Windows 3.x, and Windows 95/98. Microsoft Windows NT and Windows 2000 also can use the FAT file system. The operating system maintains a table to keep track of the status of various segments of disk space used for file storage.
- ◆ FAT32 (File Allocation Table) — A derivative of the file allocation table (FAT) file system. FAT32 supports smaller cluster sizes than FAT, thus providing more efficient space allocation on FAT32 drives. FAT32 is designed for larger disks than FAT.

See also the “[NTFS](#)” glossary entry.

Failover

With the Dynamic Multipathing software, failover refers to the automatic process where an alternative path to data on a storage array is activated when the current data path fails.

Fault Tolerance

The characteristic of ensuring data integrity when hardware failures occur.

FlashSnap

VERITAS FlashSnap is a multi-step process that allows you to create independently addressable multi-purpose volumes (MPVs) that are copies or mirrors of the volumes on your server. These MPVs can be easily moved to another server for backup or other purposes, such as loading or updating data warehouses or performing application testing with real production data while business continues.

FlashSnap makes use of FastResync, several Snapshot commands, and the Dynamic Disk Group Split and Join commands. For more on FlashSnap, see the section “[VERITAS FlashSnap](#)” on page 313.

Foreign Disk

The status of a dynamic disk that was created on another computer and moved to the current computer, or the status of a disk that was moved or deleted from a computer and then returned to it.

See “[Merge Foreign Disk Command](#)” on page 174 and “[Bringing a Foreign Disk Back to an Online State](#)” on page 434.

Free Space

Available space that can be used to create a primary or extended partition or a logical drive on a basic disk or to create a dynamic volume on a dynamic disk.

FT Disk

Refers to a disk that contains FT volumes that are created in Windows NT Disk Administrator. See the next entry for definition of FT volumes.

FT Volume

Refers to a RAID volume that was originally created in Windows NT Disk Administrator. These volumes include spanned volumes (volume sets), mirrored volumes (mirror sets), striped volumes (stripe sets), and RAID-5 volumes (stripe sets with parity). The FT refers to fault tolerant, even though some of the volume sets are not fault tolerant.

Volume Manager can maintain and repair these volumes, but it cannot recreate them. You can, however, upgrade a disk that contains these volumes to dynamic, and the volumes will be converted to dynamic volumes of the corresponding type. See “[Converting NT Disk Administrator Basic Volumes to Dynamic Volumes](#)” on page 135 for details.

Hot Relocation

When a disk fails, hot relocation automatically moves all subdisks from redundant volumes on the failed disk to hot spare disks, or to free space on other disks if enough space is not available on hot spare disks.

See also “[About Hot Relocation Mode](#)” on page 262.



Hot Spare

If there are I/O errors anywhere on a disk, all healthy subdisks and subdisks of redundant volumes on that disk will automatically be moved to a designated spare disk.

See also “[About Hot Relocation Mode](#)” on page 262.

Hot Spot

A hot spot is an area of high I/O activity that may cause bottlenecks in I/O throughput. The Online Monitoring window and the Volume to Disk Mapping window display a hot spot indicator. For more information, see “[Online Monitoring Window Features](#)” on page 228 and “[Volume to Disk Mapping](#)” on page 237.

Load Balancing

Refers to the process of balancing the data load between disks so that I/O demands are spread as evenly as possible across an I/O subsystem’s resources. With Volume Manager 3.0 and 3.1 for Windows 2000, load balancing is achieved either by moving subdisks between disks or by using the Active/Active path configuration with DMP to distribute the data load across multiple disks.

Logical Drive

A logical drive is a simple volume that resides on an extended partition on a basic disk. Logical drives are limited to the space on the extended partition. They cannot span multiple disks. A logical drive can be formatted and assigned a drive letter.

An extended partition can be subdivided into as many as 32 logical drives. You can use all or part of the free space in an extended partition when creating logical drives.

See also the “[Basic Disk](#),” “[Boot Partition or Volume](#),” and “[Extended Partition](#)” glossary entries.

LUN

Logical Unit Number — The number that, when combined with the Target ID, uniquely identifies a disk on the port.

Mirrored Striped Volume

RAID 1+0 volumes are mirrors of striped volumes. For example, a two-disk stripe can be mirrored to two additional disks. This RAID type provides the advantages of both speed (from striping) and fault tolerance (from mirroring). You can add more mirrors to a mirrored striped volume, and you can extend this type of volume onto additional dynamic disks within the dynamic disk group.

See also “[RAID Level 1+0 \(Mirrored Striped Volumes\)](#)” on page 101.

Mirrored Volume (RAID-1)

A mirrored dynamic volume is a fault-tolerant volume that duplicates your data on two or more physical disks. A mirror provides redundancy by simultaneously writing the same data onto two or more separate mirrors (or plexes) that reside on different disks. If one of the disks fails, data continues to be written to and read from the unaffected disk or disks. Volume Manager for Windows 2000 supports up to 32 mirrors.

In contrast, the mirrored volumes originally created in Disk Administrator and supported for use on basic disks have only two mirrors.

A mirrored volume is slower than a RAID-5 volume in read operations but faster in write operations. You can create mirrored volumes only on dynamic disks. In Volume Manager for Windows 2000, you can extend mirrored volumes.

See also [“Dynamic Mirrored Volumes”](#) on page 91 and [“RAID Level 1 \(Mirroring\)”](#) on page 100.

Monitor Interval

DMP (Dynamic Multipathing) monitors the paths to an array to determine whether they are functioning properly. The Monitor Interval specifies the time interval for the monitoring of that array.

NTFS

An advanced file system designed for use specifically within the Windows NT and Windows 2000 operating systems. It supports file system recovery, extremely large storage media, long file and folder names, and file and folder compression. NTFS is also called the Windows NT file system.

If you want to extend a dynamic volume in Volume Manager, you must format it with NTFS.

See also the [“FAT and FAT32”](#) glossary entry.

Off-Host Backup

Refers to a situation in which the processing of the backup of a server is moved to another server. This allows the applications on the working server to be maintained at a consistently higher performance level because the backup is performed on another machine. In Volume Manager 3.0 and 3.1 for Windows 2000, off-host backup is done by using the FlashSnap process.

See also the [“Same-Host Backup”](#) glossary entry and [“Summary of Steps for Off-Host and Same-Host Backup”](#) on page 401.



Parity

Redundant information that is associated with a block of information. In VERITAS software, parity is a calculated value used to reconstruct data after a failure.

RAID-5 volumes stripe data and parity intermittently across a set of disks. Within each stripe, the data on one disk is parity data and the data on the other disks is normal data. RAID-5 volumes, therefore, require at least three disks to allow for this extra parity information. When a disk fails, VERITAS software uses the parity information on the good disks to recreate the data on the failed disk.

See the [“RAID-5 Volume”](#) glossary entry, as well as the sections [“Dynamic RAID-5 Volumes”](#) on page 92 and [“RAID Level 5 \(Striping with Distributed Parity\)”](#) on page 101.

Partition

A portion of a physical disk that functions as though it were a physically separate disk. Partitions can be created only on basic disks. Partitions cannot span disks; they must be contiguous regions. When a basic disk that contains partitions is upgraded to a dynamic disk, the partitions become simple volumes on the dynamic disk.

See also the [“Extended Partition,”](#) [“Primary Partition,”](#) and [“System Partition or Volume”](#) glossary entries.

Plex

A plex refers to an instance of the volume. Mirrored volumes have two or more plexes. All other volumes have one plex.

Plexes, columns, and subdisks are the constituent parts of the volume.

Polling Interval

The polling interval is the interval at which Volume Manager checks volume capacities. The minimum and default value is 20 seconds. See the section [“Capacity Monitoring for All Volumes”](#) on page 61.

Preferred Path

The Preferred Path command on the DMP menu is used to specify the currently selected path as the preferred path to the disk. This menu option is available only when the operational mode for the array's paths to the disks is specified as Active/Passive. The Preferred Path is the path that is used to transfer data to and from the disks. For the specific steps in selecting the Preferred Path, see [“Specifying the Preferred Path”](#) on page 368.

See also the glossary entries [“Active/Active”](#) and [“Active/Passive.”](#)

Primary Partition

A volume you create by using unallocated space on a basic disk. Microsoft Windows NT and other operating systems can start from a primary partition. You can create up to four primary partitions on a basic disk, or three primary partitions and an extended partition. Primary partitions can be created only on basic disks and cannot be subpartitioned. However, the extended partition can be further divided into as many as 32 logical drives.

See also the “[Partition](#)” and “[Extended Partition](#)” glossary entries.

Projection

In the Disk View, the Projection command highlights all the subdisks associated with a selected volume and shows the volume configuration across disks.

See also “[Projection](#)” on page 60.

Providers

In Volume Manager, providers are similar to drivers. Each provider manages a specific hardware or software storage component. For example, there is a disk provider that manages all disks that Windows 2000 sees as disks. The providers discover the existing physical and logical entities and store that information in Volume Manager’s distributed database.

Purge Disks

The DMP command Purge Disks allows you to remove failed paths from the GUI display when all the paths on an array fail. The command also removes all disk objects associated with the array from the GUI. The command does not disconnect the failed path hardware. For more information about this command, see “[Purge Disks](#)” on page 354.

RAID

RAID (Redundant Array of Independent Disks) is a collection of specifications that describe a system for ensuring the reliability and stability of data stored on large disk subsystems. For full details on the RAID terminology and the RAID levels that VERITAS software supports, see the section “[RAID Terminology](#)” on page 98.

RAID-5 Logging

RAID-5 logging ensures prompt recovery of a RAID-5 volume after a system crash. With RAID-5 logging, updates need to be made only to the data and parity portions of the volume that were in transit during the system crash. Thus, the entire volume does not have to be resynchronized. A log can be created when a volume is created, or it can be added later.

See also “[RAID-5 Logging](#)” on page 259.



RAID-5 Volume

A RAID-5 volume is a fault-tolerant volume with data and parity striped intermittently across three or more physical disks. Parity is a calculated value that is used to reconstruct data after a failure. If a portion of a physical disk fails, you can recreate the data that was on the failed portion from the remaining data and parity. You can create RAID-5 volumes only on dynamic disks. You cannot mirror RAID-5 volumes.

See also the sections “[Dynamic RAID-5 Volumes](#)” on page 92 and “[RAID Level 5 \(Striping with Distributed Parity\)](#)” on page 101.

RAID 1+0 Volume

See the glossary entry “[Mirrored Striped Volume.](#)”

Region

Contiguous area of storage on a disk. These regions can also be referred to as subdisks.

See the glossary entry “[Subdisk.](#)”

Same-Host Backup

Refers to a situation in which the backup process of a server is done on the server itself. This is the most common method of backup. Same-host backup can be done by using the FlashSnap procedure.

See also the “[Off-Host Backup](#)” glossary entry and “[Summary of Steps for Off-Host and Same-Host Backup](#)” on page 401.

Simple Dynamic Volume

A simple dynamic volume consists of a single contiguous region (or subdisk) on a single physical disk. This definition of simple volume is different from the Windows 2000 Disk Management definition, which allows a simple volume to have multiple subdisks on the same disk.

Simple dynamic volumes can be extended or mirrored. You can extend a simple volume within the same disk or onto additional disks.

When a basic disk with a partition is upgraded, the partition becomes a simple volume. An extended partition on a basic disk also becomes a simple volume when the disk is upgraded to dynamic.

See also “[Dynamic Simple Volumes](#)” on page 90.

Spanned Volume

A volume made up of disk space on more than one physical disk. You can add more space to a spanned volume by extending it at any time. You can create spanned volumes only on dynamic disks. Spanned volumes by themselves are not fault tolerant. However, they can be mirrored to be made fault tolerant.

See also [“Dynamic Spanned Volumes”](#) on page 90.

Startup Floppy Disk for Windows 2000

For information on this topic, see the [“Boot Disk”](#) glossary entry.

Statistics Threshold

The statistics threshold is the minimum amount of I/O per second that a disk or subdisk has to have to display a color other than blue on its status icon. Blue designates the lowest state, Low I/O activity. The default threshold is 15. You set this threshold in the Configure Statistical Parameters window. For details, see the section [“Selecting Online Display Options”](#) on page 232.

Striped Volume (RAID-0)

A volume that stores data in stripes on two or more physical disks. Data in a striped volume is allocated alternately and evenly (in stripes) to the disks of the striped volume. You can create striped volumes only on dynamic disks. Striped volumes by themselves are not fault tolerant; however, they can be mirrored to be made fault tolerant. They also can be extended.

See also [“Dynamic Striped Volumes”](#) on page 90.

Subdisk

Refers to a region of contiguous space on a disk. Subdisks are the basic units in which Volume Manager allocates disk space in a volume. A Volume Manager disk can be divided into one or more subdisks. Each subdisk represents a specific portion of the volumes on a dynamic disk.

A Volume Manager disk may contain multiple subdisks, but subdisks cannot overlap or share the same portions of a Volume Manager disk. Any Volume Manager disk space that is not part of a subdisk is considered to be unallocated space, which can be used to create new volumes.

You can move subdisks to improve disk performance. For information about moving subdisks, see [“Moving Subdisks”](#) on page 251.

Subsystem

Refers to all the objects on a hardware RAID controller array. Volume Manager 3.0 and 3.1 for Windows 2000 do not support hardware controller arrays.



System Partition or Volume

The partition or volume that has the files needed to load the operating system. It is the same as the active partition or volume. In Windows NT and in Windows 2000, the system partition or volume is the one the computer starts from, while the boot volume is the one that has the operating system and support files. The system partition or volume and the boot partition or volume can share the same partition or volume.

See also the “[Active Partition or Volume](#)” and the “[Boot Partition or Volume](#)” glossary entries.

Target ID

The number that, when combined with the LUN, uniquely identifies a disk on the port.

Threshold Error

The percentage of volume capacity at which Volume Manager reports an error. The default is 90%.

See the section “[Capacity Monitoring for All Volumes](#)” on page 61.

Threshold Warning

The percentage of volume capacity at which Volume Manager sends out a warning message. The default is 80%.

See the section “[Capacity Monitoring for All Volumes](#)” on page 61.

Unallocated Space

Available disk space that is not allocated to any partition, logical drive, or volume. The type of object you can create on unallocated space depends on the disk type (basic or dynamic). For basic disks, you can use unallocated space outside partitions to create primary or extended partitions. You can use free space inside an extended partition to create a logical drive. For dynamic disks, you can use unallocated space to create dynamic volumes.

See also the “[Free Space](#)” glossary entry.

Volume

A volume is a logical entity that is made up of a portion or portions of one or more physical disks. A volume can be formatted with a file system and can be accessed by a drive letter or a mount path. Like disks, volumes can be basic or dynamic.

See also the “[Basic Volume](#)” and “[Dynamic Volume](#)” glossary entries.

Volume to Disk Mapping

Volume to Disk Mapping tracks the I/O activity level for disks and subdisks within a selected disk group. The Disk/Volume Map command provides a graphical display that shows the I/O activity level of each volume on its associated disks and subdisks and allows you to see at a glance any areas with High or Critical activity levels.

Volume Read Policy

The volume read policy on a dynamic volume allows you to specify either that a particular mirror be used for reads or that all mirrors be read in turn in “round-robin” fashion for each nonsequential I/O detected. When a particular mirror is selected, it becomes known as the “preferred mirror.” In Volume Manager 2.7 for Windows 2000, this mirror was known as the “preferred plex.”

See also [“Setting the Volume Read Policy”](#) on page 159.





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