

# **VERITAS Storage Foundation™ 4.1**

## **Release Notes**

**HP-UX**

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# VERITAS Storage Foundation Release Notes

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This document provides release information about the products in the VERITAS Storage Foundation 4.1 HP-UX product suite:

- ◆ VERITAS Storage Foundation (Standard, Standard HA, Enterprise, and Enterprise HA)
- ◆ VERITAS Volume Manager (VxVM)
- ◆ VERITAS File System (VxFS)
- ◆ VERITAS Storage Foundation *for Oracle* (Standard, Enterprise, and HA Editions), formerly known as VERITAS Database Edition *for Oracle*.

Each of these products is activated by a single license key. You must obtain a license key before installing the product. For information on obtaining a license key, see the *VERITAS Storage Foundation Installation Guide*.

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**Note** For the latest information on updates, patches, and software issues regarding this release, see the following TechNote on the VERITAS Technical Support website: <http://support.veritas.com/docs/275787>.

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Review this entire document before installing the VERITAS Storage Foundation product.

This document does not contain release information for VERITAS Volume Replicator or VERITAS Cluster Server. For release information on these products, see the *VERITAS Volume Replicator Release Notes* and the *VERITAS Cluster Server Release Notes*.

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**Note** Throughout this document, reference numbers for issues are included in square brackets, for example [xxxxxx], where xxxxxx is a number. If you contact VERITAS Technical Support about an issue, please provide the reference number where available.

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## Storage Foundation Product Suites

The following table lists the VERITAS products and optionally licensed features available with each Storage Foundation product suite.

Storage Foundation Version	Products and Features
Storage Foundation Standard	VERITAS Volume Manager VERITAS File System  <b>Optionally licensed features:</b> VERITAS Volume Replicator Option
Storage Foundation Standard HA	VERITAS Volume Manager VERITAS File System VERITAS Cluster Server  <b>Optionally licensed features:</b> VERITAS Volume Replicator Option
Storage Foundation Enterprise	VERITAS Volume Manager VERITAS File System VERITAS FlashSnap Option  <b>Optionally licensed features:</b> VERITAS Volume Replicator Option
Storage Foundation Enterprise HA	VERITAS Volume Manager VERITAS File System VERITAS Cluster Server VERITAS FlashSnap Option  <b>Optionally licensed features:</b> VERITAS Volume Replicator Option
Storage Foundation <i>for Oracle</i> Standard	VERITAS Storage Foundation <i>for Oracle</i> VERITAS Volume Manager VERITAS File System VERITAS Quick I/O Option VERITAS Extension for Oracle Disk Manager Option



Storage Foundation Version	Products and Features
Storage Foundation <i>for Oracle</i> Enterprise	VERITAS Storage Foundation <i>for Oracle</i> VERITAS Volume Manager VERITAS File System VERITAS FlashSnap Option VERITAS Quick I/O Option VERITAS Extension for Oracle Disk Manager Option VERITAS Storage Checkpoint Option VERITAS Storage Mapping Option  <b>Optionally licensed features:</b> VERITAS Volume Replicator Option
Storage Foundation <i>for Oracle</i> Enterprise HA	VERITAS Storage Foundation <i>for Oracle</i> VERITAS Volume Manager VERITAS File System VERITAS Cluster Server VERITAS FlashSnap Option VERITAS Quick I/O Option VERITAS Extension for Oracle Disk Manager Option VERITAS Storage Checkpoint Option VERITAS Storage Mapping Option  <b>Optionally licensed features:</b> VERITAS Volume Replicator Option



## Product and Feature Descriptions

The following are brief descriptions of the various products and features that are part of VERITAS Storage Foundation:

- ◆ [VERITAS Volume Manager](#)
- ◆ [VERITAS File System](#)
- ◆ [VERITAS Storage Foundation for Oracle](#)
- ◆ [VERITAS Volume Replicator](#)
- ◆ [VERITAS Cluster Server](#)

### VERITAS Volume Manager

VERITAS Volume Manager is a storage management tool that removes the physical limitations of disk storage so that you can configure, share, manage, and optimize storage I/O performance online without interrupting data availability. VxVM also provides easy-to-use, online storage management tools to reduce planned and unplanned downtime.

### VERITAS File System

VERITAS File System provides high performance and online management capabilities to facilitate the creation and maintenance of file systems. File systems are a collection of directories organized into a structure that enable you to locate and store files. All information is eventually stored in a file system.

The primary purposes of a file system are to:

- ◆ Provide shared access to data storage.
- ◆ Provide structured access to data.
- ◆ Control access to data.
- ◆ Provide a common, portable application interface.
- ◆ Enable the manageability of data storage.



## Using VERITAS Quick I/O

The VERITAS File System package, `VRTSvxfs`, includes the VERITAS Quick I/O for Databases feature. This feature is described in the *VERITAS File System Administrator's Guide*. Quick I/O is intended for operation only with VERITAS Storage Foundation for Databases products. See [“Getting Help”](#) on page 53 for contact information on VERITAS products.

## Using Cluster File Systems

VERITAS Storage Foundation Cluster File System (SFCFS) is the file system clustering functionality of VxFS. SFCFS is a separately licensable feature of VxFS that requires several other VERITAS products to enable communication services and provide shared disk storage resources. VERITAS Cluster Server and VERITAS Volume Manager are packaged with VxFS to provide a complete clustering environment. There is also a high availability version, VERITAS Storage Foundation Cluster File System HA. See [“Getting Help”](#) on page 53 for contact information on these products.

## VERITAS Storage Foundation for Oracle

VERITAS Storage Foundation *for Oracle* combines the strengths of the core VERITAS products with database-specific enhancements to offer unrivaled performance, availability, and manageability for databases. The database feature options are as follows:

### VERITAS FlashSnap Option

The VERITAS FlashSnap option, when applied to databases, lets you create, resynchronize, and reverse resynchronize volume snapshots for databases. The snapshots can be used on a second host. Also, database administrators can perform these tasks without root privileges.

This option is available with the Enterprise version of VERITAS Storage Foundation *for Oracle*.

### VERITAS Quick I/O Option

VERITAS Quick I/O is a VERITAS File System feature that improves the throughput for databases built on VERITAS File Systems. Quick I/O delivers raw device performance to databases run on VxFS, providing the administrative advantages of using file systems without performance penalties. VERITAS Cached Quick I/O further enhances database performance by leveraging large system memory to selectively buffer frequently accessed data.



This option is available with the Enterprise version of VERITAS Storage Foundation *for Oracle*.

### **VERITAS Extension for Oracle Disk Manager Option**

VERITAS Extension for Oracle Disk Manager is a custom storage interface designed specifically for Oracle9i and 10g. Oracle Disk Manager improves the performance and manageability of system bandwidth through an improved application programming interface (API) that contains advanced kernel support for file I/O.

This option is available with both the Standard and Enterprise versions of VERITAS Storage Foundation *for Oracle*.

### **VERITAS Storage Checkpoint Option**

VERITAS Storage Checkpoint technology lets you create a point-in-time image of a file system or a database. Storage Checkpoints are treated like any other VxFS file system and can be created, mounted, unmounted, and removed.

This option is available with the Enterprise versions of VERITAS Storage Foundation *for Oracle*.

### **VERITAS Storage Mapping Option**

Storage Mapping lets you map datafiles to physical devices and display storage object I/O statistics. Both storage object I/O statistics and the storage structure can be displayed for a specific file.

This option is available with the Enterprise versions of VERITAS Storage Foundation *for Oracle*.

In addition, with VERITAS Storage Foundation *for Oracle*, mapping information showing which tablespaces reside on which physical disks can be obtained for a specified database.

## **VERITAS Volume Replicator**

VERITAS Volume Replicator (VVR) is data-replication software designed to contribute to an effective disaster recovery plan by maintaining an exact or consistent copy of application data at one or more remote locations.



## **VERITAS Cluster Server**

VERITAS Cluster Server provides an open systems clustering solution that eliminates both planned and unplanned downtime, facilitates server consolidation and failover, and effectively manages a wide range of applications in heterogeneous environments.



## New and Enhanced Features

The following new features and enhancements have been incorporated into VERITAS Storage Foundation, VERITAS Volume Manager (VxVM), VERITAS File System (VxFS), and VERITAS Storage Foundation *for Oracle*.

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**Note** For information about new features in VVR, see the *VERITAS Volume Replicator Release Notes*. For information about new features in VCS, see the *VERITAS Cluster Server Release Notes*.

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### VERITAS Volume Manager

This release of VERITAS Volume Manager includes new features and enhancements.

#### Intelligent Storage Provisioning (ISP)

The Intelligent Storage Provisioning (ISP) service is an alternative to the traditional method of creating and managing volumes. ISP creates volumes from available storage with capabilities that you specify by consulting the externally defined rule base for creating volumes, and comparing it to the properties of the storage that is available. Because ISP is very rich in functionality, there is a new separate Administrator's Guide titled *VERITAS Volume Manager Intelligent Storage Provisioning Administrator's Guide*.

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**Note** Volumes created with the `vxassist` utility can be migrated for use with ISP. After migration, volumes can no longer be administered using `vxassist`.

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#### Dynamic Multipathing Enhancements

There are a number of enhancements in the area of the Dynamic Multipathing (DMP) feature:

- ◆ You can now use the `vxdmadm setattr` command to change the I/O policy for distributing I/O load across multiple paths to a disk array or enclosure. You can set policies for an enclosure, for all enclosures of a particular type, or for all enclosures of a particular array type (Active/Active or Active/Passive). Once configured, the I/O policies are persistent across reboots of the system. For more information, see the "Administering Dynamic Multipathing (DMP)" chapter of the *VERITAS Volume Manager Administrator's Guide*.
- ◆ With this release, the generic framework within the Device Discovery Layer (DDL) enables Dynamic Multipathing (DMP) to coexist with other third party multi-pathing drivers such as EMC PowerPath.



- ◆ Failback is now a cluster-wide operation that provides significant performance improvements.
- ◆ A/PF type arrays are now supported by DMP in a clustered environment.
- ◆ DMP supports the B\_FAILFAST flag if the underlying device driver exports the `ddi-failfast-supported` property. The B\_FAILFAST flag allows the disk drivers to avoid heroic, time-consuming retry behavior when it is not required or is inappropriate. The B\_FAILFAST flag is intended to allow modified error recovery behavior in the disk driver when no communication can be established with the device. However it does not dictate specific retry behavior, nor does it imply or guarantee deterministic failure times.

When I/O is requested to a device associated with the `ddi-failfast-supported` property, and the device has multiple paths available or I/O request is for a Read operation from a volume that has an alternate source (mirror), DMP will set the B\_FAILFAST flag in the I/O request. While DMP sets the B\_FAILFAST flag, DMP has no knowledge of whether the underlying disk driver's behavior is influenced by B\_FAILFAST.

- ◆ Performance improvements have been made to DMP.

## Device Discovery Layer Enhancements

The Device Discovery Layer (DDL) was introduced in an earlier release of VxVM. This release enhances the DDL by adding the following functionality:

- ◆ DDL services are now available to other VERITAS products through VERITAS Enterprise Administrator (VEA).
- ◆ Dynamic discovery of disks or their attributes
- ◆ Allowing DMP kernel extensions to support multipathing and/or load balancing in a configuration that is specific to a particular disk array.
- ◆ Integration with other discovery agents such as Storage Area Network (SAN) Access Layer (SAL) and VERITAS Array Integration Layer (VAIL).
- ◆ Previous releases of VxVM supported two naming schemes: OS-Native Scheme and Enclosure-based Naming. Although VxVM provided the means of changing between the two schemes dynamically, it was necessary to restart `vxconfigd` which is a time-consuming operation. With this release, the `vxconfigd` restart operation is no longer necessary.
- ◆ VxVM now supports persistent device names. The disk names, once assigned, will remain constant across reconfiguration and rebooting.
- ◆ Device discovery is now multi-threaded.



## Elimination of rootdg as a Special Disk Group

In previous versions of VxVM, a disk group with the name `rootdg` (root disk group) was required. This disk group had special properties, and often acted as the default disk group when a disk group had not been specified. For VxVM to function, the `rootdg` disk group had to exist, and it had to contain at least one disk. This release of VxVM does not require a `rootdg` disk group to be present on the system. You may find it convenient to create a system-wide default disk group, which need not be named `rootdg`.

For operations that require a disk group, the system-wide default disk group will be used if the VxVM command is not specified with the `-g` option. The main benefit of creating a default disk group is that the VxVM commands default to the default disk group and you will not need to use the `-g` option. To verify the default disk group after it has been created, enter the command:

```
# vxvg defaultdg
```

For further information, see the “Administering Disk Groups” chapter of the *VERITAS Volume Manager Administrator’s Guide*.

## Simplification of vxinstall

Because VxVM no longer requires a `rootdg` disk group to be configured, `vxinstall` has been much simplified, and you can no longer use this command to configure disk groups on your system after installation. You should now use `vxdiskadm` or the VERITAS Enterprise Administrator.

## Instant Snapshots

Instant (copy-on-write) snapshots are easier to configure and offer more flexibility of use than traditional third-mirror break-off snapshots. Once created, an instant snapshot is immediately available for use. For preference, new volumes should be configured to use instant snapshots, but this also requires rewriting of administration scripts that assume the traditional third-mirror snapshot model. Legacy volumes can also be reconfigured to use instant snapshots.

## Multi-Device Support

Multi-Device Support allows several volumes to be represented by a single logical object. All I/O to and from the underlying logical volume is directed via the I/O interfaces of the volume sets. This feature is designed primarily for the multi-device file system enhancement for VERITAS File System VxFS.



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## Configuration Backup and Restore Support

Configuration Backup and Restore support allows you to backup and restore or replicate all VxVM configuration data for disk groups and volumes. This applies only to VxVM configuration data and does not apply to user and application data.

## Cross-platform Data Sharing

Cross-platform Data Sharing (CDS) allows the sharing of data between heterogeneous systems where each system has direct access to the physical devices that are used to hold the data. Because CDS is very rich in functionality, there is a new separate Administrator's Guide titled the *VERITAS Storage Foundation Cross-Platform Data Sharing Administrator's Guide*.

With the introduction of the CDS, the format for a disk defaults to CDS rather than to `simple`, which was the format in earlier releases. In addition, the `simple` disk format has been renamed as `hpdisk`. For instructions on converting from a CDS format disk to a `hpdisk` format disk, see the "Creating and Administering Disk Groups" chapter in the *VERITAS Volume Manager Administrator's Guide*. The section, "Creating a Disk Group," includes information on disk formats and disk group formats.

The ability to import a Cross-platform Data Sharing (CDS) disk group on a platform that is different from the platform on which the disk group was last imported is controlled by a CDS license. CDS does not normally require an "Add-on" license, however if you want to import a disk group from a platform that is different from your own platform, you will need an "Add-on" license. CDS licenses are included as part of the VERITAS Storage Foundation license.

CDS disk groups have certain physical disk alignment restrictions for subdisk. For more information on this feature and CDS disk groups in general, see the *VERITAS Cross-platform Data Sharing Administrator's Guide*

A further change in this release is that the default disk type is now `auto`. This means that disks that used to show up in the output from `vxdisk list` as `simple` will now show up as `auto:hpdisk`.

CDS does not support VERITAS Volume Replicator (VVR).

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**Note** The CDS feature is also referred to as Portable Data Containers.

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## Hitachi Extended Copy Facility

The Hitachi E-Copy facility allows a host server to request data movement from disk to tape or to another disk without the overhead of server CPU time I/O during the actual movement of data.



## Storage Expert

System Administrators sometimes find that gathering and interpreting data about large and complex configurations can be a difficult task. Consisting of a set of simple commands that collect and analyze VxVM configuration data, Storage Expert produces a summary report that recommends configuration improvements.

## Detecting and Correcting the Serial Split Brain Condition in a Disk Group

Under certain circumstances a serial split brain condition can occur in a disk group where the actual serial numbers on disks are different from those listed in the configuration database copies on the disks. To recover from such a situation, you can use the `vxsplitlines` command to diagnose the problem. This command also details other commands that you can use to correct the condition. For more information, see the “Creating and Administering Disk Groups” chapter of the *VERITAS Volume Manager Administrator’s Guide*.

## Online Node Addition

VxVM now allows you to add a node to a cluster dynamically.

## Dynamic LUN Expansion

Previous releases of VxVM did not allow you to take advantage of a change in the size of a disk once the disk had been initialized; any attempt to do so would result in loss of data.

In this release, Dynamic LUN Expansion (DLE) allows you to resize a virtual disk device while preserving the existing data. Once a LUN has been expanded, HP-UX commands such as `diskinfo` do not display the new size until you run the `vxdisk resize` command. See the description of the `resize` option on the `vxdisk(1M)` manual page and the *VERITAS Volume Manager Hardware Notes* for more information.

## Disability Requirements Conformance

VxVM is compliant with the US Government’s section 508 article.



## Menu-driven Installation

With this release, VxVM provides support for installation through a menu-driven front end. This enhancement, which will be common across all VERITAS products, is intended to provide a common look and feel to the installation experience. The traditional installation process using `pkgadd` is still supported, but users are encouraged to move to the menu-driven interface.

## Unique Number for Messages

To enable easy identification of messages, each message contains a unique identifier. Using this ID number when reporting messages to VERITAS support will enable them to respond more easily to customer requests.

## Enhancement of Local Detach Policy

Local Detach policy now works uniformly on both master and slave nodes in a cluster. If the master node cannot handle the local detach policy, it leaves the cluster rather than disabling disk groups.

## VxVM 4.1 Licenses

The following table shows the levels of licensing in VERITAS Volume Manager 4.1 and the features supported at each level:

VxVM License	Description of Supported Features
Base	Concatenation, spanning, rootability and root disk mirroring, multiple disk groups and VERITAS Enterprise Administrator (VEA).
Full	Concatenation, spanning, rootability, volume resizing, multiple disk groups, co-existence with native volume manager, striping, mirroring, DRL logging for mirrors, striping plus mirroring, mirroring plus striping, RAID-5, RAID-5 logging, Smartsync, hot sparing, hot-relocation, online data migration, online relayout, volume snapshots, Intelligent Storage Provisioning, FastResync with Instant Snapshots, Storage Expert, Device discovery Layer, multipath DMP, and VEA.
Add-on Licenses	Features that augment the Full VxVM license such as FlashSnap™ (FastResync and Dynamic Disk Group Split and Join) and clustering functionality (cluster-shareable disk groups and shared volumes).



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**Note** You need a Full VxVM license to make effective use of Add-on licenses to VxVM. For example, FastResync (a FlashSnap license feature) reduces the time taken to resynchronize volume snapshots (a Full VxVM license feature).

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To see the license features that are enabled in VxVM 4.1, enter the command:

```
# vxdctl license
```

## VERITAS File System

This release of VERITAS File System includes the following new features and enhancements.

### Cross-platform Data Sharing

Cross-platform Data Sharing (CDS) allows data to be serially shared among heterogeneous systems where each system has direct access to the physical devices that hold the data. This feature can be used only in conjunction with VERITAS Volume Manager.

There are two new VxFS commands associated with this feature:

<code>fscdstask</code>	Perform various CDS operations
<code>fscdsconv</code>	Convert the byte order of a VxFS file system

The CDS feature is also referred to as Portable Data Containers.

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**Note** To use the CDS feature, a VxFS license is required that enables CDS.

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### Multi-Volume Support

The Multi-Volume Support (MVS) feature allows several volumes to be represented by a single logical object. All I/O to and from an underlying logical volume is directed by way of *volume sets*. This feature can be used only in conjunction with VERITAS Volume Manager.

There are two new VxFS commands associated with this feature:

<code>fsapadm</code>	VxFS allocation policy administration utility.
<code>fsvoladm</code>	VxFS device administration utility.

Multi-volume file systems include the following functions in the MVS API:

<code>vxfs_ap_assign_ckpt</code>	<code>vxfs_ap_assign_file</code>	<code>vxfs_ap_assign_fs</code>
<code>vxfs_ap_define</code>	<code>vxfs_ap_enforce_file</code>	<code>vxfs_ap_enumerate</code>
<code>vxfs_ap_remove</code>	<code>vxfs_ap_query</code>	<code>vxfs_ap_query_ckpt</code>
<code>vxfs_ap_query_file</code>	<code>vxfs_ap_query_fs</code>	<code>vxfs_vol_add</code>
<code>vxfs_vol_deencapsulate</code>	<code>vxfs_vol_encapsulate</code>	<code>vxfs_vol_enumerate</code>
<code>vxfs_vol_remove</code>	<code>vxfs_vol_resize</code>	<code>vxfs_vol_stat</code>

---

**Note** To use the MVS feature, a VxFS license is required that enables MVS.

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## Large File Systems and Large File Support

The 4.1 release is the first VxFS release to support a new disk layout Version 6 that enables the creation of files and file systems up to 256 TB in size. File systems created on VxFS 4.1 will by default use the Version 6 disk layout. File systems larger than 1 TB can be created only on 64-bit kernels and must be created on VERITAS Volume Manager volumes. The maximum file system size on a 32-bit kernel is still 1 TB. A 32 TB file system requires a 2 K block size, a 64 TB file system requires a 4 K block size, and a 128 TB or larger file system requires an 8 K block size. File systems over 32 TB are called *extra large* file systems and require a license to create.

An online conversion utility, `vxupgrade`, is provided to upgrade existing disk layouts to Version 6 on mounted file systems.

VxFS has been tested on file systems up to 9.5 TB with physical storage. Using a virtual disk driver that emulates large devices, file systems up to 256 TB have been tested.

## Quality of Storage Service

The Quality of Storage Service (QoSS) option is built on the multi-volume support technology introduced in this release. Using QoSS, you can map more than one device to a single file system. You can then configure policies that automatically relocate files from one device to another, or relocate files by running file relocation commands. Having multiple devices lets you determine where files are located, which can improve performance for applications that access specific types of files. QoSS is managed using the VEA GUI, or the `fssweep`, `fsmove` and `fsrpadm` commands. QoS functionality is a separately licensable feature that is available with the `VRTSfspro` package.

There are three new commands associated with this feature:

`fsmove` Relocates files to a destination component volume.



<code>fssweep</code>	Traverses the directory structure of one or more file systems.
<code>fsrpadm</code>	Administers relocation policies.

---

**Note** To use the QoS feature, a VxFS license is required that enables QoS.

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## Storage Checkpoint Quotas

Usage limits can now be set on Storage Checkpoints. The following keywords were added to the `fsckptadm` command to administer Storage Checkpoints' quota functionality:

<code>getquotalimit</code>	Displays current quota limits, current usage, and flags set.
<code>setquotalimit</code>	Sets the hard limit and soft limits for Storage Checkpoint quotas.
<code>quotaon</code>	Turns Storage Checkpoint quotas on and off.
<code>quotaoff</code>	

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**Note** To use storage checkpoint quotas, a VxFS license is required to enable storage checkpoints.

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## Storage Checkpoint File System Restore

Storage Checkpoints can be used by backup and restore applications to restore either individual files or an entire file system. Restoring from Storage Checkpoints can recover data from incorrectly modified files, but typically cannot be used to recover from hardware damage or other file system integrity problems. File system restoration can be done using the `fsckpt_restore(1M)` administrative command.

There is one new command associated with this feature:

`fsckpt_restore` VxFS Storage Checkpoint restore utility.

---

**Note** To use storage checkpoint file system restore, a VxFS license is required to enable storage checkpoints.

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## File Change Log

The VxFS File Change Log (FCL) tracks changes to files and directories in a file system. The FCL can be used by applications, such as backup products, web crawlers, search engines, indexing engines, and replication software that typically scan an entire file system searching for modifications since a previous scan.

There is one new command associated with this feature:

`fcladm` VxFS File Change Log administration utility.

There are three new tunable parameters associated with this feature:

`fcl_keeptime` Specifies the minimum amount of time that the VxFS File Change Log (FCL) keeps records in the log.

`fcl_maxalloc` Specifies the maximum amount of space that can be allocated to the FCL.

`fcl_winterval` Specifies the interval that must elapse before the FCL records subsequent writes to a file.

See the `vxtunefs(1M)` online manual page for more information on tunable parameters.

The FCL feature includes the following function in the API:

`vxfs_fcl_sync` Sets a synchronization point in the VxFS File Change Log.

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**Note** FCL functionality is available with the Online JFS 4.1 license.

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## Reverse Name Lookup

The reverse path name lookup feature obtains the full path name of a file or directory by providing an inode number as an argument to the `vxlsino` administrative command. Reverse path name lookup can be useful in a variety of applications, such as for clients of the VxFS File Change Log feature, in backup and restore utilities, and in replication products.

There is one new command associated with this feature:

`vxlsino` VxFS reverse path name lookup utility.

The reverse name lookup feature includes the following function in the API:

`vxfs_inotopath` Returns path names for a given inode number.

`vxfs_inotopath_gen` Returns path names for a given inode number with a specific generation count.



## Intent Log Resize

With the Version 6 disk layout, the VxFS intent log can be increased or decreased using the `log` option of the `fsadm_vxfs`. Dynamically changing the intent log size can improve system performance. The maximum intent log size is now 2 GB. See the *VERITAS File System Administrator's Guide* and the `mkfs_vxfs(1M)` and `fsadm_vxfs(1M)` manual pages for more information on intent log size.

---

**Note** Intent log resize is a licensed feature and requires a Online JFS or full license.

---

## Named Data Streams

Traditional UNIX files have an inode identifier and a single stream of file data. Using named data streams, the inode is retained, but can now be associated with multiple data streams. In VxFS 4.1, the original data stream is accessed in the same way as in previous releases, but other data streams are referenced through a new directory inode associated with the file. The directory inode points to the new inodes, one per stream. The directory containing the named streams is not directly visible to the user.

VxFS named data stream functionality is available only through the following API functions:

<code>vxfs_nattr_link</code>	Links to a named data stream.
<code>vxfs_nattr_open</code>	Open a named data stream.
<code>vxfs_nattr_rename</code>	Renames a named data stream.
<code>vxfs_nattr_unlink</code>	Removes a named data stream.

## VxFS Enhancements and Changes

- ◆ The `fsadm` command now allows fragmentation reporting and defragmentation operations on an individual file or directory, or on Storage Checkpoints.
- ◆ Disk layout versions prior to Version 4 cannot be mounted. Use the `vxfsconvert` command to convert them to a disk layout version that can be mounted.
- ◆ The `vxupgrade` command now upgrades only Version 4 and Version 5 disk layouts. Disk layout versions prior to Version 4 cannot be mounted.
- ◆ The `largefiles` option is now the default file size option for the `mount` command and `mkfs` command.
- ◆ The `delaylog` option is now the default intent logging mount option. The change of the default mount option from `log` to `delaylog` does not increase the risk of data loss, but allows VxFS to cache data to improve performance. See the *VERITAS File System Administrator's Guide* for more information.

- ◆ The default Storage Checkpoint creation mode is now removable.
- ◆ Operation of the intent log replay was improved to increase the speed of recovery after a file system failure.
- ◆ The `histlog` function was implemented in the `fsdb_vxfs` command. The history log records structural changes to the file system to aid in product support.
- ◆ Two new tunable parameters, `inode_aging_count` and `inode_aging_size`, for use with the Storage Checkpoint API, were added to the `vxtunefs` command. See the `vxtunefs(1M)` manual page for more information.
- ◆ More VxFS functions can be performed from the VES GUI. See the *VERITAS Enterprise Administrator (VEA 500 Series) Getting Started* manual for more information.
- ◆ The `vxfsu_get_iooffsets` library call was renamed `vxfs_get_iooffsets`.
- ◆ `vx_ninode` and `vxfs_bc_bufhwm` can now be dynamically tuned without rebooting the machine. The changes take effect immediately, although they can be optionally made to take effect only after a reboot. See the *VERITAS File System Administrator's Guide* for more information.

## VERITAS Storage Foundation for Oracle

This release of VERITAS Storage Foundation *for Oracle* includes the following new features and enhancements.

### Storage Topology Analyzer

This release introduces functionality that maps tablespaces to physical disks and retrieves this mapping information, including the percentage of disk space used by a tablespace. This functionality is available using the CLI only.

### Unified Message Identifiers

Logging, error, and warning messages are now saved to a log file with a standard-format Unique Message Identifier. An example of the standardized format is:

```
SFORA rollback INFO V-81-3000 VxDBA Rollback for Database to a
Storage Checkpoint.
```



## Support for Multivolume File Systems in Storage Checkpoint Policy Administration

Storage Checkpoint policy administration functionality now allows database administrators to specify the volumes on which Storage Checkpoints can be created for each file system within the database. This allows you to control the space used by Storage Checkpoints and prevent Storage Checkpoints from fragmenting the space in the primary fileset. This functionality is available using the CLI.

## Storage Checkpoint Quota Administration

With VERITAS Storage Foundation for Oracle, you can now administer file system quotas for Storage Checkpoints for a database or for multiple file systems using the CLI.

## GUI Enhancements for Cloning a Database

The GUI has been enhanced to offer a single wizard for cloning a database using either a Storage Checkpoint or Database FlashSnap, as well as a single wizard for removing a clone database using either a Storage Checkpoint or Database FlashSnap.

## New CLI Commands

The following VERITAS Storage Foundation *for Oracle* CLI commands and corresponding online manual pages have been added:

---

Command Name	Description
<code>dbed_analyzer</code>	Maps tablespaces to physical disks and retrieves the information, including the percentage of disk space used by a tablespace.  This option is not available through the VxDBA utility menu or through the GUI.
<code>dbed_ckptpolicy</code>	Creates and administers Storage Checkpoint allocation policies for a Multi-Volume File System (MVS). You can display, create, update, assign, and remove Storage Checkpoint allocation policies using this command.  This option is not available through the VxDBA utility menu or the GUI.
<code>dbed_ckptquota</code>	Administers quotas for Storage Checkpoints.  This option is not available through the VxDBA utility menu or the GUI.

---



Command Name	Description
edgetmsg2	Manages message log files. This option is not available through the VxDBA utility menu or the GUI.

## Enhanced CLI Commands

The following VERITAS Storage Foundation *for Oracle* CLI commands have been enhanced:

Command Name	Description
dbed_clonedb	New options have been added that allow you to restart and remove a clone database created with a Storage Checkpoint. These options are <code>-o restartdb</code> and <code>-o umount</code> .
dbed_ckptcreate	A new <code>-p ckpt_policy[,ckpt_metadata]</code> option has been added that allows you to assign an allocation policy for Storage Checkpoint data. You can also optionally assign an allocation policy for Storage Checkpoint metadata.



# System Requirements

## HP-UX Operating System Requirements

The VERITAS Storage Foundation 4.1 product line operates on HP operating systems running releases September 2004 HP-UX 11i version 2.0 or later.

### ▼ To verify the operating system version

Use the `swlist` command as follows:

```
# swlist | grep HPUXBaseAux
HPUXBaseAux    B.11.23.0409 HP-UX Base OS Auxiliary
```

JFS must be installed on your system prior to installing any VERITAS software.

### ▼ To verify that JFS is installed

Use the `swlist` command as follows:

```
# swlist -l product JFS
JFS B.11.23    The Base VxFS File System
```

## Hardware Requirements

For information on hardware requirements, see the *VERITAS Volume Manager Hardware Notes*.

## Supported Oracle and HP-UX Combinations

The following list identifies the supported Oracle and HP-UX combinations if you plan to use VERITAS Storage Foundation with an Oracle database:

---

Oracle Release	September 2004 HP-UX 11i version 2.0 or later
9.2	Yes
10.1	Yes

---

## Hard Disk Array Support

To enable hard disk array support on VERITAS Storage Foundation *for Oracle*, you must install the following patches to September 2004 HP-UX 11i version 2.0 (update 2):

- ◆ PHSS\_32228
- ◆ PHSS\_32231

---

**Note** These patches apply only to the IA architecture.

---



## Known Issues

This section documents the known issues in this release of VERITAS Storage Foundation 4.1.

### VERITAS Storage Foundation Known Issue

To install a VERITAS Storage Foundation product, configure VERITAS Volume Manager as described in Chapter 2, "Installing the VERITAS Software," of the *VERITAS Storage Foundation Installation Guide*. Then, follow the instructions in Chapter 3, "Upgrading the VERITAS Software," of the *VERITAS Storage Foundation Installation Guide*.

Because VERITAS Volume Manager 3.5 and VERITAS File System 3.5 are bundled in the September 2004 HP-UX 11i version 2.0 release, a fresh installation is *not* possible. You must perform an upgrade to move to the 4.1 versions of the VERITAS products.

### VERITAS Storage Foundation for Oracle Known Issues

---

Incident	Description
299007 and 301804	Both of these incidents are related. If <code>dbed_vmchecksnap</code> is run with <code>-H</code> option and <code>/oracle/ora9i/</code> is specified as home rather than <code>/oracle/ora9i</code> (without the forward slash), you will see an error. Make sure to <i>not</i> add the <code>'/'</code> at the end

---

---

# Software Limitations

The following sections describe VERITAS Storage Foundation software limitations that exist in this release.

## VERITAS File System Software Limitations

### End of Product Support

- ◆ VxFS 4.1 does not support creating of file systems using Version 1 disk layout and mounting of file systems using Version 2 or 3 disk layouts. VxFS 4.1 still provides the capability to upgrade Version 3 disk layouts using the `vxfsconvert` utility, but this is the last release to do so. VERITAS recommends that you upgrade all older disk layouts.

The next major release will be the last to support the VxFS Version 4 and Version 5 disk layouts. VERITAS recommends that you upgrade file systems using these older disk layouts to Version 6. See “[Compatibility With Previous Versions of VxFS](#)” on page 25 for more information on upgrading.

- ◆ The QuickLog feature is not available in the VxFS 4.1 release. See the *VERITAS File System Administrator’s Guide* for information on migrating QuickLog devices to the multi-volume support function. The document is available on the Doc CD.
- ◆ This is the last release to support shared (cluster) mounts on VxFS disk layout Version 5 cluster file systems. Upgrade all current cluster file system disk layouts to Version 6 to enable new VERITAS File System features and to support upgrades in future releases.
- ◆ The `nau`, `ausize`, `aufirst`, `aupad` and `ninode` options to the `mkfs` command are not supported. The `mkfs` command will accept this option but ignore them without a warning. These options may be omitted from the `mkfs` command in future releases.

### Compatibility With Previous Versions of VxFS

VxFS 4.1 release does not supports creating or mounting disk layout Version 3 file systems. VxFS 4.1 is the last major release to support disk layout Version 4 and Version 5. VERITAS recommends upgrading any previously installed VxFS file system to the disk layout Version 6 that is available with VxFS 4.1.

---

**Caution** Do **not** upgrade `/stand` and `/` file systems to disk layout Version 6. The HP bootloader does not understand this layout.

---



The disk layout of a VxFS file system can be upgraded after installing VxFS 4.1. Use `vxupgrade(1M)` command to upgrade the disk layout from Version 4 or 5 to disk layout Version 6 on a mounted file system. Use `vxfsconvert(1M)` to convert an unmounted file system to VxFS disk layout Version 4.

---

**Note** A disk layout Version 6 file system created with VxFS 4.1 software will not be accessible if the VxFS 4.1 file system software is removed and the system is reverted to VxFS 3.5. In addition, if a disk layout Version 6 file system exists on a boot disk and VxFS 3.5 is removed, the host will not reboot successfully and will remain at the `bcheckrc` prompt. To reboot the host successfully, first edit the `fstab` file and comment out disk layout Version 6 file system entries.

---

See the *VERITAS File System Installation Guide* for more information on upgrading previous file system disk layout Versions. See the *VERITAS File System Administration Guide* for more information on supported disk layout Versions.

---

**Note** VxFS file systems must be cleanly unmounted before upgrading to the VERITAS File System 4.1 release from any previous release. For more information, see TechNote 265504, available at: <http://support.veritas.com/docs/265504>.

---

## VERITAS Storage Foundation for Oracle Software Limitations

### No Support for Intelligent Storage Provisioning

The Standard, Standard HA, Enterprise, and Enterprise HA versions of VERITAS Storage Foundation *for Oracle* do not support Intelligent Storage Provisioning (ISP).

### Disk Layouts Version 5 and Earlier Do Not Display Storage Checkpoint Quotas in the GUI

You can click the **Quota** tab for the Storage Checkpoint available via the GUI. If the file system and the Storage Checkpoint are on a version prior to Disk Layout Version 6, you will see the error 4646.

For Disk Layout Version 5 and earlier to display Storage Checkpoints Quotas via the GUI, perform the following steps:

1. Using VERITAS File System 3.5, create a file system.
2. Upgrade to VERITAS File System 4.1 but *do not* upgrade the file system.
3. Create a checkpoint and then click the **Quota** tab accessible via the GUI.

## Storage Checkpoint Limitations

- ◆ You cannot create a clone database using a mounted Storage Checkpoint. [32726]
- ◆ You must run the `dbed_update` command after upgrading to VERITAS Storage Foundation 4.1 *for Oracle* from a previous release. This will allow you to roll back to a Storage Checkpoint that was created prior to this release. [86431]
- ◆ If you create an Oracle instance using the `spfile` option, you must run the `dbed_update` command before you can successfully perform any Storage Checkpoint or Database FlashSnap functions.

## VEA and VxDBA Menu Utility Limitations

- ◆ VERITAS Enterprise Administrator (VEA) and the VxDBA menu utility do not display tablespace information when the `v$table` column names are changed using the SQL\*Plus profile facility. Normally this happens when SQL\*Plus settings are used in `login.sql` to change column names in reports. [34446]
- ◆ VEA may display system fonts incorrectly. On a Japanese desktop, VEA may incorrectly display system fonts. Japanese characters may not be properly displayed when you select the non-default font for the VEA GUI.

## Database FlashSnap Limitations

- ◆ The Database FlashSnap feature does not support RAID-5 volumes. [34570]
- ◆ When cloning a database using Database FlashSnap, the Oracle database must have at least one mandatory archive destination, otherwise `dbed_vmchecksnap` results in this error message:

```
SFORA dbed_vmchecksnap ERROR V-81-5677 Could not find a
mandatory, primary and valid archive destination for database
PROD.
```

Please review the `LOG_ARCHIVE_DEST_n` parameters and check `v$archive_dest`.

This example shows how to establish a mandatory archive destination using SQL\*Plus:

```
alter system set log_archive_dest_1 =
'LOCATION=/ora_mnt/oracle/oradata/PROD/archivelogs MANDATORY
[REOPEN]' [scope=both];
```

For more information about Oracle parameters for archiving redo logs, see your Oracle documentation. [270905]



- ◆ Existing snapshot plexes created by the `vxassist` command are not supported. A combination of snapshot plexes created by `vxassist` and `vxsnap` is also not supported.

## Oracle Disk Manager Limitations

- ◆ Because Oracle Disk Manager uses the Quick I/O driver to perform asynchronous I/O, do not turn off the Quick I/O mount option. The default option is the correct option to use.
- ◆ Using Oracle Disk Manager with Cached Quick I/O enabled is not supported and could cause your system to panic [34281]. To avoid a system panic, ensure the following:
  - ◆ If you are using Oracle Disk Manager, do not enable Cached Quick I/O on your file system.
  - ◆ If you are converting from Quick I/O to Oracle Disk Manager, make sure you disable Cached Quick I/O.

## Clone Database ORACLE\_SID Character Limit

When cloning an Oracle instance using the `dbed_clonedb` or `dbed_vmclonedb` command, the clone database's `ORACLE_SID` can be only eight characters or less. You will receive an error (ERROR V-81-5713) if the `ORACLE_SID` is more the eight characters.

## Renaming Columns in `login.sql`

Renaming columns in `login.sql` can sometimes cause scripts to fail or produce incorrect results. To prevent this, make the following changes in the user environment to generally avoid loading `login.sql`:

1. Move `login.sql` to another directory, for example, to `~oracle/login.sql`.
2. Make sure this new directory is included in `SQLPATH`, for example:

```
export SQLPATH=~oracle/sql:$SQLPATH
```



3. Do not make SQLPATH read-only, so that Storage Foundation *for Oracle* scripts can unset it at runtime.
4. Avoid starting Storage Foundation *for Oracle* scripts from the directory where `login.sql` resides, unless you are sure that `login.sql` does not contain any settings or commands that change the default output for queries against the data dictionary or increase the startup time for SQL\*Plus.

Also avoid using any settings or commands in the `glogin.sql` file that change the default output for queries against the data dictionary, or that may increase the startup time for SQL\*Plus.



## Software Issues

The following sections describe VERITAS Storage Foundation software issues that exist in this release. These issues are expected to be resolved in future releases.

### VERITAS Volume Manager Software Issues

See the following sections for information about known problems and issues in this release of VxVM.

#### Installation and Upgrade Issues

##### Upgrading Systems Running VxVM 3.5 Prior to Command Cumulative Patch 06

Before upgrading a system that is running under VxVM 3.5 at a patch level prior to Command Cumulative Patch 06 (PHCO\_30834), it is strongly recommended that you download and apply this patch, and then run the `ckpublen.sh` utility script, as documented in TechNote 270407, available at: <http://support.veritas.com/docs/270407>. If the script reports that any disks need to be re-initialized, back up the file systems and data residing on the volumes on those disks, and restore them after re-initializing the disks and recreating the volumes. You can then proceed to upgrade the system with the VERITAS Storage Foundation 4.1 software.

#### Utility Issues

##### Warning Message at Boot Time

A message such as the following is displayed if an attempt is made to open a volume at boot time before any disk group has been imported.

```
WARNING: VxVM vxio V-5-0-23 Open on an spurious volume device
(hex_id) encountered. This device may be valid, but has not yet
been configured in the kernel.
```

This message may be ignored. Once the disk group has been imported successfully, there should be no problem in accessing its volumes.

## Shrinking a Swap Volume

`vxassist` has no built-in protection to prevent you from shrinking the swap volume without first shrinking what the system sees as available swap space. If it is necessary to shrink the swap volume, the operation must be done in single user mode and the system must be rebooted immediately. Failing to take these precautions can result in unknown system behavior or lock-up. [i6154]

## Adding a Log and Mirror to a Volume

The `vxassist` command does not add a mirror and a log when processing a command such as the following:

```
# vxassist mirror volume layout=log ...
```

The mirror is added, but the log is silently omitted. To add a log and a mirror, add them in two separate `vxassist` invocations, as follows:

```
# vxassist mirror volume ...
# vxassist addlog volume ...
```

[i13488]

## Using `vxdiskadm` to Replace a Failed Disk

The `vxdiskadm` command requires two attempts to replace a failed disk. The first attempt can fail with a message of the form:

```
/usr/lib/vxvm/voladm.d/bin/disk.repl: test: argument expected
```

The command is not completed and the disk is not replaced. If you now rerun the command, using Option 5, the replacement successfully completes. [i102381]

## Replacement of the `old_layout` Attribute

The `vxdisksetup` command gives the error message `Attribute unrecognized` when the `old_layout` attribute is used to make a disk into a VxVM controlled disk. The `old_layout` attribute is no longer supported. Use the `noreserve` attribute instead. [i121258]

## Using `vxvol` and `vxmend` with Layered Volumes

The `vxvol` and `vxmend` commands do not handle layered volumes very well. When `vxmend` is executed on the top level volume to change the state of a volume, it is executed only on the top level volume; the change is not propagated to the lower level volumes. As a result, the volume states can become inconsistent and a subsequent `vxvol init` command might fail.



The `vxvol` command also exhibits the same problem. When a `vxvol init` command is executed on the top level volume, the change is not propagated to the volumes corresponding to its subvolumes.

**Workaround:** When executing the `vxvol` or `vxmend` command on a layered volume, first issue the command to the lower level volumes in a bottom-up fashion; then execute the command on the top-level volume.

In this example, a volume, `vol`, has two subvolumes, `vol-L01` and `vol-L02`. The state of the volumes is first set to `empty`, and then the initialization commands are executed:

```
# vxmend -o force -g mydg fix empty vol
# vxmend -o force -g mydg fix empty vol-L01
# vxmend -o force -g mydg fix empty vol-L02
# vxvol -g mydg init zero vol
# vxvol -g mydg init zero vol-L01
# vxvol -g mydg init zero vol-L02
```

[i134932]

### Growing or Shrinking Layered Volumes

Due to the current implementation of a resize of layered volumes, it is recommended that you do not grow or shrink layered volumes (for example; `stripe-mirror`, `concat-mirror`) during resynchronization. This limitation does not apply to ISP layered volumes.

Internally, VxVM converts the layout of layered volumes and updates the configuration database before it does the actual resize. This causes any ongoing operation, such as a resynchronization, to fail.

If the system reboots before the `grow` or `shrink` of a layered volume completes, the volume is left with an intermediate layout. In this case, you have to use `vxassist convert` to restore the volume to its original layout.

After a layered volume is resized, the volume, plex and subdisk names associated with the subvolumes, are changed.

### Maximum Size of a VxVM Volume

VxVM supports volume lengths up to  $2^{63}-1$  disk sectors when using VERITAS-specific `ioctl` calls. However, system calls such as `seek`, `lseek`, `read` and `write` are limited to a maximum offset that is determined by the operating system. For a system that supports large files, this is usually  $2^{63}-1$  bytes. Otherwise, the maximum offset value is usually  $2^{31}-1$  bytes (1 byte less than 2 terabytes). [i141024]

## vxconfigf Hangs Due to a Faulty Disk

If I/O hangs for some reason such as a disk failing while the VxVM configuration daemon, `vxconfigd`, is performing I/O from/to the disks, there is no way to communicate with `vxconfigd` via signals or native interprocess communication. This can potentially cause two kinds of problem:

- ◆ The node becomes unavailable for VxVM administrative commands.
- ◆ In a clustered or HA environment where VERITAS Cluster Server agents need to communicate with `vxconfigd` to determine the health of VxVM components, service groups start timing out and failing.

## Device Issues

### Unsupported Disk Arrays

To ensure that DMP is set up correctly on a multiported JBOD or other disk array that is not supported by VxVM, use the procedure given in “Adding Unsupported Disk Arrays to the DISKS Category” in the “Administering Disks” chapter of the *VERITAS Volume Manager Administrator’s Guide*. Otherwise, VxVM treats the independent paths to the disks as separate devices, which can result in data corruption.

### Hitachi Arrays in Active/Active Mode

When Hitachi DF400 and DF500 arrays are configured in Active/Active mode, performance is degraded. [i73154]

### HDS9500V Array Support Library

In VxVM 3.5, support for the Hitachi Data Systems HDS9500V array was provided by the `VRTShds9500v` array support library (ASL). Release 4.1 of VxVM includes built-in support for the HDS9500V array. If the `VRTShds9500v` ASL is currently installed on your VxVM 3.5 system, use the following command to remove this ASL before installing VxVM 4.1:

```
# swremove VRTShds9500v
```

If you have already upgraded to VxVM 4.1 with the `VRTShds9500v` ASL installed, remove this ASL and reboot the system. This will ensure that the ASL provided with VxVM 4.1 is the one that is claiming your HDS9500V devices.



## Adding HP-EVA Disks

When HP-EVA disks are added to VxVM 4.1, debug messages such as the following are displayed:

```
# vxdctl enable
Printing Name-Value Pair
CAB_SERIAL_NO   : 50001FE100270DF0Printing Name-Value Pair
CAB_SERIAL_NO   : Printing Name-Value Pair
Printing Name-Value Pair
Printing Name-Value Pair
CAB_SERIAL_NO   : Printing Name-Value Pair

50001FE100270DF0
LUN_SERIAL_NO   : 50001FE100270DF0
600508B40010293D00006000012A0000Printing
Name-Value Pair
Printing Name-Value Pair
Printing Name-Value Pair
.
.
.
```

These messages are harmless and can be ignored.

## Hot-Relocation Issues

### Impact of Hot-Relocation on Performance

Except for `rootvol` and `swapvol`, hot-relocation does not guarantee the same layout of data or performance after relocation. It is therefore possible that a single subdisk that existed before relocation may be split into two or more subdisks on separate disks after relocation (if there is not enough contiguous space on a single disk to accommodate that subdisk). [i14894]

### Disk Information in Notification Messages

When a disk failure occurs, the hot-relocation feature notifies the system administrator of the failure and any relocation attempts through electronic mail messages. The messages typically include information about the device offset and disk access name affected by the failure. However, if a disk fails completely or a disk is turned off, the disk access name and device offset information is not included in the mail messages. This is because VxVM no longer has access to this information. [i14895]

---

## DMP Issues

### Usage of `dmp_failed_io_threshold` Parameter

Data loss can occur after the failure of a single path in a multipathed environment. This might happen because of an interaction between an Application or file system and Volume Manager. This issue applies to configurations in which:

- ◆ VxVM volumes are not mirrored.
- ◆ There are multiple paths to the disk.
- ◆ A portion of the I/O path below DMP fails in such a way that the error is not returned to DMP before 10 minutes have elapsed. Examples of failures that have been seen to cause this condition, include bad hardware (HBA, FCOT, GBIC, Switch Port, Array Controller) and HBA reconfigured to retry endlessly.

---

**Note** It is the failure condition in the third type of configuration that triggers the problem. These failures are rare and are not seen during the normal operation of a healthy SAN. This is not a time-out. No DMP activity will occur after the 10 minutes has passed. DMP only checks the elapsed time of the I/O after it is returned by the lower layer. If the elapsed time is greater than `dmp_failed_io_threshold` seconds (default 600), the error will be returned to VxVM without retries. DMP will wait as long as it takes for the I/O to be returned.

---

If the delay in returning the I/O is caused by a problem in the I/O path to the device rather than the device itself, DMP will incorrectly return the error to the VxVM layer rather than retrying the I/O on another path. If the volume is mirrored, VxVM will satisfy the I/O from the other plex, and detach the plex that failed and prevented the volume from becoming hung.

If the volume is not mirrored, the error will be passed to the File System or application layer. This can result in the File System marking inodes for deletion when they are still valid. If raw volumes are in use, the application might believe that the data on the disk is corrupted when it is actually clean.

To prevent this possibility in situations where mirrored volumes are not used, the threshold should be tuned to a sufficiently high value that is unlikely to be reached. For example, to change the value of `dmp_failed_io_threshold` to 16 hours (57600 seconds), modify the value defined in `/kernel/drv/vxdmp.conf` as shown here:

```
dmp_failed_io_threshold=57600
```

After changing the value, reboot the system.



In situations in which mirrored volumes are in use, and an application time-out is being hit when there is still a valid plex with the data, the value of `dmp_failed_io_threshold` can be tuned to a smaller value so that the I/O can succeed on the mirror without triggering an application failure.

## Cluster Functionality Issues

If a node leaves the cluster while a plex is being attached to a volume, the volume can remain in the SYNC state indefinitely. To avoid this, after the plex attach completes, resynchronize the volume manually with the following command:

```
# vxvol -f resync volume  
[i20448]
```

## RAID-5 Volumes

VxVM does not currently support RAID-5 volumes in cluster-shareable disk groups.

## File Systems Supported in Cluster-Shareable Disk Groups

The use of file systems other than VERITAS Storage Foundation Cluster File System (SFCFS) on volumes in cluster-shareable disk groups can cause system deadlocks.

## Reliability of Information About Cluster-Shareable Disk Groups

If the `vxconfigd` program is stopped on both the master and slave nodes and then restarted on the slaves first, VxVM output and VEA displays are not reliable until the `vxconfigd` program is started on the master and the slave is reconnected (which can take about 30 seconds). In particular, shared disk groups are marked `disabled` and no information about them is available during this time. The `vxconfigd` program must therefore be started on the master first.

## Messages Caused by Open Volume Devices

When a node aborts from the cluster, open volume devices in shared disk groups on which I/O is not active are not removed until the volumes are closed. If this node later joins the cluster as the master while these volumes are still open, the presence of these volumes does not cause a problem. However, if the node tries to rejoin the cluster as a slave, this can fail with the following error message:

```
cannot assign minor #
```

This message is accompanied by the console message:

```
WARNING:minor number ### disk group group in use
```



---

## Data Integrity Issues

### Disks with Write-Back Caches

Disk drives configured to use a write-back cache, or disk arrays configured with volatile write-back cache, exhibit data integrity problems. The problems occur after a power failure, SCSI bus reset, or other event in which the disk has cached data, but has not yet written it to non-volatile storage. Contact your disk drive or disk array manufacturer to determine whether your system disk drives use a write-back cache, and if the configuration can be changed to disable write-back-caching.

## Snapshot and Snapback Issues

### Using Snapshots as Root Disks

It is recommended that you do not use snapshots of the root volume as a bootable volume. A snapshot can be taken to preserve the data of the root volume, but the snapshot will not be bootable. The data from the snapshot would have to be restored to the original root volume before the machine could be booted with the preserved data.

### Warning Message when Taking a Snapshot of a SFCFS File System

When taking a snapshot of a SFCFS file system, the following warning message might appear:

```
VxVM vxio WARNING V-5-0-4 Plex plex detached from volume volume
```

**Workaround:** No action is required. This behavior is normal and is *not* the result of an error condition.

### File System Check of a Snapshot

Normally, a file system would have no work to do when a snapshot is taken. However, if an SFCFS file system is not mounted, it is likely that the `fsck` of the snapshot will take longer than is usually necessary, depending on the I/O activity at the time of the snapshot.

**Workaround:** When taking a snapshot of an SFCFS file system, you should ensure that at least one of the volumes defined in the command line is mounted on the cluster master.



## Mount Operation Can Cause Inconsistencies in Snapshots

Inconsistencies can arise in point-in-time copies if any of the following snapshot operations are performed on a volume while a file system in the volume is being mounted: `vxassist snapshot`, `vxplex snapshot`, `vxsnap make`, `vxsnap refresh`, or `vxsnap restore`.

## Intelligent Storage Provisioning Issues

### Creating Application Volumes

To create application volumes successfully, the appropriate licenses must be present on your system. For example, you need a full VERITAS Volume Manager and a VERITAS FlashSnap license to use the instant snapshot feature. Vendors of disk arrays may also provide capabilities that require special licenses for certain features of their hardware. [i137185]

## Miscellaneous Issues

### Auto-import of Disk Groups

If a disk that failed while a disk group was imported returns to life after the group has been deported, the disk group is auto-imported the next time the system boots. This contradicts the normal rule that only disk groups that are (non-temporarily) imported at the time of a crash are auto-imported.

If it is important that a disk group *not* be auto-imported when the system is rebooted, the disk group should be imported temporarily when the intention is to deport the disk group (for example, in HA configurations). Use the `-t` flag to `vx dg import`. [i13741]

### Volumes Not Started Following a Reboot

During very fast boots on a system with many volumes, `vxconfigd` may not be able to auto-import all of the disk groups by the time `vxrecover -s` is run to start the volumes. As a result, some volumes may not be started when an application starts after reboot.

**Workaround:** Check the state of the volumes before starting the application, or place a sleep (`sleep sec`) before the last invocation of `vxrecover`. [i14450]

### Forcibly Starting a Volume

The `vxrecover` command starts a volume only if it has at least one plex that is in the ACTIVE or CLEAN state and is not marked STALE, IOFAIL, REMOVED, or NODAREC. If such a plex is not found, VxVM assumes that the volume no longer contains valid

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up-to-date data, so the volume is not started automatically. A plex can be marked STALE or IOFAIL as a result of a disk failure or an I/O failure. In such cases, to force the volume to start, use the following command:

```
# vxvol -f start volume
```

However, try to determine what caused the problem before you run this command. It is likely that the volume needs to be restored from backup, and it is also possible that the disk needs to be replaced. [i14915]

### Failure of Memory Allocation

On machines with very small amounts of memory (32 megabytes or less), under heavy I/O stress conditions against high memory usage volumes (such as RAID-5 volumes), a situation occurs where the system cannot allocate physical memory pages any more.

### Messages About VVR Licenses

The following messages may get displayed on the console during a system reboot or during VxVM initialization when you are running vxinstall:

```
No VVR license installed on the system; vradmind not started
No VVR license installed on the system; in.vxrsyncd not started
```

These messages are informational only, and can be safely ignored if you are not a VERITAS Volume Replicator (VVR) user.

### Number of Columns in a RAID-5 ISP Volume

If an ISP volume is created with the RAID-5 capability, the parameters `ncols` and `nmaxcols` refer only to the number of data columns, and do not include the parity column. For this reason, the actual number of columns that are created in such a volume is always one more than the number specified.

## VEA Issues

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**Note** Refer to the *VERITAS Storage Foundation Installation Guide* for information on how to set up and start the VEA server and client.

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### Name Service Switch Configuration File

For VEA to operate successfully, the name service switch configuration file, `/etc/nsswitch.conf`, must be present on the system. See the `nsswitch.conf(4)` manual page for more information.



### Accessing the Task Log

The task log accessed from the Log tree is not supported. At this time, entries are written to the log file in `/var/vx/isis/command.log`. [i76683, i97076]

### Setting a Comment on an ISP Volume

If you create a new ISP volume by right-clicking on a user template and selecting the **New Volume** menu item, a comment that you specify to the Create Volume Dialog is not set on the volume. To specify a comment for the newly created volume, select the volume, choose **Properties** from the pop-up menu, enter a comment in the **Comment** field and then click **OK**. [i137098]

### Administering a Cache Volume Created on an ISP Volume

It may not be possible to use the VEA GUI to add or remove mirrors to or from a cache volume (used by space-optimized instant snapshots) that is created on an ISP volume, or to delete a cache volume. The cache object, but not the cache volume, is visible in the graphical interface.

**Workaround:** Stop and restart the VEA server. [i137625]

### Permitting Remote Access to the X Windows Server

The following X Windows system error may occur when starting VEA:

```
Xlib: connection to "hostname:0.0" refused by server
Xlib: Client is not authorized to connect to Server
```

**Workaround:** Allow access to the local X server by using the following command:

```
# xhost + [hostname]
```

### Disk Group Creation Failure with Duplicate Disk ID

VEA fails to create a disk group with a duplicate disk ID, and gives no other options.

### Creating non-CDS disks

By default, VEA always creates CDS disk groups, and will therefore initialize disks with the CDS format. In order to create non-CDS disk groups through VEA, you need to create the following two files (or, edit the files accordingly if they already exist). This changes the default format setting for disk creation from `format=cdsdisk` in the `/etc/default/vxdisk` file, and the default CDS attribute setting from `cds=on` in the `/etc/default/vxdg` file.

### ▼ To create non-CDS disk groups through VEA:

1. Create the file `/etc/default/vxdisk`, and add a line describing the desired non-CDS disk format as:  
format=simple  
or  
format=hpdisk
2. Create the file `/etc/default/vxdg`, and add a line describing the CDS attribute as:  
cfs=off

To create CDS disk groups at a later stage, you will need to change the settings back again to `format=cfsdisk` and `cfs=on`. For more information, see the *VERITAS Storage Foundation Cross-Platform Data Sharing Administrator's Guide*.

### Incorrect vxpool command

The VEA GUI may incorrectly show the `-p` option as an argument to the `vxpool list` command, although the command is not actually invoked. [i135566].

### Comments in Japanese on a Snapshot Volume Are Not Saved or Displayed Correctly

Comments that are entered in the Japanese character set in the **Snapshot Options** dialog of the **Create Instant Snapshot** screen of the VEA GUI are not saved or displayed correctly. [322954]

## Internationalization Issues

### Some ISP Attributes Have Not Been Translated

The Intelligent Storage Provisioning (ISP) window for annotating a disk is not fully localized. In particular, auto-discovered attributes such as `DiskGroup` and `Enclosure` are not translated. [i139162]

### Inaccuracies in ISP Attribute Fields

The ISP User Template Wizard shows two "attribute value" fields rather than one "attribute value" and one "attribute name" field. [i139762]



## Upgrading Disk Group Versions

All disk groups have a version number associated with them. Each VxVM release supports a specific set of disk group versions and can import and perform tasks on disk groups with those versions. Some new features and tasks work only on disk groups with the current disk group version, so you need to upgrade existing disk groups before you can perform the tasks. The following table summarizes the disk group versions that correspond to each VxVM release from 2.0 onward:

VxVM Release	Cluster Protocol Versions	Disk Group Version	Supported Disk Group Versions
3.0	n/a	60	60
3.1	n/a	60	60
3.2	30	60	60
3.5	40	90	60, 90
4.1	60	120	60, 90, 120

You can use the following command to find out the version number of a disk group:

```
# vxdg list disk_group_name
```

You can also determine the disk group version by using the `vxdprint(1M)` command with the `-l` format option.

To upgrade a disk group, use the following command:

```
# vxdg [-T version] upgrade disk_group_name
```

Unless a disk group version is specified, this command upgrades the disk group to the highest version supported by the VxVM version on your system.

For shared disk groups, the latest disk group version is only supported by the latest cluster protocol version. To see the current cluster protocol version, type:

```
# vxdctl support
```

To upgrade the protocol version for the entire cluster, enter the following command on the master node:

```
# vxdctl upgrade
```

See the “Administering Cluster Functionality” chapter of the *VERITAS Volume Manager Administrator’s Guide* for more information on changing the cluster protocol version.



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## VERITAS File System Software Issues

### Applications Using `statvfsdev(3C)` Interface

The applications that use the `statvfsdev(3C)` interface on a device name need to relink with the new LIBC to be able to understand the disk layout Version 6. Disk Layout Version 6 is available with this release. If the applications are not relinked, they cannot recognize a file system with disk layout Version 6. However, they would continue to recognize file systems with disk layout Version 4 and 5.

### Large File Support

VxFS 4.1 only supports files up to 2 TB on 64-bit kernels. See related issue [“Large File Systems and Large File Support”](#) on page 15 for more information.

### Mapping a Large Offset of a File

Calling the `mmap(2)` function on a large offset of a file might require a large amount of swap space. If `mmap(2)` is called on a 1 TB offset in `MAP_SHARED` mode, then approximately 256 MB of virtual memory pages could be instantiated. This means that VM requires space to hold 256 MB of data structures. Each of these structures are 16 bytes, thus approximately 4 GB space is required. Since these data structures are able to be paged, more than 4 GB of swap space is reserved when `mmap(2)` is called.

### System Hang Can Occur on Systems with Less Cache Memory

VxFS allocates a fixed amount of memory. You can change the amount of memory allocated using the tunables `vx_ninode` and `vxfs_bc_bufhwm`. After long hours of operation, low-memory systems (that is, systems having less physical RAM), may slow down or hang due to memory pressure. To alleviate this problem, lower the values of `vx_ninode` and `vxfs_bc_bufhwm` to limit VxFS memory consumption.

---

**Note** VxFS consumes a fixed percentage of memory for storing the default values of tunables, such as `vx_ninode` and `vxfs_bc_bufhwm`. For example, VxFS consumes nearly 10% of total physical memory for the default value of `vx_ninode`. If the system has 512 MB of memory, VxFS will require up to 52 MB to store the VxFS inode cache. Therefore it is necessary to tune the tunables according to the type of load on the system.

---



## Tuning Down the Inode Cache

VxFS file systems allocate and release inodes based on the file system load. Generally, larger inode caches help the file systems to perform better in the case of a file server or web server load. The global (static) tunable, `vx_ninode`, determines the maximum possible size of the VxFS inode cache. If the default value of `vx_ninode` is set to zero, VxFS automatically tunes the size of the inode cache at boot time, based on the size of the physical memory on the system. On systems with a RAM size of less than or equal to 1 GB per CPU, you can manually tune down `vx_ninode` to a value not less than that of `nfile` (`nfile` is an HP-UX tunable that represents the maximum number of file descriptors).

## Tuning Down the Buffer Cache

VxFS 4.1 implements a private buffer cache to use exclusively for metadata. The allocations to this buffer cache vary during system usage based on file system load and the maximum cache size specified in the global (static) tunable, `vxfs_bc_bufhwm`. If the value of `vxfs_bc_bufhwm` is set to zero, VxFS automatically tunes the maximum size of the metadata buffer cache at boot time, based on the system memory size. On systems with a RAM size of 1 GB per CPU or less, you can manually tune down the value of `vxfs_bc_bufhwm` to a minimum of 6144 (6MB).

## 100% Full File System Cannot Be Resized

In some circumstances, the `fsadm` command cannot resize a 100% full file system due to lack of space for updating structural information. Check VxFS file systems on a regular basis and increase their size if they approach 100% capacity. If a file system is busy or too fragmented, the resize operation can also fail.

## Setting `max_thread_proc` Tunable

Setting `max_thread_proc` to a low value may result in the system being in a hung state. If the value of this tunable is less than 1100, the value will be automatically set to 1100 when VxFS is installed. This value must be maintained at or above 1100.

## DMAPI `dm_get_dirattr` Can Skip Directory Entries

`vx_hsm_get_dirattr()` reads a directory's `dirents` 8 KB at a time, if the passed in user buffer is not large enough to hold the combined entries' corresponding file stats information (up to ~114kb). Then the next call to `vx_hsm_get_dirattr()` will continue from the wrong offset within the directory, resulting in some directory entries being skipped.



---

**Note** There is no error indication. The expectation is to continue from the last dirent information that could fit into the user's buffer. However, the next directory read will begin 8 KB further down the directory.

---

As a workaround this issue can be avoided by passing a sufficiently large user buffer.

## **File System With Quotas Cannot Be Mounted After Doing CDS Conversion**

If a file system is using quotas, it cannot be mounted with quotas turned on after converting the byte order of the file system with the `fscdsconv(1M)` utility. Similarly, quotas cannot be turned on, if the converted file system is first mounted with quotas turned off. See the `fscdsconv(1M)` manual page for the workaround.

## **CDS Validate Error Running in ja\_JP.UTF-8-Encoded Locale**

The `fscdstask validate` command returns an error when files on the specified mount point have names with `ja_JP.eucJP` or `ja_JP.PCK` encodings, but the locale has been changed to `jp_JP.UTF-8`. The error is as follows:

```
xargs: Input file is corrupt. : Incorrect byte order
```

Files should be created with the same locale encoding as the file system on which they reside.

## **Data Integrity Issues with Disks and Disk Arrays with Write-back Caches**

Disk drives configured to use a write-back cache, or disk arrays configured with a volatile write-back cache, exhibit data integrity problems. The problems occur after a power failure, SCSI bus reset, or other event in which the disk has cached data, but has not yet written it to non-volatile storage. Contact your disk drive or disk array manufacturer to determine whether your disk drives use a write-back cache, and if the configuration can be changed to disable write-back caching.

## **Under Some Conditions, fsadm Cannot Truncate a Directory**

The `fsadm` command cannot truncate a directory if it has only one extent that is more than two blocks in length, even if all the directory entries are deleted.



## Inode Limitation on File Systems Without Large File Support

For a file system to have more than 8 million inodes, you must create it using the `largefiles` option of `mkfs` (the `fsadm` utility can also be used to set the `largefiles` flag on the file system). See the `mkfs_vxfs(1M)` and `fsadm_vxfs(1M)` manual pages for details. The `largefiles` option is enabled by default on VxFS 4.1. In previous VxFS releases, `nolargefiles` was the default mount option.

## Non-standard Command Behavior When Using ACLs

The output of the `ls -l` command on VxFS file systems shows `mask/CLASS_OBJ` in place of group permissions if Access Control Lists (ACLs) are in use on a file or a directory. You can determine the effective group permissions by using the `getacl` command. In the next release of VxFS, the behavior of `ls -l` will show effective group permissions, that is, `GROUP_OBJ` masked by `CLASS_OBJ`.

The `chmod` command changes `mask/CLASS_OBJ` instead of the group permissions if ACLs are in use on a file or a directory. `GROUP_OBJ` is not changed by `chmod`, and because effective group permissions are determined by `GROUP_OBJ` and `CLASS_OBJ`, the default group may not receive the permissions specified by `chmod`. Because `ls -l` shows `mask` only (which is changed by `chmod`), it only *appears* that the group permissions are changed as specified in `chmod`. Use of the `chmod` command is not advisable on files with ACLs. Instead, use the `getacl` command to manipulate permissions.

In the next release of VxFS, the behavior of both `mask/CLASS_OBJ` and `GROUP_OBJ` will be to change after executing the `chmod` command. Even in that case, using the `getacl` command is advisable for manipulating permissions.

Even if the parent directory has default ACLs, `umask` is applied to a newly created file. According to POSIX standards, `umask` should be applied only if the parent directory does not have any default ACLs. In the next release of VxFS, this behavior will be made POSIX compliant.

See the following manual pages for ACL-related information: `aclsort(3C)`, `chmod(1)`, `getacl(1)`, `ls(1)`, `setacl(1)`, and `uname(1)`.

## The `newfs -R` Command Allows Reserving Swap Space Larger Than the Device

The `newfs -R` command will reserve swap space greater than is available on the underlying device. This problem will be addressed in a future patch release from HP.

## Large Files Should Be Mounted Only on Systems With Sufficient Memory

When a file system is mounted, VxFS keeps certain data structures in the kernel. As the size of the file system increases, the amount of data structures stored by VxFS also increases. The file system typically keeps approximately 128 bytes per allocation unit (32,768 file system blocks). This translates to a usage of 512K per 1 TB for an 8K block size file system (4 MB per 1 TB for a 1K block size file system). Therefore, large file systems must be mounted only on systems that have sufficient memory. The memory requirements for mounting large file systems are shown in the tables below.

Memory Usage for a File System With a 1K Block Size

File System Size	128 GB	1 TB	8 TB	64 TB	256 TB
Memory Usage	1 MB	4 MB	32 MB	N/A	N/A

Memory Usage for a File System With a 2K Block Size

File System Size	128 GB	1 TB	8 TB	64 TB	256 TB
Memory Usage	512K	2 MB	16 MB	128 MB	N/A

Memory Usage for a File System With a 4K Block Size

File System Size	128 GB	1 TB	8 TB	64 TB	256 TB
Memory Usage	256K	1 MB	8 MB	64 MB	N/A

Memory Usage for a File System With an 8K Block Size

File System Size	128 GB	1 TB	8 TB	64 TB	256 TB
Memory Usage	128K	512K	4 MB	32 MB	128 MB

While performing a full `fsck`, the system keeps certain data structures in the core for validating the space usage and inode usage. The space needed depends on the number of inodes and the number of blocks in the file system. The `fsck` command needs approximately 16 MB per 1 TB for an 8K block size file system (128 MB per 1 TB for a 1K block size file system) and 32 MB per million inodes. Sufficient memory and swap space should be configured on the system before running a full `fsck` on a large file-enabled system.

A replay `fsck` does not need a significant amount of memory and does not have these issues.



## Some Disk Quota Operations Do Not Function on NFS

When VxFS file systems are exported via NFS, quotas on the file system apply to users when accessing the file system from NFS clients. However, the HP-UX quota commands on the NFS client cannot be used to edit quotas. The VxFS quota commands can be used on the server to edit quotas.

## Files and Directories

To maximize VxFS performance, do not exceed 100,000 files in the same directory. Use multiple directories instead.

## Cross-Platform Data Sharing (CDS)

- ◆ External Quota File

CDS does not support converting the external quota file. The external quota file would need to be manually migrated as follows:

*On source:*

Prior to unmounting the file system, remove the `quotas` file. Run the `fscdsconv` command after unmounting the file system.

*On target:*

Mount the file system without quotas. Manually edit the `quotas` and the `quotas.grp` file to enter the limits.

- ◆ Handling ACLs with CDS

Because not all target platforms support ACLs, converting a file system with ACLs from the source to a target on which ACLs are not supported results in ACLs not being enabled on the target. If the file system is converted back to a target on which ACLs are supported, permission checks are enforced again.

### **Quick I/O Files Cannot Be Sparse Files**

If you try to convert a sparse file to a Quick I/O file, the Oracle instance can fail if Oracle tries to write into an unallocated block. Specifically, datafiles used by the Oracle8i and Oracle9i temporary tablespace may be sparse files, so do not convert these to Quick I/O files. See the *VERITAS Storage Foundation 4.1 for Oracle Database Administrator's Guide* for more information.

### **PHCO\_33308 Required for LVM Commands to Recognize Disk Layout Version 6**

When reducing a volume, LVM checks the volume to prevent any part of the existing file system from being thrown away. Likewise, when an LVM physical volume is created, LVM ensures that it is not clobbering an existing file system. However, LVM does not recognize a VxFS 4.1 file system with disk layout Version 6, which is the default disk layout version in VxFS 4.1. Install PHCO\_33308 for LVM to work with disk layout Version 6.

### **PHCO\_33238 Required for swapon Command to Recognize Disk Layout Version 6**

The `swapon` command does not recognize a VxFS file system with disk layout Version 6, and therefore does not produce a warning while using a device that has such a file system. Install PHCO\_33238 to enhance the `swapon` command to recognize the VxFS disk layout Version 6.

## **No Longer Supported**

- ◆ VERITAS Storage Foundation 4.1 is the last major release to support scheduling Storage Checkpoint creation.
- ◆ VERITAS Storage Foundation 4.1 is the last major release to support Oracle Disk Manager for raw devices.
- ◆ VERITAS Storage Foundation 4.1 is the last major release to support the text-based VxDBA menu interface.



- ◆ VERITAS Storage Foundation 3.5 was the last major release to support the VERITAS Space Capacity Planning utility for Storage Checkpoints in the GUI. The 4.1 release supports the VERITAS Space Capacity Planning utility with the CLI only.
- ◆ In VERITAS Storage Foundation 4.1, snapshot plexes created by the `vxassist` command are not supported. A combination of snapshot plexes created by `vxassist` and `vxsnap` is also not supported in this release.

## Available Documentation

After the installation procedure is complete, documents are available online under the `/opt/VRTS/docs` directory. Documents are provided as Adobe Portable Document Format (PDF) files and in a searchable HTML-based format. To view or print PDF documents, you must have the Adobe Acrobat Reader installed.

Installing documentation and online manual pages is optional.

## VERITAS Documentation Disc

The VERITAS documentation disc provides searchable, HTML documentation for each product in this release. Printable PDF documents are also included on the disc.

All documentation is organized by product groups.

## Release Notes and Installation Guides

Release notes and installation guides are not installed by any packages. VERITAS recommends that you copy them from the software disc to the `/opt/VRTS/docs` directory on your system after product installation so that they are available for future reference.

Release notes for component products in all versions of the VERITAS Storage Foundation are located under the `storage_foundation/release_notes` directory of the VERITAS Storage Foundation disc or the `cluster_server/release_notes` directory of the VERITAS Cluster Server disc.

Installation guides in all versions of the VERITAS Storage Foundation are located under the `storage_foundation/docs` directory of the VERITAS Storage Foundation disc or the `cluster_server/docs` directory of the VERITAS Cluster Server disc.

It is important that you read the relevant component product release notes before installing any version of VERITAS Storage Foundation:

- ◆ *VERITAS Volume Replicator Release Notes* (`vvr_notes.pdf`)
- ◆ *VERITAS Cluster Server Release Notes* (`vcs_notes.pdf`)

## VERITAS Storage Foundation Guides

The following manuals, along with the online help, comprise the VERITAS Storage Foundation documentation set:

### Guides in VERITAS Storage Foundation Documentation Set

<b>Guide Title</b>	<b>Filename</b>
<i>VERITAS Storage Foundation and High Availability Getting Started Guide</i>	getting_started.pdf
<i>VERITAS Storage Foundation Release Notes (this document)</i>	sf_notes.pdf
<i>VERITAS Storage Foundation Installation Guide</i>	sf_install.pdf
<i>VERITAS Storage Foundation Oracle Administrator's Guide</i>	sf_ora_admin.pdf
<i>VERITAS Array Integration Layer Configuration Guide</i>	vail_config.pdf
<i>VERITAS Volume Manager Administrator's Guide</i>	vxvm_admin.pdf
<i>VERITAS Storage Foundation Intelligent Storage Provisioning Administrator's Guide</i>	sf_isp_admin.pdf
<i>VERITAS Storage Foundation Cross-Platform Data Sharing Administrator's Guide</i>	sf_cds_admin.pdf
<i>VERITAS Enterprise Administrator (VEA 500 Series) Getting Started</i>	veax5_getting_started.pdf
<i>VERITAS Volume Manager Troubleshooting Guide</i>	vxvm_tshoot.pdf
<i>VERITAS Volume Manager Hardware Notes</i>	vxvm_hwnotes.pdf
<i>VERITAS FlashSnap Point-In-Time Copy Solutions Administrator's Guide</i>	flashsnap_admin.pdf
<i>VERITAS File System Administrator's Guide</i>	vxfs_admin.pdf



## VERITAS Cluster Server Documentation

The following VERITAS Cluster Server documentation is available with all VERITAS Storage Foundation HA product suites:

Guides in VERITAS Cluster Server Documentation Set

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<b>Guide Title</b>	<b>Filename</b>
<i>VERITAS Cluster Server Release Notes</i>	<i>vcs_notes.pdf</i>
<i>VERITAS Cluster Server Installation Guide</i>	<i>vcs_install.pdf</i>
<i>VERITAS Cluster Server User's Guide</i>	<i>vcs_users.pdf</i>
<i>VERITAS Cluster Server Agent Developer's Guide</i>	<i>vcs_agent_dev.pdf</i>
<i>VERITAS Cluster Server Bundled Agents Reference Guide</i>	<i>vcs_bundled_agents.pdf</i>
<i>VCS Enterprise Agent for Oracle Installation and Configuration Guide</i>	<i>vcs_oracle_install.pdf</i>

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## VERITAS Volume Replicator Documentation

The following VERITAS Volume Replicator documentation is available with the VERITAS Volume Replicator option:

Guides in VERITAS Volume Replicator Documentation Set

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<b>Guide Title</b>	<b>Filename</b>
<i>VERITAS Volume Replicator Release Notes</i>	<i>vvr_notes.pdf</i>
<i>VERITAS Volume Replicator Installation Guide</i>	<i>vvr_install.pdf</i>
<i>VERITAS Volume Replicator Administrator's Guide</i>	<i>vvr_admin.pdf</i>
<i>VERITAS Volume Replicator Planning and Tuning Guide</i>	<i>vvr_planning.pdf</i>
<i>VERITAS Volume Replicator Web Console Administrator's Guide</i>	<i>vvr_web_admin.pdf</i>
<i>VERITAS Volume Replicator Advisor User's Guide</i>	<i>vvr_advisor_users.pdf</i>

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Guides in VERITAS Volume Replicator Documentation Set

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Guide Title	Filename
<i>VERITAS Cluster Server Agents for VERITAS Volume Replicator Configuration Guide</i>	vvr_agents_config.pdf

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## Manual Pages

The VERITAS online manual pages are installed in the `/opt/VRTS/man` directory. This directory must be added to the `MANPATH` environment variable.

Installing documentation and online manual pages is optional.

## Getting Help

For technical assistance, visit <http://support.veritas.com> and select phone or email support. This site also provides access to resources such as TechNotes, product alerts, software downloads, hardware compatibility lists, and the VERITAS customer email notification service. Use the Knowledge Base Search feature to access additional product information, including current and past releases of product documentation.

Diagnostic tools are also available to assist in troubleshooting problems associated with the product. These tools are available on disc or can be downloaded from the VERITAS FTP site. See the `README.VRTSspt` file in the `/support` directory for details.

For license information, software updates and sales contacts, visit <https://my.veritas.com/productcenter/ContactVeritas.jsp>. For information on purchasing product documentation, visit <http://webstore.veritas.com>.



