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Hitachi Simple Modular Storage Copy-on-Write SnapShot User's Guide

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MK-97DF8018-00

Preface

This document provides instructions on assessing your snapshot requirements, designing an implementation to meet those requirements, and implementing and operating Copy-on-Write Snapshot software using the Storage Navigator 2 graphical user interface.

This preface includes the following information:

Notice: The use of the Hitachi Simple Modular Storage 100and all Hitachi Data Systems products is governed by the terms of your agreement(s) with Hitachi Data Systems.

Document Revision Level

This section provides a history of the revision changes to this document.

Revision	Date	Description
MK-97DF8018-00	October 2007	Initial Release

Safety and Warnings

This document uses the following symbols to draw attention to important safety and operational information. The Danger, Electric Shock, and ESD symbols are included only in hardware manuals.

Symbol	Meaning	Description
	Tip	Tips provide helpful information, guidelines, or suggestions for performing tasks more effectively.
	Note	Notes emphasize or supplement important points of the main text.
	Caution	Cautions indicate that failure to take a specified action could result in damage to the software or hardware.

Intended Audience

This document is intended for users with the following background:

- Background in data processing and understands RAID storage systems and their basic functions.
- Familiarity with Hitachi Modular Storage systems.
- Familiarity with operating systems such as the Windows 2000, Windows Server 2003 operating system, or UNIX.

Product Version

This document applies to Hitachi Simple Modular Storage 100 microcode versions 1810/A and higher.

Release Notes

Make sure to read the Release Notes before enabling and using this product. The Release Notes are located on the installation CD. They may contain requirements and/or restrictions that are not fully described in this document. The Release Notes may also contain updates and/or corrections to this document.

Document Organization

The following table provides an overview of the contents and organization of this document. Click the chapter title in the first column to go to that chapter. The first page of every chapter or appendix contains a brief list of the contents of that section of the manual, with links to the pages where the information is located.

Chapter/Appendix Title	Description
Chapter 1, SnapShot Overview	Provides descriptions of SnapShot components and how they work together.
Chapter 2, Planning and Design	Provides detailed planning and design information.
Chapter 3, Requirements	Provides SnapShot requirements.
Chapter 4, Enabling and Disabling SnapShot	Provides instructions for enabling SnapShot.
Chapter 5, Configuring SnapShot	Provides detailed configuration and testing information.
Chapter 6, Using SnapShot	Provides detailed information and procedures for using SnapShot.
Chapter 7, Monitoring and Maintenance	Provides monitoring and maintenance information.
Chapter 8, Troubleshooting	Provides information for correcting system problems.
Appendix A, Operations Using CLI	Provides detailed Navigator 2 Command Line Interface instructions for configuring and using SnapShot.
Appendix B, SnapShot Specifications	Provides SnapShot specifications.
Glossary	Provides definitions for terms and acronyms found in this document.
Index	Provides locations to specific information in this document.

Referenced Documents

These documents contain information that is related to the topics in this document and can provide additional information about them.

- Hitachi Storage Navigator 2 Command Line Interface (CLI) User's Guide (MK-97DF8038), used to develop scripts.
- Hitachi Command Control Interface (CCI) software for Modular Storage User's Guide (MK-97DF8016).
- Hitachi Storage Navigator Modular 2 program Help, which explains SnapShot operations using the Navigator 2 GUI application.

Document Conventions

The following table describes the typographic conventions used in this document.

Convention	Description
Bold	Indicates text on a window, other than the window title, including menus, menu options, buttons, fields, and labels. Example: Click OK.
Italic	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: copy source-file target-file. **Note**: Angled brackets (< >) are also used to indicate variables.
`screen/code`	Indicates text that is displayed on screen or entered by the user. Example: # pairdisplay -g oradb
`< > angled brackets`	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: # pairdisplay -g <group> **Note**: Italic font is also used to indicate variables.
`[ ] square brackets`	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
`{ } braces`	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.
underline	Indicates the default value. Example: [a | b]

Convention for Storage Capacity Values

Storage capacity values for hard disk drives (HDDs) in Hitachi Data Systems' storage products are calculated based on the following values:

- 1 KB = 1,000 bytes
- 1 MB = $1{,}000^2$ bytes
- 1 GB = $1{,}000^3$ bytes
- 1 TB = $1{,}000^4$ bytes

Storage capacity values for hard disk drives (HDDs) in the Hitachi Simple Modular Storage 100 are calculated based on the following values:

- 1 KB (kilobyte) = 1,024 bytes
- 1 MB (megabyte) = $1{,}024^2$ bytes
- 1 GB (gigabyte) = $1{,}024^3$ bytes
- 1 TB (terabyte) = $1{,}024^4$ bytes

For further information on the Hitachi storage system, refer to the user's guide for the system (for example, *Hitachi Simple Modular Storage Hardware Guide*, MK-96DF8061).

Getting Help

If you have questions after reading this guide, contact an Hitachi Data Systems authorized service provider[H1] or visit the Hitachi Data Systems support website, http://support.hds.com.

Support Contact Information

If you purchased this product from an authorized Hitachi Data Systems reseller, contact that reseller for support. For the name of your nearest Hitachi Data Systems authorized reseller, refer to the Hitachi Data Systems support web site for locations and contact information.

To contact the Hitachi Data Systems Support Center, please visit the Hitachi Data Systems website for current telephone numbers and other contact information. http://support.hds.com

Please provide at least the following information about the problem:

- Product name, model number, part number (if applicable) and serial number
- System configuration, including names of optional features installed, host connections, and storage configuration such as RAID groups and LUNs
- Operating system name and revision or service pack number
- The exact content of any error message(s) displayed on the host system(s)
- The circumstances surrounding the error or failure
- A detailed description of the problem and what has been done to try to solve it
- Confirmation that the Hitachi Data Systems Hi-Track remote monitoring feature has been installed and tested.

Comments

Your comments and suggestions to improve this document are greatly appreciated. When contacting HDS, please include the document title, number, and revision. Please refer to specific section(s) and paragraph(s) whenever possible.

- E-mail: doc.comments@hds.com
- Fax: 858-695-1186
- Mail: Technical Writing, M/S 35-10
  Hitachi Data Systems
  10277 Scripps Ranch Blvd.
  San Diego, CA 92131

Thank you! (All comments become the property of Hitachi Data Systems Corporation.)

Table of Contents

1

SnapShot Overview

Snapshot creates virtual copies of data volumes within Hitachi Simple Modular Storage systems. These copies can be used for recovery from logical errors. They are identical to the original volume at the point in time they were taken.

This guide provides instructions for planning and designing, configuring and testing, and using and monitoring SnapShot. In this chapter, see:

Copy-on-Write SnapShot Software

Hitachi's Copy-on-Write Snapshot software creates virtual backup copies of any data volume within the Simple Modular Storage systems with minimal impact to host service or performance levels. These snapshots are suitable for immediate use in decision support, software testing and development, data backup, or rapid recovery operations.

SnapShot minimizes disruption of planned or unplanned outages for any application that cannot tolerate downtime for any reason or that requires non-disruptive sharing of data. Since each snapshot captures only the changes to the original data volume, the amount of storage space required for each Copy-on-Write Snapshot is significantly smaller than the original data volume.

The most probable types of target applications for Copy-on-Write Snapshot are:

- Database copies for decision support/database inquiries
- Non-disruptive backups from a Copy-on-Write Snapshot V-VOL
- Periodic point-in-time disk copies for rapid restores in the event of a corrupted data volume

Hardware and Software Configuration

A typical SnapShot hardware configuration includes a Hitachi Simple Modular Storage system, a host connected to the storage system and software to configure and manage SnapShot (management software). The host is connected to the storage system via iSCSI connections. The management software is connected to the storage system via a management LAN.

SnapShot employs primary volumes (P-VOLs), virtual volumes (V-VOLs), data pool, and Hitachi Storage Navigator Modular 2 Graphical User Interface. Advanced user functionality is available with Storage Navigator 2 Command-Line interface (CLI) and Hitachi Command Control Interface (CCI). Figure 1-1 shows a typical SnapShot configuration.

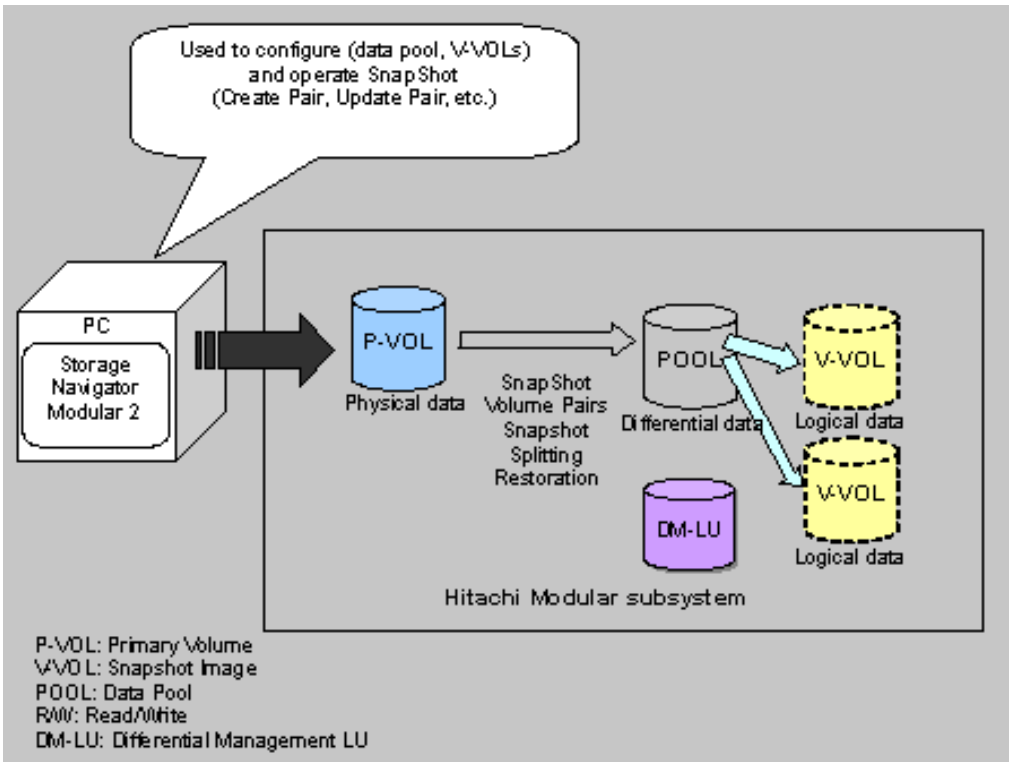


Figure 1-1: SnapShot functional components

The following sections describe how these components work together.

How SnapShot Works

SnapShot creates a virtual duplicate volume of another volume. This volume "pair" is created when you:

- Select a volume that you want to replicate
- Identify another volume that will contain the copy
- Associate the primary and secondary volumes
- Create a snapshot of the primary volume data in the virtual (secondary) volume.

Until the new or re-synchronized pair is split, all data written to the primary volume is also copied to the virtual volume. When the pair is split, the primary volume continues being updated, but the snapshot in the virtual volume remains as it was at the time of the split. The pair can be made identical again by re-synchronizing changes from primary-to-secondary or secondary-to-primary.

Volume Pairs—P-VOLs and V-VOLs

A volume pair is a relationship established by SnapShot between two volumes. A pair consists of a production volume, which contains the original data and is called the primary volume (P-VOL), and from 1 to 32 virtual volumes (V-VOLs), which contain copies of the P-VOL. The P-VOL and its V-VOL(s) are located in the same Simple Modular Storage system.

A V-VOL is a mirror image of the P-VOL at the time of the snapshot. Unlike the P-VOL, which contains the actual data, the V-VOL is made up of pointers to the data.

To maintain the snapshot image of the P-VOL as new data is being written to the P-VOL, SnapShot copies data being replaced to the data pool. V-VOL pointers are updated to reference the original data's new location in the pool. Figure 1-2 illustrates SnapShot volumes and data pool interaction.

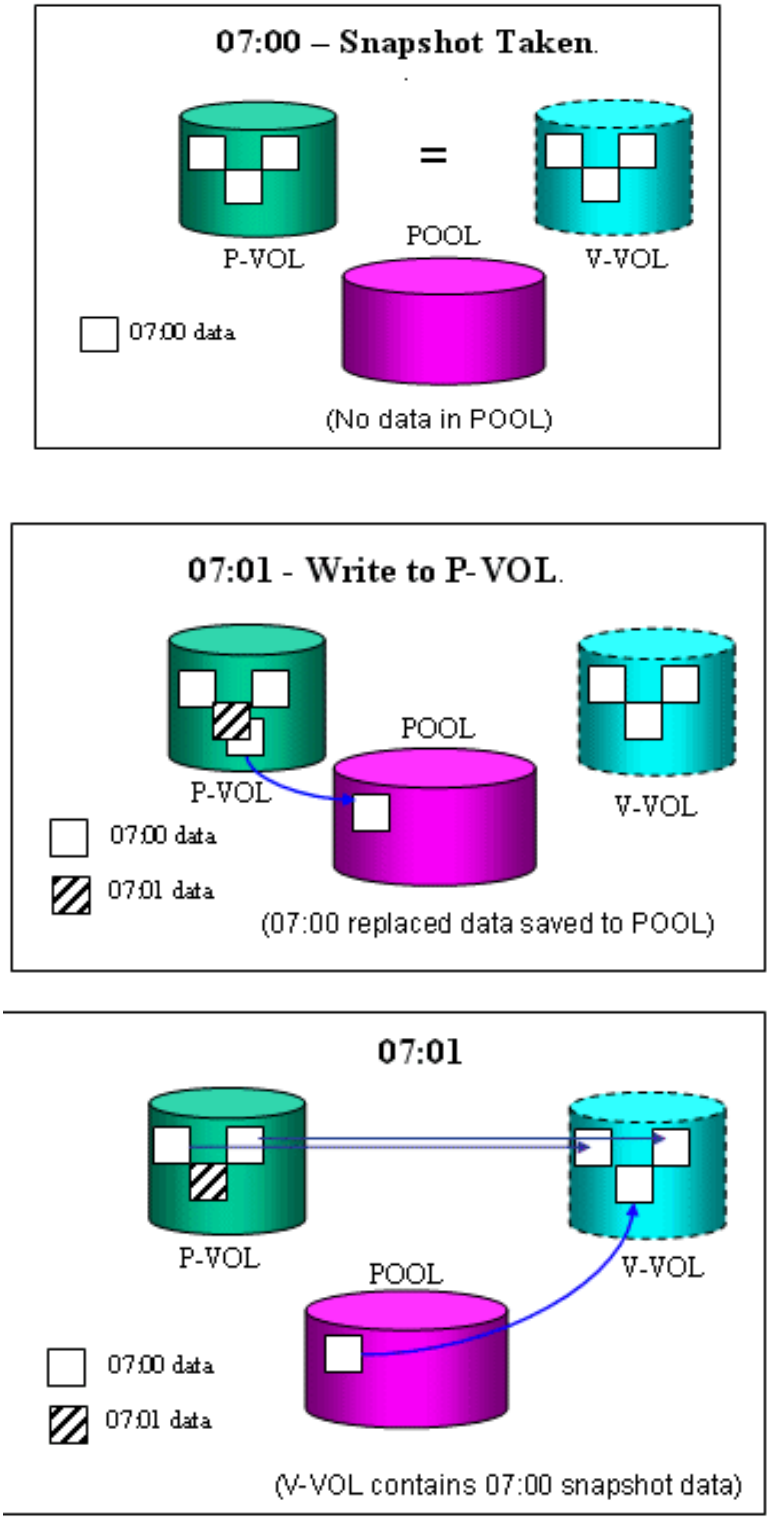


Figure 1-2: V-VOL Maintains SnapShot Data

Data Pools

After a snapshot, the V-VOL maintains a static copy of the P-VOL even as new writes are updating the P-VOL. To do this, before an updated block is written to the P-VOL, SnapShot sends the data that is being replaced to the data pool. Pointers in the V-VOL are updated to locate the replaced data that is now located in the data pool, thus maintaining the V-VOL point-in-time image of the P-VOL.

The data pool's function in the SnapShot process is illustrated in Figure 1-2.

Up to 64 data pools can be set for each controller. Each data pool can be assigned to two or more P-VOLs plus the differential data of two or more V-VOLs.

Differential Management LUs (DM-LU)

The DM-LU is an exclusive volume used for storing SnapShot information when the array system is powered down. The DM-LU is treated the same as other volumes in the storage system, but is hidden from a host. The DM-LU is set at the factory at 10 GB. User configuration is not required

Consistency Group (CTG)

Application data often spans more than one volume. With SnapShot, it is possible to manage operations spanning multiple volumes as a single group. In a "consistency group" (CTG), all primary logical volumes are treated as a single entity.

Managing SnapShot primary volumes as a consistency group allows multiple operations to be performed on grouped volumes concurrently. Write order is guaranteed across application logical volumes, since snapshots can be taken at the same time.

SnapShot Interface—Storage Navigator Modular 2

Use Storage Navigator Modular 2 (Navigator 2) on the workstation to perform SnapShot tasks. Configure, operate, and monitor SnapShot functions with either of two interfaces: a graphical user interface (GUI) or a Command Line Interface (CLI). Instructions in this guide refer to both interfaces.

CAUTION! Storage Navigator 2 CLI is provided for users with significant storage management expertise. Improper use of this CLI could void your Hitachi Simple Modular Storage 100 system warranty. Please consult with your reseller before using CLI**.**

2

Planning and Design

A backup insures that a volume with bad or missing data can be restored. With SnapShot you create copies of your production data that can be used for backup and other uses.

Creating a backup system that fully supports business continuity is best done when SnapShot is configured to match your business needs.

This chapter guides you in planning a configuration that meets organization needs and the workload requirements of your host application.

The Plan and Design Workflow

The SnapShot planning effort consists of finding the number of V-VOLs your organization requires for the P-VOL, the V-VOL(s)' lifespan — how long they must be held before being updated again — the frequency that snapshots are taken, and the size of the data pool. The answers are determined by analyzing the organization's business needs and measuring the write workload that is generated by the host application.

The plan and design workflow consists of the following:

- Assess business needs.
- Determine how often a snapshot should be taken.
- Determine how long the snapshot should be held.
- Determine the number of snapshot copies required per P-VOL.
- Measure production system write workload.
- Size the data pool. (For a description of the data pool, see Data Pools on page 1-6.

These objectives are addressed in detail in this chapter. Two other tasks are required before your design can be implemented. These are also addressed in this chapter.

- When you have established your SnapShot system design, the system's maximum allowed capacity must be calculated. This has to do with how the Storage system manages segments.
- Equally important in the planning process are the ways that various operating systems interact with SnapShot. Make sure to review the information at the end of the chapter.

Assessing Business Needs

Business needs have to do with how long back-up data needs to be retained and what the business or organization can tolerate when disaster strikes.

These organizational priorities help determine the following:

- How often a snapshot should be made (frequency)
- How long a snapshot (the V-VOL) should be held (lifespan)
- The number of snapshots (V-VOLs) that will be required for the P-VOL.

Establishing How Often a Copy Is Made (Copy Frequency)

The frequency that copies need to be made is determined by how much data can be lost in a disaster before business is significantly impacted.

To determine how often a snapshot should be taken

- Using knowledge of your business, decide how much data could be lost in a disaster without significant impact to the business.

Ideally, a business desires no data loss. In the real world, disasters occur and data is lost. You or your organization's decision makers must decide the number of business transactions, the number of hours required to key in lost data, and so on.

- If losing 4 hours of business transaction is acceptable, but not more, backups should be planned every 4 hours. If 24 hours of business transaction can be lost, backups may be planned every 24 hours.

Determining how often copies should be made is one of the factors used to determine data pool size. The more time that elapses between snapshots, the more data accumulates in the data pool. Copy frequency may need to be modified to reduce the data pool size

Selecting a Reasonable Time Between Snapshots

The length of time between snapshots, if too short or too long, can cause problems.

- When short periods are indicated by your company's business needs, consider also that snapshots taken too frequently could make it impossible to recognize logical errors in the storage system. This would result in snapshots of bad data. How long does it take to notice and correct such logical errors? The time span for snapshots should provide ample time to locate and correct logical errors in the storage system.
- When longer periods between snapshots are indicated by business needs, consider that the longer the period, the more data accumulates in the data pool. Longer periods between backups require more space in the data pool.

This effect is multiplied if more than one V-VOL is used. If you have two snapshots of the P-VOL, then two V-VOLs are tracking changes to the P-VOL at the same time.

Establishing How Long a Copy Is Held (Copy Lifespan)

Copy lifespan is the length of time a copy (V-VOL) is held, before a new backup is made to the volume. Lifespan is determined by two factors:

- Your organization's data retention policy for holding onto backup copies.
- Secondary business uses of the backup data.

When you determine the snapshot's lifespan, you can then calculate the number of V-VOLs your system requires.

Lifespan Based on Backup Requirements

- If the snapshot is to be used for tape backups, the minimum lifespan must be => the time required to copy the data to tape. For example:

  Hours to copy a V-VOL to tape = 3 hours
  V-VOL lifespan => 3 hours

- If the snapshot is to be used as a disk-based backup available for online recovery, you can determine the lifespan by multiplying the number of generations of backup you want to keep online by the snapshot frequency. For example:

  Generations held = 4
  Snapshot frequency = 4 hours
  4 x 4 = 16 hours
  V-VOL lifespan = 16 hours

Lifespan Based on Business Uses

- If you use snapshot data (the V-VOL) for testing an application, the testing requirements determine the amount of time a snapshot is held.
- If snapshot data is used for development purposes, development requirements may determine the time the snapshot is held.
- If snapshot data is used for business reports, the reporting requirements can determine the backup's lifespan.

Establishing the Number of V-VOLs that Are Required

V-VOL frequency and lifespan determine the number of V-VOLs your system needs per P-VOL.

For example: Suppose your data must be backed up every 12 hours, and business-use of the data in the V-VOL requires holding it for 48 hours. In this case, your SnapShot system would require 4 V-VOLs, since there are four 12-hour intervals during the 48-hour period. This is illustrated in Figure 2-1.

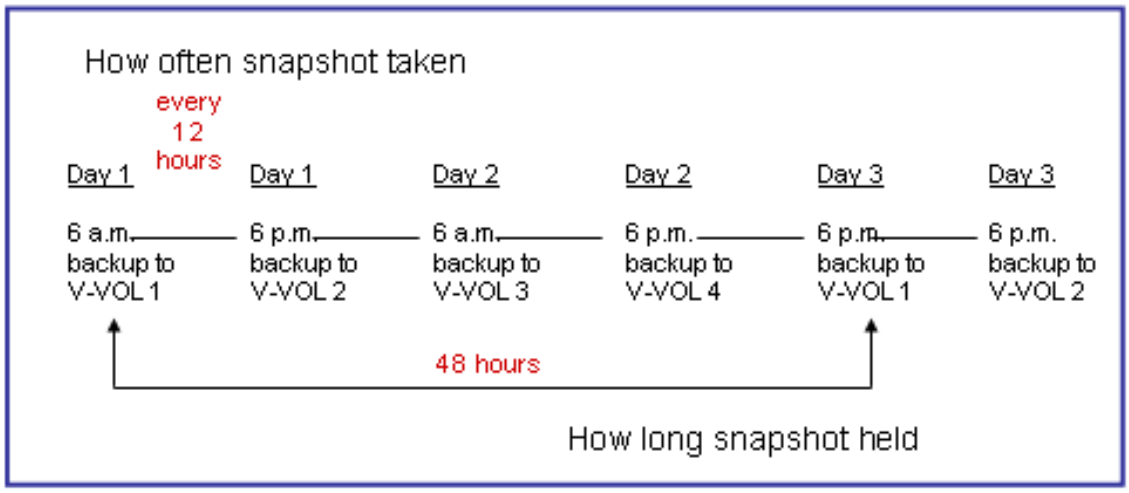


Figure 2-1: V-VOL Frequency, Lifespan

Establishing Data Pool Size

The data pool holds data from the P-VOL that is being replaced. By holding this original data in the data pool, the mirror image of the V-VOL is maintained at the time of the snapshot.

You determine the size of the data pool that your system requires by:

- Measuring the amount of write workload that passes from the host application to the P-VOL. Write workload is the megabytes per second that are written to the primary volume over a specific time.
- Calculating the amount of data that would accumulate during the lifespan of your V-VOL
- Multiplying times the number of V-VOLs

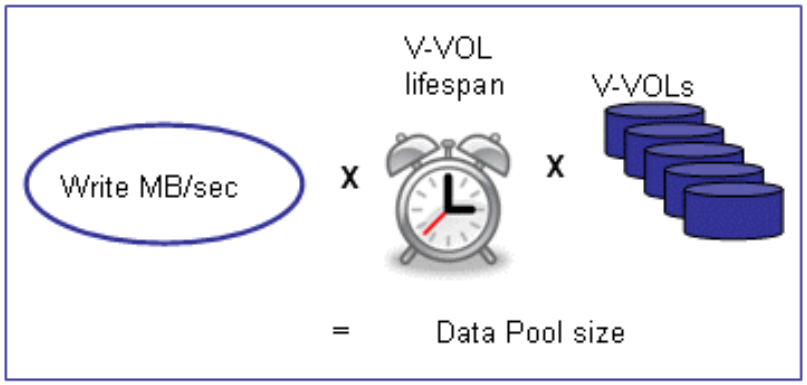


Figure 2-2: Write workload and data pool size

Measuring Workload Data

To set up SnapShot, you must measure the amount of data that changes in your production system. The amount of data written to the primary volume indicates how large the data pool must be.

Workload data is collected using performance monitoring software on your operating system—preferably during the busiest time of month, quarter, and year. The goal is to collect data that shows your system's actual workloads during high peaks and spikes, when more is changing and the demands on the system are greatest.

To collect workload data

1. Using your operating system's performance monitoring software, collect the following:
   - Disk-write bytes/second for every physical volume that will be replicated.
   - Collect this data at 10 minute intervals.
   - Collect this data over a 4-6 week period that includes high peaks and spikes, and when the demands on the system are greatest.

2. At the end of the period, convert the data to MB/second, if it is not already so, and import into a spreadsheet tool. Figure 2-3 shows collected raw data, in megabytes per second in 10 minute segments.

	A	B
1	**Time**	**Raw Data**
2	0:00	16.34
3	0:10	28.19
4	0:20	15.86
5	0:30	20.58
6	0:40	4.57
7	0:50	11.36
8	1:00	20.04
9	1:10	35.69
10	1:20	26.44
11	1:30	23.97
12	1:40	20.69

Figure 2-3: Raw Data Example in MB/sec

3. Using the copy frequency established earlier, calculate averages over the collection period. Most spreadsheet tools have an average function. For example:

   If copy frequency is 1 hour, then calculate 60 minute rolling averages using the values in 6 10-minute intervals.

   If copy frequency is 4 hours, then calculate 240 minute rolling averages using the values in 24 10-minute intervals.

   Figure 2-4 illustrates 60-minute rolling averages.

	A	B	C
1	**Time**	**Raw Data**	**60 Min Rolling Avg**
2	0:00	16.34	
3	0:10	28.19	
4	0:20	15.86	16.15
5	0:30	20.58	16.77
6	0:40	4.57	18.02
7	0:50	11.36	19.78
8	1:00	20.04	20.35
9	1:10	35.69	23.03
10	1:20	26.44	24.28
11	1:30	23.97	25.11
12	1:40	20.69	23.41

Figure 2-4: Rolling Averages Calculated Using V-VOL Frequency

Example rolling-average procedure using Excel:

a. In cell C4, type `=Average(b2:b7)`.

b. Press Enter.

   This instructs the tool to calculate the average value in cells B2 through B7 and populates C4 with that data.

c. Copy the value in C4.

d. Highlight cells C5 to the last C cell in the last row of workload data in the spreadsheet.

e. Right-click the highlighted cells and select the paste option.

   Excel maintains the logic and increments the formula values initially entered in C4. It then calculates all the point in time averages and populates the C cells.

   Figure 2-5 illustrates rolling averages graphed over raw measurement data averages.

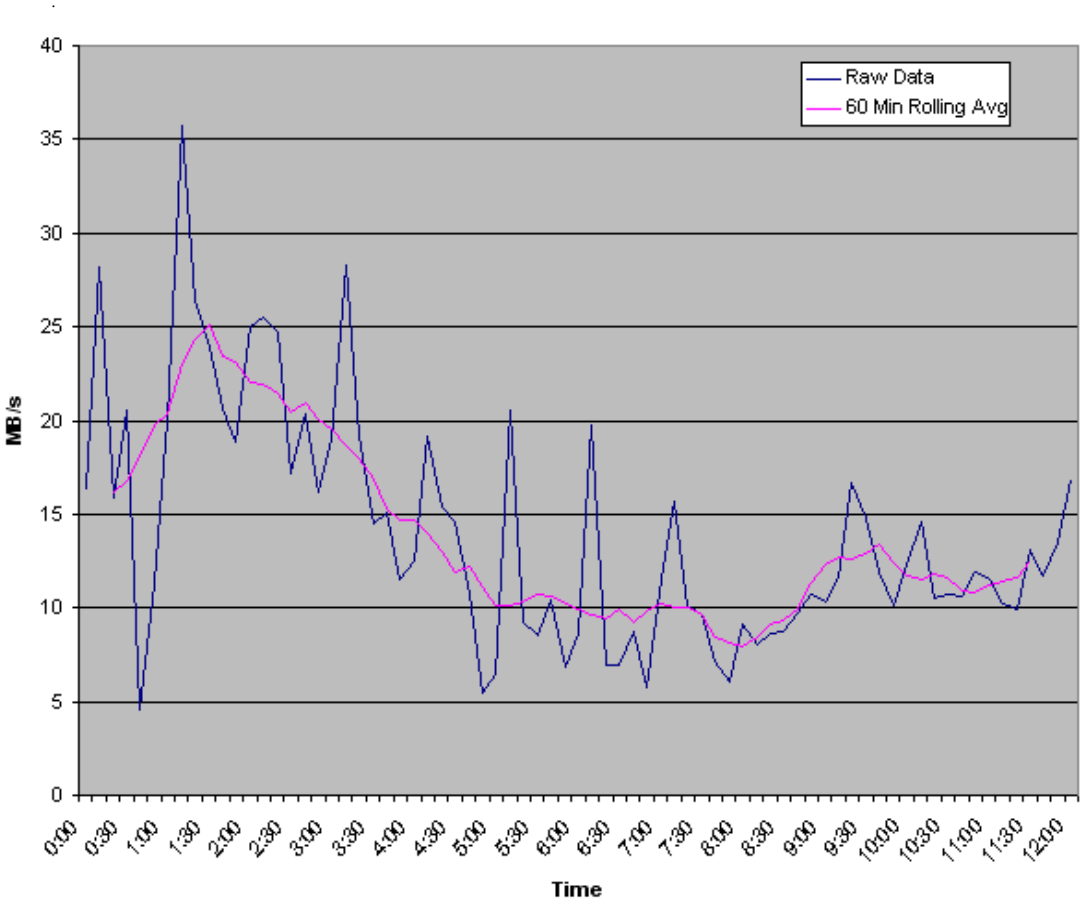


Figure 2-5: Rolling Averages Graphed Over Raw Averages

4. Locate the maximum rolling average (RA) value in the C column. Using this peak value and the following formula, calculate the *cumulative peak data change* over the lifespan of a copy (V-VOL):

(RA peak MB/sec) x (V-VOL lifespan seconds) = (Cumulative data over V-VOL lifespan)

For example, if the RA peak is 25 MB/sec, and the V-VOL lifespan is 3600 seconds (1 hour), then:

```
25MB/sec x 3600 seconds = 90,000 MB
```

The cumulative data over a V-VOL's 1-hour lifespan is 90,000 MB.

5. Calculate the *base data pool* size for your primary/virtual volumes by multiplying the MB size of one V-VOL in Step 4 by the number of V-VOLs, which was established earlier. For example:

   `90,000 MB` x 4 V-VOLS = 360,000 MB

   This is the base data pool size for a SnapShot system in which the copy frequency is 1 hour, the copy lifespan is 4 hours, and the number of copies (V-VOLs) is 4.

6. It is highly recommended that a safety factor of 20%, be calculated. Do so using the following formula:

   `(Base data pool size) x 1.2.` For example:

   `360,000 MB x 1.2 = 432,000 MB`

7. It is also advisable to factor in annual increases in data transactions. Do this by multiplying the base pool size by the percentage of expected annual growth. For example:

   `432,000 MB x 1.2 (20 percent growth rate for per year)`
   `= 518,400 MB`

   This is the size of the data pool with growth factored for the first year.

8. Repeat this step for each year the solution will be in place. For example:

   `518, 400 MB x 1.2 (20 percent growth rate for second year)`
   `= 622,080 MB`

   This is the size of the data pool with growth factored for the second year.

Rule of Thumb Calculation

When measurements of host workload has not been performed, Hitachi suggests the change rates shown in Table 2-1.

Table 2-1: Workload Rates when No Measurement

Snapshot lifespan	Suggested write workload change rate
1-4 hours	10%
4-8 hours	15%
8-12 hours	20%
12-24 hours	25%

Data pool calculation using the suggested change rates in Table 2-1 is:

```
Data Pool size = (P-VOL x % of changed data x 2.5 safety rate)
x a number of V-VOLs
```

For example:

1. `P-VOL = 1 TB. 1 snapshot per 24 hours. 25% of 1 TB = 250 GB.`
2. Multiply the initial calculation by the Hitachi safety factor of 2.5. In the example above: `2.5 x 250 GB = 625 GB`. This is the base data pool size.

3. Multiply the base data pool size by the number of V-VOLs. Thus:
   `4 V-VOLs x 625 GB = 2500 GB (2.5 TB).`

Data Pool Key Points

- The data pool must be on same controller as the P-VOL and V-VOL(s).
- Data pool capacity should be at least 20 GB.
- Up to 64 volumes can be assigned to a data pool.
- When a volume is assigned to a data pool, it is no longer recognized by a host.

Calculating Maximum Capacity

Simple Modular Storage manages capacity for in-system replication systems in segments of 15.75 GB for P-VOLs and 3.2 GB for data pools. As a result, your local replication system's managed capacity must be calculated using the formulas provided below and compared to the maximum supported capacity.

To calculate SnapShot capacity

1. List the size of each P-VOL in the Storage system. For example:
   `P-VOL 1 = 100 GB`
   `P-VOL 2 = 50 GB`
2. Calculate managed P-VOL capacity, using the formula:
   `ROUNDUP (P-VOL capacity / 15.75) * 15.75`
   For example:
   ```
   P-VOL1: ROUNDUP (100 / 15.75) = 7
           7 * 15.75 = 110.25 GB, the managed P-VOL Capacity
   P-VOL2: ROUNDUP (50 / 15.75) = 4
           4 * 15.75 = 63 GB, the managed P-VOL Capacity
   ```
3. For each P-VOL, list the data pools and their sizes. For example:
   ```
   P-VOL1 has 1 data pool whose capacity = 100 GB
   P-VOL2 has 1 data pool whose capacity = 60 GB
   ```
4. Calculate managed data pool capacity, using the formula:
   `ROUNDUP (data pool capacity / 3.2) * 3.2`
   For example:
   ```
   P-VOL 1 data pool: ROUNDUP (100 / 3.2 = 32)
           32 * 3.2 = 102.4 GB, the managed data pool capacity
   P-VOL 2 data pool: ROUNDUP (60 / 3.2 = 19)
           19 * 3.2 = 60.8 GB, managed data pool capacity
   ```
5. Calculate maximum capacity using the following equation:

`(Total P-VOL capacity) / 5 + (Total Data Pool capacity) < = 800 GB`

   For example:

```
Total PVOL size = 173.25 GB
Total data pool size = 163.2 GB
```

Thus:

```
173.25 GB / 5 = 34.65 GB
34.65 GB + 163.2 GB = 197.85 GB
```

In this example, the SnapShot maximum capacity is 197.85 GB, well below the maximum supported capacity of 800 GB.

If ShadowImage is used in addition to SnapShot

6. List the total size of SnapShot P-VOLs. Using the example above:

   ```
   Total SnapShot P-VOL capacity = 150 GB
   ```

7. List the total size of ShadowImage S-VOLs. For example:

   ```
   Total SI S-VOL = 14 TB (14,000 GB)
   ```

8. Divide the total S-VOL capacity by 17. For example:

   ```
   14,000 GB / 17 = 824 GB
   ```

9. Subtract the resulting quotient from 32 TB (the maximum capacity allowed for concurrent copy systems). For example:

   ```
   32,000 - 824 GB = 31176 GB
   ```

10. From this difference, subtract the SnapShot P-VOL capacity. The difference must be 0 or greater. For example:

    ```
    31176 GB - 150 GB = 31026 GB
    ```

If your system's maximum capacity exceeds the maximum allowed capacity, you can do one or more of the following:

- Change the P-VOL size
- Reduce the number of P-VOLs
- Change the data pool size
- Reduce the number of V-VOLs
- Reduce the lifespan of the V-VOL
- Reduce ShadowImage P-VOL/S-VOL sizes

Operating System Considerations

The following sections provide necessary considerations when planning a SnapShot system.

Identifying P-VOL and V-VOL

The LU number is used to specify the P-VOL and V-VOL in Navigator 2. In order to understand the mapping of your Windows disk to an LUN, proceed as follows:

1. Identify the HLUN of your Windows disk.
   a. From the Windows Server 2003 Control Panel, select Computer Management>Disk Administrator.

b. Right-click the disk whose HLUN you want to know, then select **Properties**. The number displayed to the right of "LUN" in the dialog window is the HLUN.

2. Identify HLUN-to-LUN Mapping.
   a. In Start Storage Navigator Modular 2, select the desired array.
   b. In the array tree that displays, click the **Group** icon then click **iSCSI Target** icon in the Groups tree.
   c. On the iSCSI Target screen, select an iSCSI target.
   d. On the target screen, select the Logical Units tab. Find the identified HLUN. The LUN displays in the next column.
   e. If the HLUN is not present on a target screen, on the iSCSI Target screen, select another iSCSI target and repeat Step d.

Cluster Software, Path Switching Software

Do not make the V-VOL an object of the cluster software and the path switching software.

Microsoft Cluster Server (MSCS)

A host cannot recognize both a P-VOL and its V-VOL at the same time. Map the P-VOL and V-VOL to separate hosts.

Veritas Volume Manager (VxVM)

A host cannot recognize both a P-VOL and its V-VOL at the same time. Map the P-VOL and V-VOL to separate hosts.

Windows 2000

Multiple V-VOLs per P-VOL cannot be recognized from the same host. Limit host recognition to one V-VOL.

Windows Server 2003

- Multiple V-VOLs per P-VOL cannot be recognized from the same host. Limit host recognition to one V-VOL.
- When mounting volumes, must use the CCI `mount` command. Do not use `mountvol` command that is included in Windows Server 2003 by standard. Please install CCI on the server on which the `mount` command is to be executed. For more information, see the Hitachi Simple Modular Storage Command Control Interface (CCI) Reference Guide.
- When using CCI, if a path fails for more than one minute, the command device may not be recognized when the path is recovered. Execute Windows' "re-scan the disks" to make recovery. Restart CCI if Windows cannot access the command device even if CCI is able to recognize it.

Linux and LVM Configuration

A host cannot recognize both a P-VOL and its V-VOL at the same time. Map the P-VOL and V-VOL to separate hosts.

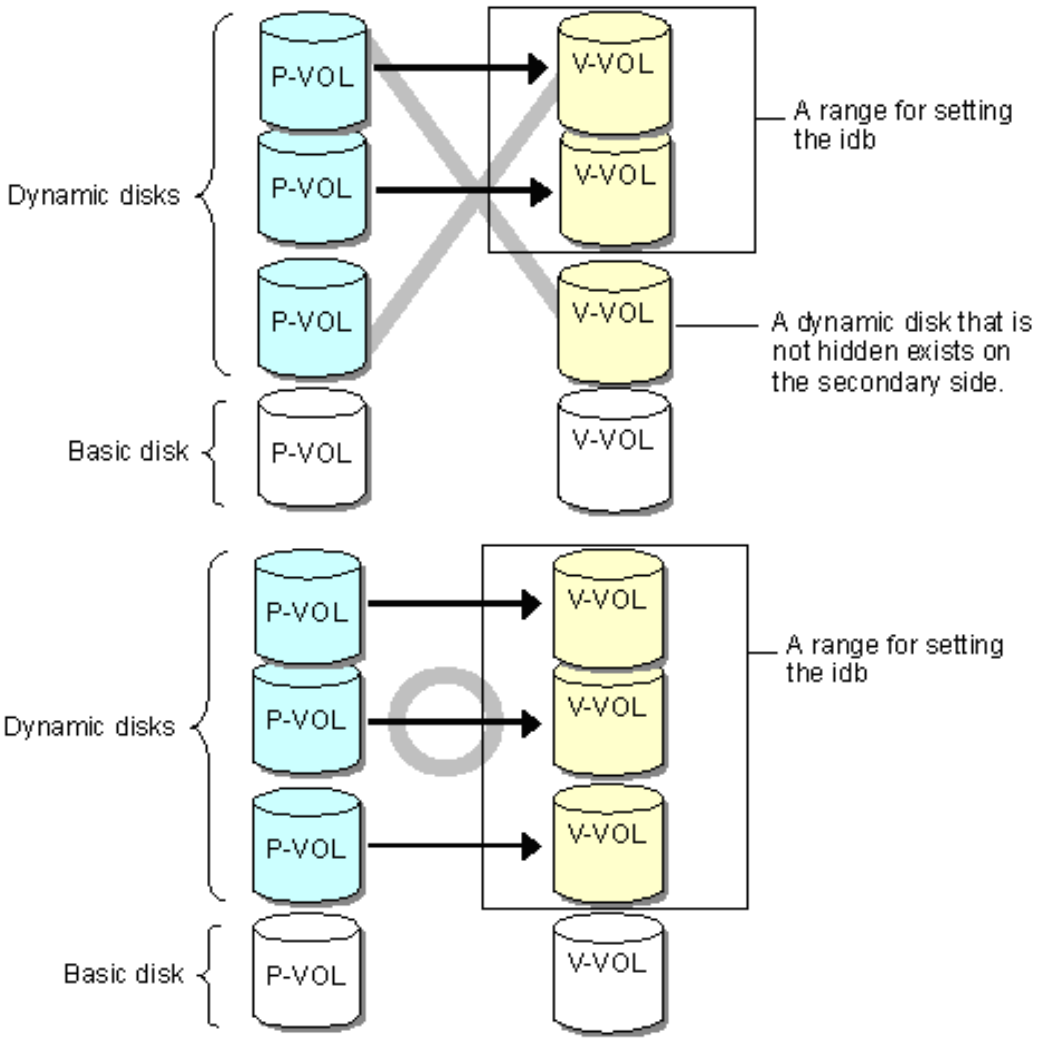
Windows Server 2003/Windows 2000 and Dynamic Disk

Observe the following when using Windows Server 2003 dynamic disk:

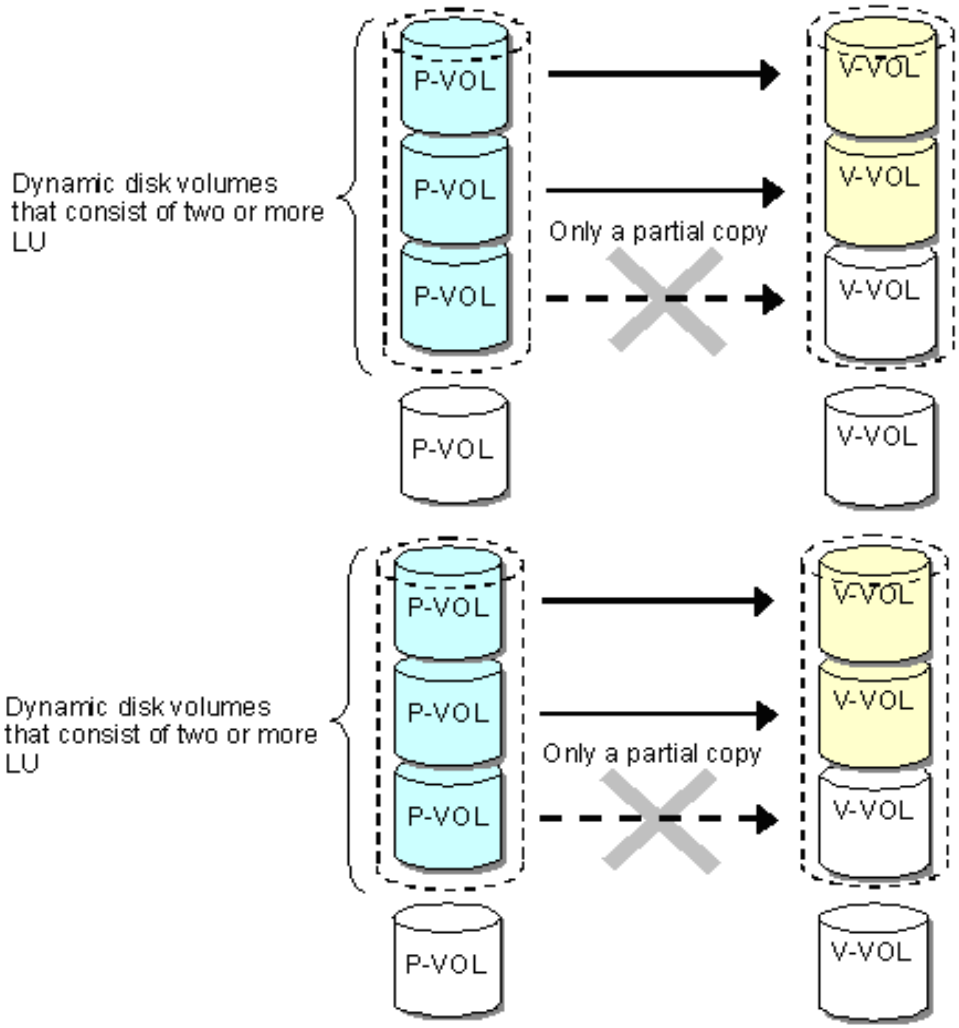
- You cannot make a P-VOL and a V-VOL into a dynamic disk; however you can use a P-VOL and a V-VOL as a dynamic disk.
- When using a V-VOL with a secondary host, insure that the pair status is Split.
- A host cannot recognize both a P-VOL and its V-VOL at the same time. Map the P-VOL and V-VOL to separate hosts.
- An LU, in which two or more dynamic disk volumes coexist, cannot be copied.
- Do not use a dynamic disk function for volumes other than a V-VOL on the secondary host side.

  When copying, hide all the dynamic disks that exist on the primary side using the `raidvchkset –vg idb` command. No restriction is placed on the primary side. Hide all the dynamic disk volumes to be restored on the primary side at the time of restoration.

If any one of the dynamic disks is left unhidden, a **Missing** drive occurs. When this occurs, delete it manually using the `diskpart` delete command (CCI required).



- Copy dynamic disk volumes that consist of two or more LUs only after hiding all LUs from a host. When the copy is completed, you can have them recognized by a host.



- A dynamic disk cannot be used with a cluster (MSCS, VCS, etc.).
- A dynamic disk cannot be used with VxVM and HDLM.

3

Requirements

This chapter describes minimum operational requirements.

- System Requirements
- Supported Platforms

System Requirements

Table 3-1 shows the minimum requirements for SnapShot. See Appendix B, SnapShot Specifications for additional information.

Table 3-1: Storage System Requirements

Minimum Requirements
• Simple Modular Storage system microcode: Version 1810/A or greater. • Storage Navigator Modular 2: Version 1.00 or greater. • CCI: Version 01-20-03/05 or greater—optional. CCI is provided for advanced users.
• Number of controllers: 2. Primary volume and data pool must be defined under the same controller. • Data Pool: Minimum of one per controller, maximum of 64. • Data Pool: Maximum of 64 volumes may be assigned to a pool per controller • Data Pool: One or more pairs can be assigned to a data pool.
• Command devices: Max. 128. The command device is required only when CCI is used for SnapShot operation. CCI is provided for advanced users only. The command device volume size must be greater than or equal to 33 MB.

Supported Platforms

Table 3-2 shows the supported platforms and operating system versions required for SnapShot.

Table 3-2: Supported Platforms

Platforms	Operating System Version
SUN	Solaris 8 (SPARC)
	Solaris 9 (SPARC)
	Solaris 10 (SPARC)
	Solaris 10 (x86)
	Solaris 10 (x64)
PC Server (Microsoft)	Windows 2000
	Windows Server 2003 (IA32)
	Windows Server 2003 (x64)
	Windows Server 2003 (IA64)
Red Hat	Red Hat Linux AS2.1 (IA32)
	Red Hat Linux AS/ES 3.0 (IA32)
	Red Hat Linux AS/ES 4.0 (IA32)
	Red Hat Linux AS/ES 3.0 (AMD64/EM64T)
	Red Hat Linux AS/ES 4.0 (AMD64/EM64T)
	Red Hat Linux AS/ES 3.0 (IA64)
	Red Hat Linux AS/ES 4.0 (IA64)

4

Enabling and Disabling SnapShot

SnapShot is bundled with the Simple Modular Storage system. It must be enabled before using. SnapShot can also be disabled.

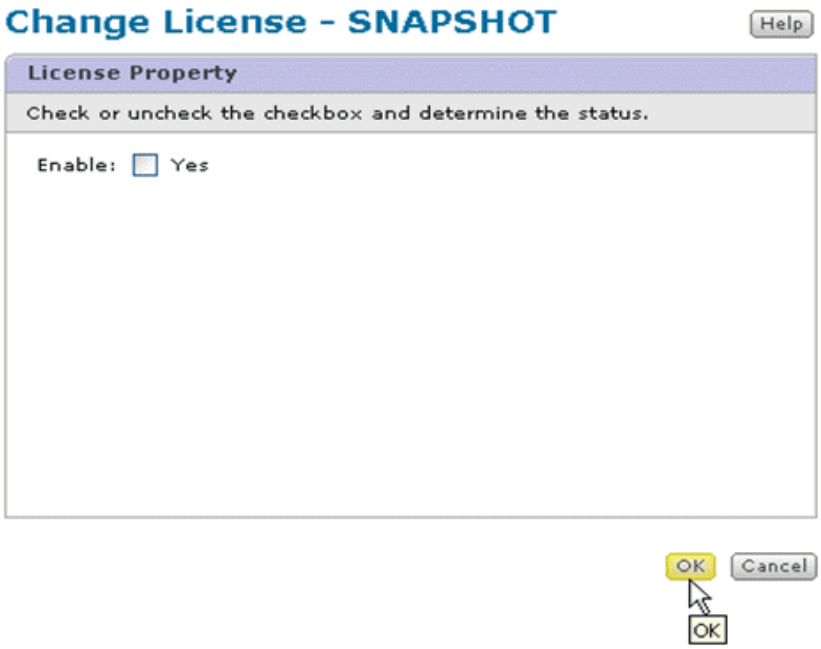
- Enabling/Disabling SnapShot

Enabling/Disabling SnapShot

To enable/disable SnapShot

1. In the Navigator 2 GUI, select the array where you want to enable SnapShot and click the **Show & Configure Array** button.
2. In the tree view, click **Settings**, then click **Licenses**.
3. Select **SnapShot** in the Licenses list, then click the **Change Status** button at the bottom of the page.

   The Change License screen appears.



4. To enable, click the **Enable: Yes** check box.

   To disable, clear the **Enable: Yes** check box.

NOTE: When disabling, SnapShot pairs must be deleted.

5. Click **OK**.
6. In the confirmation screen that appears for the enabling and disabling actions, click **OK**. The Reboot Array message appears confirming the operation is complete. Before beginning the restart process, make sure that the host has stopped accessing data.

7. When ready, click the **Yes, I have read ...** check box at the bottom of the message, then click **Reboot Array**. The reboot time displays. If the Storage system does not respond after 15 minutes, check its condition.
8. When rebooting has finished, a message appears stating that the restart is successful. Click **Close**.

5

Configuring SnapShot

This chapter describes the steps for setting up SnapShot.

Configuration Workflow

The following configuration tasks must be completed for SnapShot functions to become operational. The P-VOL should be set up in your Simple Modular Storage system prior to SnapShot configuration. See Appendix B, SnapShot Specifications for more information.

- Assign volumes for:
  - Data pools
  - Virtual volumes (V-VOL)

Assign Volumes for the Data Pool

The data pool stores differential data after the snapshot is created. Differential data is the data in the P-VOL that is being updated. The original data is stored in the data pool to retain the snapshot. For more information on the data pool see Data Pools on page 1-6.

To create and assign volumes for data pools

(Advanced users using CLI, see Setting the POOL on page A-3.)

1. In Navigator 2 GUI, select the desired array, then click the **Show & Configure Array** button.
2. From the Replication tree, select the **Local Replication** icon, then select the **Setup** icon. The Setup screen displays.
3. Select **Data Pools.** View screen instructions by clicking the Help button.

Notes on Adding a Data Pool

- To review the data pool sizing procedure, see Establishing Data Pool Size on page 2-5.
- Up to 64 volumes can be assigned to a data pool.
- Hitachi recommends a minimum of 20 GB for data pool size.
- The default **Threshold** value is 70%.
  - When capacity reaches the Threshold plus 1 percent, both data pool and pair status change to "Threshold over", and the Storage system issues a warning.
  - If capacity reaches 100 percent, the pair fails and all data in the V-VOL is lost.

Set Up the Virtual Volume (V-VOL) (manual method)

When the Backup Wizard in the Navigator 2 GUI is used, V-VOLs are created and set up automatically. You do not need to perform any V-VOL setup.

If you are not using the Backup Wizard but the Create Pair procedure, then proceed with the instructions below. Using the Create Pair procedure is a more involved method that allows you to set copy pace, assign the pair to a group (and create a group), and automatically split the pair after creating.

When you create the pair, you select the primary and virtual volumes. Set up a virtual volumes in Navigator 2 GUI as described in the following procedure.

To assign volumes as V-VOLs

(Advanced users using CLI, see Setting the V-VOL on page A-4.)

1. In Navigator 2 GUI, select the desired array, then click the **Show & Configure Array** button.
2. From the Replication tree, select the **Local Replication** icon, then select the **Setup** icon. The Setup screen displays.
3. Select **SnapShot Logical Units**. The SnapShot Logical Units page displays
4. Click **Create SnapShot LU**. The Create Logical Unit for SnapShot window appears.
5. Enter the **LUN** to be used for the V-VOL. You can use any unused LUN that matches the P-VOL in size. The lowest available LU number is the default.
6. Enter the V-VOL size in the **Capacity** field. Capacity must equal the size of the P-VOL. The Capacity range is 1 MB - 128 TB.
7. Click **OK**.

6

Using SnapShot

This chapter describes the SnapShot data replication workflow and processes. Details are provided for in-system replication along with sample scenarios using SnapShot functionality.

- SnapShot Replication Workflow
- Back Up Your Volume—Create a Pair
- Update the V-VOL
- Restore the P-VOL from the V-VOL
- Use the V-VOL for Tape Backup, Testing, Reports, Etc.
- Edit Pairs, Data Pool
- Delete Pairs, V-VOLs, Data Pools.
- Test the Configuration

SnapShot Replication Workflow

Following the initial creation of the SnapShot pair, which is a one time operation, a SnapShot workflow includes the following basic processes:

- Back up a volume
- Update the V-VOL
- Restore the P-VOL from the V-VOL
- Delete the pair, V-VOL, and data pool
- Edit the pair and data pool

The following sections describe these processes.

Back Up Your Volume—Create a Pair

During the short time that a snapshot copy is being created, the P-VOL remains accessible to the host. The V-VOL is unavailable until the snapshot is complete and the pair is split.

- There are two ways to back up a volume using the Navigator 2 GUI.
  - Use the backup wizard, described below. This is the simplest and quickest method. Preparation consists of the following:
    - Make sure the primary volume is set up on the array. See Table B-1 on page B-2 for primary volume specifications.
    - Create a data pool by assigning a volume. See Assign Volumes for the Data Pool on page 5-2.
  - Use the create pair procedure, which allows more customization—described on Page 6-3. This is a more involved method that allows you to set copy pace, assign the pair to a group (and create a group), and automatically split the pair after it is created. Preparation consists of the following:
    - Make sure the primary volume is set up on the array. See Table B-1 on page B-2 for primary volume specifications.
    - Create a data pool by assigning a volume. See Assign Volumes for the Data Pool on page 5-2
    - Set up the V-VOL. See Set Up the Virtual Volume (V-VOL) (manual method) on page 5-3
- (Advanced users using Navigator 2 CLI, please see Creating SnapShot Pairs on page A-5.)

Using the Backup Wizard

1. In Navigator 2 GUI, select the desired array, then click the **Show & Configure Array** button. The
2. On the array page under Common Array Tasks, click the **Backup Volume** link. The Backup Your Volume Wizard window opens.
3. On the Introduction screen, click **Next**. The Select Primary Volume screen displays.

4. Existing volumes in the array are listed in the **Primary Volume** box. Click the button next to the **LUN** that you want to back up, then click **Next**. The Prepare Secondary Volume screen displays.
5. The system will create a secondary volume (SnapShot virtual volume) in the array, with the same capacity as the selected P-VOL. In the **LUN** box, use the default value (if present), or the enter an available logical unit number. Then click **Next**. The Set Pair Parameters screen displays.
6. Use the default **Pair Name**, or enter a new name.
7. From the **Pool Number** drop-down box, select a data pool for the pair, then click **Next**. The Confirm screen displays.
8. Click **Confirm**, then click **Finish**. The backup pair is created.

Create Pair Procedure

Unlike the backup wizard, this method allows you to set copy pace, assign the pair to a group (and create a group), and automatically split the pair after it is created.

1. In Navigator 2 GUI, select the desired array, then click the **Show & Configure Array** button.
2. From the Replication tree, select the **Local Replication** icon. The **Pairs** screen displays.
3. Select the **Create Pair** button. The Create Pair screen displays.
4. In the Copy Type area, click the **SnapShot radio** button. There may be a brief delay while the screen refreshes.
5. In the **Pair Name** box, enter a name for the pair.
6. In the **Primary** and **Secondary Volume** fields, select the primary and secondary volumes that you want to pair. For SnapShot, the secondary volume list contains the virtual volumes that have been previously set up. Capacity of the V-VOL must be equal to the P-VOL capacity.
7. From the **Data Pool Number** dropdown list, select the data pool, previously set up, that you want to assign to the pair.
8. Click the **Advanced** tab.
9. From the **Copy Pace** dropdown list, select the speed that copies will be made. Copy pace is the speed at which a pair is created or resynchronized. Select one of the following:
   - Slow — The process takes longer when host I/O activity is heavy. The time of copy or resync completion cannot be guaranteed.
   - Medium — (Recommended) The process is performed continuously, but the time of completion cannot be guaranteed. The pace differs depending on host I/O activity.
   - Fast — The copy/resync process is performed continuously and takes priority. Host I/O performance is restricted. The time of copy/resync completion is guaranteed.

10. In the **Group Assignment** area, you have the option of assigning the new pair to a consistency group. See Consistency Group (CTG) on page 1-6 for a description. Do one of the following:
    - If you do not want to assign the pair to a consistency group, leave the **Ungrouped** button selected.
    - To create a group and assign the new pair to it, click the **New or existing Group Number** button and enter a new number for the group in the box.
    - To assign the pair to an existing group, enter the consistency group number in the **Group Number** box, or enter the group name in the **Existing Group Name** box.

    NOTE: Add a Group Name for a consistency group as follows:
    a. On the **Pairs** screen, check the box for the pair belonging to the group.
    b. Click the **Edit Pair** button.
    c. On the Edit Pair screen, enter the **Group Name** then click **OK**.
11. In the **Split the pair ...** field, do one of the following:
    - Click the **Yes** box to split the pair immediately. A snapshot will be taken and the V-VOL will become a mirror image of the P-VOL at the time of the split.
    - Leave the **Yes** box unchecked to create the pair. The V-VOL will stay up-to-date with the P-VOL until the pair is split.
12. Click **OK**, then click **Close** on the confirmation screen that appears. The pair has been created.

Update the V-VOL

Updating the V-VOL means to take a new snapshot. Two steps are involved when you update the V-VOL: a resync of the pair and splitting the pair.

- Resyncing means that the P-VOL and V-VOL are re-synchronized. This is necessary because the pair became out of sync when the pair was split previously. After a pair split, no new updates are copied to the V-VOL. When the V-VOL is updated, it is again updated and resynchronized with the P-VOL, then split again.
- Splitting the pair is the taking of the snapshot. The V-VOL and the P-VOL are the same at the time the split occurs. After the split the V-VOL does not change. The V-VOL can then be used for tape-backup and in operations by a secondary host.

To update the V-VOL

(Advanced users using CLI, see Updating SnapShot Logical Unit on page A-6.)

1. In Navigator 2 GUI, select the desired array, then click the **Show & Configure Array** button.

2. From the Replication tree, select the **Local Replication** icon. The **Pairs** screen displays.
3. Select the pair that you want to update and click the **Resync Pair** button at the bottom of the screen. The operation may take several minutes, depending on the amount of data.
4. When the Resync is completed, click the **Split Pair** button. This operation is completed quickly. When finished, the V-VOL is updated.

NOTE: Differential data is deleted from the data pool when a V-VOL is updated. The deletion may take a few moments.

Restore the P-VOL from the V-VOL

SnapShot allows you to restore your P-VOL to a previous point in time from any SnapShot image (V-VOL). The amount of time it takes to restore your data depends on the size of the P-VOL and the amount of data that has changed.

When you restore the P-VOL, two processes *take place.

- The V-VOL is validated to insure that the restoration will complete successfully. During the validation stage, the host cannot access the P-VOL. Once validation is complete, the P-VOL is again available.
- The restoration takes place. The actual copying from V-VOL to P-VOL is performed in the background. The P-VOL is available for read/write from the host during the restoration.

To restore the P-VOL from the V-VOL

1. Shut down the host application.
2. Un-mount the P-VOL from the production server.
3. In the Storage Navigator 2 GUI, select the **Local Replication** icon in the Replication tree view.

   Advanced users using the Navigator 2 CLI, please refer to Restoring V-VOL to P-VOL on page A-6.
4. In the GUI, select the pair to be restored in the **Pairs** list.
5. Click **Restore Pair.** View subsequent screen instructions by clicking the Help button.

Restore from Tape

You can restore the P-VOL from tape directly or indirectly, as follows:

- If the V-VOL is in Failure status.
- Data pool capacity

Use the V-VOL for Tape Backup, Testing, Reports, Etc.

Your snapshot image (V-VOL) can be used to fulfill a number of data management tasks performed on a secondary server. These management tasks include backing up production data to tape, using the data to develop or test an application, generating reports, populating a data warehouse, and so on.

Whichever task you are performing, the process for preparing and making your data available is the same. The following process can be performed using the Navigator 2 GUI or CLI, in combination with an operating system scheduler. The process should be performed during non-peak hours for the host application.

To use the V-VOL for secondary functions

1. Un-mount the V-VOL. This is only required if the V-VOL is currently being used by secondary server.
2. Resync the pair before stopping or quiescing the host application. This is done to minimize the down time of the production application.
   - Navigator 2 GUI users, please see the resync pair instruction in Update the V-VOL on page 6-4.
   - Advanced users using CLI, please see the resync pair instruction in Updating SnapShot Logical Unit on page A-6.

NOTE: Some applications can continue to run during a backup operation, while others must be shut down. For those that stay running (placed in backup mode or quiesced rather than shut down), there may be a performance slowdown on the P-VOL.

3. When pair status becomes "Paired", shut down or quiece (quiet) the production application, if possible.
4. Split the pair. Doing this insures that the backup will contain the latest mirror image of the P-VOL.
   - Navigator 2 GUI users, please see the split pair instruction in Update the V-VOL on page 6-4.
   - Advanced users using CLI, please see the split pair instruction in Updating SnapShot Logical Unit on page A-6.
5. Un-quiesce or start up the production application so that it is back in normal operation mode.
6. Mount the S-VOL (V-VOL) on another server.
7. Run the backup program using the snapshot image (V-VOL).

NOTE: When performing read operations against the snapshot image (V-VOL), you are effectively reading from the P-VOL. This extra I/O on the P-VOL affects the performance.

Edit Pairs, Data Pool

You can edit certain information concerning a pair and a data pool.

- For pairs, you can change the name, group name, and copy pace.
- For data pools, you can increase the size, edit capacity threshold, and add LUs (volumes).

To edit pairs

1. In the Navigator 2 GUI, select the **Local Replication** icon in the Replication tree view.

   Advanced users using Navigator 2 CLI, see Changing Pair Information on page A-8.
2. In the GUI, select the pair that you want to edit in the **Pairs** list.
3. Click the **Edit Pair** button. View screen instructions for specific information by clicking the Help button.

To edit a data pool

1. In the Storage Navigator 2 GUI, select the **Local Replication** icon in the Replication tree view.

   Advanced users using Navigator 2 CLI, please refer to *Storage Navigator Modular 2 Command Line Interface (CLI) User's Guide* for more information.
2. In the GUI, select **Setup**, then select **Data Pool**. `
3. Select the LUN (data pool) that you want to edit.
4. Make changes to editable fields as needed, then click **OK**.

Delete Pairs, V-VOLs, Data Pools

You can delete a pair, the V-VOL, and data pool to free space or when you no longer need them.

- Pair: When a pair is deleted, the primary and virtual volumes return to their SIMPLEX state. Both are available for use in another pair.
- V-VOL: The pair must be deleted before a V-VOL is deleted.
- Data pool: When a data pool is deleted, the V-VOLs must also be deleted.

To delete a pair

1. Select the **Local Replication** icon in the Replication tree view.

   Advanced users using the Storage Navigator 2 CLI, see Releasing SnapShot Pairs on page A-7.
2. In the GUI, select the pair you want to delete in the **Pairs** list.
3. Click **Delete Pair.**

To delete a V-VOL

1. Make sure that the pair is deleted first. The pair status must be SIMPLEX to delete the V-VOL.

2. Select the **SnapShot Logical Units** icon in the tree view.
3. In the Logical Units for Snapshot list, select the V-VOL that you want to delete.
4. Click **Delete LU for SnapShot**. A message appears.
5. Click **Close**. The V-VOL is deleted.

To delete a data pool

1. Select the **Data Pools** icon in the tree view.
2. Select a data pool you want to delete in the **Data Pool** list.
3. Click **Delete Data Pool**.
4. A message appears. Click **Close**.

Test the Configuration

You should confirm your system's configuration by closely monitoring pair status and data pool usage. See Monitoring SnapShot on page 7-2 for monitoring procedures.

7

Monitoring and Maintenance

Your business depends on the data protection provided by SnapShot. It is important that data pool capacity is sufficient to handle the differential data from your P-VOLs. If a data pool should become full, the V-VOLs associated with it are invalidated, and backup data is lost.

This chapter provides information and instructions for monitoring and maintaining the SnapShot system.

Monitoring SnapShot

The SnapShot data pool must have sufficient capacity to handle the differential data demands placed on it. You must insure that sufficient capacity is always available for the write workload by closely monitoring the following:

- Pair status
- Data pool usage

Monitoring Pair Status

To monitor pair status

(Advanced users using CLI, see the *Storage Navigator Modular 2 Command Line Interface (CLI) User's Guide*.)

1. In Navigator 2 GUI, select the desired array, then click the **Show & Configure Array** button.
2. From the Replication tree, select the **Local Replication** icon. The **Pairs** screen displays.
3. Locate the pair whose status you want to review in the **Pair** list, then review the **Status** column. Click the **Refresh Information** button to make sure the data is current.Statuses and definitions are listed in Table 7-1.

Table 7-1: Pair Statuses

Pair Status	Description	Action
Simplex	Status when the volume has not have been paired or when the pair has been deleted. The volume has no SnapShot association with another volume.	
Paired	V-VOL is a mirror image of the P-VOL. Updates to the P-VOL are copied to the V-VOL.	
Reverse Synchronizing	P-VOL restoration from V-VOL is in progress.	
Split	The snapshot is executed.	
Thresholdover	Threshold value for the data pool is exceeded; warning status.	Consider increasing data pool capacity.
Failure	Copying is suspended due to a hardware failure or data pool overflow. All V-VOLs become invalid.	If data pool overflow is the cause, increase data pool capacity.

Monitoring Data Pool Usage

The data pools should be monitored frequently.

To monitor data pool usage level

(Advanced users using CLI, see the *Storage Navigator Modular 2 Command Line Interface (CLI) User's Guide*.)

1. In Navigator 2 GUI, select the desired array, then click the **Show & Configure Array** button.
2. From the Replication tree, select the **Local Replication** icon, then select the **Setup** icon. The Setup screen displays.
3. Select **Data Pools**. The Data Pools screen displays.
4. Locate the desired data pool and review the **% Used** column. This shows the percentage of the data pool that is being used. Click the **Refresh Information** button to make sure the data is current.

If usage reaches the Threshold level or is close to it on a regular basis, the data pool should be expanded, and/or the lifespan and number of V-VOLs reduced.

NOTE: Threshold is set by the user. It is a percentage of the data pool that, when reached, indicates that maximum capacity is close to being reached. The default Threshold level is 70%.

Expanding the Data Pool

When monitoring indicates that the data pool is in danger of filling, you can add new volumes to expand its size.

To expand the data pool capacity

The Storage system allows a maximum of 128 volumes for data pools. One data pool may consist of up to 64 volumes.

1. Split the pair. For instructions, see Update the V-VOL on page 6-4.
2. Add a volume or volumes to the data pool.

Other Methods for Lowering Data Pool Load

When a data pool is in danger of being full, the following actions can be taken as alternatives or in addition to expanding the data pool:

- Delete one or more V-VOLs. With fewer V-VOLs, less data accumulates in the data pool.
- Reduce V-VOL lifespan. By holding snapshots for a shorter length of time, less data accumulates, which relieves the load on the data pool.

A re-evaluation of your SnapShot system's design may show that not enough data pool space was originally allocated. See Planning and Design on page 2-1 for more information.

8

Troubleshooting

Two types of problem can be experienced with a SnapShot system: pair failure and data pool capacity exceeded. This chapter discusses the causes and provides solutions for these problems.

Pair Failure

A pair failure can have two causes:

- A hardware failure affecting either the pair volumes or data pool
- A data pool whose capacity is exceeded

To determine the cause of pair failure

1. Check the status of the data pool whose associated pairs' status is changed to Failure. For details on checking pair status, see Monitoring Pair Status on page 7-2.
2. If the status of the data pool is POOL FULL, the pair failure is due to capacity is exceeded.
3. if the status of the data pool is other than POOL FULL, the pair failure is due to hardware failure.

The procedure for restoring the pair differs according to the cause.

Recovering from Pair Failure Due to POOL FULL

To recover pairs when status is POOL FULL

1. Delete all the pairs that are using the full data pool.
2. Review SnapShot system configuration. See Chapter 2, Planning and Design for detailed information on the following:
   - Measuring write workload and sizing of the data pool. This addresses the amount of data your that accumulates in the data pool and provide calculations for determining the correct size of the data pool.
   - Assessing business requirements to establish the lifespan and number of V-VOLs
3. Do one or more of the following:
   - Increase the size of the data pool. See Assign Volumes for the Data Pool on page 5-2.
   - Reduce the number of V-VOLs
   - Reduce the lifespan of V-VOLs
4. Re-create the pairs.

Recovering from Pair Failure Due to a Hardware Failure

To recover the SnapShot system after a hardware failure

1. Review the information log to see what the hardware failure is.
2. Restore the array. See Navigator 2 program Help for details.
3. When the array is restored, delete the pair. See Delete Pairs, V-VOLs, Data Pools on page 6-7 for more information.
4. Re-create the pair.

Data Pool Capacity Exceeded

When your data pool capacity is exceeded, you must increase the size of the data pool. Most likely, the POOL FULL condition has caused pair failures as well. To address these problems, please see Recovering from Pair Failure Due to POOL FULL on page 8-2.

Operations Using CLI

CAUTION! Storage Navigator 2 CLI is provided for users with significant storage management expertise. Improper use of this CLI could void your Hitachi Simple Modular Storage 100 system warranty. Please consult with your reseller before using CLI**.**

This appendix describes Storage Navigator 2 Command Line Interface (CLI) procedures for Snapshot enabling, configuration and operations.

Enabling and Disabling SnapShot

SnapShot is bundled with the Simple Modular Storage system. You must enabled it before using.

The following describes the enabling/disabling procedure.

NOTE: The following conditions must be satisfied in order to disable SnapShot: All SnapShot pairs must be released (that is, the status of all LUs are SMPL); All Data Pools must be deleted; All Snapshot Images (V-VOL) must be deleted

1. From the command prompt, register the array in which the status of the feature is to be changed, then connect to the array.
2. Execute the `auopt` to change the status (enable or disable).

   Following is an example of changing the status from enable to disable. If you want to change the status from disable to enable, enter enable after the `-st` option.

```
% auopt -unit subsystem-name -option SNAPSHOT -st disable
Are you sure you want to disable the option? (y/n[n]): y
The option has been set successfully.
In order to complete the setting, it is necessary to reboot the
subsystem.
Host will be unable to access the subsystem while restarting. Host
applications that use the subsystem will terminate abnormally.
Please stop host access before you restart the subsystem.
Also, if you are logging in, the login status will be canceled
when restarting begins.
When using Remote Replication, restarting the remote subsystem
will cause both R
emote Replication paths to fail.
Remote Replication pair status will be changed to "Failure(PSUE)"
when pair status is "Paired(PAIR)" or "Synchronizing(COPY)".
Please change Remote Replication
pair status to "Split(PSUS)" before restart.
Do you agree with restarting? (y/n [n]): y
Are you sure you want to execute?
 (y/n [n]): y
Now restarting the subsystem. Start Time hh:mm:ss Time Required
4 - 15min.
The subsystem restarted successfully.
%
```

   It may take time for the subsystem to respond, depending on the condition of the subsystem. If it does not respond after 15 minutes, check the condition of the subsystem.

3. Execute `auopt` to confirm whether the status has been changed. An example is shown below.

```
% auopt -unit subsystem-name -refer
Option NameType      Term     Status
SNAPSHOTPermanent ---      Disable
%
```

Snapshot Enable/Disable is complete.

Operations for SnapShot Configuration

Setting the POOL

Up to 64 data pools can be designated for each subsystem, by assigning a logical unit that has been created and formatted. Up to 64 logical units can be assigned to each data pool. The accurate capacity of a data pool cannot be determined immediately after an LU has been assigned. Data pool capacity can only be confirmed approximately 3 minutes per 100 GB.

The following restrictions apply to LUs assigned to a data pool:

- Logical units once assigned to a data pool are no longer recognized by a host.
- Because data will be lost when excess over the limited value of the POOL capacity occurs, 20 GB at least is recommended as a standard POOL capacity. Incidentally, when the POOL capacity being used exceeds the threshold value (default value: usage rate of 70%), the pair in the Split status is changed to the Pool full status.
- An LU with a SAS drive and an LU with a SATA drive cannot coexist in a data pool.
- When using SnapShot with Cache Partition Manager, the segment size of the LU belonging to a data pool must be the default size (16 kB) or less.

The following is the procedure for creating a POOL for storing differential data for use by Snapshot.

To designate data Pool(s) (POOL(s)):

1. From the command prompt, register the subsystem to which you want to create the Data Pool, then connect to the subsystem.
2. Execute the `aupool` command create a Data Pool.

   First, display the LUs to be assigned to a Data Pool, and then create a Data Pool.

   The following is the example of specifying LU 100 for Data Pool 0.

```
% aupool -unit subsystem-name -availablelist -poolno 0
Data Pool    : 0
Available Logical Units
  LUN  Capacity RAID Group RAID Level  Type Status
  100   30.0GB           0  6( 9D+2P)  SAS  Normal
  200   35.0GB           0  6( 9D+2P)  SAS  Normal
%
% aupool -unit subsystem-name -add -poolno 0 -lu 100
Are you sure you want to add the logical unit(s) to the data pool
0?
 (y/n[n]): y
The logical unit has been successfully added.
%
```

3. Execute the `aupool` command to verify that the Data Pool has been created. Refer to the following example.

```
% aupool -unit subsystem-name -refer -poolno 0
Data Pool    : 0
  Data Pool Usage Rate: 6% (2.0/30.0 GB)
  Threshold           : 70%
  Status              : Normal
      LUN  Capacity      RAID Group  RAID Level   Type Status
      100    30.0GB               0    6( 9D+2P)  SAS  Normal
%
```

4. When deleting the logical unit set as the Data Pool, it is necessary to delete all Snapshot images (V-VOLs). To delete an existing Data Pool, refer to the following example.

```
% aupool -unit subsystem-name -rm -poolno 0
Are you sure you want to delete all logical units from the data
pool 0?
 (y/n[n]): y
The logical units have been successfully deleted.
%
```

5. To change an existing threshold value for a Data Pool, refer to the following example.

```
% aupool -unit subsystem-name -cng -poolno 0 -thres 70
Are you sure you want to change the threshold of usage rate in
the data pool?
 (y/n[n]): y
The threshold of the data pool usage rate has been successfully
changed.
%
```

Setting the V-VOL

To create a SnapShot pair you must first set a V-VOL.

If a specification for the logical unit assigned to a V-VOL is omitted when setting the V-VOL, Navigator 2 assigns the smallest undefined number to the logical unit.

To set the V-VOL:

1. From the command prompt, register the subsystem to which you want to set the V-VOL, then connect to the subsystem.
2. Execute the `aureplicationvvol` command create a V-VOL. For example:

```
% aureplicationvvol -unit subsystem-name -add -lu 1000 -size 1
Are you sure you want to create the SnapShot logical unit 1000?
 (y/n[n]): y
The SnapShot logical unit has been successfully created.
%
```

3. To delete an existing SnapShot logical unit, refer to the following example of deleting SnapShot logical unit 1000. When deleting the V-VOL, the pair state must be Simplex.

```
% aureplicationvvol –unit subsystem-name –rm -lu 1000
Are you sure you want to delete the SnapShot logical unit 1000?
 (y/n[n]): y
The SnapShot logical unit has been successfully deleted.
%
```

Performing SnapShot CLI Operations

The `aureplicationlocal` command operates SnapShot pair. To refer the `aureplicationlocal` command and its options, type in `aureplicationlocal -help` at the command prompt.

Creating SnapShot Pairs

To create SnapShot pairs:

1. From the command prompt, register the subsystem to which you want to create the SnapShot pair, then connect to the subsystem.
2. Execute the `aureplicationlocal` command create a pair.

   First, display the LUs to be assigned to a P-VOL, and then create a pair. Refer to the following example:

```
% aureplicationlocal –unit subsystem-name –ss –availablelist
–pvol
Available Logical Units
  LUN  Capacity RAID Group RAID Level  Type Status
  100   30.0 GB          0  6( 9D+2P)  SAS  Normal
  200   35.0 GB          0  6( 9D+2P)  SAS  Normal
%
% aureplicationlocal –unit subsystem-name –ss –create –pvol 200
–svol 1001 –compsplit
Are you sure you want to create pair “SS_LU0200_LU1001”?
 (y/n[n]): y
The pair has been created successfully.
%
```

3. Execute the `aureplicationlocal` command to verify that the pair has been created. Refer to the following example.

```
% aureplicationlocal –unit subsystem-name –ss –refer
Pair name                  LUN  Pair LUN  Status
Copy Type    Group
SS_LU0200_LU1001            200  1001    Split(100%)
SnapShot     ---:Ungrouped
%
```

The Snapshot pair is created.

Updating SnapShot Logical Unit

To update the V-VOL:

1. From the command prompt, register the subsystem to which you want to update the SnapShot pair, then connect to the subsystem.
2. Execute the `aureplicationlocal` command update the pair.

   Change the Split status of the Snapshot pair to Paired status using `-resync` option. Then, change the status to Split using `-split` option. Refer to the following example.

```
% aureplicationlocal -unit subsystem-name -ss -resync -pvol 200
-svol 1001
Are you sure you want to re-synchronize pair?
 (y/n[n]): y
The pair has been re-synchronized successfully.
%
% aureplicationlocal -unit subsystem-name -ss -split -pvol 200
-svol 1001
Are you sure you want to split pair?
 (y/n[n]): y
The pair has been split successfully.
%
```

3. Execute `aureplicationlocal` to update the pair. Refer to the following example.

```
% aureplicationlocal -unit subsystem-name -ss -refer
Pair name                   LUN  Pair LUN  Status
Copy Type    Group
SS_LU0200_LU1001             200  1001    Split(100%)
SnapShot     ---:Ungrouped
%
```

The V-VOL was updated.

Restoring V-VOL to P-VOL

To restore the V-VOL to the P-VOL:

1. From the command prompt, register the subsystem to which you want to restore the SnapShot pair, then connect to the subsystem.
2. Execute the `aureplicationlocal` command restore the pair.

   First, display the pair status, and then restore the pair. Refer to the following example.

```
% aureplicationlocal –unit subsystem-name –ss –refer
Pair name                  LUN  Pair LUN  Status
Copy Type    Group
SS_LU0200_LU1001            200  1001    Split(100%)
SnapShot     ---:Ungrouped
%
% aureplicationlocal –unit subsystem-name –ss –restore –pvol 200
–svol 1001
Are you sure you want to restore pair?
 (y/n[n]): y
The pair has been restored successfully.
%
```

3. Execute `aureplicationlocal` to restore the pair. Refer to the following example.

```
% aureplicationlocal –unit subsystem-name –ss –refer
Pair name                  LUN  Pair LUN  Status
Copy Type    Group
SS_LU0200_LU1001            200  1001    Paired( 40%)
SnapShot     ---:Ungrouped
%
```

V-VOL to P-VOL is restored.

Releasing SnapShot Pairs

To release the Snapshot pair and change the status to Simplex:

1. From the command prompt, register the subsystem to which you want to release the SnapShot pair, then connect to the subsystem.
2. Execute the `aureplicationlocal` command release the pair. Refer to the following example.

```
% aureplicationlocal –unit subsystem-name –ss –simplex –pvol 200
–svol 1001
Are you sure you want to release pair?
 (y/n[n]): y
The pair has been released successfully.
%
```

3. Execute `aureplicationlocal` to release the pair. Refer to the following example.

```
% aureplicationlocal –unit subsystem-name –ss –refer
DMEC002015: No information is displayed.
%
```

The Snapshot pair is released.

Changing Pair Information

You can change the pair name, group name, and/or copy pace.

1. From the command prompt, register the subsystem to which you want to change the SnapShot pair information, then connect to the subsystem.
2. Execute the `aureplicationlocal` command change the pair information. This is an example of changing a copy pace.

```
% aureplicationlocal –unit subsystem-name –ss –chg –pace slow
–pvol 200 –svol 1001
Are you sure you want to change pair information?
 (y/n[n]): y
The pair information has been changed successfully.
%
```

The Snapshot pair information is changed.

Creating Pairs that Belong to a Group

To create multiple SnapShot pairs that belong to a group:

1. Create the first pair that belongs to a group specifying an unused group number for the new group with the –gno option. The new group has been created and in this group, the new pair has been created too. Refer to the following example.

```
% aureplicationlocal –unit subsystem-name –ss –create –pvol 200
–svol 1001 –gno 20
Are you sure you want to create pair “SS_LU0200_LU1001”?
 (y/n[n]): y
The pair has been created successfully.
%
```

2. Add the name to the group if necessary using command to change the pair information. Refer to the following example.

```
% aureplicationlocal –unit subsystem-name –ss –chg –gno 20 –pvol
200 –svol 1001
                    -newgname group-name
Are you sure you want to change pair information?
 (y/n[n]): y
The pair information has been changed successfully.
%
```

3. Create the next pair that belongs to the created group specifying the number of the created group with –gno option.

   SnapShot pairs that share the same P-VOL must use same Data Pool.

4. By repeating the step 3, the multiple pairs that belong to the same group can be created.

Sample Back Up Script for Windows

This section provides sample script for backing a volume on Windows.

```
echo off
REM Specify the registered name of the arrays
set UNITNAME=Array1
REM Specify the group name (Specify "Ungroup" if the pair doesn't
belong to any group)
set G_NAME=Ungrouped
REM Specify the pair name
set P_NAME=SS_LU0001_LU0002
REM Specify the directory path that is mount point of P-VOL and
V-VOL
set MAINDIR=C:\main
set BACKUPDIR=C:\backup
REM Specify GUID of P-VOL and V-VOL
PVOL_GUID=xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx
SVOL_GUID=yyyyyyyy-yyyy-yyyy-yyyy-yyyyyyyyyyyy

REM Unmounting the V-VOL
pairdisplay -x umount %BACKUPDIR%
REM  Re-synchoronizeing pair (Updating the backup data)
aureplicationlocal -unit %UNITNAME% -ss -resync -pairname
%P_NAME% -gname %G_NAME%
aureplicationmon -unit %UNITNAME% -evwait -ss -pairname %P_NAME%
-gname %G_NAME% -st paired -pvol

REM Unmounting the P-VOL
pairdisplay -x umount %MAINDIR%
REM  Splitting pair (Determine the backup data)
aureplicationlocal -unit %UNITNAME% -ss -split -pairname %P_NAME%
-gname %G_NAME%
aureplicationmon -unit %UNITNAME% -evwait -ss -pairname %P_NAME%
-gname %G_NAME% -st split -pvol
REM Mounting the P-VOL
pairdisplay -x mount %MAINDIR% Volume{%PVOL_GUID%}

REM Mounting the V-VOL
pairdisplay -x mount %BACKUPDIR% Volume{%SVOL_GUID%}
< The procedure of data copy from C:\backup to backup appliance>
```

NOTE: In case Windows 2000 or Windows Server 2003 is used, mount command of CCI must be used when mounting/un-mounting a volume. The GUID, which is displayed by mountvol command, is needed as argument to use mount command of CCI. For more detail about mount command, see the *Hitachi Simple Modular Storage Command Control Interface (CCI) Reference Guide*.

B

SnapShot Specifications

This appendix provides external specifications for SnapShot Snapshot.

- General Specifications

General Specifications

Table B-1 lists external specifications for SnapShot.

Table B-1: General Specifications

Item	Specification
Simple Modular Storage model	SMS100 (For dual configuration only.)
Host interface	iSCSI
Number of pairs	SMS100: 510 (maximum)
Command devices	Up to 128 per disk subsystem can be set. The command device volume size must be greater than or equal to 33 MB.
Unit of pair management	Volumes are the target of SnapShot pairs, and are managed per logical unit.
Pair structure (number of V-VOLs per P-VOL)	1:32
RAID level	P-VOL: RAID 6 S-VOL: RAID 6
Combination of RAID levels	Not applicable.
Volume size	Make the volume size of the P-VOL the same as or larger than that of the data pool. (The data pool in this case means a single data pool capacity used by a single V-VOL.)
Consistency Group (CTG) number	Up to 256 consistency groups allowed per array. Applies to SnapShot if used by itself or concurrently with ShadowImage. For SMS100, up to 510 pairs can be assigned to a consistency group.
Data pools	Maximum of 64 data pools/controller (data pool number is 0 to 63); Up to 64 volumes can be set for one data pool. Up to 128 volumes per subsystem can be set for data pools. Unified volume can't be set for data pool.
Differential Management LU (DM-LU)	Exclusive volume used for storing SnapShot information when the array system is powered down. The DM-LU is set at the factory at 10 GB
Max supported capacity of P-VOL and data pool	The supported capacity of SnapShot has limitations based on P-VOL and data pool size. For details, see Calculating Maximum Capacity on page 2-9.
Access to the volumes for data pool from a host	Data pool volumes are not recognizable from the host.
Expansion of data pool capacity	Data pool capacity can be expanded by adding volumes. The data pool can be expanded while the P-VOL and V-VOL exist.

Table B-1: General Specifications

Item	Specification
Reduction of data pool capacity	Possible only when all the pairs that use the data pool have been released.
Expansion of data pool volume	No.
Formatting of volumes in a pair	No.
Pairing with an expanded volume	Only P-VOL can be expanded
Formatting or expanding V-VOL	No.
Deletion of the V-VOL	Only possible when P-VOL and V-VOL are in simplex status and not paired.
Swap V-VOL for P-VOL	No.
Concurrent use with ShadowImage	SnapShot and ShadowImage can be used at the same time on the same array. However, SnapShot volumes cannot be paired with ShadowImage volumes.
SnapShot use with expanded volumes	Yes.
Concurrent use with LUN Manager	Yes.
Concurrent use with Password Protection	Yes.
Potential effect caused by a P-VOL failure	V-VOL data also exists in the P-VOL, therefore P-VOL failure results in a V-VOL failure also.

Glossary

This glossary provides definitions for replication terms as well as terms related to the technology that supports your Hitachi Simple Modular Storage 100 array. Click the letter of the glossary section to display that page.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

A

array

A set of hard disks mounted in a single enclosure and grouped logically together to function as one contiguous storage space.

asynchronous

Asynchronous data communications operate between a computer and various devices. Data transfers occur intermittently rather than in a steady stream. Asynchronous replication does not depend on acknowledging the remote write, but it does write to a local log file. Synchronous replication depends on receiving an acknowledgement code (ACK) from the remote system and the remote system also keeps a log file.

B

background copy

A physical copy of all tracks from the source volume to the target volume.

bps

Bits per second, the standard measure of data transmission speeds.

C

cache

A temporary, high-speed storage mechanism. It is a reserved section of main memory or an independent high-speed storage device. Two types of caching are found in computers: memory caching and disk caching. Memory caches are built into the architecture of microprocessors and often computers have external cache memory. Disk caching works like memory caching; however, it uses slower, conventional main memory that on some devices is called a memory buffer.

capacity

The amount of information (usually expressed in megabytes) that can be stored on a disk drive. It is the measure of the potential contents of a device; the volume it can contain or hold. In communications, capacity refers to the maximum possible data transfer rate of a communications channel under ideal conditions.

CCI

See command control interface.

CLI

See command line interface.

cluster

A group of disk sectors. The operating system assigns a unique number to each cluster and then keeps track of files according to which clusters they use.

cluster capacity

The total amount of disk space in a cluster, excluding the space required for system overhead and the operating system. Cluster capacity is the amount of space available for all archive data, including original file data, metadata, and redundant data.

command control interface (CCI)

Hitachi's Command Control Interface software provides command line control of Hitachi array and software operations through the use of commands issued from a system host. Hitachi's CCI also provides a scripting function for defining multiple operations.

command devices

Dedicated logical volumes that are used only by management software such as CCI, to interface with the storage systems. Command devices are not used by ordinary applications. Command devices can be shared between several hosts.

command line interface (CLI)

A method of interacting with an operating system or software using a command line interpreter. With Hitachi's Storage Navigator Modular Command Line Interface, CLI is used to interact with and manage Hitachi storage and replication systems.

concurrency of S-VOL

Occurs when an S-VOL is synchronized by simultaneously updating an S-VOL with P-VOL data AND data cached in the primary host memory. Discrepancies in S-VOL data may occur if data is cached in the primary host memory between two write operations. This data, which is not available on the P-VOL, is not reflected on to the S-VOL. To ensure concurrency of the S-VOL, cached data is written onto the P-VOL before subsequent remote copy operations take place.

concurrent copy

A management solution that creates data dumps, or copies, while other applications are updating that data. This allows end-user processing to continue. Concurrent copy allows you to update the data in the files being copied, however, the copy or dump of the data it secures does not contain any of the intervening updates.

configuration definition file

The configuration definition file describes the system configuration for making CCI operational in a TrueCopy Extended Distance Software environment. The configuration definition file is a text file created and/or edited using any standard text editor, and can be defined from the PC where the CCI software is installed. The configuration definition file describes configuration of new TrueCopy Extended Distance pairs on the primary or remote storage system.

consistency group (CTG)

A group of two or more logical units in a file system or a logical volume. When a file system or a logical volume which stores application data, is configured from two or more logical units, these multiple logical units are managed as a consistency group (CTG) and treated as a single entity. A set of volume pairs can also be managed and operated as a consistency group.

consistency of S-VOL

A state in which a reliable copy of S-VOL data from a previous update cycle is available at all times on the remote storage system A consistent copy of S-VOL data is internally pre-determined during each update cycle and maintained in the remote data pool. When remote takeover operations are performed, this reliable copy is restored to the S-VOL, eliminating any data discrepancies. Data consistency at the remote site enables quicker restart of operations upon disaster recovery.

CRC

Cyclical Redundancy Checking, a scheme for checking the correctness of data that has been transmitted or stored and retrieved. A CRC consists of a fixed number of bits computed as a function of the data to be protected, and appended to the data. When the data is read or received, the function is recomputed, and the result is compared to that appended to the data.

CTG

See Consistency Group.

cycle time

A user specified time interval used to execute recurring data updates for remote copying. Cycle time updates are set for each storage system and are calculated based on the number of consistency groups CTG.

cycle update

Involves periodically transferring differential data updates from the P-VOL to the S-VOL. TrueCopy Extended Distance Software remote replication processes are implemented as recurring cycle update operations executed in specific time periods (cycles).

D

data pool

One or more disk volumes designated to temporarily store un-transferred differential data (in the local storage system or snapshots of backup data in the remote storage system). The saved snapshots are useful for accurate data restoration (of the P-VOL) and faster remote takeover processing (using the S-VOL).

data volume

A volume that stores database information. Other files, such as index files and data dictionaries, store administrative information (metadata).

differential data control

The process of continuously monitoring the differences between the data on two volumes and determining when to synchronize them.

differential data copy

The process of copying the updated data from the primary volume to the secondary volume. The data is updated from the differential data control status (the pair volume is under the suspended status) to the primary volume.

Differential Management Logical Unit (DM-LU)

The volumes used to manage differential data in a storage system. In a TrueCopy Extended Distance system, there may be up to two DM logical units configured per storage system. For Copy-on-Write and ShadowImage, the DM-LU is an exclusive volume used for storing data when the array system is powered down.

differential-data

The original data blocks replaced by writes to the primary volume. In Copy-on-Write, differential data is stored in the data pool to preserve the copy made of the P-VOL to the time of the snapshot.

disaster recovery

A set of procedures to recover critical application data and processing after a disaster or other failure. Disaster recovery processes include failover and failback procedures.

disk array

An enterprise storage system containing multiple disk drives. Also referred to as "disk array device" or "disk storage system."

DM-LU

See Differential Management-Logical Unit.

dual copy

The process of simultaneously updating a P-VOL and S-VOL while using a single write operation.

duplex

The transmission of data in either one or two directions. Duplex modes are full-duplex and half-duplex. Full-duplex is the simultaneous transmission of data in two direction. For example, a telephone is a full-duplex device, because both parties can talk at once. In contrast, a walkie-talkie is a half-duplex device because only one party can transmit at a time.

E

entire copy

Copies all data in the primary volume to the secondary volume to make sure that both volumes are identical.

extent

A contiguous area of storage in a computer file system that is reserved for writing or storing a file.

F

failover

The automatic substitution of a functionally equivalent system component for a failed one. The term failover is most often applied to intelligent controllers connected to the same storage devices and host computers. If one of the controllers fails, failover occurs, and the survivor takes over its I/O load.

fallback

Refers to the process of restarting business operations at a local site using the P-VOL. It takes place after the storage systems have been recovered.

Fault tolerance

A system with the ability to continue operating, possibly at a reduced level, rather than failing completely, when some part of the system fails.

FC

See fibre channel.

fibre channel

A gigabit-speed network technology primarily used for storage networking.

firmware

Software embedded into a storage device. It may also be referred to as Microcode.

full duplex

The concurrent transmission and the reception of data on a single link.

G

Gbps

Gigabit per second.

granularity of differential data

Refers to the size or amount of data transferred to the S-VOL during an update cycle. Since only the differential data in the P-VOL is transferred to the S-VOL, the size of data sent to S-VOL is often the same as that of data written to the P-VOL. The amount of differential data that can be managed per write command is limited by the difference between the number of incoming host write operations (inflow) and outgoing data transfers (outflow).

GUI

Graphical user interface.

I

I/O

Input/output.

initial copy

An initial copy operation involves copying all data in the primary volume to the secondary volume prior to any update processing. Initial copy is performed when a volume pair is created.

initiator ports

A port-type used for main control unit port of Fibre Remote Copy function.

IOPS

I/O per second.

iSCSI

Internet-Small Computer Systems Interface, a TCP/IP protocol for carrying SCSI commands over IP networks.

iSNS

Internet-Small Computer Systems Interface, a TCP/IP protocol for carrying SCSI commands over IP networks.

L

LAN

Local Area Network, a computer network that spans a relatively small area, such as a single building or group of buildings.

load

In UNIX computing, the system load is a measure of the amount of work that a computer system is doing.

logical

Describes a user's view of the way data or systems are organized. The opposite of logical is physical, which refers to the real organization of a system. A logical description of a file is that it is a quantity of data collected together in one place. The file appears this way to users. Physically, the elements of the file could live in segments across a disk.

logical unit

See logical unit number.

logical unit number (LUN)

An address for an individual disk drive, and by extension, the disk device itself. Used in the SCSI protocol as a way to differentiate individual disk drives within a common SCSI target device, like a disk array. LUNs are normally not entire disk drives but virtual partitions (or volumes) of a RAID set.

LU

Logical unit.

LUN

See logical unit number.

LUN Manager

This storage feature is operated through Storage Navigator Modular 2 software and manages access paths among host and logical units for each port in your array.

M

metadata

In sophisticated data systems, the metadata -- the contextual information surrounding the data -- will also be very sophisticated, capable of answering many questions that help understand the data.

microcode

The lowest-level instructions directly controlling a microprocessor. Microcode is generally hardwired and cannot be modified. It is also referred to as firmware embedded in a storage subsystem.

Microsoft Cluster Server

Microsoft Cluster Server is a clustering technology that supports clustering of two NT servers to provide a single fault-tolerant server.

mount

To mount a device or a system means to make a storage device available to a host or platform.

mount point

The location in your system where you mount your file systems or devices. For a volume that is attached to an empty folder on an NTFS file system volume, the empty folder is a mount point. In some systems a mount point is simply a directory.

P

pair

Refers to two logical volumes that are associated with each other for data management purposes (e.g., replication, migration). A pair is usually composed of a primary or source volume and a secondary or target volume as defined by the user.

pair splitting

The operation that splits a pair. When a pair is "Paired", all data written to the primary volume is also copied to the secondary volume. When the pair is "Split", the primary volume continues being updated, but data in the secondary volume remains as it was at the time of the split, until the pair is re-synchronized.

pair status

Internal status assigned to a volume pair before or after pair operations. Pair status transitions occur when pair operations are performed or as a result of failures. Pair statuses are used to monitor copy operations and detect system failures.

paired volume

Two volumes that are paired in a disk array.

parity

The technique of checking whether data has been lost or corrupted when it's transferred from one place to another, such as between storage units or between computers. It is an error detection scheme that uses an extra checking bit, called the parity bit, to allow the receiver to verify that the data is error free. Parity data in a RAID array is data stored on member disks that can be used for regenerating any user data that becomes inaccessible.

parity groups

RAID groups can contain single or multiple parity groups where the parity group acts as a partition of that container.

peer-to-peer remote copy (PPRC)

A hardware-based solution for mirroring logical volumes from a primary site (the application site) onto the volumes of a secondary site (the recovery site).

point-in-time logical copy

A logical copy or snapshot of a volume at a point in time. This enables a backup or mirroring application to run concurrently with the system.

pool volume

Used to store backup versions of files, archive copies of files, and files migrated from other storage.

primary or local site

The host computer where the primary volume of a remote copy pair (primary and secondary volume) resides. The term "primary site" is also used for host failover operations. In that case, the primary site is the host computer where the production applications are running, and the secondary site is where the backup applications run when the applications on the primary site fail, or where the primary site itself fails.

primary volume (P-VOL)

The storage volume in a volume pair. It is used as the source of a copy operation. In copy operations a copy source volume is called the P-VOL while the copy destination volume is called "S-VOL" (secondary volume).

P-VOL

See primary volume.

R

RAID

Redundant Array of Independent Disks, a disk array in which part of the physical storage capacity is used to store redundant information about user data stored on the remainder of the storage capacity. The redundant information enables regeneration of user data in the event that one of the array's member disks or the access path to it fails.

Recovery Point Objective (RPO)

After a recovery operation, the RPO is the maximum desired time period, prior to a disaster, in which changes to data may be lost. This measure determines up to what point in time data should be recovered. Data changes preceding the disaster are preserved by recovery.

Recovery Time Objective (RTO)

The maximum desired time period allowed to bring one or more applications, and associated data back to a correct operational state. It defines the time frame within which specific business operations or data must be restored to avoid any business disruption.

remote or target site

Maintains mirrored data from the primary site.

remote path

A route connecting identical ports on the local storage system and the remote storage system. Two remote paths must be set up for each storage system (one path for each of the two controllers built in the storage system).

remote volume stem

In TrueCopy operations, the remote volume (R-VOL) is a volume located in a different subsystem from the primary host subsystem.

resynchronization

Refers to the data copy operations performed between two volumes in a pair to bring the volumes back into synchronization. The volumes in a pair are synchronized when the data on the primary and secondary volumes is identical.

RPO

See Recovery Point Objective.

RTO

See Recovery Time Objective.

S

SAS

Serial Attached SCSI, an evolution of parallel SCSI into a point-to-point serial peripheral interface in which controllers are linked directly to disk drives. SAS delivers improved performance over traditional SCSI because SAS enables up to 128 devices of different sizes and types to be connected simultaneously.

SATA

Serial ATA is a computer bus technology primarily designed for the transfer of data to and from hard disks and optical drives. SATA is the evolution of the legacy Advanced Technology Attachment (ATA) interface from a parallel bus to serial connection architecture.

secondary volume (S VOL)

A replica of the primary volume (P-VOL) at the time of a backup and is kept on a standby storage system. Recurring differential data updates are performed to keep the data in the S-VOL consistent with data in the P-VOL.

SMPL

Simplex.

snapshot

A term used to denote a copy of the data and data-file organization on a node in a disk file system. A snapshot is a replica of the data as it existed at a particular point in time.

SNM2

See Storage Navigator Modular 2.

Storage Navigator Modular 2

A multi-featured scalable storage management application that is used to configure and manage the storage functions of Hitachi arrays. Also referred to as "Navigator 2".

suspended status

Occurs when the update operation is suspended while maintaining the pair status. During suspended status, the differential data control for the updated data is performed in the primary volume.

S-VOL

See secondary volume.

S-VOL determination

Independent of update operations, S-VOL determination replicates the S-VOL on the remote storage system. This process occurs at the end of each update cycle and a pre-determined copy of S-VOL data, consistent with P-VOL data, is maintained on the remote site at all times.

T

target copy

A file, device, or any type of location to which data is moved or copied.

V

virtual volume (V-VOL)

In Copy-on-Write, a secondary volume in which a view of the primary volume (P-VOL) is maintained as it existed at the time of the last snapshot. The V-VOL contains no data but is composed of pointers to data in the P-VOL and the data pool. The V-VOL appears as a full volume copy to any secondary host.

volume

A disk array object that most closely resembles a physical disk from the operating environment's viewpoint. The basic unit of storage as seen from the host.

volume copy

Copies all data from the P-VOL to the S-VOL.

volume pair

Formed by pairing two logical data volumes. It typically consists of one primary volume (P-VOL) on the local storage system and one secondary volume (S-VOL) on the remote storage systems.

V-VOL

See virtual volume.

V-VOLTL

Virtual Volume Tape Library.

W

WMS

Workgroup Modular Storage.

write order guarantee

Ensures that data is updated in an S-VOL, in the same order that it is updated in the P-VOL, particularly when there are multiple write operations in one update cycle. This feature is critical to maintain data consistency in the remote S-VOL and is implemented by inserting sequence numbers in each update record. Update records are then sorted in the cache within the remote system, to assure write sequencing.

write workload

The amount of data written to a volume over a specified period of time.

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Hitachi Data Systems

Corporate Headquarters
750 Central Expressway
Santa Clara, California 95050-2627
U.S.A.
Phone: 1 408 970 1000
www.hds.com
info@hds.com

Asia Pacific and Americas
750 Central Expressway
Santa Clara, California 95050-2627
U.S.A.
Phone: 1 408 970 1000
info@hds.com

Europe Headquarters
Sefton Park
Stoke Poges
Buckinghamshire SL2 4HD
United Kingdom
Phone: + 44 (0)1753 618000
info.eu@hds.com

Hitachi Data Systems

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