



**Hitachi Freedom Storage™
Lightning 9900™ V Series
CruiseControl™ User's Guide**

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Document Revision Level

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Source Documents Used in this Revision

- *Hitachi Lightning 9900™ V Series Performance Management User's Guide*, RSD source document (Pfm45d2), dated 6/17/03
- *Hitachi Lightning 9900™ V Series Performance Management User's Guide*, RSD source document (Pfm45d2a1), dated 7/25/03
- *Hitachi Lightning 9900™ V Series Performance Management User's Guide*, RSD source document (Pfm45d3b), dated 10/15/03

Changes in this Revision

- Modified Preface regarding document assumptions.
- Upgraded microcode level to 21-07-2x.
- Added notes about Hitachi CruiseControl source and target volumes (see section 2.3).

Referenced Documents

- *Hitachi Freedom Storage™ Lightning 9900™ V Series User and Reference Guide* (MK-92RD100)
- *Hitachi Freedom Storage™ Lightning 9900™ V Series Performance Monitor User's Guide* (MK-92RD133)
- *Hitachi Freedom Storage™ Lightning 9900™ V Series Priority Access User's Guide* (MK-92RD117)
- *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator™ User's Guide* (MK-92RD101)
- *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console Error Codes* (MK-92RD132)
- *Hitachi Freedom Storage™ Lightning 9900™ V Series Priority Access User's Guide* (MK-92RD117)

Preface

The CruiseControl™ User's Guide describes and provides instructions for using CruiseControl™ software to balance workload among hard disk drives, logical volumes, and processors to remove bottlenecks from your system. This document assumes that:

- the user has a background in data processing and understands direct-access storage device (DASD) subsystems and their basic functions,
- the user has read and understands the *Hitachi Freedom Storage™ Lightning 9900™ V Series User and Reference Guide* (MK-92RD100), the *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator™ User's Guide* (MK-92RD101), and the *Hitachi Freedom Storage™ Lightning 9900™ V Series Performance Monitor User's Guide* (MK-92RD133), and
- the user is familiar with the operating system (e.g., Windows®, Solaris™, and Linux®) and web browser software (e.g., Internet Explorer, Netscape®, and Mozilla) on the system hosting the 9900V Storage Navigator and Performance Management remote console software.

Notes:

- The term “9900V” refers to the entire Lightning 9900™ V Series subsystem family, unless otherwise noted. The term “Web Console” refers to “Storage Navigator” unless otherwise noted. The terms “PPC” and “Prioritized Port Control” refer to SVP (web server) “Priority Access” unless otherwise noted. For additional information on the 9900V disk array subsystems please refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series User and Reference Guide* (MK-92RD100) or contact your Hitachi account team. For additional information on the 9900V Storage Navigator computer, please refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator™ User's Guide* (MK-92RD101) or contact your Hitachi account team.
- The use of CruiseControl™, the CruiseControl™/Storage Navigator software, and all other Hitachi Data Systems products is governed by the terms of your license agreement(s) with Hitachi Data Systems.
- The screens shown in this document were captured on a Windows® system with the Internet Explorer web browser. The screens may display differently on other operating systems and browsers. Please refer to the *9900V Remote Console - Storage Navigator User's Guide* for further information on UNIX® operating systems and browsers.

Microcode Level

This document revision applies to 9900V microcode versions 21-07-2x and higher.

COMMENTS

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Make sure to include the document title, number, and revision.

Please refer to specific page(s) and paragraph(s) whenever possible.

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Thank you!

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Chapter 1 Hitachi Performance Management Solution

The Hitachi Freedom Storage™ Lightning 9900™ V Series includes a suite of performance management software products. These products allow you to monitor and tune disk subsystem performance. The performance management suite of software consists of the following:

- **Performance Monitor**
- **CruiseControl™**
- **Priority Access (Prioritized Port Control)**

Performance Monitor lets you obtain usage statistics about the physical hard disk drive, logical volumes, processors, or other resources in your disk subsystem. Performance Monitor also lets you obtain statistics about workloads on disk drives and traffic between hosts and the disk subsystem. The Hitachi Performance Monitor panel displays a line graph that indicates changes in the usage rates, workloads, or traffic. You can view information in the panel and analyze trends in disk I/Os and detect peak I/O time. If the system performance is low, you can use information in the panel to detect bottlenecks in the system. For details, see *Hitachi Freedom Storage™ Lightning 9900™ V Series Performance Monitor User's Guide* (MK-92RD133).

CruiseControl™ lets you balance workload among hard disk drives, logical volumes, and processors to remove bottlenecks from your system. If Performance Monitor indicates that a lot of I/Os are made to certain hard disk drives, you can use CruiseControl™ to distribute workloads to other disk drives. For details, see Chapter 2.

Priority Access (Prioritized Port Control) lets you tune the system to provide high-priority hosts with relatively higher throughput. Priority Access can prevent production servers from suffering lowered performance. For details, see the *Hitachi Freedom Storage™ Lightning 9900™ V Series Priority Access User's Guide* (MK-92RD117).

Figure 1.1 graphically illustrates the Hitachi performance management solution.

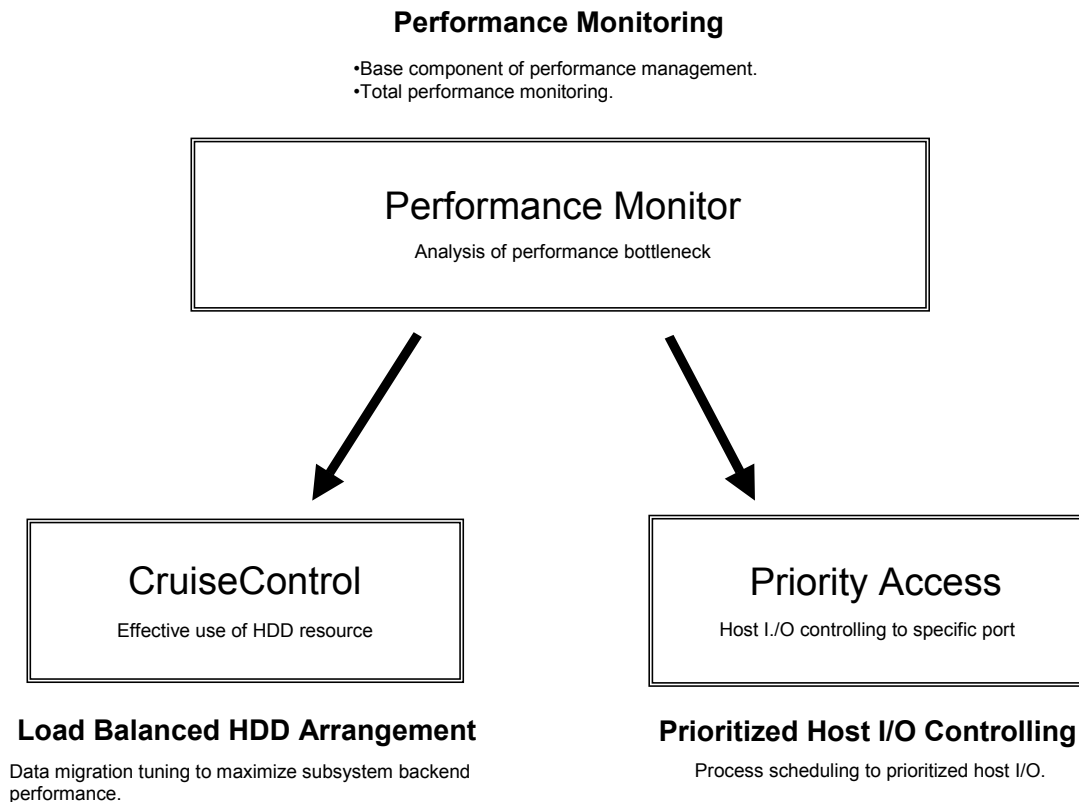


Figure 1.1 Performance Management Solution Components

Using Hitachi Storage Navigator along with Performance Monitor, CruiseControl™, and Priority Access provides a simple and straight-forward performance management solution. Figure 1.2 illustrates a somewhat simplified view of the performance management process.

CAUTIONS:

- If Performance Monitor is not enabled, you cannot use CruiseControl™ or Priority Access.
- Performance management operations (Performance Monitor, CruiseControl™, and Priority Access) involve the collection of large amounts of monitoring data. This requires considerable web client computer memory. It is therefore recommended that you exit the Storage Navigator program when not conducting performance management operations, thereby freeing up system memory.
- The 9900 V Series documents may sometimes use the term Disk Processor (DKP) to refer to the Array Control Processor (ACP).

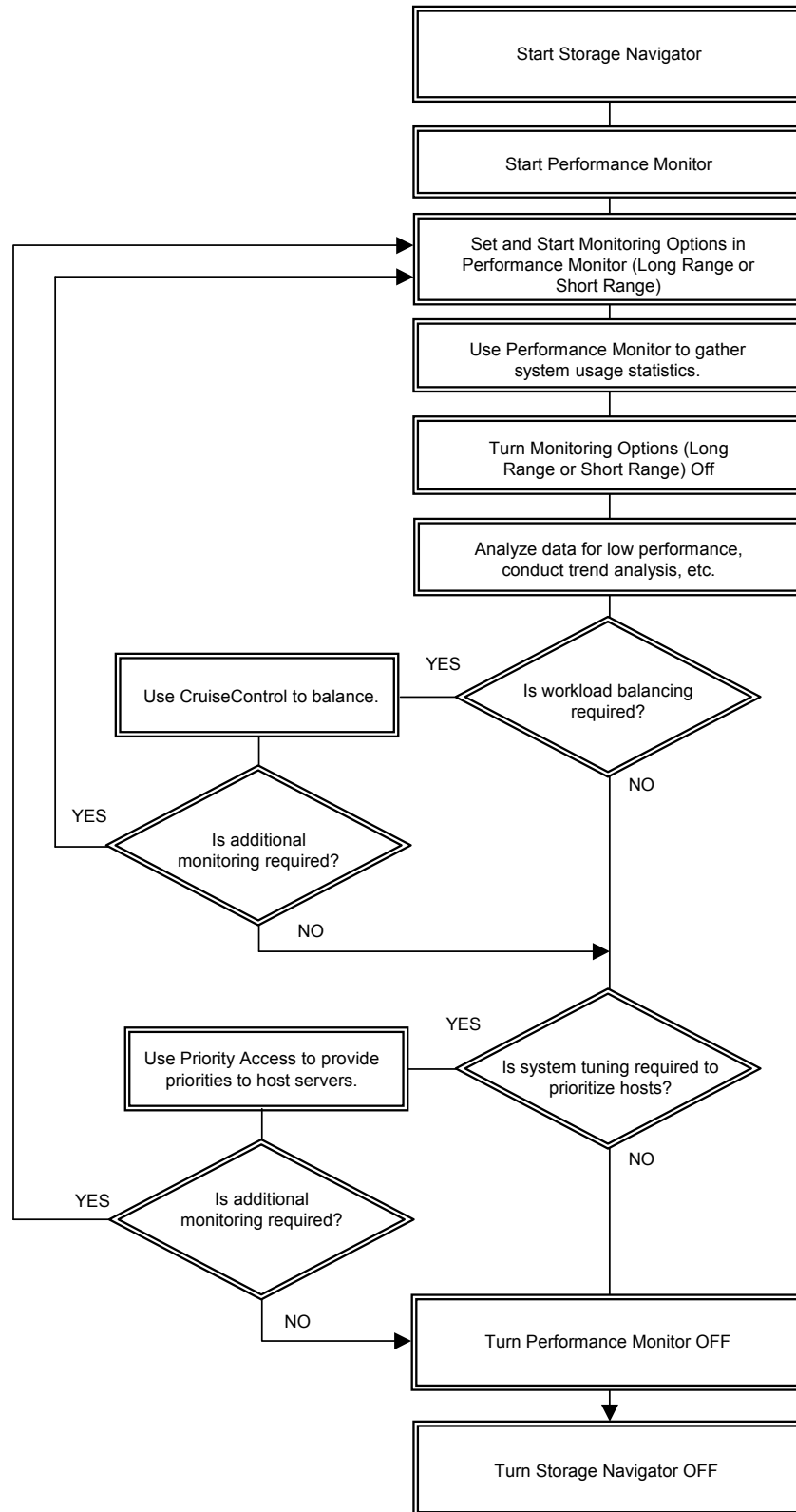


Figure 1.2 Performance Management Process Flow Diagram

Chapter 2 CruiseControl™ Overview

CruiseControl™ allows you to optimize your data storage and retrieval on the 9900V subsystem. CruiseControl™ tuning operations can be used to balance resource utilization and resolve bottlenecks of system activity.

If I/O accesses from hosts converge on particular disk drives, the hosts might suffer response time delay. To overcome this situation, CruiseControl™ lets you migrate high-usage volumes to a low-usage disk drive or a fast disk drive. Volume migration can balance workloads among disk drives and thus remove bottlenecks from the system. Volume migration can also balance workloads among array control processors (ACPs) that control disk I/Os.

Volume migration operations are classified into *manual migrations* and *auto migrations*.

- **Manual Migration** - In manual migrations, the system administrator specifies the volumes to be migrated and the migration destinations, and then executes migrations.
- **Auto Migration** - In auto migrations, CruiseControl™ automatically determines the volumes to be migrated and the migration destinations, and also executes migrations automatically.

CruiseControl™ operations are completely non-disruptive - the data being migrated can remain online to all hosts for read and write I/O operations throughout the entire volume migration process.

Note: CruiseControl™ migration should be performed only when you can expect a large improvement in subsystem performance. CruiseControl™ migration may not provide significant improvement for cases in which parity group or volume usage varies only slightly, or for cases in which overall ACP or DRR usage is relatively high.

Note: Also keep in mind that subsystem-tuning operations can improve performance in one area while at the same time decreasing performance in another. For example, assume that parity groups A and B have average usage values of 20% and 90%, respectively. CruiseControl™ estimates that if one logical volume is migrated from parity group B to parity group A, the usage values will become 55% and 55%. If you perform this migration operation, the I/O response time for parity group B will probably decrease, and the I/O response time for parity group A may increase, while the overall throughput may increase or decrease.

CAUTION: Do not use monitor data collected during an error condition as the basis for planning CruiseControl™ migration operations. Resource usage can increase or become unbalanced when an error condition exists in the 9900V subsystem.

2.1 Migrating Logical Volumes Manually

CruiseControl™ enables you to balance workloads among parity groups to improve system performance. To balance workloads, you select high-usage logical volumes from a high-usage parity group and then move the logical volumes to a different parity group. Executing a migration plan accomplishes this.

CAUTION: When performing a series of manual migration operations, remember that the configuration changes after each migration is complete.

2.1.1 Procedure for Manually Migrating

Before you can migrate a logical volume from one parity group to another, you must create a migration plan. A migration plan specifies the following:

- a logical volume to be migrated
- the migration destination or target

However, before you can create a migration plan, you must determine which volume should be migrated to which parity group (disk drive).

To determine which volume to migrate, you will use the CruiseControl™ Manual Plan tab to check logical volume usage rates. You will want to migrate a volume with a high usage rate (for details, see sections 4.1 and 5.2).

To determine a migration destination, you will use the CruiseControl™ Attribute tab to find fast parity groups (i.e., fast disk drives). From these fast parity groups you will then choose a low-usage parity group to serve as the migration destination (for details, see sections 4.3 and 5.2).

Once created, migration plans are executed to carry out volume migration. Figure 2.1 shows an example of a migration plan. In this figure, **Source LDEV** indicates the volume that should be migrated. **Target LDEV** indicates the migration destination for the volume in **Source LDEV**.

Stat	DEL	%	Source LDEV						Target LDEV			
			LDEV	Emulation	Capacity	RAID	PG	HDD	LDEV	RAID	PG	HDD
-	-	-	 00:02	OPEN-3	2.29GB	1(2D+2D)	1-1	DKR1B-J047FC	 00:0C	5(3D+1P)	1-2	DKR1B-J047FC

Figure 2.1 Example Migration Plan Displayed in the CruiseControl™ Panel

2.1.2 Mechanisms for Manual Migration

Note: The 9900V documents (including this manual) use the term *source volumes* to refer to volumes that should be migrated and the term *target volumes* to refer to volumes that should become migration destinations.

The CruiseControl™ volume migration operation consists of two steps:

- Copy the source volume data to the target volume
- Transfer host access

2.1.2.1 Copying Source Volume Data

In this step, data on the CruiseControl™ source volume is copied to the CruiseControl™ target volume (see Figure 2.2).

The target volume is reserved prior to migration to prevent host access during migration. The source and target volumes can be located anywhere within the subsystem. The CruiseControl™ copy operation copies the entire contents of the source volume to the target volume cylinder by cylinder (24 tracks at a time, not including the diagnostic and unassigned alternate tracks). If the source volume is updated by write I/Os during the copy operation, the 9900V keeps track of the updates on a cylinder map and performs additional copy operations after the initial copy is complete to duplicate the updates at the target volume.

Note: The CruiseControl™ source volume can be online to hosts during migration.

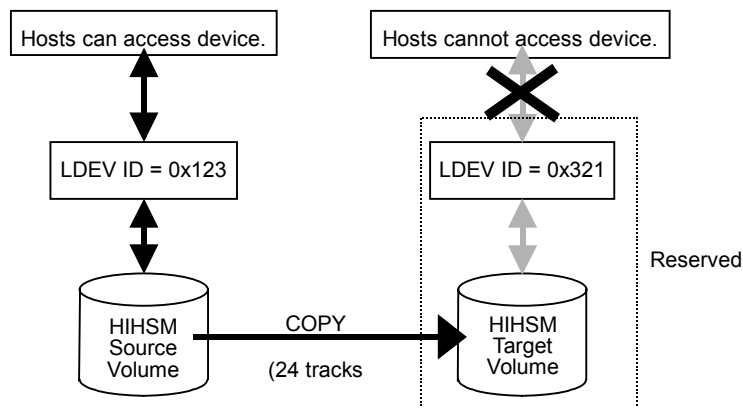


Figure 2.2 Situation During a CruiseControl™ Volume Migration Operation

2.1.2.2 Transferring Host Access

In this step, host access is transferred to the target volume to complete the migration (see Figure 2.3).

When the volumes are fully synchronized (no differential data on source volume), the 9900V completes the migration by swapping the reserve attribute (target is normal, source is reserved) and redirecting host access to the target volume. CruiseControl™ performs all migration operations sequentially (i.e., one volume migration at a time).

Note: Approximate copy times with no other I/O activity are:

- OPEN-3 = 1.5 min
- OPEN-9 = 4.5 min
- OPEN-E = 9 min.

Note: For manual and automatic migration operations, CruiseControl™ checks the current subsystem *write pending rate* and cancels a migration operation if the *write pending rate* is higher than 60%. For auto migration, CruiseControl™ also checks the current disk utilization of the source volumes and source and target parity groups, and cancels the auto migration operation if current disk utilization is higher than the user-specified maximum disk utilization for auto migration.

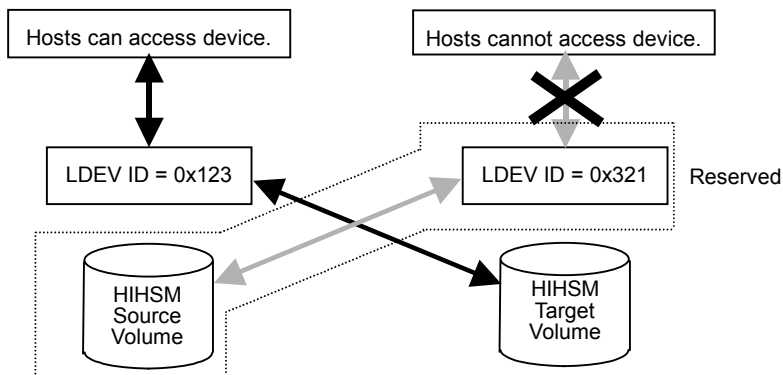


Figure 2.3 Simulation After a CruiseControl™ Volume Migration Operations

Note: CruiseControl™ migration should be performed only when you can expect a large improvement in subsystem performance. CruiseControl™ migration may not provide significant improvement for cases in which parity group or volume usage varies only slightly, or for cases in which overall ACP or DRR usage is relatively high. Also keep in mind that subsystem tuning operations can improve performance in one area while at the same time decrease performance in another. For example, assume that parity groups A and B have average usage values of 20% and 90%, respectively. CruiseControl™ estimates that if one logical volume is migrated from parity group B to parity group A, the usage values will become 55% and 55%. If you perform this migration operation, the I/O response time for parity group B will probably decrease, and the I/O response time for parity group A may increase, while the overall throughput may increase or decrease.

2.2 Automating Volume Migrations

As explained in section 2.1, CruiseControl™ allows you to create and execute migration plans. However, CruiseControl™ also allows you to automate creation and execution of volume migrations plans. If you automate creation and execution of migration plans, you will not need to analyze usage rates of subsystem resources and speed of disk drives. CruiseControl™ automatically determines volumes to be migrated, determines migration destinations, and performs volume migrations.

CAUTION: Do not perform manual migration operations while the auto migration function is active. Always turn off the auto migration function and cancel any existing auto migration plans before performing manual migration operations (see section 5.3.5).

CAUTION: When performing a series of manual migration operations, remember that the configuration changes after each migration is complete.

Note: If you use the manual migration function, you can analyze disk usage, processor usage, and access path usage when you create migration plans. If you use the auto migration function, CruiseControl™ only uses disk usage and does not analyze processor usage and access path usage when creating migration plans.

2.2.1 Procedure for Automating Migration Operations

If you want to automate creation and execution of migration plans, the following operations must be performed:

- **Step 1: Use Performance Monitor to monitor disk usage.** CruiseControl™ automatically analyzes past disk usage and then creates migration plans. To enable CruiseControl™ to analyze disk usage, you must use Performance Monitor to collect disk usage statistics.
Note: You must use Long Range Monitoring within Performance Monitor to collect the statistics. For details, please refer to the Setting Monitoring Options section of *Hitachi Freedom Storage™ Lightning 9900™ V Series Performance Monitor User's Guide* (MK-92RD133).
- **Step 2: If necessary, specify fixed parity groups.** If you automate volume migrations, some of the logical volumes and parity groups might suffer delay in I/O speed. For example, if the logical volume 0:01 is migrated from the parity group Grp1-1 of the class A to the parity group Grp-2-1 of the class B, the volume 0:01 is migrated to a lower-speed disk drive and thus might suffer from delay in I/O speed.
Note: **Classes** indicate disk access speed for parity groups. Classes are ranked A, B, C, and so on. The fastest parity groups (or groups of fastest disks) belong to class A.
CruiseControl™ lets you prevent a parity group delay in I/O speed. If you specify a parity group as a *fixed parity group*, the parity group will not be affected by the auto migration function. For example, if you specify Grp1-1 as a fixed parity group, logical volumes in Grp1-1 will not be migrated to any other parity group. Also, no logical volumes will be migrated to Grp1-1. For details on how to specify fixed parity groups, see section 5.3.1.

- **Step 3: Review the disk usage limit for each HDD class.** Each HDD class is assigned a disk usage limit by default. Disk usage limits affect system performance after volume migrations. If the disk usage limit for one class is high, a lot of logical volumes might be migrated to parity groups in that class. If the disk usage limit for one class is low, fewer logical volumes might be migrated to parity groups in that class.

CruiseControl™ lets you change the disk usage limit. The default usage limits are rough estimates only and may not provide the best results. For details on how to change the disk usage limit, see section 5.3.3.

- **Step 4: Specify the time period for which you want to improve disk access performance.** As explained earlier, CruiseControl™ automatically analyzes past disk usage and then creates migration plans. To enable CruiseControl™ to analyze disk usage, you must specify a time period to narrow disk usage statistics to be analyzed. It is recommended that you specify a time period for which you want to improve disk access performance. For example, if you want to improve disk access performance every day from 9:00 a.m. to 5:00 p.m., you are advised to specify *every day from 9:00 a.m. to 5:00 p.m.* CruiseControl™ will analyze disk usage statistics for the specified time period and create migration plans based on the analysis. For how to specify a time period, see section 5.3.3.
- **Step 5: Specify the time when CruiseControl™ executes migration plans.** You must specify the time when CruiseControl™ executes migration plans. You are advised to specify a time when disk usage rate is low because volume migrations are likely to produce heavy workloads on disk drives.

CruiseControl™ executes migration plans every day at the specified time. For details on how to change the disk usage limit, see section 5.3.3.
- **Step 6: Specify parameters that affect the system performance.** The CruiseControl™ panel lets you specify parameters that affect the system performance after volumes are migrated. You can specify these parameters, if necessary. For details, see section 5.3.3.
- **Step 7: Set the auto migration function to ON.** To automate creation and execution of migration plans, you must set the Auto Migration Function option to **ON**. For details, see section 5.3.3.

After you finish these operations, CruiseControl™ automatically creates migration plans and executes the plans. CruiseControl™ creates plans 30 minutes later than the time period specified in step 4 (For example, if 13:00 - 15:00 is specified, plan creation will be performed at 15:30). The migration plans will be executed every day at the time specified in step 5.

Note: You can change or cancel automatically created migration plans before CruiseControl™ executes the plans. For details, see sections 5.3.4 and 5.3.5.

After auto migration finishes, you can use Performance Monitor to check whether the workloads on disk drives are balanced and the system performance is improved. If the migration results are not satisfactory, you can change settings for fixed parity groups, settings for disk usage limits, and/or change other parameters and then retry auto migrations.

2.2.2 Mechanism for Auto Migrations

The auto migration function allows you to specify the maximum usage rate for each HDD class in the 9900V subsystem. The maximum usage rate applies to all the parity groups in the HDD class. This section describes how the specified usage limit affects auto migration behavior.

When a parity group exceeds the specified maximum usage rate, the auto migration function makes a plan to migrate one or more volumes in this parity group to another parity group in a higher HDD class (see Figure 2.4) or to a parity group in the same HDD class with lower utilization. This storage tuning method addresses, and can eliminate, bottlenecks of disk drive activity and also provides load balancing of disk drive usage. CruiseControl™ uses the estimated usage rates to verify each proposed auto migration and will not perform a migration operation that might result in a target parity group exceeding the user-specified maximum disk usage rate.

Note: The default maximum usage values are rough estimates only and may not provide the best results.

As shown in Figure 2.4, the auto migration function identifies parity groups that exceed the user-specified usage limit, and then selects the high-usage volumes as the source volumes to be migrated to parity groups in higher HDD classes or to other parity groups in the same HDD class with lower utilization.

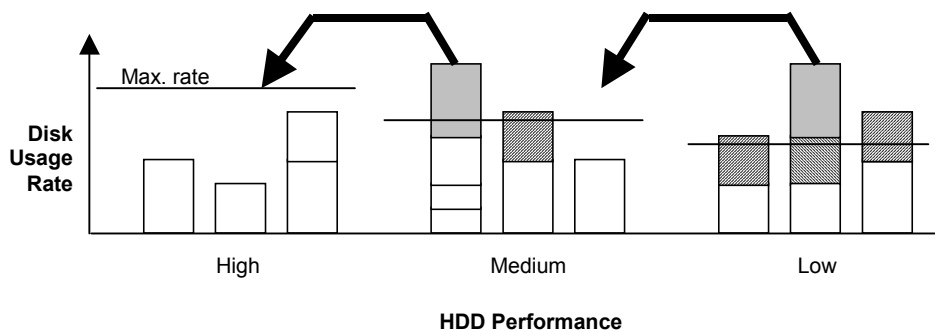


Figure 2.4 Migrating to Improve Disk Usage

When the parity groups in the highest HDD classes have run out of reserved (empty) volumes, CruiseControl™ automatically migrates low-usage volumes from higher HDD class groups to lower HDD class groups to maintain available reserve volumes (see Figure 2.5).

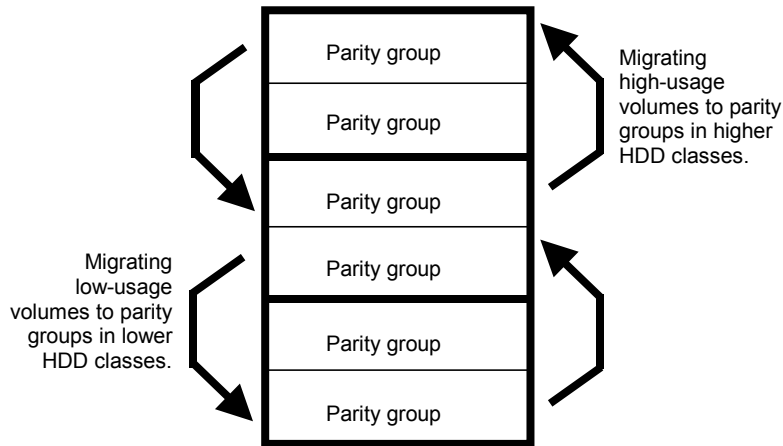


Figure 2.5 Keeping Reserve Volumes in the High HDD Class Available

As explained above, the auto migration function can move a high-usage volume to a higher HDD class group, forcing a low-usage volume out of that HDD class group. To be able to move one volume into a different HDD class group and then force another volume out of that class group, the auto migration function requires a minimum of five (5) percent difference in estimated disk usage between the two volumes (see Figure 2.6). If the difference in disk usage is less than 5%, this migration is considered ineffective, and the volume is not moved.

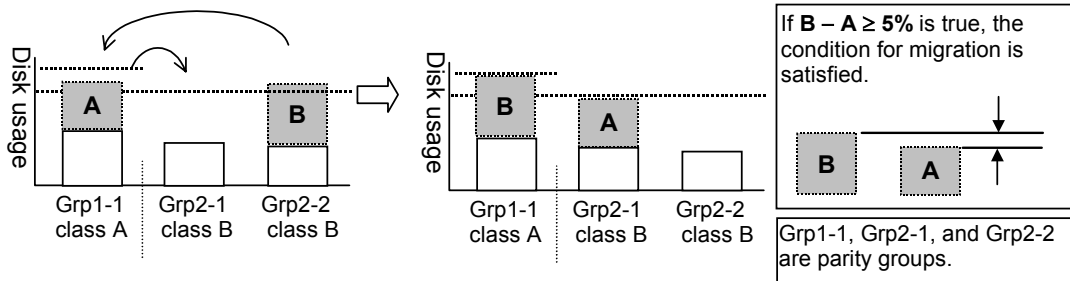


Figure 2.6 Migrating a Volume Automatically to a Lower HDD Class

The auto migration function can also move a volume from one parity group to another group of the same HDD class, forcing another volume out of the destination parity group. To be able to move one volume into a parity group of the same HDD class and force another volume out of that parity group, the auto migration function requires a minimum of twenty (20) percent difference in estimated disk usage between the two volumes (see

Figure 2.7). If the difference in disk usage is less than 20%, this migration is considered ineffective, and the volume is not moved.

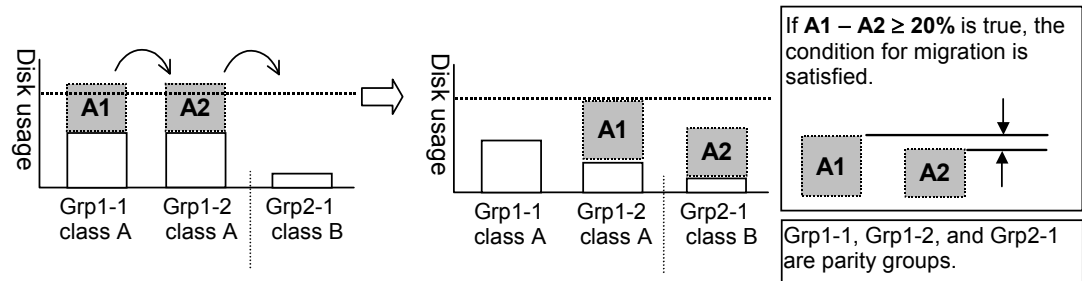


Figure 2.7 Migrating a Volume Automatically Within the Same HDD Class

2.3 Requirements and Restrictions

The requirements and restrictions for performing CruiseControl™ operations are:

- **Logical volumes.** The source and target volumes must be specified by LDEV ID, not VOLSER or port/TID/LUN. The source and target volumes must be within the same 9900V subsystem and have the same emulation type and capacity.

If you want to use a normal volume as the source volume, you cannot use a CVS volume (i.e., a volume to which the Customized Volume function is applied) as the corresponding target volume. Also, if you want to use a CVS volume as the source volume, you cannot use a normal volume as the corresponding target volume.

- **Source volumes.** The following volumes cannot be used as source volumes:
 - Volumes set as command devices (reserved for use by the host)
 - Volumes that are in an abnormal or inaccessible condition (e.g., pinned track, fenced)
 - Volumes used by the XRC host software function. **Note:** If the status of an XRC volume is *suspended* because the session was canceled, the volume can be used as a source volume.
 - Volumes used by the Concurrent Copy (CC) host software function
 - Volumes that form a Hi-Copy pair.
 - Volumes that have FlashAccess data or FlashAccess - S/390® data stored in cache

TrueCopy-S/390®: If the status of a TrueCopy-S/390® volume is *suspended* or *simplex*, the volume can be used as a source volume. If not, the volume cannot be used as a source volume. When a TrueCopy-S/390® volume is deleted from the MCU, the status of both volumes change to *simplex*, and both volumes can be used as source volumes. When a TrueCopy-S/390® volume is deleted from the RCU, the status of the M-VOL changes to *suspended* and the status of the R-VOL changes to *simplex*, and both volumes can be used as source volumes.

Hitachi TrueCopy: If the status of a Hitachi TrueCopy volume is PSUS, PSUE, or SMPL, the volume can be used as a source volume. If not, the volume cannot be used as a source volume. When a Hitachi TrueCopy pair is deleted from the MCU, the status of both volumes changes to SMPL, and both volumes can be used as source volumes. When a Hitachi TrueCopy pair is deleted from the RCU, the status of the P-VOL changes to PSUS and the status of the S-VOL changes to SMPL, and both volumes can be used as source volumes.

ShadowImage-S/390®: If the status of a ShadowImage-S/390® volume is *not* split-pending (*SP-Pend*), the volume can be used as a source volume. If the status of the volume is *SP-Pend*, the volume cannot be used as a source volume.

ShadowImage: Usage of a ShadowImage volume as a source volume depends on the status and cascade configuration of the volume:

If the status of a ShadowImage volume is *not* split-pending **COPY(SP)** or **PSUS(SP)**, the volume can be used as a source volume. If the status is **COPY(SP)** or **PSUS(SP)**, the volume cannot be used as a source volume. This applies to cascade and non-cascade volumes.

Table 2.1 specifies which non-cascade volumes can be used as source volumes.

Table 2.2 specifies which cascade volumes can be used as source volumes.

Table 2.1 Non-Cascade Volumes and CruiseControl™ Source Volumes

Pair Configuration [Status ≠ COPY(SP) or PSUS(SP)]	Can P-VOL be used as a source volume?	Can S-VOLs be used as source volumes?
Ratio of P-VOL to S-VOLs is 1:1	Yes	Yes
Ratio of P-VOL to S-VOLs is 1:2	Yes	Yes
Ratio of P-VOL to S-VOLs is 1:3	No	Yes

Table 2.2 Cascade Volumes and CruiseControl™ Source Volumes

Pair Configuration [Status ≠ COPY(SP) or PSUS(SP)]	Can P-VOL be used as a source volume?	Can S-VOLs be used as source volumes?
L1 pair, ratio of P-VOL to S-VOLs is 1:1	Yes	Yes
L1 pair, ratio of P-VOL to S-VOLs is 1:2	Yes	Yes
L1 pair, ratio of P-VOL to S-VOLs is 1:3	No	Yes
L2 pair, ratio of P-VOL to S-VOLs is 1:1	Yes	No
L2 pair, ratio of P-VOL to S-VOLs is 1:2	No	No

CAUTION: If any of the following operations is performed on a CruiseControl™ source volume during migration, the CruiseControl™ volume migration process stops:

- XRC operation
- Concurrent Copy operation
- TrueCopy-S/390® operation that changes the volume status to something other than *suspended* or *simplex*.
- Hitachi TrueCopy operation that changes the volume status to something other than PSUS, PSUE, or SMPL.
- ShadowImage-S/390® operation that changes the volume status to *SP-Pend*.
- ShadowImage operation that changes the volume status to COPY(SP) or PSUS(SP).
- **Expanded LUs as source volumes.** If you want to specify an expanded LU as a source volume for migration, you can specify individual LDEVs within the expanded LU (e.g., LDEVs with high usage), and CruiseControl™ will migrate only the specified LDEVs. If desired, you can also specify all LDEVs of the expanded LU to relocate the entire expanded LU. In this case, you must make sure that the required reserved target LDEVs are available.

- **Target volumes.** Target volumes must be reserved prior to migration using the CruiseControl™ software. Hosts cannot access reserved volumes.

The following volumes cannot be reserved as target volumes:

- Expanded LUs
- Volumes that are set as command devices (devices reserved for use by the host)
- Volumes that are assigned to ShadowImage or Hitachi TrueCopy pairs
- Volumes that are used by the Extended Remote Copy (XRC) host software function

Note: If the status of an XRC volume is *suspended* because the session was canceled, the volume can be used as a source volume.

- Volumes that are used by the Concurrent Copy (CC) host software function
- Volumes that are reserved for ShadowImage operations
- Volumes that have FlashAccess data or FlashAccess - S/390® data stored in cache
- Volumes that form a Hi-Copy pair
- Volumes that are in an abnormal or inaccessible condition (e.g., pinned track, fenced)

- **Number of volumes:**

- The maximum number of CruiseControl™ copy operations that can be requested at the same time is 36. CruiseControl™ performs migration operations sequentially (one volume at a time).
- If the number of CU images is 4 or fewer, the maximum possible number of CruiseControl™ migration volumes plus ShadowImage/ShadowImage - S/390® pairs is 2,048.
- If the number of CU images is 5 or greater, the maximum possible number of CruiseControl™ migration volumes plus ShadowImage/ShadowImage - S/390® pairs is 4,096.

- **Auto migration planning.** CruiseControl™ will **not** plan an auto migration operation when:

- There is no reserve volume with the same emulation and capacity as the source volume in the same or next higher/lower HDD class (auto migration is performed only between consecutive classes or within the same class).
- The usage rate for the target parity group cannot be estimated, because some condition is preventing CruiseControl™ from estimating expected usage (e.g., invalid monitor data).
- The estimated usage of the target parity group or volume is over the user-specified maximum disk utilization value for that HDD class.
- The estimated performance improvement is not large enough.

- **Auto migration execution.** CruiseControl™ will **not** execute an auto migration operation when:
 - The current usage (last 15 min) of the source or target parity group or volume is over the maximum disk utilization rate for auto migration.
 - The current write pending rate for the subsystem is 60% or higher.
- **Manual migration execution.** CruiseControl™ will **not** execute a manual migration operation when the current write pending rate for the subsystem is 60% or higher.
- **Heavy workloads imposed on disk subsystem.** Avoid volume migration operations when heavy workloads are imposed onto your disk subsystem due to I/O requests from hosts. If you should perform volume migration, the migration could fail. If migration fails, please reduce the workloads on your disk subsystem and then retry volume migration.
- **Maintenance.** Do not perform CruiseControl™ migration operations during subsystem maintenance activities (e.g., cache or drive installation, replacement, or uninstallation).

Note 1: Auto migration parameters are initialized when a change is made to the disk subsystem configuration. For example, the parameters are initialized when new drives or LDEVs are installed. The parameters include the disk usage limit and the migration time. After a change is made to the subsystem configuration, you must specify auto migration parameters again.

Note 2: If you want to turn the power off at the disk subsystem, please confirm whether migration of volumes is finished. If migration is unfinished, it is strongly recommended that you do not turn off the power until the migration is finished.

If you turn the power off when migration is in progress, data migration stops and some of the data are not migrated. If you turn the power on later, CruiseControl™ resumes data migration. If the data remains in the shared memory (which is a volatile memory), CruiseControl™ attempts to copy only the data that have not been migrated to the migration destination. However, if data is lost from the shared memory, CruiseControl™ attempts to copy all the data to the migration destination. In this instance, the copy operation will take considerable time. CruiseControl™ attempts to copy data that have not been migrated, and also attempts to copy data that have already been copied to the migration destination.

Chapter 3 Preparing for CruiseControl™ Operations

3.1 System Requirements

To be able to use CruiseControl™, you need:

- the 9900V subsystem installed
- the Hitachi Performance Monitor software enabled (refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator™ User's Guide* (MK-92RD101))
- a web client computer(s) connected to the 9900V subsystem via LAN (intended for use as a remote console(s))
- the CruiseControl™ software enabled (refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator™ User's Guide* (MK-92RD101))

To use Hitachi Performance Monitor, you must use the web client computer(s) to log on to the SVP (web server). When you are logged on, the Storage Navigator program, which is a Java™ applet, will be downloaded to the web client computer(s). You will then be able to perform Performance Monitor operations within the Storage Navigator panel.

For details on all of the above, please refer to *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator™ User's Guide* (MK-92RD101).

3.2 Starting Storage Navigator™ and Configuring Your Web Client Computer

Hitachi Performance Monitor and CruiseControl™ operations require the Storage Navigator program, which is downloaded to your web client computer. Your web client computer must be connected to the 9900V subsystem via LAN. Browser settings are also required on your web client computer. For details, refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Remote Console - Storage Navigator™ User's Guide* (MK-92RD101).

Note: When you use Storage Navigator on UNIX® workstations or in other non-Windows® environments, certain additional operating conventions must be followed. For details, refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Remote Console - Storage Navigator™ User's Guide* (MK-92RD101).

Note: Performance management operations (Performance Monitor, CruiseControl™, and Priority Access) involve the collection of large amounts of monitoring data. This requires considerable web client computer memory. It is therefore recommended that you exit the Storage Navigator program when not conducting performance management operations, thereby freeing up system memory.

3.3 Starting CruiseControl™

Before you can start CruiseControl™, Storage Navigator and Performance Monitor must be running (refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Remote Console - Storage Navigator™ User's Guide* (MK-92RD101) and the *Hitachi Freedom Storage™ Lightning 9900™ V Series Performance Monitor User's Guide* (MK-92RD133)).

To start CruiseControl™:

1. Ensure that the Storage Navigator main panel is in **Modify** mode.

The Storage Navigator main panel is in Modify mode if the background color of the  icon is light yellow. If the background color is gray, the panel is in **View** mode and you must change it to Modify mode by taking the following steps:

- a) Check to see if the background color of the lock icon  is blue.

If the background color is red , you will not be able to switch from View mode to Modify mode. Wait for a while and click the  button. If the background color turns blue, you can go to the next step.

- b) Click the  icon.

A message appears, asking whether you want to change the mode.

- c) Click **OK** to close the message.

The background color of the icon changes to light yellow. The mode changes to **Modify** mode.

2. Ensure that the **Physical** tab in the Hitachi Performance Monitor panel (see Figure 3.1) is selected (for details, please refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Performance Monitor User's Guide* (MK-92RD133)).

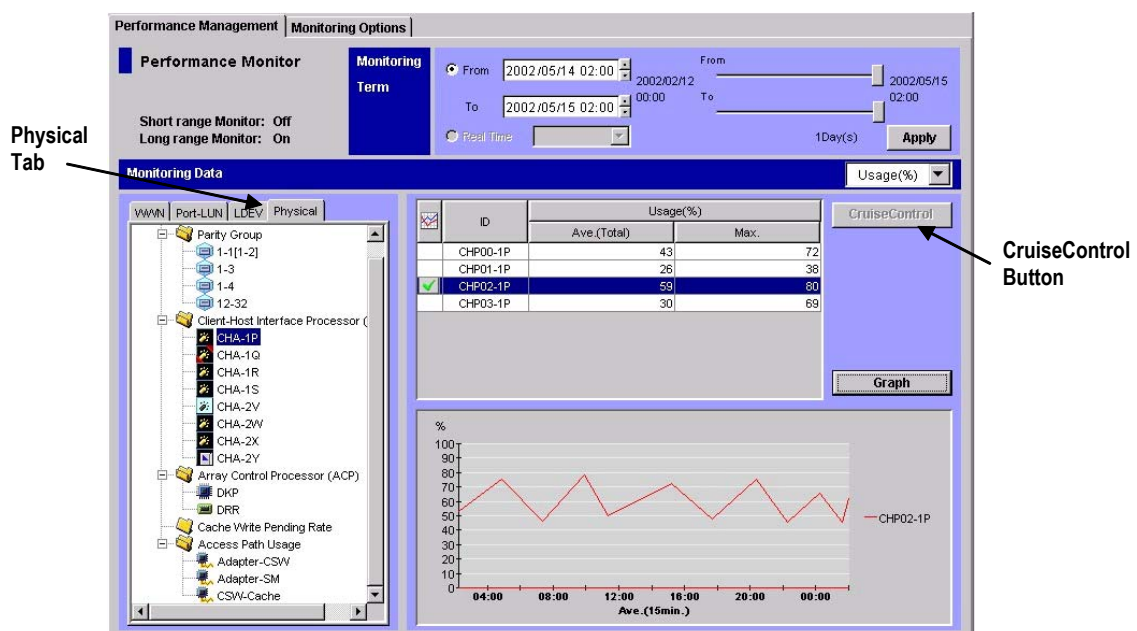


Figure 3.1 Physical Tab of the Performance Monitor Panel

3. Click the **CruiseControl™** button.

The CruiseControl™ panel appears (see Figure 3.2).

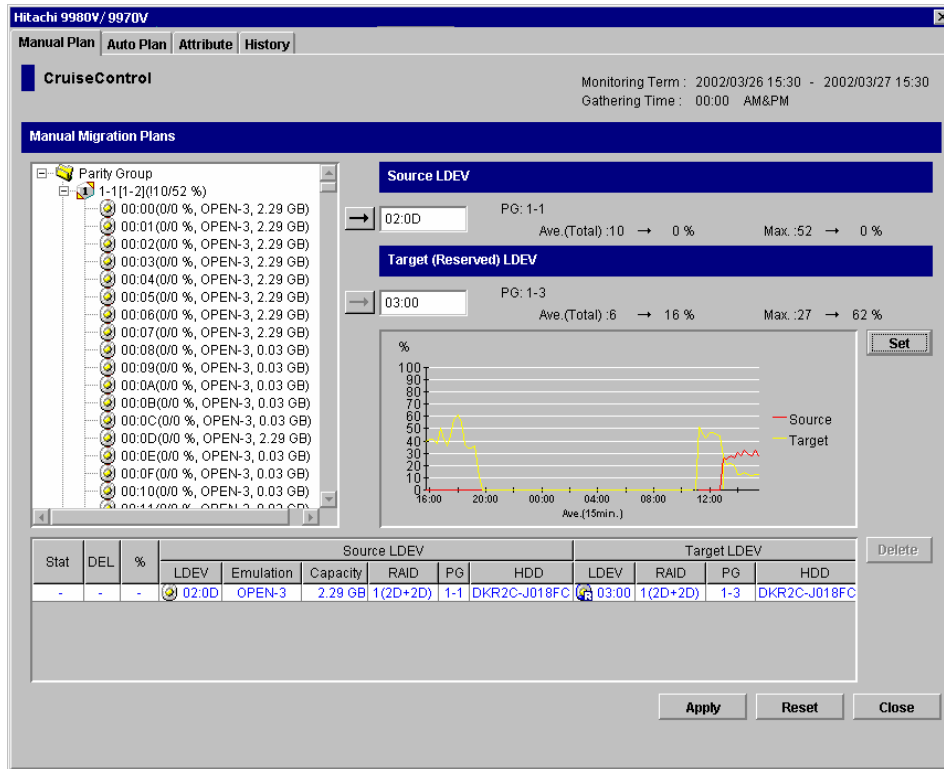


Figure 3.2 The CruiseControl™ Panel

Chapter 4 Reviewing the CruiseControl™ Panel

The CruiseControl™ Panel consists of the following four tabs.

- Manual Plan Tab
- Auto Plan Tab
- Attribute Tab
- History Tab

This chapter describes options, buttons and other components in the CruiseControl™ panel and tabs.

Note: Performance Monitor must be running to allow CruiseControl™ operations. The CruiseControl™ panel appears when the CruiseControl™ button in the Performance Monitor Physical tab is clicked, as shown in Figure 4.1.

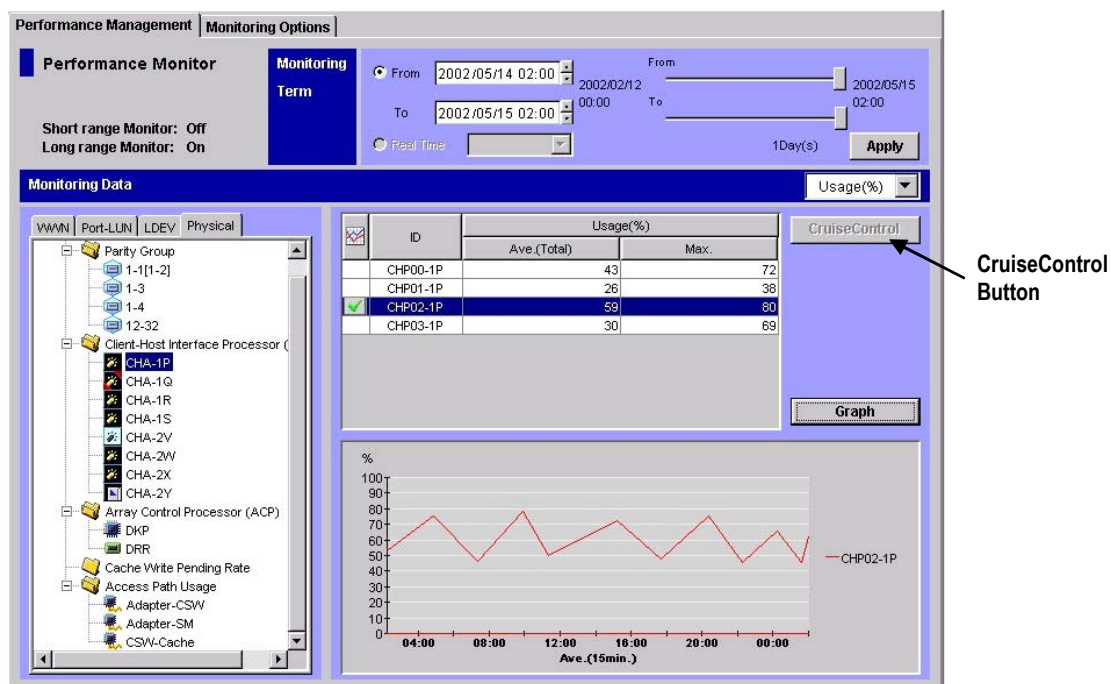


Figure 4.1 Physical Tab in the Performance Monitor Panel

4.1 The Manual Plan Tab in the CruiseControl™ Panel

The **Manual Plan** tab lets you create and execute manual migration plans.

For details on operations in this tab, refer to section 5.2.

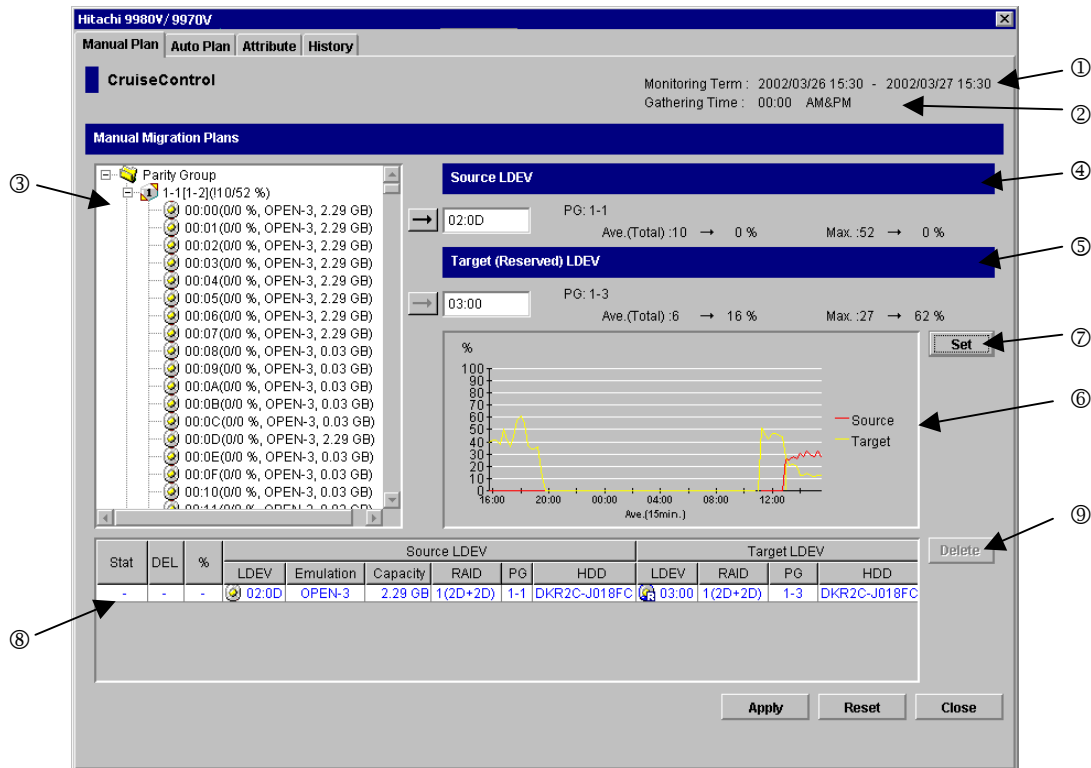


Figure 4.2 The Manual Plan Tab in the CruiseControl™ Panel

The **Manual Plan** tab displays the following:

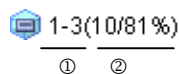
- **Monitoring Term ①**: Displays the monitoring period specified in the Hitachi Performance Monitor panel of Performance Monitor.
CruiseControl™ analyzes disk usage information collected by Performance Monitor during the monitoring period, and then calculates estimated usage rates of the source and target parity groups after a proposed volume migration.
- **Gathering Time ②**: Displays the time specified in the Monitoring Options panel of Performance Monitor.
SVP (web server) collects usage statistics about resources (such as hard disk drives) at the specified **Gathering Time**. Then CruiseControl™ uses the collected usage statistics to estimate usage rates of parity groups after a proposed volume migration.

- **Tree view ③:** The tree view lists parity groups in the disk subsystem. When you double-click a parity group icon, a list of logical volumes in that parity group appears.

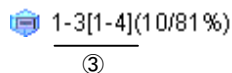
The following icons can appear in the tree view:

-  (no pin) indicates a normal parity group.
-  (red pin) indicates a fixed parity group.
-  (green pin) indicates a fixed parity group containing volumes that can be used as target volumes for manual migration. When you specify a source volume, CruiseControl™ checks each parity group for volumes that can be used as target volumes. If a parity group containing volumes that can be used as target volumes is found, the icon for the parity group is changed automatically. The color of the pin in the icon changes from **red** to **green**.
-  indicates a normal logical volume that can be migrated to a different parity group but cannot be used as a migration destination.
-  indicates a volume reserved as a migration destination. When you specify a source volume in the **Manual Plan** tab, CruiseControl™ checks reserved volumes to find volumes that can be used as target volumes. If a reserved volume that can be used as target volumes is found, the volume icon is changed automatically to .
-  indicates a logical volume that can be used as a migration destination.
-  indicates a logical volume that is being migrated, or a normal logical volume that is registered in a migration plan.

Figure 4.3 defines the information displayed to the right of a **parity group** icon:



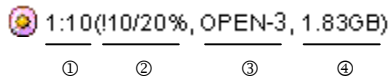
- ① The parity group ID. The number before the hyphen is the frame number.
The number after the hyphen is the parity group number.
- ② The number before the slash is the average usage rate.
The number after the slash is the maximum usage rate.



- ③ The parity group 1-3 is connected with the parity group 1-4.

Figure 4.3 Parity Group Information

Figure 4.4 defines the information displayed to the right of Volume icon:



- ① The logical volume ID. The number before the colon is the CU image number.
The number after the colon is the LDEV number.
- ② The number before the slash is the average usage rate.
The number after the slash is the maximum usage rate.
If an exclamation symbol (!) appears before a usage rate, the usage rate might be incorrect.
- ③ The emulation type
- ④ The size of the logical volume

Figure 4.4 Volume Information

- The → buttons specify the volume selected in the tree view as the migration source or the migration target (destination). To specify the volume as the migration source, select the upper → button. To specify the volume as the migration target, select the lower → button.
- **Source LDEV Area ④:** The text box lets you specify the source volume (that is, the logical volume that you want to migrate). To the right of the text box appear the following:
 - the current usage rate for the parity group to which the source volume belongs
 - an estimated usage rate for the parity group after a proposed volume migration
- **Target (Reserved) LDEV Area ⑤:** The text box lets you specify the target volume (that is, the location to which you want to migrate the source volume). To the right of the text box appear the following:
 - the current usage rate for the parity group that the target volume belongs to
 - an estimated usage rate for the parity group after a proposed volume migration
- **Line Graph Area ⑥:** The line graph illustrates how the usage rates have changed for the source volume and the target volume.
- **Set Button ⑦:** The **Set** button adds a new manual migration plan to the table. The new manual migration plan consists of the logical volume in **Source LDEV** and the logical volume in **Target (Reserved) LDEV**.
- **Table Area ⑧:** Each row in the table indicates a migration plan, which is a pair of a source volume and the corresponding target volume. **Note:** Newly created migration plans are displayed highlighted in **blue**. Migration plans awaiting execution or being executed are displayed highlighted in **black**.

The **Stat** column displays an error code if an error occurs during execution of a migration plan. To view detailed information about an error, select and right-click the error code and then select **Detail** from the pop-up menu.

- The **DEL** column displays the character “D” if you attempt to delete a migration plan that is waiting for execution. Migration plans indicated by “D” are actually deleted when you click the **Apply** button.
- The **% column** indicates the progress of the manual migration.
- The **Source LDEV** columns display information about source volumes:
 - **LDEV** indicates the logical volume ID. The number before the colon (:) is the CU image number. The number after the colon is the device ID.
 - **Emulation** indicates the emulation type of the logical volume.
 - **Capacity** indicates the capacity of the logical volume.
 - **RAID** indicates the RAID type.
 - **PG** indicates the parity group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
 - **HDD** indicates the type of the hard disk drive.
- The **Target LDEV** columns display information about target volumes:
 - **LDEV** indicates the logical volume ID. The number before the colon (:) is the CU image number. The number after the colon is the device ID.
 - **RAID** indicates the RAID type.
 - **PG** indicates the parity group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
 - **HDD** indicates the type of the hard disk drive.
- **Delete Button @:** The **Delete** button deletes the migration plan (that is, a row in the table) selected in the table.

If you select a black highlighted migration plan (i.e., a migration plan that is waiting for execution or is being executed) and click the **Delete** button, the **DEL** column displays the character “D” and the selected migration plan will not be deleted until you click the **Apply** button.

The **Delete** button does not take effect when both blue and black migration plans are selected. Confirm that only blue or black migration plans are selected before you click **Delete**.
- The **Apply** button applies manual migration plans in the table to the disk subsystem to start volume migrations.
- The **Reset** button: If you click this button after you click the **Apply** button, execution of manual migration plans will be canceled.
- The **Close** button closes the CruiseControl™ panel.

4.2 The Auto Plan Tab in the CruiseControl™ Panel

The Auto Plan tab lets you make settings for automating volume migrations.

For details on operations in this tab, see section 5.3.

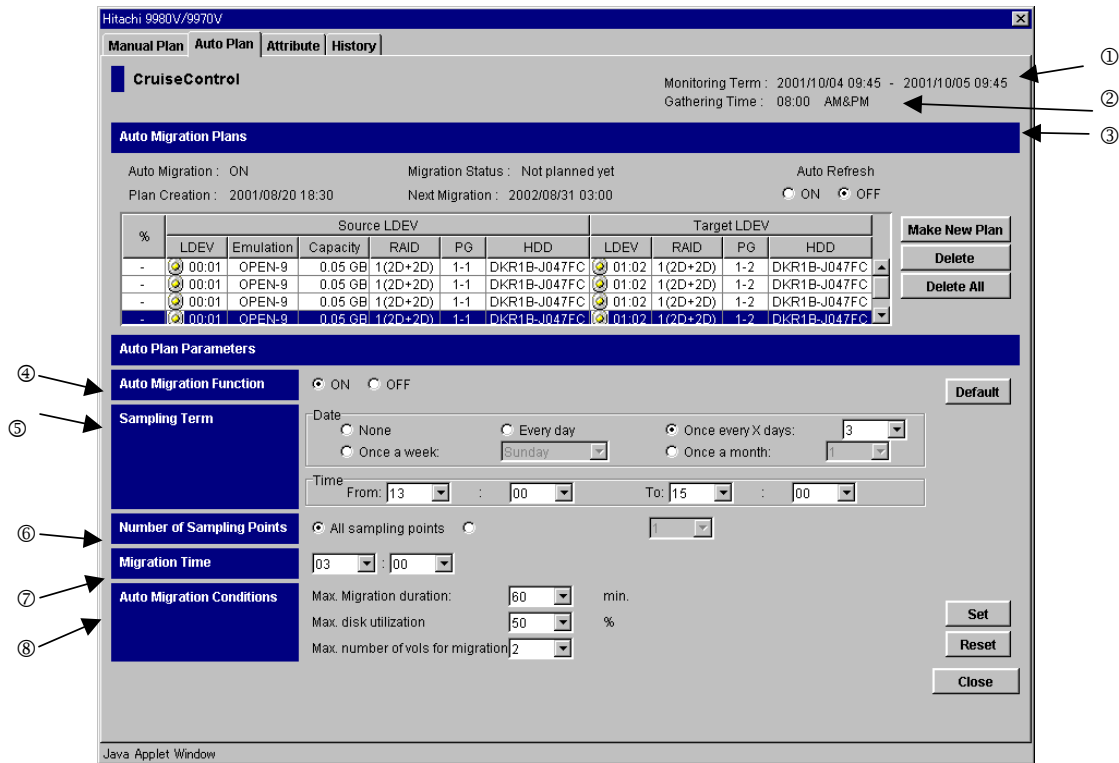


Figure 4.5 The Auto Plan Tab in the CruiseControl™ Panel

The Auto Plan tab displays the following:

- **Monitoring Term ①:** Displays the monitoring period specified in the Hitachi Performance Monitor panel of Performance Monitor.
CruiseControl™ analyzes disk usage information collected by Performance Monitor during the monitoring period, and then creates auto migration plans based on that analysis.
- **Gathering Time ②:** Displays the time specified in the Monitoring Options panel of Performance Monitor.
CruiseControl™ analyzes disk usage information collected during the monitoring period, and then creates auto migration plans based on that analysis. The disk usage information is updated by the SVP (web server) at the specified **Gathering Time**.

- **Auto Migration Plans Area ③:** The following items are displayed above the table:
 - **Auto Migration** indicates whether auto migrations will take place. If this option is **ON**, auto migrations will take place at the time displayed at **Next Migration**. If this option is **OFF**, auto migrations will not take place.
 - **Migration Status** indicates the progress of auto migration plans.
 - If **Not planned yet** is displayed, CruiseControl™ has not yet created auto migration plans.
 - If **Not performed yet** is displayed, CruiseControl™ has created auto migration plans but has not executed them yet.
 - If **Failed to make plan** is displayed, CruiseControl™ failed to create auto migration plans.
 - If **Under migration** is displayed, CruiseControl™ is executing an auto migration plan.
 - If **Last migration has been canceled (Please see log file)** is displayed, CruiseControl™ has canceled the last migration plan.
 - **Migration successfully ended. X plans have been executed** is displayed, CruiseControl™ successfully executed the auto migration plans.
 - **Plan Creation** indicates when the auto migration plans were created.
 - **Next Migration** indicates the next time that CruiseControl™ will perform auto migration operations.
 - **Auto Refresh** enables you to specify whether to automate updating of information about migration plans, which should be displayed in the table.
 - If you select **ON**, information in the table will automatically be updated, so that you will be able to check the progress of migrations in real time. If a new plan is created, the new plan will automatically be added to the table. A message appears whenever information in the table is updated.
 - If you select **OFF**, information in the table will not automatically be updated.
- Note:** The time values displayed on this panel are retrieved from the SVP (web server), and may not correspond to the time displayed on the Storage Navigator computer.
- **Table Area:** The table displays auto migration plans (that is, pairs of the source volume and the target volume).
 - The **% column** indicates the progress of the auto migration. A hyphen appears if CruiseControl™ has not executed the auto migration plan yet.

- The **Source LDEV** columns display information about source volumes.
 - **LDEV** indicates the logical volume ID. The number before the colon (:) is the CU image number. The number after the colon is the device ID.
 - **Emulation** indicates the emulation type of the logical volume.
 - **Capacity** indicates the capacity of the logical volume.
 - **RAID** indicates the RAID type.
 - **PG** indicates the parity group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
 - **HDD** indicates the type of the hard disk drive.
- The **Target LDEV** columns display information about target volumes.
 - **LDEV** indicates the logical volume ID. The number before the colon (:) is the CU image number. The number after the colon is the device ID.
 - **RAID** indicates the RAID type.
 - **PG** indicates the parity group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.
 - **HDD** indicates the type of the hard disk drive.

To the right of the table appear the following buttons:

- The **Make New Plan** button discards the existing auto migration plans and then creates new auto migration plans.
- The **Delete** button deletes the auto migration plan selected in the table.
- The **Delete All** button deletes all the auto migration plans in the table.
- **Auto Plan Parameters** lets you specify parameters that affect automatic creation and execution of migration plans.
 - **Auto Migration Function** ④: Specifies whether to automate volume migrations. If you select **ON**, logical volumes are automatically migrated. If you select **OFF**, logical volumes are not automatically migrated.
 - **Sampling Term** ⑤: The CruiseControl™ auto migration function analyzes resource usage within the specified Sampling Term and then creates auto migration plans based on that analysis. Sampling Term is used to narrow resource usage statistics to be analyzed. **Note:** CruiseControl™ does not analyze resource usage statistics outside of the specified sampling term.
 - **Date:**

If the **None** radio button is selected, CruiseControl™ does not analyze resource usage statistics and does not create auto migration plans.

If the **Every day** radio button is selected, CruiseControl™ creates auto migration plans every day.

If the **Once every X days** radio button is selected, CruiseControl™ creates auto migration plans every X days. The drop-down list is used to specify the number of days (that is, the value of X).

If the **Once a week** radio button is selected, CruiseControl™ creates auto migration plans on the selected day of the week. The drop-down list is used to select a day.

If the **Once a month** radio button is selected, CruiseControl™ creates auto migration plans on the Xth day of the month. The drop-down list is used to specify a day.

- **Time** lets you specify a period. CruiseControl™ analyzes resource usage statistics within the specified period.
- **Number of Sampling Points ⑥:**
 - **All sampling points:** If this radio button is selected, CruiseControl™ uses all the average usage rates during the **Sampling Term** to determine disk usage.
 - **X highest sampling points:** If this radio button is selected, CruiseControl™ uses only the Xth highest average usage rate during the **Sampling Term** to determine disk usage. The drop-down list is used to specify the value of X.
- **Migration Time ⑦:** Lets you specify the time when auto migration starts. If the **Auto Migration Function** option is **ON**, the auto migration operation starts at the specified time.
- **Auto Migration Conditions ⑧:** Lets you specify the following auto migration parameters:
 - **Max. migration duration** lets you specify the time limit (10-120 minutes) for an auto migration plan. If the auto migration plan is not complete within this limit, the remaining migration operation(s) are performed at the next scheduled execution time (if a new plan is not made).
 - **Max. disk utilization** lets you specify the disk usage limit (10-100%) during auto migration. If the most recent usage for any source or target parity group is over this limit when auto migration starts, CruiseControl™ cancels the auto migration plan and will retry the plan at the next execution time (if a new plan is not made before then).
 - **Max. number of vols for migration** lets you specify the maximum number of volumes (1-40) that can be migrated during one auto migration plan.
- The **Default** button sets each parameter in **Auto Plan Parameters** to the default value and then issues the parameter to the disk subsystem.
- The **Set** button applies each parameter in **Auto Plan Parameters** to the disk subsystem.
- The **Reset** button restores each parameter in **Auto Plan Parameters** to the value before change.
- The **Close** button closes the CruiseControl™ panel.

4.3 The Attribute Tab in the CruiseControl™ Panel

The **Attribute** tab lets you find out which parity group belongs to which HDD class. The **Attribute** tab also lets you view information about parity groups, such as parity group usage, logical volume capacity, and RAID type.

You must use the **Attribute** tab to reserve target volumes.

For details on operations in this tab, see sections 5.1, 5.3.1, and 5.3.2.

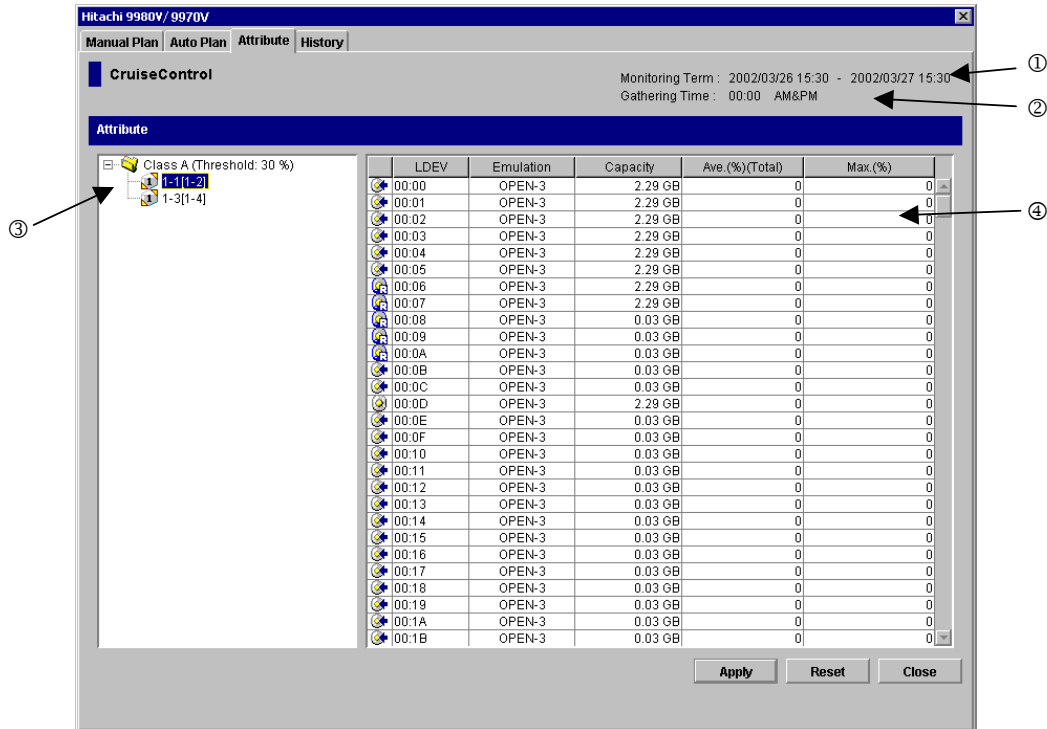


Figure 4.6 The Attribute Tab in the CruiseControl™ Panel

The **Attribute** tab displays the following information:

- **Monitoring Term ①**: Displays the monitoring period specified in the Performance Monitor panel.
- **Gathering Time ②**: Displays the time specified in the Performance Monitor Monitoring Options panel.

- **Tree view ③:** The tree view lists HDD classes.. When you double-click an HDD class icon, a list of parity groups in that HDD class appears.

The icon  (no pin) indicates a **normal** parity group.

The icon  (red pin) indicates a **fixed** parity group disallowing auto migration. Volumes cannot automatically be migrated from and to fixed parity groups.

The icon  (green pin) indicates a **fixed** parity group allowing manual migration. Volumes cannot automatically be migrated from and to fixed parity groups. However, use of this icon indicates the fixed parity group contains volumes that can be used as target volumes for **manual** migration.

Parity group icons can represent a single parity group. Parity group icons can also represent two or more parity groups that are concatenated. For example, if the text 1-3 appears on the right of an icon, the icon represents the parity group 1-3. If the text 1-3[1-4] appears on the right of an icon, the icon represents two parity groups (that is, 1-3 and 1-4) that are concatenated.

- **Table Area ④:** When you select a class in the tree view, the table displays information about parity groups in that class as shown in Figure 4.7.

Parity group icons can represent a single parity group. Parity group icons can also represent two or more parity groups that are concatenated. For example, if the text 1-3 appears on the right of an icon, the icon represents the parity group 1-3. If the text 1-3 [1-4] appears on the right of an icon, the icon represents two parity groups (that is, 1-3 and 1-4) that are concatenated.

PG	HDD	Ave.(%)(Total)	Max.(%)	Total	Reserved
 1-1	DKR1B-J047FC	10	81	24	0
 1-2	DKR1B-J047FC	10	81	8	6

Figure 4.7 Parity Group Information Relating to a Selected Class

The following describes each of the table columns:

- **PG** indicates the parity group ID. The number before the hyphen (-) is the frame number. The number after the hyphen is the group number.

The icon  (no pin) indicates a normal parity group.

The icon  (red pin) indicates a fixed parity group disallowing auto migration. Volumes cannot automatically be migrated from and to fixed parity groups.

The icon  (green pin) indicates a fixed parity group allowing manual migration. Volumes cannot automatically be migrated from and to fixed parity groups. However, use of this icon indicates the fixed parity group contains volumes that can be used as target volumes for **manual** migration.

- **HDD** indicates the type of the hard disk drive.
- **Ave.** indicates the average usage rate for the parity group.

If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (e.g., volumes have been moved by CruiseControl™ or changed by Virtual LVI).

- **Max.** indicates the maximum usage rate for the parity group.

If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (e.g., volumes have been moved by CruiseControl™ or changed by Virtual LVI).

- **Total** indicates the total number of logical volumes in the parity group.
- **Reserved** indicates the number of reserved logical volumes.

When you select a **parity** group in the tree view, the table displays information about logical volumes in that parity group as shown in Figure 4.8.

	LDEV	Emulation	Capacity	Ave.%(Total)	Max.%(Total)
	00:00	OPEN-3	2.29GB	!10	120
	00:01	OPEN-3	2.29GB	15	25
	00:02	OPEN-3	2.29GB	0	0
	00:03	OPEN-3	2.29GB	0	0
	00:04	OPEN-3	2.29GB	0	0
	00:05	OPEN-3	2.29GB	0	0
	00:06	OPEN-3	2.29GB	0	0
	00:07	OPEN-3	2.29GB	0	0

Figure 4.8 Logical Volume Information Relating to a Selected Parity Group

The following describes each of the table columns:

- **LDEV** indicates the logical volume ID. The number before the colon (:) is the CU image number. The number after the colon is the device ID.

The icon  indicates a normal logical volume that cannot be used as a migration destination.

The icon  indicates a *reserved volume*, which are reserved as a migration destination. When you specify a source volume in the **Manual Plan** tab, CruiseControl™ checks reserved volumes to find volumes that can be used as target volumes. If CruiseControl™ finds a reserved volume that can be used as target volumes, CruiseControl™ changes the volume icon to .

The icon  indicates a volume that can be changed to a reserved volume.

Note: The table does not display logical volumes that are used as an LUSE.

- **Emulation** indicates the emulation type of the logical volume.
- **Capacity** indicates the capacity of the logical volume.
- **Ave.** indicates the average usage rate for the logical volume.

If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (e.g., volumes have been moved by CruiseControl™ or changed by Virtual LVI).

- **Max.** indicates the maximum usage rate for the logical volume.

If an exclamation mark (!) is displayed, the reported usage rate is likely to be inaccurate, because the configuration has changed (e.g., volumes have been moved by CruiseControl™ or changed by Virtual LVI).

- The **Apply** button applies the settings in the **Attribute** tab to the disk subsystem.
- The **Reset** button discards changes in the **Attribute** tab and restores the original settings.
- The **Close** button closes the CruiseControl™ panel.

4.4 The History Tab in the CruiseControl™ Panel

The **History** tab displays information about auto migration operations and manual migration operations in the past. For example, you can find out when migration operations took place and also find out whether migration operation finished successfully.

For details on operations in this tab, see section 5.4.

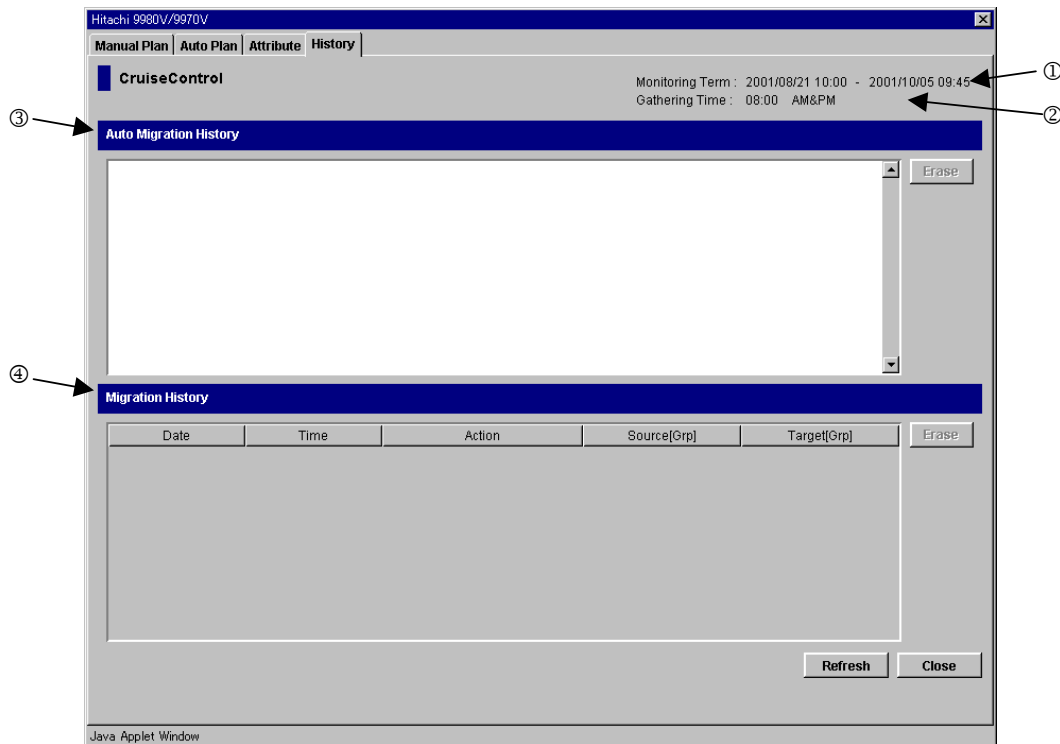


Figure 4.9 The History Tab in the CruiseControl™ Panel

The **History** tab displays the following information:

- **Monitoring Term ①:** Displays the monitoring period specified in the Hitachi Performance Monitor panel of Performance Monitor.
- **Gathering Time ②:** Displays the time specified in the Monitoring Options panel of Performance Monitor.
- **Auto Migration History ③:** Displays logs of creation and execution of auto migration plans.
 - The **Erase** button lets you erase the entire information.
- **Migration History ④:** Displays logs of volume migration events.

- The **Table Area**: Displays the following information:

- The date and time when the event occurs.
- The event.
- The source volume and the parity group.
- The target (destination) volume and the parity group.

Note: The time displayed in this area is the 9900V SVP time. For further information contact your Hitachi Data Systems representative.

- The **Refresh** button updates information in the **History** tab.
- The **Close** button closes the CruiseControl™ panel.

Chapter 5 Performing CruiseControl™ Operations

CruiseControl™ can be used to balance workloads among disk drives and thus remove bottlenecks from the system. CruiseControl™ can migrate logical volumes from the current parity group to another parity group. Volume migrations can be performed manually by the system administrator or automatically by CruiseControl™ as described earlier (for details, refer to sections 2.1 and 2.2.)

Note: Various requirements and restrictions apply to CruiseControl™. For details, please refer to section 2.3.

5.1 Reserving Migration Destinations for Logical Volumes

To be able to migrate volumes, you must reserve disk spaces (actually, logical volumes) that can be used for migration destinations. You must reserve volumes regardless of migration methods (manual migration or automatic migration). Migration will not take place without a reserved logical volume.

To reserve a logical volume as a migration destination:

1. Start CruiseControl™ (see section 3.3).
2. From the CruiseControl™ panel, click the **Attribute** tab (see Figure 5.1).

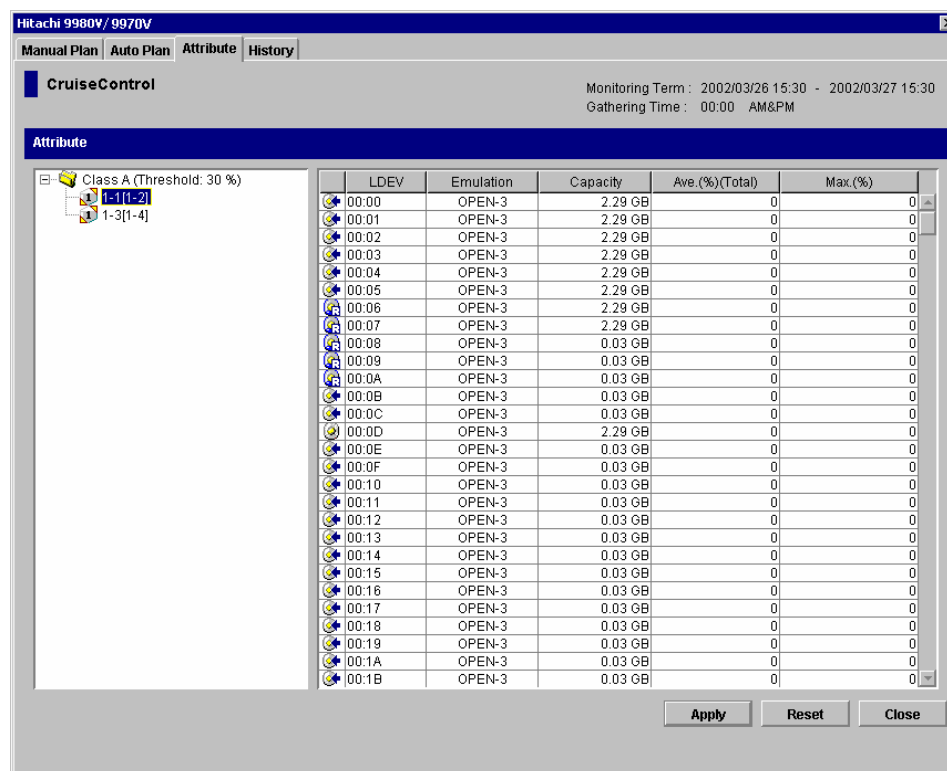


Figure 5.1 The Attribute Tab

3. In the tree view, locate a logical volume that you want to use as a migration destination.

To locate a volume, first double-click an **HDD class** in the tree view to display a list of parity groups in that class. Next, click a **parity group**. The table on the right displays a list of logical volumes in that group.

4. In the table to the right of the tree view, locate logical volumes preceded by the  icon. From those logical volumes select the desired logical volume and **right-click** it.

Note: If you want to reserve two or more logical volumes, you can select the desired logical volumes and right-click the selection.

5. From the resulting pop-up menu, select **Reserved LDEV** as shown in Figure 5.2.



Figure 5.2 The Reserved LDEV Pop-Up Menu

The icon changes to .

6. Click the **Apply** button.

The settings in the panel are applied to the disk subsystem. The specified logical volume is reserved as a migration destination.

Notes:

- When you click the **Apply** button one time, up to 64 logical volumes can be reserved as migration destinations. If you click the **Apply** button to reserve more than 64 logical volumes, an error occurs. If you want to reserve more than 64 logical volumes, you must follow the above procedure at least twice. For example, if you want to reserve 100 logical volumes, you need to reserve 64 or fewer logical volumes and then reserve the remaining logical volumes.
- If you right-click the logical volumes preceded by the  icon (reserved volume) and then choose **Normal LDEV** from the pop-up menu, you will not be able to use the volume as a migration destination.
- Throughout the 9900V documentation set, the term “**reserved volume**” is used to refer to a volume that is reserved for use as a migration destination (). The term “**normal volume**” is used to refer to a volume that is not reserved as a migration destination.

5.2 Creating Migration Plans and Manually Migrating

To be able to migrate logical volumes manually, you must create migration plans. A migration plan is a pairing of a source volume and a corresponding target (destination) volume. If you want to migrate more than one logical volume, you must create a migration plan for each migration.

However, before you can create a migration plan, you must determine which volume should be migrated to which parity group (disk drive). You should choose a volume with a high usage rate as your migration source (the volume to migrate). To determine a migration target or destination, you first need to find fast parity groups (i.e., fast disk drives). From these fast parity groups you will choose a low-usage parity group to serve as the migration destination. As you make these choices, you are in fact building a migration plan. When you are finished, CruiseControl™ will estimate the results of the proposed migration and display that information to you.

Notes:

- When you use CruiseControl™ for the first time, you must reserve logical volumes for migration destinations. Reserved volumes are indicated by the  icon. For details, see section 5.1.
- 9900V documents sometimes use the term *reserve volumes* to refer to disk areas reserved as migration destinations (that is, volumes preceded by the  icon).

CAUTION: Do not perform manual migration operations while the auto migration function is active. Always turn off auto migration and cancel any existing auto migration plan before performing a manual migration (for details, see section 5.3.5).

To create a migration plan and perform a manual migration:

1. Start CruiseControl™ (refer to section 3.3).
2. From the CruiseControl™ panel, click the **Manual Plan** tab (see Figure 5.3).

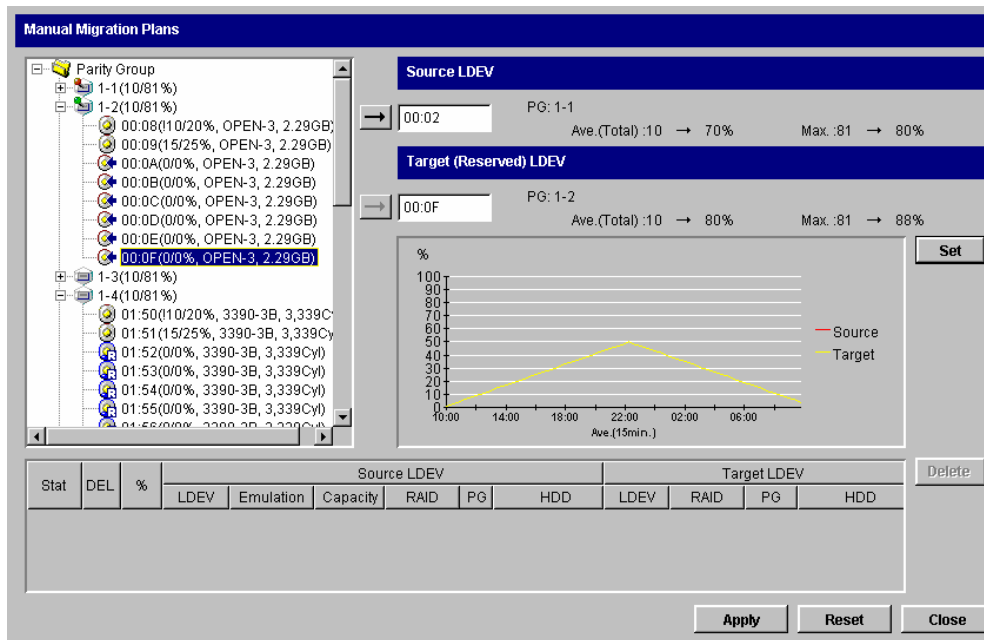


Figure 5.3 The Manual Plan Tab

3. In the **tree view**, locate the source volume (i.e., the logical volume that you want to migrate).

To locate the logical volume, double-click a parity group in the tree view. A list of logical volumes in that parity group appears.

From the expanded parity group list, choose a volume with a high usage rate (see Figure 5.4)

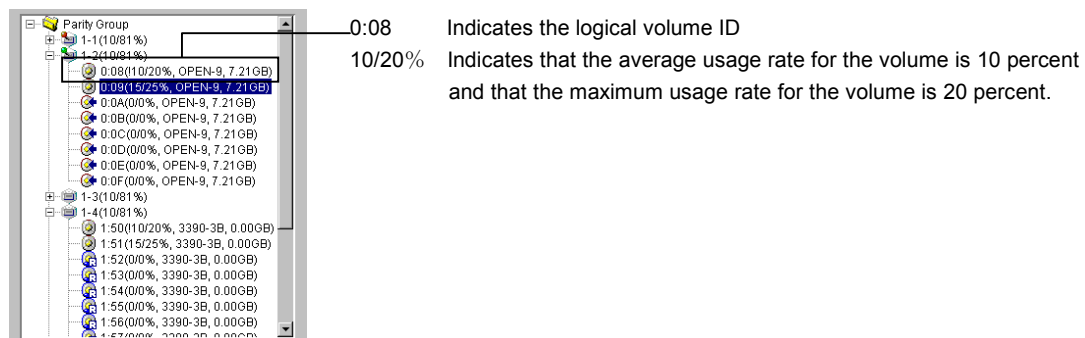


Figure 5.4 Usage Rate for a Logical Volume Displayed in the Panel (example only)

4. Select the source volume in the tree view and click the → button to the left of the **Source LDEV** text box (see Figure 5.5). The selected volume appears in the **Source LDEV** text box. *Tip:* If you are using Windows®, you can drag and drop the source volume to the **Source LDEV** text box.

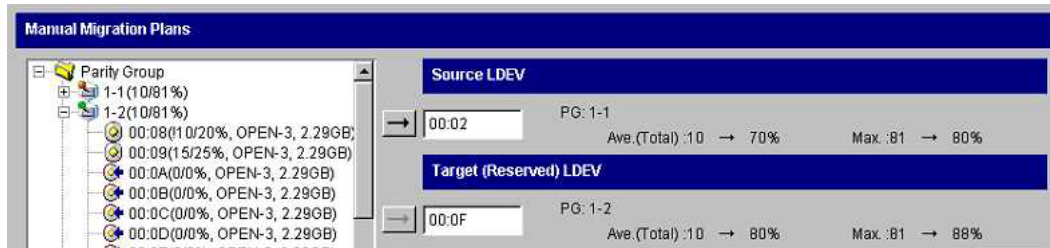


Figure 5.5 Source and Target Text Boxes (example only)

5. In the tree view, check the usage rate of each parity group and determine which parity group the source volume should be migrated to.

Note: The usage rate of the target (destination) parity group should be lower than the source parity group.

6. In the tree view, double-click the parity group to which you want to migrate the source volume. A list of **logical volumes** in that parity group appears.
7. In the tree view, select the **target** (destination) volume and click the → button on the left side of the **Target LDEV** text box (refer to Figure 5.5). **Tip:** If you are using Windows®, you can drag and drop the target volume to the **Target LDEV** text box.

Note: Only the volumes preceded by the  icon (reserved volume) can be used as migration destinations (for details, refer to section 5.1).

8. Check the estimated results in **Source LDEV**, **Target LDEV** and the graph.

CruiseControl™ calculates an estimated usage rate of the source and target parity group. The estimated results are displayed to the right of the **Source LDEV** and the **Target LDEV** text box.

CruiseControl™ uses past resource usage rates, the type of the hard disk drive, and the RAID level when calculating the estimated usage rate. In the example shown in Figure 5.6, if the logical volume 00:00 in the parity group 1-1 is migrated the reserved volume 02:08 in the parity group 2-1, the parity group 1-1 can expect 5 percent decrease in the average usage rate (from 40 percent to 35 percent). The destination parity group 2-1 can expect 5 percent increase in the average usage rate (from 0 percent to 5 percent). If the estimated result is not satisfactory, you can change the migration destination by repeating the above steps.

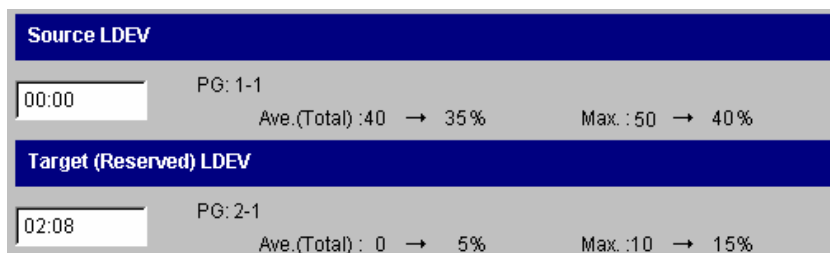


Figure 5.6 Estimated Usage Rate for Parity Groups (example only)

The line graph in the Manual Migration Plans area indicates how the usage rate has changed for the source volume and the target volume.

- If you think this proposed migration plan will produce the desired disk performance, go to the next step:
- If not, return to step 4 or 6 to change the source and target volumes.

Note: You can create more than one migration plan. If there are any other high-usage volumes, you can continue to create migration plans. If you finish creating migration plans, you can execute the migration plans to start volume migrations.

9. Click the **Set** button.

A new migration plan, consisting of the specified source and target volumes, is added to the table. The new migration plan is highlighted in blue.

Note: Throughout the 9900V documentation set, the terms “migration plan” and “CruiseControl™ pair” are used to refer to a pairing of a source volume and a corresponding target volume.

If you want to migrate more than one logical volume manually, repeat the previous steps to add migration plans.

10. Click the **Apply** button.

The migration plan is applied to the disk subsystem. The font color of the migration plan changes from **blue** to **black**. **Note:** If you click the **Apply** button one time, up to eight migration plans can be executed. Migration plans will execute one after another in the order they are arranged in the table.

When a logical volume starts migration, the progress of the migration is displayed in the % column of the table. If an error occurs during migration, an error code appears in the **Stat** column. To view detailed information about the error, select and right-click the error code and then select **Detail** from the pop-up menu.

Related topics:

- To delete a migration plan, select a migration plan and then click the **Delete** button.
- If you select a migration plan in **black** (a migration plan that is waiting for execution or being executed) and then click the **Delete** button, the character “**D**” appears in the **DEL** column, and the migration plan will not be deleted until you click the **Apply** button.

CAUTION:

- If you delete a migration plan that is being executed, the data in the target volume will not be guaranteed.
- When an error condition exists in the 9900V subsystem, resource usage can increase or become unbalanced. **Do not** use usage statistics collected during an error condition as the basis for planning CruiseControl™ migration operations.

5.3 Automating Volume Migrations

You can make settings so that volume migrations automatically take place every day at the specified time. This section explains the following procedures for automating volume migrations:

- Setting fixed parity group
- Changing the maximum disk usage rate for each HDD class
- Setting Auto Migration parameters
- Remaking Auto Migration plans

5.3.1 Setting Fixed Parity Group

A fixed parity group is a parity group that cannot be used by the auto migration function. If you want to exclude a parity group (all logical volumes in the group) from auto migration operations, you need to fix the parity group. Volumes in fixed parity groups will not be used for auto migration operations, but can be used as needed for manual migration operations.

To fix a parity group so that it cannot be migrated manually:

1. Start CruiseControl™ (refer to section 3.3).
2. From the CruiseControl™ panel, click the **Attribute** tab (see Figure 5.7).

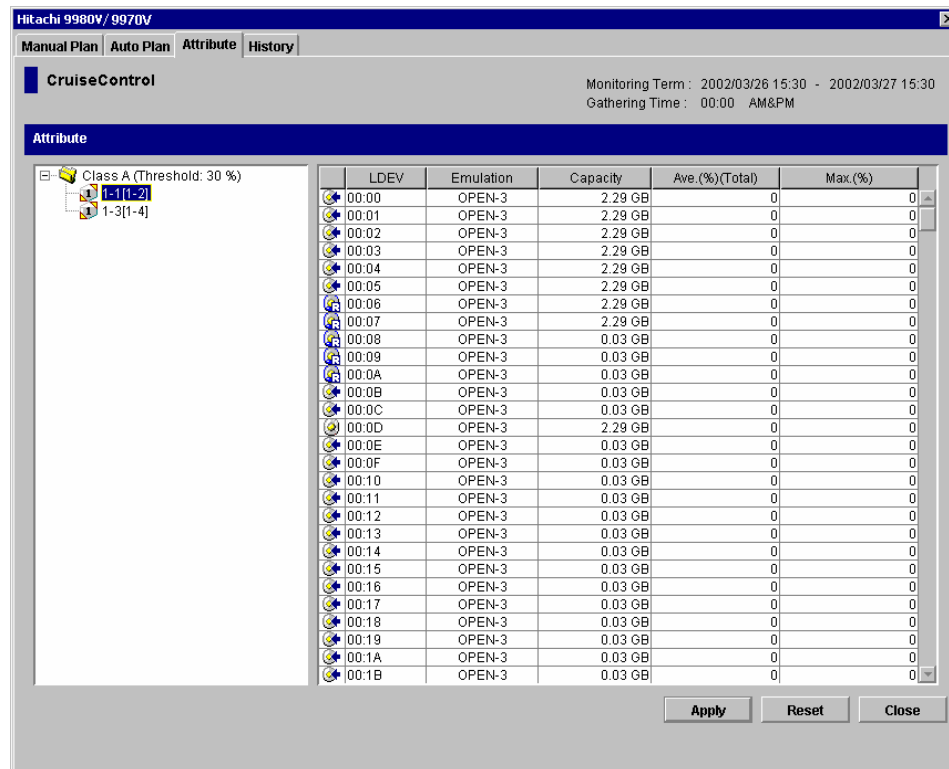


Figure 5.7 The Attribute Tab

3. In the tree view, double-click an **HDD class** folder.

The table to the right of the tree view displays a list of parity groups in the HDD class. The  (no pin) normal parity group icon indicates parity groups that can include source or target volumes. The  (red pin) parity group icon indicates “fixed” parity groups, which cannot include source nor target volumes.

4. From the  normal parity groups, select a parity group that you want to exclude from auto migration operations. Next, right click the  normal parity group icon and select **Fixed PG** from the pop-up menu (see Figure 5.8). The selected parity group is indicated by the  (red pin) parity group icon and becomes “fixed.”

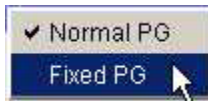


Figure 5.8 Fixed Parity Group Pop-Up Menu

5. Click the **Apply** button in the CruiseControl™ panel.

Tip: If you want to enable logical volumes in a fixed parity group to be moved to another parity group, you must change the fixed parity group to a “normal” parity group. To do this, right-click the fixed parity group (indicated by the  (red pin) icon) and then select **Normal PG** from the pop-up menu (refer to Figure 5.8).

5.3.2 Changing the Maximum Disk Usage Rate for Each HDD Class

By default, each HDD class is assigned a certain limit on disk usage rate. As explained earlier, this limit affects auto migration behavior. If necessary, you can change the limit on disk usage rate.

To change the limit on disk usage rate for an HDD class:

1. Start CruiseControl™ (refer to section 3.3).
2. From the CruiseControl™ panel, click the **Attribute** tab (refer to Figure 5.7).
3. In the tree view, right-click an HDD class folder and then select **Change Class Threshold** from the pop-up menu (see Figure 5.9).



Figure 5.9 Change Class Threshold Pop-Up Menu

The Change Threshold panel appears (see Figure 5.10).

4. From the **Threshold** drop-down list, select the value that you want to use as the limit and then click **OK**.

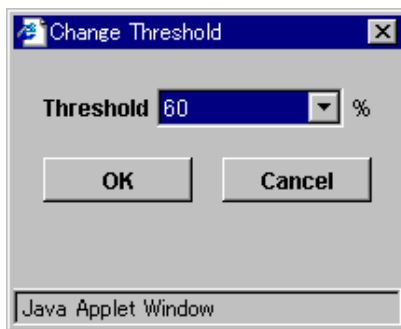


Figure 5.10 The Change Threshold Panel

In the tree view, the selected value appears to the right of the specified class (**Threshold: 60%**).

5. Click the **Apply** button in the CruiseControl™ panel.
The specified limit is applied to the disk subsystem.

5.3.3 Setting Auto Migration Parameters

To be able to automate volume migration, you must specify migration parameters such as the migration time.

To configure auto migration parameters:

1. Start CruiseControl™ (refer to section 3.3).
2. From the CruiseControl™ panel, click the **Auto Plan** tab (see Figure 5.11).

Hitachi 9980V/9970V

Manual Plan | **Auto Plan** | Attribute | History

CruiseControl

Monitoring Term : 2001/10/04 09:45 - 2001/10/05 09:45
Gathering Time : 08:00 AM&PM

Auto Migration Plans

Auto Migration : ON Migration Status : Not planned yet Auto Refresh
Plan Creation : 2001/08/20 18:30 Next Migration : 2002/08/31 03:00 ☐ ON ☒ OFF

%	Source LDEV						Target LDEV			
	LDEV	Emulation	Capacity	RAID	PG	HDD	LDEV	RAID	PG	HDD
-	00:01	OPEN-9	0.05 GB	1(2D+2D)	1-1	DKR1B-J047FC	01:02	1(2D+2D)	1-2	DKR1B-J047FC
-	00:01	OPEN-9	0.05 GB	1(2D+2D)	1-1	DKR1B-J047FC	01:02	1(2D+2D)	1-2	DKR1B-J047FC
-	00:01	OPEN-9	0.05 GB	1(2D+2D)	1-1	DKR1B-J047FC	01:02	1(2D+2D)	1-2	DKR1B-J047FC
-	00:01	OPEN-9	0.05 GB	1(2D+2D)	1-1	DKR1B-J047FC	01:02	1(2D+2D)	1-2	DKR1B-J047FC

Make New Plan
Delete
Delete All

Auto Plan Parameters

Auto Migration Function ☒ ON ☐ OFF Default

Sampling Term

Date: ☐ None ☐ Every day ☒ Once every X days: 3 ☐ Once a week: Sunday ☐ Once a month: 1

Time: From: 13 : 00 To: 15 : 00

Number of Sampling Points ☒ All sampling points ☐

Migration Time 03 : 00

Auto Migration Conditions

Max. Migration duration: 60 min.
Max. disk utilization: 50 %
Max. number of vols for migration: 2

Set
Reset
Close

Java Applet Window

Figure 5.11 The Auto Plan Tab

3. In **Auto Refresh**, specify **ON** or **OFF**.
 - If you specify **ON**, a new plan will be automatically added to the **Auto Migration Plans** table when the plan is automatically created. If a migration plan executes, the progress of execution is displayed and will automatically be updated in the **Auto Migration Plans** table. CruiseControl™ displays a message whenever the **Auto Migration Plans** table is updated.
 - If you specify **OFF**, the **Auto Migration Plans** table will not be updated when a migration plan is automatically created or executed.
4. In the **Sampling Term** area, use the **Date** and **Time** boxes to specify a period so that CruiseControl™ analyzes resource usage statistics for that period.

For example, if you want to improve disk access speed every day from 9:00 a.m. to 5:00 p.m., you should specify the period as “*every day from 9:00 a.m. to 5:00 p.m.*”

Important: Make sure that the sampling term and the auto migration execution time are separated by at least an hour. For example, if the sampling term is from 10:00 to 14:00, auto migration should not be performed between 09:00 and 15:00.

Note: Auto migration plans will **not** be created if you select **None** in the **Date** box.

5. In **Number of Sampling Points**, do either of the following:
 - To enable CruiseControl™ to analyze all the average usage rates in the sampling term, select **All sampling points**.
 - To enable CruiseControl™ to analyze only the X highest average usage rates in the sampling term, select **X highest sampling points** and then select the value of X from the drop-down list.
6. In **Migration Time**, specify when to start auto migration operations.

CAUTIONS:

- Volume migrations might impose heavy workloads on disks. For this reason, you are advised to specify a time when disk usage rates are low.
- Auto migration is likely to place a heavy workload on servers. Therefore, auto migration might slow down processing on the web clients.
- The migration time must precede the specified **Sampling Term** start time by the specified **Max. migration duration** plus at least **15** minutes.
- The migration time must be at least **60** minutes later than the specified **Sampling Term** end time.

7. If necessary, specify auto migration parameters as follows:
 - a) Use the **Max. migration duration** drop-down list to set a time limit for auto migrations.

Note: If auto migration is not complete within this limit, CruiseControl™ cancels the incomplete operations.
 - b) Use the **Max. disk utilization** drop-down list to set a disk usage limit.
 - c) Use the **Max. number of vols for migration** drop-down list to specify the maximum number of volumes that can be auto migrated at the same time.

8. Click the **Set** button.

The settings in this panel will be applied to the disk subsystem.

Migration plans will be automatically created **30** minutes later than the specified sampling term. For example, if you specified 13:00 - 15:00 for the sampling term, plan creation will be performed at 15:30.

9. Click the **Close** button to close the CruiseControl™ panel.

Related topics

- To delete all the auto migration plans, click the **Delete All** button.
- To delete an auto migration plan, select the plan in the table and then click the **Delete** button.

5.3.4 Remaking Auto Migration Plans

If auto migration operations did not produce enough improvements in disk access performance, you can discard the current migration plans and make new auto migration plans.

To make new auto migration plans:

1. If necessary, do the following:
 - Change the limit on disk usage rate for HDD classes. For details, refer to section 5.3.2.
 - Change parameters in **Auto Plan Parameters**. For details see section 5.3.3.
2. In the **Auto Plan** tab, click the **Make New Plan** button (see Figure 5.12).

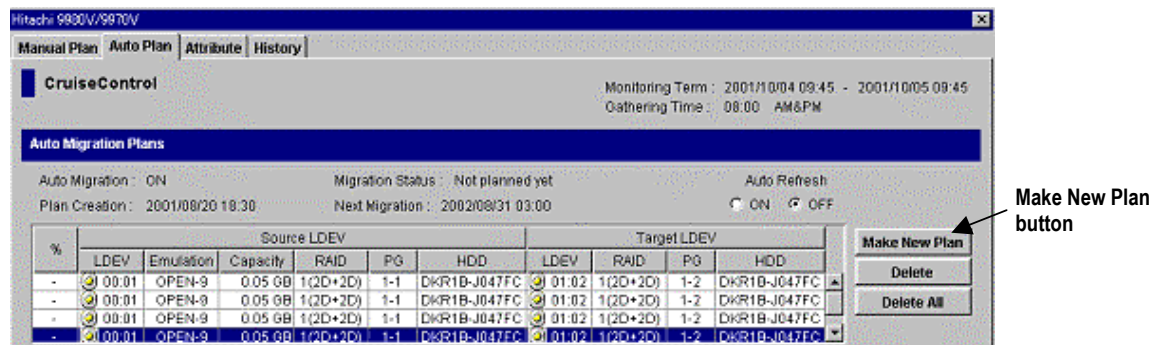


Figure 5.12 Make New Plan Button in Auto Plan Tab

All the existing auto migration plans are deleted and new auto migration plans are created.

3. Click the **Close** button to close the CruiseControl™ panel.

5.3.5 Deleting/Turning off Auto Migration Plans

To delete/turn off auto migration:

1. From the **CruiseControl™ Panel**, click the **Auto Plan** tab (for details, refer to Figure 5.11)
2. In the **Auto Migration Plans** area, click the **Delete All** button to remove all the auto migration plans.
3. In the **Auto Migration Function** area, select the **OFF** radio button.
4. Click the **Set** button to apply the settings to the disk subsystem.

5.4 Viewing the Migration History Log

The **History** tab displays logs of auto migration operations and manual migration operations (see Figure 5.13).

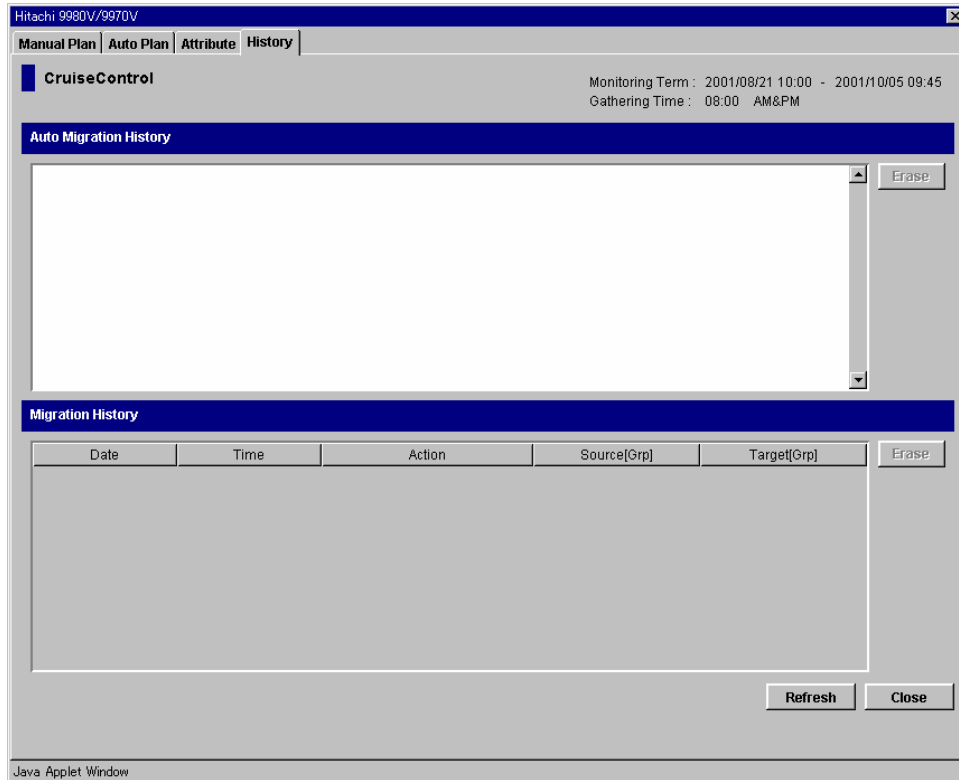


Figure 5.13 The History Tab

To view migration logs:

1. Start CruiseControl™ (refer to section 3.3).
2. From the CruiseControl™ panel, click the **History** tab.
 - To view logs of auto migration operations, look at **Auto Migration History**. Table 5.1 shows an example of messages that might appear in **Auto Migration History**.
 - To view logs of manual migration operations, look at **Migration History**. Table 5.2 shows an example of messages that might appear in **Migration History**.

Note: It is possible that the messages in the **History** tab are not arranged in the order the corresponding events take place.

Table 5.1 Messages in the Auto Migration Logs (example only) (continues on the following pages)

Plan execution was finished normally:	
yyyy/mm/dd hh:min : Migration plan executed (CU:LDEV->CU:LDEV)	
(a)	(b) (c)
(a) Execution end time	
(b) Source volume	
(c) Target volume	
Migration was canceled (over the limit duration):	
Migration canceled (CU:LDEV->CU:LDEV) Start:yyyy/mm/dd hh:min:sec -> End:yyyy/mm/dd hh:min:sec	
(a)	(b) (c) (d)
(a) Source volume	
(b) Target volume	
(c) Copy start time	
(d) Copy end time	
Migration was canceled (invalid parity group):	
Migration canceled (CU:LDEV (X-X)->CU:LDEV (X-X)) yyyy/mm/dd hh:min:sec (Invalid Parity Group)	
(a)	(b) (c) (d) (e)
(a) Source volume	
(b) Parity group of the source volume	
(c) Target volume	
(d) Parity group of the target volume	
(e) Canceled time	
Migration was stopped (other reason):	
Migration stopped (CU:LDEV->CU:LDEV) yyyy/mm/dd hh:min:sec (XXXXXXXXXXXX)	
(a)	(b) (c) (d)
(a) Source volume	
(b) Target volume	
(c) Canceled time	
(d) Reason for cancellation:	
No reserve volume.	No reserved volume is set. Please make another plan.
Emulation type mismatch between reserve volumes.	The reserved volume's emulation type is different.
Utilization check.	The usage rate is over the limit, or there is no monitor data.
Migration failed. Error code: XXXX.	The migration operation failed.
Reserve volume size mismatch.	Reserve volume size is different.
Unsupported emulation type.	The emulation type of reserved volume is not supported.
Utilization check failed.	The check of the usage rate finished abnormally.
Reserve volume check failed.	The check of the reserved volume finished abnormally.
Unknown reserve check error.	A reserve check error occurred.
Migration plan was deleted (because the previous plan had been deleted):	
CruiseControl™ failed to execute a migration plan. So, CruiseControl™ deleted the remaining plans.	
(CU:LDEV->CU:LDEV) yyyy/mm/dd hh:min:sec	
(a)	(b) (c)
(a) Source volume	
(b) Target volume	
(c) Canceled time	
Started making an auto migration plan:	
yyyy/mm/dd hh:min : MakePlan function starts	
(a)	
(a) Start time	

Table 5.1 Messages in the Auto Migration Logs (example only) (continued)

Finished making an auto migration plan: yyyy/mm/dd hh:min : MakePlan function finishes (a) (a) End time	
Output the auto migration plans: X plans are output (a) (a) Number of plans	
Contents of auto migration plan: PlanXXX: Src LDEV CU:LDEV in Grp X-X, Dst LDEV CU:LDEV in Grp X-X (a) (b) (c) (d) (e) (a) Plan number (b) Source volume (c) Parity group of the source volume (d) Target volume (e) Parity group of the target volume	
Failed making an auto migration plan: ① yyyy/mm/dd hh:min : MakePlan is terminated by error: XXXXXXXXXX (a) (b) (a) End time (b) Reason for failure: Cannot make proper migration plan. Not enough CruiseControl™ data in the monitor sampling term. Failed to get XXXXXXXXXX (information or data). Failed to write to XXXXXXXXXX (information or data). Invalid XXXXXXXXXX (information or data). Memory allocation error. ② "C:\dkc200\others\hihsmatm.ini does not exist."	The program could not make a proper migration plan. Check the number of the reserved volumes and their locations. Check the maximum disk usage and change if necessary. The program did not have enough data to make the plan in the target term. Check the monitored data and/or gather more monitor data. Check the monitor sampling term. The program failed to get the information or data to make a plan. In the case of information, review the setting. In the case of data, check the status of gathered data and get them again. The program failed to write the information to make a plan. The required information/data could not be used because the information was invalid. In the case of information, review the setting. In the case of data, check the status of gathered data and get them again. The program failed to allocate the memory to make the plan. CruiseControl™ failed to make plans because the hihsmatm.ini file did not exist. Contact the maintenance operator.

Table 5.1 Messages in the Auto Migration Logs (example only) (continued)

Log entry that the auto migration plan could not be made: Cannot make plan: Class X Grp X-X (a) (b) (a) Class (b) Parity group
Some monitor data samples were invalidated: Grp X-X: X samples are invalidated because of migration. To reduce the influence of migration during the monitor term, CruiseControl™ made a plan without using some data samples.
New volumes have been installed: New entries are added for following LDEVs: CU:LDEV, CU:LDEV, ...
Invalid data: Too many invalid data: invalidated all data The contents of data in the indicated group or volumes is invalid. CruiseControl™ made a plan without those data.
Volume utilization check failed: Utilization check failed Check volume usage failed because the necessary data could not be obtained. Please get the data again.
Volume reserve attribute check failed: Reserve volume check failed Check volume reserve attribute failed because the necessary data could not be obtained. Please get the data again.
Started to execute a plan: Yyyy/mm/dd hh:min : Migration started. (a) (a) Start time
Auto migration was stopped because the SVP (web server) was rebooted: Yyyy/mm/dd hh:min : SVP rebooted. Auto migration stopped. (a) (a) Time when auto migration was stopped
CruiseControl™ failed to obtain statistics and stopped creating plans: Yyyy/mm/dd hh:min : CruiseControl™ failed to obtain statistics and stopped creating plans. (a) (a) Time when plan creation was stopped

Table 5.1 Messages in the Auto Migration Logs (example only) (continued)

CruiseControl™ failed to obtain statistics and stopped executing plans: Yyyy/mm/dd hh:min : CruiseControl™ failed to obtain statistics and stopped auto migration. (a) (a) Time when migration was stopped
CruiseControl™ finished plan execution: Yyyy/mm/dd hh:min : Migration ended. (a) (a) Time when migration ended

Table 5.2 Messages in the Migration Logs (example only)

Message	Meaning
Migration Started	The migration operation started.
Migration Completed	The migration operation completed successfully.
Migration Canceled by User	The migration operation was canceled by the user.
Migration Failed	The migration operation failed.
Migration Canceled by CruiseControl™	The migration operation was canceled by CruiseControl™ (e.g., volume usage rate exceeded specified maximum).

5.5 Exiting CruiseControl™

When finished using CruiseControl™, you must exit the application before returning to Performance Monitor or to the Storage Navigator panel.

To exit CruiseControl™:

1. Click the **Close** button in any of the CruiseControl™ panel.
2. The CruiseControl™ panel closes and the Performance Monitor panel reactivates.

Note: When exiting CruiseControl™ on UNIX® and other non-Windows® workstations, certain conventions must be followed. For details, refer to *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator™ User's Guide* (MK-92RD101).

Chapter 6 Troubleshooting

This chapter gives troubleshooting information on CruiseControl™. For troubleshooting information on Storage Navigator, please refer to the following documents:

- *9900V Remote Console - Storage Navigator User's Guide* (MK-92RD101)
- *9900V Remote Console - Storage Navigator Error Codes* (MK-92RD132)

6.1 CruiseControl™ Error Codes

The CruiseControl™ software displays error messages on the Storage Navigator computer when error conditions occur during CruiseControl™ operations.

If you need to call the Hitachi Data Systems Support Center, make sure to provide as much information about the problem as possible, including error codes. For information on other error codes displayed on the Storage Navigator computer, please refer to *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi Remote Console Error Codes* (MK-92RD132).

6.2 Calling the Hitachi Data Systems Technical Support Center

If you need to call the Hitachi Data Systems Technical Support Center, be sure to provide as much information about the problem as possible. Include the circumstances surrounding the error or failure and the exact content of any error codes and/or messages displayed on the Storage Navigator. The worldwide Hitachi Data Systems Technical Support Centers are:

- Hitachi Data Systems North America/Latin America
San Diego, California, USA
1-800-348-4357
- Hitachi Data Systems Europe
Contact Hitachi Data Systems Local Support
- Hitachi Data Systems Asia Pacific
North Ryde, Australia
011-61-2-9325-3300

Acronyms and Abbreviations

ACP	array control processor (previously called a disk processor)
CC	concurrent copy
class	Classes indicate disk access speed for parity groups. Classes are ranked A, B, C, and so on. The fastest parity groups (or groups of fastest disks) belong to class A.
CruiseControl™ pair	See migration plan.
CU	control unit (logical control unit)
DASD	direct-access storage device
DKA	disk adapter
DKP	disk processor (also known as an array control processor)
DRR	Disaster Recovery and Regeneration Processor
HDD	Hard Disk Drive
LAN	local area network
LDEV	logical device
LU	logical unit
LUN	logical unit number
migration plan	synonymous with CruiseControl™ pair. A pairing of a source volume and a corresponding target volume.
P-VOL	primary volume
RAID	redundant array of independent disks
SMPL	simplex
S-VOL	secondary volume
SVP	service processor
TID	target ID
VOLSER	volume serial number
XRC	extended remote copy

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