HITACHI
Inspire the Next

Hitachi Command Suite

Dynamic Link Manager
(for AIX) User Guide

FastFind Links

Hitachi Data Systems

MK-92DLM111-32

Contents

Preface

This document describes how to use the Hitachi Dynamic Link Manager.

Intended audience

This document is intended for storage administrators who use Hitachi Dynamic Link Manager (HDLM) to operate and manage storage systems, and assumes that readers have:

- Knowledge of AIX and its management functionality
- Knowledge of Storage system management functionality
- Knowledge of Cluster software functionality
- Knowledge of Volume management software functionality

Product version

This document revision applies to HDLM for AIX v8.1.3 or later.

Release notes

Read the release notes before installing and using this product. They may contain requirements or restrictions that are not fully described in this document or updates or corrections to this document.

Document organization

The following table provides an overview of the contents and organization of this document. Click the chapter title in the left column to go to that chapter. The first page of each chapter provides links to the sections in that chapter.

Chapter/Appendix	Description
Chapter 1, Overview of HDLM on page 1-1	Gives an overview of HDLM, and describes its features.
Chapter 2, HDLM Functions on page 2-1	Describes management targets and the system configuration of HDLM, and the basic terms and functions for HDLM.
Chapter 3, Creating an HDLM Environment on page 3-1	Describes the necessary preparations for installing HDLM, and then describes how to install HDLM and set up the various functions.
Chapter 4, HDLM Operation on page 4-1	Describes procedures for operating HDLM by using the HDLM commands, and procedures for manually starting and stopping the HDLM manager. This chapter also describes how to configure the appropriate environment for operating HDLM, such as changing the HDLM management-target devices that connect paths or replacing the hardware that comprises a path.
Chapter 5, Troubleshooting on page 5-1	Explains how to troubleshoot a path error, HDLM failure, or any other problems that you might encounter.

Chapter/Appendix	Description
Chapter 6, Command Reference on page 6-1	Describes all the HDLM commands.
Chapter 7, Utility Reference on page 7-1	Describes the HDLM utilities.
Chapter 8, Messages on page 8-1	Provides information about viewing messages output by HDLM. It also lists and explains the HDLM messages and shows the actions to be taken in response to each message.
Appendix A, Functional Differences Between Versions of HDLM on page A-1	Explains the differences in functionality between HDLM versions.
Appendix B, Differences Between HDLM Version 5.9 or Later and Version 5.8.1 or Earlier on page B-1	Explains the changes from HDLM version 5.8.1 or earlier.

Related documents

The following related Hitachi Command Suite documents are available on the documentation CD:

- *Hitachi Command Suite Global Link Manager User Guide*, MK-92HC214
- *Hitachi Command Suite Global Link Manager Installation and Configuration Guide*, MK-95HC107
- *Hitachi Command Suite Global Link Manager Messages*, MK-95HC108
- *Hitachi Adaptable Modular Storage Series User's Guide*
- *Hitachi Simple Modular Storage Series User's Guide*
- *Hitachi Unified Storage Series User's Guide*
- *Hitachi USP Series User's Guide*
- *Hitachi Workgroup Modular Storage Series User's Guide*
- *Universal Storage Platform V Series User's Guide*
- *Universal Storage Platform VM Series User's Guide*
- *Virtual Storage Platform Series User's Guide*
- *VSP G1000 Series User's Guide*
- *Reference Manual / File Conversion Utility & File Access Library*

Document conventions

This document uses the following typographic conventions:

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

Conventions for storage capacity values

Physical storage capacity values (for example, disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 kilobyte (KB)	1,000 (10^3) bytes
1 megabyte (MB)	1,000 KB or $1{,}000^2$ bytes
1 gigabyte (GB)	1,000 MB or $1{,}000^3$ bytes
1 terabyte (TB)	1,000 GB or $1{,}000^4$ bytes
1 petabyte (PB)	1,000 TB or $1{,}000^5$ bytes
1 exabyte (EB)	1,000 PB or $1{,}000^6$ bytes

Logical storage capacity values (for example, logical device capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes
1 KB	1,024 (2^{10}) bytes

Logical capacity unit	Value
1 MB	1,024 KB or $1,024^2$ bytes
1 GB	1,024 MB or $1,024^3$ bytes
1 TB	1,024 GB or $1,024^4$ bytes
1 PB	1,024 TB or $1,024^5$ bytes
1 EB	1,024 PB or $1,024^6$ bytes

Accessing product documentation

The HDLM user documentation is available on the Hitachi Data Systems Portal: https://portal.hds.com. Check this site for the most current documentation, including important updates that may have been made after the release of the product.

Getting help

Hitachi Data Systems Support Portal is the destination for technical support of your current or previously-sold storage systems, midrange and enterprise servers, and combined solution offerings. The Hitachi Data Systems customer support staff is available 24 hours a day, seven days a week. If you need technical support, log on to the Hitachi Data Systems Support Portal for contact information: https://portal.hds.com.

Hitachi Data Systems Community is a new global online community for HDS customers, partners, independent software vendors, employees, and prospects. It is an open discussion among these groups about the HDS portfolio of products and services. It is the destination to get answers, discover insights, and make connections. The HDS Community complements our existing Support Portal and support services by providing an area where you can get answers to non-critical issues and questions. **Join the conversation today!** Go to community.hds.com, register, and complete your profile.

Comments

Please send us your comments on this document: doc.comments@hds.com. Include the document title and number, including the revision level (for example, -07), and refer to specific sections and paragraphs whenever possible. All comments become the property of Hitachi Data Systems Corporation.

Thank you!

1

Overview of HDLM

HDLM is a software package that manages paths between a host and a storage system. HDLM is designed to distribute loads across multiple paths and will switch a given load to another path if there is a failure in the path that is currently being used, thus improving system reliability.

This chapter gives an overview of HDLM and describes its features.

What is HDLM?

The widespread use of data warehousing and increasing use of multimedia data have increased the need for high-speed processing of large volumes of data on networks. To satisfy this need, networks dedicated to data transfer, such as a SAN, are now being used to provide access to storage systems.

The HDLM software manages access paths to storage systems. HDLM uses MPIO functionality supported by AIX 5L V5.2 or later.

HDLM, as an extended module of MPIO, provides functionality for distributing the load across paths and switching to another path if there is a failure in a path being used, thus improving system availability and reliability.

The figure below shows the connections between hosts and storage systems. A server on which HDLM is installed is called a *host*.

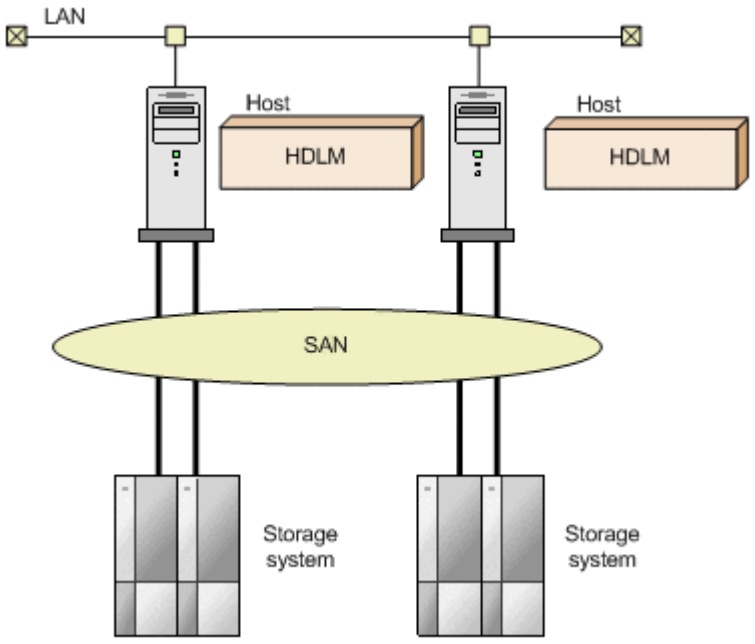


Figure 1-1 Connections between hosts and storage systems

For details about the storage systems supported by HDLM, see Storage Systems Supported by HDLM on page 3-6.

HDLM Features

HDLM features include the following:

The ability to distribute a load across multiple paths. This is also known as *load balancing*.

When a host is connected to a storage system via multiple paths, HDLM can distribute the load across all the paths. This prevents one, loaded down path from affecting the processing speed of the entire system.

For details on load balancing, see *Distributing a Load Using Load Balancing on page 2-8*.

The ability to continue running operations between a host and storage system, even if there is a failure. This is also known as performing a *failover*.

When a host is connected to a storage system via multiple paths, HDLM can automatically switch to another path if there is some sort of failure in the path that is currently being used. This allows operations to continue between a host and a storage system.

For details on performing failovers, see *Performing Failovers and Failbacks Using Path Switching on page 2-14*.

The ability to bring a path that has recovered from an error back online. This is also known as performing a *failback*.

If a path is recovered from an error, HDLM can bring that path back online. This enables the maximum possible number of paths to always be available and online, which in turn enables HDLM to better distribute the load across multiple paths.

Failbacks can be performed manually or automatically. In an automatic failback, HDLM will automatically restore the path to an active state after the user has corrected the problem that exists on the physical path.

For details on performing failbacks, see *Performing Failovers and Failbacks Using Path Switching on page 2-14*.

The ability to automatically check the status of any given path at regular intervals. This is also known as *path health checking*.

HDLM can easily detect errors by checking the statuses of paths at user-defined time intervals. This allows you to check for any existing path errors and to resolve them promptly and efficiently.

For details on setting up and performing path health checking, see *Detecting errors by using path health checking on page 2-30*.

2

HDLM Functions

This chapter describes the various functions that are built into HDLM. Before the function specifications are explained though, this chapter will go into detail about the HDLM management targets, system configuration, and basic terms that are necessary to know to effectively operate HDLM. After that, the rest of the chapter focus on describing all the HDLM functions, including the main ones: load distribution across paths and path switching.

- Integrated HDLM management using Global Link Manager
- Cluster support

Devices Managed by HDLM

Below is a list of devices that can or cannot be managed by HDLM. The devices that can be managed by HDLM are called *HDLM management-target devices*.

HDLM management-target devices:

The following devices are from the storage systems listed in Section *What is HDLM? on page 1-2*:

- SCSI devices
- Boot disks (including boot disks on a client logical partition in a virtual I/O server environment)
- Command devices (such as Hitachi RAID Manager command devices)
- Dump devices
- Swap devices

Non-HDLM management-target devices:

- SCSI devices other than those that are in the storage systems listed in Section *What is HDLM? on page 1-2*
- Built-in disks on a host
- Non-disk devices (tape devices, etc.)

System Configuration

HDLM manages routes between a host and a storage system by using the SCSI driver. The host and storage systems are connected using SAN with fiber cables. The cable port on the host is a *host bus adapter* (HBA). The cable port on the storage system is a *port* (P) on a *channel adapter* (CHA).

A *logical unit* (LU) contained in a storage system is the target of input to, or output from, the host. An area in an LU is called a *Dev*. A route that connects a host and a Dev in an LU is called a *path*.

HDLM manages a path by assigning an ID to it. This ID is called the *AutoPATH_ID*. A path may also be called a *management target*. The ID that AIX assigns to a path is called the *OS management path ID*. The OS management path ID can be displayed by executing the AIX `lspath` command. Also, HDLM can display the OS management path ID that corresponds to the path management `PATH_ID` when you execute the HDLM command's `view` operation with the `-lu` or `-drv` parameter specified. For details about the `view` operation, see *view (Displays Information) on page 6-34*.

The following figure shows the HDLM system configuration.

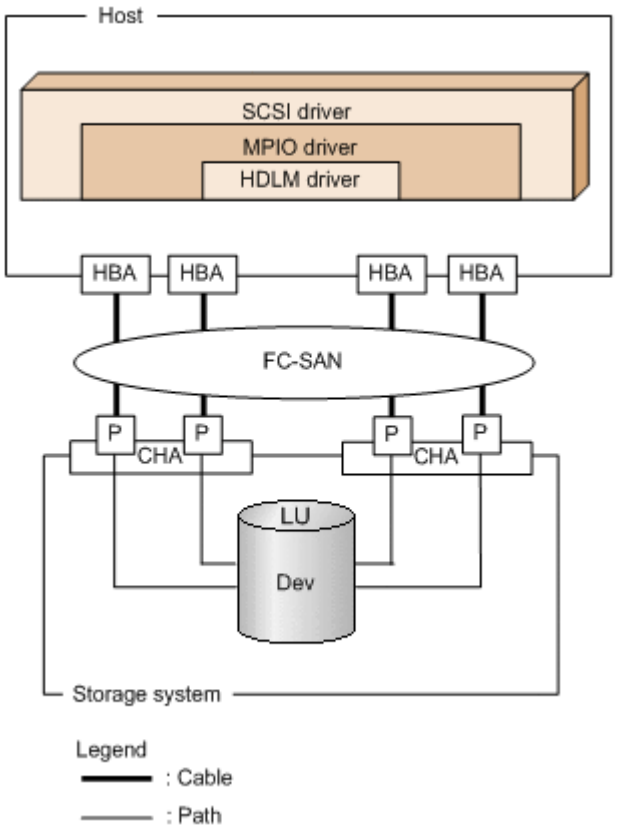


Figure 2-1 HDLM System Configuration

The following table lists and describes the HDLM system components.

Table 2-1 HDLM System Components

Components	Description
HBA	A host bus adapter. This serves as a cable port on the host.
SAN	A dedicated network that is used for data transfer between the host machine and storage systems.
CHA	A channel adapter.
P	A port on a CHA. This serves as a cable port on a storage system.
LU	A logical unit (a logical volume defined on the storage system). This serves as the target of input or output operations from the host.
Dev	An area in an LU.
Path	A route that connects a host and a Dev.

LU Configuration

On a system using HDLM, the logical device file for the HDLM management-target device is used to access the target LU.

An LU recognized by a host after HDLM installation, is called a *host LU* (HLU). The areas in a host LU that correspond to the Dev in a storage system LU are called *host devices* (HDev).

An LU in the storage system corresponds one-to-one with a host LU, a host device, or an hdisk.

The following figure shows the LU configuration recognized by the host, after the installation of HDLM.

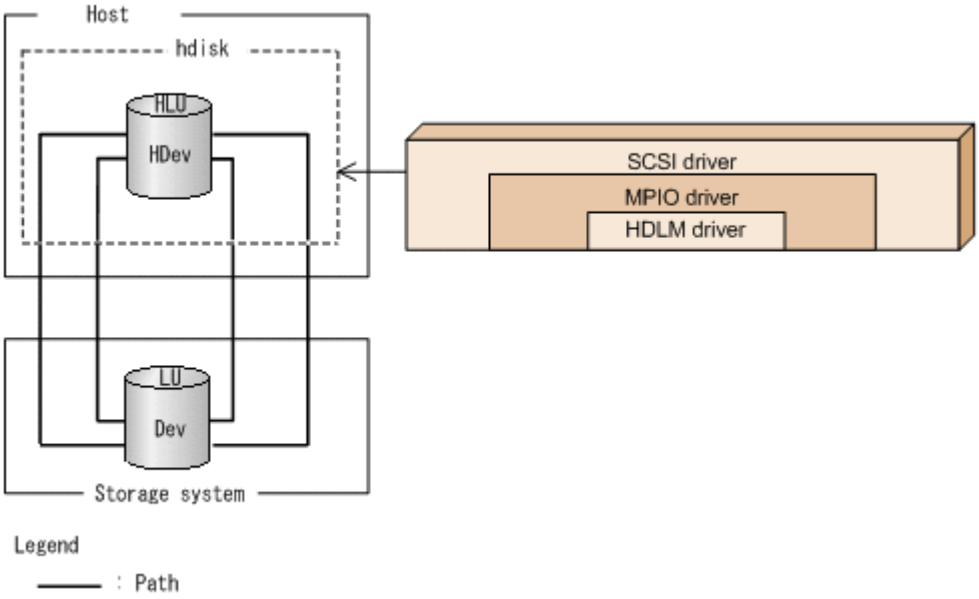


Figure 2-2 LU configuration of the host where HDLM is installed and correspondence with an hdisk

The following table lists and describes the components recognized by the host.

Table 2-2 Components recognized by the host

Components	Description
HLU	An LU that the host recognizes via the HDLM driver. It is called a *host LU*. No matter how many paths exist, one host LU is recognized for one LU in the storage system.
HDev	A Dev in an LU that the host recognizes via the HDLM driver. It is called a *host device*. No matter how many paths exist, one host device is recognized for one Dev in the storage system.

Program Configuration

HDLM is actually a combination of several programs. Because each program corresponds to a specific HDLM operation, it is important to understand the name and purpose of each program, along with how they are all interrelated.

The following figure shows the configuration of the HDLM programs.

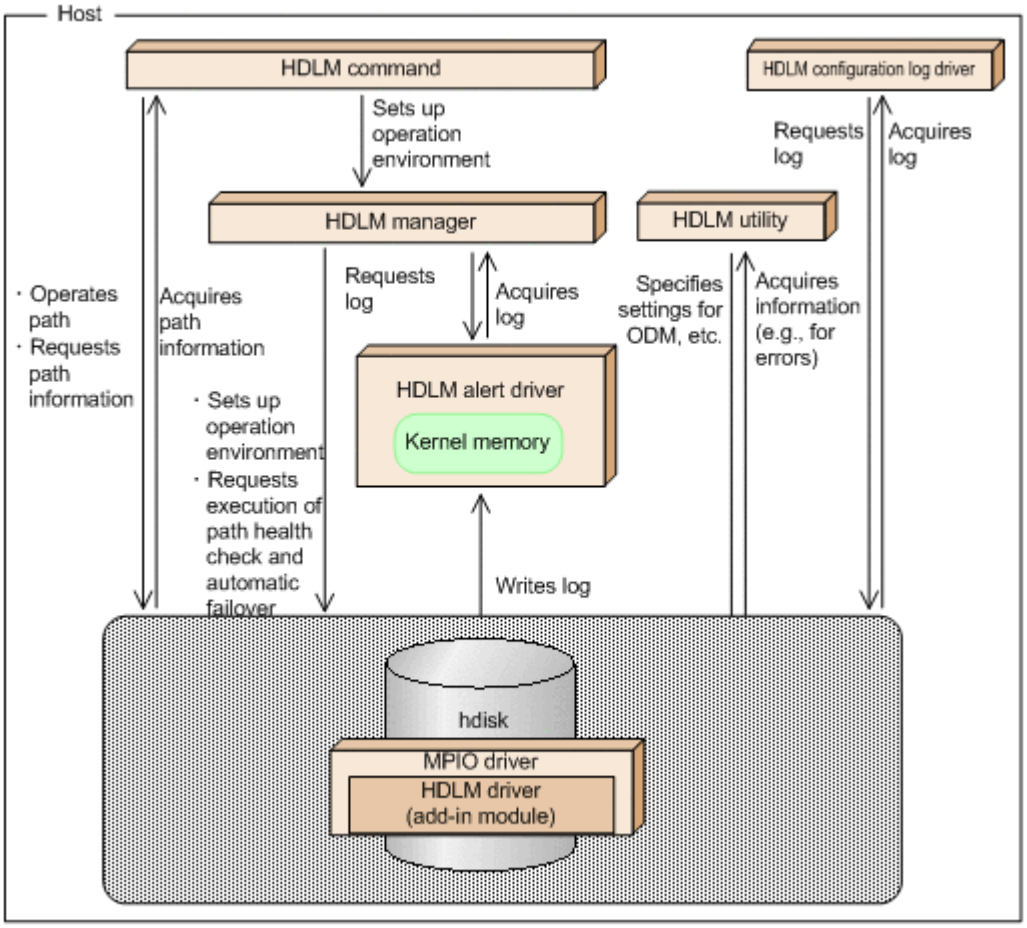


Figure 2-3 Configuration of the HDLM Programs

The following table lists and describes the functions of these programs.

Table 2-3 Functionality of HDLM Programs

Program name	Functions
HDLM command	Provides the `dlnkmgr` command, which enables you to: • Manage paths • Display error information • Set up the HDLM operating environment
HDLM utility	Provides the HDLM utility, which enables you to: • Collect error information • Change the default value of the hdisk attribute

Program name	Functions
	• Migration of HDLM • Clear HDLM persistent reservation • Exclude the hdisk recognized as a boot disk from being an HDLM management target • Set ODM to define HDLM operations • Delete hdisks according to the parameter settings • Install HDLM • The unattended installation of HDLM • Install Hitachi Command Suite Common Agent Component • Collect information about errors that occur during HDLM installation • Perform maintenance when HDLM-managed devices are restored
HDLM manager	Provides the HDLM manager, which enables you to: • Configures the HDLM operating environment • Request path health checks and automatic failbacks to be performed • Collects error log data
HDLM alert driver	Reports the log information collected by the HDLM driver to the HDLM manager. The driver name is `dlmadrv`.
HDLM driver	Controls HDLM functionality, manages paths, and detects errors. This is an add-in module of the AIX MPIO driver. The HDLM driver consists of the following: • Core logic component Controls the basic functionality of HDLM. • Filter component Sends and receives I/O data.
HDLM configuration log driver	Acquires operation logs of the configuration processing for the HDLM driver.

Position of the HDLM Driver and hdisk

The HDLM driver is positioned above the SCSI driver and is an add-in module of MPIO driver located in the AIX standard hdisk. Each application on the host uses the hdisk (logical device file) created by HDLM, to access LUs in the storage system. The following figure shows the position of the HDLM driver and hdisk. The logical device file name can be changed by using the `rendev` command. In this manual, the file name of a default logical device of the OS (hdisk*n*) or an hdisk name is used as the logical device file name.

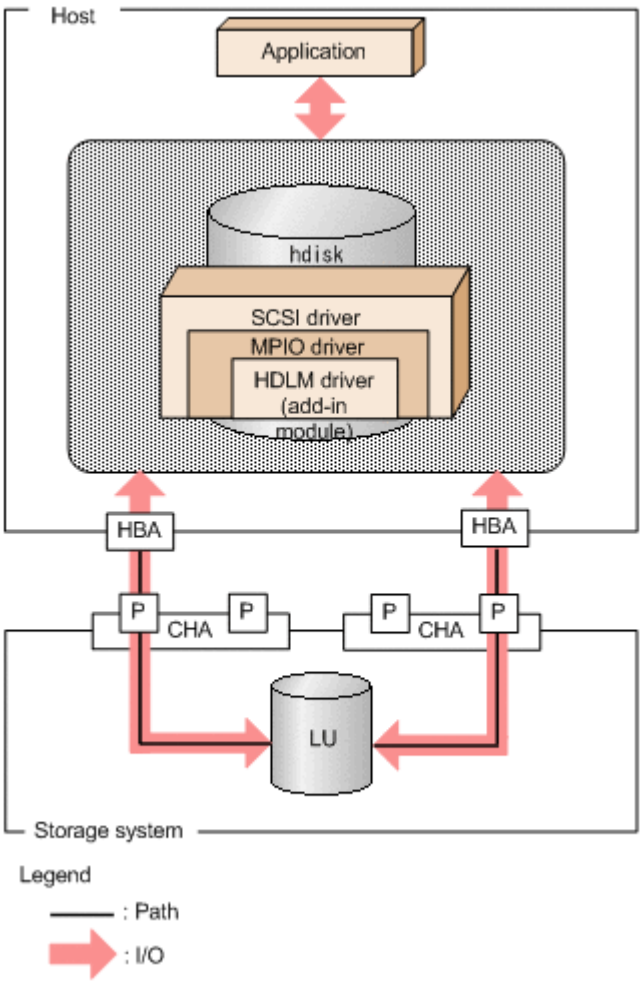


Figure 2-4 Position of the HDLM Driver and hdisk

Distributing a Load Using Load Balancing

When the system contains multiple paths to a single LU, HDLM can distribute the load across the paths by using multiple paths to transfer the I/O data. This function is called *load balancing,* and it prevents a single, heavily loaded path from affecting the performance of the entire system.

Figure 2-5 Flow of I/O Data When the Load Balancing Function Is Not Used on page 2-9 shows the flow of I/O data when the load balancing function is not used. *Figure 2-6 Flow of I/O Data When the Load Balancing Function Is Used on page 2-10* shows the flow of I/O data when the load balancing function is used. Both figures show examples of I/O operations being issued for the same LU by multiple applications.

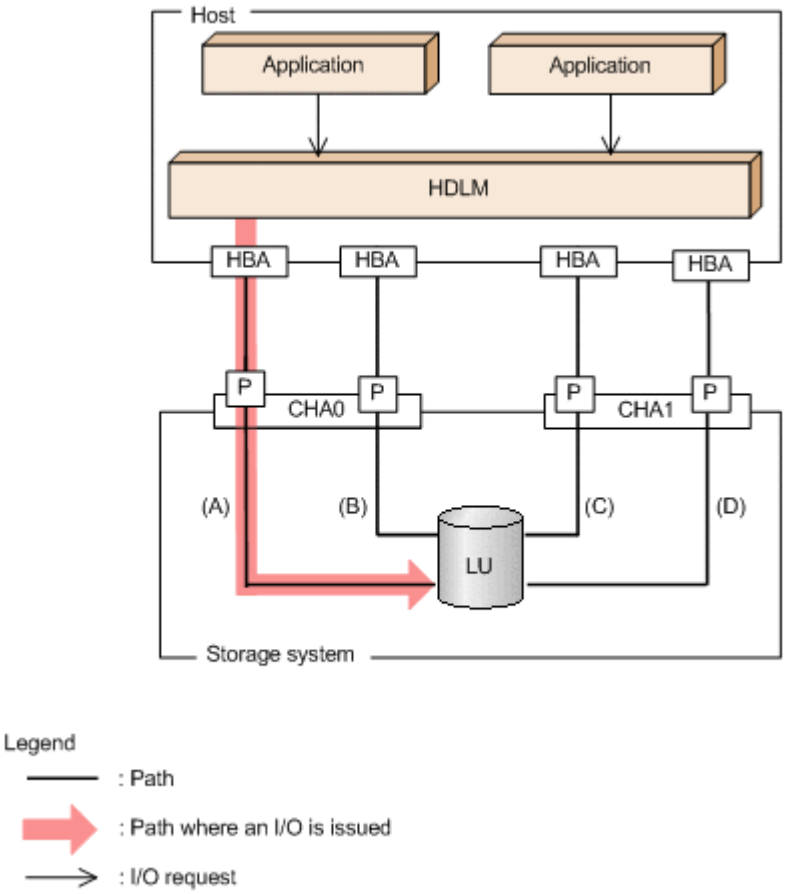


Figure 2-5 Flow of I/O Data When the Load Balancing Function Is Not Used

When the load balancing function is not being used, I/O operations converge on one physical path (A). The load on the physical path (A) will cause a bottleneck, which might cause deterioration of the whole system's performance.

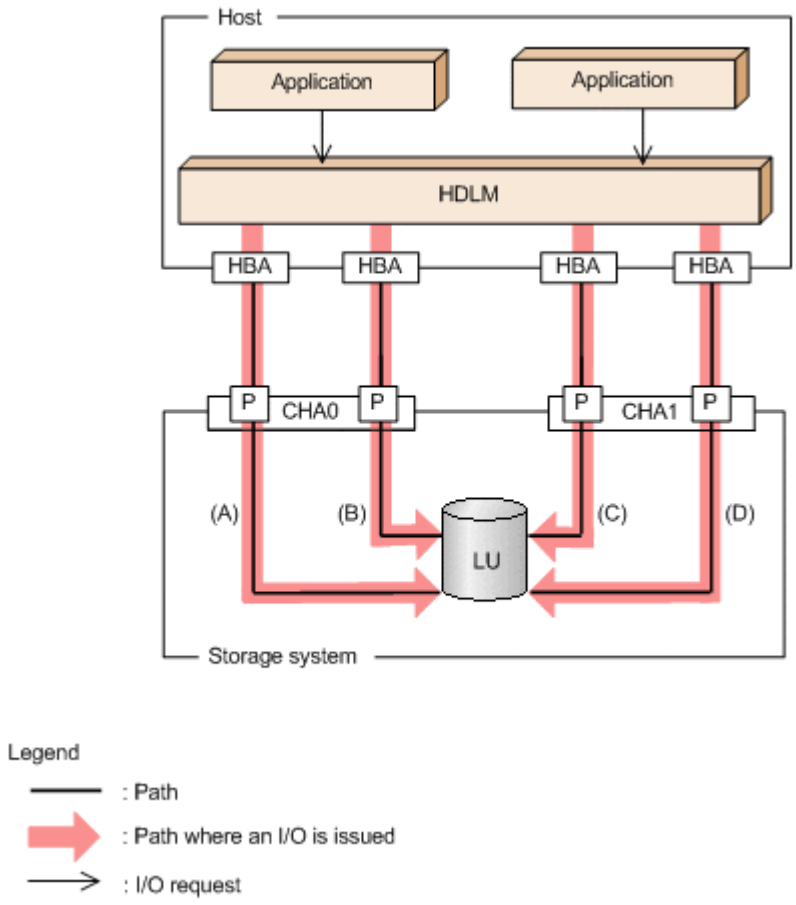


Figure 2-6 Flow of I/O Data When the Load Balancing Function Is Used

When the load balancing function is being used, I/O operations are distributed via physical paths (A), (B), (C), and (D). This prevents deterioration of the whole system's performance from a bottleneck on one path.

Paths to which load balancing is applied

This subsection describes, for each type of storage system, the paths to which the load balancing function is applied.

When Using the Hitachi AMS/WMS Series

When HDLM performs load balancing, it differentiates between load balancing among owner paths and among non-owner paths. An *owner path* is a path that passes through the *owner controller* for a target LU. When you set up an LU, you have to specify which CHA to be used as the owner controller for the LU. Because different LUs might have different owner controllers, different LUs might also have different owner paths. A *non-owner path* is a path that passes through a CHA other than the owner controller. This type of CHA is also known as a *non-owner controller*. An owner path is usually used in preference to a non-owner path. In order to prevent system performance from slowing down, HDLM does not perform load balancing between owner

paths and non-owner paths. If failures occur across some of the owner paths, load balancing will be performed among the remaining, usable owner paths. It is only when absolutely no owner paths are available, that load balancing is then performed among the non-owner paths.

For the example in *Figure 2-7 Overview of load balancing on page 2-11*, suppose that in the owner controller of LU0 is CHA0. When the LU is accessed, the load is balanced between the two paths A and B, which are both owner paths. When one of the paths (A) cannot be used, then the LU is accessed from the only other owner path (B). When the physical paths (A) and (B) cannot be used, the load is balanced between the physical paths (C) and (D) (that is, between non-owner paths).

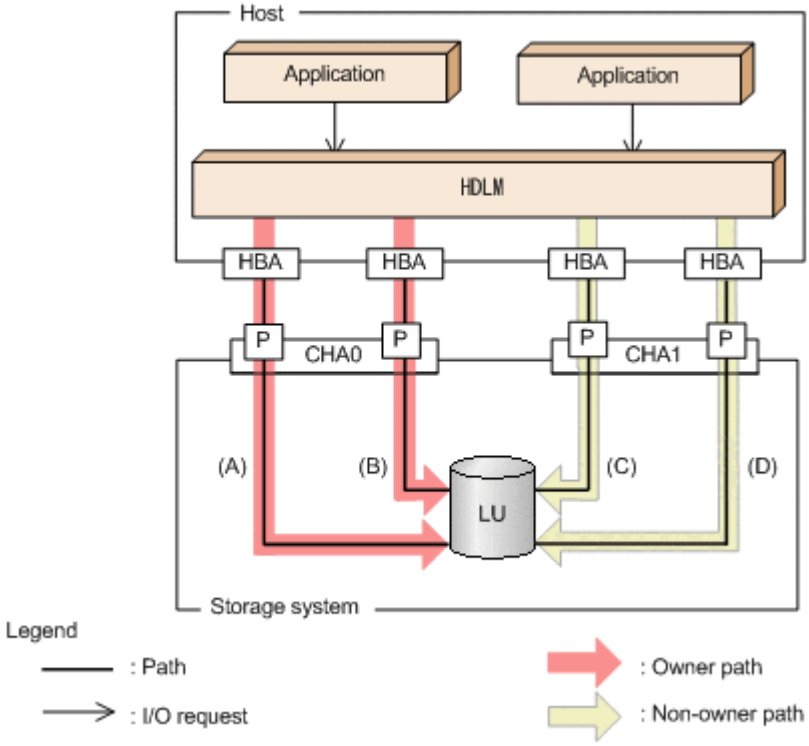


Figure 2-7 Overview of load balancing

When Using Other Than the Hitachi AMS/WMS Series

All online paths are owner paths. Therefore, for the example in *Figure 2-6 Flow of I/O Data When the Load Balancing Function Is Used on page 2-10*, the load is balanced among the four paths A, B, C, and D. If one of the paths were to become unusable, the load would be balanced among the three, remaining paths.

Notes:

Load balancing is performed for the following storage systems:

- Hitachi USP series
- Universal Storage Platform V/VM series
- Virtual Storage Platform series

- VSP G1000 series
- VSP G200, G400, G600
- Hitachi AMS2000 series#
- Hitachi SMS series#
- HUS100 series#
- HUS VM

#: This storage system applies when the dynamic I/O path control function is disabled.

When Using a Global-Active Device for the VSP G1000 Series

The default settings of the storage system specify that all paths are owner paths. Load balancing is performed on all paths that access the primary and secondary volumes of global-active device pairs.

However, if the primary site and the secondary site are far apart, I/O performance might be low for I/O issued to a site other than the location of the host. In such a case, specify the non-preferred path option on the storage system at the site where the host is not located. A path for which the non-preferred path option is specified is a non-owner path and cannot be used until all the owner paths become unavailable.

If you specify the non-preferred path option on the storage system when the HDLM device is already configured, execute the `refresh` operation of the HDLM command, or restart the host.

Load Balancing Algorithms

HDLM has the following six load balancing algorithms:

- The Round Robin algorithm
- The Extended Round Robin algorithm
- The Least I/Os algorithm
- The Extended Least I/Os algorithm
- The Least Blocks algorithm
- The Extended Least Blocks algorithm

The above algorithms are divided into two categories, which differ in their processing method. The following describes both of these processing methods:

The Round Robin, Least I/Os, and Least Blocks algorithms

These algorithms select which path to use every time a certain number of I/Os are issued. The path that is used is determined by the following:

- Round Robin

  The paths are simply selected in order from among all the connected paths.
- Least I/Os

The path that has the least number of I/Os being processed is selected from among all the connected paths.

- Least Blocks

  The path that has the least number of I/O blocks being processed is selected from among all the connected paths.

The Extended Round Robin, Extended Least I/Os, and Extended Least Blocks algorithms

These algorithms determine which path to allocate based on whether the data of the I/O to be issued is sequential with the data of the I/O that was issued immediately beforehand.

If the data is sequential, the path used will be the one to which the data of the I/O that was issued immediately beforehand was distributed. However, if a specified number of I/Os has been issued to a path, processing switches to the next path.

If the data is not sequential, these algorithms select the path to be used each time an I/O request is issued.

- Extended Round Robin

  The paths are simply is selected in order from among all the connected paths.

- Extended Least I/Os

  The path that has the least number of I/Os being processed is selected from among all the connected paths.

- Extended Least Blocks

  The path that has the least number of I/O blocks being processed is selected from among all the connected paths.

The following table lists and describes the features of the load balancing algorithms.

Table 2-4 Features of the Load Balancing Algorithms

Algorithm type	Algorithm features
• Round Robin# • Least I/Os • Least Blocks	These types of algorithms are most effective when a lot of discontinuous, non-sequential I/Os are issued.
• Extended Round Robin • Extended Least I/Os • Extended Least Blocks	If there is a read request for I/O data that is sequential with the data of the I/O that was issued immediately beforehand, an improvement in reading speed can be expected due to the storage system cache functionality. These types of algorithms are most effective when many continuous I/Os are issued (the I/O data is sequential).

#

Some I/O operations managed by HDLM can be distributed across all paths, and some cannot. Thus, you should be aware that even if you specify the Round Robin algorithm, I/O operations cannot always be allocated uniformly across all paths.

By default, the Extended Least I/Os algorithm is set when HDLM is first installed. When an upgrade installation of HDLM is performed, the existing setting is inherited.

Select the load balancing algorithm most suitable for the data access patterns in your system environment. If there are no recognizable data access patterns, we recommend applying the Extended Least I/Os algorithm.

You can specify the load balancing function by the `dlnkmgr` command's `set` operation. For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.

Performing Failovers and Failbacks Using Path Switching

When the system contains multiple paths to an LU and an error occurs on the path that is currently being used, HDLM can switch to another functional path, so that the system can continue operating. This is called a *failover*.

If a path in which an error has occurred recovers from the error, HDLM can then switch back to that path. This is called a *failback*.

Two types of failovers and failbacks are available:

- Automatic failovers and failbacks
- Manual failovers and failbacks

Failovers and failbacks switch which path is being used and also change the statuses of the paths. A path status is either *online* or *offline*. An online status means that the path can receive I/Os. On the other hand, an offline status means that the path cannot receive I/Os. A path will go into the offline status for the following reasons:

- An error occurred on the path.
- A user executed the HDLM command's `offline` operation.
  For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.

For details on path statuses and the transitions of those statuses, see *Path status transition on page 2-20*.

Automatic path switching

The following describes the automatic failover and failback functions, which automatically switch a path.

Automatic failovers

If you detect an error on the path that is currently being used, you can continue to use the system by having the status of that path automatically changed to offline, and then automatically have the system switch over to another online path. This functionality is called *automatic failover*. Automatic failovers can be used for the following levels of errors:

Critical

A fatal error that might stop the system.

Error

A high-risk error, which can be avoided by performing a failover or some other countermeasure.

For details on error levels, see *Filtering of error information on page 2-34*.

When the Hitachi AMS/WMS series is being used, HDLM will select the path to be used next from among the various paths that access the same LU, starting with owner paths, and then non-owner paths. For example, in *Figure 2-8 Path switching on page 2-16*, the owner controller of an LU is CHA0, and access to the LU is made via only one path (A). After that access path (A) is placed offline, the first choice for the switching destination is the other path connected to CHA0 (B). If an error also occurs on that path (B), then the next possibility for a path comes from one of the two paths (C or D) connected to CHA1.

When the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series#, Hitachi SMS series#, HUS100 series#, or HUS VM is being used, all the paths are owner paths. This means all the paths accessing the same LU can be possible switching destinations. For example, in *Figure 2-8 Path switching on page 2-16*, the LU is accessed using only the path (A). After the access path is placed offline, the switching destination is one of the paths (B), (C), and (D).

#

This storage system applies when the dynamic I/O path control function is disabled.

For details on the priority for determining which of the paths to the same LU is used as the switching destination, see *Priority of Switching Destination Paths on page 2-16*.

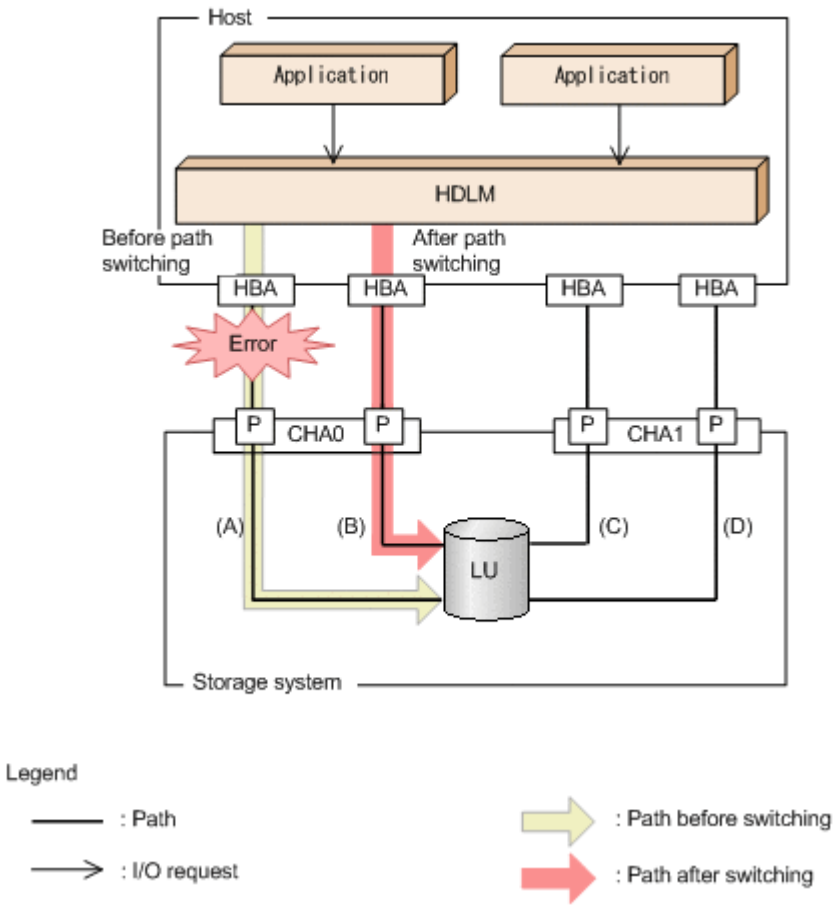


Figure 2-8 Path switching

Priority of Switching Destination Paths

Priority of paths varies depending on the architecture of the host machine.

If the architecture of the host is CHRP, the switching destination path is selected based on four keys. First, the path with the smallest path priority number (first key) is selected. If there are multiple paths with the smallest path priority number, the order for selecting a unique path is smallest slot number (second key), smallest CHA port number (third key), and smallest `PATH_ID` value (fourth key).

If the architecture of the host is not CHRP, the switching destination path is selected based on three keys. First, the path with the smallest path priority number (first key) is selected. If there are multiple paths with the smallest path priority number, the order for selecting a unique path is smallest CHA port number (second key) and then smallest `PATH_ID` value (third key).

This sub-section explains these keys.

Path priority number

This number indicates the priority level set for each path. Priority levels can be set from `1` to `255`. The lower the number, the higher the priority. The default is `1`. The priority level is set by using OS commands. The

following shows an example of the procedure for setting the path priority number.

a. Execute a command that displays the path information for the LU:

```
# lspath -l hdisk4 -F"name parent path_id connection
path_status status"
hdisk4 fscsi0 0 50060e8005271720,31000000000000 Available
Enabled
hdisk4 fscsi1 1 50060e8005271730,31000000000000 Available
Enabled
hdisk4 fscsi2 2 50060e8005271740,31000000000000 Available
Enabled
hdisk4 fscsi3 3 50060e8005271750,31000000000000 Available
Enabled
```

b. Execute a command that displays the information for the path whose path priority number you want to set:

```
# lspath -l hdisk4 -p fscsi0 -w
50060e8005271720,31000000000000 -E
scsi_id 0x651400 SCSI ID False
node_name 0x50060e8005271720 FC Node Name False
state Enabled N/A True
priority 1 N/A True
```

c. Execute a command that changes the path priority number:

```
# chpath -l hdisk4 -p fscsi0 -w
50060e8005271720,31000000000000 -a priority=5
path Changed
```

d. Execute a command that displays the information for the path for which a new path priority number has been set:

```
# lspath -l hdisk4 -p fscsi0 -w
50060e8005271720,31000000000000 -E
scsi_id 0x651400 SCSI ID False
node_name 0x50060e8005271720 FC Node Name False
state Enabled N/A True
priority 5 N/A True
```

Slot number

This number indicates the position of the slot where an HBA is mounted.

You can find the order of the slot numbers by comparing their physical location code.

The following describes how to obtain the physical location code.

a. Execute the following command to find `hdisk`, based on AutoPATH_ID.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -drv
PathID HDevName OSPathID LDEV
000000 hdisk7   00000    HUS_VM.210945.0961
000001 hdisk7   00001    HUS_VM.210945.0961
000002 hdisk6   00000    HUS_VM.210945.0960
```

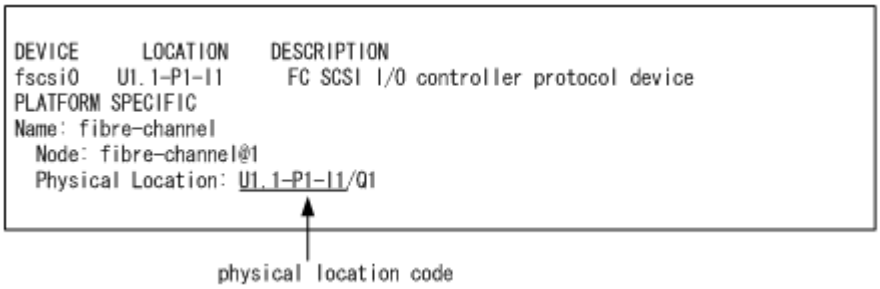
```
000003 hdisk6   00001    HUS_VM.210945.0960
000004 hdisk8   00000    HUS_VM.210945.0962
000005 hdisk8   00001    HUS_VM.210945.0962
000006 hdisk10  00000    VSP_G1000.10051.001837
000007 hdisk10  00001    VSP_G1000.10051.001837
000008 hdisk9   00000    VSP_G1000.10051.001836
000009 hdisk9   00001    VSP_G1000.10051.001836
000010 hdisk11  00000    VSP_G1000.10051.001838
000011 hdisk11  00001    VSP_G1000.10051.001838
```

b. Execute the following command to find the parent device of `hdisk` (the HBA device instance).

```
# lsdev -C -l hdisk4 -F 'parent'
fscsi0
```

c. Execute the following command to find the physical location code, based on the HBA device instance.

```
# lscfg -vp -l fscsi0
```



The obtained physical location code is in the U*aa*.*bb*-P*cc*-I*dd* format. The first letters, U*aa*.*bb*, depend on the model of the host. HDLM selects the path with the lowest value for *aabbccdd*. When the physical location code is in another format, the priority of paths is not decided. Note that the top priority path does not change because of, for example, restarting a computer in the same environment.

Note

Depending on the HBA, you need to repeat steps b and c.

For details on the position of slots, see the manual of the host.

CHA port number

The port number of the CHA.

You can check this number by using the `dlnkmgr` command's `view` operation. For details on the `view` operation, see *view (Displays Information) on page 6-34*.

AutoPATH_ID

The ID assigned to a path. This ID is re-assigned each time the host or the HDLM Manager is started.

You can check this ID by using the `dlnkmgr` command's `view` operation. For details on the `view` operation, see *view (Displays Information) on page 6-34*.

Automatic failbacks

When a path recovers from an error, HDLM can automatically place the recovered path back online. This function is called the *automatic failback* function.

In order to use the automatic failback function, HDLM must already be monitoring error recovery on a regular basis.

When using the Hitachi AMS/WMS series HDLM will select the next path to be used first from among the online owner paths, and then from the online non-owner paths. As a result, if an owner path recovers from an error, and then HDLM automatically places the recovered path online while a non-owner path is in use, the path will be automatically switched over from the non-owner path to the owner path that just recovered from the error.

When the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series[#1], Hitachi SMS series[#1], HUS100 series[#1], or HUS VM is being used, all the paths are owner paths. Therefore, if an owner path recovers from an error and HDLM automatically places the recovered path online, the path to use is not switched.

When intermittent errors[#2] occur on paths and you are using the automatic failback function, the path status might frequently alternate between the online and offline statuses. In such a case, because the performance of I/Os will most likely decrease, if there are particular paths in which intermittent errors might be occurring, we recommend that you set up intermittent error monitoring so you can detect these paths, and then remove them from those subject to automatic failbacks.

You can specify the automatic failback function or intermittent error by the `dlnkmgr` command's `set` operation. For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.

#1

This storage system applies when the dynamic I/O path control function is disabled.

#2

An *intermittent error* means an error that occurs irregularly because of some reason such as a loose cable connection.

Manual path switching

You can switch the status of a path by manually placing the path online or offline. Manually switching a path is useful, for example, when system maintenance needs to be done.

You can manually place a path online or offline by doing the following:

- Execute the `dlnkmgr` command's `online` or `offline` operation.

For details on the `online` operation, see *online (Places Paths Online) on page 6-12*. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.

However, if there is only one online path for a particular LU, that path cannot be manually switched offline. Also, a path with an error that has not been recovered from yet cannot be switched online.

HDLM uses the same algorithms to select the path that will be used next, regardless of whether automatic or manual path switching is used.

When using the Hitachi AMS/WMS series HDLM selects the switching destination path from owner paths and then from non-owner paths. When the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series#, Hitachi SMS series#, HUS100 series#, or HUS VM is being used, all paths that access the same LU are candidates for the switching destination path. All other paths that run through the same physical path are switched.

Executing the `online` operation places the offline path online. For details on the `online` operation, see *online (Places Paths Online) on page 6-12*. After the path status is changed to online (by executing the `online` operation), HDLM selects the path to use in the same way as for automatic path switching. When using the Hitachi AMS/WMS series HDLM selects the path to use from online owner paths, and then from online non-owner paths. When the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series#, Hitachi SMS series#, HUS100 series#, or HUS VM is being used, since all the paths are owner paths, the path to use is not switched even if you change the path status to online by using the `online` operation.

#

This storage system applies when the dynamic I/O path control function is disabled.

Path status transition

Each of the online and offline statuses described in *Performing Failovers and Failbacks Using Path Switching on page 2-14* is further subdivided into several statuses. The path statuses (the online path statuses and offline path statuses) are explained below.

The online path status

The online path statuses are as follows:

- `Online`

  I/Os can be issued normally.

- `Online(E)`

  An error has occurred on the path, but none of the other paths that access the same LU are in the `Online` status.

If none of the paths accessing a particular LU are in the `Online` status, one of the paths is changed to the `Online(E)` status. This ensures that the LU can be accessed through at least one path.

The (E) means *error*, which indicates that an error has occurred on the path from some previous operation.

The offline path status

The offline path statuses are as follows:

- `Offline(C)`

  The status in which I/O cannot be issued because the `offline` operation was executed. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.

  The (C) indicates the command attribute, which indicates that the path was placed offline by using the command.

- `Offline(E)`

  The status indicating that an I/O could not be issued on a given path, because an error occurred on the path.

  The (E) means *error*.

- `Online(S)`#

  The paths to the primary volume (P-VOL) in the HAM environment have recovered from an error, but I/O to the P-VOL is suppressed.

- `Online(D)`#

  The paths to the primary volume (P-VOL) in an HAM environment have recovered from an error, but I/O to the P-VOL is suppressed. If an error occurs in all the paths to a secondary volume (S-VOL), the status of the P-VOL paths will be automatically changed to the `Online` status. To change the status to the `Online(D)` status, specify the `-dfha` parameter for the HDLM command's `online` operation.

#

The status changes to this status when using HAM (High Availability Manager).

Correspondence Between Path Statuses Displayed by the OS and by HDLM

The following table lists the correspondence between the path statuses displayed when commands such as the AIX `lspath` command are executed and the path statuses displayed when the HDLM command's `view` operation is executed.

Table 2-5 Correspondence Between Path Statuses Displayed by the OS and by HDLM

Path status displayed by an AIX command	Path status displayed by the HDLM
Enabled	Either Online, Online(E), Online(S), or Online(D)
Disabled	Offline(C)
Failed	Offline(E)

Status transitions of a path

The following figure shows the status transitions of a path.

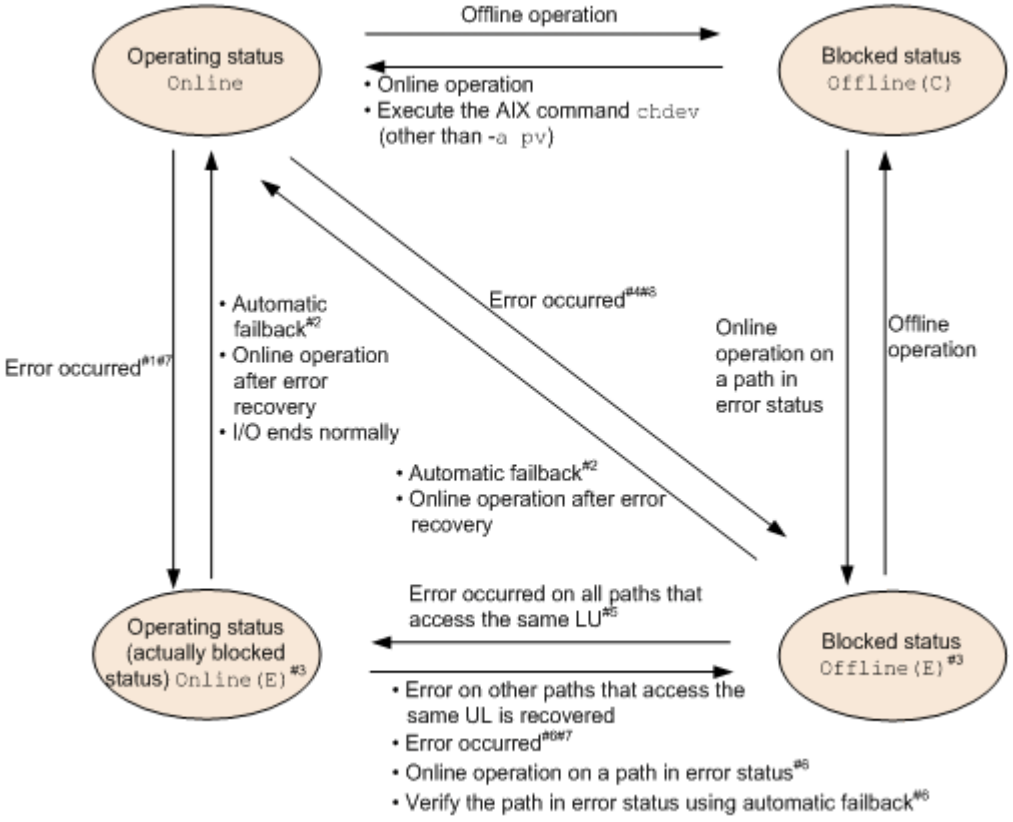


Figure 2-9 Path status transitions

Legend:

Online operation: Online operation performed by executing the `dlnkmgr` command's `online` operation.

Offline operation: Offline operation performed by executing the `dlnkmgr` command's `offline` operation.

#1

When no `Online` or `Offline(E)` paths exist among the paths that access the same LU.

#2

When the following conditions are satisfied, a path that has been determined to have an intermittent error also becomes subject to automatic failback:

- All the paths connected to an LU are `Online(E)`, `Offline(E)`, or `Offline(C)`.
- All the paths connected to an LU have been determined to have an intermittent error.
- The processing of continuous I/O operations issued to an LU is successful.

#3

This path is deleted when the AIX `chdev` command is executed on an hdisk where an `Online` or `Offline(E)` path exists. To restore the deleted path, remove the cause of the error and then execute the AIX `mkdev -l` *hdisk-name* or `cfgmgr` command.

#4

When an `Online` or `Offline(E)` path exists among the paths that access the same LU.

#5

One of the `Offline(E)` paths is changed to the `Online(E)` path.

#6

When an `Offline(E)` path exists among the paths that access the same LU.

#7

The path status changes when I/O is issued to a path where a failure has occurred.

#8

The path status changes when I/O is issued to a path where a failure has occurred or when HDLM detects a path failure during path health checking. For details on path health checking, see Detecting errors by using path health checking on page 2-30.

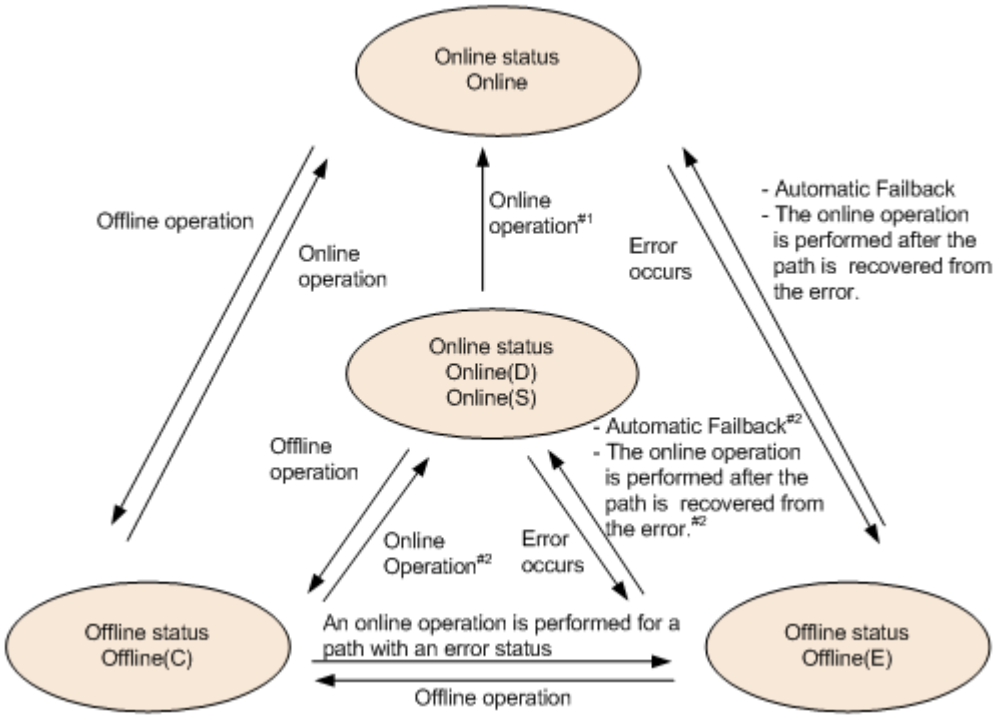


Figure 2-10 Path Status Transitions (P-VOL in HAM environment)

Legend:

Online operation: Online operation performed by executing the `dlnkmgr` command's `online` operation.

Offline operation: Offline operation performed by executing the `dlnkmgr` command's `offline` operation.

#1

Also when an error occurs in all the paths to an S-VOL in the `Online(D)` status.

#2

When I/O operations are processed on an S-VOL.

The last available online path for each LU cannot be placed offline by executing the `offline` operation. This ensures access to the LU. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.

If an error occurs in the last available online path for each LU, the status of the path is changed to `Online(E)`.

If you are using automatic failback, when the path recovers from an error, HDLM automatically places the path online.

When you are using intermittent error monitoring, the path in which the intermittent error occurred is not automatically placed online when the path recovers from the error. In such a case, place the path online manually.

Note

If there is a path failure immediately after a path is taken offline by using either the an HDLM command, the status might change from `Offline(C)` to `Offline(E)`. If an offline operation was just performed, wait about 2 minutes, check the path status by using an HDLM command, and then make sure that the status has changed to `Offline(C)`. If it is still `Offline(E)`, retry the offline operation.

Monitoring intermittent errors (functionality when automatic failback is used)

An intermittent error refers to an error that occurs irregularly because of something like a loose cable. In such a case, I/O performance might decrease while an automatic failback is being performed to repair an intermittent error. This is because the automatic failback operation is being performed repeatedly (because the intermittent error keeps occurring). To prevent this from happening, HDLM can automatically remove the path where an intermittent error is occurring from the paths that are subject to automatic failbacks. This process is called *intermittent error monitoring*.

We recommend that you use intermittent error monitoring along with the automatic failback function.

A path in which an error occurs a specified number of times within a specified interval is determined to have an intermittent error. The path where an intermittent error occurs has an error status until the user chooses to place the path back online. Failbacks are not performed for such paths. This status is referred to as the *not subject to auto failback* status.

Checking intermittent errors

You can check the paths in which intermittent errors have occurred by viewing the execution results of the HDLM command's `view` operation.

For details on the `view` operation, see *view (Displays Information) on page 6-34*.

Setting up intermittent error monitoring

When you enable the intermittent error monitoring function, specify the following monitoring conditions: the error monitoring interval, and the number of times that the error needs to occur. If an error occurs on a particular path the specified number of times within the specified error-monitoring interval, then an intermittent error will occur on the path. For example, if you specify 30 for the error monitoring interval and 3 for the number of times that the error needs to occur, the path is determined to have an intermittent error if an error occurs 3 or more times in 30 minutes.

You can set up intermittent error monitoring by executing the `dlnkmgr` command's `set` operation.

Intermittent error monitoring can be used only when automatic failback has already been enabled. The values that can be specified for intermittent error monitoring depend on the values specified for automatic failbacks. For details on how to specify the settings, see *set (Sets Up the Operating Environment) on page 6-18*.

Intermittent Error Monitoring Actions

Intermittent error monitoring is performed on each path, and it automatically starts as soon as a path is recovered from an error by using the automatic failback function.

This subsection describes the following intermittent error monitoring actions:

- When an intermittent error occurs
- When an intermittent error does not occur
- When the conditions for an intermittent error to occur are changed during error monitoring
- When failures occur on all paths while monitoring for intermittent errors

When an Intermittent Error Occurs

When an error occurs on a path a specified number of times within a specified interval, the error monitoring will finish and the path is determined to have an intermittent error, upon which the path is removed from those subject to automatic failbacks. The path that is removed will remain in the error status until the `online` operation is performed. However, if the path satisfies certain conditions (see *Figure 2-9 Path status transitions on page 2-22*), it will be subject to automatic failbacks and change to the `Online` status.

The figure below shows the action taken when an intermittent error is assumed to have occurred on the path. For this example, the path is determined to have an intermittent error when the error occurs 3 or more times within 30 minutes. The events that occur are described by using the time arrows.

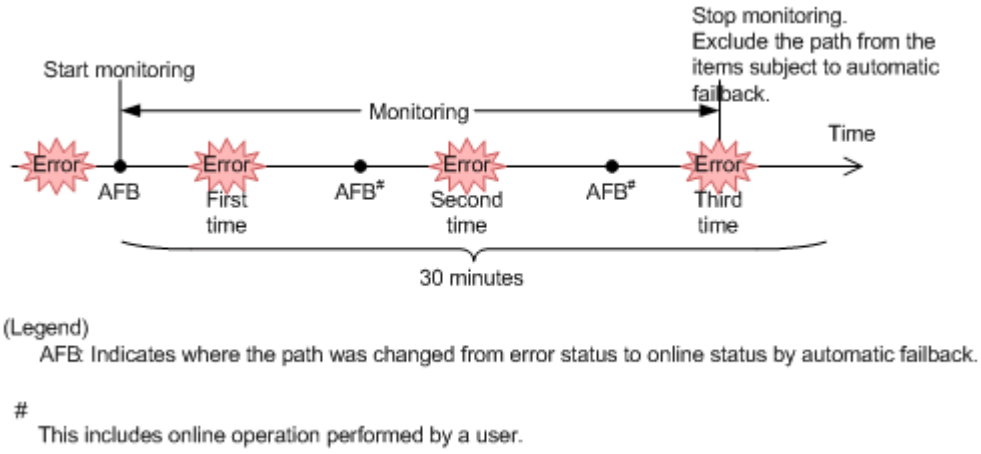


Figure 2-11 Action What Will Happen When an Intermittent Error Occurs on a Path

When an Intermittent Error Does Not Occur

If an error does not occur on a path a specified number of times within a specified interval, an intermittent error will not occur. In such a case, the error monitoring will finish when the specified error-monitoring interval finishes, upon which the number of errors is reset to 0. If an error occurs on the path again at a later time, error monitoring will resume when the path is recovered from the error via an automatic failback.

If it takes a long time for an error to occur, an intermittent error can be more easily detected by increasing the error-monitoring interval or by decreasing the number of times that the error needs to occur.

The figure below shows the action taken when an intermittent error is assumed not to have occurred on the path. For this example, the path is determined to have an intermittent error if the error occurs three or more times in 30 minutes. The events that occur are described by using the time arrows.

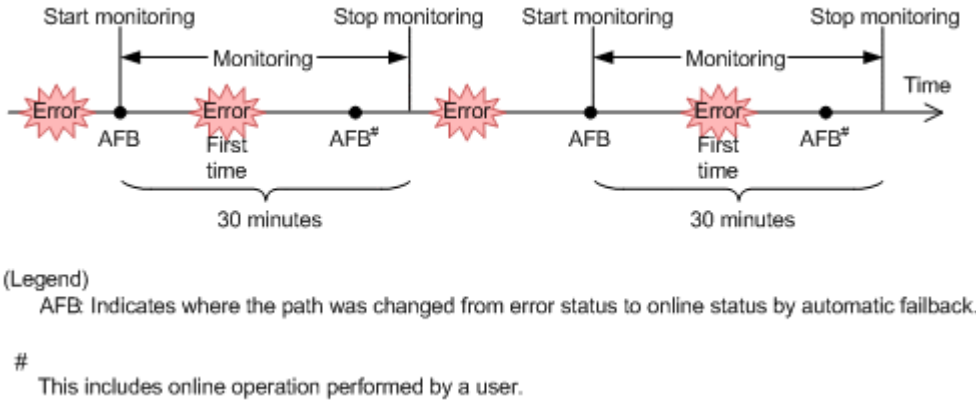


Figure 2-12 What Will Happen When an Intermittent Error Does Not Occur on a Path

As shown in *Figure 2-12 What Will Happen When an Intermittent Error Does Not Occur on a Path on page 2-27*, normally the count for the number of times that an error occurs is started after the path is first recovered from an error by using the automatic failback function. However, if all the paths connected to the LU are in the `Offline(E)`, `Online(E)`, or `Offline(C)` status (which is due to the disconnection of the paths or some other reason), the paths will not be recovered and put back online by using the automatic failback function. If I/O operations are continuously being issued to such an LU, the count for the number of times that the error occurs might be started even though the path will not be placed online. If the number of times that the error occurs reaches the specified value, the path is determined to have an intermittent error. In such a case, remove the cause of the error, and then manually place the path online.

When the Conditions for an Intermittent Error Are Changed During Error Monitoring

When the conditions for an intermittent error are changed during error monitoring, the number of errors and the amount of time that has passed

since the error monitoring started are both reset to 0. As such, the error monitoring will not finish, and it will start over by using the new conditions.

If the conditions are changed while error monitoring is not being performed, error monitoring will start up again and use the updated conditions after any given path is recovered from an error by performing an automatic failback.

The figure below shows the action taken when the conditions for an intermittent error are changed during intermittent error monitoring. For this example, the conditions have been changed from 3 or more errors in 30 minutes, to 3 or more errors in 40 minutes. The events that occur are described by using the time arrows.

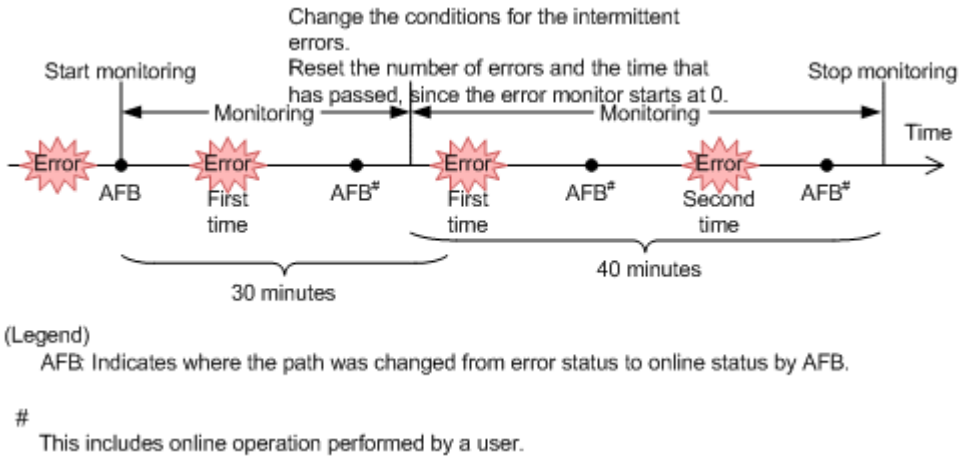


Figure 2-13 What Will Happen When Conditions Are Changed During Error Monitoring

When Failures Occur on All Paths While Monitoring for Intermittent Errors

When I/Os are performed continuously for an LU whose paths are all `Offline(E)`, `Online(E)`, `Online(S)`, `Online(D)`, or `Offline(C)` because of a failure such as a broken wire, the number of times that an error occurs (the IEP value when "`dlnkmgr view -path -iem`" is executed) during intermittent error monitoring might increase even though the automatic failback function did not recover some paths. In such a case, even though an intermittent error did not occur, HDLM often assumes an intermittent error, and excludes paths from the automatic failback function. In such a case, after recovery from the failure, to change the status of a path excluded from automatic failback to online, manually change the status to online.

When a User Changes the Intermittent Error Information

The following might be reset when a user changes any of the values set for the intermittent error or the path status: the number of errors that have already been counted during error monitoring, the amount of time that has passed since error monitoring has started, and the information about whether an intermittent error has occurred. *Table 2-6 When Effects of a User Changing the Intermittent Error Information on page 2-29* lists whether the above items are reset.

If you want to check whether intermittent error monitoring is being performed for the path, check the IEP item displayed when the `dlnkmgr` command's `view -path` operation is executed with the `-iem` parameter. If a numerical value of 0 or greater is displayed in the **Intermittent Error Path** item, then intermittent error monitoring is being performed.

Table 2-6 When Effects of a User Changing the Intermittent Error Information

User operation		Number of errors and time passed since error monitoring started	Information about paths not subject to automatic failback
Changing the intermittent error monitoring settings	Turning `off`	Reset	Reset[#1]
	Changing the conditions for an intermittent error while intermittent error monitoring is being performed	Reset[#2]	Inherited
	Turning intermittent error monitoring `on` by executing the `set` operation, (but not changing the conditions) while intermittent error monitoring is being performed		
	Changing the intermittent error monitoring conditions while intermittent error monitoring is not being performed	(Not applicable) (Not counted.)	Inherited
Changing the automatic failback settings	Turning `off`	Reset	Reset
Changing the path status	Taking the path `Offline(C)`	Reset	Reset
	Placing the path `Online` while intermittent error monitoring is not being performed	(Not applicable) (Not counted.)	Reset
	Placing the path `Online` while intermittent error monitoring is being performed	Inherited	(Not applicable) If a path has been removed from the paths subject to automatic monitoring, that path is no longer monitored.
Restarting the HDLM manager		Reset[#3]	Inherited

User operation	Number of errors and time passed since error monitoring started	Information about paths not subject to automatic failback
Restarting the host	Reset	Reset

#1

When you turn the intermittent error monitoring function off, information about paths not subject to automatic failback will be reset. If you do not want to reset the information about paths not subject to automatic failback when you turn the intermittent error monitoring function off, change the target paths to `Offline(C)`.

#2

The number of errors and the time passed since error monitoring had started are both reset to `0`, and then monitoring restarts from the time the setting change is made in accordance with the changed monitoring conditions.

#3

The number of errors and the time passed since error monitoring had started are both reset to `0`, and then monitoring restarts from the time the HDLM manager starts.

Detecting errors by using path health checking

HDLM can check the status of paths for which I/O operations are not being performed at regular intervals. This function is called *path health checking*.

Without path health checking, an error is not detected unless I/O is performed because the system only checks the path status when I/O is performed. With path health checking, however, the system checks the status of online paths at regular intervals regardless of whether I/O is performed. If an error is detected in a path, path health checking functionality switches the status of that path to `Offline(E)` or `Online(E)`, so you can use the `dlnkmgr` command's `view` operation to check the path error.

For example, in a normal state, I/O operations are not performed on the paths coming from the standby host in the cluster configuration or on non-owner paths (that is, some of the paths that access a Hitachi AMS/WMS series storage system). Because of this, for the standby host or for a host connected to non-owner paths, we recommend that you use path health checking to detect errors. This enables the system to use the most up-to-date path-status information when selecting the next path to use.

You can configure path health checking by executing the `dlnkmgr` command's `set` operation. For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.

Distributing a Load by Using the Dynamic I/O Path Control Function

The result of using HDLM load balancing to distribute a load can be improved, by applying the HDLM dynamic I/O path control function to the storage system in which the dynamic load balance control function is installed.

What is the Dynamic Load Balance Control Function

In a system configuration in which multiple hosts and a storage system are connected, the I/O processing load tends to concentrate on the controller of the storage system, causing throughput performance of the entire system decrease. The dynamic load balance controller function evaluates such load statuses on the controller and prevents storage system performance from decreasing.

The following is a list of the storage systems that provide the dynamic load balance controller function and are supported by HDLM.

- Hitachi AMS2000 series#
- HUS100 series

#

For using the dynamic load balance controller function there are restrictions on the versions of the microprograms you install. For details, see the release notes of HDLM.

Dynamic I/O Path Control Function

In a storage system in which the dynamic load balance controller function is installed, enable the dynamic I/O path control function to make the HDLM load balancing effective.

When the dynamic I/O path control function is enabled, the controller selected by the dynamic load balance controller function is recognized as the owner controller. Other controllers are recognized as non-owner controllers.

The dynamic I/O path control function can be enabled or disabled based on each host, connected storage system, or LU.

The dynamic I/O path control function can be specified by using the HDLM command's `set` operation. For details about the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.

Error management

For troubleshooting purposes, HDLM collects information and stores it into log files. The error information to be collected can be filtered out by error level, and then stored into the log files. The following figure shows the flow of data when error information is collected on a host which is running HDLM.

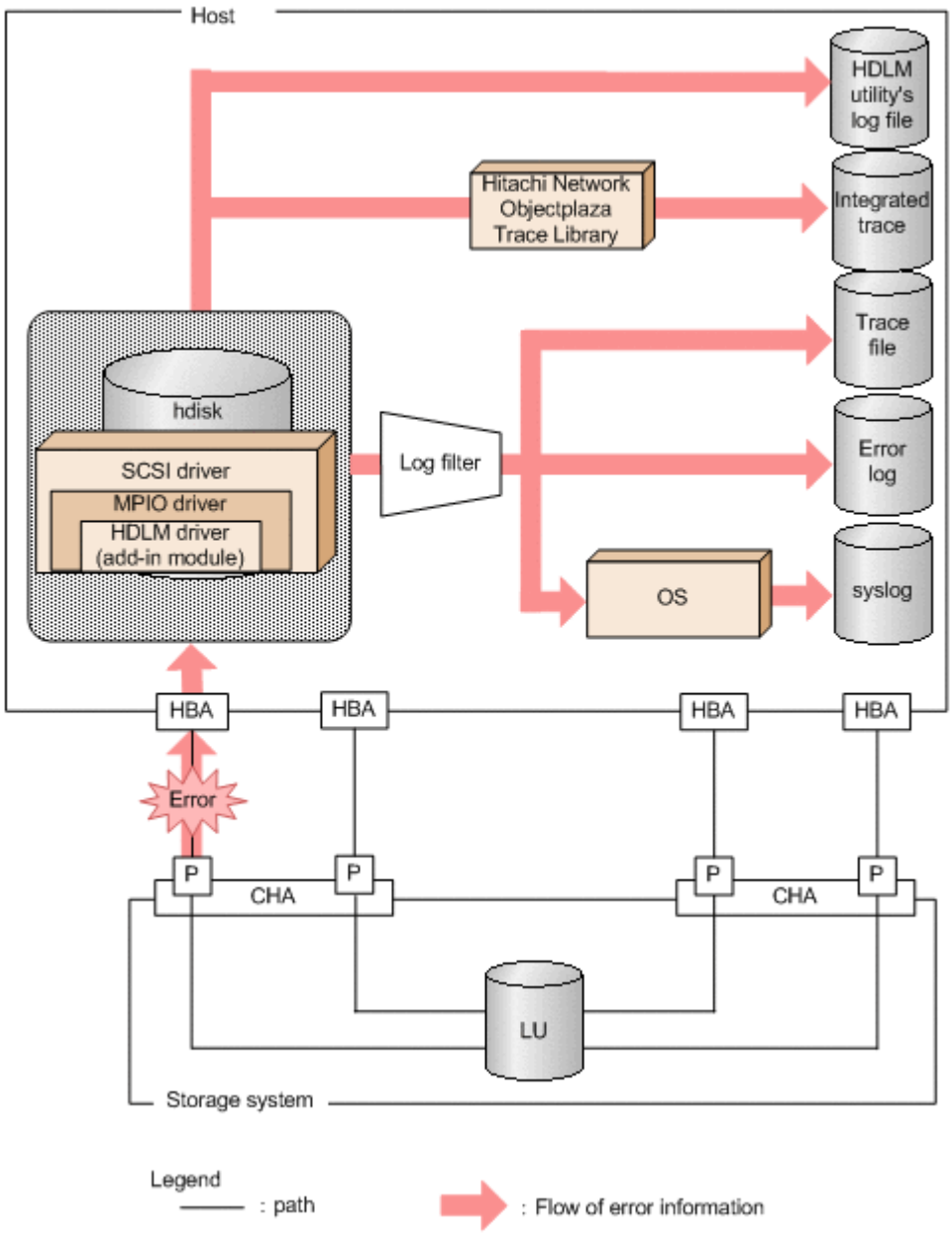


Figure 2-14 Flow of Data When Collecting Error Information

Logs might be collected in layers below HDLM, such as for the HBA driver. For more details, see the AIX documentation.

Types of Collected Logs

HDLM collects information on the detected error and trace information in the *integrated trace file*, *trace file*, *error logs*, *HDLM utility's log file*, and *syslog*. You can use the error information to examine the status of an error and analyze the cause of the error.

The following table lists and describes the error information that can be collected in logs.

Table 2-7 Types of error information

Log name	Description	Output destination
Integrated trace file	Operation logs of the HDLM command are collected.	The default file path is `/var/opt/hitachi/HNTRLib2/spool/hntr2[1-16].log`. To specify the output destination directory and the file prefix for the integrated trace file, use a Hitachi Network Objectplaza Trace Library (`HNTRLib2`) utility.
Trace file	Trace information on the HDLM manager is collected at the level specified by the user. If an error occurs, you might need to change the settings to collect trace information.	The trace file name is `/var/DynamicLinkManager/log/hdlmtr[1-64].log`

Error log	Error information is collected for the user-defined level. By default, HDLM collects all error information.	HDLM Manager logs:
		`/var/DynamicLinkManager/log/dlmmgr[1-16].log`
		Hitachi Command Suite Common Agent Component logs:
		`/var/DynamicLinkManager/log/dlmwebagent[1-N].log`
		The value *n* depends on the setting in the file `dlmwebagent.properties`.

HDLM utility's log file	Logs are collected when the *HDLM* utility is executed.	The following is the log file name: `/var/DynamicLinkManager/log/dlmutil[1-2].log`
Syslog	The HDLM messages on or above the level set by the user with `/etc/syslog.conf` are collected.# We recommend that you configure the system so that information at the Information level and higher is output. Syslogs can be checked using a text editor.	Syslog is not output by default. To output syslog, The syslog file path is specified in the file `/etc/syslog.conf`. For details, see the AIX documentation.
HDLM Inquiry log	An HDLM Inquiry log is a response log when the Inquiry command is issued to the hdisk.	`/var/DynamicLinkManager/log/dlminquiry[1-2].log`

Log name	Description	Output destination
HDLM configuration log	HDLM configuration log is an operation log of the configuration processing for the HDLM driver.	/var/DynamicLinkManager/log/dlmconfig[1-2].log

#

When you want to configure the system so that HDLM messages are output to syslog, specify user for the facility in the /etc/syslog.conf file. The following shows an example where the system function name is user, and messages at the info level or higher are output to the /tmp/syslog.user.log file:

```
user.info           /tmp/syslog.user.log
```

For details on error levels, see *Filtering of error information on page 2-34*.

Filtering of error information

Errors detected by HDLM are classified into various error levels. The following table lists and describes the error levels, in the order of most to least severe to the system.

Table 2-8 Error levels

Error level	Meaning	Level output in syslog
Critical	Fatal errors that may stop the system.	err
Error	Errors that adversely affect the system. This type of error can be avoided by performing a failover or other countermeasures.	err
Warning	Errors that enable the system to continue but, if left, might cause the system to improperly operate.	warning
Information	Information that simply indicates the operating history when the system is operating normally.	info

Error information is filtered according to the error level, and then collected.

In syslog, the HDLM messages on or above the level set by the user configured in /etc/syslog.conf are collected. It is recommended that you set the Information to be output at the info level or higher.

The error information in error logs and trace files are collected based on a user-defined collection level. The collection levels are as follows:

Collection levels for error logs

- Collects no error information.

- Collects error information at the Error level and higher.
- Collects error information at the Warning level and higher.
- Collects error information at the Information level and higher.
- Collects error information at the Information level and higher (including maintenance information).

Collection levels for log information in trace files:

- Outputs no trace information
- Outputs error information only
- Outputs trace information on program operation summaries
- Outputs trace information on program operation details
- Outputs all trace information

For details on how to set the collection level, see *Setting Up the HDLM Functions on page 3-89*.

Collecting error information using the utility for collecting HDLM error information (DLMgetras)

HDLM has a utility for collecting HDLM error information (`DLMgetras`).

By executing this utility, you can simultaneously collect all the information required for analyzing errors: information such as error logs, integrated trace files, trace files, definition files, core files, system crash dump files, and libraries. You can use the collected information when you contact your HDLM vendor or maintenance company (if there is a maintenance contract for HDLM).

For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

Collecting installation error information using the utility for collecting HDLM installation error information (dlmgetrasinst)

HDLM has a utility for collecting HDLM installation error information (`dlmgetrasinst`).

By executing the `dlmgetrasinst` utility, you can collect system information and log files needed to analyze errors that occurred during installation. You can use the collected information when you contact your HDLM vendor or maintenance company (if there is a maintenance contract for HDLM).

For details on the `dlmgetrasinst` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

Collecting Audit Log Data

HDLM and other Hitachi storage-related products provide an audit log function so that compliance with regulations, security evaluation standards, and industry-specific standards can be shown to auditors and evaluators. The following table describes the categories of audit log data that Hitachi storage-related products can collect.

Table 2-9 Categories of Audit Log Data that Can Be Collected

Category	Explanation
StartStop	An event indicating the startup or termination of hardware or software, including: • OS startup and termination • Startup and termination of hardware components (including micro-program) • Startup and termination of software running on storage systems, software running on SVPs (service processors), and Hitachi Command Suite products
Failure	An abnormal hardware or software event, including: • Hardware errors • Software errors (such as memory errors)
LinkStatus	An event indicating the linkage status between devices: • Link up or link down
ExternalService	An event indicating the result of communication between a Hitachi storage-related product and an external service, including: • Communication with a RADIUS server, LDAP server, NTP server, or DNS server • Communication with the management server (SNMP)
Authentication	An event indicating that a connection or authentication attempt made by a device, administrator, or end-user has succeeded or failed, including: • FC login • Device authentication (FC-SP authentication, iSCSI login authentication, or SSL server/client authentication) • Administrator or end-user authentication
AccessControl	An event indicating that a resource access attempt made by a device, administrator, or end-user has succeeded or failed, including: • Device access control • Administrator or end-user access control
ContentAccess	An event indicating that an attempt to access critical data has succeeded or failed, including: • Access to a critical file on a NAS or content access when HTTP is supported • Access to the audit log file

Category	Explanation
ConfigurationAccess	An event indicating that a permitted operation performed by the administrator has terminated normally or failed, including: • Viewing or updating configuration information • Updating account settings, such as adding and deleting accounts • Setting up security • Viewing or updating audit log settings
Maintenance	An event indicating that a maintenance operation has terminated normally or failed, including: • Adding or removing hardware components • Adding or removing software components
AnomalyEvent	An event indicating an abnormal state such as exceeding a threshold, including: • Exceeding a network traffic threshold • Exceeding a CPU load threshold • Reporting that the temporary audit log data saved internally is close to its maximum size limit or that the audit log files have wrapped back around to the beginning
	An event indicating an occurrence of abnormal communication, including: • A SYN flood attack or protocol violation for a normally used port • Access to an unused port (such as port scanning)

The categories of audit log data that can be collected differ depending on the product. The following sections explain only the categories of audit log data that can be collected by HDLM. For the categories of audit log data that can be collected by a product other than HDLM, see the corresponding product manual.

Categories and Audit Events that HDLM Can Output to the Audit Log

The following table lists and explains the categories and audit events that HDLM can output to the audit log. The severity is also indicated for each audit event.

Table 2-10 Categories and Audit Events that Can Be Output to the Audit Log

Category	Explanation	Audit event	Severity#1	Message ID
StartStop	Startup and termination of the software	Startup of the HDLM manager was successful.	6	KAPL15401-I

Category	Explanation	Audit event	Severity[#1]	Message ID
		Startup of the HDLM manager failed.	3	KAPL15402-E
		The HDLM manager stopped.	6	KAPL15403-I
		Startup of the `DLMgetras` utility	6	KAPL15060-I
		Termination of the `DLMgetras` utility[#2]	6	KAPL15061-I
		Startup of the `dlmgetrasinst` utility	6	KAPL15084-I
		Termination of the `dlmgetrasinst` utility[#3]	6	KAPL15085-I
`Authentication`	Administrator or end-user authentication	Permission has not been granted to execute the HDLM command.	4	KAPL15111-W
		Permission has not been granted to execute HDLM utilities.	4	KAPL15010-W
		Permission has not been granted to start or stop the HDLM manager.	4	KAPL15404-W
`ConfigurationAccess`	Viewing or updating configuration information	Processing of the `dlmpremkcd -c` command was successful.	6	KAPL15088-I
		Processing of the `dlmpremkcd -c` command failed.	3	KAPL15089-E
		Processing of the `dlmpremkcd -u` command was successful.	6	KAPL15090-I
		Processing of the `dlmpremkcd -u` command failed.	3	KAPL15091-E
		Processing of the `dlmrmprshkey -l hdisk`*n* command was successful.	6	KAPL15092-I
		Processing of the `dlmrmprshkey -l`	6	KAPL15093-I

Category	Explanation	Audit event	Severity#1	Message ID
		`hdisk`*n* `-R RegistKey` command was successful.		
		Processing of the `dlmrmprshkey` command failed.	3	KAPL15094-E
		Initialization of path statistics was successful.	6	KAPL15101-I
		Initialization of path statistics failed.	3	KAPL15102-E
		An attempt to place a path online or offline was successful.	6	KAPL15103-I
		An attempt to place a path online or offline failed.	4	KAPL15104-W
		Setup of the operating environment was successful.	6	KAPL15105-I
		Setup of the operating environment failed.	3	KAPL15106-E
		An attempt to display program information was successful.	6	KAPL15107-I
		An attempt to display program information failed.	3	KAPL15108-E
		An attempt to display HDLM management-target information was successful.	6	KAPL15109-I
		An attempt to display HDLM management-target information failed.	3	KAPL15110-E
		Processing of the `dlmpr -k` command was successful.	6	KAPL15001-I
		Processing of the `dlmpr -k` command failed.	3	KAPL15002-E
		Processing of the `dlmpr -c` command was successful.	6	KAPL15008-I

Category	Explanation	Audit event	Severity#1	Message ID
		Processing of the `dlmpr -c` command failed.	3	KAPL15009-E
		Processing of the `dlmodmset -o` command was successful.	6	KAPL15005-I
		Processing of the `dlmchpdattr -o` command was successful.	6	KAPL15080-I
		Processing of the `dlmchpdattr -o` command failed.	3	KAPL15081-E
		Processing of the `dlmchpdattr -a` command was successful.	6	KAPL15082-I
		Processing of the `dlmchpdattr -a` command failed.	3	KAPL15083-E
		The status of a path was successfully changed to Online.	6	KAPL15116-I
		A path was successfully added.	6	KAPL15117-I
		Path addition failed.	4	KAPL15118-W
		A path was successfully deleted.	6	KAPL15119-I
		Path deletion failed.	4	KAPL15120-W
		The refresh operation was successful.	6	KAPL15121-I
		The refresh operation failed.	4	KAPL15122-W

#1

The severity levels are as follows:

3: Error, 4: Warning, 6: Informational

#2

If you use **Ctrl** + **C** to cancel the `DLMgetras` utility for collecting HDLM error information, audit log data indicating that the `DLMgetras` utility has terminated will not be output.

#3

If you use **Ctrl** + **C** to cancel the `dlmgetrasinst` utility for collecting HDLM installation error information, audit log data indicating that the `dlmgetrasinst` utility has terminated will not be output.

Requirements for Outputting Audit Log Data

HDLM can output audit log data when all of the following conditions are satisfied:

- The `syslog` daemon is active.
- The output of audit log data has been enabled by using the HDLM command's `set` operation.

However, audit log data might still be output regardless of the above conditions if, for example, an HDLM utility is executed from external media.#

#:

The following audit log data is output:

- Categories: `StartStop`, `Authentication`, and `ConfigurationAccess`
- Severity: 6 (Critical, Error, Warning, or Informational)
- Destination: syslog (facility value: `user`)

Note:

- Enable `syslog` since `syslog` is disabled by default in AIX.
  For details on how to enable `syslog`, see *Destination and Filtering of Audit Log Data on page 2-41* or the AIX documentation.
- You might need to perform operations such as changing the log size and backing up and saving collected log data, because the amount of audit log data might be quite large.
- If the severity specified by the HDLM command's `set` operation differs from the severity specified by the configuration file `/etc/syslog.conf`, the higher severity level is used for outputting audit log data.

Destination and Filtering of Audit Log Data

Audit log data is output to `syslog`. Because HDLM messages other than audit log data are also output to `syslog`, we recommend that you specify the output destination that is used exclusively for audit log data.

For example, to change the output destination of audit log data to `/usr/local/audlog`, specify the following two settings:

- Specify the following setting in the `/etc/syslog.conf` file:

  ```
  local0.info /usr/local/audlog
  ```

- Use the HDLM command's `set` operation to specify `local0` for the audit log facility:

You can also filter the audit log output by specifying a severity level and type for the HDLM command's `set` operation.

Filtering by severity:

The following table lists the severity levels that can be specified.

Table 2-11 Severity Levels That Can Be Specified

Severity	Audit log data to output	Correspondence with syslog severity levels
0	None	Emergency
1		Alert
2	Critical	Critical
3	Critical and Error	Error
4	Critical, Error, and Warning	Warning
5		Notice
6	Critical, Error, Warning, and Informational	Informational
7		Debug

Filtering by category:

The following categories can be specified:

- `StartStop`
- `Authentication`
- `ConfigurationAccess`
- All of the above

For details on how to specify audit log settings, see *Setting Up the HDLM Functions on page 3-89*.

Audit Log Data Formats

The following describes the format of audit log data:

Format of audit log data output to syslog:

- *priority*
- *date-and-time*
- *host-name*
- *program-name*
- [*process-ID*]
- *message-section*

The following shows the format of *message-section* and explains its contents.

The format of message-section:

common-identifier,*common-specification-revision-number*,*serial-number*,*message-ID*,*date-and-time*,*entity-affected*,*location-affected*,*audit-event-type*,*audit-event-result*,*subject-ID-for-audit-event-result*,*hardware-identification-information*,*location-information*,*location-identification-information*,*FQDN*,*redundancy-identification-information*,*agent-information*,*host-sending-request*,*port-number-sending-request*,*host-receiving-request*,*port-number-receiving-request*,*common-operation-ID*,*log-type-information*,*application-identification-information*,*reserved-area*,*message-text*

Up to 950 bytes of text can be displayed for each *message-section*.

Table 2-12 Items Output in the Message Section

Item#	Explanation
Common identifier	Fixed to `CELFSS`
Common specification revision number	Fixed to `1.1`
Serial number	Serial number of the audit log message
Message ID	Message ID in KAPL15*nnn*-*l* format
Date and time	The date and time when the message was output. This item is output in the following format: *yyyy*-*mm*-*dd*T*hh*:*mm*:*ss*.*s time-zone*
Entity affected	Component or process name
Location affected	Host name
Audit event type	Event type
Audit event result	Event result
Subject ID for audit event result	Depending on the event, an account ID, process ID, or IP address is output.
Hardware identification information	Hardware model name or serial number
Location information	Hardware component identification information
Location identification information	Location identification information
FQDN	Fully qualified domain name
Redundancy identification information	Redundancy identification information
Agent information	Agent information
Host sending request	Name of the host sending a request
Port number sending request	Number of the port sending a request
Host receiving request	Name of the host receiving a request

Item#	Explanation
Port number receiving request	Number of the port receiving a request
Common operation ID	Operation serial number in the program
Log type information	Fixed to `BasicLog`
Application identification information	Program identification information
Reserved area	This field is reserved. No data is output here.
Message text	Data related to the audit event is output.

#: The output of this item depends on the audit event.

Example of the message section for the audit event *An attempt to display HDLM management-target information was successful*:

```
CELFSS,1.1,0,KAPL15109-I,
2008-04-09T10:18:40.6+09:00,HDLMCommand,hostname=moon,Configur
ationAccess,Success,uid=root,,,,,,,,,,,,,"Information about
HDLM-management targets was successfully displayed. Command
Line = /usr/DynamicLinkManager/bin/dlnkmgr view -path "
```

Integrated HDLM management using Global Link Manager

By using Global Link Manager, you can perform integrated path management on systems running multiple instances of HDLM.

For large-scale system configurations using many hosts running HDLM, the operational load for managing paths on individual hosts increases with the size of the configuration. By linking HDLM and Global Link Manager, you can centrally manage path information for multiple instances of HDLM and reduce operational load. In addition, you can switch the operational status of paths to perform system-wide load balancing, and centrally manage the system by collecting HDLM failure information in Global Link Manager.

Global Link Manager collects and centrally manages information about paths from instances of HDLM installed on multiple hosts. Even if multiple users manage these hosts, they can control and view this centralized information from client computers.

Note:

You cannot manage a single HDLM host from multiple Global Link Manager servers.

The following figure is an example of a system configuration using HDLM and Global Link Manager.

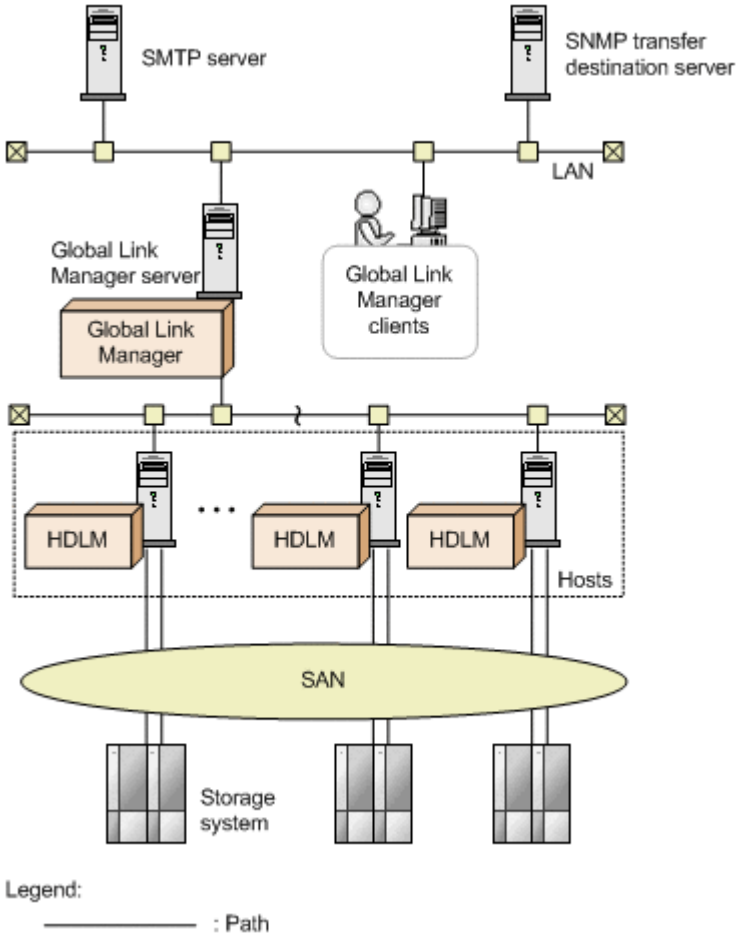


Figure 2-15 Example System Configuration Using HDLM and Global Link Manager

Cluster support

HDLM can also be used in cluster configurations.

HDLM supports the cluster software listed below.

- GPFS
- PowerHA
- Oracle RAC 10g
- Oracle RAC 11g
- VCS
- DB2 pureScale

HDLM uses a path of the *active host* to access an LU.

The details of host switching depend on the application.

3

Creating an HDLM Environment

This chapter describes the procedures for creating an HDLM environment and for canceling the setup.

Make sure that HDLM is installed and its functions have been set up. The volume groups and cluster software programs must be set up appropriately for your system environment.

Note that, in the required procedures and notes, there are differences between HDLM version 5.8.1 or earlier, and HDLM version 5.9 or later. For details, see *Appendix B, Differences Between HDLM Version 5.9 or Later and Version 5.8.1 or Earlier on page B-1*.

- Settings for Using Oracle RAC 10g or Oracle RAC 11g
- Settings for Using VCS
- Removing HDLM

HDLM System Requirements

Check the following before installing HDLM.

For OS patches and software provided by OS vendors, download them from the Web site of the appropriate OS vendor.

For the requirements for using HDLM in an HAM environment, see the release notes of HDLM.

Host and OS Support for HDLM

You can install HDLM on hosts running the OSs in the following table.

Table 3-1 Applicable OSs for the Host

OS	Kernel
AIX 5L V5.3#1	For Technology Level 06: Apply SP9 or later For Technology Level 07: Apply SP6 or later For Technology Level 08: Apply APAR IZ43371 For Technology Level 09: Apply SP2 or later and APAR IZ42658 For Technology Level 10 Apply SP1 or later Technology Level 11#2 For Technology Level 12 Apply SP1 or later
AIX 5L V5.3 (Virtual I/O Server)#4	ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number)
AIX V6.1#1, #3	If Technology Level is not installed: Apply SP1 or later and APAR IZ11722 For Technology Level 01: Apply APAR IZ42661 For Technology Level 02: Apply SP2 or later and APAR IZ42662 For Technology Level 03 Apply SP1 or later Technology Level 04#2 For Technology Level 05 Apply SP1 or later Technology Level 06 Technology Level 07 For Technology Level 08

OS	Kernel
	Apply SP1 or later For Technology Level 09 Apply SP1 or later
AIX V6.1 (Virtual I/O Server)#3, #4	ioslevel 2.1.0.01 to 2.2.3.*xx* (where *xx* is a number)
AIX V7.1#1, #3	No Technology Level Technology Level 01 For Technology Level 02 Apply SP1 or later For Technology Level 03 Apply SP1 or later
AIX V7.1 (Virtual I/O Server)#3, #4	ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number)

#1

Every SP is applicable, unless otherwise specified.

#2

To set up a boot disk environment that uses a storage system of the Hitachi AMS2000/AMS/WMS/SMS series, or HUS100 series, apply SP2 or a later service pack.

#3

An environment in which the Secure by Default functionality is enabled during installation of the OS is not supported.

#4

HDLM supports PowerVM Live Partition Mobility in an environment in which a virtual SCSI device or virtual HBA is used as the HDLM device.

Prerequisite Programs for HDLM

Before you install HDLM, confirm that the required programs written below have been installed. For details about HTC_ODM and XP_ODM, contact the storage system vendor.

- VisualAge C++ Runtime 5.0.0.0 or later, IBM XL C/C++ V7 Runtime 7.0.0.0 to IBM XL C/C++ V8 Runtime 8.0.0.0 or 8.0.0.6 or later (8.0.0.1 to 8.0.0.5 are not supported), IBM XL C/C++ V9 Runtime 9.0.0.1 or later, IBM XL C/C++ V10 Runtime 10.0.0.1 or later, IBM XL C/C++ V11 Runtime 11.1.0.1 or later, IBM XL C/C++ V12 Runtime 12.1.0.0 or later, or IBM XL C/C++ V13 Runtime 13.1.0.0 or later

  Execute the following command, as applicable, to check the runtime version:

  For AIX 5L V5.3:

  ```
  # lslpp -L xlC.aix50.rte
  ```

  For AIX V6.1

```
# lslpp -L xlC.aix61.rte
```

For AIX V7.1

```
# lslpp -L xlC.aix61.rte
```

- HTC_ODM 5.0.52.1 or later

  If you are using the following storage systems, use HTC_ODM 5.0.52.1 or later:

  - Hitachi AMS2000/AMS/WMS/SMS series
  - Hitachi USP series (excluding the XP series)
  - Universal Storage Platform V/VM series (excluding XP20000 and XP24000)
  - Hitachi Virtual Storage Platform
  - VSP G1000
  - VSP G200, G400, G600
  - HUS100 series
  - HUS VM

  Note:

  When you install HTC_ODM in an HDLM environment where XP_ODM has already been installed, install HTC_ODM, and then re-install HDLM.

- XP_ODM 5.0.52.1 or later

  If you are using the following storage systems, use XP_ODM 5.0.52.1 or later:

  - XP series
  - P9500
  - HP XP7

  Note:

  When you install XP_ODM in an HDLM environment where HTC_ODM has already been installed, install XP_ODM, and then re-install HDLM.

- JDK required for linkage with Global Link Manager

  To link with Global Link Manager, make sure that JDK package 1.4.2 (32-bit version) or later, JDK package 5.0 (32-bit version) or later, JDK package 6.0 (32-bit version) or later, or JDK package 7.0 (32-bit version) or later is already installed on the host. The JDK does not need to be installed if linkage with Global Link Manager is not used. When HDLM is installed in an environment in which the JDK has not been installed, the KAPL09241-W message is displayed. If linkage with Global Link Manager is not used, this message requires no action. Note that the display of the KAPL09241-W message does not affect HDLM operation.

Storage Systems Supported by HDLM

Storage Systems

HDLM supports the following storage systems:

- Hitachi Universal Storage Platform V
- Hitachi Universal Storage Platform VM
- XP10000/XP12000/XP20000/XP24000
- Hitachi AMS2000/AMS/WMS/SMS series
- Hitachi NSC55
- Hitachi Universal Storage Platform 100
- Hitachi Universal Storage Platform 600
- Hitachi Universal Storage Platform 1100
- Hitachi Virtual Storage Platform
- Hitachi Virtual Storage Platform G1000
- HP StorageWorks P9500 Disk Array
- HP XP7 Storage
- Hitachi Virtual Storage Platform G200
- Hitachi Virtual Storage Platform G400
- Hitachi Virtual Storage Platform G600
- SVS
- HUS100 series
- HUS VM

The applicable storage systems require a dual controller configuration. If you use the system in a hub-connected environment, you must set unique loop IDs for all connected hosts and storage systems.

For details about microprograms, see the *HDLM Release Notes*.

List of information for storage settings

To use HDLM, you need to set the information for storage settings that are indicated in the table below. The character string enclosed in square brackets [ ] indicates the items to be set. Selecting the item after the item enclosed in square brackets [ ] displays the next item. Specify the values indicated in the Setting value column.

For other settings, see the maintenance manual of the storage system.

Table 3-2 Storage Settings (Hitachi AMS/WMS Series)

Items	Items to be set	Setting value
Dual configuration	[System Startup Attribute]	**Dual Active Mode**

Items	Items to be set	Setting value
Host mode	[Host Connection Mode 1] (Set for the host group.)	**Standard mode**
Option	[Host Connection Mode 2] (Set for the host group.) - [UA (06/2A00) suppress mode]	**ON**
	[Host Connection Mode 2] (Set for the host group.) - [NACA mode]	**ON**
	[Host Connection Mode 2] (Set for the host group.) - [Unique Reserve Mode 1]	**ON**
	[Port Option] (Set for all the ports.) - [Reset Mode]#	**ON**

#

Specify this item when using a Hitachi AMS/WMS series storage system in an HACMP environment.

Table 3-3 Storage Settings (Hitachi USP series, Universal Storage Platform V/VM series, Hitachi Virtual Storage Platform, VSP G1000, XP series, P9500, XP7, VSP G200, G400, G600, SVS, and HUS VM)

Items	Items to be set	Setting value
Host Mode	-	**0F**
Option	-	• Select **2** • Select **72**#

#

When you set the reserve_policy attribute for hdisk to PR_shared on Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, P9500, or HUS VM perform the setup.

Table 3-4 Storage Settings (Hitachi SMS series, Hitachi AMS2000 series, HUS100 series)

Items	Items to be set	Setting value
Dual configuration	[System Startup Attribute]	**Dual Active Mode**
Option	[Host Connection Mode 2] (Set for the host group.) - [NACA mode]	**ON**
	When using "Simple Setting"	Select **VCS** from the Middleware pulldown.
	When using "Additional setting"	Select the **Unique Reserve Mode 1** checkbox.

HBA

For applicable HBAs, see the *HDLM Release Notes*.

When Handling Intermediate Volumes Managed by Hitachi RapidXchange

The following table lists the related programs that are required when you convert data with intermediate volumes managed by Hitachi RapidXchange.

Table 3-5 HDLM-Related Programs Required When Handling Intermediate Volumes Managed by Hitachi RapidXchange

OS	Related Programs
AIX 5L V5.3	File Access Library and File Conversion Utility (FAL/FCU) 01-03-56/20 or later
	File Access Library and File Conversion Utility (FAL/FCU) 01-04-64/21 or later
AIX V6.1	File Access Library and File Conversion Utility (FAL/FCU) 01-07-68/00 or later
AIX V7.1	File Access Library and File Conversion Utility (FAL/FCU) 01-05-66/25 or later
	File Access Library and File Conversion Utility (FAL/FCU) 01-06-67/21 or later

For details about Hitachi RapidXchange, see the manual *File Access Library & File Conversion Utility for Solaris HP-UX AIX Windows Tru64 UNIX NCR SVR4 DYNIX/ptx Linux*.

Cluster Software Supported by HDLM

The following table lists the related programs required when you combine cluster configurations.

Table 3-6 HDLM-Related Programs When Combining Cluster Configurations

OS	Related Programs
AIX 5L V5.3	• PowerHA 6.1
	• Oracle RAC 10g 10.1.0.5.0 If the HDLM device is specified for direct access: ASM + raw devices#1 • Oracle RAC 10g 10.2.0.2.0 If the HDLM device is specified for direct access: ASM + raw devices#1, or raw devices#1 • Oracle RAC 10g 10.2.0.3.0 If the HDLM device is specified for direct access: ASM + raw devices#1#2

OS	Related Programs
	• Oracle RAC 10g 10.2.0.4.0 If the HDLM device is specified for direct access: ASM + raw devices[#1] • Oracle RAC 10g 10.2.0.5.0 If the HDLM device is specified for direct access: ASM + raw devices[#1] • Oracle RAC 11g 11.1.0.6.0 If the HDLM device is specified for direct access: ASM + raw devices[#1], or raw devices[#1] • Oracle RAC 11g 11.1.0.7.0 If the HDLM device is specified for direct access: ASM + raw devices[#1] • Oracle RAC 11g 11.2.0.3.0[#9] If the HDLM device is specified for direct access: ASM + raw devices[#1]
	• GPFS 3.3[#3, #6] • GPFS 3.4[#3]
	• VCS 5.0[#4] • VCS 5.0.1[#4] • VCS 5.0.3[#4, #5] • VCS 5.1[#4]
AIX 5L V5.3 (Virtual I/O Server)	• PowerHA 6.1 Client: Technology Level 07 or later Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number)
AIX V6.1	• PowerHA 6.1 • PowerHA 7.1 • PowerHA 7.1.1 • PowerHA 7.1.2 • PowerHA 7.1.3
	• Oracle RAC 10g 10.2.0.4.0 If the HDLM device is specified for direct access: ASM + raw devices • Oracle RAC 10g 10.2.0.5.0 If the HDLM device is specified for direct access: raw devices • Oracle RAC 11g 11.2.0.2.0 If the HDLM device is specified for direct access: ASM + raw devices • Oracle RAC 11g 11.2.0.3.0[#9] If the HDLM device is specified for direct access:

OS	Related Programs
	ASM + raw devices When a logical volume is used: PowerHA 6.1[#2]
	• GPFS 3.3[#3, #6] • GPFS 3.4[#3] • GPFS 3.5[#7]
	• VCS 5.0.1[#4] • VCS 5.0.3[#4, #5] • VCS 5.1[#4]
	• DB2 pureScale 9.8[#8] • DB2 pureScale 10.1[#8] • DB2 pureScale 10.5[#8]
AIX V6.1 (Virtual I/O Server)	• PowerHA 6.1 Client: Technology Level 02 or later Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1 Client: Technology Level 06 or later Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1.1 Client: Technology Level supported by PowerHA Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1.2 Client: Technology Level supported by PowerHA Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1.3 Client: Technology Level supported by PowerHA Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number)
	• VCS 5.1[#4]
AIX V7.1	• PowerHA 6.1 • PowerHA 7.1 • PowerHA 7.1.1 • PowerHA 7.1.2 • PowerHA 7.1.3
	• Oracle RAC 11g 11.2.0.2.0 If the HDLM device is specified for direct access: ASM + raw devices • Oracle RAC 11g 11.2.0.3.0[#9] If the HDLM device is specified for direct access: ASM + raw devices • Oracle RAC 11g 11.2.0.4.0[#9]

OS	Related Programs
	If the HDLM device is specified for direct access: ASM + raw devices
	• GPFS 3.4#3 • GPFS 3.5#7
	• DB2 pureScale 9.8#8 • DB2 pureScale 10.1#8 • DB2 pureScale 10.5#8
AIX V7.1 (Virtual I/O Server)	• PowerHA 6.1 Client: No Technology Level, or Technology Level 01 or later Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1 Client: No Technology Level, or Technology Level 01 or later Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1.1 Client: Technology Level supported by PowerHA Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1.2 Client: Technology Level supported by PowerHA Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number) • PowerHA 7.1.3 Client: Technology Level supported by PowerHA Server: ioslevel 2.1.0.0 to 2.2.3.*xx* (where *xx* is a number)

#1

When using Technology Level 05, apply IY92037.

#2

If you have updated the host environment by, for example, applying Oracle-specific patches, the Oracle I/O timeout threshold (`MISSCOUNT`) might have been changed. Therefore, when you update an environment, you need to review the `MISSCOUNT` value.

#3

Only the NSD (Network Shared Disk) configuration is supported. Set the `usePersistentReserve` option to `no` in the GPFS cluster configuration information.

#4

VxVM is not supported.

#5

Sometimes, if JFS2 is being used and a crash (`halt -q`) fails over a node, the resource to be mounted on the failover-destination node is not properly mounted. This problem occurs regardless of whether HDLM is installed.

#6

Apply fix pack 3.3.0.3 or later.

#7

Only the NSD (Network Shared Disk) configuration is supported.

#8

To use Tiebreaker Disk, Global Link Manager is required. Use Global Link Manager to set Tiebreaker Disk load balancing to off.

#9

It is recommended that you use external redundancy for ASM disk groups. To use normal or high redundancy, contact the Oracle Corporation.

Memory and Disk Capacity Requirements

The table below shows the memory requirements for the host.

Memory Requirements

Table 3-7 Memory Requirements for the Host on page 3-12 shows the memory requirements for the host.

Table 3-7 Memory Requirements for the Host

OS	Required memory
AIX	5000 KB + 0.256 KB × *number-of-LUs* + 1.28 KB × *number-of-paths*

Disk Capacity Requirements

The following table lists the disk capacity used by the host.

Table 3-8 Disk Capacity Occupied by the Host

Directory	Disk capacity requirement
/etc	150 KB
/opt	2 MB
/usr	220 MB
/var	*p* MB[#1] +4MB + 2 MB + *q* MB[#2] + 19 MB + 200 KB[#3]

#1

This value depends on the error log file settings. The maximum is 30,000 MB.

$p = (s \times m) / 1024$ (in MB),

where:

s is the size of the error log file (units: KB, default is 9,900), and

m is the number of error log files (default is 2). The resulting fraction will be rounded up.

#2

This value depends on the trace file settings. The maximum is 1000 MB.

$q = (t \times n) / 1024$ (in MB),

where:

t is the size of the trace file (units: KB, default is 1,000), and

n is the number of trace files (default is 4). The resulting fraction will be rounded up.

#3

This is the amount of unused capacity required to use the `installhdlm` utility. For details on this utility, see *installhdlm Utility for Installing HDLM on page 7-32*.

Number of LUs and Paths That Are Supported in HDLM

The following table lists the number of LUs and paths that are supported by HDLM.

Table 3-9 Number of LUs and Paths That Are Supported by HDLM

Item	Supported number
Number of LUs	1 to 4,096#1
Number of paths available to connect to an LU	1 to 64#2
Number of paths for a boot disk	1 to 4
Total number of paths	1 to 8,192

#1

For details on the maximum number of LUs that can be recognized by a CHA port, see the specifications of the storage system that you use.

#2

If the reservation policy is `PR_exclusive`, and the Hitachi AMS2000/AMS/WMS/SMS series, or HUS100 series, is used, the number of supported paths to an LU is 1 to 32.

If the reservation policy is `PR_exclusive` or `PR_shared`, and a storage system other than the Hitachi AMS2000/AMS/WMS/SMS series, or HUS100 series is used, the maximum number of supported paths to an LU is limited. For details, contact the storage system vendor.

For details on reservation policy, see *About the Reservation Policy on page 3-104*.

Flow for Creating an HDLM Environment

Set up the environment to use HDLM as follows.

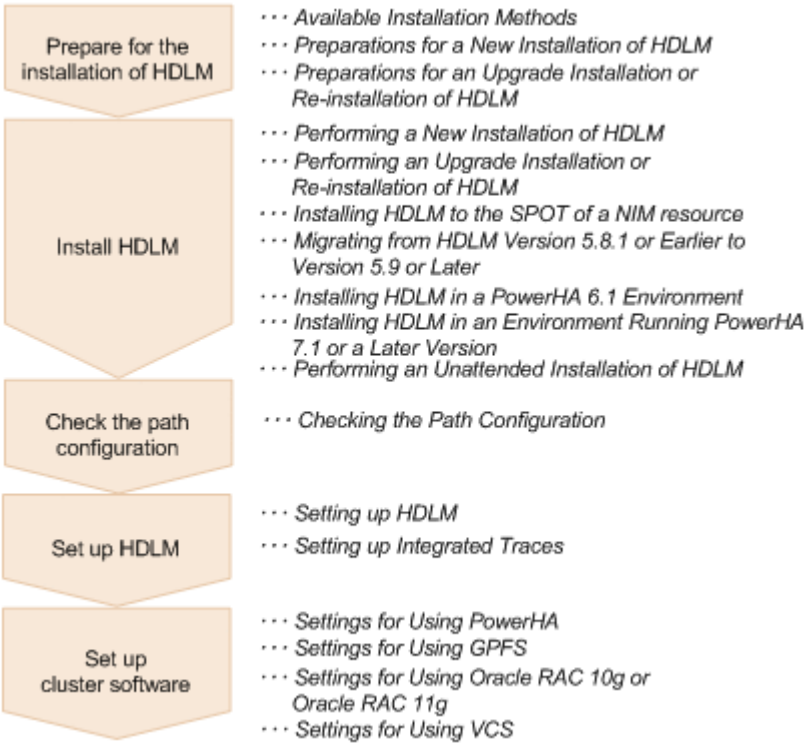


Figure 3-1 Flow of HDLM Environment Setup

Types of HDLM Installation

This section describes the following HDLM installation types: new installation, upgrade installation, migration, and re-installation.

New installation of HDLM

Installing HDLM on a server where HDLM has not yet been installed is called a *new installation*.

Upgrade installation of HDLM

Installing a new version of HDLM over an already installed, earlier version of HDLM without first removing the earlier version is called an *upgrade installation*.

You can perform an upgrade installation only for HDLM version 5.9 or later.

Migration of HDLM

Removing HDLM version 5.8.1 or earlier, and then performing a new installation of HDLM 5.9 or later is called a *migration*. During a migration, you can inherit the earlier ODM settings and the HDLM functionality settings.

Migration is necessary because HDLM version 5.8.1 or earlier cannot be upgraded to HDLM version 5.9 or later. By performing the procedure described in *Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later on page 3-69*, you can inherit only the ODM settings and the HDLM functionality settings.

Re-installation of HDLM

Installing the same version of HDLM for repair purposes without removing the existing instance of HDLM is called *re-installation* of HDLM.

Notes on Creating an HDLM Environment

This section provides notes on creating an HDLM environment.

For notes on operating HDLM, see *Notes on Using HDLM on page 4-2*.

Notes on Installing HDLM

- Install HDLM on the boot disk.
- To install HDLM, a license key is required. For more details, see the Notification of Software License Key provided with this package.
- Install HDLM in a multi-user mode environment.
- The HDLM-dedicated device files below are created when HDLM is installed. Do not use these device files.

  ```
  /dev/dlmadrv
  /dev/rdlmfdrvio
  /dev/rdlmcldrv
  ```
- HDLM version 5.9 or later cannot coexist with Auto-Path, Auto Path XP, Hitachi Path Manager, or HDLM version 5.8.1 or earlier. Before installing HDLM version 5.9 or later, you must remove any installed copies of these products. For details on migrating from HDLM version 5.8.1 or earlier, see *Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later on page 3-69*.
- When HDLM is installed, all devices shown under *Devices that HDLM can manage* in *Devices Managed by HDLM on page 2-3* are set to be targets for HDLM management.
- When installing HDLM on a host where version 5.0 or later of a Device Manager agent is installed, do not execute any of the following Device Manager agent commands during the installation:

  ```
  hbsasrv, HiScan, hdvmagt_account, hdvmagt_schedule, hldutil, TIC
  ```

Notes on an Upgrade Installation or Re-installation of HDLM

When you upgrade or re-install HDLM, note the following:

- Information, such as the driver configuration, HDLM functionality settings, and log files will be inherited without being initialized when the upgrade installation or re-installation is complete. For details on the information to be inherited, see *Table 3-14 List of Files Inherited During an Upgrade Installation or Re-installation on page 3-39* in *Performing an Upgrade Installation or Re-installation of HDLM on page 3-39*.

- If you upgrade or re-install HDLM before you resolve a path failure, LU reservations might persist without being released. In such a case, use the utility for clearing HDLM persistent reservations (`dlmpr`) to release the LU reservation, if necessary.
- Performing an upgrade installation or re-installation might change the physical volume (hdisk name). For this reason, you must check and, if necessary, revise relevant settings, such as the settings for applications that directly access a hard disk recognized as an HDLM management-target device. Use the output information of the `view` operation (with the `-drv` parameter) to check the correspondence between the hdisk and the LU.

Notes on the Virtual I/O Server

- Before you install HDLM, change the ioslevel version of the virtual I/O server to a version supported by HDLM. For details about the ioslevel versions supported by HDLM, see *Cluster Software Supported by HDLM on page 3-8*.
- If you want to apply a virtual SCSI disk to a client partition in a virtual I/O server environment, install HDLM into the virtual I/O server partition. If you want to apply a virtual HBA to a client partition, install HDLM into the client partition.
- Specify an hdisk, or a logical volume configured for HDLM, as the virtual target device. For details about how to configure a virtual target device, see the installation procedure in *Performing a New Installation of HDLM on page 3-27* and *Performing an Upgrade Installation or Re-installation of HDLM on page 3-39*.
- To set up a virtual SCSI disk MPIO configuration in a client partition, or to use PowerHA in a client partition, set the hdisk reservation policy in the virtual I/O server partition to `no_reserve`.
- If you want to use HDLM in a client partition to which a virtual HBA is applied by using the virtual I/O server NPIV functionality, set the NPIV option to `on`. If the option is not set to `on`, HDLM might not be able to recognize a path that goes through the virtual HBA.

  To set the NPIV option, execute the `dlmodmset` utility. For details on this utility, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*.

  If the HDLM device has already been configured, and NPIV option settings are changed, stop and restart the host. For a local boot disk environment, instead of stopping and restarting the host, you can also perform the following procedure:

  a. Execute the `dlmrmdev` utility for deleting HDLM drivers to change the HDLM device status to `Defined`, or delete the HDLM driver.

     For details on the `dlmrmdev` utility, see *dlmrmdev Utility for Deleting HDLM Drivers on page 7-30*.

  b. Execute the following command to reconfigure the HDLM device:

     ```
     # cfgmgr
     ```

When the NPIV option is set to `on`, *HBA adapter number* and *bus number* for `PathName`, which are output by HDLM command `view` operations, are changed to *adapter type* and *adapter number* respectively.

The `view` operation parameters for which the above changes are to be applied are as follows:

- `-path` parameter (displays path information)
- `-lu` parameter (displays LU information)
- `-hba` parameter (displays HBA port information)

For details on the `view` operations, see *view (Displays Information) on page 6-34*.

Notes on the License Key and License Key File

- A license key or license key file is required when performing any of the following types of installation:
  - Performing a new installation of HDLM.
  - Migrating from HDLM version 5.8.1 or earlier to version 5.9 or later.
  - Upgrading or re-installing HDLM after the valid license period has expired.
- To update the HDLM license, specify the `-lic` parameter in the HDLM command's `set` operation, and then execute this command. The license key type determines the expiration date of the license. For details about license key types and the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.

Notes on Trace Files

In HDLM 5.6 or later, trace files for versions of HDLM earlier than 5.6 are divided into integrated trace files and trace files. The logs for the HDLM command are output to integrated trace files. Trace information for an HDLM manager is output to trace files. The output destinations for the files are changed as follows:

When you migrate from HDLM 04-00 or earlier

Trace files before the migration: `/opt/hitachi/HNTRLib/spool/hntr`*`n`*`.log` (*n* indicates a file number)

Integrated trace files after the migration: `/var/opt/hitachi/HNTRLib2/spool/hntr2`*`n`*`.log` (*n* indicates a file number)

Trace files after the migration: `/var/DynamicLinkManager/log/hdlmtr`*`n`*`.log` (*n* indicates a file number)

When you migrate from HDLM 05-00 or later

Trace files before the migration: `/var/opt/hitachi/HNTRLib2/spool/hntr2`*`n`*`.log` (*n* indicates a file number)

Integrated trace files after the migration: `/var/opt/hitachi/HNTRLib2/spool/hntr2`*`n`*`.log` (*n* indicates a file number)

Trace files after the migration: `/var/DynamicLinkManager/log/hdlmtr`*n*`.log` (*n* indicates a file number)

Notes on Storage Systems

- Do not change the vendor ID or product ID of a storage system. If you do, HDLM will not be able to recognize the storage system.
- Before you connect multiple storage systems to the same host, make sure that the storage systems have unique serial numbers. If there is a duplication of serial numbers, use a tool such as Disk Array Management Program to assign a unique serial number to each device.
- If you restart a storage system when using an hdisk that meets both of the following conditions, the persistent reservation of the LU registered in this volume group will be cancelled:
  - The `reserve_policy` attribute has been set to `PR_exclusive`.
  - The volume group has been activated.

  Perform the procedure below to inactivate the volume group, and then re-activate it. Also, when you perform a planned restart of a storage system, make sure you perform the operation while the volume group is inactive.

  a. Execute the following command to inactivate the volume group:
  ```
  # varyoffvg volume-group-name
  ```
  b. Execute the following command to make sure that the inactivated volume group is no longer displayed:
  ```
  # lsvg -o
  ```
  c. Execute the following command to activate the volume group:
  ```
  # varyonvg volume-group-name
  ```

Notes on the Cluster

- When you use HDLM in a cluster configuration, you must install the same version of HDLM on all the nodes that comprise the cluster. If different versions of HDLM are installed, the cluster system may not operate correctly. If the `HDLM Version` and `Service Pack Version`, which are displayed by executing the following command, are the same, the versions of HDLM are the same:

  ```
  # /usr/DynamicLinkManager/bin/dlnkmgr view -sys
  ```
- When you use PowerHA, GPFS, Oracle RAC 10g, Oracle RAC 11g, or VCS, settings such as script registration or the reservation policy setting are required. For details about the settings used for each cluster, see the following:

  For PowerHA: *Settings for Using PowerHA on page 3-105*.

  For GPFS: *Settings for Using GPFS on page 3-108*.

  For Oracle RAC 10g or Oracle RAC 11g: *Settings for Using Oracle RAC 10g or Oracle RAC 11g on page 3-108*.

  For VCS: *Settings for Using VCS on page 3-111*.

- If you are using PowerHA, note that HDLM does not support non-concurrent volume groups due to limitations in PowerHA. For details, contact IBM.
- If all of the following conditions are met, HDLM can be migrated without stopping PowerHA services:
  - The shared volume groups used by PowerHA are concurrent volume groups.
  - A custom disk method is specified in the PowerHA script.
  - A virtual I/O server environment is not used on the host.

Notes on the Automatic Failback

If the automatic failback processing starts before a path failure has been recovered from, the cluster system switchover time might become longer. To prevent this, for the automatic failback checking interval, specify a value that is greater than the value obtained from the following formula:

checking-interval (minutes)

= *maximum-number-of-paths-among-the-LUs* × *number-of-connected-storage-devices*

Notes on the queue_depth Parameter Value for an HDLM-Managed device

Hitachi recommends that you set the `queue_depth` parameter of an hdisk for an HDLM-managed device to a value greater than or equal to the number of paths that are connected to the hdisk. For details on how to specify the `queue_depth` parameter, see the AIX documentation.

Notes on Linking with Global Link Manager

When you manage HDLM by using Global Link Manager, do not register one HDLM host into two or more Global Link Manager servers.

Installing HDLM

When you install HDLM, Hitachi Network Objectplaza Trace Library will also be installed. The file path of the integrated trace information file of Hitachi Network Objectplaza Trace Library is `/var/opt/hitachi/HNTRLib2/spool/hntr2`*`n`*`.log`, where *n* is the number of the integrated trace information file.

note:

The message KAPL09311-W might be output during installation. In such a case, HDLM installation continues, but installation of the Hitachi Network Objectplaza Trace Library has failed. After installing HDLM, install the Hitachi Network Objectplaza Trace Library. For details about how to install

the library, see Installing the Hitachi Network Objectplaza Trace Library on page 3-86.

Available Installation Methods

To install HDLM, use one of the following procedures:

- Use `installux.sh`.

  By using `installux.sh`, you can install HDLM from the DVD-ROM or the directory to which the contents of the DVD-ROM have been copied without needing to consider the location in which the files to be installed are stored. You can use the `installux.sh` command to perform the following installations:

  - New installation
  - Upgrade installation
  - Re-installation
  - Unattended installation

- Use SMIT or the `installp` command.

  You can also copy the contents of the HDLM DVD-ROM to a desired directory, and then perform installation from that directory.

  Copy the following files from the installation DVD-ROM to the same directory:

  - `DLManager.mpio.bff`
  - `.toc`

  To use SMIT, in *software-input-device/directory* specify the directory in which the contents of the DVD-ROM have been copied.

- Unattended installation

  An unattended installation enables a user to install HDLM without entering information. For details about how to perform an unattended installation of HDLM, see *Performing an Unattended Installation of HDLM on page 3-78*.

- Installation on alternate disks

  To use the AIX `nimadm` command, see *Using the nimadm command to simultaneously upgrade HDLM and migrate the OS on page 3-66* in *Performing an Upgrade Installation or Re-installation of HDLM on page 3-39*.

  By using the `alt_disk_copy` or `nim` command of AIX, you can replicate the running system (clone) on an alternate disk, and then perform an upgrade installation or re-installation of HDLM in AIX on the alternate disk. The hdisk where the replication is created is called an alternate disk.

- Installation in a multibos environment

  By using the AIX `multibos` command, you can perform an upgrade installation of HDLM when a standby BOS is created or on an already created standby BOS.

In addition to installing HDLM on a typical host, you can install it in the following environments:

- Boot disk
- You can install HDLM on a virtual I/O server.
  A virtual I/O server is a system that enables multiple client logical partitions to share one resource.
- PowerHA environments
  PowerHA is IBM's HA cluster software that runs on AIX.

When Performing a New Installation, Upgrade Installation, or Re-installation of HDLM

Table 3-10 Combination of Available Installation Methods and Installation Environments on page 3-21 lists the combinations of available installation methods and installation environments.*Table 3-11 Combination of Installation Methods that Are Available in an PowerHA Environment and the Supported Installation Environments on page 3-22* lists the combinations of installation methods that are available in an PowerHA environment versus the supported installation environments.

Table 3-10 Combination of Available Installation Methods and Installation Environments

Installation method	Installation environment			
	Host		Virtual I/O server	
	Local boot disk environment	Boot disk environment	Local boot disk environment	Boot disk environment
`installux.sh` or `installp` command	Yes	Yes	Yes	Yes
SMIT	Yes	Yes	Yes	Yes
Unattended installation	Yes	Yes	Yes	Yes
Installation on alternate disks	Yes#1	Yes#1	Yes#1	Yes#1
Installation in a multibos environment	Yes#2	Yes#2	Yes#2	Yes#2

Legend:

Yes: Can be executed

No: Cannot be executed

#1

Only upgrade installations and re-installations are supported.

#2

Only upgrade installations are supported.

Table 3-11 Combination of Installation Methods that Are Available in an PowerHA Environment and the Supported Installation Environments

Installation method	Installation environment			
	Host		Virtual I/O server	
	Local boot disk environment	Boot disk environment	Local boot disk environment	Boot disk environment
`installux.sh`[#1] or `installp` command	Yes	Yes	Yes	Yes
SMIT	Yes	Yes	Yes	Yes
Unattended installation	No	No	No	No
Installation on alternate disks	Yes[#2]	Yes[#2]	Yes[#2]	Yes[#2]
Installation in a multibos environment	Yes[#3]	Yes[#3]	Yes[#3]	Yes[#3]

Legend:

Yes: Can be executed

No: Cannot be executed

#1

Only new installations, upgrade installations, and re-installations are supported.

#2

Only upgrade installations and re-installations are supported.

#3

Only upgrade installations are supported.

The installation procedures are explained in this manual in the locations shown below.

`installux.sh` or `installp` command

- *Performing a New Installation of HDLM on page 3-27*
- *Performing an Upgrade Installation or Re-installation of HDLM on page 3-39*
- *Upgrading or Re-installing HDLM in a PowerHA 6.1 Environment (in a Local Boot Disk Environment) on page 3-73* in *Installing HDLM in a PowerHA 6.1 Environment on page 3-73*

- *Upgrading or Re-installing HDLM in a PowerHA 6.1 Environment (in a Boot Disk Environment) on page 3-73* in *Installing HDLM in a PowerHA 6.1 Environment on page 3-73*
- *Installing HDLM in an Environment Running PowerHA 7.1 or a Later Version on page 3-76*

Unattended installation

Performing an Unattended Installation of HDLM on page 3-78

Installation on alternate disks

When Installing HDLM on Alternate Disks on page 3-60 in *Performing an Upgrade Installation or Re-installation of HDLM on page 3-39*

To use SMIT, see the AIX documentation.

When Performing a Migration of HDLM

Table 3-12 Combination of Available Migration Methods and Migration Environments on page 3-23 lists the combinations of available migration methods and target environments. *Table 3-13 Combinations of Migration Methods Available in an PowerHA Environment and the Migration Environments on page 3-24* lists the combinations of migration methods that are available in an PowerHA environment and the migration destinations.

Table 3-12 Combination of Available Migration Methods and Migration Environments

Migration method	Migration environment			
	Host		Virtual I/O server	
	Local boot disk environment	Boot disk environment	Local boot disk environment	Boot disk environment
`installux.sh`# or `installp` command	Yes	N/A	Yes	N/A
SMIT	Yes	N/A	Yes	N/A
Unattended installation	No	N/A	No	N/A
Installation on alternate disks	No	No	No	No
Installation in a multibos environment	No	No	No	No

Legend:

Yes: Can be executed

No: Cannot be executed

N/A: Not applicable

#

Only new installations, upgrade installations, and re-installations are supported.

Table 3-13 Combinations of Migration Methods Available in an PowerHA Environment and the Migration Environments

Migration method	Migration environment			
	Host		Virtual I/O server	
	Local boot disk environment	Boot disk environment	Local boot disk environment #1	Boot disk environment
`installux.sh`#2 or `installp` command	Yes	N/A	No	N/A
SMIT	Yes	N/A	No	N/A
Unattended installation	No	N/A	No	N/A
Installation on alternate disks	No	No	No	No
Installation in a multibos environment	No	No	No	No

Legend:

Yes: Can be executed

No: Cannot be executed

N/A: Not applicable

#1

Before you migrate HDLM to an environment that uses PowerHA and a virtual I/O server, cancel the virtual disk definitions of the virtual I/O server. After you have migrated HDLM, redefine these virtual disk definitions.

#2

Only new installations, upgrade installations, and re-installations are supported.

For details about how to migrate, see each location shown below.

`installux.sh` or `installp` command

Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later on page 3-69, and *Migrating HDLM in a PowerHA 6.1 Environment on page 3-74* in *Installing HDLM in a PowerHA 6.1 Environment on page 3-73*.

To use SMIT, see the AIX documentation.

Preparations for a New Installation of HDLM

In this subsection, you will perform such preparations as backing up the HDLM management-target devices, applying AIX patches, and performing hardware setup.

When using HDLM in a cluster configuration, make sure to perform the operations described in the following sub-sections on all hosts that comprise the cluster.

Perform Operations for HDLM Management-Target Devices

If you have already defined physical volumes and have been running the HDLM management-target devices, perform the following procedure:

1. Terminate the processes of all applications that are accessing the HDLM management-target devices.
2. If necessary, back up all HDLM management-target devices to a medium such as tape.
3. Unmount the disks.

   If the HDLM management-target devices are mounted, unmount them as follows:

   - First, execute the command below to check the current settings.

     ```
     # mount -p
     ```

     The current settings will be output as follows:

     ```
     # mount -p
       node        mounted      mounted over   vfs         date     options
     --------   -------------- -------------- ------ ------------  ---------------
                /dev/hd4       /              jfs    mmm  dd hh:mm rw,log=/dev/hd8
                /dev/hd2       /usr           jfs    mmm  dd hh:mm rw,log=/dev/hd8
                /dev/hd9var    /var           jfs    mmm  dd hh:mm rw,log=/dev/hd8
                /dev/hd3       /tmp           jfs    mmm  dd hh:mm rw,log=/dev/hd8
                /dev/hd1       /home          jfs    mmm  dd hh:mm rw,log=/dev/hd8
                /proc          /proc          procfs mmm  dd hh:mm rw
                /dev/hd10opt   /opt           jfs    mmm  dd hh:mm rw,log=/dev/hd8
                /dev/lv02      /mntpt         jfs    mmm  dd hh:mm rw,log=/dev/loglv01
     #
     ```

     Figure 3-2 Execution Result Example of the Mount -p Command (Preparations for a New Installation of HDLM)

     In this example, assume that HDLM manages the shaded portion of the devices.

   - Execute the following command to unmount the disk.

     ```
     # umount /mntpt
     ```

4. Execute the following command to inactivate the applicable volume group:

   ```
   # varyoffvg volume-group-name
   ```

Set Up the Hardware

Check the topology (Fabric, AL, etc.) and perform setup as appropriate.

1. Set up the storage system.

For details on how to set up the storage system, see the maintenance documentation for the storage system. If you are using PowerHA, see also *Storage System Settings on page 3-106* of *Settings for Using PowerHA on page 3-105*.

2. Set up the Fibre Channel switches.
   For details on how to set up a Fibre Channel switch, see the documentation for the Fibre Channel switch. If you do not use Fibre Channel switches, this setup is not necessary.
3. Set up the HBA.
   For details on how to set up an HBA, see the documentation for the HBA.
   Make sure that all HBAs that are on a single host and connected to HDLM-managed disks are of the same type and have the same microprogram version. If you are using more than one type of HBA, paths will not be able to be switched when an error occurs. Set the SCSI target ID according to the HBA settings. For details on checking the target ID, see the HBA documentation.
4. Make sure the OS recognizes the LU.
   Execute the `cfgmgr` command to configure the device, and then execute the `lsdev` command to make sure that the physical volume has been recognized as hdisk.

```
# cfgmgr
# lsdev -Cc disk
```

Switch the Kernel Mode

Before installing HDLM, decide which kernel mode you will use to operate AIX, and change to the desired kernel mode if necessary.

The following shows how to switch the kernel mode.

1. Check the kernel mode currently being used.
   Execute the following command.

```
# bootinfo -K
```

   `32` will be displayed when the 32-bit kernel is being used, and `64` will be displayed when the 64-bit kernel is being used.
2. Switch the kernel mode.
   When AIX is running, change the symbolic link for `/usr/lib/boot/unix` and `/unix` to switch the current kernel mode to the desired mode.
   - The path for the 64-bit kernel mode
     `/usr/lib/boot/unix_64`
   - The path for the 32-bit kernel mode
     `/usr/lib/boot/unix_up` (for a uni-processor)
     `/usr/lib/boot/unix_mp` (for a multi-processor)
3. Execute the `bosboot` command.

```
# bosboot -ad /dev/ipldevice
```

4. Restart the system.

```
# shutdown -Fr
```

5. Execute the following command to confirm that the kernel mode has been changed properly.

```
# bootinfo -K
```

Set Up Cluster Software

To use HDLM in a cluster configuration, you need to perform the following setup for the cluster software.

To set up cluster software:

1. Install the cluster software on all of the hosts in the cluster.
   For details on the installation, see the documentation of the corresponding cluster software.
2. Stop the cluster software services.
   For details on how to stop the services, see the documentation of the corresponding cluster software.

Performing a New Installation of HDLM

When Installing HDLM in a Local Boot Disk Environment

To perform a new installation of HDLM:

1. Log in to AIX as the root user.
   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.
2. If there is no directory for mounting the DVD-ROM, make the directory.

   ```
   # mkdir /cdrom
   ```

   cdrom is the desired directory name. Hereafter, *cdrom* is used for purposes of explanation.
3. Mount the DVD-ROM.

   ```
   # mount -r -v cdrfs /dev/cd0 /cdrom
   ```

   The `/dev/cd0` part depends on the system.
4. Execute the following command to check that the devices to be managed by HDLM have been recognized by the system:

   ```
   # lsdev -Cc disk
   hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
   hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
   hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
   hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
   hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
   ...
   ```

In this example, hdisk3 and hdisk4 are recognized as devices to be managed by HDLM. If all devices to be managed by HDLM are recognized, proceed to step 5.

If any devices to be managed by HDLM are not recognized, proceed to step 7.

5. Execute the following utility to remove, from the running kernel, the HDLM management-target device:

```
# /cdrom/HDLM_AIX/hdlmtool/dlmrmdev -f
```

The KAPL10529-I message is displayed.

If the KAPL10529-I message is not displayed, the HDLM management-target device has not been deleted. Make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then re-execute the above utility.

6. Execute the following command to make sure that the hdisk recognized as the device to be managed by HDLM has been deleted:

```
# lsdev -Cc disk
```

7. Prepare the license key or license key file.

   - When only the license key has been provided

     Create the /var/DLM directory, and then, in this directory, create the license key file (dlm.lic_key). The following shows an example when the license key is 123456789ABCDEF:

     ```
     # mkdir /var/DLM
     # echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
     ```

   - When the license key file has been provided

     Store the license key file directly under the /var/tmp/ directory by using the hdlm_license name.

     ```
     /var/tmp/hdlm_license
     ```

   Note that the hdlm_license and dlm.lic_key files are deleted after installation finishes successfully.

8. Execute the following command:

   - When installing HDLM from the DVD-ROM

     ```
     # /directory-in-which-the-DVD-ROM-is-mounted/installux.sh
     ```

     or

     ```
     # installp -aXgd /directory-in-which-the-DVD-ROM-is-mounted/HDLM_AIX all
     ```

   - When installing HDLM from the directory to which the DVD-ROM was copied

     ```
     # /directory-copied-from-DVD-ROM/installux.sh
     ```

     or

     ```
     # installp -aXgd /directory-copied-from-DVD-ROM/HDLM_AIX all
     ```

   Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host.

If the KAPL09172-E message is displayed, the hdisk for the device that is managed by HDLM still remains. Re-execute the procedure starting from step 5.

During installation, the KAPL09241-W message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the KAPL09241-W message if necessary.

9. Execute the following command to make sure that the package is installed.

```
# lslpp -la DLManager.mpio.rte
```

Make sure that the fileset item in the output listing contains DLManager.mpio.rte, and all the displayed statuses are COMMITTED.

If one or more of the displayed statuses are BROKEN, remove and then re-install HDLM.

10. Unmount the DVD-ROM.

```
# umount /cdrom
```

11. Delete the created mount directory.

```
# rm -r /cdrom
```

12. As required, execute the dlmodmset utility for setting the HDLM execution environment ODM.

For details, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*.

13. Execute the following command to configure the hdisk:

```
# cfgmgr
```

If the hosts and storage systems are connected by a Fibre Channel switch, perform steps 14 to 18. If the hosts and storage systems are not connected by a Fibre Channel switch, go to step 19.

14. Finish defining the parent device (fscsi*n*).

```
# rmdev -l fscsin -R
```

Note that you can use the following command to check the parent device:

```
# lsdev -C -l hdisk-name -F 'parent'
```

15. Change the fc_err_recov setting of the parent device (fscsi*n*) to fast_fail.

```
# chdev -l fscsin -a fc_err_recov=fast_fail
```

16. Verify that the settings for the parent device (fscsi*n*) are enabled.

Also, verify that the fc_err_recov setting has been changed to fast_fail.

```
# lsattr -El fscsin
fc_err_recov fast_fail FC Fabric Event Error RECOVERY Policy TRUE
```

17. Repeat steps 14 to 16 for each parent device (fscsi*n*) being used.

18. Enable the defined parent device (`fscsi`*n*).

```
# cfgmgr
```

19. Execute the `chdev` command, as required, to change the attributes of the hdisk:

```
# chdev -l hdisk-name -a queue_depth=8

# chdev -l hdisk-name -a rw_timeout=60
```

20. Execute one of the following commands, as required, to add `/usr/DynamicLinkManager/bin` to the `PATH` environment variable.

    When using a Bourne shell or Korn shell:

    ```
    # PATH=$PATH:/usr/DynamicLinkManager/bin
    # export PATH
    ```

    When using a C shell:

    ```
    # set path=( $path /usr/DynamicLinkManager/bin )
    ```

    To simplify command execution, you can temporarily add the `PATH` environment variable. To execute HDLM commands or the HDLM utility without setting the `PATH` environment variable, specify an absolute path to execute the commands.

21. Make sure that hdisks are available:

```
# lsdev -Cc disk
hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
...
```

    Make sure that the status of all displayed hdisks is `Available`.

    hdisks 0 to 2 are the physical device file names for the host's internal disks.

    hdisk 3 and the following are the logical device file names that correspond to physical volumes in the storage system.

22. Execute the `dlnkmgr` command's `view` operation to check the status of each program:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                  : x.x.x-xx
Service Pack Version          :
Load Balance                  : on(extended lio)
Support Cluster               :
Elog Level                    : 3
Elog File Size (KB)           : 9900
Number Of Elog Files          : 2
Trace Level                   : 0
Trace File Size(KB)           : 1000
Number Of Trace Files         : 4
Path Health Checking          : on(30)
Auto Failback                 : on(60)
Intermittent Error Monitor    : off
Dynamic I/O Path Control      : off(10)
```

```
HDLM Manager Ver       WakeupTime
Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver       WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver       WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
```

Even if cluster software is used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

23. From the execution result of the `view` operation, check that the correct version of HDLM is installed.

    If `HDLM Version` is *x.x.x-xx*, the installed version of HDLM is correct.

    x.x.x-xx is the installed version of HDLM.

24. From the execution result of the `view` operation, check that the programs are running properly.

    If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

    If you are not using a virtual I/O server, go to step 28.

25. If you are using a virtual I/O server, define an hdisk as a virtual target device.

    Execute the following command on the virtual I/O server:

    When creating the hdisk as a virtual target device:

    ```
    $ mkvdev -vdev hdisk-name -vadapter virtual-SCSI-server-
    adapter-name
    ```

    When creating the logical volume as a virtual target device:

    ```
    $ mkvdev -vdev logical-volume-name -vadapter virtual-SCSI-
    server-adapter-name
    ```

26. Execute the following command in the client logical partition to reconfigure the device:

    ```
    # cfgmgr
    ```

27. Execute the following command in the client logical partition to confirm that the physical volume has been recognized as hdisk.

    If the following message is displayed, then the physical volume (hdisk) was recognized correctly:

    ```
    # lsdev -Cc disk
    hdisk1 Available  Virtual SCSI Disk Drive
    ```

28. Activate the volume group used by HDLM.

    ```
    # varyonvg volume-group-name
    ```

29. Mount the file system used by HDLM.

```
# mount file-system-mount-point
```

30. Check the path configuration according to the procedure described in *Checking the Path Configuration on page 3-87*.

When Installing HDLM in a Boot Disk Environment

To perform a new installation of HDLM:

1. For AIX 5.3, use a single-path configuration for hosts and storage systems.

   For AIX 6.1 or AIX 7.1, you can use a single-path configuration or a multi-path configuration for hosts and storage systems.
2. Log in to AIX as the root user.

   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.
3. If the boot disk is in a multi-path configuration, execute the commands below to confirm that the physical volume containing the boot logical volume `hd5` is the same as the physical volume used for booting.

   If the boot disk is in a single-path configuration, you do not have to perform this step.

   - Identify the physical volume that contains the boot logical volume `hd5`:

     ```
     # lsvg -M rootvg | grep -w hd5
     hdisk3:1        hd5:1
     ```

     In this example, `hdisk3` contains the boot logical volume `hd5`.
   - Identify the physical volume used for booting:

     ```
     # getconf BOOT_DEVICE
     hdisk3
     ```

     In this example, `hdisk3` is used for booting.

   If the boot physical volume that contains the logical volume `hd5` is different from the physical volume used for booting, the following message appears, and the HDLM installation ends with an error:

   ```
   0503-497 installp: An error occurred during bosboot test
   processing.
   ```

   To make the physical volume that contains the boot logical volume `hd5` the same as the physical volume used for booting, execute the `bootlist` command by specifying the physical volume that contains the boot logical volume `hd5`, and then restart the host.

   The following shows an example of executing the command when the physical volume that contains the boot logical volume `hd5` is `hdisk3`:

```
# bootlist -m normal hdisk3
```

After restarting the host, perform the procedure again from step 2.

4. If there is no directory for mounting the DVD-ROM, make the directory.

```
# mkdir /cdrom
```

cdrom is the desired directory name. Hereafter, *cdrom* is used for purposes of explanation.

5. Mount the DVD-ROM.

```
# mount -r -v cdrfs /dev/cd0 /cdrom
```

The `/dev/cd0` part depends on the system.

6. Execute the following command to check that the devices to be managed by HDLM have been recognized by the system:

```
# lsdev -Cc disk
hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
...
```

In this example, `hdisk3` and `hdisk4` are recognized as devices to be managed by HDLM. If all devices to be managed by HDLM are recognized, proceed to step 6.

If any devices to be managed by HDLM are not recognized, proceed to step 8.

7. Execute the following utility to remove, from the running kernel, the HDLM management-target device:

```
# /cdrom/HDLM_AIX/hdlmtool/dlmrmdev -f
```

The `KAPL10529-I` message is displayed.

If the `KAPL10529-I` message is not displayed, the HDLM management-target device has not been deleted. Make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then re-execute the above utility.

Note that an hdisk recognized as a boot disk will not be deleted.

8. Execute the following command to make sure that the hdisks recognized as the devices to be managed by HDLM have been deleted:

```
# lsdev -Cc disk
```

9. Prepare the license key or license key file.

   - When only the license key has been provided

     Create the `/var/DLM` directory, and then, in this directory, create the license key file (`dlm.lic_key`). The following shows an example when the license key is `123456789ABCDEF`:

     ```
     # mkdir /var/DLM
     ```

```
# echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
```

- When the license key file has been provided

  Store the license key file directly under the `/var/tmp/` directory by using the `hdlm_license` name.

  ```
  /var/tmp/hdlm_license
  ```

Note that the `hdlm_license` and `dlm.lic_key` files are deleted after installation finishes successfully.

10. Execute the following command:

    - When installing HDLM from the DVD-ROM

      ```
      # /directory-in-which-the-DVD-ROM-is-mounted/installux.sh
      ```

      or

      ```
      # installp -aXgd /directory-in-which-the-DVD-ROM-is-mounted/
      HDLM_AIX all
      ```

    - When installing HDLM from the directory to which the DVD-ROM was copied

      ```
      # /directory-copied-from-DVD-ROM/installux.sh
      ```

      or

      ```
      # installp -aXgd /directory-copied-from-DVD-ROM/HDLM_AIX all
      ```

    Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host.

    If the KAPL09172-E message is displayed, the hdisk for the device that is managed by HDLM still remains. Re-execute the procedure starting from step 6.

    During installation, the KAPL09312-W message might be output, reporting that the host needs to restart. At this point, installation of HDLM continues, keeping the physical volumes to be used. However, execution of HDLM commands and HDLM path health checks cannot be performed until the host restarts.

    During installation, the `KAPL09241-W` message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the `KAPL09241-W` message if necessary.

11. Execute the following command to make sure that the package is installed.

    ```
    # lslpp -la DLManager.mpio.rte
    ```

    Make sure that the fileset item in the output listing contains `DLManager.mpio.rte`, and all the displayed statuses are `COMMITTED`.

    If one or more of the displayed statuses are `BROKEN`, remove and then re-install HDLM.

12. Unmount the DVD-ROM.

    ```
    # umount /cdrom
    ```

13. Delete the created mount directory.

    ```
    # rm -r /cdrom
    ```

14. If a single-path configuration is used, connect cables to all HBAs to change the configuration to a multi-path configuration.

    Note that, regardless of the configuration, do not execute the `cfgmgr` command.

15. Execute the following command to restart the host:

    ```
    # shutdown -Fr
    ```

16. Make sure that the boot disk is in a multi-path configuration:

    ```
    # lspath -l hdisk10 -s available
    Available hdisk10 fscsi0
    Available hdisk10 fscsi1
    ...
    ```

    The following procedure assumes that `hdisk10` is recognized as a boot disk:

17. Check the current boot disk list:

    ```
    # bootlist -m normal -o
    hdisk10 blv=hd5
    hdisk0 blv=hd5
    hdisk1 blv=hd5
    ...
    ```

18. Specify boot disks that are suitable for your host environment:

    ```
    # bootlist -m normal hdisk10 hdisk0 hdisk1
    ```

19. Make sure that the number of configured boot disks is the same as the number of paths that you checked in step 15:

    ```
    # bootlist -m normal -o
    hdisk10 blv=hd5
    hdisk10 blv=hd5
    hdisk0 blv=hd5
    hdisk1 blv=hd5
    ...
    ```

    If the hosts and storage systems are connected by a Fibre Channel switch, perform steps 19 to 23. If the hosts and storage systems are not connected by a Fibre Channel switch, go to step 24.

20. Finish defining the parent device (`fscsi`*n*).

    ```
    # rmdev -l fscsin -R
    ```

    Note that you can use the following command to check the parent device:

    ```
    # lsdev -C -l hdisk-name -F 'parent'
    ```

21. Change the `fc_err_recov` setting of the parent device (`fscsi`*n*) to `fast_fail`.

    ```
    # chdev -l fscsin -a fc_err_recov=fast_fail
    ```

22. Verify that the settings for the parent device (`fscsi`*n*) are enabled.

Also, verify that the fc_err_recov setting has been changed to fast_fail.

```
# lsattr -El fscsin
fc_err_recov fast_fail FC Fabric Event Error RECOVERY Policy TRUE
```

23. Enable the defined parent device (fscsi*n*).

```
# cfgmgr -l fscsin
```

24. Repeat steps 19 to 22 for each parent device (fscsi*n*) being used.

25. Execute the chdev command, as required, to change the attributes of the hdisk:

```
# chdev -l hdisk-name -a queue_depth=8

# chdev -l hdisk-name -a rw_timeout=60
```

26. Execute one of the following commands, as required, to add /usr/DynamicLinkManager/bin to the PATH environment variable.

When using a Bourne shell or Korn shell:

```
# PATH=$PATH:/usr/DynamicLinkManager/bin
# export PATH
```

When using a C shell:

```
# set path=( $path /usr/DynamicLinkManager/bin )
```

To simplify command execution, you can temporarily add the PATH environment variable. To execute HDLM commands or the HDLM utility without setting the PATH environment variable, specify an absolute path to execute the commands.

27. Make sure that hdisks are available:

```
# lsdev -Cc disk
hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
...
```

Make sure that the status of all displayed hdisks is Available.

hdisks 0 to 2 are the physical device file names for the host's internal disks.

hdisk 3 and the following are the logical device file names that correspond to physical volumes in the storage system.

After executing the lspv command, if there is no hdisk other than the one that constitutes rootvg, re-execute the procedure starting from step 14.

28. Execute the dlnkmgr command's view operation to check the status of each program:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                : x.x.x-xx
```

```
Service Pack Version         :
Load Balance                 : on(extended lio)
Support Cluster              :
Elog Level                   : 3
Elog File Size (KB)          : 9900
Number Of Elog Files         : 2
Trace Level                  : 0
Trace File Size(KB)          : 1000
Number Of Trace Files        : 4
Path Health Checking         : on(30)
Auto Failback                : on(60)
Intermittent Error Monitor   : off
Dynamic I/O Path Control     : off(10)
HDLM Manager Ver       WakeupTime
Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver       WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver       WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
```

Even if cluster software is used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

29. From the execution result of the `view` operation, check that the correct version of HDLM is installed.

    If `HDLM Version` is *x.x.x-xx*, the installed version of HDLM is correct.

    x.x.x-xx is the installed version of HDLM.

30. From the execution result of the `view` operation, check that the programs are running properly.

    If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

    If you are not using a virtual I/O server, go to step 33.

31. If you are using a virtual I/O server, define an hdisk as a virtual target device.

    Execute the following command on the virtual I/O server:

    When creating the hdisk as a virtual target device:

    ```
    $ mkvdev -vdev hdisk-name -vadapter virtual-SCSI-server-
    adapter-name
    ```

    When creating the logical volume as a virtual target device:

    ```
    $ mkvdev -vdev logical-volume-name -vadapter virtual-SCSI-
    server-adapter-name
    ```

32. Execute the following command in the client logical partition to reconfigure the device:

    ```
    # cfgmgr
    ```

33. Execute the following command in the client logical partition to confirm that the physical volume has been recognized as hdisk.

    If the following message is displayed, then the physical volume (hdisk) was recognized correctly:

```
# lsdev -Cc disk
hdisk1 Available  Virtual SCSI Disk Drive
```

34. Check the path configuration according to the procedure described in *Checking the Path Configuration on page 3-87*.

Preparations for an Upgrade Installation or Re-installation of HDLM

Make necessary preparations, such as backing up the HDLM management-target devices.

When using HDLM in a cluster configuration, make sure to perform the operations described in the following sub-sections on all hosts that comprise the cluster.

Stop Applications

HDLM manager stops during an upgrade installation or re-installation, so stop any applications that require HDLM manager operations before you start the upgrade installation or re-installation.

Perform Operations for HDLM Management-Target Device

1. Terminate the processes of all applications that are accessing the HDLM management-target devices.
2. If necessary, back up all HDLM management-target devices to a medium such as tape.
3. Unmount the disks.

   If the HDLM management-target devices are mounted, unmount them as follows:

   - First, execute the command below to check the current settings.

     ```
     # mount -p
     ```

     The current settings will be output as follows:

```
# mount -p
  node       mounted        mounted over    vfs       date     options
--------  ---------------  ---------------  ------  ------------  ---------------
          /dev/hd4         /                jfs     mmm  dd hh:mm rw,log=/dev/hd8
          /dev/hd2         /usr             jfs     mmm  dd hh:mm rw,log=/dev/hd8
          /dev/hd9var      /var             jfs     mmm  dd hh:mm rw,log=/dev/hd8
          /dev/hd3         /tmp             jfs     mmm  dd hh:mm rw,log=/dev/hd8
          /dev/hd1         /home            jfs     mmm  dd hh:mm rw,log=/dev/hd8
          /proc            /proc            procfs  mmm  dd hh:mm rw
          /dev/hd10opt     /opt             jfs     mmm  dd hh:mm rw,log=/dev/hd8
          /dev/lv02        /mntpt           jfs     mmm  dd hh:mm rw,log=/dev/loglv01
#
```

Figure 3-3 Example of Results from Executing the Mount -p Command (Preparations for an Upgrade Installation or Re-installation of HDLM)

In this example, assume that HDLM manages the shaded portion of the devices.

- Execute the following command to unmount the disk.

  ```
  # umount /mntpt
  ```

4. Execute the following command to inactivate the applicable volume group:

   ```
   # varyoffvg volume-group-name
   ```

Performing an Upgrade Installation or Re-installation of HDLM

This subsection explains how to perform an upgrade installation from an earlier version, or how to re-install HDLM.

Because HDLM version 5.8.1 or earlier cannot be upgraded to HDLM version 5.9 or later, migration is necessary. For details about migration, see *Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later on page 3-69*.

The following table lists and describes the files that are inherited during an upgrade installation or re-installation of HDLM.

Table 3-14 List of Files Inherited During an Upgrade Installation or Re-installation

File	Description
/usr/DynamicLinkManager/config/dlmmgr.xml	File for setting up HDLM functionality
/var/DynamicLinkManager/log/dlmmgr[1-16].log	Log files of HDLM Manager
/var/DynamicLinkManager/log/dlminquiry[1-2].log	Log files of HDLM Inquiry information
/usr/DynamicLinkManager/config/dlmwebagent.properties	Hitachi Command Suite Common Agent Component settings file
/var/DynamicLinkManager/log/hdlmtr[1-64].log	Trace files
/var/DynamicLinkManager/log/dlmconfig[1-2].log	Configuration log file
/var/DynamicLinkManager/log/mmap/hdlmtr.mm	Trace management file
/var/DynamicLinkManager/log/dlmwebagent[1-16].log	Hitachi Command Suite Common Agent Component log files
/var/DynamicLinkManager/log/dlmutil[1-2].log	HDLM utility's log file
/var/DynamicLinkManager/log/mmap/dlmutil.mm	HDLM utility's log trace management file
/var/DynamicLinkManager/log/installhdlm.log	Unattended installation execution log

When Installing HDLM in a Local Boot Disk Environment (if HDLM has been deleted or defined)

1. Log in to AIX as a user with root permissions.
   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.
2. Back up the HDLM settings.
   If an upgrade installation or re-installation fails, AIX automatically removes HDLM, and the HDLM settings are deleted.
   Perform this step so that a copy of the HDLM settings is available in this case.
   If an upgrade installation or re-installation fails, perform a new installation, and then re-execute setup to reflect the settings that have been backed up.
   - Save the HDLM environment settings information.
     `# /usr/DynamicLinkManager/bin/dlnkmgr view -sys > any-file-name`
     Make sure that the license has not expired.
   - Save the HDLM execution environment ODM settings.
     `# /usr/DynamicLinkManager/bin/dlmodmset -o > any-file-name`

   Reconfigure the HDLM device. If HDLM devices and virtual target devices are mapped on the virtual I/O server, go to step 3. If HDLM devices are not mapped as virtual target devices on the virtual I/O server, and if you want to automatically perform processes required for the reconfiguration, such as unmounting the file system and changing the volume group statuses, go to step 9. To manually perform these processes, go to step 10.
3. Terminate the processes of all applications that access the hdisks connected to HDLM devices in the client logical partition.
4. If file systems are mounted on the hdisks connected to HDLM devices in the client logical partition, unmount the file systems.

   ```
   # umount file-system-mount-point
   ```
5. Execute the following command for the client logical partition to display all the activated volume groups.

   ```
   # lsvg -o
   ```
6. From the displayed list of volume groups, inactivate the volume groups used by the hdisks connected to HDLM devices.

   ```
   # varyoffvg volume-group-name
   ```
7. To prevent inheritance of the existing hdisk configuration, delete the hdisks.
8. On the virtual I/O server, remove the mapping between HDLM devices and virtual target devices.

To inherit the hdisk configuration of the virtual I/O client, inherit the mapping between virtual target devices and HDLM devices.

- To inherit the mapping between virtual target devices and HDLM devices:

  ```
  $ rmdev -dev virtual-target-device-name -ucfg
  ```

- To prevent inheritance of the mapping between virtual target devices and HDLM devices:

  ```
  $ rmdev -dev virtual-target-device-name
  ```

9. Execute the utility for removing HDLM devices (`dlmrmdev`) with the `-A` parameter specified.

   To inherit the existing hdisk configuration, execute the `dlmrmdev` utility with the `-e` parameter specified. If you execute the `dlmrmdev` utility without the `-e` parameter specified, the existing HDLM device is deleted.

   To inherit the mapping between virtual target devices and HDLM devices on the virtual I/O server, specify the `-e` parameter to inherit the existing hdisk configuration.

   Note that if you want to inherit the existing hdisk configuration when the installed HDLM version is earlier than 6.2, use the `dlmrmdev` utility included in the installation DVD-ROM of the HDLM version to be installed.

   When `dlmrmdev` is executed, a message is displayed asking you to continue processing. Enter `y` to continue processing.

   To inherit the existing hdisk configuration when the version of the installed HDLM is earlier than 6.2:

   ```
   # /directory-in-which-the-DVD-ROM-is-mounted/HDLM_AIX/hdlmtool/
   dlmrmdev -e -A
   KAPL10528-I The volume group will be made inactive, and the file
   system that is using HDLM will be unmounted. Is this OK? [y/n]:y
   KAPL10526-I An attempt to unmount the file system has succeeded.
   (file system = /mnt/fs01)
   KAPL10527-I An attempt to inactivate the volume group has
   succeeded. (volume group = vg01)
   hdisk7 Defined
   hdisk8 Defined
   hdisk9 Defined
   hdisk10 Defined
   KAPL10531-I The status of all of the HDLM drivers was changed to
   "Defined".
   ```

   To inherit the existing hdisk configuration when the version of the installed HDLM is 6.2 or later:

   ```
   # /usr/DynamicLinkManager/bin/dlmrmdev -e -A
   KAPL10528-I The volume group will be made inactive, and the file
   system that is using HDLM will be unmounted. Is this OK? [y/n]:y
   KAPL10526-I An attempt to unmount the file system has succeeded.
   (file system = /mnt/fs01)
   KAPL10527-I An attempt to inactivate the volume group has
   succeeded. (volume group = vg01)
   hdisk7 Defined
   hdisk8 Defined
   hdisk9 Defined
   ```

```
hdisk10 Defined
KAPL10531-I The status of all of the HDLM drivers was changed to
"Defined".
```

To avoid inheriting the existing hdisk configuration:

```
# /usr/DynamicLinkManager/bin/dlmrmdev -A
KAPL10528-I The volume group will be made inactive, and the file
system that is using HDLM will be unmounted. Is this OK? [y/n]:y
hdisk7 deleted
hdisk8 deleted
hdisk9 deleted
hdisk10 deleted
KAPL09012-I All HDLM drivers were removed.
```

- When the existing hdisk configuration has been successfully inherited, the `KAPL10531-I` message is displayed.

  If the `KAPL10531-I` message is not displayed, make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then perform step 9 again.
- When an existing hdisk has been successfully deleted, the `KAPL09012-I` message is displayed.

  If the `KAPL09012-I` message is not displayed, make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then perform step 9 again.

After the `dlmrmdev` utility successfully finishes, go to step 14.

10. Execute the following command to unmount the file system used by HDLM.

    ```
    # umount file-system-mount-point
    ```

11. Execute the following command to display all the activated volume groups.

    ```
    # lsvg -o
    ```

12. Among the displayed volume groups, inactivate the volume groups used by HDLM.

    ```
    # varyoffvg volume-group-name
    ```

13. Execute the `dlmrmdev` utility to change the status of the hdisks recognized as HDLM management-target devices by the active kernel, and then stop the HDLM manager.

    To inherit the existing hdisk configuration, execute the `dlmrmdev` utility, with the `-e` parameter specified, that is included in the installation DVD-ROM of the HDLM version to be installed. If you execute the `dlmrmdev` utility without the `-e` parameter specified, the existing HDLM device is deleted.

    To inherit the mapping between virtual target devices and HDLM devices on the virtual I/O server, specify the `-e` parameter to inherit the existing hdisk configuration.

    ```
    /DVD-ROM-mounted-directory/HDLM_AIX/hdlmtool/dlmrmdev
    ```

- Deleting an existing hdisk

  When an existing hdisk is successfully deleted, the KAPL09012-I message is displayed. If the KAPL09012-I message is not displayed, make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then re-execute the procedure of step 13.

- Inheriting the existing hdisk configuration

  When the existing hdisk configuration is successfully inherited, the KAPL10531-I message is displayed.

  If the KAPL10531-I message is not displayed, make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then re-execute the procedure of step 13.

14. Execute the following command and verify the status of the hdisks recognized as HDLM-managed devices:

```
# lsdev -Cc disk
```

- If you attempted to delete an existing hdisk by executing the dlmrmdev utility, verify that the hdisk has been deleted.
- If you attempted to inherit the existing hdisk configuration by executing the dlmrmdev utility, verify that the status of the hdisks recognized as HDLM-managed devices is Defined.

```
hdisk0 Available 1S-08-00-8,0    16 Bit LVD SCSI Disk Drive
hdisk1 Available 1S-08-00-9,0    16 Bit LVD SCSI Disk Drive
hdisk2 Available 1S-08-00-10,0   16 Bit LVD SCSI Disk Drive
hdisk3 Defined 1H-08-02        Hitachi Disk Array (Fibre)
hdisk4 Defined 1H-08-02        Hitachi Disk Array (Fibre)
...
```

15. If the license has expired, prepare the license key or license key file.
    If the license has not expired, proceed to step 16.

- When only the license key has been provided

  Create the /var/DLM directory, and then, in this directory, create the license key file (dlm.lic_key). The following shows an example when the license key is 123456789ABCDEF:

```
# mkdir /var/DLM
# echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
```

- When the license key file has been provided

  Store the license key file directly under the /var/tmp/ directory by using the hdlm_license name.

```
/var/tmp/hdlm_license
```

Note that the hdlm_license and dlm.lic_key files are deleted after installation finishes successfully.

16. Insert the HDLM DVD-ROM into the DVD-ROM drive, and mount the DVD-ROM.

If you install HDLM by using a directory to which the DVD-ROM is copied, you do not have to perform this step.

17. For an upgrade installation, execute the following command:

    - When installing HDLM from the DVD-ROM

      # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

      or

      # installp -aXgd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

    - When installing HDLM from the directory to which the DVD-ROM was copied

      # /*directory-copied-from-DVD-ROM*/installux.sh

      or

      # installp -aXgd /*directory-copied-from-DVD-ROM*/HDLM_AIX all

    Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host.

    If you execute the dlmrmdev utility without the -e parameter specified at step 9 or 13 and then the KAPL09048-E message is displayed, the hdisk for the device that is managed by HDLM still remains.

    If you execute the dlmrmdev utility with the -e parameter specified at step 9 or 13 and then the KAPL09048-E message is displayed, the hdisk for the device that is managed by HDLM still remains, and its status is Available. Re-execute the procedure in step 3.

    During installation, the KAPL09241-W message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the KAPL09241-W message if necessary.

18. For a re-installation, execute the following command:

    - When installing HDLM from the DVD-ROM

      # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

      or

      # installp -aXFd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

    - When installing HDLM from the directory to which the DVD-ROM was copied

      # /*directory-copied-from-DVD-ROM*/installux.sh

      or

      # installp -aXFd /*directory-copied-from-DVD-ROM*/HDLM_AIX all

    Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host.

    If you execute the dlmrmdev utility without the -e parameter specified at step 9 or 13 and then the KAPL09048-E message is displayed, the hdisk for the device that is managed by HDLM still remains.

    If you execute the dlmrmdev utility with the -e parameter specified at step 9 or 13 and then the KAPL09048-E message is displayed, the hdisk

for the device that is managed by HDLM still remains, and its status is `Available`. Re-execute the procedure in step 9.

During installation, the `KAPL09241-W` message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the `KAPL09241-W` message if necessary.

19. Execute the following command to make sure that the package is installed.

```
# lslpp -la DLManager.mpio.rte
```

Make sure that the fileset item in the output listing contains `DLManager.mpio.rte`, and all the displayed statuses are `COMMITTED`.

If one or more of the displayed statuses are `BROKEN`, remove and then re-install HDLM.

20. Execute the following command to configure the hdisk:

```
# cfgmgr
```

21. Execute the following command and verify that the status of the hdisks is `Available`:

```
# lsdev -Cc disk
hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
...
```

Make sure that all the displayed HDLM-related devices are `Available`.

hdisks 0 to 2 are the physical device file names of the host's internal disks.

hdisk 3 and the following are the logical device file names that correspond to physical volumes in the storage system.

22. Activate the volume group used by HDLM.

```
# varyonvg volume-group-name
```

23. Mount the file system used by HDLM.

```
# mount file-system-mount-point
```

24. Execute the `dlnkmgr` command's `view` operation to check the status of each program:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                : x.x.x-xx
Service Pack Version        :
Load Balance                : on(rr)
Support Cluster             :
Elog Level                  : 3
Elog File Size (KB)         : 9900
Number Of Elog Files        : 2
Trace Level                 : 0
Trace File Size(KB)         : 1000
```

```
Number Of Trace Files        : 4
Path Health Checking         : on(30)
Auto Failback                : on(60)
Intermittent Error Monitor   : off
Dynamic I/O Path Control     : off(10)
HDLM Manager Ver       WakeupTime
Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver       WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver       WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
```

Even when cluster software is being used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

25. From the execution result of the `view` operation, check that the correct version of HDLM is installed.

    If `HDLM Version` is *x.x.x-xx*, the installed version of HDLM is correct. *x.x.x-xx* is the installed version of HDLM.

26. From the execution result of the `view` operation, check that the programs are running properly.

    If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

    If you are not using a virtual I/O server, the upgrade installation or re-installation of HDLM is complete.

    For details about the files to be inherited after the upgrade installation or re-installation of HDLM, see *Table 3-14 List of Files Inherited During an Upgrade Installation or Re-installation on page 3-39*.

27. If you are using a virtual I/O server, define an hdisk as a virtual target device.

    Execute the following command on the virtual I/O server:

    When creating an hdisk as a virtual target device:

    ```
    $ mkvdev -vdev hdisk-name -vadapter virtual-SCSI-server-
    adapter-name
    ```

    When creating a logical device as a virtual target device:

    ```
    $ mkvdev -vdev logical-volume-name -vadapter virtual-SCSI-
    server-adapter-name
    ```

28. Execute the following command in the client logical partition to reconfigure the device:

    ```
    # cfgmgr
    ```

29. Execute the following command in the client logical partition to confirm that the physical volume has been recognized as hdisk.

    If the following message is displayed, then the physical volume (hdisk) was recognized correctly.

```
# lsdev -Cc disk
hdisk1 Available Virtual SCSI Disk Drive
```

When Installing HDLM in a Local Boot Disk Environment (if you did not delete usable HDLM devices)

1. Log in to AIX as a user with root permissions.
   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.
2. Back up the HDLM settings.
   If an upgrade installation or re-installation fails, AIX automatically removes HDLM, and the HDLM settings are deleted.
   Perform this step so that a copy of the HDLM settings is available in this case.
   If an upgrade installation or re-installation fails, perform a new installation, and then re-execute setup to reflect the settings that have been backed up.
   - Save the HDLM environment settings information.
     `# /usr/DynamicLinkManager/bin/dlnkmgr view -sys > any-file-name`
   - Save the HDLM execution environment ODM settings.
     `# /usr/DynamicLinkManager/bin/dlmodmset -o > any-file-name`

   If HDLM devices and virtual target devices are mapped on the virtual I/O server, go to step 3.
   If HDLM devices are not mapped as virtual target devices on the virtual I/O server, go to step 7.
3. End the processes of all applications that access the hdisks connected to HDLM devices in the client logical partition, because a reboot on the virtual I/O server is required.
4. If file systems are mounted on the hdisks connected to HDLM devices in the client logical partition, unmount the file systems.

   ```
   # umount file-system-mount-point
   ```
5. Execute the following command for the client logical partition to display all the activated volume groups.

   ```
   # lsvg -o
   ```
6. From the displayed list of volume groups, inactivate the volume groups used by the hdisks connected to HDLM devices.

   ```
   # varyoffvg volume-group-name
   ```
7. If the license has expired, prepare the license key or license key file.
   If the license has not expired, proceed to step 15.
   - When only the license key has been provided

Create the /var/DLM directory, and then, in this directory, create the license key file (dlm.lic_key). The following shows an example when the license key is 123456789ABCDEF:

```
# mkdir /var/DLM
# echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
```

- When the license key file has been provided

  Store the license key file directly under the /var/tmp/ directory by using the hdlm_license name.

  /var/tmp/hdlm_license

Note that the hdlm_license and dlm.lic_key files are deleted after installation finishes successfully.

8. Insert the HDLM DVD-ROM into the DVD-ROM drive, and mount the DVD-ROM.

   If you install HDLM by using a directory to which the DVD-ROM is copied, you do not have to perform this step.

9. For an upgrade installation, execute the following command:

   - When installing HDLM from the DVD-ROM

     # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

     or

     # installp -aXgd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

   - When installing HDLM from the directory to which the DVD-ROM was copied

     # /*directory-copied-from-DVD-ROM*/installux.sh

     or

     # installp -aXgd /*directory-copied-from-DVD-ROM*/HDLM_AIX all

   During installation, the KAPL09312-W message might be output, reporting that the host needs to restart. At this point, installation of HDLM continues, keeping the physical volumes to be used. However, execution of HDLM commands and HDLM path health checks cannot be performed until the host restarts.

   During installation, the KAPL09241-W message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the KAPL09241-W message if necessary.

10. For a re-installation, execute the following command:

    - When installing HDLM from the DVD-ROM

      # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

      or

      # installp -aXFd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

    - When installing HDLM from the directory to which the DVD-ROM was copied

      # /*directory-copied-from-DVD-ROM*/installux.sh

or

```
# installp -aXFd /directory-copied-from-DVD-ROM/HDLM_AIX all
```

During installation, the KAPL09312-W message might be output, reporting that the host needs to restart. At this point, installation of HDLM continues, keeping the physical volumes to be used. However, execution of HDLM commands and HDLM path health checks cannot be performed until the host restarts.

During installation, the KAPL09241-W message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the KAPL09241-W message if necessary.

11. Execute the following command to make sure that the package is installed.

```
# lslpp -la DLManager.mpio.rte
```

Make sure that the fileset item in the output listing contains DLManager.mpio.rte, and all the displayed statuses are COMMITTED.

If any of the displayed statuses are BROKEN, perform step 12, uninstall HDLM, and then reinstall HDLM.

12. Execute the following command to restart the host:

```
# shutdown -Fr
```

13. Execute the following command and verify that the status of the hdisks is Available:

```
# lsdev -Cc disk
hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
...
```

Make sure that all the displayed HDLM-related devices are Available.

hdisks 0 to 2 are the physical device file names of the host's internal disks.

hdisk 3 and the following are the logical device file names that correspond to physical volumes in the storage system.

14. Execute the dlnkmgr command's view operation to check the status of each program:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                : x.x.x-xx
Service Pack Version        :
Load Balance                : on(rr)
Support Cluster             :
Elog Level                  : 3
Elog File Size (KB)         : 9900
Number Of Elog Files        : 2
Trace Level                 : 0
Trace File Size(KB)         : 1000
Number Of Trace Files       : 4
Auto Failback               : on(60)
```

```
Intermittent Error Monitor   : off
Dynamic I/O Path Control     : off(10)
HDLM Manager Ver       WakeupTime
Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver        WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver       WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
```

Even when cluster software is being used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

15. From the execution result of the `view` operation, check that the correct version of HDLM is installed.

    If `HDLM Version` is *x.x.x-xx*, the installed version of HDLM is correct. *x.x.x-xx* is the installed version of HDLM.

16. From the execution result of the `view` operation, check that the programs are running properly.

    If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

When Installing HDLM in a Boot Disk Environment (if HDLM has been deleted or defined)

1. Log in to AIX as a user with root permissions.

   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.

2. Back up the HDLM settings.

   If an upgrade installation or re-installation fails, AIX automatically removes HDLM, and the HDLM settings are deleted.

   Perform this step so that a copy of the HDLM settings is available in this case.

   If an upgrade installation or re-installation fails, perform a new installation, and then re-execute setup to reflect the settings that have been backed up.

   - Save the HDLM environment settings information.

     `# /usr/DynamicLinkManager/bin/dlnkmgr view -sys >` *any-file-name*

     Make sure that the license has not expired.

   - Save the HDLM execution environment ODM settings.

     `# /usr/DynamicLinkManager/bin/dlmodmset -o >` *any-file-name*

   If HDLM devices and virtual target devices are mapped on the virtual I/O server, go to step 3.

   If HDLM devices are not mapped as virtual target devices on the virtual I/O server, go to step 9.

3. Terminate the processes of all applications that access the hdisks connected to HDLM devices on the virtual I/O client.
4. If file systems are mounted on the hdisks connected to HDLM devices on the virtual I/O client, unmount the file systems.

   ```
   # umount file-system-mount-point
   ```

5. Execute the following command for the virtual I/O client to display all the activated volume groups.

   ```
   # lsvg -o
   ```

6. From the displayed list of volume groups, inactivate the volume groups used by the hdisks connected to HDLM devices.

   ```
   # varyoffvg volume-group-name
   ```

7. To prevent inheritance of the existing hdisk configuration, delete the hdisks.
8. On the virtual I/O server, remove the mapping between HDLM devices and virtual target devices. To inherit the hdisk configuration of the virtual I/O client, inherit the mapping between virtual target devices and HDLM devices.
   - To inherit the mapping between virtual target devices and HDLM devices:

     ```
     $ rmdev -dev virtual-target-device-name -ucfg
     ```

   - To prevent inheritance of the mapping between virtual target devices and HDLM devices:

     ```
     $ rmdev -dev virtual-target-device-name
     ```

9. Execute the following command to unmount the file system used by HDLM.

   ```
   # umount file-system-mount-point
   ```

10. Execute the following command to display all the activated volume groups.

    ```
    # lsvg -o
    ```

11. Among the displayed volume groups, inactivate the volume groups used by HDLM.

    ```
    # varyoffvg volume-group-name
    ```

12. Execute the utility indicated below to change the status of the hdisks recognized as HDLM management-target devices by the active kernel, and then stop the HDLM manager.

    To inherit the existing hdisk configuration, execute the `dlmrmdev` utility with the `-e` parameter specified.

    To inherit the mapping between virtual target devices and HDLM devices on the virtual I/O server, specify the `-e` parameter to inherit the existing hdisk configuration.

If you are using HDLM version 6.2 or earlier and you want to inherit the existing hdisk configuration, use the dlmrmdev utility that is included in the installation DVD-ROM of the HDLM version to be installed.

```
/DVD-ROM-mounted-directory/HDLM_AIX/hdlmtool/dlmrmdev
```

- Deleting an existing hdisk
  When an existing hdisk is successfully deleted, the KAPL09012-I message is displayed.
  If the KAPL09012-I message is not displayed, make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then re-execute the procedure of step 12. The hdisk of the boot disk cannot be deleted.
- Inheriting the existing hdisk configuration
  When the existing hdisk configuration is successfully inherited, the KAPL10531-I message is displayed.
  If the KAPL10531-I message is not displayed, make sure that no processes, services, file systems, or volume groups are using any HDLM management-target paths, and then re-execute the procedure in step 12. The status of the boot disk's hdisk cannot be changed.

13. Execute the following command and verify the status of the hdisks recognized as HDLM-managed devices:

```
# lsdev -Cc disk
```

- If you attempted to delete an existing hdisk by executing the dlmrmdev utility, verify that the hdisk has been deleted.
- If you attempted to inherit the existing hdisk configuration by executing the dlmrmdev utility with the -e parameter specified, verify that the status of the hdisks is Defined.

```
hdisk0 Available 1S-08-00-8,0    16 Bit LVD SCSI Disk Drive
hdisk1 Available 1S-08-00-9,0    16 Bit LVD SCSI Disk Drive
hdisk2 Available 1S-08-00-10,0   16 Bit LVD SCSI Disk Drive
hdisk3 Defined 1H-08-02        Hitachi Disk Array (Fibre)
hdisk4 Defined 1H-08-02        Hitachi Disk Array (Fibre)
...
```

14. If the license has expired, prepare the license key or license key file.
  If the license has not expired, proceed to step 15.

- When only the license key has been provided
  Create the /var/DLM directory, and then, in this directory, create the license key file (dlm.lic_key). The following shows an example when the license key is 123456789ABCDEF:

```
# mkdir /var/DLM
# echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
```

- When the license key file has been provided
  Store the license key file directly under the /var/tmp/ directory by using the hdlm_license name.

/var/tmp/hdlm_license

Note that the hdlm_license and dlm.lic_key files are deleted after installation finishes successfully.

15. Insert the HDLM DVD-ROM into the DVD-ROM drive, and mount the DVD-ROM.

    If you install HDLM by using a directory to which the DVD-ROM is copied, you do not have to perform this step.

16. For an upgrade installation, execute the following command:

    - When installing HDLM from the DVD-ROM

      # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

      or

      # installp -aXgd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

    - When installing HDLM from the directory to which the DVD-ROM was copied

      # /*directory-copied-from-DVD-ROM*/installux.sh

      or

      # installp -aXgd /*directory-copied-from-DVD-ROM*/HDLM_AIX all

    Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host.

    If you execute the dlmrmdev utility without the -e parameter specified at step 12 and then the KAPL09172-E message is displayed, the hdisk for the device that is managed by HDLM still remains.

    If you execute the dlmrmdev utility with the -e parameter specified at step 12 and then the KAPL09172-E message is displayed, the hdisk for the device that is managed by HDLM still remains, and its status is Available. Re-execute the procedure in step 12.

    If an upgrade installation ends with an error, HDLM might be removed. In this case, proceed to step 19.

    During installation, the KAPL09312-W message might be output, reporting that the host needs to restart. At this point, installation of HDLM continues, keeping the physical volumes to be used. However, execution of HDLM commands and HDLM path health checks cannot be performed until the host restarts.

    During installation, the KAPL09241-W message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the KAPL09241-W message if necessary.

17. For a re-installation, execute the following command:

    - When installing HDLM from the DVD-ROM

      # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

      or

      # installp -aXFd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

- When installing HDLM from the directory to which the DVD-ROM was copied

  ```
  # /directory-copied-from-DVD-ROM/installux.sh
  ```

  or

  ```
  # installp -aXFd /directory-copied-from-DVD-ROM/HDLM_AIX all
  ```

Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host.

If you execute the `dlmrmdev` utility without the `-e` parameter specified at step 12 and then the `KAPL09172-E` message is displayed, the hdisk for the device that is managed by HDLM still remains.

If you execute the `dlmrmdev` utility with the `-e` parameter specified at step 12 and then the `KAPL09172-E` message is displayed, the hdisk for the device that is managed by HDLM still remains, and its status is `Available`. Re-execute the procedure in step 12.

If re-installation ends with an error, HDLM might be removed. In this case, proceed to step 19.

During installation, the KAPL09312-W message might be output, reporting that the host needs to restart. At this point, installation of HDLM continues, keeping the physical volumes to be used. However, execution of HDLM commands and HDLM path health checks cannot be performed until the host restarts.

During installation, the `KAPL09241-W` message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the `KAPL09241-W` message if necessary.

18. Execute the following command to make sure that the package is installed.

    ```
    # lslpp -la DLManager.mpio.rte
    ```

    Make sure that the fileset item in the output listing contains `DLManager.mpio.rte`, and all the displayed statuses are `COMMITTED`.

    If one or more of the displayed statuses are `BROKEN`, remove HDLM, and then proceed to step 19 to perform a new installation of HDLM.

19. If HDLM was not upgraded or re-installed properly, perform a new installation of HDLM.

    - When AIX 5L V5.3 is used, and the boot disk is in a multi-path configuration

      Execute the following command to shut down the host, and then perform the procedure in *Perform Operations for HDLM Management-Target Device on page 3-38*:

      ```
      # shutdown -F
      ```

    - When an environment other than the above is used

      Execute the following command to restart the host, and then perform the procedure in *Perform Operations for HDLM Management-Target Device on page 3-38*:

      ```
      # shutdown -Fr
      ```

After performing a new installation of HDLM, set up HDLM again based on the HDLM settings backed up in step 2.

20. Execute the following command to restart the host:

```
# shutdown -Fr
```

21. Execute the following command to make sure that the hdisk driver has been installed in the active kernel and is enabled:

```
# lsdev -Cc disk
hdisk0 enabled 1S-08-00-8,0  16-bit LVD SCSI disk drive
hdisk1 enabled 1S-08-00-9,0  16-bit LVD SCSI disk drive
hdisk2 enabled 1S-08-00-10,0 16-bit LVD SCSI disk drive
hdisk3 enabled 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4 enabled 1H-08-02      Hitachi Disk Array (Fibre)
...
```

Make sure that all the displayed HDLM-related devices are enabled.

hdisk0 through hdisk2 are the names of the physical device files for internal disks on the host.

The files beginning at hdisk3 are the names of the logical device files corresponding to the storage system's physical volumes.

After executing the lspv command, if there is no hdisk other than the one that constitutes rootvg, re-execute the procedure starting from step 20.

22. Execute the dlnkmgr command's view operation to check the status of each program:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                  : x.x.x-xx
Service Pack Version          :
Load Balance                  : on(rr)
Support Cluster               :
Elog Level                    : 3
Elog File Size (KB)           : 9900
Number Of Elog Files          : 2
Trace Level                   : 0
Trace File Size(KB)           : 1000
Number Of Trace Files         : 4
Path Health Checking          : on(30)
Auto Failback                 : on(60)
Intermittent Error Monitor    : off
Dynamic I/O Path Control      : off(10)
HDLM Manager Ver       WakeupTime
Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver       WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver       WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
```

Even when cluster software is being used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

23. From the execution result of the `view` operation, check that the correct version of HDLM is installed.

    If `HDLM Version` is *x.x.x-xx*, the installed version of HDLM is correct. *x.x.x-xx* is the installed version of HDLM.

    If the KAPL01012-E message is displayed, the HDLM device has not been configured. Re-execute the procedure starting from step 20.

24. From the execution result of the `view` operation, check that the programs are running properly.

    If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

    If you are not using a virtual I/O server, the upgrade installation or re-installation of HDLM is complete.

    For details about the files to be inherited after the upgrade installation or re-installation of HDLM, see *Table 3-14 List of Files Inherited During an Upgrade Installation or Re-installation on page 3-39*.

25. If you are using a virtual I/O server, define an hdisk as a virtual target device.

    Execute the following command on the virtual I/O server:

    When creating an hdisk as a virtual target device:

    ```
    $ mkvdev -vdev hdisk-name -vadapter virtual-SCSI-server-adapter-name
    ```

    When creating a logical device as a virtual target device:

    ```
    $ mkvdev -vdev logical-volume-name -vadapter virtual-SCSI-server-adapter-name
    ```

26. Execute the following command in the client logical partition to reconfigure the device:

    ```
    # cfgmgr
    ```

27. Execute the following command in the client logical partition to confirm that the physical volume has been recognized as hdisk.

    If the following message is displayed, then the physical volume (hdisk) was recognized correctly:

    ```
    # lsdev -Cc disk
    hdisk1 Available Virtual SCSI Disk Drive
    ```

When Installing HDLM in a Boot Disk Environment (if you did not delete usable HDLM devices)

1. Log in to AIX as a user with root permissions.

   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.

2. Back up the HDLM settings.

If an upgrade installation or re-installation fails, AIX automatically removes HDLM, and the HDLM settings are deleted.

Perform this step so that a copy of the HDLM settings is available in this case.

If an upgrade installation or re-installation fails, perform a new installation, and then re-execute setup to reflect the settings that have been backed up.

- Save the HDLM environment settings information.

  ```
  # /usr/DynamicLinkManager/bin/dlnkmgr view -sys > any-file-name
  ```

- Save the HDLM execution environment ODM settings.

  ```
  # /usr/DynamicLinkManager/bin/dlmodmset -o > any-file-name
  ```

If HDLM devices and virtual target devices are mapped on the virtual I/O server, go to step 3.

If HDLM devices are not mapped as virtual target devices on the virtual I/O server, go to step 7.

3. End the processes of all applications that access the hdisks connected to HDLM devices in the client logical partition, because a reboot on the virtual I/O server is required.
4. If file systems are mounted on the hdisks connected to HDLM devices in the client logical partition, unmount the file systems.

   ```
   # umount file-system-mount-point
   ```

5. Execute the following command for the client logical partition to display all the activated volume groups.

   ```
   # lsvg -o
   ```

6. From the displayed list of volume groups, inactivate the volume groups used by the hdisks connected to HDLM devices.

   ```
   # varyoffvg volume-group-name
   ```

7. If the license has expired, prepare the license key or license key file.

   If the license has not expired, proceed to step 15.

   - When only the license key has been provided

     Create the `/var/DLM` directory, and then, in this directory, create the license key file (`dlm.lic_key`). The following shows an example when the license key is `123456789ABCDEF`:

     ```
     # mkdir /var/DLM
     # echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
     ```

   - When the license key file has been provided

     Store the license key file directly under the `/var/tmp/` directory by using the `hdlm_license` name.

     ```
     /var/tmp/hdlm_license
     ```

Note that the hdlm_license and dlm.lic_key files are deleted after installation finishes successfully.

8. Insert the HDLM DVD-ROM into the DVD-ROM drive, and mount the DVD-ROM.

   If you install HDLM by using a directory to which the DVD-ROM is copied, you do not have to perform this step.

9. For an upgrade installation, execute the following command:

   - When installing HDLM from the DVD-ROM

     # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

     or

     # installp -aXgd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

   - When installing HDLM from the directory to which the DVD-ROM was copied

     # /*directory-copied-from-DVD-ROM*/installux.sh

     or

     # installp -aXgd /*directory-copied-from-DVD-ROM*/HDLM_AIX all

   During installation, the KAPL09312-W message might be output, reporting that the host needs to restart. At this point, installation of HDLM continues, keeping the physical volumes to be used. However, execution of HDLM commands and HDLM path health checks cannot be performed until the host restarts.

   During installation, the KAPL09241-W message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the KAPL09241-W message if necessary.

10. For a re-installation, execute the following command:

    - When installing HDLM from the DVD-ROM

      # /*directory-in-which-the-DVD-ROM-is-mounted*/installux.sh

      or

      # installp -aXFd */directory-in-which-the-DVD-ROM-is-mounted*/HDLM_AIX all

    - When installing HDLM from the directory to which the DVD-ROM was copied

      # /*directory-copied-from-DVD-ROM*/installux.sh

      or

      # installp -aXFd /*directory-copied-from-DVD-ROM*/HDLM_AIX all

    During installation, the KAPL09312-W message might be output, reporting that the host needs to restart. At this point, installation of HDLM continues, keeping the physical volumes to be used. However, execution of HDLM commands and HDLM path health checks cannot be performed until the host restarts.

    During installation, the KAPL09241-W message might be output. In this case, installation of HDLM continues, but installation of HDLM components

has failed. After installing HDLM, resolve the problem according to the KAPL09241-W message if necessary.

11. Execute the following command to make sure that the package is installed.

    ```
    # lslpp -la DLManager.mpio.rte
    ```

    Make sure that the fileset item in the output listing contains DLManager.mpio.rte, and all the displayed statuses are COMMITTED.

    If one or more of the displayed statuses are BROKEN, remove HDLM, and then proceed to step 12 to perform a new installation of HDLM.

12. If HDLM was not upgraded or re-installed properly, perform a new installation of HDLM.

    - When AIX 5L V5.3 is used, and the boot disk is in a multi-path configuration

      Execute the following command to shut down the host, and then perform the procedure in *When Installing HDLM in a Boot Disk Environment on page 3-32*:

      ```
      # shutdown -F
      ```

    - When an environment other than the above is used

      Execute the following command to restart the host, and then perform the procedure in *When Installing HDLM in a Boot Disk Environment on page 3-32*:

      ```
      # shutdown -Fr
      ```

    After performing a new installation of HDLM, set up HDLM again based on the HDLM settings backed up in step 2.

13. Execute the following command to restart the host:

    ```
    # shutdown -Fr
    ```

14. Execute the following command and verify that the status of the hdisks is Available:

    ```
    # lsdev -Cc disk
    hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
    hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
    hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
    hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
    hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
    ...
    ```

    Make sure that all the displayed HDLM-related devices are Available.

    hdisks 0 to 2 are the physical device file names of the host's internal disks.

    hdisk 3 and the following are the logical device file names that correspond to physical volumes in the storage system.

15. Execute the dlnkmgr command's view operation to check the status of each program:

    ```
    # /usr/DynamicLinkManager/bin/dlnkmgr view -sys
    HDLM Version                : x.x.x-xx
    Service Pack Version        :
    ```

```
Load Balance                 : on(rr)
Support Cluster              :
Elog Level                   : 3
Elog File Size (KB)          : 9900
Number Of Elog Files         : 2
Trace Level                  : 0
Trace File Size(KB)          : 1000
Number Of Trace Files        : 4
Auto Failback                : on(60)
Intermittent Error Monitor   : off
Dynamic I/O Path Control     : off(10)
HDLM Manager Ver       WakeupTime
Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver       WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver       WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
```

Even when cluster software is being used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

16. From the execution result of the `view` operation, check that the correct version of HDLM is installed.

    If `HDLM Version` is *x.x.x-xx*, the installed version of HDLM is correct. *x.x.x-xx* is the installed version of HDLM.

17. From the execution result of the `view` operation, check that the programs are running properly.

    If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

When Installing HDLM on Alternate Disks

Perform the procedure below if you want to install HDLM on an alternate disk in a local boot disk environment or a boot disk environment. Only upgrade installations and re-installations are supported when HDLM is installed on alternate disks.

1. Log in to AIX as a user with root permissions.

   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.

2. If the license has expired, prepare the license key or license key file.

   If the license has not expired, proceed to step 3.

   - When only the license key has been provided

     Create the `/var/DLM` directory, and then, in this directory, create the license key file (`dlm.lic_key`). The following shows an example when the license key is `123456789ABCDEF`:

     ```
     # mkdir /var/DLM
     # echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
     ```

- When the license key file has been provided

  Store the license key file directly under the `/var/tmp/` directory by using the `hdlm_license` name.

  `/var/tmp/hdlm_license`

Note that the `hdlm_license` and `dlm.lic_key` files are deleted after installation finishes successfully.

3. Insert the DVD-ROM into the DVD-ROM drive, and mount the DVD-ROM.

   You do not need to mount the DVD-ROM. If you install HDLM by using a directory to which the DVD-ROM is copied or if you use the `nim` command, you do not have to perform this step.

4. For an upgrade installation, execute the following command:

   - When installing HDLM on an alternate disk from the DVD-ROM

     `# alt_disk_copy -d` *hdisk-name hdisk-name* `... -w DLManager.mpio.rte -l /`*directory-in-which-the-DVD-ROM-is-mounted*`/HDLM_AIX`

   - When installing HDLM onto an alternate disk from the directory to which the DVD-ROM was copied

     `# alt_disk_copy -d` *hdisk-name hdisk-name* `... -w DLManager.mpio.rte -l /`*directory-copied-from-DVD-ROM*`/HDLM_AIX`

   - When installing HDLM on an alternate disk on a NIM client from a NIM server by using the `nim` command

     A NIM server is a machine that manages the installation or upgrade installation of software via a network. A NIM client is a machine whose software installation status is managed by a NIM server.

     `# nim -o alt_disk_install -a source=rootvg -a disk=`*hdisk-name hdisk-name* `... -a filesets=DLManager.mpio.rte -a installp_bundle=`*NIM-resource-including-HDLM NIM-client*

   For details about the `alt_disk_copy` and `nim` commands, see the manual for AIX.

5. For a re-installation, execute the following command:

   - When installing HDLM on an alternate disk from the DVD-ROM

     `# alt_disk_copy -d` *hdisk-name hdisk-name* `... -I aXF -w DLManager.mpio.rte -l /`*directory-in-which-the-DVD-ROM-is-mounted*`/HDLM_AIX`

   - When installing HDLM onto an alternate disk from the directory to which the DVD-ROM was copied

     `# alt_disk_copy -d` *hdisk-name hdisk-name* `... -I aXF -w DLManager.mpio.rte -l /`*directory-copied-from-DVD-ROM*`/HDLM_AIX`

   - When installing HDLM on an alternate disk on a NIM client from a NIM server by using the `nim` command

     A NIM server is a machine that manages the installation or upgrade installation of software via a network. A NIM client is a machine whose software installation status is managed by a NIM server.

```
# nim -o alt_disk_install -a source=rootvg -a disk=hdisk-name hdisk-name ... -a filesets=DLManager.mpio.rte -a installp_bundle=NIM-resource-including-HDLM -a installp_flags=aXF NIM-client
```

For details about the `alt_disk_copy` and `nim` commands, see the manual for AIX.

6. When the system is rebooted from the alternate disk, execute the HDLM command's `view` operation to display the status of each program.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                  : x.x.x-xx
Service Pack Version          :
Load Balance                  : on(rr)
Support Cluster               :
Elog Level                    : 3
Elog File Size (KB)           : 9900
Number Of Elog Files          : 2
Trace Level                   : 0
Trace File Size(KB)           : 1000
Number Of Trace Files         : 4
Path Health Checking          : on(30)
Auto Failback                 : on(60)
Intermittent Error Monitor    : off
Dynamic I/O Path Control      : off(10)
HDLM Manager Ver       WakeupTime
Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver       WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver       WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
```

Even when cluster software is being used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

7. From the execution result of the `view` operation, check that the correct version of HDLM is installed.

   If `HDLM Version` is *x.x.x–xx*, the installed version of HDLM is correct. *x.x.x–xx* is the installed version of HDLM.

8. From the execution result of the `view` operation, check that the programs are running properly.

   If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

Performing an Installation in a Multibos Environment

By using the AIX `multibos` command, you can perform an upgrade installation of HDLM on a standby BOS to be newly created or on an already created BOS. Only upgrade installation is supported for installation of HDLM in a multibos environment. Before you perform an upgrade installation of

HDLM, make sure that your HDLM license has not expired. If the license has expired, prepare a valid license key or license key file.

1. Log in to AIX as a user with root permissions.

   If you are using a virtual I/O server, see the virtual I/O server documentation for the procedure to log in to AIX. If your license is still valid, go to step 6. If you have prepared a license key or license key file, go to the following steps:

   - If you prepared a license key for an upgrade installation of HDLM on a standby BOS to be newly created, go to step 2.
   - If you prepared a license key file for an upgrade installation of HDLM on a standby BOS to be newly created, go to step 3.
   - If you prepared a license key for an upgrade installation of HDLM on an already created standby BOS, go to step 4.
   - If you prepared a license key file for an upgrade installation of HDLM on an already created standby BOS, go to step 5.

2. Store the license key you prepared. Create the `/var/DLM` directory, and then, in this directory, create the license key file (`dlm.lic_key`).

   The following is an example of executing the command when the license key is `123456789ABCDEF`:

   ```
   # mkdir /var/DLM
   # echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
   ```

   The `dlm.lic_key` file is automatically deleted after the upgrade installation of HDLM is completed normally. Go to step 6.

3. Store the license key file you prepared. Store the license key file with the name of `hdlm_license` in the `/var/tmp/` directory.

   The following is an example of executing the command:

   ```
   /var/tmp/hdlm_license
   ```

   The `hdlm_license` file is automatically deleted after the upgrade installation of HDLM is completed normally. Go to step 6.

4. Mount the file system of an already created standby BOS, and then store the license key you prepared. Create the `/bos_inst/var/DLM` directory, and then, in this directory, create the license key file (`dlm.lic_key`). Then unmount the file system of the standby BOS.

   The following is an example of executing the command when the license key is `123456789ABCDEF`.

   ```
   # multibos -Xm
   # mkdir /bos_inst/var/DLM
   # echo "123456789ABCDEF" > /bos_inst/var/DLM/dlm.lic_key
   # multibos -Xu
   ```

   The `dlm.lic_key` file is automatically deleted after the upgrade installation of HDLM is completed normally. Go to step 6.

5. Mount the file system of an already created standby BOS, and then store the license key file you prepared. Store the license key file with the name `hdlm_license` in the `/bos_inst/var/tmp/` directory. Then unmount the file system of the standby BOS.

   The following is an example of executing the command:

```
# multibos -Xm
/bos_inst/var/tmp/hdlm_license
# multibos -Xu
```

The hdlm_license file is automatically deleted after the upgrade installation of HDLM is completed normally. Go to step 6.

6. If you install HDLM as an installation bundle, create a bundle file containing the HDLM syntax. The following is an operation example of adding the HDLM syntax to a bundle file named /tmp/hdlm_bandle:

```
# echo "I:DLManager.mpio.rte" > /tmp/hdlm_bandle
```

7. Insert the DVD-ROM, and then mount it.

   This step is not necessary when you install HDLM from a directory to which you have copied the contents of the DVD-ROM.

8. Execute the following commands to perform an upgrade installation of HDLM.

   When performing an upgrade installation of HDLM at the same time as creating a standby BOS

   - An example of executing the command to install HDLM from the DVD-ROM or the directory to which the contents of the DVD-ROM have been copied:

     ```
     # multibos -Xs -a -l name-of-the-directory-to-which-the-DVD-ROM-is-mounted-or-the-contents-of-the-DVD-ROM-have-been-copied/HDLM_AIX
     ```

   - An example of executing the command to install HDLM as an installation bundle from the DVD-ROM or a directory to which the contents of the DVD-ROM have been copied:

     ```
     # multibos -Xs -b name-of-the-bundle-file-in-which-the-HDLM-syntax-is-written -l /name-of-the-directory-to-which-the-DVD-ROM-is-mounted-or-the-contents-of-the-DVD-ROM-have-been-copied/HDLM_AIX
     ```

   When performing an upgrade installation of HDLM on an already created standby BOS

   - An example of executing the command to install HDLM from the DVD-ROM or a directory to which the contents of the DVD-ROM have been copied:

     ```
     # multibos -Xc -a -l name-of-the-directory-to-which-the-DVD-ROM-is-mounted-or-the-contents-of-the-DVD-ROM-have-been-copied/HDLM_AIX
     ```

   - An example of executing the command to install HDLM as an installation bundle from the DVD-ROM or a directory to which the contents of the DVD-ROM have been copied:

     ```
     # multibos -Xc -b name-of-the-bundle-file-in-which-the-HDLM-syntax-is-written -l /name-of-the-directory-to-which-the-DVD-ROM-is-mounted-or-the-contents-of-the-DVD-ROM-have-been-copied/HDLM_AIX
     ```

   For details about the multibos command, see the AIX documentation.

9. Restart the standby BOS, and then execute the following command to make sure that the package has been installed:

   ```
   # lslpp -la DLManager.mpio.rte
   ```

   Make sure that `DLManager.mpio.rte` exists among the file set items on the output list, and that only the `COMMITTED` status is displayed.

   If there is even one BROKEN status displayed, remove HDLM and then perform a new installation, or delete the standby BOS and then re-create the standby BOS.

10. Execute the HDLM command's `view` operation to display the status of the programs.

    The following is an example of executing the command:

    ```
    # /usr/DynamicLinkManager/bin/dlnkmgr view -sys
    HDLM Version                  : x.x.x-xx
    Load Balance                  : on(rr)
    Support Cluster               :
    Elog Level                    : 3
    Elog File Size (KB)           : 9900
    Number Of Elog Files          : 2
    Trace Level                   : 0
    Trace File Size(KB)           : 1000
    Number Of Trace Files         : 4
    Path Health Checking          : on(30)
    Auto Failback                 : off
    Intermittent Error Monitor    : off
    Dynamic I/O Path Control      : off(10)
    HDLM Manager Ver          WakeupTime
    Alive         x.x.x-xx    yyyy/mm/dd hh:mm:ss
    HDLM Alert Driver Ver          WakeupTime           ElogMem Size
    Alive              x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
    HDLM Driver Ver          WakeupTime
    Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
    License Type Expiration
    Permanent    -
    KAPL01001-I The HDLM command completed normally. Operation name
    = view, completion time = yyyy/mm/dd  hh:mm:ss
    ```

    Even if cluster software is used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

11. Use the `view` operation to check the installed version of HDLM.

    If *x.x.x-xx* is displayed for `HDLM Version`, the installed version of HDLM is correct. *x.x.x-xx* is the installed version of HDLM.

12. Use the `view` operation to check whether the programs are running properly.

    If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

Using the nimadm command to simultaneously upgrade HDLM and migrate the OS

To use the `nimadm` command to upgrade HDLM on a NIM client, perform the steps below from a NIM master.

A NIM master is a machine that manages the installation or upgrade installation of software via a network. A NIM client is a machine whose software installation status is managed by a NIM server.

Before you upgrade HDLM on a NIM client, make sure that your HDLM license has not expired. If the license has expired, prepare a valid license key or license key file.

Make sure that the following conditions are met before using the `nimadm` command to upgrade HDLM:

- The OS version after migration is AIX 7.1 TL02 SP01, or AIX 6.1 TL08 SP1 or later.
- The target disk of a NIM client used as an alternate disk is in a boot disk environment.

1. If the HDLM license on the NIM client has expired, renew the license.
   If the license has not expired, proceed to step 2.
   - When only the license key has been provided
     On the NIM client, execute the `set` operation of the HDLM command while specifying the `-lic` parameter to enter a license key.

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr set -lic
     KAPL01049-I Would you like to execute the operation?
     Operation name = set [y/n]:y
     KAPL01083-I There is no license key file. File name =/var/tmp/
     hdlm_license
     KAPL01068-I Enter a license key:*************
     KAPL01071-I The permanent license was installed.
     #
     ```
   - When the license key file has been provided
     Store the license key file directly under the `/var/tmp/` directory on a NIM client by using the `hdlm_license` name.
     `/var/tmp/hdlm_license`
     On the NIM client, execute the `set` operation of the HDLM command while specifying the `-lic` parameter.

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr set -lic
     KAPL01049-I Would you like to execute the operation?
     Operation name = set [y/n]:y
     KAPL01071-I The permanent license was installed.
     #
     ```

   For details about license key types and the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.
2. Log in to the NIM master as a user with root privileges.
3. On the NIM master, execute the following `nimadm` command:

```
# nimadm -c NIM-client-name -l NIM-resource-containing-HDLM -s
NIM-SPOT-name -d NIM-client-target-disk... -Y
```

For details about the `nimadm` command, see the AIX documentation.

4. After restarting the NIM client from the alternate disk, execute the following command on the NIM client to confirm that the package has been installed:

   ```
   # lslpp -la DLManager.mpio.rte
   ```

   Make sure that `DLManager.mpio.rte` exists among the file set items on the output list, and that only the `COMMITTED` status is displayed.

   If there is even one BROKEN status displayed, remove HDLM and then perform a new installation, or re-create the alternate disk.

5. On the NIM client, execute the `view` operation of the HDLM command to display the status of each program.

   The following is an example of executing the command:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr view -sys
   HDLM Version                : x.x.x-xx
   Load Balance                : on(rr)
   Support Cluster             :
   Elog Level                  : 3
   Elog File Size (KB)         : 9900
   Number Of Elog Files        : 2
   Trace Level                 : 0
   Trace File Size(KB)         : 1000
   Number Of Trace Files       : 4
   Path Health Checking        : on(30)
   Auto Failback               : off
   Intermittent Error Monitor  : off
   Dynamic I/O Path Control    : off(10)
   HDLM Manager Ver         WakeupTime
   Alive        x.x.x-xx    yyyy/mm/dd hh:mm:ss
   HDLM Alert Driver Ver         WakeupTime          ElogMem Size
   Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
   HDLM Driver Ver         WakeupTime
   Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
   License Type Expiration
   Permanent    -
   KAPL01001-I The HDLM command completed normally. Operation name
   = view, completion time = yyyy/mm/dd  hh:mm:ss
   ```

   Even if cluster software is used, the name of the cluster software is not displayed in `Support Cluster`. However, the cluster support function is operating normally.

6. Use the `view` operation to check the installed version of HDLM.

   If *x.x.x-xx* is displayed for `HDLM Version`, the installed version of HDLM is correct. *x.x.x-xx* is the installed version of HDLM.

7. Use the `view` operation to check whether the programs are running properly.

   If `HDLM Manager`, `HDLM Alert Driver`, and `HDLM Driver` are all `Alive`, all programs are running correctly.

Installing HDLM to the SPOT of a NIM resource

This subsection explains how to install HDLM to the SPOT of a NIM resource.

Note that, to install HDLM to a SPOT, all of the following conditions must be satisfied:

- The OS version of the NIM master that manages the SPOT is AIX 7.1 or AIX 6.1.
- HTC_ODM or XP_ODM is installed on the SPOT on which HDLM is to be installed.

1. Log in to AIX as a user with root permissions.
2. If you are going to perform a new installation of HDLM to SPOT, or if the HDLM license in SPOT has expired, prepare a valid license key or license key file. If the license has not expired, proceed to step 3.
   - If only a license key has been provided

     Directly under the `/usr/lpp/bos/inst_root/var/DLM` directory in the SPOT where HDLM will be installed, store the `dlm.lic_key` file that contains the license key.

     The following is an example of executing the command where the name of the SPOT to which HDLM is installed is `spot_7102_HDLM` and the license key is `123456789ABCDEF`:

     ```
     # lsnim -l spot_7102_HDLM | grep location
       location = /export/spot_7102/spot_7102_HDLM/usr
     # mkdir /export/spot_7102/spot_7102_HDLM/usr/lpp/bos/
     inst_root/var/DLM
     # echo "123456789ABCDEF" > /export/spot_7102/
     spot_7102_HDLM/usr/lpp/bos/inst_root/var/DLM/dlm.lic_key
     ```
   - If a license key file has been provided

     Name the license key file `hdlm_license`, and store it directly under the `/usr/lpp/bos/inst_root/var/tmp` directory in the SPOT where HDLM will be installed.

     The following is an example of executing the command to check the location of `spot_7102_HDLM` when the name of the SPOT to which HDLM is installed is `spot_7102_HDLM`:

     ```
     # lsnim -l spot_7102_HDLM | grep location
       location      = /export/spot_7102/spot_7102_HDLM/usr
     ```

     In the above example, the license key file will be `/export/spot_7102/spot_7102_HDLM/usr/lpp/bos/inst_root/var/tmp/hdlm_license`.
3. Execute the following command to perform a new or upgrade installation:

   ```
   # nim -o cust -a lpp_source=Ipp-source-resources-that-contain-
   HDLM -a filesets=DLManager.mpio.rte NIM-SPOT-name-of-HDLM-
   installation-destination
   ```

   For details about the `nim` command, see the AIX documentation.
4. Execute the following command to perform a reinstallation:

```
# nim -o cust -a lpp_source=lpp-source-resources-that-contain-HDLM -a filesets=DLManager.mpio.rte -a installp_flags=aXF NIM-SPOT-name-of-HDLM-installation-destination
```

For details about the `nim` command, see the AIX documentation.

5. Execute the following command to verify that the package has been installed:

```
# nim -o lslpp name-of-NIM-SPOT-where-HDLM-is-installed
```

Make sure that the fileset item in the output listing contains `DLManager.mpio.rte`, and that the `State` item is `COMMITTED`.

If the `State` item is a value other than `COMMITTED`, uninstall `DLManager.mpio.rte`, and then repeat the installation procedure to the SPOT.

6. If you installed HDLM to a SPOT, and you then use that SPOT to install the operating system to a NIM client, after the installation, perform the procedure below to run the utility for HDLM restoration support (`dlmpostrestore`).

   a. After the OS is installed and the host starts, log in to that host as the root user.

   b. Execute the `dlmpostrestore` utility.

```
# /usr/DynamicLinkManager/bin/dlmpostrestore
```

   A message (in a local boot disk environment, the KAPL10552-I message, or in a boot disk environment, the KAPL10555-I message) appears and asks for confirmation that processing is to continue. To continue the processing, enter `y`. In a boot disk environment, the host restarts.

For details about the `dlmpostrestore` utility, see *dlmpostrestore Utility for HDLM Restoration Support on page 7-25*.

Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later

When HDLM version 5.8.1 or earlier is migrated to HDLM version 5.9 or later, the logical device file that can be controlled by the HDLM driver changes from the HDLM device (`dlmfdrv`*n*) to hdisk. If the user application uses an LU managed by HDLM, modify the user application appropriately.

To migrate to HDLM version 5.9 or later:

1. Log in to AIX as a user with root permissions.
   - If you are using a virtual I/O server, see the virtual I/O server documentation for details about how to log in to AIX.
   - If you are not using a virtual I/O server, proceed to step 10.
2. Check the virtual SCSI disk recognition method being used.

   Execute the `dlmodmset` utility for setting the HDLM execution environment ODM in order to check the `unique_id` value:

The following shows an example of executing this utility when HDLM 5.6.3 has been installed:

```
# dlmodmset -o
Inquiry Log             : on
Inquiry Log File Size   : 1000
hdisk error check flag  : on
HDLM pbuf count         : 16384
Lun Reset               : off
unique_id               : off
HDLM Subclass           : node
KAPL10800-I The dlmodmset utility completed normally.
#
```

If the `unique_id` value is `on`, the `unique_id` method is being used. If it is `off`, the PVID method is being used. If the `unique_id` method is being used, proceed to step 8.

3. Execute the following command to activate the volume group that is using the virtual SCSI disk of the HDLM management-target hdisk:

   ```
   # varyonvg volume-group-name
   ```

4. Execute the following command to mount the file system (under control of the volume group) in the client logical partition:

   ```
   # mount file-system-mount-point
   ```

5. Execute the following command to back up the volume group in the client logical partition:

   ```
   # savevg -i -f any-file-name-or-device-volume-name volume-group-name
   ```

6. Execute the following command to unmount the file system in the client logical partition:

   ```
   # umount file-system-mount-point
   ```

7. Execute the following command to delete the volume group in the client logical partition:

   ```
   # reducevg -df volume-group-name hdisk-name
   ```

8. Execute the following command to delete the virtual SCSI disk in the client logical partition:

   ```
   # rmdev -dl hdisk-name
   ```

9. Execute the following command to delete the virtual target device in the virtual I/O server:

   ```
   $ rmdev -dev vtscsin
   ```

10. Insert the DVD-ROM.
11. If there is no directory for mounting the DVD-ROM, make the directory.

    ```
    # mkdir /cdrom
    ```

cdrom is the desired directory name. Hereafter, *cdrom* is used for purposes of explanation.

12. Mount the DVD-ROM.

    ```
    # mount -r -v cdrfs /dev/cd0 /cdrom
    ```

    The `/dev/cd0` part depends on the system.

13. Back up the HDLM settings.

    To check whether the HDLM settings information has been properly inherited after migration, save the HDLM settings information into separate files.

    - Save the HDLM environment settings information.

      ```
      # /usr/DynamicLinkManager/bin/dlnkmgr view -sys > any-file-name
      ```

    - Save the HDLM execution environment ODM settings.

      ```
      # /usr/DynamicLinkManager/bin/dlmodmset -o > any-file-name
      ```

14. Back up the HDLM settings.

    Execute the `dlmmigsts` utility, for assisting HDLM migrations, to save the HDLM environment settings and the HDLM execution environment ODM settings. For details about this utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.

    ```
    # /cdrom/HDLM_AIX/hdlmtool/dlmmigsts -b -odm
     /tmp/any-desired-directory/odm-environment-settings-file-name -
    set /tmp/any-desired-directory/set-environment-settings-file-name
    ```

    Also, back up the information for the applications you are using, if necessary.

15. Remove HDLM.

    See the HDLM manual for the version you are going to remove.

    Because HDLM version 5.9 or later requires deletion of `hdisk`, do not attempt to perform device configuration (`cfgmgr` command) before performing step 17.

16. Perform a new installation of HDLM version 5.9 or later.

    Perform steps 4 to 9 of *When Installing HDLM in a Local Boot Disk Environment on page 3-27* in *Performing a New Installation of HDLM on page 3-27*. Note that you do not have to perform steps 2 to 3.

17. Execute the `dlmmigsts` utility to restore the HDLM environment settings information and the HDLM execution environment ODM settings that you saved in step 14.

    ```
    # /cdrom/HDLM_AIX/hdlmtool/dlmmigsts -r -odm /tmp/any-desired-
    directory/odm-environment-settings-file-name -set /tmp/any-
    desired-directory/set-environment-settings-file-name
    ```

    For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.

18. Execute the following command to reconfigure the device:

    ```
    # cfgmgr
    ```

19. Make sure that the HDLM settings information has been properly inherited.
    - Make sure that the HDLM environment settings information has been properly inherited.

      Execute the following command, and then compare the current HDLM environment settings information with the settings information saved in step 13:

      ```
      # /usr/DynamicLinkManager/bin/dlnkmgr view -sys
      ```
    - Make sure that the HDLM execution environment ODM settings information has been properly inherited.

      Execute the following command, and then compare the current HDLM execution environment ODM settings information with the settings information saved in step 13:

      ```
      # /usr/DynamicLinkManager/bin/dlmodmset -o
      ```

    If the HDLM settings information has been properly inherited, skip to step 21.
20. If the HDLM settings information has not been properly inherited, execute the following command:

    ```
    # /usr/DynamicLinkManager/bin/dlmrmdev
    ```

    Check the file names for *odm-environment-settings-file-name* and *set-environment-setting-file-name*, and then perform this procedure again from step 17, specifying the correct file names in the command.
21. Delete the `odm` environment settings file and the `set` environment settings file.

    ```
    # rm -r /tmp/any-desired-directory-that-stores-odm-environment-settings-file
    # rm -r /tmp/any-desired-directory-that-stores-set-environment-setting-file
    ```
22. Perform the procedure described in *When Installing HDLM in a Local Boot Disk Environment on page 3-27* in *Performing a New Installation of HDLM on page 3-27*, starting from step 14.
23. If you performed step 5, restore the volume group you backed up.

    ```
    # restvg -f any-desired-file-name-or-device-name hdisk-name
    ```
24. Check the path configuration according to the steps described in *Checking the Path Configuration on page 3-87*.
25. Unmount the DVD-ROM.

    ```
    # umount /cdrom
    ```
26. Delete any mount directory you may have created in step 11.

    ```
    # rm -r /cdrom
    ```

Installing HDLM in a PowerHA 6.1 Environment

This subsection explains how to install HDLM when you are running services in a PowerHA 6.1 environment.

Upgrading or Re-installing HDLM in a PowerHA 6.1 Environment (in a Local Boot Disk Environment)

Because HDLM version 5.8.1 or earlier cannot be upgraded to HDLM version 5.9 or later, migration is necessary. For details about migration, see *Migrating HDLM in a PowerHA 6.1 Environment on page 3-74*.

For details about setting up PowerHA, see the PowerHA documentation.

To upgrade or re-install HDLM in an environment that uses PowerHA and a local boot disk:

1. Log in to AIX as the root user.
   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.
2. Stop PowerHA on the standby host.
3. Upgrade or re-install HDLM on the standby host.
   To do so, perform either steps 2 through 29 in When Installing HDLM in a Local Boot Disk Environment (if HDLM has been deleted or defined) on page 3-40 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or steps 2 through 16 in When Installing HDLM in a Local Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-47 on the standby host.
4. Start PowerHA on the standby host.
5. Stop PowerHA on the active host.
   Specify takeover as the shutdown mode.
6. Upgrade or re-install HDLM on the active host.
   To do so, perform either steps 2 through 29 in When Installing HDLM in a Local Boot Disk Environment (if HDLM has been deleted or defined) on page 3-40 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or steps 2 through 16 in When Installing HDLM in a Local Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-47 on the active host.
7. Start PowerHA on the active host.

Upgrading or Re-installing HDLM in a PowerHA 6.1 Environment (in a Boot Disk Environment)

For details about setting up PowerHA, see the PowerHA documentation.

To upgrade or re-install HDLM in an environment that uses PowerHA and a boot disk:

1. Log in to AIX as the root user.
   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.

2. Stop PowerHA on the standby host.
3. Upgrade or re-install HDLM on the standby host.
   To do so, perform either steps 2 through 27 in When Installing HDLM in a Boot Disk Environment (if HDLM has been deleted or defined) on page 3-50 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or steps 2 through 17 in When Installing HDLM in a Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-56 on the standby host.
4. Start PowerHA on the standby host.
5. Stop PowerHA on the active host.
   Specify takeover as the shutdown mode.
6. Upgrade or re-install HDLM on the active host.
   To do so, perform either steps 2 through 27 in When Installing HDLM in a Boot Disk Environment (if HDLM has been deleted or defined) on page 3-50 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or steps 2 through 17 in When Installing HDLM in a Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-56 on the active host.
7. Start PowerHA on the active host.

Migrating HDLM in a PowerHA 6.1 Environment

When HDLM version 5.8.1 or earlier is migrated to HDLM version 5.9 or later, the logical device file that can be controlled by the HDLM driver changes from the HDLM device (`dlmfdrv`*n*) to hdisk. If the user application uses an LU managed by HDLM, modify the user application appropriately.

In a virtual I/O server environment, you cannot migrate HDLM when you are running PowerHA services.

The following procedure explains how to migrate HDLM in an PowerHA environment. This procedure explains how to migrate HDLM when you are using PowerHA 6.1. For details about how to use PowerHA, see the PowerHA documentation along with this manual.

To migrate HDLM in an PowerHA environment:

1. Log in to AIX as the root user.
2. If disk heartbeats are set, delete the disk heartbeat settings (because you need to change the disk name from `dlmfdrv` to `hdisk`).
   For details, see the PowerHA documentation.
3. Stop PowerHA on the standby host.
4. Migrate HDLM on the standby host.
   To do so, perform steps 10 to 26 in *Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later on page 3-69* on the standby host.
5. Start PowerHA on the standby host.
   When PowerHA starts, a warning message may be output, stating that the custom disk method file (`/usr/DynamicLinkManager/cluster/`

dlm_hacmp_gdisk_check) does not exist. This message can be ignored because it does not affect any operations.

The following is an example of such a message:

```
WARNING: Custom disk method: ghostdisks's file:
 /usr/DynamicLinkManager/cluster/dlm_hacmp_gdisk_check does not
exist or is not executable on node: xxx#
```

#

Name of the node being used.

6. Stop PowerHA on the active host.

   Specify takeover as the shutdown mode.

7. Migrate HDLM on the active host.

   To do so, perform steps 10 to 26 in *Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later on page 3-69* on the active host.

8. Start PowerHA on the active host.

   When PowerHA starts, a warning message may be output, stating that the custom disk method file (/usr/DynamicLinkManager/cluster/dlm_hacmp_gdisk_check) does not exist. This message can be ignored because it does not affect any operations.

   The following is an example of such a message:

   ```
   WARNING: Custom disk method: ghostdisks's file:
    /usr/DynamicLinkManager/cluster/dlm_hacmp_gdisk_check does not
   exist or is not executable on node: xxx#
   ```

   #

   Name of the node being used.

   If this warning message is output, proceed to step 9. If it is not output, proceed to step 12.

9. While PowerHA is running, delete the custom disk method defined in 5.8.1 or earlier, or in 5.9 or later.
10. Add an HDLM custom disk method.
11. Synchronize the cluster resources.
12. Delete the custom disk method.

    To do so, perform the procedure described in *Canceling Cluster Software (PowerHA) Settings on page 3-120* on the active host.

13. Configure a custom disk method.

    To do so, perform the procedure described in *Registering the HDLM Script for PowerHA on page 3-106* on the active host.

14. If you deleted the disk heartbeat settings in step 2, re-configure the disk heartbeats.

    For details, see the PowerHA documentation.

Installing HDLM in an Environment Running PowerHA 7.1 or a Later Version

In an environment running PowerHA 7.1 or a later version, even if the cluster service is stopped, the cluster repository disk remains in the used state. Therefore, if you perform a new installation, upgrade installation, or re-installation of HDLM in an environment in which PowerHA is already in use, perform the procedure below. For details on how to use and set up PowerHA, see the PowerHA documentation.

1. Log in to the standby host as the root user.
2. Execute the following command on the standby host to stop PowerHA.

```
# smitty cl_stop
```

3. Execute the following command on the standby host.

   When the OS used in a PowerHA environment is AIX V6.1 TL06 or AIX V7.1 with no TL:

```
# clcmd stopsrc -s clconfd
# clusterconf -fu
```

   When the OS used in a PowerHA environment is AIX V6.1 TL07 or later or AIX V7.1 TL01 or later:

```
# clctrl -stop -m node-name
```

4. Perform a new installation, upgrade installation, or re-installation of HDLM on the standby host.

   When performing a new installation of HDLM in a local boot disk environment:

   Perform the procedure described in Stop Applications on page 3-38 of Preparations for an Upgrade Installation or Re-installation of HDLM on page 3-38.

   When performing a new installation of HDLM in a boot disk environment:

   Perform the procedure described in Perform Operations for HDLM Management-Target Device on page 3-38 of Preparations for an Upgrade Installation or Re-installation of HDLM on page 3-38.

   When performing an upgrade installation or re-installation of HDLM in a local boot disk environment:

   Perform the procedure described in either When Installing HDLM in a Local Boot Disk Environment (if HDLM has been deleted or defined) on page 3-40 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or When Installing HDLM in a Local Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-47.

   When performing an upgrade installation or re-installation of HDLM in a boot disk environment:

Perform the procedure described in either When Installing HDLM in a Boot Disk Environment (if HDLM has been deleted or defined) on page 3-50 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or When Installing HDLM in a Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-56.

5. Execute the following command on the standby host.

   When the OS used in a PowerHA environment is AIX V6.1 TL06 or AIX V7.1 with no TL:

   ```
   # clusterconf -r hdiskxx
   ```

   When the OS used in a PowerHA environment is AIX V6.1 TL07 or later or AIX V7.1 TL01 or later:

   ```
   # clctrl -start -m node-name
   ```

6. Execute the following command on the standby host to start PowerHA.

   ```
   # smitty cl_start
   ```

7. Execute the following command on the active host to stop PowerHA.

   ```
   # smitty cl_stop
   ```

8. Execute the following command on the active host.

   When the OS used in a PowerHA environment is AIX V6.1 TL06 or AIX V7.1 with no TL:

   ```
   # clcmd stopsrc -s clconfd
   # clusterconf -fu
   ```

   When the OS used in a PowerHA environment is AIX V6.1 TL07 or later or AIX V7.1 TL01 or later:

   ```
   # clctrl -stop -m node-name
   ```

9. Perform a new installation, upgrade installation, or re-installation of HDLM on the active host.

   When performing a new installation of HDLM in a local boot disk environment:

   Perform the procedure described in Stop Applications on page 3-38 of Preparations for an Upgrade Installation or Re-installation of HDLM on page 3-38.

   When performing a new installation of HDLM in a boot disk environment:

   Perform the procedure described in Perform Operations for HDLM Management-Target Device on page 3-38 of Preparations for an Upgrade Installation or Re-installation of HDLM on page 3-38.

When performing an upgrade installation or re-installation of HDLM in a local boot disk environment:

Perform the procedure described in either When Installing HDLM in a Local Boot Disk Environment (if HDLM has been deleted or defined) on page 3-40 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or When Installing HDLM in a Local Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-47.

When performing an upgrade installation or re-installation of HDLM in a boot disk environment:

Perform the procedure described in either When Installing HDLM in a Boot Disk Environment (if HDLM has been deleted or defined) on page 3-50 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or When Installing HDLM in a Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-56.

10. Execute the following command on the active host.

When the OS used in a PowerHA environment is AIX V6.1 TL06 or AIX V7.1 with no TL:

```
# clusterconf -r hdiskxx
```

When the OS used in a PowerHA environment is AIX V6.1 TL07 or later or AIX V7.1 TL01 or later:

```
# clctrl -start -m node-name
```

11. Execute the following command on the active host to start PowerHA.

```
# smitty cl_start
```

Performing an Unattended Installation of HDLM

This subsection explains how to install HDLM using the `installhdlm` utility. The unused capacity required to execute the `installhdlm` utility is as follows:

- `/tmp` directory

  100 KB
- Any log output directory that can be specified by users (the default directory is `/var/tmp`)

  200 KB

When Installing HDLM in a Local Boot Disk Environment

To install HDLM in a local boot disk environment:

1. Log in to AIX as the root user.

If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.

2. Insert the DVD-ROM.

   If you are installing HDLM from a directory in which files on the DVD-ROM are copied, make sure that the file organization has not been changed. If the file organization has changed, the `installhdlm` utility might not function correctly:

   ```
   # mkdir /cdrom
   # mount -r -v cdrfs /dev/cd0 /cdrom
   # mkdir /tmp/hdlm
   # cp -rp /cdrom/HDLM_AIX /tmp/hdlm/
   # cp -p /cdrom/installux.sh /tmp/hdlm/
   ```

   If you copied the files on the DVD-ROM to your desired directory, proceed to step 5.

3. If there is no directory for mounting the DVD-ROM, make the directory.

   ```
   # mkdir /cdrom
   ```

   cdrom is the desired directory name. Hereafter, *cdrom* is used for purposes of explanation.

4. Mount the DVD-ROM.

   ```
   # mount -r -v cdrfs /dev/cd0 /cdrom
   ```

   The `/dev/cd0` part depends on the system.

5. If you are using a copy of the `installhdlm` utility that you have placed in a separate directory to install HDLM, make sure you copy the necessary files from the `/cdrom/HDLM_AIX/hdlmtool/instutil` directory.

   The necessary files to be copied from the `/cdrom/HDLM_AIX/hdlmtool/instutil` directory are shown below:

   - `installhdlm`
   - `installhdlm_analysis`
   - `dlmrmdev`

   Also, these files need to be copied to the same directory to which the `installhdlm` utility is copied.

   For a new installation, proceed to step 7.

6. If you are upgrading or re-installing HDLM, back up the HDLM settings.

   If an upgrade installation or re-installation fails, AIX automatically removes HDLM, and the HDLM settings are deleted.

   Perform this step so that a copy of the HDLM settings is available in this case.

   If an upgrade installation or re-installation fails, perform a new installation, and then re-execute setup to reflect the settings that have been backed up.

   - Save the HDLM environment settings information.

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr view -sys > any-file-name
     ```

Make sure that the license has not expired.

- Save the HDLM execution environment ODM settings.

  ```
  # /usr/DynamicLinkManager/bin/dlmodmset -o > any-file-name
  ```

7. In the following cases, prepare the license key or the license key file:

   - If you are installing HDLM for the first time
   - If you are upgrading or re-installing HDLM after the licensing term has expired

   If the directory that contains the license key or the license key file is specified in the installation information settings file, you can use any storage directory name and file name.

   The following shows examples of when the default storage directory specified in the installation information settings file is to be used:

   - When only the license key has been provided

     Create the `/var/DLM` directory, and then, in this directory, create the license key file (`dlm.lic_key`). The following shows an example when the license key is `123456789ABCDEF`:

     ```
     # mkdir /var/DLM
     # echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
     ```

   - When the license key file has been provided

     Store the license key file directly under the `/var/tmp/` directory by using the `hdlm_license` name.

     ```
     /var/tmp/hdlm_license
     ```

   The license key file or license key is not deleted after the installation.

8. Create an installation information settings file.

   To use the sample file, copy it from the DVD-ROM to a directory on the hard disk.

   ```
   # cp -p /cdrom/HDLM_AIX/hdlmtool/instutil/
   sample_installhdlm.conf /any-directory
   ```

   You can change the `sample_installhdlm.conf` file name.

   The following shows an example of copying the `sample_installhdlm.conf` file, and then changing the file name to `install_set.conf`:

   ```
   # cp -p /cdrom/HDLM_AIX/hdlmtool/instutil/
   sample_installhdlm.conf /any-directory/install_set.conf
   ```

   For details about how to edit the installation information settings file, which is used by the `installhdlm` utility, see *Items To Be Defined in an installation-information Settings File on page 7-33*.

9. Execute either of the following commands:

   To execute `installux.sh`:

   ```
   # /cdrom/installux.sh -f /any-directory/installation-
   information-settings-file
   ```

To execute `installhdlm`:

```
# /cdrom/HDLM_AIX/hdlmtool/instutil/installhdlm -f /any-directory/installation-information-settings-file
```

Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host. When installation is successful, the `KAPL09211-I` message is output.

During installation, the `KAPL09241-W` message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the `KAPL09241-W` message if necessary.

For an upgrade installation or re-installation of HDLM, the configuration of the existing hdisks recognized as HDLM management-target devices is inherited.

10. Unmount the DVD-ROM.

```
# umount /cdrom
```

11. Delete the created mount directory.

```
# rm -r /cdrom
```

12. Delete the installation information settings file.

```
# rm -r /directory-containing-the-installation-information-settings-file
```

13. Perform the procedure appropriate for the installation type.

If you are performing a new installation, perform steps 14 to the end of the procedure described in *When Installing HDLM in a Local Boot Disk Environment on page 3-27* of *Performing a New Installation of HDLM on page 3-27*.

If you are performing an upgrade installation or a re-installation, perform either the steps from 21 to the end of the procedure described in When Installing HDLM in a Local Boot Disk Environment (if HDLM has been deleted or defined) on page 3-40 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or the steps from 13 to the end of the procedure described in When Installing HDLM in a Local Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-47.

When Installing HDLM in a Boot Disk Environment

To install HDLM in a boot disk environment:

1. For AIX 5.3, use a single-path configuration for host and storage systems.

   For AIX 6.1 or AIX 7.1, you can use a single-path configuration or a multi-path configuration for host and storage systems.

2. Log in to AIX as the root user.

   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.

3. If you are performing a new installation, and the boot disk is in a multi-path configuration, execute the commands below to confirm that the physical volume containing the boot logical volume `hd5` is the same as the physical volume used for booting.

   If the boot disk is in a single-path configuration, you do not have to perform this step.

   - Identify the physical volume that contains the boot logical volume `hd5`:

     ```
     # lsvg -M rootvg | grep -w hd5
     hdisk3:1        hd5:1
     ```

     In this example, `hdisk3` contains the boot logical volume `hd5`.

   - Identify the physical volume used for booting:

     ```
     # getconf BOOT_DEVICE
     hdisk3
     ```

     In this example, `hdisk3` is used for booting.

   If the boot physical volume that contains the logical volume `hd5` is different from the physical volume used for booting, the following message appears, and the HDLM installation ends with an error:

   ```
   0503-497 installp: An error occurred during bosboot test
   processing.
   ```

   To make the physical volume that contains the boot logical volume `hd5` the same as the physical volume used for booting, execute the `bootlist` command by specifying the physical volume that contains the boot logical volume `hd5`, and then restart the host.

   The following shows an example of executing the command when the physical volume that contains the boot logical volume `hd5` is `hdisk3`:

   ```
   # bootlist -m normal hdisk3
   ```

   After restarting the host, perform the procedure again from step 2.

4. Insert the DVD-ROM.

   If you are installing HDLM from a directory in which files on the DVD-ROM are copied, make sure that the file organization has not been changed. If the file organization has changed, the `installhdlm` utility might not function correctly:

   ```
   # mkdir /cdrom
   # mount -r -v cdrfs /dev/cd0 /cdrom
   # mkdir /tmp/hdlm
   # cp -rp /cdrom/HDLM_AIX /tmp/hdlm/
   # cp -p /cdrom/installux.sh /tmp/hdlm/
   ```

   If you copied the files on the DVD-ROM to your desired directory, proceed to step 6.

5. If there is no directory for mounting the DVD-ROM, make the directory.

   ```
   # mkdir /cdrom
   ```

   cdrom is the desired directory name. Hereafter, *cdrom* is used for purposes of explanation.

6. Mount the DVD-ROM.

   ```
   # mount -r -v cdrfs /dev/cd0 /cdrom
   ```

   The `/dev/cd0` part depends on the system.

7. If you are using a copy of the `installhdlm` utility that you have placed in a separate directory to install HDLM, make sure you copy the necessary files from the `/cdrom/HDLM_AIX/hdlmtool/instutil` directory.

   The necessary files to be copied from the `/cdrom/HDLM_AIX/hdlmtool/instutil` directory are shown below:

   - `installhdlm`
   - `installhdlm_analysis`
   - `dlmrmdev`

   Also, these files need to be copied to the same directory to which the `installhdlm` utility is copied.

   For a new installation, proceed to step 8.

8. If you are upgrading or re-installing HDLM, back up the HDLM settings.

   If an upgrade installation or re-installation fails, AIX automatically removes HDLM, and the HDLM settings are deleted.

   Perform this step so that a copy of the HDLM settings is available in this case.

   If an upgrade installation or re-installation fails, perform a new installation, and then re-execute setup to reflect the settings that have been backed up.

   - Save the HDLM environment settings information.

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr view -sys > any-file-name
     ```

     Make sure that the license has not expired.

   - Save the HDLM execution environment ODM settings.

     ```
     # /usr/DynamicLinkManager/bin/dlmodmset -o > any-file-name
     ```

9. In the following cases, prepare the license key or the license key file:

   - If you are installing HDLM for the first time
   - If you are upgrading or re-installing HDLM after the licensing term has expired

   If the directory that contains the license key or the license key file is specified in the installation information settings file, you can use any storage directory name and file name.

   The following shows examples of when the default storage directory specified in the installation information settings file is to be used:

- When only the license key has been provided

  Create the /var/DLM directory, and then, in this directory, create the license key file (dlm.lic_key). The following shows an example when the license key is 123456789ABCDEF:

  ```
  # mkdir /var/DLM
  # echo "123456789ABCDEF" > /var/DLM/dlm.lic_key
  ```

- When the license key file has been provided

  Store the license key file directly under the /var/tmp/ directory by using the hdlm_license name.

  ```
  /var/tmp/hdlm_license
  ```

The license key file or license key is not deleted after the installation.

10. Create an installation information settings file.

    To use the sample file, copy it from the DVD-ROM to a directory on the hard disk.

    ```
    # cp -p /cdrom/HDLM_AIX/hdlmtool/instutil/
    sample_installhdlm.conf /any-directory
    ```

    You can change the sample_installhdlm.conf file name.

    The following shows an example of copying the sample_installhdlm.conf file, and then changing the file name to install_set.conf:

    ```
    # cp -p /cdrom/HDLM_AIX/hdlmtool/instutil/
    sample_installhdlm.conf /any-directory/install_set.conf
    ```

    For details about how to edit the installation information settings file, which is used by the installhdlm utility, see *Items To Be Defined in an installation-information Settings File on page 7-33*.

    Additionally, since HDLM must be restarted after installation, change the setting for the restart key in the installation information settings file from n to y.#

    #

    After you have performed an unattended installation, you can also manually restart HDLM.

    If you plan to manually restart HDLM, you do not need to change the setting for the restart key in the installation information settings file from n to y.

    However, in that case, this procedure must be modified as described below:

    - The host does not restart after the KAPL09211-I message is output (step 11).

    - Before you perform step 13, execute the following command to restart the host:

    ```
    # shutdown -Fr
    ```

11. If a single-path configuration is used, connect cables to all HBAs to change the configuration to a multi-path configuration.

Note that, regardless of the configuration, do not execute the `cfgmgr` command.

12. Execute either of the following commands:

    To execute `installux.sh`:

    ```
    # /cdrom/installux.sh -f /any-directory/installation-information-settings-file
    ```

    To execute `installhdlm`:

    ```
    # /cdrom/HDLM_AIX/hdlmtool/instutil/installhdlm -f /any-directory/installation-information-settings-file
    ```

    Even though a message asking you to restart the host is displayed during installation, you do not have to restart the host.

    During installation, the `KAPL09241-W` message might be output. In this case, installation of HDLM continues, but installation of HDLM components has failed. After installing HDLM, resolve the problem according to the `KAPL09241-W` message if necessary.

    When installation is successful, the `KAPL09211-I` message is output and the host restarts. After the host has restarted, check to make sure that the settings have been updated as specified in the installation information settings file.

    Note that, if the upgrade installation or re-installation ends in an error, HDLM may no longer be installed at all. In this case, proceed to step 12.

    If unattended installation ends normally, proceed to step 13.

13. If HDLM was not upgraded or re-installed properly, perform a new installation of HDLM.

    - When AIX 5L V5.3 is used, and the boot disk is in a multi-path configuration

      Execute the following command to shut down the host, and then perform the new installation procedure from step 1:

      ```
      # shutdown -F
      ```

    - When an environment other than the above is used

      Execute the following command to restart the host, and then perform the new installation procedure from step 1:

      ```
      # shutdown -Fr
      ```

    After performing a new installation of HDLM, set up HDLM again based on the HDLM settings backed up in step 7.

14. Unmount the DVD-ROM.

    ```
    # umount /cdrom
    ```

15. Delete the created mount directory.

    ```
    # rm -r /cdrom
    ```

16. Delete the installation information settings file.

```
# rm -r /directory-containing-the-installation-information-settings-file
```

17. Perform the procedure appropriate for the installation type.

    If you are performing a new installation, perform steps 15 to the end of the procedure described in *When Installing HDLM in a Boot Disk Environment on page 3-32* of *Performing a New Installation of HDLM on page 3-27*.

    If you are performing an upgrade installation or a re-installation, perform either the steps from 21 to the end of the procedure described in When Installing HDLM in a Boot Disk Environment (if HDLM has been deleted or defined) on page 3-50 of Performing an Upgrade Installation or Re-installation of HDLM on page 3-39 or the steps from 14 to the end of the procedure described in When Installing HDLM in a Boot Disk Environment (if you did not delete usable HDLM devices) on page 3-56.

Installing the Hitachi Network Objectplaza Trace Library

If the message KAPL09311-W is output during HDLM installation, install the Hitachi Network Objectplaza Trace Library.

To install the Hitachi Network Objectplaza Trace Library:

1. Log in to AIX as the root user.
2. Move to a directory where temporary files can be output.
3. Execute the following command to extract the command `D002setup` for installing the Hitachi Network Objectplaza Trace Library:

   ```
   # tar -xpf /usr/DynamicLinkManager/common/D002.tar D002setup
   ```

4. Execute the following command to make sure that the file is extracted:

   ```
   # ls -l ./D002setup
   ```

5. Execute the following command to install the Hitachi Network Objectplaza Trace Library:

   ```
   # ./D002setup /usr/DynamicLinkManager/common/D002.tar
   ```

   Make sure that the return value of the command is `0`.

6. Execute the following command to make sure that HDLM is registered in the Hitachi Network Objectplaza Trace Library:

   ```
   # /opt/hitachi/HNTRLib2/etc/hntr2getname
   ```

   If "Hitachi Dynamic Link Manager " is output, the library is registered. Proceed to step 9. If "Hitachi Dynamic Link Manager " is not output, proceed to step 7.

7. Execute the following command to register HDLM in the Hitachi Network Objectplaza Trace Library:

   ```
   # /opt/hitachi/HNTRLib2/etc/hntr2regist -daemon "Hitachi Dynamic Link Manager"
   ```

8. Execute the following command to make sure that HDLM is registered in the Hitachi Network Objectplaza Trace Library:

   ```
   # /opt/hitachi/HNTRLib2/etc/hntr2getname
   ```

   If HDLM is registered, "Hitachi Dynamic Link Manager " is output.

9. Execute the following command to register the daemon of the Hitachi Network Objectplaza Trace Library:

   ```
   # /opt/hitachi/HNTRLib2/etc/hntr2setup 1
   ```

10. Execute the following command to make sure that the daemon of the Hitachi Network Objectplaza Trace Library is registered:

    ```
    # /usr/sbin/lsitab hntr2mon
    ```

    Make sure that the return value of the command is `0`.

11. Execute the following command to start the integrated trace collection process:

    ```
    # /opt/hitachi/HNTRLib2/bin/hntr2mon -d
    ```

    Make sure that the return value of the command is `0`.

12. Delete the file D002setup.

    ```
    # rm ./D002setup
    ```

Checking the Path Configuration

HDLM functions, such as load balancing and failover, are only available for HDLM management-target *devices* that have more than one active path. After you install HDLM or change the hardware configuration, check the structure and statuses of the paths.

To check the path information, use the `dlnkmgr` command's `view` operation.

The following describes how to check path information by using the `dlnkmgr` command's `view` operation. For details about the view operation, see *view (Displays Information) on page 6-34*.

Specify the `-path` parameter and check the output information:

Execute the following command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path > redirect-destination-file-1
```

Open *redirect-destination-file-1* and check the following:

- Make sure that an LU accessed by a path exists.
  A path can be identified with `PathName`. The LU that is accessed by a path can be identified with a combination of `DskName` and `iLU`.
- Make sure that all paths are online.
  Make sure that `PathStatus` is `Online`. If there is a path whose status is not online, `Reduced` will be displayed.

- Make sure that the combinations of the CHA port (`ChaPort`), through which paths access the same LU, and the HBA port (the HBA adapter number and bus number or the adapter type and adapter number displayed in the `PathName` column) are different.

  The digits displayed on the left of `PathName` indicate an HBA adapter number or adapter type. The numbers displayed between the period to the right of the HBA adapter number and the next period indicate a bus number or adapter number.
- Make sure that different HBA adapter numbers and bus numbers (or different adapter types and adapter numbers) exist for the number of the physical HBA ports.

To make sure that the OS and HDLM recognize the same HDLM management-target device:

a. Execute the following command:

```
# lsdev -Cc disk > redirect-destination-file-2
```

b. Open both *redirect-destination-file-1* and *redirect-destination-file-2*.

c. Make sure that all hdisk name displayed in the `HDevName` column in *redirect-destination-file-1* are the same with hdisk name displayed on the `Hitachi Disk Array (Fibre)` row in *redirect-destination-file-2*.

Setting up HDLM

HDLM includes functions like the load balancing function, the automatic failback function, the error logging function, the audit logging function, etc. You can set up these functions by using the `dlnkmgr` command's `set` operation. The following subsections describe these setup methods.

Checking the Current Settings

This chapter describes how to check the HDLM function settings before any changes are made by using the `dlnkmgr` command's `view` operation.

Check the current settings by executing the following command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -sfunc
HDLM Version                    : x.x.x-xx
Service Pack Version            :
Load Balance                    : on(extended lio)
Support Cluster                 :
Elog Level                      : 3
Elog File Size(KB)              : 9900
Number Of Elog Files            : 2
Trace Level                     : 0
Trace File Size(KB)             : 1000
Number Of Trace Files           : 4
Path Health Checking            : on(30)
Auto Failback                   : on(60)
Intermittent Error Monitor      : off
```

```
Dynamic I/O Path Control       : off(10)
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

To check the current audit log settings, execute the following command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -audlog
Audit Log                      : off
Audit Log Category             : -
Audit Log Facility             : -
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd  hh:mm:ss
#
```

Setting Up the HDLM Functions

The table below summarizes the functions that can be set in HDLM. For details about each function, see Setting Up Load Balancing on page 3-90 and subsequent sections.

Each function has a default value and a recommended value. If no function is set by the HDLM command's set operation, the default value is applied for each function. The recommended values are used as the guideline values when functions are configured.

Table 3-15 The Recommended and Default Values of Each Function

Function	Default value	Recommended value
Load-balancing	on The Extended Least I/Os algorithm is used.	on The recommended algorithm depends on the operating environment.
Path health checking	on 30-minute check interval	on The recommended checking interval depends on the operating environment.
Automatic failback	on 60-minute check interval	The recommended checking interval depends on the operating environment.
Intermittent Error Monitor	off	on The recommended checking interval depends on the operating environment.
Dynamic I/O path control[#]	off 10-minute check interval	off The recommended checking interval depends on the operating environment.
Logging level	3: Collects all the error information for the "Information" level or higher	3: Collects all the error information for the "Information" level or higher

Function	Default value	Recommended value
Trace level	0: Do not output trace files	0: Do not output trace files
File size for the Error log	9900 (KB)	9900 (KB)
Number of files for the Error logs	2	2
File size for trace information	1000 (KB)	1000 (KB)
Number of files for trace information	4	4
Collection of audit log data	`off`	The recommended value depends on the operating environment. Set `on`, if you want to collect audit log data.
Audit log facility	user	local0 to local7

#

This function is applied only when Hitachi AMS2000 series, Hitachi SMS series, or HUS100 series storage is used.

Setting Up Load Balancing

You can select whether to enable load balancing.

The following is an example command to set load-balancing.

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -lb on -lbtype exlio
```

Set it to `on` to enable load balancing. Otherwise, set it to `off`. When you set `on`, specify one of the following algorithm values after the `-lbtype` option:

- `rr` for the Round Robin algorithm
- `exrr` for the Extended Round Robin algorithm
- `lio` for the Least I/Os algorithm
- `exlio` for the Extended Least I/Os algorithm
- `lbk` for the Least Blocks. algorithm
- `exlbk` for the Extended Least Blocks algorithm

The type of algorithm specified by the `-lbtype` parameter remains stored in the system, even if, you disable the load balancing function by specifying `-lb off`. If you decide to re-enable load balancing at a later time, and you do not specify an algorithm, load balancing will still be executed by using the algorithm that was previously specified.

Setting Up Path Health Checking

You can choose whether you want to use path health checking.

The following is an example of how to set up path health checking by using a command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -pchk on -intvl 10
```

When path health checking is enabled by specifying `on` for the `-pchk` parameter, you can also specify the `-intvl` parameter, in order to specify the *checking* interval. If the *checking* interval is not specified, then the previously specified value will be automatically applied. For example, if you turn off path health checking after the *checking* interval was specified as `15` minutes, and then you enable path health checking again (but without specifying a *checking* interval) the `15` value that was specified from before will be used again.

Setting Up the Automatic Failback Function

When intermittent error monitoring is enabled and the number of error occurrences is `2` or more, the following condition must be satisfied.

error-monitoring-interval >= checking-interval-for-automatic-failbacks × number-of-times-an-error-is-to-occur-during-intermittent-error-monitoring

If this condition is not satisfied, an error will occur and the warning message KAPL01080-W will be output.

If this happens, change any of the following settings: the checking interval for automatic failbacks, the intermittent error-monitoring interval, or the number of times that the error needs to occur.

If you set the number of times that the error needs to occur to `1`, the above condition does not need to be satisfied.

The following is an example of setting up automatic failback by using a command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -afb on -intvl 10
```

To enable the automatic failback function, set it to `on`. The *checking* interval can be specified by the `-intvl` parameter. The previously specified value will be applied when a *checking* interval is not specified. For example, if you turn off the automatic failback function after the *checking* interval was specified as `5` minutes, and then you turn it back on (but without specifying a *checking* interval) the `5` minutes that were specified from before will be used again.

Setting Up Intermittent Error Monitoring

Intermittent error monitoring is specifiable only when the automatic failback function is enabled. To prevent an intermittent error from reducing I/O performance, we recommend that you monitor intermittent errors when automatic failback is enabled.

When intermittent error monitoring is enabled, you can specify intermittent error conditions. The default value for the intermittent error-monitoring interval is 210. The default value for the number of error occurrences is 3.

The system assumes that an intermittent error has occurred if the specified number of times that the error needs to occur is reached during the specified monitoring interval (minutes). A path that is assumed to have an intermittent error is excluded from performing an automatic failback. Intermittent error monitoring starts right when the path is recovered from the error by performing an automatic failback. Monitoring is performed on each, individual path.

When a value of 2 or more is specified for the number of times an error needs to occur, make sure that the condition shown in *Setting Up the Automatic Failback Function on page 3-91* is satisfied.

To determine whether a path is invalid for an automatic failback, you can use the results of the `dlnkmgr` command's `view` operation.

The following is an example of setting up intermittent error monitoring by using a command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -iem on -intvl 20 -iemnum 2
```

`on` specifies that intermittent error monitoring is to be used. To disable intermittent error monitoring, specify `off`. When you set this parameter to `on`, you can specify intermittent error conditions by using the `-intvl` and `-iemnum` parameters. Specify the monitoring interval for an intermittent error in the `-intvl` parameter, and the number of times that the error needs to occur in the `-iemnum` parameter. When these parameters are omitted, the default values of 210 and 3 are used, respectively.

Setting Up Dynamic I/O Path Control

To prevent degrading of I/O performance, this function dynamically switches the output controllers for HDLM, following the switching of controllers performed by the storage system.

The dynamic I/O path control function can be set for each storage system or LU. The checking interval for reviewing the switching status information can also be set in order to properly follow the switching of controllers performed by the storage system,

The following is an example of setting the dynamic I/O path control function:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -dpc on -pathid 000001 -lu
# /usr/DynamicLinkManager/bin/dlnkmgr set -dpcintvl 10
```

Specify "on" to enable the dynamic I/O path control function, or "off" to disable the function. For the `-pathid` parameter, specify an LU, or the ID of a path connected to the storage system. For the `-dpcintvl` parameter, specify the checking interval (in minutes) for reviewing the information about the switching of controllers performed by the storage system.

Setting the Error Log Collection Level

The error log (the HDLM manager log (`dlmmgr`*n*`.log` (*n* indicates a file number from `1` to `16`)) collection level can be set.

The following table lists and describes the values for the error log collection level setting.

Table 3-16 Values for the Error Log Collection Level Setting

Value	Description
0	No error logs are collected.
1	All information for errors of the "Error" level or higher is collected.
2	All information for errors of the "Warning" level or higher is collected.
3	All information for errors of the "Information" level or higher is collected.
4	All information for errors of the "Information" level or higher (including maintenance information) is collected.

If an error occurs, you might have to set the error log collection level to 1 or higher to collect any log information.

The higher this value is set, the more information that will be output. As the amount of log information to be output increases, it will take less time to overwrite the old error log information with the new information.

The following is an example of setting up the error log collection level by using a command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -ellv 2
```

Specify the error log collection level as a number.

Setting the Trace Level

The trace output level can be set.

You can set up the trace level for a trace file `hdlmtr`*n*`.log` (*n* indicates a file number from `1` to `64`).

The following table lists and describes the values for the trace level setting.

Table 3-17 Values for the Trace Level Setting

Value	Description
0	No trace is output.
1	Only error information is output.
2	Program operation summaries are output.

Value	Description
3	Program operation details are output.
4	All information is output.

If an error occurs, you may have to set the trace level to 1 or higher to collect any trace information.

The higher this value is set, the more information that will be output. As the amount of trace information to be output increases, it will take less time to overwrite the old trace information with the new information.

For normal operation, we recommend that you set the trace level to `0`. If you set the trace level to a value higher than necessary, HDLM performance might decrease, or trace information required to analyze the cause of an error might be overwritten.

The following is an example of setting up the trace level by using a command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -systflv 1
```

Specify the trace level in as a number.

Setting the Error Log File Size

The error log file size (the HDLM manager log (`dlmmgr`*n*`.log` (*n* indicates a file number from `1` to `16`))) can be set.

You can specify a value (in kilobytes) from 100 to 2000000 for the error log file size. The specified value is applied for HDLM manager logs.

When an error log file reaches the specified size, the information in the old error log file is replaced with new information, beginning with the oldest file. By specifying both the log file size and the number of log files, you can collect up to 32000000KB (approximately 30 GB) of error logs in total.

The following shows an example of executing the command to set the error log file size.

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -elfs 1000
```

Specify the size of the error log file in kilobytes.

Setting the Number of Error Log Files

The number of the error log files (the HDLM manager log (`dlmmgr`*n*`.log` (*n* indicates a file number from `1` to `16`))) can be set.

You can specify a value from 2 to 16 for the number of error log files (log files for the HDLM manager).

By specifying both the log file size and the number of log files, you can collect up to 32000000KB (approximately 30 GB) of error logs in total.

The following shows an example of setting the number of error log files.

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -elfn 5
```

Specify the number of error log files in numbers.

Setting the Trace File Size

The trace file size can be set.

Trace files for which a trace file size can be set are `hdlmtrn.log` (*n* indicates a file number from `1` to `64`). The length of a trace file is fixed, regardless of how much trace information is actually in the file.

For the trace file size, you can specify a value (in kilobytes) from 100 to 16000. If you specify a value smaller than the setting value, the message (`KAPL01097-W`) will be displayed to confirm the execution, and the trace file will be is temporarily deleted.

When all the trace files become full, the oldest file is overwritten with any new trace data.

By specifying both the trace file size and the number of trace files, you can collect up to 1024000KB of trace data.

The following is an example of setting up the trace file size by using a command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -systfs 2000
```

Specify the size of the trace file in kilobytes.

Setting the Number of Trace Files

You can set the number of the trace files.

Trace files for which the number of files can be set are `hdlmtrn.log` (*n* indicates a file number from `1` to `64`).

For the number of the trace files, you can specify a value from 2 to 64. If you specify a value smaller than the value that has already been specified, the KAPL01097-W message will be displayed to confirm the execution, and the trace file will be temporarily deleted.

By specifying both the trace file size and the number of trace files, you can collect up to 1024000KB of trace data.

The following is an example of setting up the number of trace files by using a command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -systfn 10
```

Specify the number of trace files by using numbers.

Setting Up Audit Log Data Collection

You can set whether to collect audit log data.

If you want to collect audit log data, you must also specify the collection level for audit log data and the audit log categories.

The table below lists and describes the values for the audit log collection level setting.

An audit log data collection level is a severity level. The default is `6`.

Table 3-18 Values Indicating Audit Log Data Collection Levels

Value (severity)	Explanation
0	No audit log data is collected.
1	
2	Critical-level audit log data is collected.
3	Critical-level and Error-level audit log data is collected.
4	Critical-level, Error-level, and Warning-level audit log data is collected.
5	
6	Critical-level, Error-level, Warning-level, and Informational-level audit log data is collected.
7	

The table below lists and describes the values for the audit log category setting. The default is `all`.

Table 3-19 Values Indicating Audit Log Data Categories

Value	Explanation
`ss`	Audit log events of the `StartStop` category are collected.
`a`	Audit log events of the `Authentication` category are collected.
`ca`	Audit log events of the `ConfigurationAccess` category are collected.
`all`	Audit log events of the `StartStop`, `Authentication`, and `ConfigurationAccess` categories are all collected.

This example shows how to enable the collection of audit log data:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -audlog on -audlv 6 -
category all
```

Specify `on` if you want to collect audit log data, and `off` if you do not want to collect audit log data. If you specify `on`, you can use the `-audlv` parameter to specify the collection level for audit log data and the `-category` parameter to specify the audit log categories.

If you want to set the audit log facility, see *Setting the Audit Log Facility on page 3-97*.

Setting the Audit Log Facility

The following describes how to specify the output destination for audit log data.

If you want to specify the output destination for audit log data, first specify the audit log facility by using the `dlnkmgr set -audfac` command. Next, define the output destination of the facility in the `/etc/syslog.conf` file. The table below lists the values for the audit log facility setting. The default is `user`.

Table 3-20 Values Indicating Audit Log Facility

Value	Corresponding facility value in the /etc/syslog.conf file
`user` or `1`	`user`
`local0` or `16`	`local0`
`local1` or `17`	`local1`
`local2` or `18`	`local2`
`local3` or `19`	`local3`
`local4` or `20`	`local4`
`local5` or `21`	`local5`
`local6` or `22`	`local6`
`local7` or `23`	`local7`

This example shows how to specify the audit log facility:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -audfac local0
```

Checking the Updated Settings

This chapter describes steps involved in how to check the updated settings by using the `dlnkmgr` command's `set` operation after settings have been changed.

When you change some settings, you can display information about all of HDLM function settings. The following is an example of executing the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -sfunc
HDLM Version                    : x.x.x-xx
Service Pack Version            :
Load Balance                    : on(extended lio)
Support Cluster                 :
Elog Level                      : 2
Elog File Size(KB)              : 1000
Number Of Elog Files            : 5
Trace Level                     : 1
Trace File Size(KB)             : 2000
Number Of Trace Files           : 10
```

```
Path Health Checking           : on(10)
Auto Failback                  : on(10)
Intermittent Error Monitor     : on(2/20)
Dynamic I/O Path Control       : off(10)
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

After you have set up the collection of audit log data, use the following command to make sure that the setting has been specified correctly:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -audlog
Audit Log                      : on(6)
Audit Log Category             : all
Audit Log Facility             : local0
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd  hh:mm:ss
#
```

Setting up Integrated Traces

When HDLM is used, the `dlnkmgr` command logs are output to the *integrated trace information files* of Hitachi Network Objectplaza Trace Library (HNTRLib2) (`/var/opt/hitachi/HNTRLib2/spool/hntr2`*n*`.log` (*n* indicates a file number)).

If a lot of integrated trace information is output, the older information might end up getting deleted in a very short amount of time. Also, if a large amount of integrated trace information is suddenly all output at the same time, any integrated trace information that is overflowing the buffer might not be saved into the integrated trace files. To save as much information as possible, change the settings for Hitachi Network Objectplaza Trace Library, increasing the integrated trace file size and buffer size. Note that if the values are too large, it will place a heavy load on the system. When determining these values, be sure to consider these operational tradeoffs.

The following table lists the default values and recommended values for the integrated trace file setting.

Table 3-21 Default and Recommended Values for the Integrated Trace File Settings

Setting		Default value	Recommended value
Integrated trace file size		256 (KB)	4096 (KB)
Number of integrated trace files		4	8
Buffer size per monitoring interval	Monitoring cycle	10 (seconds)	5 (seconds)
	Buffer size per monitoring interval	64 (KB)	256 (KB)
Number of messages to be output per	Monitoring cycle	0 (seconds)	0 (seconds)

Setting		Default value	Recommended value
monitoring interval	Number of messages to be output	0	0

If Hitachi Network Objectplaza Trace Library (HNTRLib2) is already installed, the existing settings will be inherited. If you change these settings, keep in mind that programs other than HDLM also use them.

Notes on Using the Hitachi Network Objectplaza Trace Library

Note the following when using Hitachi Network Objectplaza trace library:

- If HNTRLib has already been installed when you install HDLM, the settings in the trace library will not be inherited by HNTRLib2. HDLM uses the HNTRLib2 default settings.
- If HNTRLib2 has already been installed on a host when you install HDLM, the settings in the trace library will be inherited.
- If a different Hitachi product is using HNTRLib2 when you attempt to remove HDLM, HNTRLib2 will not be removed.

Displaying the Hitachi Network Objectplaza Trace Library setup menu

To display the Hitachi Network Objectplaza Trace Library setup menu:

1. Log on as a root user.
2. Execute the following command:

```
# /opt/hitachi/HNTRLib2/bin/hntr2utl2
```

The Hitachi Network Objectplaza Trace Library setup menu appears.

```
Hitachi Network Objectplaza Trace Library 2 - Configuration Utility  Rel 2.0

   Select the item you want to change.  (Type 1-7 or e)

         [Log Files]
      1: Size of a log file.      256 KB
      2: Number of log files.       4
      3: Name of log files.      /var/opt/hitachi/HNTRLib2/spool/hntr2*.log

         [Monitor]
      4: Size of buffer.           64 KB
      5: Interval timer.           10 Sec

         [Logging Restriction]
      6: Lookout span.              0 Sec
      7: Max messages per span.     0

      e: Exit

    Enter the number>
```

If you do not want to change the settings, type `e` and then press the **Enter** key to quit the menu.

The following explains how to modify each setting.

Changing the Size of Integrated Trace Files

The following procedure shows how to change the size of integrated trace files.

To change the size of integrated trace files:

1. In the Hitachi Network Objectplaza Trace Library setup menu, type `1` and then press the **Enter** key.

   A screen to set the size of the integrated trace file will appear. The current value is displayed in **Current Size (KB)**.

```
Hitachi Network Objectplaza Trace Library 2 - Configuration Utility  Rel 2.0

   Type new file size [8-8192]       (Type '!' to return)


     Current Size(KB): 256
         New Size(KB):
```

2. Enter the desired size in **New Size (KB)**.

   The specifiable range is between 8 KB and 8192 KB, with a default of 256. Set this to a value larger than that set in step 2 of *Changing the Buffer Size Per Monitoring Interval Duration on page 3-101*. We recommend setting a value of 4096 when collecting an integrated trace.

   If you do not want to change the integrated trace file size, leave **New Size (KB)** blank, type `!`, and then press the **Enter** key to return to the Hitachi Network Objectplaza Trace Library setup menu.

3. Press the **Enter** key.

   The new setting is applied and the Hitachi Network Objectplaza Trace Library setup menu appears again.

Changing the Number of Integrated Trace Files

The following procedure shows how to change the number of integrated trace files.

To change the number of integrated trace files:

1. In the Hitachi Network Objectplaza Trace Library setup menu, type `2` and then press the **Enter** key.

   A screen to set the number of integrated trace files will appear. The current value is displayed in **Current Number (KB)**.

```
Hitachi Network Objectplaza Trace Library 2 - Configuration Utility  Rel 2.0

   Type the number of files [1-16]       (Type '!' to return)


     Current Number(KB):  4
         New Number(KB):
```

2. Enter the desired number in **New Number (KB)**.
   You can specify a value from 1 to 16. The default is 4. The value set here becomes the maximum of *n* in `/var/opt/hitachi/HNTRLib2/spool/hntr2n.log`. The recommended value for integrated trace collection is 8.
   If you do not want to change the number of integrated trace files, leave **New Number (KB)** blank, type `!`, and then press the **Enter** key to return to the Hitachi Network Objectplaza Trace Library setup menu.
3. Press the **Enter** key.
   The new setting is applied and the Hitachi Network Objectplaza Trace Library setup menu appears again.

Changing the Buffer Size Per Monitoring Interval Duration

The following procedure shows how to change the buffer size per monitoring interval.

To change the buffer size per monitoring interval:

1. In the Hitachi Network Objectplaza Trace Library setup menu, type `4` and then press the **Enter** key.
   A screen to set the buffer size will appear. The current value is displayed in **Current Size (KB)**.

```
Hitachi Network Objectplaza Trace Library 2 - Configuration Utility  Rel 2.0

   Type new buffer size [8-2048]     (Type '!' to return)


     Current Size(KB):  64
         New Size(KB):
```

2. Enter the desired size in **New Size (KB)**.
   Set a new buffer size to fit the monitoring interval set in **5: Interval Timer**. The specifiable range is between 8 KB and 2048 KB, with a default of 64. Set this to a value smaller than that set in step 2 of *Changing the Size of Integrated Trace Files on page 3-100*. We recommend setting a value of 256 when collecting an integrated trace.
   To leave the buffer size as is, leave **New Size (KB)** blank, type `!` and press the **Enter** key. You will be returned to the Hitachi Network Objectplaza Trace Library setup menu.
3. Press the **Enter** key.
   The new setting is applied and the Hitachi Network Objectplaza Trace Library setup menu appears again.

4. In the Hitachi Network Objectplaza Trace Library setup menu, type 5 and then press the **Enter** key.

   A screen to set the monitoring interval will appear. The current value is displayed in **Current Span (sec)**.

```
Hitachi Network Objectplaza Trace Library 2 - Configuration Utility  Rel 2.0

  Type the value of interval timer for the monitor [1-300](Type '!' to return)


    Current Span(sec): 10
        New Span(sec):
```

5. Enter the desired interval in **New Span (sec)**.

   The specifiable range is between 1 second and 300 seconds, with a default of 10. We recommend setting a value of 5 when collecting an integrated trace.

   To leave the monitoring interval as is, leave **New Span (sec)** blank, enter ! and press the **Enter** key. You will be returned to the Hitachi Network Objectplaza Trace Library setup menu.

6. Press the **Enter** key.

   The new setting is applied and the Hitachi Network Objectplaza Trace Library setup menu appears again.

Adjusting the Number of Messages to be Output Per Monitoring Interval

This section explains how to adjust the number of messages output to fit a particular monitoring interval.

To adjust the number of messages to be output per monitoring interval:

1. In the Hitachi Network Objectplaza Trace Library setup menu, type 6 and then press the **Enter** key.

   A screen to set the monitoring interval for the amount of messages output to the integrated trace file will appear. The current value is displayed in **Current Span (sec)**.

```
Hitachi Network Objectplaza Trace Library 2 - Configuration Utility  Rel 2.0

   Type the number of lookout span [1-3600 or 0]     (Type '!' to return)


     Current Span(sec):   0
         New Span(sec):
```

2. Enter a desired interval in **New Span (sec)**.

   The specifiable range is between 0 and 3600 seconds, with a default of 0. We recommend setting a value of 0.

To leave the monitoring interval as is, leave **New Span (sec)** blank, type ! and press the **Enter** key. You will be returned to the Hitachi Network Objectplaza Trace Library setup menu.

Note that when you specify a monitoring interval of 0, even if you specify the maximum number of messages in **7: Max messages per span**, the amount of integrated trace information to be output will not be adjusted.

3. Press the **Enter** key.

   The new setting is applied and the Hitachi Network Objectplaza Trace Library setup menu appears again.

4. In the Hitachi Network Objectplaza Trace Library setup menu, type 7 and press the **Enter** key.

   A screen to set the maximum number of messages output to the integrated trace file based on the monitoring interval specified in **6: Lookout span** will appear. The current value is displayed in **Current Max (sec)**.

```
Hitachi Network Objectplaza Trace Library 2 - Configuration Utility  Rel 2.0

  Type the number of max messages [0-500]     (Type '!' to return)


    Current Max(sec):   0
        New Max(sec):
```

5. Adjust the maximum number of messages output to the integrated trace files in **New Max (sec)**.

   The specifiable range is between 0 messages and 500 messages, with a default of 0. If you want to increase the number of messages which are output to the integrated trace file as much as possible, we recommend setting a value of 0.

   When you specify a monitoring interval of 0 in **6: Lookout span**, the value set in **New Max (sec)** will be disregarded.

   Also, when you specify a value of 0 for **New Max (sec)**, even if you specify the monitoring interval in **6: Lookout span**, the maximum number of messages output will not be adjusted.

   To leave the maximum number of messages output as is, leave **New Max (sec)** blank, enter ! and press the **Enter** key. You will be returned to the Hitachi Network Objectplaza Trace Library setup menu.

6. Press the **Enter** key.

   The new setting is applied and the Hitachi Network Objectplaza Trace Library setup menu appears again.

Finishing the Hitachi Network Objectplaza Trace Library Settings

This section explains how to close the Hitachi Network Objectplaza Trace Library setup menu when you are finished.

1. In the Hitachi Network Objectplaza Trace Library setup menu, type e and press the **Enter** key.

   You will be asked to if you want to save the new settings.

2. To save the new settings, click `Yes`, otherwise, click `No`.

Applying the Hitachi Network Objectplaza Trace Library Settings

To apply the settings, after you change the amount of integrated trace information by using Hitachi Network Objectplaza Trace Library:

1. Log in as a user with root permissions.
2. Execute the following command to check the programs using HNTRLib2.
   In the following example, only HDLM uses HNTRLib2.

   ```
   # /opt/hitachi/HNTRLib2/etc/hntr2dgetname
   Hitachi Dynamic Link Manager
   #
   ```

3. Stop the programs that are using HNTRLib2.
   If programs other than HDLM are displayed in step 2, stop the programs, and then go to step 4. You do not need to stop the HDLM manager.
   If you do not know how to stop and start programs other than HDLM, do not perform the following steps, and restart the host.
4. Execute the following command to stop the integrated trace collection process:

   ```
   # /opt/hitachi/HNTRLib2/bin/hntr2kill
   ```

5. Execute the following command to delete the memory mapped file:

   ```
   # rm /opt/hitachi/HNTRLib2/mmap/hntr2mmap.mm
   ```

6. Execute the following command to start the integrated trace collection process:

   ```
   # /opt/hitachi/HNTRLib2/bin/hntr2mon -d &
   ```

7. Start the programs stopped in step 3.
   If you stopped programs other than HDLM in step 3, start them.

About the Reservation Policy

The following table lists and describes the values for the reservation policy setting.

Table 3-22 Reservation Policy Settings

Setting	Description
`no_reserve`	Ignores a reservation request and does not reserve an LU. This setting is used when any of the following are applicable: • Multiple hosts share an LU and execute unique applications that have an exclusive control feature • A virtual I/O function is used to set up an MPIO configuration for a virtual SCSI disk in a client partition • A virtual I/O function is applied in order to use PowerHA in a client partition • In an Oracle RAC environment, the hdisk for an HDLM-managed device is specified as a disk used by Oracle RAC • PowerHA 7.1 or a later version is used
`PR_exclusive`	Uses persistent reservations (exclusive-host methodology) to reserve disks.
`PR_shared`	Uses persistent reservations (shared-host methodology) to reserve disks.

About changing the reservation policy

- You should check that the hdisk is not being accessed by any other programs before you attempt to change the reservation policy.
- When you change the reservation policy, the I/O count and error count are cleared.
- The status of the paths is changed to `Online`.
- Make sure that there are no path errors before you change the reservation policy.

  If the reservation policy is changed while there is an error in a path, the erroneous path is deleted.

  To recover from this status, resolve the error and then execute one of the following commands:

  `mkdev -l` *hdisk-name*

  `cfgmgr`

Settings for Using PowerHA

To use PowerHA, install HDLM on all hosts comprising the cluster, configure the hdisks, set up the storage system (if using Hitachi AMS/WMS series devices), and register the HDLM script for PowerHA. Also, set up the same reservation policy in all of the hdisks that are shared by multiple hosts in the cluster.

Storage System Settings

Setting Up a Hitachi AMS/WMS Series Device

To use a Hitachi AMS/WMS series device as the storage system, perform the setup shown in the table below. For details about how to set up a Hitachi AMS/WMS series device, see the documentation for the Hitachi AMS/WMS series.

Table 3-23 Hitachi AMS/WMS Series Setting for Using PowerHA

Item	Setting
Reset propagation mode in *Host connection mode 2* (set to the host group to be used)	ON

Registering the HDLM Script for PowerHA

To use PowerHA, you need to add custom disk methods to the HDLM script for PowerHA. The HDLM script for PowerHA is supplied with HDLM.

The following procedure describes how to specify a custom disk method. This setup procedure assumes that PowerHA 6.1 is used. The actual screen transitions for the SMIT menu might be different depending on the PowerHA version. Therefore, also refer to the PowerHA documentation.

To specify a custom disk method:

1. From the SMIT window, display the Add Custom Disk Methods window.
   Choose the following sequence of menu items to display this window:
   Communications Applications and Services, **HACMP for AIX**, **Extended Configuration**, **Extended Resource Configuration**, **HACMP Extended Resource Configuration**, **Configure Custom Disk Methods**, and finally choose **Add Custom Disk Methods**.
2. In the Add Custom Disk Methods window, specify the items as shown below:
   The items to be set and setting contents are shown below:
   Disk Type (PdDvLn field from CuDv)
   - When a XP series is used:
     `disk/fcp/HP`
   - When a Hitachi USP series (excluding XP series), Universal Storage Platform V/VM series (excluding XP20000 and XP24000), Hitachi Virtual Storage Platform, VSP G1000, VSP G200, G400, G600, Hitachi AMS2000/AMS/WMS/SMS series, HUS100 series, or HUS VM is used:
     `disk/fcp/Hitachi`

   Method to identify ghost disks
   `SCSI3`

   Method to determine if a reserve is held

```
/usr/DynamicLinkManager/cluster/
dlm_hacmp_gdisk_reserve_check
```

Method to break a reserve

```
TARGET
```

Break reserves in parallel

false

Method to make the disk available

```
MKDEV
```

3. When you finish specifying the settings, click the **OK** button.
4. From the SMIT window, display the Single Select List window.
   Choose the following sequence of menu items to display this window: **Communications Applications and Services**, **HACMP for AIX**, **Extended Configuration**, and finally choose **Extended Verification and Synchronization**.

Setting the Reservation Policy

If you use PowerHA 7.1 or a later version, set the `reserve_policy` attribute to `no_reserve`. If you use PowerHA 6.1 or an earlier version, we recommend that you set the `reserve_policy` attribute to `PR_exclusive`. Note that if a virtual I/O function is applied in order to use PowerHA in a client partition, use the following procedure to check, in the virtual I/O server partition, the settings for the `reserve_policy` attribute of the hdisk. If `reserve_policy` is set to `PR_exclusive`, change its value to `no_reserve`.

1. Check the setting for the `reserve_policy` attribute of the hdisk.

   ```
   # lsattr -El hdisk-name -a reserve_policy
   reserve_policy   PR_exclusive                    N/A TRUE
   ```

   Perform the following steps if `reserve_policy` is set to `PR_exclusive`:
2. Quit all applications that specify and directly access the hdisk whose attribute is to be changed.
3. Execute the following command to unmount the file system used by HDLM.

   ```
   # umount file-system-mount-point
   ```

4. Execute the following command to display all the activated volume groups.

   ```
   # lsvg -o
   ```

5. Among the displayed volume groups, inactivate the volume groups used by HDLM.

   ```
   # varyoffvg volume-group-name
   ```

6. Execute the `chdev` command to change the `reserve_policy` attribute to `no_reserve`.

```
# chdev -l hdisk-name -a reserve_policy=no_reserve
```

7. Confirm that the setting was changed to `no_reserve`.

```
# lsattr -El hdisk-name -a reserve_policy
reserve_policy   no_reserve                    N/A TRUE
```

Settings for Using GPFS

To use GPFS or GPFS+RVSD, carry out the following procedure before starting GPFS or GPFS+RVSD:

1. To use GPFS+RVSD, add the following lines to the last line in the `/etc/vsd/oemdisktypes.lst` file:
   - When a XP series is used
     `disk/fcp/HP fscsi disk/fcp`
   - When a Hitachi USP series (excluding XP series), Universal Storage Platform V/VM series (excluding XP20000 and XP24000), Hitachi Virtual Storage Platform, VSP G1000, VSP G200, G400, G600, Hitachi AMS2000/AMS/WMS/SMS series, HUS100 series, or HUS VM is used
     `disk/fcp/Hitachi fscsi disk/fcp`
2. When GPFS or GPFS+RVSD is used, in the `dlmodmset` utility for setting the HDLM execution environment ODM, set the `LUN RESET` option to `on`.

```
# /usr/DynamicLinkManager/bin/dlmodmset -r on
```

Settings for Using Oracle RAC 10g or Oracle RAC 11g

Settings for MISSCOUNT and DISKTIMEOUT

When a host and an Oracle RAC voting disk are connected by multiple paths, HDLM performs failover processing for those paths (in the same way as for normal paths) when an I/O timeout occurs for one of the paths.

Note that, depending on the settings of Oracle RAC, Oracle RAC might determine that a node error has occurred before the failover processing performed by HDLM is completed, and then re-configure the cluster.

Therefore, when HDLM manages the paths that are connected to an Oracle RAC voting disk, change the following settings according to your version of Oracle RAC:

When using Oracle RAC 10g 10.1.0.3.0 or later or Oracle RAC 11g:

Change the value of `MISSCOUNT` to match the type of storage system. To do so, use the following table to obtain the value to be specified, and then

change the current value to a value equal to or greater than the value you have obtained.

Table 3-24 Formula for Calculating MISSCOUNT

Storage system type	Formula for obtaining the value of MISSCOUNT
• Hitachi AMS2000/AMS/WMS/SMS series • HUS100 series	*number-of-paths-connected-to-the-voting-disk* × 30 seconds
• Hitachi USP series • Universal Storage Platform V/VM series • Virtual Storage Platform series • VSP G1000 series • VSP G200, G400, G600 • HUS VM	*number-of-paths-connected-to-the-voting-disk* × 60 seconds

When using Oracle RAC 10g 10.2.0.2.0 or later or Oracle RAC 11g:

In addition to the value of `MISSCOUNT` shown above, also change the value of `DISKTIMEOUT`. As with `MISSCOUNT`, the value to be specified in `DISKTIMEOUT` is determined by the type of storage system. To make the change, use the following table to obtain the value to be specified, and then change the current value to a value equal to or greater than the value you have obtained.

Table 3-25 Formula for Calculating DISKTIMEOUT

Storage system type	Number of paths connected to the voting disk	Formula for obtaining the value of DISKTIMEOUT
• Hitachi AMS2000/AMS/WMS/SMS series • HUS100 series	6 or less	You do not need to change the value of `DISKTIMEOUT`.
	7 or more	*number-of-paths-connected-to-the-voting-disk* × 30 seconds
• Hitachi USP series • Universal Storage Platform V/VM series • Virtual Storage Platform series • VSP G1000 series • VSP G200, G400, G600 • HUS VM	3 or less	You do not need to change the value of `DISKTIMEOUT`.
	4 or more	*number-of-paths-connected-to-the-voting-disk* × 60 seconds

For details on how to change MISSCOUNT and DISKTIMEOUT, contact the company with which you have a contract for Oracle Support Services.

Note that when you remove HDLM from the above configuration, you must reset the values of MISSCOUNT and DISKTIMEOUT to their original values. Therefore, make a note of the original values of MISSCOUNT and DISKTIMEOUT before changing them.

Settings for Reservation Policy

When you set up an Oracle RAC environment, if you specify the hdisk for an HDLM-managed device as a disk used by Oracle RAC, use the procedure below to check the value of the reserve_policy attribute. If reserve_policy is set to PR_exclusive, change its value to no_reserve.

1. Check the setting for the reserve_policy attribute of the hdisk.

   ```
   # lsattr -El hdisk-name -a reserve_policy
   reserve_policy   PR_exclusive                    N/A TRUE
   ```

   Perform the following procedure if reserve_policy is set to PR_exclusive:
2. Quit all applications that specify and directly access the hdisk whose attribute is to be changed.
3. Execute the following command to unmount the file system used by HDLM.

   ```
   # umount file-system-mount-point
   ```
4. Execute the following command to display all the activated volume groups.

   ```
   # lsvg -o
   ```
5. Among the displayed volume groups, inactivate the volume groups used by HDLM.

   ```
   # varyoffvg volume-group-name
   ```
6. Execute the chdev command to change the reserve_policy attribute to no_reserve.

   ```
   # chdev -l hdisk-name -a reserve_policy=no_reserve
   ```
7. Confirm that the setting was changed to no_reserve.

   ```
   # lsattr -El hdisk-name -a reserve_policy
   reserve_policy   no_reserve                  N/A TRUE
   ```

Settings for Using VCS

To use VCS, install HDLM on all of the hosts that comprise the cluster, and then configure the HDLM devices. Also, carry out the following procedure before starting VCS:

1. Specify the settings for starting the `preonline` script when VCS starts.
   When you have specified the settings for starting the `preonline` script, go to step 2.
   For details on the setting method, see the VCS documentation.
   The following example shows settings for starting the `preonline` script when VCS starts:

```
# haconf -makerw
# hagrp -modify service-group PreOnline 1
# haconf -dump -makero
# cp -r /opt/VRTSvcs/bin/sample_triggers/preonline /opt/
VRTSvcs/bin/triggers
```

2. In the `preonline` script used when VCS starts, register the script provided by HDLM.
   Add the following code to the line under `# put your code here...` in the `preonline` script.

```
system("/usr/DynamicLinkManager/cluster/dlm_vcs_pgr_release
$ARGV[1]");
```

   The following shows an example of editing the `preonline` script. The shaded portion represents the part to be added.

```
@(#)src/cmd/hatrigger/unix/preonline   2.9 06/06/30 11:30:51 -  #
#ident "@(#)VCS:src/cmd/hatrigger/unix/preonline 2.9"
#
# Copyright(C) 2000 VERITAS Software Corporation.  ALL RIGHTS RESERVED.
# UNPUBLISHED -- RIGHTS RESERVED UNDER THE COPYRIGHT
                                |
$trigger="preonline";
if (!defined $ARGV[0]) {
                        $log_message = sprintf("VCS:15005:%s:Failed to continue;
                    undefined system name", $trigger);
                        `$vcs_home/bin/halog -add C ¥"$log_message¥" -msgid 15005
                    -parameters $trigger`;
        exit;
} elsif (!defined $ARGV[1]) {
                        $log_message = sprintf("VCS:15006:%s:Failed to continue;
                    undefined group name", $trigger);
                        `$vcs_home/bin/halog -add C ¥"$log_message¥" -msgid 15006
                    -parameters $trigger`;
        exit;
                                |
# put your code here...
system("/usr/DynamicLinkManager/cluster/dlm_vcs_pgr_release $ARGV[1]");
#
# # Here is a sample code that takes into account multiple groups.
#
# $group = $ARGV[1];
```

Figure 3-4 Example of Editing the Preonline Script

Removing HDLM

This section explains how to return the HDLM environment to the way it was before HDLM was installed, and describes each step of the process.

Preparations for HDLM Removal

- Back up all HDLM management-target devices onto a medium such as a tape.
- Remove HDLM in a multi-user mode environment.
- When removing HDLM on a host where version 5.0 or later of a Device Manager agent is installed, do not execute any of the following Device Manager agent commands during the removal. Also, do not remove HDLM while executing any of the following Device Manager agent commands:

  ```
  hbsasrv, HiScan, hdvmagt_account, hdvmagt_schedule, hldutil, TIC
  ```

Removing HDLM

When you remove HDLM, if the KAPL09019-E or KAPL09020-E message is output, follow the directions in *Removing Hitachi Network Objectplaza Trace Library (HNTRLib2) on page 3-119* to remove HNTRLib2. However, if the KAPL09026-I message is output, since a program other than HDLM is using Hitachi Network Objectplaza Trace Library (HNTRLib2), only HDLM will be removed.

You can use the `installp` command or SMIT to remove HDLM. The following explains how to remove HDLM using the `installp` command. For details about how to use SMIT, see the AIX documentation.

For the virtual I/O server and boot disk environment, execute the required steps among those listed below.

When Removing HDLM in a Local Boot Disk Environment

1. Log in to AIX as a user with root permissions.
   If you are using a virtual I/O server, see the virtual I/O server documentation to log in to AIX.
   If you are not using a virtual I/O server, proceed to step 9.
2. Execute the following command to activate the volume group that is using the virtual SCSI disk of the HDLM management-target hdisk:

   ```
   # varyonvg volume-group-name
   ```
3. Execute the following command for the file system used to configure volume groups in the client logical partition:

   ```
   # mount file-system-mount-point
   ```
4. Execute the following command to back up the volume group in the client logical partition:

```
# savevg -i -f any-file-name-or-device-volume-name volume-group-name
```

5. Execute the following command to unmount the file system in the client logical partition:

   ```
   # umount file-system-mount-point
   ```

6. Execute the following command to delete the volume group in the client logical partition:

   ```
   # reducevg -df volume-group-name hdisk-name
   ```

7. Execute the following command to delete the virtual SCSI disk in the client logical partition:

   ```
   # rmdev -dl hdisk-name
   ```

8. Execute the following command to delete the virtual target device on the virtual I/O server:

   ```
   $ rmdev -dev vtscsin
   ```

9. Stop all processes and services that use the HDLM management-target paths.

   Stop any process or service of an application, such as a DBMS, that is using the HDLM management-target path.

   For details about the stopping method, see the manual for each application.

10. Specify the `-A` parameter, as required, and execute the `dlmrmdev` utility to remove HDLM drivers.

    When you specify the `-A` parameter and execute the `dlmrmdev` utility, you can skip steps 11 through 14. When `dlmrmdev` is executed, a message appears asking for confirmation that processing is to continue.

    Enter `y` for this message to continue processing.

    ```
    # /usr/DynamicLinkManager/bin/dlmrmdev -A
    KAPL10528-I The volume group will be made inactive, and the file
    system that is using HDLM will be unmounted. Is this OK? [y/n]:y
    hdisk3 deleted
    KAPL09012-I All HDLM drivers were removed.
    ```

    - If you executed this step, proceed to step 16.
    - If you did not execute this step, proceed to the following step.

11. Execute the following command to unmount the file system used by HDLM:

    ```
    # umount file-system-mount-point
    ```

12. Execute the following command to display all the activated volume groups:

    ```
    # lsvg -o
    ```

13. Among the displayed volume groups in step 12, execute the following command to inactivate the volume groups used by HDLM:

```
# varyoffvg volume-group-name
```

14. Execute the following command to remove the hdisks recognized as HDLM management-target device from the running kernel, and then stop the HDLM manager:

```
# /usr/DynamicLinkManager/bin/dlmrmdev
```

The KAPL09012-I message appears.

If the KAPL09012-I message is not displayed, the HDLM driver has not been deleted, or the HDLM manager has not stopped. Make sure that no process, service, file system, or volume group is using the HDLM management-target path, and then re-execute the above command.

15. Execute the following command to make sure that the hdisks recognized as the devices to be managed by HDLM have been deleted:

```
# lsdev -Cc disk
```

16. If GPFS + RVSD was used, delete the setting information from /etc/vsd/oemdisktypes.lst
    - If XP series was used, delete the following line:

      ```
      disk/fcp/HP fscsi disk/fcp
      ```

    - If Hitachi USP series (excluding XP series), Universal Storage Platform V/VM series (excluding XP20000 and XP24000), Hitachi Virtual Storage Platform, VSP G1000, VSP G200, G400, G600, Hitachi AMS2000/AMS/WMS/SMS series, HUS100 series, or HUS VM was used, delete the following line:

      ```
      disk/fcp/Hitachi fscsi disk/fcp
      ```

17. If GPFS or GPFS + RVSD was used, execute the following utility to set the LUN RESET option to off:

```
# /usr/DynamicLinkManager/bin/dlmodmset -r off
```

18. If you have been using VCS and have registered VCS scripts, you must delete the VCS script registrations.

Delete the following line that was added to the preonline script:

```
system("/usr/DynamicLinkManager/cluster/dlm_vcs_pgr_release
$ARGV[1]");
```

19. If you do not need to start the preonline script when VCS starts, delete the preonline script and specify the settings so that the preonline script does not start.

For details on the setting method, refer to the VCS documentation.

In the following example, the settings do not start the preonline script when VCS starts:

```
# rm /opt/VRTSvcs/bin/triggers/preonline
```

```
# haconf -makerw
# hagrp -modify service-group PreOnline 0
# haconf -dump -makero
```

20. Execute the following command:

    ```
    # installp -u DLManager.mpio
    ```

    If you are not using a virtual I/O server, removal of HDLM is complete and you do not need to perform the remaining steps.

    If the KAPL09022-E message is displayed, the hdisks recognized as the devices to be managed by HDLM still remain. Re-execute the procedure starting from step 14.

21. If you are using a virtual I/O server, define an hdisk as a virtual target device.

    On the virtual I/O server, execute one of the following commands:

    - To create an hdisk as a virtual target device

      ```
      $ mkvdev -vdev hdisk-name
      -vadapter virtual-SCSI-server-adapter-name
      ```

    - To create a logical volume as a virtual target device

      ```
      $ mkvdev -vdev logical-volume-name
      -vadapter virtual-SCSI-server-adapter-name
      ```

22. Execute the following command in the client logical partition to reconfigure the device:

    ```
    # cfgmgr
    ```

23. Execute the following command in the client logical partition to check that the physical volume has been recognized as hdisk:

    ```
    # lsdev -Cc disk
    ```

    Check that the following execution result is displayed:

    ```
    hdisk1 Available  Virtual SCSI Disk Drive
    ```

24. Execute the following command to restore the backed up volume group:

    ```
    # restvg -f any-desired-file-name-or-device-name hdisk-name
    ```

When Removing HDLM in the Boot Disk Environment

1. Log in to AIX as a user with root permissions.

   If you are using a virtual I/O server, see the virtual I/O server documentation for details about how to log in to AIX.

   If you are not using a virtual I/O server, proceed to step 9.

2. Execute the following command to activate the volume group that is using the virtual SCSI disk of the HDLM management-target hdisk:

   ```
   # varyonvg volume-group-name
   ```

3. Execute the following command to mount the file system used to configure volume groups in the client logical partition:

   ```
   # mount file-system-mount-point
   ```

4. Execute the following command to back up the volume group in the client logical partition:

   ```
   # savevg -i -f any-file-name-or-device-volume-name volume-group-name
   ```

5. Execute the following command to unmount the file system in the client logical partition:

   ```
   # umount file-system-mount-point
   ```

6. Execute the following command to delete the volume group in the client logical partition:

   ```
   # reducevg -df volume-group-name hdisk-name
   ```

7. Execute the following command to delete the virtual SCSI disk in the client logical partition:

   ```
   # rmdev -dl hdisk-name
   ```

8. Execute the following command to delete the virtual target device in the virtual I/O server:

   ```
   $ rmdev -dev vtscsin
   ```

   If the boot disk is in a single-path configuration, proceed to step 12.

9. If the boot disk is in a multi-path configuration, execute the following command to shut down the host.

   ```
   # shutdown -F
   ```

10. Configure the host and storage system so that only a single path connects the host to the storage system (single-path configuration).
11. Start the host.
12. Execute the following command to unmount the file system used by HDLM:

    ```
    # umount file-system-mount-point
    ```

13. Execute the following command to inactivate volume groups other than `rootvg`:

    ```
    # varyoffvg volume-group-name
    ```

14. Execute the following command to remove the hdisks recognized as HDLM management-target devices from the running kernel, and then stop the HDLM manager:

    ```
    # /usr/DynamicLinkManager/bin/dlmrmdev
    ```

    The `KAPL09012-I` message appears.

If the KAPL09012-I message is not displayed, the HDLM driver has not been deleted, or the HDLM manager has not stopped. Make sure that no process, service, file system, or volume group is using the HDLM management-target path, and then re-execute the above command.

15. Execute the following command to make sure that the hdisk recognized as the device to be managed by HDLM has been deleted:

```
# lsdev -Cc disk
```

16. Execute the HDLM pre-remove utility dlmpreremove.

```
# /usr/DynamicLinkManager/bin/dlmpreremove
```

If you execute the dlmpreremove utility, the hdisk recognized as a boot disk stops being the HDLM's management target. When the command terminates normally, the following message appears:

```
KAPL13103-I HDLM can be removed after rebooting the host.
KAPL13101-I The dlmpreremove utility completed successfully.
```

If the KAPL13108-E message is displayed, the hdisk for the device that is managed by HDLM still remains. Re-execute the procedure starting from step 14.

If the KAPL13110-E message is displayed, the multi-path configuration still remains. Re-execute the procedure starting from step 9.

17. Restart the host.

```
# shutdown -Fr
```

18. If GPFS + RVSD was used, delete the setting information from the /etc/vsd/oemdisktypes.lst file.

    - If XP series is used, delete the following line:

      ```
      disk/fcp/HP fscsi disk/fcp
      ```

    - If Hitachi USP series (excluding XP series), Universal Storage Platform V/VM series (excluding XP20000 and XP24000), Hitachi Virtual Storage Platform, VSP G1000, VSP G200, G400, G600, Hitachi AMS2000/AMS/WMS/SMS series, HUS100 series, or HUS VM was used, delete the following line:

      ```
      disk/fcp/Hitachi fscsi disk/fcp
      ```

19. If GPFS or GPFS + RVSD was used, execute the following utility to set the LUN RESET option to off:

```
# /usr/DynamicLinkManager/bin/dlmodmset -r off
```

20. If you have been using VCS and have registered VCS scripts, you must delete the VCS script registrations.

Delete the following line that was added to the preonline script:

```
system("/usr/DynamicLinkManager/cluster/dlm_vcs_pgr_release
$ARGV[1]");
```

21. If you do not need to start the `preonline` script when VCS starts, delete the `preonline` script and specify the settings so that the `preonline` script does not start.

    For details on the setting method, refer to the VCS documentation.

    In the following example, the settings do not start the `preonline` script when VCS starts:

    ```
    # rm /opt/VRTSvcs/bin/triggers/preonline
    # haconf -makerw
    # hagrp -modify service-group PreOnline 0
    # haconf -dump -makero
    ```

22. Execute the following command:

    ```
    # installp -u DLManager.mpio
    ```

23. Change the boot device list, according to the host environment you are using.

    If you are not using a virtual I/O server, removal of HDLM is complete and you do not need to perform the remaining steps.

24. If you are using a virtual I/O server, define an hdisk as a virtual target device.

    On the virtual I/O server, execute one of the following commands:

    - To create an hdisk as a virtual target device

      ```
      $ mkvdev -vdev hdisk-name -vadapter virtual-SCSI-server-adapter-name
      ```

    - To create a logical volume as a virtual target device

      ```
      $ mkvdev -vdev logical-volume-name -vadapter virtual-SCSI-server-adapter-name
      ```

25. Execute the following command in the client logical partition to reconfigure the device:

    ```
    # cfgmgr
    ```

26. Execute the following command in the client logical partition to check that the physical volume has been recognized as hdisk:

    ```
    # lsdev -Cc disk
    ```

    Make sure that the following execution result is displayed:

    ```
    hdisk1 Available  Virtual SCSI Disk Drive
    ```

27. Execute the following command to restore the backed up volume group:

    ```
    # restvg -f any-desired-file-name-or-device-name hdisk-name
    ```

Removing a NIM resource from SPOT

This subsection explains how to remove HDLM from a SPOT.

1. Log in to AIX as the root user.

2. Execute the following command.

```
# nim -o maint -a installp_flags=u -a
filesets=DLManager.mpio.rte name-of-NIM-SPOT-that-contains-HDLM
```

For details about the `nim` command, see the AIX documentation.

Removing Hitachi Network Objectplaza Trace Library (HNTRLib2)

When you remove HDLM, if the `KAPL09019-E` or `KAPL09020-E` message is output, follow the directions below to remove HNTRLib2.

To remove HNTRLib2:

1. Log in to AIX as the root user.
2. Execute the following command to unregister the name of the bundled program products.

```
# /opt/hitachi/HNTRLib2/etc/hntr2cancel "Hitachi Dynamic Link
Manager"
```

3. Execute the following command.

```
# /opt/hitachi/HNTRLib2/etc/hntr2setup
```

The HNTRLib2 setup menu will appear.

4. From the **Setup** menu, select **9**.
HNTRLib2 will be removed.

If HNTRLib2 is not being used by any other programs:

HNTRLib2 will be removed normally, and the following message will appear.

```
Unsetup is complete.
```

If HNTRLib2 is being used by another program:

HNTRLib2 will not be removed, and the following message will appear.

```
Because a bundle PP name is registered,
I did not do the Uninstall.
```

If HNTRLib2 was not removed, execute the following command to check if any programs are using it.

```
# /opt/hitachi/HNTRLib2/etc/hntr2getname
```

If you are unable to complete removal even though no programs other than HDLM are using HNTRLib2, contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.

Note

If the log output directory set in HNTRLib2 was not the default directory, the log files will not be deleted during removal. In this case, delete these files after removal.

Removing Hitachi Network Objectplaza Trace Library (HNTRLib)

After you remove HDLM version 04-00 or earlier, if no applications other than HDLM are using HNTRLib, remove it as follows.

1. Check that no applications other than HDLM are using HNTRLib.
   See the manuals and documentation for each program to check whether the program is using Hitachi Network Objectplaza Trace Library.
2. Log in to AIX as a root user.
3. Execute the following command:
   `# /opt/hitachi/HNTRLib/etc/hntrsetup`
   The HNTRLib setup menu will appear.
4. From the setup menu, select **9**.
   HNTRLib will be removed.
5. Delete the HNTRLib common library files and the directory in which they are stored.
   When you remove HNTRLib, all directories within the `/opt/hitachi/HNTRLib` directory will be deleted, but the libraries within the `/opt/hitachi/common/lib` directory will not.
   To delete HNTRLib, delete the following files and directory.
   - Shared library files (symbolic links)
     `/opt/hitachi/common/lib/libhntr*`
   - Directory that contains shared library files
     `/opt/hitachi/common/lib/D001`

   If the `/opt/hitachi` directory only contains the files and directories shown above, delete the directory.

Note

- If the log output directory set in HNTRLib was not the default directory, the log files will not be deleted during removal. In this case, delete these files after removal.
- Even if you attempt to remove HNTRLib2 when HNTRLib is installed, HNTRLib will not be removed. If no other programs are using HNTRLib, delete it manually.

Canceling Cluster Software (PowerHA) Settings

When PowerHA is used, delete the custom disk method.

The following deletion procedure assumes that PowerHA 6.1 is used. The actual screen transitions for the SMIT menu might be different depending on the PowerHA version. Therefore, please also refer to the PowerHA documentation.

To delete a custom disk method:

1. From the SMIT window, display the Configure Custom Disk Methods window.

To display this window, choose the following sequence of menu items:

Communications Applications and Services, **HACMP for AIX**, **Extended Configuration**, **Extended Resource Configuration**, **HACMP Extended Resources Configuration**, **Configure Custom Disk Methods**, and finally choose **Remove Custom Disk Methods**.

2. In the Select Custom Disk Methods window, select the following item(s), and then delete it.

   - When XP series is used

     disk/fcp/HP

   - When Hitachi USP series (excluding XP series), Universal Storage Platform V/VM series (excluding XP20000 and XP24000), Hitachi Virtual Storage Platform, VSP G1000, VSP G200, G400, G600, Hitachi AMS2000/AMS/WMS/SMS series, HUS100 series, or HUS VM is used

     disk/fcp/Hitachi

4

HDLM Operation

This chapter describes operating procedures for HDLM, including how to operate HDLM and the HDLM manager, and how to change the configuration of the operating environment.

Some of the cautionary notes in *Notes on Using HDLM on page 4-2* are different for HDLM 5.8.1 or earlier and HDLM 5.9 or later. In addition, the contents of *Changing the Configuration of the HDLM Operating Environment on page 4-15* have changed. For details, see *Appendix B, Differences Between HDLM Version 5.9 or Later and Version 5.8.1 or Earlier on page B-1*.

Notes on Using HDLM

This section provides notes on using HDLM and using the environment in which HDLM is installed. Make sure that you read this section.

Displaying Path Information

The `AutoPATH_ID` that is displayed during the HDLM `dlnkmgr` command's `view` operation differs depending on the order in which paths are detected when the host starts. For this reason, you should always use the path name to specify a path.

When a Path Error Is Detected

When a path error is detected by HDLM, you must immediately resolve the error and restore the path.

A check for path errors is performed whenever an I/O is issued. If there are any paths through which I/O is not normally issued, such as a non-owner path, you should enable path health checking in order to detect errors even when there is no I/O. For details about path health checking, see *Detecting errors by using path health checking on page 2-30*.

When a path is in an error state and the interval specified for a path health check or a failover has been reached and you execute any of the following, the response time of the processing might slow down while the path health check or failover is being executed:

- HDLM command
- HDLM utility
- OS commands for operating volume groups
- `mount/umount` command
- `cfgmgr` command
- `mkdev` command
- `rmdev` command
- `chdev` command

When a path is in an error state, if you perform the online operation of the HDLM command with the `-s` parameter, it might take a long time for the command processing to finish.

When a path is in an error state and you want to place all paths or several paths online at the same time, we recommend that you execute the command without specifying the `-s` parameter. If you do this and a path cannot be placed online, a message confirming that you want to continue the processing is displayed. If you enter `n` in response to this message, you can suspend the command.

Storage System

- Start up the storage system before you start up the hosts, so that AIX can detect the storage system.
- To delete an LU from the storage system, you must delete the hdisk first, and then you can delete the LU.
- If you change the storage system's owner controller for the LU, you must re-configure the hdisk or restart the server.

Notes on Shutting Down a Host

When a cluster environment is not being used and you shut down a host without inactivating a volume group that satisfies all of the following conditions, other hosts will no longer be able to operate the volume group:

- The volume group was created by an LU shared by multiple hosts
- The reservation policy for the LU used to configure the volume group was set to `PR_exclusive`

Before shutting down a host, execute the following command to inactivate the volume group:

```
# varyoffvg volume-group-name
```

If you shut down the volume group without inactivating it, restart the host, activate and then inactivate the volume group.

Notes on Errors in a Host

If a cluster environment is not being used and an error occurs on a host where the reservation policy is set to `PR_exclusive` in order to exclusively use an LU, other hosts are no longer able to access the LU. In such a case, execute the `dlmpr` utility to clear the HDLM persistent reservation.

For details about the `dlmpr` utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.

While you are performing direct access operations by specifying the hdisk recognized as an HDLM management-target device, I/O might fail if you perform the operation below. Before performing this operation, you should make sure that the volume group is inactive, then perform the direct access operation by specifying the hdisk recognized as an HDLM management-target device that is not being used.

- Using the `dlmpr` utility to clear the reserve key.

Notes on Enabling Both Primary and Secondary Volumes to Be Viewed From the Same Server

To enable both primary and secondary volumes to be viewed from the same server, operate the disks according to the following steps:

1. Create a pair of the primary volume and the secondary volume (`paircreate`).
2. Split the pair (`pairsplit`).
3. Enable the secondary volume to be recognized as a volume group (`recreatevg`).

   When you execute the `recreatevg` command, characteristics of the volume group will be initialized. Therefore, change the characteristics of the volume group (`chvg`) as necessary.
4. Access the primary volume and the secondary volume.
5. Export the volume group, and then delete the volume information (`exportvg`).
6. Re-synchronize the volume pair (`pairresync`).
7. If there are several pairs of primary and secondary volumes, repeat the above steps for each pair (step 2 to step 6).

Notes on an LVM Mirror Configuration

When an error (such as one that might occur in a LVM mirror configuration) is detected and I/O access for a path in the Online(E) status continues, detection of errors will continue. When the `-i` parameter of the utility for setting the HDLM execution environment ODM (`dlmodmset`) is set to `on`, I/O access is suppressed until troubleshooting measures are taken. This can shorten the time needed to deal with the problem.

However, when this parameter is set to `on`, I/O access to the path in the Online(E) status will be suppressed, so I/O success will not automatically change the path to the Online status. To recover the path, use an `online` command or the auto failback function.

For details about the `dlmodmset` utility, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*.

Notes on When the OS Functionality in Not Available in a Boot Disk Environment

When both of the following conditions exist, the reservation for the LU used for the boot disk is not canceled:

- The reservation policy of the boot disk has been set to `PR_exclusive`.
- The OS cannot start because OS functionality is not available due to a problem such as an error occurring in all of the boot disk's paths.

To cancel the reservation for the LU, execute the `dlmpr` utility from a host that can access this LU. For details on this utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.

Notes on Replicating a System

You can use the OS's `mksysb` command to back up hosts that include HDLM-managed devices. If you then replicate (clone) a system from a mksysb image created in this manner onto another LPAR or host, you must update the HDLM information to match that of the destination system's environment.

To update the HDLM information to match that of the destination system's environment, use the following procedure to execute the HDLM restoration support utility (`dlmpostrestore`) after you have restored the mksysb image.

To update HDLM information:

1. After restoring the image, log in to the activated host as a user with root permissions.
2. Execute the `dlmpostrestore` utility.

   ```
   # /usr/DynamicLinkManager/bin/dlmpostrestore
   ```

   A message for confirming whether to continue processing is displayed (`KAPL10552-I` is displayed in a local boot disk environment, and `KAPL10555-I` is displayed in a boot disk environment). To continue processing, enter `y` in response to this message.

   If you executed the utility in a boot disk environment, you must then restart the host.

For details about the `dlmpostrestore` utility, see *dlmpostrestore Utility for HDLM Restoration Support on page 7-25*.

HDLM Operations Using Commands

This section explains how to use the HDLM command. For details on the various command operations, see *Chapter 6, Command Reference on page 6-1*.

Notes on Using Commands

- Execute the command as a user with root permissions.
- To specify a parameter value containing one or more spaces, enclose the entire value in double quotation marks (").

Viewing Path Information

This section explains how to display path information by using an HDLM command.

To display path information, execute the `dlnkmgr` command's `view` operation with the `-path` parameter specified. The following example shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

To display information only for the paths accessing the specified host device, execute the `dlnkmgr` command's `view` operation with the `-path` and `-hdev` parameters specified. The following example shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path -hdev hdisk1
Paths:000001 OnlinePaths:000001
PathStatus    IO-Count     IO-Errors
Online        0            0

PathID PathName                          DskName
iLU              ChaPort Status      Type IO-Count    IO-Errors   DNum HDevName
000006 08.11.00000000000000E2.0001      HITACHI .OPEN-3            .15001
0005             1H      Online      Own            0          0     0 hdisk1
000013 08.1D.00000000000000E3.0001      HITACHI .OPEN-3            .15001
0005             2H      Online      Own            0          0     0 hdisk1
KAPL01001-I The HDLM command completed normally. Operation name = view,
completion time = yyyy/mm/dd  hh:mm:ss
#
```

For details on the displayed items and their descriptions, see *view (Displays Information) on page 6-34*.

Changing the Status of Paths

This section explains how to change path statuses.

Changing the Status of Paths to Online

To change the status of paths to online:

1. Check the current status of the paths.

   To change the status of the path for each HBA port, CHA port, or path to online, first check the path name or AutoPATH_ID.

   The following example shows how to execute the command:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr view -path
   ```

   To change the path status to online by specifying a host device name, first check the host device name for the path and the OS management path ID.

   The following example shows how to execute the command:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr view -lu
   ```

2. To change the status of paths to online, execute the `dlnkmgr` command's `online` operation.

   The paths to be placed online can be specified by using an HBA port, CHA port, single path, or host device. For details on how to specify paths, see *online (Places Paths Online) on page 6-12*.

For example, if you want to place all the paths that pass through a specific HBA port online, execute the `dlnkmgr` command's `online` operation with the `-hba` parameter specified. The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr online -hba 01.01
KAPL01057-I All the paths which pass the specified HBA will be
changed to the Online status. Is this OK? [y/n]:y
KAPL01061-I 3 path(s) were successfully placed Online; 0 path(s)
were not. Operation name = online
#
```

3. Check to see if the statuses of all the applicable paths have changed.
   The following example shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

Changing the Status of Paths to Offline(C)

To change the status of paths to `Offline(C)`:

1. Check the current status of the paths.
   To change the status of the path for each HBA port, CHA port, or path to Offline(C), first check the path name or AutoPATH_ID.
   To change the path status to Offline(C) by specifying a host device name, first check the host device name for the path and the OS management path ID.
   The following example shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

   The following example shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu
```

2. To change the status of paths to `Offline(C)`, execute the `dlnkmgr` command's `offline` operation.
   The paths to be placed offline can be specified by using an HBA port, CHA port, single path, or host device. For details on specifying paths, see *offline (Places Paths Offline) on page 6-6*.
   For example, if you want to place all the paths that pass through a specific HBA port offline, execute the `dlnkmgr` command's `offline` operation with the `-hba` parameter specified. The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 01.01
KAPL01055-I All the paths which pass the specified CHA port will
be changed to the Offline(C) status. Is this OK? [y/n]:y
KAPL01056-I If you are sure that there would be no problem when
all the paths which pass the specified HBA are placed in the
Offline(C) status, enter y. Otherwise, enter n. [y/n]:y
KAPL01061-I 3 path(s) were successfully placed Offline(C); 0
path(s) were not. Operation name = offline
#
```

3. Check to see if the statuses of all the applicable paths have changed. The following example shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

Viewing LU Information

This section explains how to display LU information by using an HDLM command.

To display LU information, execute the `dlnkmgr` command's `view` operation with the `-lu` parameter specified. The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu
Product       : USP
SerialNumber  : 0014010
LUs           : 10

iLU  HDevName OSPathID  PathID Status
003A hdisk0   00000     000000 Online
              00001     000001 Online
003B hdisk1   00000     000002 Online
              00001     000003 Online
003C hdisk2   00000     000004 Online
              00001     000005 Online
003D hdisk3   00000     000006 Online
              00001     000007 Online
003E hdisk4   00000     000008 Online
              00001     000009 Online
003F hdisk5   00000     000010 Online
              00001     000011 Online
0040 hdisk6   00000     000012 Online
              00001     000013 Online
0041 hdisk7   00000     000014 Online
              00001     000015 Online
0042 hdisk8   00000     000016 Online
              00001     000017 Online
0043 hdisk9   00000     000018 Online
              00001     000019 Online
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd  hh:mm:ss
#
```

For details on the displayed items and their descriptions, see *view (Displays Information) on page 6-34*.

Displaying the Correspondences Between hdisks, OS Management Path IDs, and LDEVs

This section explains the use of an HDLM command to display the correspondences between hdisks, OS management path IDs, and LDEVs.

You display this information by executing the HDLM command's `view` operation with the `-drv` parameter specified. For details on the `view`

operation, see *view (Displays Information) on page 6-34*. The execution result of this operation is displayed on a single line for each path.

The following shows an example in which the `view` operation is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -drv
PathID HDevName OSPathID LDEV
000000 hdisk7   00000    HUS_VM.210945.0961
000001 hdisk7   00001    HUS_VM.210945.0961
000002 hdisk6   00000    HUS_VM.210945.0960
000003 hdisk6   00001    HUS_VM.210945.0960
000004 hdisk8   00000    HUS_VM.210945.0962
000005 hdisk8   00001    HUS_VM.210945.0962
000006 hdisk10  00000    VSP_G1000.10051.001837
000007 hdisk10  00001    VSP_G1000.10051.001837
000008 hdisk9   00000    VSP_G1000.10051.001836
000009 hdisk9   00001    VSP_G1000.10051.001836
000010 hdisk11  00000    VSP_G1000.10051.001838
000011 hdisk11  00001    VSP_G1000.10051.001838
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

For details on the displayed items and their descriptions, see *view (Displays Information) on page 6-34*.

Initializing Statistical Information for Paths

This section explains how to initialize statistical information (I/O counts and I/O errors) for all the paths managed by HDLM.

This procedure is useful when you want to check the number of I/O operations and I/O errors that have occurred since the last time the I/O counts and I/O errors were initialized to `0`.

To initialize statistical information for paths:

1. Check the current status of the path.
   The following shows how to execute the command:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr view -path
   ```

2. To initialize statistical information for all the paths managed by HDLM, execute the `dlnkmgr` command's `clear` operation with the `-pdst` parameter specified.
   The following shows an example in which the command is executed:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr clear -pdst
   KAPL01049-I Would you like to execute the operation? Operation
   name = clear [y/n]:y
   KAPL01001-I The HDLM command completed normally. Operation name
   = clear, completion time = yyyy/mm/dd hh:mm:ss
   #
   ```

3. Check to see whether the statistical information for all the paths has been initialized.
   The following shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

Viewing and Setting Up the Operating Environment

This section explains how to display and set up the HDLM operating environment.

Viewing the Operating Environment

To display the operating environment, execute the `dlnkmgr` command's `view` operation with the `-sys` and `-sfunc` parameters specified.

The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -sfunc
HDLM Version                      : x.x.x-xx
Service Pack Version              :
Load Balance                      : on(extended lio)
Support Cluster                   :
Elog Level                        : 3
Elog File Size(KB)                : 9900
Number Of Elog Files              : 2
Trace Level                       : 0
Trace File Size(KB)               : 1000
Number Of Trace Files             : 4
Path Health Checking              : on(30)
Auto Failback                     : on(60)
Intermittent Error Monitor        : off
Dynamic I/O Path Control          : off(10)
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

To display the operating environment of the audit log, execute the HDLM command's `view` operation with the `-sys` and `-audlog` parameters specified.

The following example shows how to execute the command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -audlog
Audit Log                     : off
Audit Log Category            : -
Audit Log Facility            : -
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

For details on the displayed items and their descriptions, see *view (Displays Information) on page 6-34*.

Setting Up the Operating Environment

To set up the HDLM operating environment, execute the `dlnkmgr` command's `set` operation. This operation allows you to set up the following functions:

- Load balancing

- Path health checking
- Automatic failback
- Intermittent error monitoring
- Dynamic I/O path control
- Displaying the physical storage system information
- Error log collection level
- Trace level
- Error log file size
- The number of error log files
- Trace file size
- The number of trace files
- Audit log data collection
- Audit log facility
- Number of times the same path can be used for load balancing
- Number of times the same path can be used for extended load balancing (sequential I/O)
- Number of times the same path can be used for extended load balancing (random I/O)

For details on how to set up each function, see *set (Sets Up the Operating Environment) on page 6-18*.

For example, to set up the error log collection level, execute the `dlnkmgr` command's `set` operation with the `-ellv` parameter specified. When the confirmation message is displayed, enter `y` to execute, or `n` to cancel the command.

The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -ellv 1
KAPL01049-I Would you like to execute the operation? Operation name
= set [y/n]: y
KAPL01001-I The HDLM command completed normally. Operation name =
set, completion time = yyyy/mm/dd hh:mm:ss
#
```

To check whether the settings have been applied, see *Viewing the Operating Environment on page 4-10*.

Viewing License Information

This section explains how to display license information.

To display license information, execute the `dlnkmgr` command's `view` operation with the `-sys` and `-lic` parameters specified.

The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -lic
```

```
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

For details on the displayed items and their descriptions, see *view (Displays Information) on page 6-34*.

Updating the License

This section explains how to update the license.

To update the license, execute the `dlnkmgr` command's `set` operation with the `-lic` parameter specified. When the confirmation message is displayed, enter `y` to execute, or `n` to cancel the command. If the license key file does not exist, a message asking you to enter the license key appears, so enter the license key.

Note:

When you are executing the `dlnkmgr` command's `set` operation with the `-lic` parameter to install the license, you can only execute it once a time. If you attempt to execute more than one `dlnkmgr` command containing the `set` operation with the `-lic` parameter, a core file is created and the following message might appear:

```
KAPL01075-E
A fatal error occurred in HDLM. The system environment is
invalid.
```

If this message appears, execute the `dlnkmgr` command's `view` operation with the `-sys -lic` parameter to make sure that the license is installed correctly.

The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -lic
KAPL01049-I Would you like to execute the operation? Operation name
= set [y/n]: y
KAPL01071-I A permanent license was installed.
#
```

Viewing HDLM Version Information

This section explains how to display HDLM version information.

To display HDLM version information, execute the `dlnkmgr` command's `view` operation with the `-sys` parameter specified. The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                    : x.x.x-xx
Service Pack Version            :
Load Balance                    : on(extended lio)
Support Cluster                 :
Elog Level                      : 3
```

```
Elog File Size (KB)              : 9900
Number Of Elog Files             : 2
Trace Level                      : 0
Trace File Size(KB)              : 1000
Number Of Trace Files            : 4
Path Health Checking             : on(30)
Auto Failback                    : on(60)
Intermittent Error Monitor       : off
Dynamic I/O Path Control         : off(10)
HDLM Manager Ver        WakeupTime
Alive        x.x.x-xx   yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver          WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver         WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

The value displayed in `HDLM version` indicates the HDLM version.

Viewing HDLM Component Information

This section explains how to display HDLM component information.

To display HDLM component information, execute the `dlnkmgr` command's `view` operation with the `-sys` parameter specified. The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
HDLM Version                     : x.x.x-xx
Service Pack Version             :
Load Balance                     : on(extended lio)
Support Cluster                  :
Elog Level                       : 3
Elog File Size (KB)              : 9900
Number Of Elog Files             : 2
Trace Level                      : 0
Trace File Size(KB)              : 1000
Number Of Trace Files            : 4
Path Health Checking             : on(30)
Auto Failback                    : on(60)
Intermittent Error Monitor       : off
Dynamic I/O Path Control         : off(10)
HDLM Manager Ver        WakeupTime
Alive        x.x.x-xx   yyyy/mm/dd hh:mm:ss
HDLM Alert Driver Ver          WakeupTime          ElogMem Size
Alive             x.x.x-xx    yyyy/mm/dd hh:mm:ss 4000
HDLM Driver Ver         WakeupTime
Alive       x.x.x-xx    yyyy/mm/dd hh:mm:ss
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Among the displayed items, HDLM Manager, HDLM Alert Driver, and HDLM Driver indicate the HDLM component information.

Also, you can view information for each HDLM component. Execute the dlnkmgr command's view operation with the -sys and subsequent parameter specified. The following shows an example in which the command is executed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -msrv
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -adrv
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -pdrv
```

Starting and Stopping the HDLM Manager

If an error occurs in the system, such as in an HDLM program, you may need to manually stop or start HDLM to recover from the error.

Starting the HDLM Manager

To start the HDLM manager, log in to AIX as a user with root permissions and then execute the following command.

```
# startsrc -s DLMManager
```

Lower case characters can be used for the command name (dlmmanager).

```
# startsrc -s dlmmanager
```

The startup script that was set up during HDLM installation runs, and starts the HDLM manager.

Use the following HDLM command's view operation to confirm that the HDLM manager is running:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -msrv
HDLM Manager       Ver          WakeupTime
Alive              x.x.x-xx     yyyy/mm/dd hh:mm:ss
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

When the HDLM Manager column shows Alive, the HDLM manager is active.

Stopping the HDLM Manager

To stop the HDLM manager, log in to AIX as a user with root permissions, and then execute the following command:

```
# stopsrc -s DLMManager
```

Lower case characters can be used for the command name (dlmmanager).

```
# stopsrc -s dlmmanager
```

The stop script that was set up during HDLM installation runs, and stops the HDLM manager.

Use the following `dlnkmgr` command's `view` operation to confirm that the HDLM manager has stopped.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -msrv
HDLM Manager Ver        WakeupTime
Dead
KAPL01001-I The HDLM command completed normally. Operation name =
view, completion time = yyyy/mm/dd hh:mm:ss
#
```

When the `HDLM Manager` column shows `Dead`, the HDLM manager is inactive.

HDLM Resident Processes

The table below lists and describes the resident processes in HDLM. To monitor these processes, use the names below.

Table 4-1 HDLM resident processes

Process	Description
`dlmmgr`	HDLM manager process
`hbsa_service`	Hitachi Command Suite Common Agent Component# process
`hntr2mon`	Hitachi Network Objectplaza Trace Library (HNTRLib2) process

#

You only need to monitor this process when HDLM is linked to Global Link Manager.

Changing the Configuration of the HDLM Operating Environment

This chapter describes the procedures for changing the configuration of an HDLM operating environment.

Changing an HDLM Management-Target Device

This subsection explains how to add and delete HDLM management-target devices and how to change their attributes.

Adding an HDLM Management-Target Device

Connect the device to the system and execute the following command:

```
# cfgmgr
```

Deleting an HDLM Management-Target Device

1. Execute the following command to check the device (hdisk) to be deleted:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr view -path
   ```

2. Stop all processes and services that are using the device that is to be deleted.
3. Execute the following command to unmount the file system that uses the device that is to be deleted:

   ```
   # umount file-system-mount-point
   ```

4. If the device to be deleted is registered in a volume group, execute the following command to inactivate the volume group:

   ```
   # varyoffvg volume-group-name
   ```

5. Execute the following command to delete the device (or devices):

   - To delete all devices

     ```
     # /usr/DynamicLinkManager/bin/dlmrmdev
     ```

   - To delete a specific device

     ```
     # rmdev -dl hdisk-name
     ```

6. Execute the following command to check that device deletion was successful:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr view -path
   ```

   If you deleted all devices, check that the following message appears:

   ```
   KAPL01019-W The target path was not found. Operation name = view
   ```

   If you deleted a specific device, check that the deleted device (hdisk name) is no longer displayed.

Changing an HDLM Management-Target Device

Note

If you execute the `chdev` command while a path is in error status, that path will be deleted. In such a case, first recover from the path error, then re-execute the `cfgmgr` command, and finally perform the following steps:

1. Inactivate the volume group used by HDLM.

   ```
   # varyoffvg volume-group-name
   ```

2. Execute the `chdev` command to change attributes.

   The following example changes the queue depth and timeout value:

   ```
   # chdev -l hdisk-name -a queue_depth=8

   # chdev -l hdisk-name -a rw_timeout=60
   ```

3. Inactivate the volume group used by HDLM.

```
# varyonvg volume-group-name
```

Changing hdisk attributes

hdisk attributes consist of default values and values actually used. When a new hdisk is configured, or deleted and then reconfigured, the actual value for hdisk attributes is set using the default values.

The HDLM default settings modification utility (`dlmchpdattr`) can be used to change the default values.

Note:

To change attribute values for an individual hdisk, use the `chdev` command instead of the `dlmchpdattr` utility to change the values actually used. The following explains how to use the `dlmchpdattr` utility to change default hdisk values, and apply them as the actually used values.

If you execute the `dlmchpdattr` utility with the `-A` parameter specified, after the default values are changed, hdisks will be automatically reconfigured. Note that even though you can execute the utility without specifying the `-A` parameter to change the default value, you have to manually reconfigure the hdisks.

To automatically reconfigure hdisks, perform the procedure in *Automatically Performing hdisk Reconfiguration on page 4-17*. To manually reconfigure hdisks, perform the procedure in *Manually Performing hdisk Reconfiguration on page 4-18*.

If you do not reconfigure the hdisks after changing the value of the `reserve_policy` attribute, the hdisks might become inaccessible.

For details on the `dlmchpdattr` utility, see *dlmchpdattr Utility for Changing HDLM Default Settings on page 7-13*.

Automatically Performing hdisk Reconfiguration

To automatically reconfigure an hdisk:

1. Log in to AIX as a user with root permissions.
2. Execute the `dlmchpdattr` utility with the `-A` parameter specified.

   ```
   # /usr/DynamicLinkManager/bin/dlmchpdattr -A -a
   reserve_policy=no_reserve
   ```

   A message is displayed to confirm whether processing should continue. Enter `y` to continue processing.

   If the command terminates normally, the KAPL10571-I message is displayed.
3. Make sure that the default value for the hdisk reservation policy has changed.

   Execute the `dlmchpdattr` utility with the `-o` parameter specified.

```
# /usr/DynamicLinkManager/bin/dlmchpdattr -o
uniquetype = disk/fcp/Hitachi
    reserve_policy     : no_reserve
KAPL10571-I The dlmchpdattr utility completed successfully.
```

If the execution environment is a boot disk environment, proceed to step 4. If the execution environment is a local boot disk environment, proceed to step 5.

4. Execute the following command to restart the host.

```
# shutdown -Fr
```

5. Execute the following command to make sure that the status of the hdisks recognized as HDLM-managed devices is `Available`.

```
# lsdev -Cc disk
hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
...
```

In this example, `hdisk3` and `hdisk4` are recognized as HDLM-managed devices.

If the status of all hdisks is `Available`, proceed to step 7. If there are any hdisks with the `Defined` status, proceed to step 6.

6. Execute the following command to change the hdisk status to `Available`.

```
# cfgmgr
```

After executing the command, perform step 5 again.

7. Check the setting for the hdisk reservation policy attribute.

Make sure that the changed default value is reflected in the value actually used.

```
# lsattr -El hdisk-name | grep reserve_policy
reserve_policy  no_reserve  Reserve Policy  TRUE
```

8. Activate the volume group used by HDLM.

```
# varyonvg volume-group-name
```

9. Mount the file system used by HDLM.

```
# mount file-system-mount-point
```

Manually Performing hdisk Reconfiguration

The procedure below explains how to manually reconfigure an hdisk.

Note:

In the procedure below, if you execute the `dlmchpdattr` utility without performing either step 2 or 6, any changed values will not be applied, even

though the lsattr command execution results will show that the changed values were applied. To apply the changed values, perform step 2, and then perform step 10 for a local boot disk environment, or perform step 12 for a boot disk environment.

To manually reconfigure an hdisk:

1. Log in to AIX as a user with root permissions.

   Reconfigure the HDLM device. Proceed to step 2 to automatically perform the processing needed to unmount for reconfiguration, and processing to change the active status of the volume group. Proceed to step 3 to perform these actions manually.

2. Execute the utility for deleting HDLM drivers (dlmrmdev) with the -e parameter and -A parameter specified.

   ```
   # /usr/DynamicLinkManager/bin/dlmrmdev -e -A
   ```

   For details on the dlmrmdev utility, see *dlmrmdev Utility for Deleting HDLM Drivers on page 7-30*.

   If the command terminates normally, the KAPL10531-I message is displayed.

   If the KAPL10531-I message is not displayed, make sure that HDLM-managed paths are not being used by a process, service, file system, or volume group, and then perform step 2 again.

   If the dlmrmdev utility is executed properly, proceed to step 7.

3. Execute the following command to unmount the file system used by HDLM.

   ```
   # umount file-system-mount-point
   ```

4. Execute the following command to display all the activated volume groups.

   ```
   # lsvg -o
   ```

5. Among the displayed volume groups, inactivate the volume groups used by HDLM.

   ```
   # varyoffvg volume-group-name
   ```

6. Execute the dlmrmdev utility with the -e parameter specified.

   ```
   # /usr/DynamicLinkManager/bin/dlmrmdev -e
   ```

   If the command terminates normally, the KAPL10531-I message is displayed. If the KAPL10531-I message is not displayed, make sure that HDLM-managed paths are not being used by a process, service, file system, or volume group, and then perform step 6 again.

7. Execute the following command to make sure that the status of the hdisks recognized as HDLM-managed devices is Defined.

   ```
   # lsdev -Cc disk
   hdisk0 Available 1S-08-00-8,0    16 Bit LVD SCSI Disk Drive
   hdisk1 Available 1S-08-00-9,0    16 Bit LVD SCSI Disk Drive
   hdisk2 Available 1S-08-00-10,0   16 Bit LVD SCSI Disk Drive
   ```

```
hdisk3 Defined 1H-08-02        Hitachi Disk Array (Fibre)
hdisk4 Defined 1H-08-02        Hitachi Disk Array (Fibre)
...
```

In this example, `hdisk3` and `hdisk4` are recognized as HDLM-managed devices.

8. Execute the utility for changing HDLM default settings (`dlmchpdattr`).

```
# /usr/DynamicLinkManager/bin/dlmchpdattr -A -a
reserve_policy=no_reserve
```

A message is displayed to confirm whether processing should continue. Enter `y` to continue processing.

If the command terminates normally, the KAPL10571-I message is displayed.

9. Make sure that the default value for the hdisk reservation policy has been changed.

Execute the `dlmchpdattr` utility with the `-o` parameter specified.

```
# /usr/DynamicLinkManager/bin/dlmchpdattr -o
uniquetype = disk/fcp/Hitachi
    reserve_policy     : no_reserve
KAPL10571-I The dlmchpdattr utility completed successfully.
```

Perform the following according to the execution environment:

- If the execution environment is a local boot disk environment:
  Proceed to step 10.
- If the execution environment is a boot disk environment:
  Proceed to step 11.

10. Execute the following command to change the hdisk status to `Available`.

```
# cfgmgr
```

After executing the command, proceed to step 13.

11. Execute the utility for clearing HDLM persistent reservation (`dlmpr`) for all hdisks comprising rootvg.

```
# dlmpr -c name-of-HDLM-device-comprising-rootvg
```

A message is displayed to confirm whether processing should continue. Enter `y` to continue processing.

If the reserve was cleared normally, the KAPL10642-I message is displayed. If the reserve was not cleared normally, the KAPL10650-I message is displayed.

For details on the `dlmpr` utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.

12. Execute the following command to restart the host.

```
# shutdown -Fr
```

13. Execute the following command to make sure that the status of the hdisks recognized as HDLM-managed devices is `Available`.

```
# lsdev -Cc disk
hdisk0   Available 1S-08-00-8,0  16 Bit LVD SCSI Disk Drive
hdisk1   Available 1S-08-00-9,0  16 Bit LVD SCSI Disk Drive
hdisk2   Available 1S-08-00-10,0 16 Bit LVD SCSI Disk Drive
hdisk3   Available 1H-08-02      Hitachi Disk Array (Fibre)
hdisk4   Available 1H-08-02      Hitachi Disk Array (Fibre)
...
```

In this example, `hdisk3` and `hdisk4` are recognized as HDLM-managed devices.

If the status of all hdisks is `Available`, proceed to step 14. If there are any hdisks with the `Defined` status, perform step 10 again.

14. Check the setting for the hdisk reservation policy attribute.

    Make sure that the changed default value is reflected in the value actually used.

    ```
    # lsattr -El hdisk-name | grep reserve_policy
    reserve_policy  no_reserve  Reserve Policy  TRUE
    ```

15. Activate the volume group used by HDLM.

    ```
    # varyonvg volume-group-name
    ```

16. Mount the file system used by HDLM.

    ```
    # mount file-system-mount-point
    ```

Changing a Path

This subsection explains how to add and delete paths.

Adding a Path (to a Volume Group Other than rootvg)

Connect the path to the system and execute the following command:

```
# cfgmgr
```

Adding a Path (to a Device Included in rootvg)

The following shows an example of adding a path to `hdisk0` in an environment where rootvg consists of `hdisk0` and `hdisk1`.

1. Connect the path to the system, and then execute the following command:

   ```
   # cfgmgr
   ```

2. Check the list of current boot disks.

   The following shows an example of executing the command:

   ```
   # bootlist -m normal -o
   hdisk0 blv=hd5
   hdisk1 blv=hd5
   ...
   ```

3. Specify a boot disk according to the host environment to be used.
   The following shows an example of executing the command:

```
# bootlist -m normal hdisk0 hdisk1
```

4. Make sure that the boot disk is configured with the specified number of paths.
   The following shows an example of executing the command:

```
# bootlist -m normal -o
hdisk0 blv=hd5
hdisk0 blv=hd5
hdisk1 blv=hd5
...
```

Deleting a Path (of a Volume Group Other than rootvg)

The following shows an example of deleting a path of a volume group other than rootvg.

1. Execute the following HDLM command to check the OS management path ID of the path that is to be deleted and to determine the devices (hdisk name) connected to the path.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -drv
PathID HDevName OSPathID LDEV
000000 hdisk7   00000    HUS_VM.210945.0961
000001 hdisk7   00001    HUS_VM.210945.0961
000002 hdisk6   00000    HUS_VM.210945.0960
000003 hdisk6   00001    HUS_VM.210945.0960
000004 hdisk8   00000    HUS_VM.210945.0962
000005 hdisk8   00001    HUS_VM.210945.0962
000006 hdisk10  00000    VSP_G1000.10051.001837
000007 hdisk10  00001    VSP_G1000.10051.001837
000008 hdisk9   00000    VSP_G1000.10051.001836
000009 hdisk9   00001    VSP_G1000.10051.001836
000010 hdisk11  00000    VSP_G1000.10051.001838
000011 hdisk11  00001    VSP_G1000.10051.001838
```

   For each path ID (`PathID` column), check the entries in the `HDevName` and `OSPathID` columns. In the following steps, *device-name* and *OS-management- path-ID* refer to the `HDevName` and `OSPathID` items, respectively, that you checked in this step.

2. Execute the following command to check the parent device and connection of the path to be deleted:
   Specify the *device-name* checked in step 1 in executing the following command:

```
# lspath -Hl device-name -F "name path_id parent connection"
```

   When `hdisk10` is specified, the command and the execution results would be as follows:

```
# lspath -Hl hdisk10 -F "name path_id parent connection"
name   path_id parent connection
```

```
hdisk10   0     fscsi4 50060e800436e240,6a000000000000
hdisk10   1     fscsi4 50060e800436e250,6a000000000000
hdisk10   2     fscsi5 50060e800436e240,6a000000000000
```

Search for lines in which the `path_id` item matches *OS-management-path-ID*. If matching lines are found, check the `parent` and `connection` entries. In the following steps, the checked `parent` and `connection` items correspond to *fscsi-number* and *connection-position*, respectively.

3. Delete the path.

```
# rmpath -d -l device-name -p fscsi-number -w connection-position
```

The following example deletes the path whose *OS-management-path-ID* is 2:

```
# rmpath -d -l hdisk10 -p fscsi5 -w
50060e800436e240,6a000000000000
```

4. Check that the path has been deleted.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -drv
```

Deleting a Path (of a Device Included in rootvg)

The following shows an example of deleting a path of `hdisk0` in an environment where rootvg consists of `hdisk0` and `hdisk1`.

1. Delete a path of a volume group other than rootvg by performing the procedure described in *Deleting a Path (of a Volume Group Other than rootvg) on page 4-22*:
2. Check the list of current boot disks.
   The following shows an example of executing the command:

```
# bootlist -m normal -o
hdisk0 blv=hd5
-
hdisk1 blv=hd5
...
```

3. Specify a boot disk according to the host environment to be used.
   The following shows an example of executing the command:

```
# bootlist -m normal hdisk0 hdisk1
```

4. Make sure that the boot disk is configured with the specified number of paths.
   The following shows an example of executing the command:

```
# bootlist -m normal -o
hdisk0 blv=hd5
hdisk1 blv=hd5
...
```

Replacing an HBA

If there are multiple active paths for an LU, you can replace a desired HBA while running your applications by placing offline only the path that goes through the HBA to be replaced and using other paths to continue access.

To replace an HBA:

1. Execute the following command to find the `fscsi` number that corresponds to the HBA that is to be replaced:

   ```
   # lsdev -C | grep fscsi
   ```

   The following are execution examples:

   ```
   fscsi0 available 1H-08-02 FC SCSI I/O controller protocol device
   fscsi1 available 11-08-02 FC SCSI I/O controller protocol device
   ```

   In the second line of the above examples, `11` in `11-08-02` indicates the bus number and `08` indicates the HBA adapter number. The `fscsi` number to be used when replacing this HBA is `1`.

2. Execute the `dlmodmset` utility for setting the HDLM execution environment ODM to check the NPIV option setting.

   ```
   # /usr/DynamicLinkManager/bin/dlmodmset -o
   ```

   The following are execution examples:

   ```
   Lun Reset                                 : off
   Online(E) IO Block                        : on
   NPIV Option                               : off
   OS Error Log Output                       : off
   ```

   Check the `NPIV Option` line.

3. Place in Offline (C) status the path that goes through the HBA to be replaced.

   Depending on the NPIV option setting for the `dlmodmset` utility checked in step 2, execute one of the following commands:

   - If the NPIV option is set to `off`:

     Specify the HBA adapter number and bus number, and then execute the command shown below. The following example shows how to place the path in Offline (C) status when the path goes through an HBA whose HBA adapter number is `08` and whose bus number is `11`:

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 08.11
     ```

   - If the NPIV option is set to `on`:

     Use the `fscsi` number found in step 1 to execute the command below. The following example shows how to place the path in Offline (C) status when the path goes through `fscsi` number `1` (`fscsi1`):

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 00.01
     ```

4. Execute the command shown below to delete the path connected to the HBA that is to be replaced.

Specify the device name (`fscsi` device) of the HBA that is to be replaced (where `n` is the instance number of the `fscsi` device).

```
# rmpath -p fscsin -d
```

Because the `fscsi` number found in step 1 is `1` (`fscsi1`), the result is as follows:

```
# rmpath -p fscsi1 -d
```

5. If LUN security has been set up for the storage system, add the WWN of the new HBA to the LUN security.
6. Execute the following command:

```
# diag
```

Note

For details on the operations after executing the `diag` command, see the AIX documentation. Steps 7 to 14 below provide an example of the execution procedure for AIX V6.1 (Technology Level 02).

7. From the displayed menu, choose **Task Selection**.
   The Task Selection List window appears.
8. Choose **Hot Plug Task**.
   The Hot Plug Task window appears.
9. Choose **PCI Hot Plug Manager**.
   The PCI Hot Plug Manager window appears.
10. Select **List PCI Hot Plug Slots** to check the PCI slot to be replaced:

```
# Slot  Description                      Device(s)
P1-I3   PCI 64 bit, 66MHz, 3.3 volt slot  Empty
P1-I4   PCI 64 bit, 66MHz, 3.3 volt slot  Empty
P1-I5   PCI 64 bit, 66MHz, 3.3 volt slot  fcs0
P1-I6   PCI 64 bit, 50MHz, 5 volt slot    Empty
P1-I7   PCI 64 bit, 50MHz, 5 volt slot    mg20
P1-I8   PCI 64 bit, 66MHz, 3.3 volt slot  fcs1
P1-I9   PCI 64 bit, 66MHz, 3.3 volt slot  scsi2 scsi3
P1-I10  PCI 64 bit, 66MHz, 3.3 volt slot  Empty
P1-I11  PCI 64 bit, 50MHz, 5 volt slot    pci12 ent1 ent2 ent3 ent4
P1-I12  PCI 64 bit, 50MHz, 5 volt slot    Empty
```

    The shading indicates the PCI slot where the HBA is to be replaced.
11. Go back to the PCI Hot Plug Manager window, select **Unconfigure a Device**, and enter in **Device name** the device that is to be replaced.
    For the **Unconfigure any Child Devices** and **KEEP definition in database** items, select **yes**.

```
* Device Name                                [fcs0]
  Unconfigure any Child Devices               yes
  KEEP definition in database                 yes
```

12. Go back to the PCI Hot Plug Manager window, select **Replace/Remove a PCI Hot Plug Adapter.**

Select the HBA to be replaced.

13. Select **Replace** in the input field.
14. When the following message is displayed, replace the HBA:

```
The visual indicator for the specified PCI slot has
been set to the identify state. Press Enter to continue
or enter x to exit.

The visual indicator for the specified PCI slot has
been set to the action state. Replace the PCI card
in the identified slot and press Enter to continue.
Enter x to exit. Exiting now leaves the PCI slot
in the removed state.
```

When you finish replacing the HBA, connect the cable and press **Enter**.

15. Execute the following command to reconfigure the device:

```
# cfgmgr -l fcsn
```

To reconfigure the device, specify the device name of the PCI slot where the HBA was replaced (`fcs` device); *n* indicates the instance number of the `fcs` device.

16. If LUN security has been set up for the storage system, delete the WWN of the previous HBA from the LUN security.
17. Execute the following command to check the path information:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

For details about the path information, see *view (Displays Information) on page 6-34*.

Notes

- If you replace all HBAs for a volume group without following the above procedure when all the following conditions are satisfied#, the volume group cannot be activated after the host is restarted:
  - The host was shut down while a volume group was active, and the volume group consisted of hdisks that had paths going through the HBAs to be replaced.
  - The hdisk reservation policy for the hdisks that make up the volume group has been set to `PR_exclusive`.

  #

  If you replace some HBAs for the volume group, after the host is restarted, the volume group is activated and the paths going through the new HBAs are added. However, the paths that go through the old HBAs remain defined, so delete such paths as necessary.

  To activate a volume group, perform the following:

  - **For a volume group comprising rootvg**

    Clear the reservation for the applicable LUs from the storage system or other servers.

- **For a volume group other than rootvg**

a. If LUN security has been set up for the storage system, add the WWNs of the new HBAs to the LUN security.

b. Start the host.

c. Execute the following command to delete the HDLM devices on the paths that go through the old HBAs:

```
# rmdev -dl hdisk-name
```

n indicates the instance number of the HDLM device.

d. If LUN security has been set up for the storage system, delete the WWNs of the old HBAs from the LUN security.

e. Execute the following command to reconfigure the devices:

```
# cfgmgr -l fcsn
```

Specify the device name of the PCI slot (`fcs` device) where each HBA has been replaced. *n* indicates the instance number of the `fcs` device.

f. Execute the following command to check path information:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

For details on path information, see *view (Displays Information) on page 6-34*.

g. Execute the utility for clearing HDLM persistent reservation (`dlmpr`) to clear the reservation of LUs comprising the applicable volume group:

```
# /usr/DynamicLinkManager/bin/dlmpr -c hdisk-name hdisk-name ...
```

h. Execute the following command to activate the applicable volume group:

```
# varyonvg volume-group-name
```

- After you replace an HBA, any paths that go through that HBA might be removed (due to AIX specifications) from the paths to a specified boot disk hdisk (logical device file), which will no longer be recognized as the boot disk. If this happens, it is necessary to restart the host, and then re-specify the path that goes through the replaced HBA as a path to the boot disk, as shown in the procedure below.

  To re-specify a device called `hdisk10` on the storage system as a boot disk:

a. Execute the following command to restart the host:

```
# shutdown -Fr
```

b. Make sure that the boot disk is in a multi-path configuration:

```
# lspath -l hdisk10 -s available
Available hdisk10 fscsi0
Available hdisk10 fscsi1
...
```

c. Check the current boot disk list:

```
# bootlist -m normal -o
hdisk10 blv=hd5
```

```
hdisk0 blv=hd5
hdisk1 blv=hd5
...
```

d. Specify boot disks that are suitable for your host environment:

```
# bootlist -m normal hdisk10 hdisk0 hdisk1
```

e. Make sure that the number of configured boot disks is the same as the number of paths that you checked in step 2:

```
# bootlist -m normal -o
hdisk10 blv=hd5
hdisk10 blv=hd5
hdisk0 blv=hd5
hdisk1 blv=hd5
...
```

Replacing a Fiber Cable

If there are multiple active paths for an LU, you can replace a desired cable while running your applications by placing offline only the path that goes through the cable to be replaced and using other paths to continue access.

Note

The following procedure is only for replacing a fiber cable.

To replace a fiber cable:

1. Execute the `dlmodmset` utility for setting the HDLM execution environment ODM to check the NPIV option setting.

   ```
   # /usr/DynamicLinkManager/bin/dlmodmset -o
   ```

   The following are execution examples:

   ```
   Lun Reset                                 : off
   Online(E) IO Block                        : on
   NPIV Option                               : off
   OS Error Log Output                       : off
   ```

   Check the `NPIV Option` line.

2. Place in Offline (C) status the path that goes through the cable to be replaced (path that goes through the HBA to which the cable is connected).

   Depending on the NPIV option setting for the `dlmodmset` utility checked in step 1, execute one of the following commands:

   - If the NPIV option is set to `off`:

     Specify the HBA adapter number and bus number, and then execute the command shown below. The following example shows how to place the path in Offline (C) status when the path goes through an HBA whose HBA adapter number is `08` and whose bus number is `11`:

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 08.11
     ```

- If the NPIV option is set to `on`:

  Use the `fscsi` number to execute the command below. The following example shows how to place the path in Offline (C) status when the path goes through `fscsi` number `1` (`fscsi1`):

  ```
  # /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 00.01
  ```

3. Replace the cable.

   Note

   If you change the port on the Fibre Channel switch or on the storage system, the path configuration will be changed. Delete the hdisk that are associated with the cable to be replaced and then reconfigure the device.

4. Place in Online status the path that goes through the replaced cable.

   Place in Online status the path that goes through the HBA to which the replaced cable is connected.

   Depending on the NPIV option setting for the `dlmodmset` utility checked in step 1, execute one of the following commands:

   - If the NPIV option is set to `off`:

     Specify the HBA adapter number and bus number, and then execute the command shown below. The following example shows how to place the path in Offline (C) status when the path goes through an HBA whose HBA adapter number is `08` and whose bus number is `11`:

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr online -hba 08.11
     ```

   - If the NPIV option is set to `on`:

     Use the `fscsi` number to execute the command below. The following example shows how to place the path in Offline (C) status when the path goes through `fscsi` number `1` (`fscsi1`):

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr online -hba 00.01
     ```

5. Execute the following command to check the path information:

   ```
   # /usr/DynamicLinkManager/bin/dlnkmgr view -path
   ```

   For details about path information, see *view (Displays Information) on page 6-34*.

Replacing a Fibre Channel Switch

If there are multiple active paths for an LU, you can replace a desired Fibre Channel switch while running your applications by placing offline only the path that goes through the Fibre Channel switch to be replaced and by using other Fibre Channel switches to continue access.

Note

The following procedure is only for replacing a Fibre Channel switch.

To replace a Fibre Channel switch:

1. Execute the following command to find the `fscsi` number that corresponds to the path that goes through the Fibre Channel switch that is to be replaced (the path that goes through the HBA to which the Fibre Channel switch is connected):

   ```
   # lsdev -C | grep fscsi
   ```

   The following are execution examples:

   ```
   fscsi0 available 1H-08-02 FC SCSI I/O controller protocol device
   fscsi1 available 11-08-02 FC SCSI I/O controller protocol device
   ```

   In the second line of the above examples, `11` in `11-08-02` indicates the bus number and `08` indicates the HBA adapter number. If the Fibre Channel switch is connected to this HBA, the corresponding `fscsi` number is `1`.

2. Execute the `dlmodmset` utility for setting the HDLM execution environment ODM to check the NPIV option setting.

   ```
   # /usr/DynamicLinkManager/bin/dlmodmset -o
   ```

   The following are execution examples:

   ```
   Lun Reset                                 : off
   Online(E) IO Block                        : on
   NPIV Option                               : off
   OS Error Log Output                       : off
   ```

   Check the `NPIV Option` line.

3. Place in Offline (C) status the path that goes through the Fibre Channel switch to be replaced.

   Depending on the NPIV option setting for the `dlmodmset` utility checked in step 2, execute one of the following commands:

   - If the NPIV option is set to `off`:

     Specify the HBA adapter number and bus number, and then execute the command shown below. The following example shows how to place the path in Offline (C) status when the path goes through an HBA whose HBA adapter number is `08` and whose bus number is `11`:

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 08.11
     ```

   - If the NPIV option is set to `on`:

     Use the `fscsi` number found in step 1 to execute the command below. The following example shows how to place the path in Offline (C) status when the path goes through `fscsi` number `1` (`fscsi1`):

     ```
     # /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 00.01
     ```

4. Execute the following command to delete the path that goes through the Fibre Channel switch to be replaced:

   Specify the device name (`fscsi` device) of the HBA connected to the Fibre Channel switch that is to be replaced to delete the path (where *n* is the instance number of the `fscsi` device).

```
# rmpath -p fscsin -d
```

Because the fscsi number found in step 1 is 1 (fscsi1), the result is as follows:

```
# rmpath -p fscsi1 -d
```

5. Execute the following command to get the name of the parent device:

```
# lsdev -C -l fscsin -F parent
```

6. Delete the HBA device associated with the Fibre Channel switch that is to be replaced.

```
# rmdev -dl fscsin -R
```

7. Replace the Fibre Channel switch.
8. Execute the following command to reconfigure the HBA device:

```
# cfgmgr -l fcsn
```

fcs*n* indicates the name of the parent device that was acquired in step 5; *n* indicates the instance number of the fcs device.

9. Execute the following command to check the path information:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path
```

For details about path information, see *view (Displays Information) on page 6-34*.

5

Troubleshooting

This chapter describes how to check HDLM error information, and how to take action if an error occurs in HDLM. Descriptions of the actions are separated into those for path errors, HDLM program errors, and other types of errors. If you need technical support, see *Getting help on page xvii*.

Information Collected by the DLMgetras Utility for Collecting HDLM Error Information

Immediately after an error occurs, execute the DLMgetras utility for collecting HDLM error information, since restarting the machine might delete error information before the information is collected by DLMgetras. For details about the DLMgetras utility and the error information it collects, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

Checking error information in messages

When you want to configure the system so that HDLM messages are output to syslog, specify user for the name of the system function defined in the /etc/syslog.conf file. In the following example, the system function name is user, and messages at the Information level or higher are output to the /etc/syslog.conf file:

```
user.info           /tmp/syslog.user.log
```

You can check path errors by referring to the KAPL08*xxx* messages that are output to syslog.

To obtain detailed information about the failed path, check the execution results of the view operation as indicated by the error message.

For details on this operation, see *view (Displays Information) on page 6-34*.

Based on the applicable message, detailed information about a path can be obtained by checking the execution results of the view operation.

The following is an example of a message:

```
KAPL08022-E Error in path occurred. ErrorCode = aa...aa,PathID =
bb...bb,PathName = cc...cc.dd...dd.ee...ee.ff...ff,DNum =
gg...gg,HDevName = hh...hh
```

The elements of the message are explained below.

ErrorCode

The error number generated when AIX detected the path error.

PathID

The ID assigned to a path. This ID is called the AutoPATH_ID. AutoPATH_IDs are re-assigned every time the host is restarted or every time the path configuration is changed. When you want to add a new LU without restarting the host, AutoPATH_IDs are re-assigned to each path of the LU when you execute the cfgmgr command.

This path ID is the same as the path ID displayed by the dlnkmgr command's view operation.

For details on this operation, see *view (Displays Information) on page 6-34*.

PathName

The path name, which indicates a path. When you modify the system configuration or replace a hardware item, you should check the path names to identify the paths that will be affected by the change.

A path name consists of the following four elements, separated by periods:

- HBA adapter number or adapter type (character string)
- Bus number or adapter number (character string)
- Target ID (hexadecimal)
- Host LU number (hexadecimal)

This path name is also the same as PathName displayed by the dlnkmgr command's view operation. For details on the path name, see *view (Displays Information) on page 6-34*.

DNum

A Dev number, which is equivalent to a logical volume number in AIX.

A Dev number beginning from 0 is assigned to the Dev in the LU.

In AIX, this value is fixed to 0 because one LU contains one Dev.

This is the same as the DNum that is displayed by the dlnkmgr command's view operation. For details on this operation, see *view (Displays Information) on page 6-34*.

HDevName

The name of the host device.

Hdisk name is displayed.

This is the same as the HDevName that is displayed by the dlnkmgr command's view operation. For details on this operation, see *view (Displays Information) on page 6-34*.

What To Do for a Path Error

When a path error is detected, HDLM performs a failover on the path and outputs the KAPL08022-E message. This message indicates that an error has occurred in the components, shown in the following figure, that make up the path.

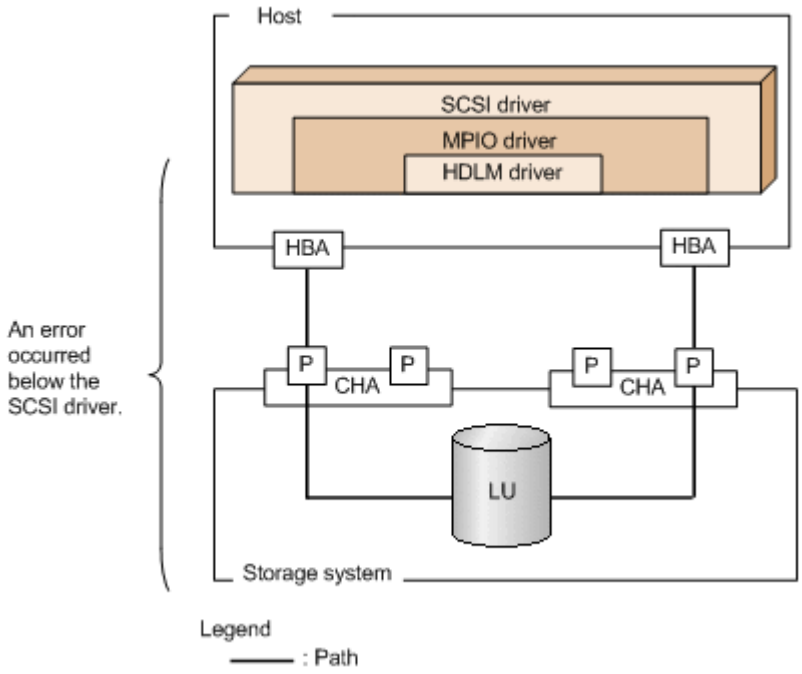


Figure 5-1 Error location when the KAPL08022-E message is output

The following figure shows the troubleshooting procedure when the KAPL08022-E message is output.

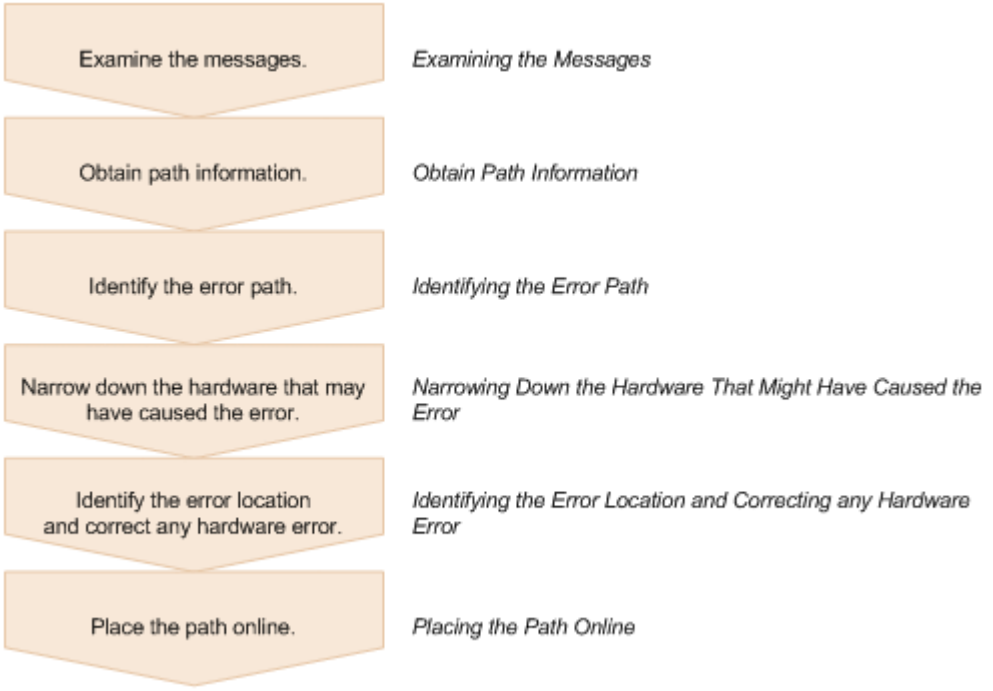


Figure 5-2 Troubleshooting procedure when a path error occurs

The following shows the procedure for using the HDLM command (`dlnkmgr`) to handle a path error.

Examining the messages

Examine the message that is output to syslog in the management-target host by using applications or tools for monitoring messages. If the KAPL08022-E message is output, view the message to check the path in which the error occurs. For details on each item displayed in the message, see *Checking error information in messages on page 5-2*.

Obtain path information

Obtain path information.

Execute the following command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path -iem -
hbaportwwn > pathinfo.txt
```

`pathinfo.txt` is the redirection-output file name. Use a file name that matches your environment.

Identifying the Error Path

Check the obtained path information to find the path with the error. In the `Status` column, the error path has the status `Offline(E)` or `Online(E)`.

Narrowing Down the Hardware That Might Have Caused the Error

Check the DskName , iLU , ChaPort , and HBAPortWWN columns of the path with the error to narrow down the hardware that may be the cause of the error. To physically identify the hardware corresponding to `DskName`, `iLU`, and `ChaPort`, use the information provided by the storage-system management program.

Identifying the Error Location and Correcting any Hardware Errors

Use the AIX and hardware management tools to identify the error location, and then take appropriate, corrective action. For hardware maintenance, contact your hardware vendor or maintenance company if there is a maintenance contract.

Placing the Path Online

After the path has recovered from the error, use the `dlnkmgr` command's `online` operation to place the path back online. For details on the `online` operation, see *online (Places Paths Online) on page 6-12*. Execute the following command:

```
# /usr/DynamicLinkManager/bin/dlnkmgr online
```

Executing this command places all the offline paths online.

If any path cannot be placed online due to an error, the KAPL01039-W message will appear. To ignore such paths and to continue processing, type `y`. Type `n` to cancel processing.

Check the statuses of the paths that cannot be placed online, and resolve the problem.

What To Do for a Program Error

The following describes what to do to handle errors that occur in an HDLM program. The following figure shows the troubleshooting procedure.

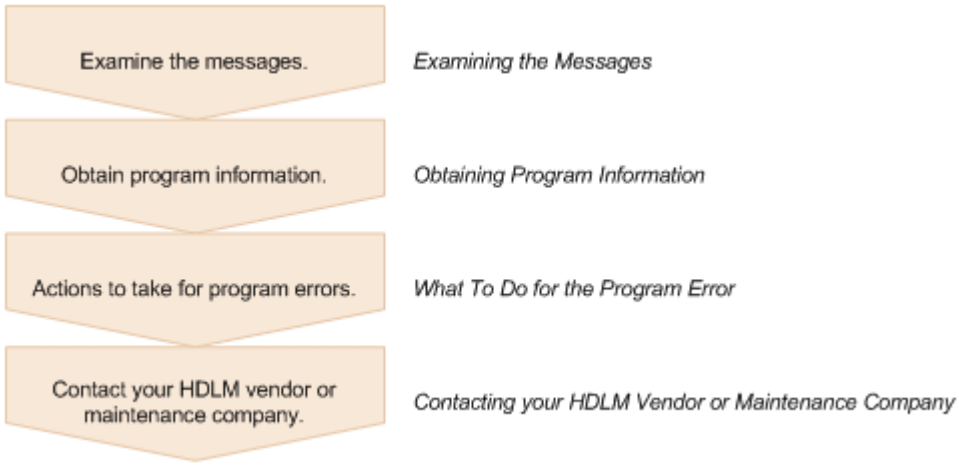


Figure 5-3 Troubleshooting Procedure When a Program Error Occurs

The following shows the procedure for handling a program error by using the HDLM command (`dlnkmgr`).

Examining the Messages

Examine the message that is output to syslog in the host. If an error occurs in an HDLM program, a message other than KAPL08*xxx* is output to syslog. Examine the content of the message. Messages with error level `E` (Error) or higher require corrective action.

Obtaining Program Information

Obtain the information that you need to report to your HDLM vendor or maintenance company.

Use the `DLMgetras` utility for collecting HDLM error information. For details on the `DLMgetras` utility and the information it collects, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

Some of the information collected by the `DLMgetras` utility might be cleared when the host is restarted. Because of this, whenever an error occurs, execute the `DLMgetras` utility as soon as possible.

What To Do for the Program Error

Follow the recommended actions for messages in *Chapter 8, Messages on page 8-1*.

If the error occurs again after you thought that you had resolved the problem, use the `dlnkmgr` command's `view` operation to check the status of the HDLM program, and then do whatever is necessary to resolve the problem. For details on the `view` operation, see *view (Displays Information) on page 6-34*.

Execute the following command:

Example:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys
```

If the KAPL01012-E message appears as a result of executing the command

The following shows the KAPL01012-E message:

```
KAPL01012-E Could not connect the HDLM manager. Operation name =
view
```

Start the HDLM manager.

For details about how to start the HDLM manager, see *Starting the HDLM Manager on page 4-14*.

If the KAPL01013-E message appears as a result of executing the command

The following shows the KAPL01013-E message:

```
KAPL01013-E An error occurred in internal processing of the HDLM
command. Operation name = view, details = aa...aa
```

aa...aa indicates character string. Restart the host.

If the same error re-occurs after you thought you had resolved the problem, go to the subsection *Contacting your HDLM Vendor or Maintenance Company on page 5-7*

Contacting your HDLM Vendor or Maintenance Company

If the error cannot be resolved, contact your HDLM vendor or maintenance company, and report the information that was collected by the `DLMgetras` utility.

What To Do for Other Errors

When the cause of an error may be related to HDLM but is neither a path error nor an HDLM program error, execute the `DLMgetras` utility to collect the HDLM error information, and then report the collected information to the HDLM vendor or maintenance company. For details about the `DLMgetras` utility and the information it collects, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

6

Command Reference

This chapter describes the HDLM command (`dlnkmgr`) and its operations.

Overview of the HDLM Command dlnkmgr

This section describes command formats and operations used for HDLM.

Command format

Enter the command using the following format:

```
dlnkmgr operation-name [parameter [parameter-value]]
```

`dlnkmgr`
The command name.

operation-name
The type of operation entered after `dlnkmgr`.

parameter
A value required for an operation.

parameter-value
A value required for a parameter.

Operations of the dlnkmgr command

Table 6-1 Operations of the dlnkmgr Command on page 6-2 shows the operations of `dlnkmgr` and their functions.

Table 6-1 Operations of the dlnkmgr Command

Operation	Functions
`clear`	Initializes(0) the statistics (I/O count and I/O errors) of all paths managed by the HDLM system. For details, see *clear (Returns the Path Statistics to the Initial Value) on page 6-3*.
`help`	Displays the format of the operation used for HDLM. For details, see *help (Displays the Operation Format) on page 6-4*.
`offline`	Places offline an online path or paths. For details, see *offline (Places Paths Offline) on page 6-6*.
`online`	Places online an offline path or paths. For details, see *online (Places Paths Online) on page 6-12*.
`set`	Sets the HDLM operating environment. For details, see *set (Sets Up the Operating Environment) on page 6-18*.
`view`	Displays HDLM program information, path information, LU information, HBA port information, CHA port information, and information about correspondences between hdisks, OS management path IDs, and LDEVs. For details, see *view (Displays Information) on page 6-34*.
`add`	Dynamically adds a path as an HDLM-management target. For details, see *add (Adds a Path Dynamically) on page 6-75*.
`delete`	Dynamically deletes a path that is an HDLM-management target. For details, see *delete (Deletes a Path Dynamically) on page 6-77*.

Operation	Functions
refresh	Applies the storage system settings to HDLM. For details, see *refresh (Applies Storage System Settings to HDLM) on page 6-78*.

Note

- Execute the command as a user with root permissions.
- To specify a value that contains a space in its parameter, enclose the entire value in double quotes (").

clear (Returns the Path Statistics to the Initial Value)

The dlnkmgr command's clear operation clears the statistics (I/O count and I/O errors) of all paths that are managed by HDLM, and returns them to their initial value.

Format

To Set the Path Statistics to 0

```
/usr/DynamicLinkManager/bin/dlnkmgr clear -pdst [-s]
```

To Display the Format of the Clear Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr clear -help
```

Parameters

To Set the Path Statistics to 0

-pdst

Clears statistics (I/O count and I/O errors) of all paths managed by HDLM to the initial value (0).

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr clear -pdst
KAPL01049-I Would you like to execute the operation?
Operation name = clear [y/n]:y
KAPL01001-I The HDLM command completed normally. Operation
name = clear, completion time = yyyy/mm/dd hh:mm:ss
#
```

-s

Executes the command without displaying a message asking for confirmation of command execution from the user. Specify this parameter if you want to skip the response to the confirmation message: for example, when you want to execute the command in a shell script or batch file.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr clear -pdst -s
KAPL01001-I The HDLM command completed normally. Operation
name = clear, completion time = yyyy/mm/dd hh:mm:ss
#
```

To Display the Format of the Clear Operation

`-help`

Displays the format of the `clear` operation.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr clear -help
clear:
  Format
    dlnkmgr clear -pdst [-s]
KAPL01001-I The HDLM command completed normally. Operation
name = clear, completion time = yyyy/mm/dd hh:mm:ss
#
```

help (Displays the Operation Format)

The `dlnkmgr` command's `help` operation displays the list of operations available for the HDLM command, or the format of individual operations.

Format

```
/usr/DynamicLinkManager/bin/dlnkmgr help
   [operation] [operation] ...
```

Parameter

operation

Specify the HDLM command operation whose format you want to know. You can specify one of the following operations:

- `clear`
- `help`
- `offline`
- `online`
- `set`
- `view`
- `add`
- `delete`
- `refresh`

If you do not specify any operations, the `help` operation displays all operations available for the HDLM command.

Examples

Example 1

The following example shows how to display all the operations available in the HDLM command.

```
# /usr/DynamicLinkManager/bin/dlnkmgr help
dlnkmgr:
  Format
    dlnkmgr { clear | help | offline | online | set | view | add
| delete | refresh}
KAPL01001-I The HDLM command completed normally. Operation name
= help, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 2

The following example shows how to display the formats of multiple operations.

```
# /usr/DynamicLinkManager/bin/dlnkmgr help online offline help
online:
  Format
    dlnkmgr online [-path] [-s]
    dlnkmgr online [-path]
            { -hba HBAPortNumber.BusNumber | -hbaid HBA_ID } [-s]
    dlnkmgr online [-path] { -cha -pathid AutoPATH_ID | -chaid
CHA_ID } [-s]
    dlnkmgr online [-path] [-pathid AutoPATH_ID] [-s]
    dlnkmgr online [-path] [-hdev Host_Device_Name [-ospathid
OS_Path_ID]] [-s]
    dlnkmgr online [-path] -hapath [-lu -pathid AutoPATH_ID] [-s]
    dlnkmgr online [-path] -dfha [-lu -pathid AutoPATH_ID] [-s]

  Valid value
    AutoPATH_ID   { 000000 - 999999 }(Decimal)
    HBA_ID         { 00000 - 99999 }(Decimal)
    CHA_ID         { 00000 - 99999 }(Decimal)
    OS_Path_ID     { 00000 - 99999 }(Decimal)
offline:
  Format
    dlnkmgr offline [-path]
            { -hba HBAPortNumber.BusNumber | -hbaid HBA_ID } [-s]
    dlnkmgr offline [-path] { -cha -pathid AutoPATH_ID | -chaid
CHA_ID } [-s]
    dlnkmgr offline [-path] -pathid AutoPATH_ID [-s]
    dlnkmgr offline [-path] -hdev Host_Device_Name -ospathid
OS_Path_ID [-s]
  Valid value
    AutoPATH_ID   { 000000 - 999999 }(Decimal)
    HBA_ID         { 00000 - 99999 }(Decimal)
    CHA_ID         { 00000 - 99999 }(Decimal)
    OS_Path_ID     { 00000 - 99999 }(Decimal)
help:
  Format
    dlnkmgr help { clear | offline | online | set | view | add |
```

```
delete | refresh }
KAPL01001-I The HDLM command completed normally. Operation name
= help, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 3

The following example shows how to display the operations that can be specified by the `help` operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr help help
help:
  Format
    dlnkmgr help { clear | offline | online | set | view | add |
delete | refresh }
KAPL01001-I The HDLM command completed normally. Operation name
= help, completion time = yyyy/mm/dd hh:mm:ss
#
```

offline (Places Paths Offline)

The `dlnkmgr` command's `offline` operation places online paths offline. Specify the paths to be placed offline by specifying an HBA port, CHA port, single path, or host device.

There must always be at least one online path accessing each LU.

Note that, for a path that is placed offline by the `offline` operation and whose status changes to Offline(C), the path status will not be inherited when the host is restarted. If the path is in a normal condition when the host is restarted, the path will become active and its status will be Online.

Placing too many paths offline might prevent paths from being able to switch if an error occurs. Before placing a path offline, use the `view` operation to check how many online paths remain. For details about the `view` operation, see *view (Displays Information) on page 6-34*.

Format

To Place Paths Offline

```
/usr/DynamicLinkManager/bin/dlnkmgr offline
   [-path]
   {-hba HBA-adapter-number.bus-number-or-adapter-type.adapter-
   number
   |-hbaid HBA-port-ID
   |-cha -pathid AutoPATH_ID
   |-chaid CHA-port-ID
   |-pathid AutoPATH_ID
   |-hdev host-device-name -ospathid OS-management-path-ID}
   [-s]
```

To Display the Format of the Offline Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr offline -help
```

Parameters

To Place Paths Offline

`-path`

Indicates that the target of the operation is a path managed by HDLM.

This parameter is optional because `offline` is always used for paths, so it is assumed.

Make sure that you specify the paths to be placed offline by using the `-hba`, `-hbaid`, `-cha`, `-chaid`, or `-pathid` parameter, or the `-hdev` and `-ospathid` parameters.

`-hba` *HBA-adapter-number*.*bus-number*

Or

`-hba` *adapter-type*.*adapter-number*

Use this parameter to place offline, at one time, all the paths that pass through a specific HBA port. The command will place offline all the paths connected to the HBA port that has the specified *HBA-adapter-number*.*bus-number* or *adapter-type*.*adapter-number*.

Specify the HBA adapter number and bus number, or adapter type and adapter number, of the target HBA port: the numbers are found in the PathName field displayed using the `view` operation. Enter a period between these two parameter values. For details about the `view` operation, see *view (Displays Information) on page 6-34*. The *HBA-adapter-number*.*bus-number* and *adapter-type*.*adapter-number* strings are case-sensitive.

Example

The following example shows how to place offline all paths connected to the HBA port whose HBA adapter number is `01` and bus number is `01`.

When the confirmation message is displayed, the user enters `y` to continue, or `n` to cancel the operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -hba 01.01
KAPL01055-I All the paths which pass the specified HBA will
be changed to the Offline(C) status. Is this OK? [y/n]:y
KAPL01056-I If you are sure that there would be no problem
when all the paths which pass the specified HBA are placed in
the Offline(C) status, enter y.  Otherwise, enter n. [y/n]:y
KAPL01061-I 3 path(s) were successfully placed Offline(C); 0
path(s) were not. Operation name = offline
#
```

`-hbaid` *HBA-port-ID*

Use this parameter to place offline, at one time, all paths that pass through a specific HBA port. The command will place offline all paths connected to the HBA port that has the specified *HBA-port-ID*. To display the HBA port IDs, execute the following `view` operation:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -hba
```

For details about how to execute the `view` operation to display the HBA port IDs, see *To Display HBA Port Information on page 6-71* in *Parameters on page 6-36*.

Example

The following example shows how to place offline all paths connected to the HBA port whose *HBA-port-ID* is `00001`.

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -hbaid 00001
KAPL01102-I All the paths which pass the specified HBA port
will be changed to the Offline(C) status. Is this OK? [y/n]:y
KAPL01103-I If you are sure that there would be no problem
when all the paths which pass the specified HBA port are
placed in the Offline(C) status, enter y. Otherwise, enter n.
[y/n]:y
KAPL01061-I 15 path(s) were successfully placed Offline(C); 0
path(s) were not. Operation name = offline
#
```

`-cha -pathid` *AutoPATH_ID*

Use this parameter to place offline, at one time, all the paths that pass through a specific CHA port. The command will place offline all the paths that pass through the CHA port to which the path with the specified *AutoPATH_ID* is connected. Paths that pass through a physical CHA port on a physical storage system will be offline.

Specify the current AutoPATH_ID of the target path, which is displayed by using the `view` operation. For details about the `view` operation, see *view (Displays Information) on page 6-34*. Leading zeros can be omitted (`000001` and `1` indicate the same *AutoPATH_ID*); however, when the target AutoPATH_ID is `000000`, enter `000000` or `0` for the parameter value.

AutoPATH_IDs are re-assigned every time the host is restarted. When you want to add a new LU without restarting the host, AutoPATH_IDs are re-assigned to each path of the LU when you execute the `cfgmgr` command. Always make sure that you use the `view` operation to find the current AutoPATH_ID of the target path, before executing the `offline` operation.

Example

The following example shows how to place offline all the paths connected to the CHA port `0A`. In this example, a path whose AutoPATH_ID is `000001` is connected to the target CHA port.

When the confirmation message is displayed, the user enters `y` to continue, or `n` to cancel the operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -cha -pathid
000001
```

```
KAPL01055-I All the paths which pass the specified CHA port
will be changed to the Offline(C) status. Is this OK? [y/n]:y
KAPL01056-I If you are sure that there would be no problem
when all the paths which pass the specified CHA port are
placed in the Offline(C) status, enter y.  Otherwise, enter
n. [y/n]:y
KAPL01061-I 2 path(s) were successfully placed Offline(C); 0
path(s) were not. Operation name = offline
#
```

`-chaid` *CHA-port-ID*

Use this parameter to place offline, at one time, all paths that pass through a specific CHA port. The command will place offline all paths connected to the CHA port that has the specified *CHA-port-ID*. Paths that pass through a specific CHA port on a storage system recognized by the operating system will be offline. If there are multiple physical CHA ports that correspond to the CHA port ID, use `-cha -pathid` *AutoPATH_ID* to place paths offline. To display the CHA port IDs, execute the following `view` operation:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -cha
```

For details about how to execute the `view` operation to display the CHA port IDs, see *To Display CHA Port Information on page 6-72* in *Parameters on page 6-36*.

Example

The following example shows how to place offline all paths connected to the CHA port whose *CHA-port-ID* is `00001`.

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -chaid 00001
KAPL01102-I All the paths which pass the specified CHA port
will be changed to the Offline(C) status. Is this OK? [y/n]:y
KAPL01103-I If you are sure that there would be no problem
when all the paths which pass the specified HBA port are
placed in the Offline(C) status, enter y. Otherwise, enter n.
[y/n]:y
KAPL01061-I 15 path(s) were successfully placed Offline(C); 0
path(s) were not. Operation name = offline
#
```

`-pathid` *AutoPATH_ID*

Use this parameter to place a single path offline.

Specify the current AutoPATH_ID of the target path, which is displayed by using the `view` operation. For details about the `view` operation, see *view (Displays Information) on page 6-34*. Leading zeros can be omitted (`000001` and `1` indicate the same *AutoPATH_ID*); however, when the target AutoPATH_ID is `000000`, enter `000000` or `0` for the parameter value.

AutoPATH_IDs are re-assigned every time the host is restarted. When you want to add a new LU without restarting the host, AutoPATH_IDs are re-assigned to each path of the LU when you execute the `cfgmgr` command. Always make sure that you use the `view` operation to find the current AutoPATH_ID of the target path, before executing the `offline` operation.

`-hdev` *host-device-name* `-ospathid` *OS-management-path-ID*

Use this parameter to place offline path connected to the specified host device.

For *host-device-name*, specify the value of `HDevName`.

For *OS-management-path-ID*, specify the value of `OSPathID`. Leading zeroes can be omitted from the OS management path ID (`00001` and `1` are the same value).

To display `HDevName` and `OSPathID`, execute the `view` operation as follows:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu
```

For details on how to execute the `view` operation and display the host device name and OS management path ID, see *To Display LU Information on page 6-58* in *Parameters on page 6-36*. Only one set of values can be specified for the `-hdev` parameter. This parameter is not case sensitive.

Example

The following shows an example of placing offline path for which the host device name is `hdisk0` and OS management path ID is `00001` while confirming command operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -path -hdev
hdisk0 -ospathid 1
KAPL01052-I The currently selected paths will be changed to
the Offline(C) status. Is this OK? [y/n]:y
KAPL01053-I If you are sure that there would be no problem
when the path is placed in the Offline(C) status, enter y.
Otherwise, enter n. [y/n]:y
KAPL01061-I 1 path(s) were successfully placed Offline(C); 0
path(s) were not. Operation name = offline
#
```

`-s`

Executes the command without displaying the message asking for confirmation of command execution from the user. Specify this parameter if you want to skip the response to the confirmation message: for example, when you want to execute the command in a shell script or batch file.

Example

The following example shows how to place a path, whose AutoPATH_ID is `000001`, offline without asking for confirmation of command execution from the user:

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -pathid 1 -s
KAPL01061-I 1 path(s) were successfully placed Offline(C); 0
path(s) were not. Operation name = offline
#
```

To Display the Format of the Offline Operation

`-help`

Displays the format of the `offline` operation.

Example

The following example shows how to display the format of the `offline` operation:

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -help
offline:
  Format
    dlnkmgr offline [-path]
          { -hba HBAPortNumber.BusNumber | -hbaid HBA_ID } [-
s]
    dlnkmgr offline [-path] { -cha -pathid AutoPATH_ID | -
chaid CHA_ID } [-s]
    dlnkmgr offline [-path] -pathid AutoPATH_ID [-s]
    dlnkmgr offline [-path] -hdev Host_Device_Name -ospathid
OS_Path_ID [-s]
  Valid value
    AutoPATH_ID    { 000000 - 999999 }(Decimal)
    HBA_ID          { 00000 - 99999 }(Decimal)
    CHA_ID          { 00000 - 99999 }(Decimal)
    OS_Path_ID      { 00000 - 99999 }(Decimal)
KAPL01001-I The HDLM command completed normally. Operation
name = offline, completion time = yyyy/mm/dd hh:mm:ss
#
```

Reference

Using the `view` operation together with standard UNIX commands enables you to filter the path information listed for a specific HBA port or CHA port. For details about the `view` operation, see *view (Displays Information) on page 6-34*.

We recommend that you use the following command and verify the information on the target paths before you execute the `offline` operation to place offline all the paths connected to a specific HBA port or CHA port.

Example 1

The following example shows how to filter and display the information on all paths that pass through the HBA port whose HBA adapter number is `04` and bus number is `01`.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path | grep 04.01
```

The above command will display information on all the paths that pass through the specified HBA port.

Example 2

The following example shows how to filter and display the information on all the paths that pass through the CHA port `1B` of the VSP G1000 series:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path -stname | grep
VSP_G1000 | grep 1B
```

The above command will display information pertaining to only those paths that pass through the specified CHA port.

online (Places Paths Online)

The dlnkmgr command's online operation places offline paths online. Specify the paths to be placed online by specifying an HBA port, CHA port, single path, or host device.

Format

To Place Paths Online

```
/usr/DynamicLinkManager/bin/dlnkmgr online
   [-path]
   [-hba HBA-adapter-number.bus-number-or-adapter-type.adapter-number
   |-hbaid HBA-port-ID
   |-cha -pathid AutoPATH_ID
   |-chaid CHA-port-ID
   |-pathid AutoPATH_ID
   |-hdev host-device-name [-ospathid OS-management-path-ID]
   |-hapath [-lu -pathid AutoPATH_ID]
   |-dfha [-lu -pathid AutoPATH_ID]]
   [-s]
```

To Display the Format of the Online Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr online -help
```

Parameters

To Place Paths Online

-path

Indicates that the target of the operation is a path managed by HDLM.

This parameter is optional because online is always used for paths, so it is assumed.

Specify the paths to be placed online by using the -hba, -hbaid, -cha, -chaid, -pathid, or -hdev parameter. If you do not specify any of these parameters, the command will place all the offline paths online. If there is a path that cannot be placed online, a message asks whether you would like to continue processing. To ignore the offline path that cannot be placed online and to continue processing, enter y. To stop the processing, enter n.

-hba *HBA-adapter-number.bus-number*

Or

-hba *adapter-type.adapter-number*

Use this parameter to place online, at one time, all the paths that pass through a specific HBA port. The command will place online all the paths connected to the HBA port that has the specified *HBA-adapter-number*.*bus-number* or *adapter-type*.*adapter-number*.

Specify the HBA adapter number and bus number, or adapter type and adapter number, of the target HBA port: the numbers are found in the PathName field displayed using the `view` operation. Enter a period between these two parameter values. For details about the `view` operation, see *view (Displays Information) on page 6-34*. The *HBA-adapter-number*.*bus-number* and *adapter-type*.*adapter-number* strings are case-sensitive.

Example

The following example shows how to place online all paths connected to an HBA port whose HBA adapter number is `01` and bus number is `01`.

When the confirmation message is displayed, the user enters `y` to continue, or `n` to cancel the operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr online -hba 01.01
KAPL01057-I All the paths which pass the specified HBA will
be changed to the Online status. Is this OK? [y/n]:y
KAPL01061-I 3 path(s) were successfully placed Online; 0
path(s) were not. Operation name = online
#
```

`-hbaid` *HBA-port-ID*

Use this parameter to place online, at one time, all paths that pass through a specific HBA port. The command will place online all paths connected to the HBA port that has the specified *HBA-port-ID*. To display the HBA port IDs, execute the following `view` operation:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -hba
```

For details about how to execute the `view` operation to display the HBA port IDs, see *To Display HBA Port Information on page 6-71* in *Parameters on page 6-36*.

Example

The following example shows how to place online all paths connected to the HBA port whose *HBA-port-ID* is `00001`.

```
# /usr/DynamicLinkManager/bin/dlnkmgr online -hbaid 00001
KAPL01104-I All the paths which pass the specified HBA port
will be changed to the Online status. Is this OK? [y/n]:y
KAPL01061-I 15 path(s) were successfully placed Online; 0
path(s) were not. Operation name = online
#
```

`-cha -pathid` *AutoPATH_ID*

Use this parameter to simultaneously place online all paths that pass through a specific CHA port. The command will place online all paths that pass through the CHA port in the path specified by the `-pathid`

parameter. Paths that pass through a specific physical CHA port on a physical storage system will be online.

Specify the current AutoPATH_ID of the target path, which is displayed by using the `view` operation. For details about the `view` operation, see *view (Displays Information) on page 6-34*. Leading zeros can be omitted (`000001` and `1` indicate the same *AutoPATH_ID*); however, when the target AutoPATH_ID is `000000`, enter `000000` or `0` for the parameter value.

AutoPATH_IDs are re-assigned every time the host is restarted. When you want to add a new LU without restarting the host, AutoPATH_IDs are re-assigned to each path of the LU when you execute the `cfgmgr` command. Always make sure that you use the `view` operation to find the current AutoPATH_ID of the target path, before executing the `online` operation.

Example

The following example shows how to place online the paths connected to the CHA port `0A`. In this example, a path whose AutoPATH_ID is `000002` is connected to the target CHA port.

When the confirmation message is displayed, the user enters `y` to continue, or `n` to cancel the operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr online -cha -pathid
000002
KAPL01057-I All the paths which pass the specified CHA port
will be changed to the Online status. Is this OK? [y/n]:y
KAPL01061-I 2 path(s) were successfully placed Online; 0
path(s) were not. Operation name = online
#
```

`-chaid` *CHA-port-ID*

Use this parameter to place online, at one time, all paths that pass through a specific CHA port. The command will place online all paths connected to the CHA port that has the specified *CHA-port-ID*. Paths that pass through a specific CHA port on a storage system recognized by the operating system will be online. If there are multiple physical CHA ports that correspond to the *CHA-port-ID*, use `-cha -pathid` *AutoPATH_ID* to place the desired paths online. To display the CHA port IDs, execute the following `view` operation:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -cha
```

For details about how to execute the `view` operation to display the CHA port IDs, see *To Display CHA Port Information on page 6-72* in *Parameters on page 6-36*.

Example

The following example shows how to place online all paths connected to the CHA port whose *CHA-port-ID* is `00001`.

```
# /usr/DynamicLinkManager/bin/dlnkmgr offline -chaid 00001
KAPL01104-I All the paths which pass the specified CHA port
will be changed to the Online status. Is this OK? [y/n]:y
```

```
KAPL01061-I 15 path(s) were successfully placed Online; 0
path(s) were not. Operation name = online
#
```

`-pathid` *AutoPATH_ID*

Use this parameter to place a single path online.

Specify the current AutoPATH_ID of the target path, which is displayed by using the `view` operation. For details about the `view` operation, see *view (Displays Information) on page 6-34*. Leading zeros can be omitted (`000001` and `1` indicate the same *AutoPATH_ID*); however, when the target AutoPATH_ID is `000000`, enter `000000` or `0` for the parameter value.

AutoPATH_IDs are re-assigned every time the host is restarted. When you want to add a new LU without restarting the host, AutoPATH_IDs are re-assigned to each path of the LU when you execute the `cfgmgr` command. Always make sure that you use the `view` operation to find the current AutoPATH_ID of the target path, before executing the `online` operation.

`-hdev` *host-device-name* `[-ospathid` *OS-management-path-ID*`]`

Use this parameter to place online path connected to the specified host device. If the `-ospathid` parameter is not specified, path with the specified host device name are placed online.

For *host-device-name*, specify the value of `HDevName`.

For *OS-management-path-ID*, specify the value of `OSPathID`. Leading zeroes can be omitted from the OS management path ID (`00001` and `1` are the same value).

To display `HDevName` and `OSPathID`, execute the `view` operation as follows:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu
```

For details on how to execute the `view` operation and display the host device name and OS management path ID, see *To Display LU Information on page 6-58* in *Parameters on page 6-36*. Only one set of values can be specified for the `-hdev` parameter. This parameter is not case sensitive.

Example

The following shows an example of placing online path for which the host device name is `hdisk0` and OS management path ID is `00001` while confirming command operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr online -path -hdev
hdisk0 -ospathid 1
KAPL01050-I The currently selected paths will be changed to
the Online status. Is this OK? [y/n]:y
KAPL01061-I 1 path(s) were successfully placed Online; 0
path(s) were not. Operation name = online
#
```

`-hapath`

Use this parameter to change to the Online status when the paths to the primary volume (P-VOL) in an HAM environment are in the Online(S) or Online(D) status. To change the status of a specific LU, use the -lu and -pathid parameters to specify the path to the LU. To change the status of all the paths in the Online(S) and Online(D) statuses, specify only -hapath.

-dfha

Use this parameter to change the paths to the primary volume (P-VOL) in an HAM environment to Online(D). The Online(S) status changes to the Online(D) status. When you do not specify this parameter, the status of the P-VOL paths in the HAM environment will be changed to the Online(S) status. If I/O operations to the secondary volume (S-VOL) have never occurred and only the paths to the P-VOL recover from an error, the path to the P-VOL will be in the Online status regardless of this parameter specification. To change the status of a specific LU, use the -lu and -pathid parameters to specify the path to the LU. To change the status of all the paths, specify only -dfha. A regular online operation is executed on the paths other than the P-VOL in an HAM environment.

If you use the -dfha parameter for a volume whose paths are all in the offline status, the processing to the P-VOL paths might output a KAPL01036-E message and fail even if the paths recover from an error. If the paths indicated in the KAPL01036-E message are in the Online(S) status and the paths to the S-VOL are in the Online status, re-execute the command with the -dfha parameter specified.

-lu -pathid AutoPATH_ID

Specify management-target paths for each LU (P-VOL). The target LUs are the LUs that belong to a path ID that you specify in the -pathid AutoPATH_ID parameter.

-s

Executes the command without displaying the message asking for confirmation of command execution from the user. Specify this parameter if you want to skip the response to the confirmation message: for example, when you want to execute the command in a shell script or batch file.

Example

The following example shows how to place a path, whose AutoPATH_ID is 000002, online without asking for confirmation of command execution from the user:

```
# /usr/DynamicLinkManager/bin/dlnkmgr online -pathid 2 -s
KAPL01061-I 1 path(s) were successfully placed Online; 0
path(s) were not. Operation name = online
#
```

To Display the Format of the Online Operation

-help

Displays the format of the `online` operation.

Example

The following example shows how to display the format of the `online` operation:

```
# /usr/DynamicLinkManager/bin/dlnkmgr online -help
online:
  Format
    dlnkmgr online [-path] [-s]
    dlnkmgr online [-path]
        { -hba HBAPortNumber.BusNumber | -hbaid HBA_ID } [-s]
    dlnkmgr online [-path] { -cha -pathid AutoPATH_ID | -
chaid CHA_ID } [-s]
    dlnkmgr online [-path] [-pathid AutoPATH_ID] [-s]
    dlnkmgr online [-path] [-hdev Host_Device_Name [-ospathid
OS_Path_ID]] [-s]
    dlnkmgr online [-path] -hapath [-lu -pathid AutoPATH_ID]
[-s]
    dlnkmgr online [-path] -dfha [-lu -pathid AutoPATH_ID] [-
s]

  Valid value
    AutoPATH_ID    { 000000 - 999999 }(Decimal)
    HBA_ID          {00000 - 99999}(Decimal)
    CHA_ID          {00000 - 99999}(Decimal)
    OS_Path_ID      {00000 - 99999}(Decimal)
KAPL01001-I The HDLM command completed normally. Operation
name = online, completion time = yyyy/mm/dd hh:mm:ss
#
```

Reference

Using the `view` operation together with standard UNIX commands enables you to filter the path information listed for a specific HBA port or CHA port. For details about the `view` operation, see *view (Displays Information) on page 6-34*.

We recommend that you use the following command and verify the information on the target paths before you execute the `online` operation to place online all the paths connected to a specific HBA port or CHA port.

Example 1

The following example shows how to filter and display the information on all paths that pass through the HBA port whose HBA adapter number is `04` and bus number is `01`.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path | grep 04.01
```

The above command will display information on all the paths that pass through the specified HBA port.

Example 2

The following example shows how to filter and display the information on all paths that pass through the CHA port `1B` of the VSP G1000 series:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path -stname | grep
VSP_G1000 | grep 1B
```

The above command will display information pertaining to only those paths that pass through the specified CHA port.

set (Sets Up the Operating Environment)

The `dlnkmgr` command's `set` operation sets the HDLM operating environment.

Format

To Set Up the HDLM Operating Environment

```
/usr/DynamicLinkManager/bin/dlnkmgr set
   {-lb {on [-lbtype {rr|exrr|lio|exlio|lbk|exlbk}]|off}
   |-ellv error-log-collection-level
   |-elfs error-log-file-size
   |-elfn number-of-error-log-files
   |-systflv trace-level
   |-systfs trace-file-size
   |-systfn number-of-trace-files
   |-pchk {on [-intvl checking-interval]|off}
   |-afb {on [-intvl checking-interval]|off}
   |-iem { on [-intvl error-monitoring-interval]
   [-iemnum number-of-times-error-is-to-occur] | off }
   |-lic
   |-audlog {on [-audlv audit-log-data-collection-level] [-category
   [[ss] [a] [ca]|all]]|off}
   |-audfac facility-value
   |-lbpathusetimes number-of-path-use-times
   |-expathusetimes number-of-path-use-times
   |-exrndpathusetimes number-of-path-use-times
   |-dpc {on|off} [-pathid path-ID -lu|-pathid path-ID -storage]
   |-dpcintvl checking-interval
   |-pstv {on|off}
   }
   [-s]
```

To Display the Format of the Set Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr set -help
```

Parameters

To Set Up the HDLM Operating Environment

The table below shows the defaults and recommended values for each setting. If you change the value of the `set` operation, the new value takes effect immediately.

Table 6-2 Default and Recommended Values

Item name	Default value	Recommended value
Load balancing	`on` The Extended Least I/Os algorithm is used.	`on` The recommended algorithm depends on the operating environment.
Error log collection level	`3`: Collect error information for the Information level and higher.	3: Collect error information for the Information level and higher.
Error log file size	`9900` (KB)	`9900` (KB)
Number of error log files	`2`	`2`
Trace level	`0`: Do not output any trace.	`0`: Do not output any trace.
Trace file size	`1000` (KB)	`1000` (KB)
Number of trace files	`4`	`4`
Path health checking	`on` (Interval is 30 minutes.)	`on` The recommended checking interval depends on the operating environment.
Automatic failback	`on` (Interval is 60 minutes.)	The recommended checking interval depends on the operating environment.
Intermittent error monitoring	`off`	`on` The recommended checking interval depends on the operating environment.
Collecting audit log data	`off`	The recommended value depends on the operating environment. Set `on`, if you want to collect audit log data.
Audit log facility	`user`	`local0` to `local7`
Number of times the same path can be used for load balancing	`20`	The recommended value depends on the operating environment.
Number of times the same path can	`100`	The recommended value depends on the operating environment.

Item name	Default value	Recommended value
be used for extended load balancing (sequential I/O)		
Number of times the same path can be used for extended load balancing (random I/O)	1	The recommended value depends on the operating environment.
Dynamic I/O path control#	off The checking interval is 10 minutes.	off The recommended checking interval depends on the operating environment.
Displaying the physical storage system information	off	The recommended value depends on the operating environment. Set to on if you want to display the physical storage system information.

#

This item is applied only when Hitachi AMS2000 series, Hitachi SMS series, or HUS100 series storage is used.

`-lb {on [-lbtype {rr|exrr|lio|exlio|lbk|exlbk}]|off}`

Enables or disables load balancing.

`on`: Enabled

`off`: Disabled

Load balancing distributes load among paths and prevents the performance of the entire system from deteriorating. As such, we recommend that you set this parameter to `on`.

`-lbtype {rr|exrr|lio|exlio|lbk|exlbk}`

Specify the algorithm to be used for load balancing.

`rr`: The Round Robin algorithm

`exrr`: The Extended Round Robin algorithm

`lio`: The Least I/Os algorithm

`exlio`: The Extended Least I/Os algorithm

`lbk`: The Least Blocks algorithm

`exlbk`: The Extended Least Blocks algorithm

The type of algorithm specified by the `-lbtype` parameter remains stored in the system, even when you disable the load balancing function by specifying `-lb off`. Therefore, if when you re-enable the load balancing function without specifying an algorithm, load balancing will be performed according to the algorithm that is stored in the system.

`-ellv` *error-log-collection-level*

Specify the level of error information you want to collect for an error log.

The HDLM manager log (`dlmmgr[1-16].log`) contains log files in which an error log collection level can be set.

Table 6-3 Values of the Error Logging Level on page 6-21 shows the values of the error logging level. If an error occurs, you may have to set the error log collection level to 1 or higher to collect log information.

Table 6-3 Values of the Error Logging Level

Value	Description
0	Collects no error log.
1	Collects error information for the Error or higher level.
2	Collects error information for the Warning or higher level.
3	Collects error information for the Information or higher level.
4	Collects error information for the Information or higher level (including maintenance information).

The higher the error log collection level value, the more log information will be output. As the amount of log information that is output increases, the amount of time before existing information will be overwritten becomes shorter.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -ellv 1
KAPL01049-I Would you like to execute the operation?
Operation name = set [y/n]: y
KAPL01001-I The HDLM command completed normally. Operation
name = set, completion time = yyyy/mm/dd hh:mm:ss
#
```

`-elfs` *error-log-file-size*

Specify a value from `100` to `2000000` (KB) for the size of the error log files (`dlmmgr`*n*`.log` (*n* indicates a file number from `1` to `16`)). The specified value is used for HDLM manager logs.

By specifying both the log file size and the number of log files, you can collect up to 32,000,000KB (approximately 30 GB) of error logs in total.

When the size of all the log files in a log file group reaches their maximum value, the new log data will overwrite the existing log data, starting with the oldest log data.

`-elfn` *number-of error-log-files*

Specify the number of error log files (`dlmmgr`*n*`.log` (*n* indicates a file number from `1` to `16`)). Specify a value from `2` to `16`.

By specifying both the log file size and the number of log files, you can collect up to 32,000,000KB (approximately 30GB) of error logs in total.

`-systflv` *trace-level*

Specify the trace output level.

The trace files for which trace levels can be set are hdlmtr*n*.log (*n* indicates a file number from 1 to 64).

Table 6-4 Trace Level Values on page 6-22 shows the values of the trace level. If an error occurs, set the trace level to 1 or higher to collect the log information.

Table 6-4 Trace Level Values

Value	Description
0	Does not output any trace.
1	Only outputs error information.
2	Outputs a summary of program operation.
3	Outputs details of program operation.
4	Outputs all information.

The higher the error log collection level value, the more log information will be output. As the amount of log information that is output increases, the amount of time before existing information is overwritten becomes shorter.

-systfs *trace-file-size*

Specify the size of the trace file in kilobytes. Specify a value from 100 to 16000.

When combined with the specification for the number of trace files, the maximum size of the trace files that can be collected is 1024000KB.

If the value is changed to something smaller than the value that is currently set, the execution confirmation message KAPL01097-W will be displayed and the trace file will be deleted temporarily.

The trace files for which a file size can be set are hdlmtr*n*.log (*n* indicates a file number from 1 to 64). The trace files are fixed in length. Thus, even if the amount of written trace information is less than the setting file size, the size of each output trace file is always the same. When all the trace files become full, the new trace data will overwrite the oldest trace data.

-systfn *number-of-trace-files*

Specify the number of trace files. Specify a value from 2 to 64.

When combined with the specification for the trace file size, the maximum total size of the trace files that can be collected is 1024000KB.

If the value is changed to something smaller than the value that is currently set, the execution confirmation message KAPL01097-W will be displayed and the trace file will be deleted temporarily.

The trace files for which the number of files can be set are hdlmtr*n*.log (*n* indicates a file number from 1 to 64).

-pchk {on [-intvl *checking-interval*]|off}

Enables or disables path health checking.

`on`: Enabled

`off`: Disabled

For a standby host, or a host connected to the Hitachi AMS/WMS series storage system, we recommend that you activate path health checking so that you can detect errors in paths where I/Os operations do not occur.

When you specify `on`, specify the checking interval of path health checking by specifying the parameter immediately following `on`. If you do not specify a checking interval, path health checking is executed in the following interval:

- When the checking interval has not been specified before:
  Every 30 minutes (default setting)
- When the checking interval has been specified before:
  The previously specified interval

The explanation for the following sub-parameter describes how to specify the checking interval.

`-intvl` *checking-interval*

Specify the checking interval between path health checks. Specify a value from 1 to 1440 minutes depending on the user environment.

When you change the checking interval, the new setting takes effect immediately. When the checking interval is shortened and the checking interval after the change (from the end of the previous path health check) has already elapsed, the path health check will start over.

The path health check interval setting remains stored in the system even if you disable the function by changing the path health checking to `off`. Therefore, when you re-enable path health checking and do not change the interval, the path health interval stored in the system is used.

`-afb {on [-intvl` *checking-interval*`]|off}`

Enables or disables automatic failback.

`on`: Enabled

`off`: Disabled

Enabling automatic failbacks might automatically place online paths online that were intentionally placed offline (for example, paths placed offline for maintenance work).

If you want to prevent such paths from automatically being placed online, disable this function. When intermittent errors occur in paths or storage systems, statuses of paths alternates between the online and offline status frequently, thus decreasing I/O performance.

Automatic failbacks are performed on the following types of paths:

- Paths where an error occurred and for which the KAPL08022-E message was displayed.
- Path where an error occurred during the startup of the HDLM manager.

To prevent intermittent errors from deteriorating I/O performance, we recommend that you also enable intermittent error monitoring when the automatic failback function is enabled. Intermittent error monitoring is specifiable only when automatic failbacks are enabled.

See *Table 6-5 Relationship Between the Setting for the Automatic Failback Function and Intermittent Error Monitoring and the Executable Operations on page 6-27* for the relationship between automatic failbacks and intermittent error monitoring.

When you specify `on`, specify the checking interval by specifying the parameter immediately following `on`. If you do not specify a checking interval, path statuses will be checked in the following way:

- When the checking interval has not been specified before:
  Every 60 minute (default setting)
- When the checking interval has been specified before:
  The previously used interval

The explanation for the following sub-parameter describes how to specify the interval between path status checks.

`-intvl` *checking-interval*

Specify the interval between path status checks. Specify a value from 1 to 1440 minutes. The default is `60`. Specify an interval appropriate for your operating environment.

If intermittent error monitoring is `on` and the number of times that the error is to occur is set to a value of 2 or more, the following condition must be satisfied:

error-monitoring-interval >= checking-interval-for-automatic-failback × number-of-times-error-is-to-occur-during-intermittent-error-monitoring

If this condition is not satisfied, the KAPL01080-W message will be output and an error will occur. If this happens, change any of the following settings: the checking interval for automatic failbacks, intermittent error-monitoring interval, or the number of times that the error is to occur.

When you set the number of times that the error is to occur to `1`, the above condition does not need to be satisfied.

When you changed the error monitor interval while intermittent error monitoring is running, the new settings will take effect immediately. When the checking interval is shortened and the checking interval time after the change has already elapsed during the current checking interval, the path status check will start over.

This setting remains stored in the system, even if you disable the function by changing the setting of automatic failbacks to `off`. Therefore, if you re-enable automatic failbacks and do not change the interval, path status checks will be executed at the interval already stored in the system.

`-iem { on [-intvl` *error-monitoring-interval*`] [-iemnum` *number-of-times-error-is-to-occur*`] | off }`

Enables or disables intermittent error monitoring.

`on`: Enabled

`off`: Disabled

Intermittent error monitoring can be enabled only when automatic failback is set to `on`.

When you use automatic failback, we recommend that you set intermittent error monitoring to `on` to prevent an intermittent error from reducing I/O performance.

If `on` is specified, be sure to also specify the intermittent error monitoring interval and the number of times that the error is to occur. The system assumes that an intermittent error is occurring if the specified number of times that the error is to occur is reached during the monitoring interval. A path that is assumed to have an intermittent error is excluded from automatic failbacks. Intermittent error monitoring is performed on each path. Intermittent error monitoring starts when a path is recovered from an error by performing an automatic failback.

If you omit the intermittent error monitoring interval or the number of times that the error is to occur, each setting is specified as follows:

- When the intermittent error monitoring interval or the number of times that the error is to occur has not been specified before:

  The intermittent error monitoring interval is set to 210 minutes, and the number of times that the error is to occur is set to 3.
- When the intermittent error monitoring interval or the number of times that the error is to occur has been specified before:

  The values specified from the last time are used.

When a value of 2 or more is specified for the number of times, the following condition must be satisfied:

error-monitoring-interval >= checking-interval-for-automatic-failback × number-of-times-error-is-to-occur-during-intermittent-error-monitoring

If this condition is not satisfied, the KAPL01080-W message will be output and an error will occur. If this happens, change any of the following settings: the checking interval for automatic failback, intermittent error monitoring interval, or the number of times that the error is to occur.

When you set the number of times that the error is to occur to `1`, the above condition does not need to be satisfied.

The following shows the sub-parameters that should be specified: the error monitoring interval and the number of times that the error is to occur:

`-intvl` *error-monitoring-interval*

Specify the monitoring interval for an intermittent error. Use a value from 1 to 1440 minutes. The default is `210`.

During intermittent error monitoring, if changes are made to the intermittent error monitoring interval setting or the setting for the number of times that an error is to occur, the error count and the elapsed time measured since monitoring has started are reset to 0.

When intermittent error monitoring is not being performed, if changes are made in the settings of the intermittent error monitoring interval or the number of times that an error is to occur, the new settings will take effect after the next time an automatic failback is successful. Because the errors and elapsed time are not counted or measured while intermittent errors are not being monitored, the those values will not change.

The monitoring interval specified in this parameter is stored even though specifying `-iem off` disables intermittent error monitoring. Therefore, when you re-enable intermittent error monitoring and a monitoring interval is not specified, error monitoring will be performed by using the stored monitoring interval.

`-iemnum` *number-of-times-error-is-to-occur*

Specify the number of times the error is to occur. Valid values are from 1 to 99. The default is `3`.

During intermittent error monitoring, if you change the number of times that the error is to occur in order for the system to determine that an intermittent error has occurred, the number of errors and the time that has passed since intermittent error monitoring has started are reset to 0. The changed setting will take effect immediately and intermittent error monitoring will restart.

When intermittent error monitoring is not being performed, if you change the number of times that the error is to occur in order for the system to determine that an intermittent error has occurred, the new value will take effect after the next automatic failback successfully completes. When intermittent error monitoring is not being performed, the number of errors that determine that an intermittent error has occurred is not counted and this value is not changed.

The number of times that the error is to occur is stored in the system, even when `-iem off` is specified and intermittent error monitoring is disabled. Therefore, when you re-enable intermittent error monitoring without specifying the number of times, the error monitoring will be executed using the value stored in the system.

When the `set -iem on` operation is executed during error monitoring, even though you do not change the conditions for intermittent error monitoring, the number of errors and the time that has passed since the error monitoring has started are reset to 0. Intermittent error monitoring will then resume with the changed settings.

If you set the automatic failback function to `off` while intermittent error monitoring is `on`, intermittent error monitoring will be disabled. Note, however, that if you use the `view -sys` operation to display the HDLM functionality configuration, `Intermittent Error Monitor` will be shown as `on`. When the automatic failback function is returned to `on`, intermittent error monitoring will once again be enabled.

The executable operations for the automatic failback function and intermittent error monitoring depend on the settings for those functions. The table below shows the relationship between the settings and available operations for automatic failback and intermittent error monitoring.

Table 6-5 Relationship Between the Setting for the Automatic Failback Function and Intermittent Error Monitoring and the Executable Operations

Setting		Available operation	Result of operation
AFB	IEM		
on	on	Set AFB to on.	The operations of AFB and IEM do not change.
		Change the AFB setting.	AFB is performed under the new settings.#1
		Set AFB to off.	• AFB and IEM are disabled. • The error count, elapsed monitoring time, and information about paths not subject to automatic failback are cleared.
		Set IEM to on.	• When a path is being monitored (during a period of conditional intermittent error monitoring), the value of the error count and the elapsed monitoring time are reset to 0, and then intermittent error monitoring will restart. • When a path is not being monitored, nothing changes.
		Change the IEM settings.	• While a path is being monitored, the value of the error count and the elapsed monitoring time are reset to 0, and then intermittent error monitoring will restart.#1 • When a path is not being monitored, the IEM settings will take effect again when the path is recovered from the error status by performing an automatic failback.
		Set IEM to off.	• IEM is disabled. • The error count, elapsed monitoring time, and information about paths not subject to automatic failbacks are cleared.
	off	Set AFB to on.	The operations of AFB and IEM do not change.
		Change the AFB setting.	AFB operates using new settings.
		Set AFB to off.	AFB is disabled.
		Set IEM to on.	IEM is enabled.#1
off	on#2	Set AFB to on.	AFB and IEM are enabled.#1
		Set AFB to off.	The operations of AFB and IEM do not change.

Setting		Available operation	Result of operation
AFB	IEM		
	off	Set AFB to on.	AFB is enabled.
		Set AFB to off.	The operations of AFB and IEM do not change.

Legend:

AFB: Automatic failback

IEM: Intermittent error monitoring

#1

When this condition is not satisfied, the KAPL01080-W message is output and an error occurs. The status of intermittent error monitoring does not change.

#2

Because automatic failback is off, intermittent error monitoring is disabled.

Example

The following example shows how to monitor for intermittent errors.

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -iem on -intvl 20 -
iemnum 2
KAPL01049-I Would you like to execute the operation?
Operation name = set [y/n]: y
KAPL01001-I The HDLM command completed normally. Operation
name = set, completion time = yyyy/mm/dd hh:mm:ss
#
```

-lic

Specify this option for when a license is updated. The HDLM license is provided via a license key or license key file. A license key file is a file that stores the HDLM license key.

If a license key file is provided:

Store the license key file named hdlm_license directly under /var/tmp, and then execute the set -lic operation. A message confirming that the license key has been registered is displayed, depending on the license key type defined in the license key file. When a temporary license key or emergency license key has been registered, the expiration period is displayed (KAPL01071-I, KAPL01072-I).

If a license key is provided:

When the set -lic operation is executed, a message (KAPL01068-I) asking the user to enter a license key appears. Enter the license key. A message confirming that the license key has been registered is displayed, depending on the license key type described in the license key file. When a temporary license key or emergency license key, the expiration period is also displayed (KAPL01071-I, KAPL01072-I).

The following table lists and describes the license key types.

Table 6-6 License Key Types

Type	Description
Permanent license key	Permanent licenses are valid for using HDLM permanently.
Temporary license key#	Temporary license key are used temporarily, for example, when a user needs to perform product evaluations. Temporary licenses keys are valid for 120 days after the installation. You cannot reuse a temporary license key.
Emergency license key	Emergency license keys are used temporarily, for example, when waiting for issuing a permanent license key to be issued. Emergency licenses keys are valid for 30 days after they are entered. You cannot reuse an emergency license key.

#

A temporary license key cannot be installed by using the `dlnkmgr set` operation.

Example 1

The following example shows how to update the license key when the license key file exists:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -lic
KAPL01049-I Would you like to execute the operation?
Operation name = set [y/n]: y
KAPL01071-I A permanent license was installed.
#
```

Example 2

The following example shows how to update the license key when the license key file does not exist:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -lic
KAPL01049-I Would you like to execute the operation?
Operation name = set [y/n]: y
KAPL01083-I There is no license key file. File name =/var/tmp/
hdlm_license
KAPL01068-I Enter a license key:*************
KAPL01071-I A permanent license was installed.
#
```

`-audlog {on [-audlv` *audit-log-data-collection-level*`] [-category [[ss] [a] [ca]|all]]|off}`

Specifies whether to collect audit log data.

`on`: Audit log data is collected.

`off`: Audit log data is not collected.

`-audlv` *audit-log-data-collection-level*

Specifies the severity level of audit log data to be collected. The table below lists and describes the values used for this setting. The default is `6`.

Table 6-7 Values Indicating Audit Log Data Collection Levels

Value (severity)	Explanation
0	No audit log data is collected.
1	
2	Critical-level audit log data is collected.
3	Critical-level and Error-level audit log data is collected.
4	Critical-level, Error-level, and Warning-level audit log data is collected.
5	
6	Critical-level, Error-level, Warning-level, and Informational-level audit log data is collected.
7	

`-category [[ss] [a] [ca]|all]`

Specifies the categories of audit log data to be collected. The table below lists and describes the values used for this setting. The default is `all`. Note that if you enter `-category` without specifying any category (`ss`, `a`, `ca`, or `all`), it is assumed that `all` is specified.

Table 6-8 Values Indicating Audit Log Data Categories

Value	Explanation
`ss`	Audit log events of the `StartStop` category are collected.
`a`	Audit log events of the `Authentication` category are collected.
`ca`	Audit log events of the `ConfigurationAccess` category are collected.
`all`	Audit log events of the `StartStop`, `Authentication`, and `ConfigurationAccess` categories are collected.

`-audfac` *facility-value*

Specifies the audit log facility.

The table below lists the values used for this setting. The default is `user`.

Table 6-9 Values of the Audit Log Facility

Value	Corresponding facility value in the /etc/syslog.conf file
`user` or `1`	`user`
`local0` or `16`	`local0`

Value	Corresponding facility value in the /etc/syslog.conf file
local1 or 17	local1
local2 or 18	local2
local3 or 19	local3
local4 or 20	local4
local5 or 21	local5
local6 or 22	local6
local7 or 23	local7

-lbpathusetimes *number-of-path-use-times*

Specifies the number of times the same path can be used for I/O operations when the Round Robin (rr), Least I/Os (lio), or Least Blocks (lbk) algorithm is used for load balancing.

You can specify a decimal (base 10) value from 0 to 999999. The default is 20.

If you specify 0, operation is the same as when load balancing is disabled.

-expathusetimes *number-of-path-use-times*

Specifies the number of times the same path can be used for sequential I/O operations when the extended Round Robin (exrr), Least I/Os (exlio), or Least Blocks (exlbk) algorithm is used for load balancing.

You can specify a decimal (base 10) value from 0 to 999999. The default is 100.

If you specify 0, the same path is used as long as the sequential I/O operations continue.

-exrndpathusetimes *number-of-path-use-times*

Specifies the number of times the same path can be used for random I/O operations when the extended Round Robin (exrr), Least I/Os (exlio), or Least Blocks (exlbk) algorithm is used for load balancing.

You can specify a decimal (base 10) value from 0 to 999999. The default is 1.

If you specify 0, the same path is used as long as the random I/O operations continue.

-dpc {on|off} [-pathid *path-ID* -lu | -pathid *path-ID* -storage]

Enables or disables the dynamic I/O path control function for each storage system or LU. The default value is "off".

on: Enabled

off: Disabled

-pathid *path-ID* -lu

Sets the dynamic I/O path control function to enabled or disabled for each LU. Specify one of the IDs of the paths connected to the target LU.

`-pathid` *path-ID* `-storage`

Sets the dynamic I/O path control function to enabled or disabled for each storage system. Specify one of the IDs of the paths connected to the target storage system.

If the `-pathid` parameter is not specified, the setting is performed for each system, and the setting for each storage system or LU is cleared.

`-dpcintvl` *checking-interval*

Specifies the checking interval (in minutes) for reviewing information about switching of controllers performed by the storage system which is used in the dynamic I/O path control function. Specify a value in the range from 1 to 1440. The default value is "10".

`-pstv {on|off}`

Enables or disables the display of the physical storage system information. The default value is "off".

`on`: Enabled

`off`: Disabled

If the display of the physical storage system information is enabled, information about the physical storage system is displayed. If the display of the physical storage system information is disabled, information about the storage system recognized by the operating system is displayed. For a virtualized storage system, virtual information is displayed, and for a non-virtualized storage system, physical information is displayed.

The display results of view operations depend on whether the display of the physical storage system information is enabled or disabled. The following table shows the display items for which the display results differ.

Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification

Operation	Display Item
`view -path`	DskName
	iLU
	ChaPort (CP)
`view -lu`	Product
	SerialNumber (S/N)
	iLU
	ChaPort
`view -drv`	LDEV

The `set -pstv` setting does not affect the display results of the `view -cha` operation. Information about the physical storage system is always displayed.

`-s`

Executes the command without displaying the message asking for confirmation of command execution from the user. Specify this parameter if you want to skip the response to the confirmation message: for example, when you want to execute the command in a shell script or batch file.

To Display the Format of the Set Operation

`-help`

Displays the format of the `set` operation.

Example

The following example shows how to display the format of the `set` operation:

```
# /usr/DynamicLinkManager/bin/dlnkmgr set -help
set:
  Format
    dlnkmgr set { -lb on [ -lbtype { rr | exrr | lio | exlio
| lbk | exlbk } ]
                | -lb off
                | -ellv ElogLevel
                | -elfs ElogFileSize
                | -elfn Number-Of-ElogFiles
                | -systflv TraceLevel
                | -systfs TraceFileSize
                | -systfn Number-Of-TraceFiles
                | -pchk on [ -intvl Interval-Time ]
                | -pchk off
                | -afb  on [ -intvl Interval-Time ]
                | -afb  off
                | -iem  on
                        [ -intvl Error-Monitor-Interval ]
                        [ -iemnum Number-Of-Times ]
                | -iem  off
                | -lic
                | -audlog on
                          [ -audlv AudlogLevel ]
                          [ -category Category-Value ]
                | -audlog off
                | -audfac { Facility-Name | Facility-Number }
                | -lbpathusetimes Number-Of-PathUseTimes
                | -expathusetimes Number-Of-ExPathUseTimes
                | -exrndpathusetimes Number-Of-
ExRndPathUseTimes
                | -dpc { on | off } [-pathid AutoPATH_ID { -
lu | -storage } ]
                | -dpcintvl Dpc-Interval
                | -pstv { on | off }
                }
                [-s]
  Valid value
```

```
    ElogLevel                    { 0 | 1 | 2 | 3 | 4 }
(Default Value 3)
    ElogFileSize                 { 100 - 2000000 }(KB)
(Default Value 9900)
    Number-Of-ElogFiles          { 2 - 16 }(Files)
(Default Value 2)
    TraceLevel                   { 0 | 1 | 2 | 3 | 4 }
(Default Value 0)
    TraceFileSize                { 100 - 16000 }(KB)
(Default Value 1000)
    Number-Of-TraceFiles         { 2 - 64 }(Files)
(Default Value 4)
    Interval-Time                { 1 - 1440 }(Minute)
(Default Value 30)
      (pchk)
    Interval-Time                { 1 - 1440 }(Minute)
(Default Value 60)
      (afb)
    Error-Monitor-Interval       { 1 - 1440 }(Minute)
(Default Value 210)
    Number-Of-Times              { 1 - 99 }(Times)
(Default Value 3)
    AudlogLevel                  { 0 - 7 }
(Default Value 6)
    Category-Value               { [ss] [a] [ca] |
                                                 all }
(Default Value all)
    Facility-Name                { user |
                                   local0 - local7 }
(Default Value user)
    Facility-Number              { 1 | 16 - 23 }
(Default Value 1)
    Number-Of-PathUseTimes       { 0 - 999999 }(Times)
(Default Value 20)
    Number-Of-ExPathUseTimes     { 0 - 999999 }(Times)
(Default Value 100)
    Number-Of-ExRndPathUseTimes { 0 - 999999 }(Times)
(Default Value 1)
    AutoPATH_ID                  { 000000 - 999999 }(Decimal)
    Dpc-Interval                 { 1 - 1440 }(Minute)
(Default Value 10)
KAPL01001-I The HDLM command completed normally. Operation
name = view, completion time = yyyy/mm/dd hh:mm:ss
#
```

view (Displays Information)

The `view` option displays HDLM program information, path information, LU information, HBA port information, CHA port information, and the correspondences between hdisks, OS management path IDs, and LDEVs.

Format

To Display Program Information

```
/usr/DynamicLinkManager/bin/dlnkmgr view -sys
   [-sfunc|-msrv|-adrv|-pdrv|-lic|-audlog|-lbpathusetimes|-
   expathusetimes|-exrndpathusetimes|-pstv]
   [-t]
```

To Display Path Information

To display path information

```
/usr/DynamicLinkManager/bin/dlnkmgr view -path
   [-pstv|-vstv]
   [-hdev host-device-name]
   [-stname]
   [-iem]
   [-srt {pn|lu|cp}]
   [-hbaportwwn]
   [-t]
```

To display path information (by selecting a display item)

```
/usr/DynamicLinkManager/bin/dlnkmgr view -path -item
   [pn] [dn] [lu] [cp] [type] [ic] [ie] [dnu] [hd] [iep]
   [hbaportwwn] [phys] [virt] [vid] [ha]
   [-pstv|-vstv]
   [-hdev host-device-name]
   [-stname]
   [-srt {pn|lu|cp}]
   [-t]
```

To display a summary of path information

```
/usr/DynamicLinkManager/bin/dlnkmgr view -path -c
   [-pstv|-vstv]
   [-stname]
   [-srt {lu|cp}]
   [-t]
```

To Display LU Information

To display LU information

```
/usr/DynamicLinkManager/bin/dlnkmgr view -lu
   [-pstv|-vstv]
```

```
[-hdev host-device-name | -pathid AutoPATH_ID]
[-t]
```

To display LU information (by adding items to be displayed)

```
/usr/DynamicLinkManager/bin/dlnkmgr view -lu -item
   [ [slpr] [pn] [cp] [clpr] [type] [ic] [ie] [dnu] [iep]
   [vg] [dpc] [phys] [virt] [vid] [ha] [hastat] | all ]
   [-pstv|-vstv]
   [-hdev host-device-name | -pathid AutoPATH_ID]
   [-t]
```

To display a summary of LU information

```
/usr/DynamicLinkManager/bin/dlnkmgr view -lu -c [-pstv|-vstv] [-
t]
```

To display a summary of LU information (by adding items to be displayed)

```
/usr/DynamicLinkManager/bin/dlnkmgr view -lu -c -item
   [[slpr] [vg] | all ]
   [-pstv|-vstv]
   [-t]
```

To Display HBA Port Information

```
/usr/DynamicLinkManager/bin/dlnkmgr view -hba [-srt pb] [-
portwwn] [-t]
```

To Display CHA Port Information

```
/usr/DynamicLinkManager/bin/dlnkmgr view -cha [-srt cp] [-t]
```

Correspondences Between hdisks, OS Management Path IDs, and LDEVs

```
/usr/DynamicLinkManager/bin/dlnkmgr view -drv [-pstv|-vstv] [-t]
```

To Display the Format of the View Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr view -help
```

Parameters

This section describes the parameters for the `view` operation, in the following order:

To Display Program Information on page 6-37

To Display Path Information on page 6-45

To Display LU Information on page 6-58

To Display HBA Port Information on page 6-71

To Display CHA Port Information on page 6-72

To Display the Correspondences Between hdisks, OS Management Path IDs, and LDEVs on page 6-73

To Display the Format of the View Operation on page 6-75

To Display Program Information

```
-sys [-sfunc|-msrv|-adrv|-pdrv|-lic|-audlog|-lbpathusetimes|-
expathusetimes|-exrndpathusetimes|-pstv]
```

Displays the HDLM program information.

Use one of the sub-parameters (following `-sys`) to specify the program information that you want to display. If you do not specify a sub-parameter, the command displays all of the program information except the information about the audit log data collection settings, the number of times the same path can be used for load balancing, the number of times the same path can be used for extended load balancing, and the value of the display-of-the-physical-storage-system-information setting.

Table 6-11 Displayed Program Information on page 6-37 describes the specifiable parameters, displayed information, displayed items, and a corresponding description.

`-t`

Does not display the title for each information item.

Table 6-11 Displayed Program Information

Parameter and program information to be displayed	Item	Description
`-sfunc` Information about the HDLM function settings	`HDLM Version`	HDLM version number
	`Service Pack Version`	HDLM SP version number. This item is blank if no a SP is present.
	`Load Balance`	Settings for load balancing • Setting status: `on`: Enabled `off`: Disabled • Algorithm When the setting status of load balancing is `on`, one of the following types of algorithms is used for load balancing is displayed in the parentheses following `on`. `rr`: The Round Robin algorithm

Parameter and program information to be displayed	Item	Description
		extended rr: The Extended Round Robin algorithm lio: The Least I/Os algorithm extended lio: The Extended Least I/Os algorithm lbk: The Least Blocks algorithm extended lbk: The Extended Least Blocks algorithm
	Support Cluster	Blank#
	Elog Level	Error logging level: • 0: Collects no error information. • 1: Collects error information at the Error level or higher. • 2: Collects error information at the Warning level or higher. • 3: Collects error information at the Information level or higher. • 4: Collects error information at the Information level or higher (including maintenance information).
	Elog File Size (KB)	Size of the error log file in kilobytes
	Number Of Elog Files	Number of error log files
	Trace Level	Trace output level: • 0: Does not output any trace. • 1: Only outputs error information. • 2: Outputs a summary of program operation. • 3: Outputs details of program operation. • 4: Outputs all information.
	Trace File Size(KB)	Trace file size in kilobytes
	Number Of Trace Files	Number of trace files.
	Path Health Checking	• Settings for path health checking: on: Enabled off: Disabled

Parameter and program information to be displayed	Item	Description
		• Checking interval: When the setting of the path health checking is `on`, the checking interval of path health checking is displayed within the parentheses following `on`. The time is in minutes.
	`Auto Failback`	• Settings for an automatic failback: `on`: Enabled `off`: Disabled • Checking interval: When the setting of the automatic failback is `on`, the checking interval of automatic failback is displayed within the parentheses following `on`. The time is in minutes.
	`Intermittent Error Monitor`	• Setting for intermittent error monitoring `on`: Enabled `off`: Disabled When automatic failback is `off`, intermittent error monitoring is disabled although `Intermittent Error Monitor` will be shown as `on`. When the automatic failback function is `on`, intermittent error monitoring will be enabled. • Intermittent error monitoring interval and number of times that the error needs to occur When intermittent error monitoring is `on`, the specified intermittent error monitoring interval and number of times that the error needs to occur are displayed within the parentheses following `on`. The format is *number-of-times-error-is-to-occur*/*monitoring-interval*. The time is in minutes.
	`Dynamic I/O Path Control`	Setting status of the dynamic I/O path control function • Setting status on: Enabled off: Disabled • Checking interval The parentheses following the setting status shows the checking interval for reviewing information about the switching of controllers performed by the storage system. "Minute" is used as the unit. If different settings have been specified for each storage system or LU, an asterisk (`*`) is added

Parameter and program information to be displayed	Item	Description
		after the parentheses in which the checking interval is displayed.
-msrv Information about the HDLM manager	HDLM Manager	Status of the HDLM manager: Alive: Normal Dead: Stopped
	Ver	Version number of the HDLM manager
	WakeupTime	Startup time of the HDLM manager
-adrv Information about the HDLM alert driver	HDLM Alert Driver	Status of the HDLM alert driver: Alive: Normal Dead: Stopped
	Ver	Version number of the HDLM alert driver
	WakeupTime	Startup time of the HDLM alert driver
	ElogMem Size	Size of error log memory for the HDLM alert driver in kilobytes
-pdrv Information about the HDLM driver	HDLM Driver	Status of the HDLM driver: Alive: Normal Dead: Stopped
	Ver	Version number of the HDLM driver
	WakeupTime	Startup time of the HDLM driver
-lic Information about the HDLM license	License Type	License type • Permanent: permanent license • Temporary: temporary license • Emergency: emergency license
	Expiration	License expiration When using a permanent license: - When using a temporary license or emergency license: The license expiration period is displayed in the format: *yyyy/mm/dd* (*n*days after). When the view -sys -lic operation is executed, (*n*days after) appears if there are *n* days left until the license period expires. • When there are 100 days left until the license period (2006/08/21) expires 2006/08/21(100days after)
-audlog	Audit Log	Settings for audit log data collection: • Whether collection is enabled:

Parameter and program information to be displayed	Item	Description
Information about audit log data collection settings		on: Enabled off: Disabled • Audit log data collection level: When audit log data collection is on, the collection level that has been set is displayed within the parentheses following on. The collection level indicates a severity level. A value from 0 to 7 is displayed as the collection value.
	Audit Log Category	The categories of audit log data to be output are displayed. When more than one category is displayed, commas (,) are used as separators. ss: StartStop a: Authentication ca: ConfigurationAccess If all the above categories are specified, all is displayed. If the collection of audit log data is disabled, a hyphen (-) is displayed.
	Audit Log Facility	The name of the audit log facility is displayed. user, local0, local1, local2, local3, local4, local5, local6, or local7 is displayed. If the collection of audit log data is disabled, a hyphen (-) is displayed.
-lbpathusetimes The number of times the same path can be used for load balancing	Times Same Path Was Used	The number of times the same path can be used for I/O operations when the Round Robin (rr), Least I/Os (lio), or Least Blocks (lbk) algorithm is used for load balancing. If you used Global Link Manager to set the number of times the same path can be used in units of LUs, an asterisk (*) is added after the value.
-expathusetimes The number of times the same path can be used for extended	Times Same ExPath Was Used	The number of times the same path can be used for sequential I/O operations when the extended Round Robin (exrr), Least I/Os (exlio), or Least Blocks (exlbk) algorithm is used for load balancing. If you used Global Link Manager to set the number of times the same path can be used in units of LUs, an asterisk (*) is added after the value.

Parameter and program information to be displayed	Item	Description
load balancing (sequential I/O)		
-exrndpath usetimes The number of times the same path can be used for extended load balancing (random I/O)	Times Same ExPath Was Used(R)	The number of times the same path can be used for random I/O operations when the extended Round Robin (exrr), Least I/Os (exlio), or Least Blocks (exlbk) algorithm is used for load balancing. If you used Global Link Manager to set the number of times the same path can be used in units of LUs, an asterisk (*) is added after the value.
-pstv The display-of-the-physical-storage-system-information setting	Physical Storage View	The value of the display-of-the-physical-storage-system-information setting is displayed. on: Enabled off: Disabled

#

When you use cluster software, the settings of the cluster support function and the product name of the cluster software is not displayed. However, the cluster support function will operate normally.

Examples

Example 1

The following example shows how to display information about the HDLM function settings:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -sfunc
HDLM Version                  : x.x.x-xx
Service Pack Version          :
Load Balance                  : on(extended lio)
Support Cluster               :
Elog Level                    : 3
```

```
Elog File Size(KB)             : 9900
Number Of Elog Files           : 2
Trace Level                    : 1
Trace File Size(KB)            : 1000
Number Of Trace Files          : 4
Path Health Checking           : on(30)
Auto Failback                  : on(60)
Intermittent Error Monitor     : off
Dynamic I/O Path Control       : off(10)
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 2

The following example shows how to display information about the HDLM manager.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -msrv
HDLM Manager      Ver          WakeupTime
Alive             x.x.x-xx     yyyy/mm/dd hh:mm:ss
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 3

The following example shows how to display information about the HDLM alert driver.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -adrv
HDLM Alert Driver Ver          WakeupTime          ElogMem Size
Alive             x.x.x-xx     yyyy/mm/dd hh:mm:ss 4000
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 4

The following example shows how to display information about the HDLM driver.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -pdrv
HDLM Driver       Ver          WakeupTime
Alive             x.x.x-xx     yyyy/mm/dd hh:mm:ss
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 5

The following example shows how to display information about the HDLM license.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -lic
License Type Expiration
Permanent    -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 6

The following example shows how to display information about the audit log settings:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -audlog
Audit Log                     : off
Audit Log Category            : -
Audit Log Facility            : -
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 7

The following example shows how to display the number of times the same path can be used for load balancing:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -lbpathusetimes
Times Same Path Was Used    : 20
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 8

The following example shows how to display the number of times the same path can be used for extended load balancing (sequential I/O):

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -expathusetimes
Times Same ExPath Was Used    : 100
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 9

The following example shows how to display the number of times the same path can be used for extended load balancing (random I/O):

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -sys -
exrndpathusetimes
Times Same ExPath Was Used(R): 1
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

Example 10

The following example shows how to display the value of the display-of-the-physical-storage-system-information setting:

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -sys -pstv
Physical Storage View    : off
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

To Display Path Information

When displaying path information, if you specify either the -item or -c parameter and also specify the -path parameter, you can select the items to display and display a summary of path information. This section describes each parameter, path information and displayed items.

Parameters to display path information:

-path

When you specify the -path parameter and do not specify either the -c or -item parameter, the information will be displayed about the HDLM managed paths without abbreviating or selecting items.

In the sub-parameters (following -path), you can filter the paths to be listed using -hdev and sort the list using -srt. When you omit both parameters, the command displays information for all the paths in order of increasing AutoPATH_IDs.

For details on what is displayed in each item, see *Table 6-13 Displayed Path Information on page 6-51*.

AutoPATH_IDs displayed by the -path parameter depend on the sequence in which HDLM detects the paths after when a host is started up. Because of this, make sure that you use the path name PathName to identify a path.

The sub-parameters are as follows:

-pstv|-vstv

If the -pstv parameter is specified, information about the physical storage system is displayed. If the -vstv parameter is specified, information about the storage system recognized by the operating system is displayed. If neither parameter is specified, information is displayed according to the value specified in the -pstv parameter of set operations.

For information about the items that are displayed differently depending on the specified -pstv and -vstv parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

-hdev *host-device-name*

Displays information only for the paths accessing the specified host device.

Specify hdisk name for *host-device-name*.

The *host-device-name* string is case -sensitive.

-stname

Use this parameter to display the model ID of the storage system in the product ID element of the DskName field. When this parameter is omitted, the command displays the product ID or emulation type of the storage system instead.

For details about the information displayed for product IDs, see *Table 6-15 Product ID Displayed by the View -Path Operation on page 6-57*.

`-iem`

Use this parameter to add `IEP` to path information and display information about intermittent errors.

`-srt {pn|lu|cp}`

Use this parameter to sort the path information in ascending order, according to the specified sorting keys.

The sorting keys are as follows: the first sorting key is the name of the storage system (`DskName`), the second sorting key is the value specified by the `-srt` parameter, and the third sorting key is AutoPATH_ID.

The available parameter values to specify the second sorting key are:

- `pn`: Path name
- `lu`: LU number of the storage system
- `cp`: Port number of the CHA

When the `-srt` parameter is omitted, the path information is listed in ascending order of AutoPATH_IDs.

`-hbaportwwn`

Displays port WWN information for the HBAs connected to the storage system.

`-t`

Omits the title for each information item.

Example

The following example shows how to display information about the paths that access a host device `hdisk1`.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path -hdev hdisk1
Paths:000001 OnlinePaths:000001
PathStatus    IO-Count     IO-Errors
Online        0            0

PathID PathName                          DskName
iLU              ChaPort Status      Type IO-Count   IO-Errors  DNum HDevName
000006 08.11.000000000000000E2.0001      HITACHI .OPEN-3           .15001
0005             1H      Online      Own           0          0    0 hdisk1
000013 08.1D.000000000000000E3.0001      HITACHI .OPEN-3           .15001
0005             2H      Online      Own           0          0    0 hdisk1
KAPL01001-I The HDLM command completed normally. Operation name = view,
completion time = yyyy/mm/dd  hh:mm:ss
#
```

Parameters to display path information by selecting a display item:

`-path -item`

When you specify the -path parameter together with the -item parameter, the command only displays the items specified by the value of the -item parameter.

If you specify no value for the -item parameter, only the PathID and the Status fields are displayed.

The following table lists the correspondence between the display items that can be selected by using the -item parameter and the parameter values that can be specified after the -item parameter.

Table 6-12 Items That Can Be Selected by the -path -item Parameter and the Sub-parameters

Selectable items	Sub-parameters
PathID#	None
PathName	pn
DskName	dn
iLU	lu
ChaPort	cp
Status#	None
Type	type
IO-Count	ic
IO-Errors	ie
DNum	dnu
HDevName	hd
IEP	iep
HBAPortWWN	hbaportwwn
Physical-LDEV	phys
Virtual-LDEV	virt
Physical-DskName	vid
Physical-iLU	vid
Physical-ChaPort	vid
Org-DskName	ha
Org-iLU	ha

#

Because both PathID and Status are always displayed, you do not have to specify any parameters.

In the sub-parameters following -path -item, you can list the paths (-hdev) and sort the list (-srt). If you omit both parameters, the command displays information for all the paths in ascending order of AutoPATH_IDs.

These sub-parameters are:

`-pstv|-vstv`

If the `-pstv` parameter is specified, information about the physical storage system is displayed. If the `-vstv` parameter is specified, information about the storage system recognized by the operating system is displayed. If neither parameter is specified, information is displayed according to the value specified in the `-pstv` parameter of `set` operations.

For information about the items that are displayed differently depending on the specified `-pstv` and `-vstv` parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

`-hdev` *host-device-name*

Displays information only for the paths accessing the specified host device.

Specify hdisk name for *host-device-name*.

The *host-device-name* string is case sensitive.

When you specify this parameter, `HDevName` is displayed by default. Therefore, it is not necessary to specify `hd` for the `-item` parameter.

`-stname`

Use this parameter to display the model ID of the storage system in the product ID element of the `DskName` field. When this parameter is omitted, the command displays the product ID or emulation type of the storage system instead.

For details about the information displayed for product IDs, see *Table 6-15 Product ID Displayed by the View -Path Operation on page 6-57*.

When you use this parameter, `DskName` is displayed by default. Therefore, it is not necessary to specify `dn` for the `-item` parameter.

`-srt {pn|lu|cp}`

Use this parameter to sort the path information in ascending order, according to the specified sorting keys.

The sorting keys are as follows: the first sorting key is the name of the storage system (`DskName`), the second sorting key is the value specified by the `-srt` parameter, and the third sorting key is AutoPATH_ID.

The available parameter values to specify the second sorting key are:

- `pn`: Path name
- `lu`: LU number of the storage system
- `cp`: Port number of the CHA

When the `-srt` parameter is omitted, the path information is listed in ascending order of AutoPATH_IDs.

When you use this parameter, the items used for the sorting keys (DskName, AutoPATH_ID, and the item specified by this parameter) are displayed by default. Therefore, it is not necessary to specify these items for the `-item` parameter.

`-t`

Omits the title for each information item.

Example

In the following example, `IO-Count` is selected as the display item and the path information is sorted in ascending order by LUs.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path -item ic -srt lu -stname
Paths:000012 OnlinePaths:000012
PathStatus   IO-Count    IO-Errors
Online       0          0

PathID DskName                    iLU        Status    IO-Count
000002 HITACHI .HUS_VM            .210945    0960      Online      0
000003 HITACHI .HUS_VM            .210945    0960      Online      0
000000 HITACHI .HUS_VM            .210945    0961      Online      0
000001 HITACHI .HUS_VM            .210945    0961      Online      0
000004 HITACHI .HUS_VM            .210945    0962      Online      0
000005 HITACHI .HUS_VM            .210945    0962      Online      0
000008 HITACHI .VSP_G1000         .10051     001836      Online      0
000009 HITACHI .VSP_G1000         .10051     001836      Online      0
000006 HITACHI .VSP_G1000         .10051     001837      Online      0
000007 HITACHI .VSP_G1000         .10051     001837      Online      0
000010 HITACHI .VSP_G1000         .10051     001838      Online      0
000011 HITACHI .VSP_G1000         .10051     001838      Online      0
KAPL01001-I The HDLM command completed normally. Operation name = view, completion time =
yyyy/mm/dd hh:mm:ss
#
```

To display a summary of path information

`-path -c`

If the `-c` parameter is specified at the same time as the `-path` parameter, only PathID, DskName, iLU, CP, Status, and Type are displayed for the path information. The displayed contents are also shortened, so that each path information item is displayed on a single line.

The items that are displayed are `PathID`, `DskName`, `iLU`, `CP`, `Status`, and `Type`.

For details on what is displayed for each item, see *Table 6-13 Displayed Path Information on page 6-51*.

When you use the `-c` parameter, the number of characters that can be displayed in the product ID element of the `DskName` field is limited to 10. When there are 11 or more characters in the product ID, the 8th and following characters are abbreviated to ellipses (...).

The sub-parameters (following `-path -c`) are:

`-pstv|-vstv`

If the `-pstv` parameter is specified, information about the physical storage system is displayed. If the `-vstv` parameter is specified, information about the storage system recognized by the operating

system is displayed. If neither parameter is specified, information is displayed according to the value specified in the -pstv parameter of set operations.

For information about the items that are displayed differently depending on the specified -pstv and -vstv parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

-stname

Use this parameter to display the model ID of the storage system in the product ID element of the DskName field. When this parameter is omitted, the command displays the product ID or emulation type of the storage system instead.

For details about the information about product IDs, see *Table 6-15 Product ID Displayed by the View -Path Operation on page 6-57*.

-srt {lu|cp}

Use this parameter to sort the path information in ascending order, according to the specified sorting key.

The sorting keys are as follows: the first sorting key is the name of the storage system (DskName), the second sorting key is the value specified by the -srt parameter, and the third sorting key is AutoPATH_ID.

The available parameter values to specify the second sorting key are:

- lu: LU number of the storage system
- cp: Port number of the CHA

When the -srt parameter is omitted, the path information is listed in ascending order of AutoPATH_IDs.

-t

Omits the title for each information item.

Example

The following example shows how to display a summary of the path information in order of iLUs.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -path -c -srt lu
Paths:000012 OnlinePaths:000012
PathStatus    IO-Count     IO-Errors
Online        1616         0

PathID DskName                                iLU              CP Status      Type
000000 HITACHI .DF600F     .0051              0005             0A Online      Own
000003 HITACHI .DF600F     .0051              0005             1A Online      Non
000001 HITACHI .DF600F     .0051              0014             0A Online      Non
000004 HITACHI .DF600F     .0051              0014             1A Online      Own
000002 HITACHI .DF600F     .0051              0015             0A Online      Non
000005 HITACHI .DF600F     .0051              0015             1A Online      Own
000006 HITACHI .OPEN-3     .15001             0005             1H Online      Own
000009 HITACHI .OPEN-3     .15001             0005             2H Online      Own
000007 HITACHI .OPEN-3     .15001             0015             1H Online      Own
000010 HITACHI .OPEN-3     .15001             0015             2H Online      Own
000008 HITACHI .OPEN-3     .15001             0020             1H Online      Own
000011 HITACHI .OPEN-3     .15001             0020             2H Online      Own
KAPL01001-I The HDLM command completed normally. Operation name = view,
completion time = yyyy/mm/dd  hh:mm:ss
#
```

Displayed path information

Table 6-13 Displayed Path Information on page 6-51 describes the displayed path information. The following explains the table headings:

- No summary displayed: The user specifies only the `-path` parameter or the`-path -item` parameter.
- Summary displayed: The user specifies the `-path -c` parameter.

Table 6-13 Displayed Path Information

Displayed Item		Description
No summary displayed	**Summary displayed**	
`Paths`		Total number of displayed paths, indicated by a decimal (i.e., base 10) number.
`OnlinePaths`		Number of online paths from within the displayed paths, indicated by a decimal number. When the value of `Paths` equals the value of `OnlinePaths`, then all the paths are online. If the value of `OnlinePaths` is less than that of `Paths`, some paths are offline. In this case, you should check the offline paths and take appropriate action for any paths that have an error status.
`PathStatus`		Status of the displayed paths. The displayed status indicates the following: • `Online`: All paths are available. • `Reduced`: Some paths are not available. `Reduced` means that some paths might have an error status, in which case you should check the status of individual paths and resolve the problem for any paths that have an error status.

Displayed Item		Description
No summary displayed	Summary displayed	
IO-Count		Total I/O count for all the displayed paths, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O count reaches the maximum value, it is reset, and the count is re-started from 0.
IO-Errors		Total I/O error count for all the displayed paths, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O error count reaches the maximum value, it is reset, and the count is re-started from 0.
PathID		The AutoPATH_ID indicated by a decimal number. The AutoPATH_ID is assigned every time the host is restarted or when a path configuration is changed. When a new LU was added and the host has not been restarted, AutoPATH_ID is assigned to each path of the LU when you execute the cfgmgr command.
PathName#1	-	The path name, which indicates a path. When you modify the system configuration or replace a hardware item, you should check the path names to identify the path that will be affected by the change. Path name consists of the following four elements, separated by periods: • HBA adapter number or adapter type (character string) • Bus number or adapter number (character string) • Target ID (hexadecimal number) • Host LU number (hexadecimal number) For details about each element of the path name and its representation in AIX, see *Table 6-14 Elements of a Path Name on page 6-56*.
DskName#1	DskName	Storage system name, which identifies the storage system that is accessed by a path. A storage system name consists of the following three elements, separated by periods: • Vendor ID: The name of the storage system vendor (for example, HITACHI). • Product ID: Indicates the storage system product ID, emulation type, or model name (for example, OPEN-3). • Serial number: The serial number of the storage system (for example, 15001). You can identify an actual storage system by referencing the above information from the storage system management program.
iLU#1	iLU	LU number of the storage system This number combined with the storage system name (shown in DskName) identifies the LU that is accessed by a path.

Displayed Item		Description
No summary displayed	Summary displayed	
		• For the Hitachi NSC55, Hitachi Universal Storage Platform 100, Hitachi Universal Storage Platform 600, Hitachi Universal Storage Platform 1100, or HUS VM, indicated by a hexadecimal number. The first two characters of `iLU` are the CU number, and the last two characters are the internal LU number within the CU. • For SVS, indicated by a hexadecimal number. The first three characters of `iLU` are the CU number, and the last two characters are the internal LU number within the CU. The first character of the CU number is the value `0`. • For XP20000/XP24000, P9500, or XP7, indicated by a hexadecimal number. The first two characters of `iLU` are `00`, the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU. • For the Hitachi AMS2000/AMS/WMS/SMS series, or HUS100 series, indicated by a decimal number. The entire value of `iLU` is the internal LU number within the storage system. You can identify an actual LU by referencing `iLU` from the storage system management program. • For Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000, or VSP G200, G400, G600 indicated by a hexadecimal number. The first two characters of iLU are the number of the logical DKC (Disk Controller), the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU.
`ChaPort`#1	`CP`	Port number of the CHA, which identifies the CHA port that is mounted on the storage system. You can identify an actual CHA port by referencing this number from the storage system management program.
`Status`		Status of the path • `Online`: Online • `Offline(C)`: Offline status caused by a command operation • `Offline(E)`: Offline due to an error • `Online(E)`: Failure has occurred (If none of the paths accessing one LU have an `Online` status, one of those paths is changed to the `Online(E)` status.) • `Online(S)`: I/O operations to the primary volume (P-VOL) in an HAM environment are suppressed. • `Online(D)`: The paths to the primary volume (P-VOL) in an HAM environment can be recovered automatically. Paths that are `Offline(E)` or `Online(E)` require corrective action. The appropriate action can be determined by referring to *What To Do for a Path Error on page 5-3*.

Displayed Item		Description
No summary displayed	**Summary displayed**	
Type[#1]	Type	Attribute of the path • Own: Owner path • Non: Non-owner path When connecting to the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series[#2], Hitachi SMS series[#2], HUS100 series[#2], or HUS VM, all paths are owner paths.
IO-Count[#1]	-	Total I/O count for the path, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O count reaches the maximum value, it will re-start from 0. To reset the IO-Count value to 0, execute the dlnkmgr command's clear operation. Executing the clear operation also resets the number of I/O errors (IO-Errors) to 0. For details about the clear operation, see *clear (Returns the Path Statistics to the Initial Value) on page 6-3*.
IO-Errors[#1]	-	Total I/O error count for the path, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O error count reaches the maximum value, it will re-start from 0. To reset the IO-Errors value to 0, execute the dlnkmgr command's clear operation. Executing the clear operation also clears the number of I/O operations (IO-Count) to 0. For details about the clear operation, see *clear (Returns the Path Statistics to the Initial Value) on page 6-3*.
DNum[#1]	-	Dev number, indicated by a decimal number. This item pertains to a logical volume number. There is one Dev in an LU, so the number is fixed to 0.
HDevName[#1]	-	Host device name. Hdisk name is displayed.
IEP[#1]	-	Information about the intermittent error. This item is displayed only when you specify -iem with the -path parameter. One of the following values is displayed for each path: • - Indicates that intermittent error monitoring is disabled or the monitoring time for an intermittent error is out of range. • A value of at least 0 Indicates the number of errors that occurred during intermittent error monitoring. • *

Displayed Item		Description
No summary displayed	Summary displayed	
		Indicates that an intermittent error occurred (automatic failbacks do not check the path).
HBAPortWWN[#1]	-	A 16-digit hexadecimal number indicating the WWN information for an HBA connected to the storage system. This item is displayed only when you specify `-iem` together with the `-hbaportwwn` parameter.
Physical-LDEV	-	The model ID, serial number, and iLU number of a physical volume are separated by periods and displayed. You can identify the physical volume from this information. If the volume is not virtualized, a hyphen (-) is displayed.
Virtual-LDEV	-	Displays the model ID, serial number, and iLU number of a virtual volume, separated by periods. You can identify the virtual volume from this information. If the volume is not virtualized, a hyphen (-) is displayed.
Physical-DskName	-	When a path is migrated using a virtual ID, displays the name of the storage system that is connected by the migration-destination path. A storage system name consists of the following three elements, separated by periods: • Vendor ID: The name of the storage system vendor. • Product ID: Indicates the storage system product ID, emulation type, or model name. • Serial number: The serial number of the storage system. When a virtual ID is not used, a hyphen (-) is displayed.
Physical-iLU	-	When a path is migrated using a virtual ID, displays LU number in the storage system that is connected by the migration-destination path. • For Hitachi Virtual Storage Platform, indicated by a hexadecimal number. The first two characters of `iLU` are the number of the logical DKC (Disk Controller), the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU. When a virtual ID is not used, a hyphen (-) is displayed.
Physical-ChaPort	-	When a path is migrated using a virtual ID, displays port number of the CHA that is connected by the migration-destination path. When a virtual ID is not used, a hyphen (-) is displayed.
Org-DskName	-	For HAM environments, the name of the storage system on the secondary volume (S-VOL) is displayed. A storage system name consists of the following three elements, separated by periods: • Vendor ID: The name of the storage system vendor.

Displayed Item		Description
No summary displayed	Summary displayed	
		• Product ID: Indicates the storage system product ID, emulation type, or model ID. For more details, see *Table 6-15 Product ID Displayed by the View -Path Operation on page 6-57*. • Serial number: The serial number of the storage system. If an HAM environment is not used, a hyphen (-) is displayed.
Org-iLU	-	For HAM environments, an LU number on the secondary volume (S-VOL) is displayed. • For HUS VM, indicated by a hexadecimal number. The first two characters of iLU are the CU number, and the last two characters are the internal LU number within the CU. • For Hitachi Virtual Storage Platform, indicated by a hexadecimal number. The first two characters of iLU are the number of the logical DKC (Disk Controller), the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU. If an HAM environment is not used, a hyphen (-) is displayed.

Legend:

-: Not displayed

#1

The path information is displayed only when a value is specified for the -path -item parameter.

#2

This storage system applies when the dynamic I/O path control function is disabled.

Table 6-14 Elements of a Path Name

Element	AIX representation	Corresponding information
HBA adapter number (example: 08)#1	HBA adapter number	The HBA adapter number, which is displayed by executing the lsdev -Cc disk command
Bus number (example: 14)#1	PCI bus number	The parent bus number, which is displayed by executing the lsdev -Cc disk command
Adapter type (example: 00)#2	None	Always 00

Element	AIX representation	Corresponding information
Adapter number (example: 01)#2	`fscsi` number (the *xx* part of `fscsi`*xx*)	The `fscsi` number, which is displayed by executing the `lsdev -C` command
Target ID (example: 00000000000000E2)	Target ID	The value of `scsi_id`, which is displayed by executing the `lsattr -El` *hdisk-name* command
Host LU number(example: 0001)	Logical unit ID or LUN	The value of `lun_id`, which is displayed by executing the `lsattr -El` *hdisk-name* command

#1

This element is applied when the NPIV option is set to `off` for the `dlmodmset` utility for setting the HDLM execution environment ODM.

#2

This element is applied when the NPIV option is set to `on` for the `dlmodmset` utility for setting the HDLM execution environment ODM.

Table 6-15 Product ID Displayed by the View -Path Operation

Model names of storage systems	Product ID	
	Without the -stname parameter	With the -stname parameter (Displays the following for the model name)
Hitachi AMS2000 series	product identifier#	AMS
Hitachi AMS series		AMS
Hitachi WMS series		WMS
Hitachi SMS series		SMS
HUS100 series		HUS100
SVS	Emulation type#	SVS
• Hitachi Universal Storage Platform 100 • Hitachi Universal Storage Platform 600 • Hitachi Universal Storage Platform 1100 • Hitachi NSC55		USP
• Hitachi Universal Storage Platform V		USP_V

Model names of storage systems	Product ID	
	Without the -stname parameter	With the -stname parameter (Displays the following for the model name)
• Hitachi Universal Storage Platform VM		
Hitachi Virtual Storage Platform		VSP
VSP G1000		VSP_G1000
VSP G200, G400, G600		VSP_Gx00
HUS VM		HUS_VM
P9500		P9500
XP7		XP7
XP10000		XP10000
XP12000		XP12000
XP20000		XP20000
XP24000		XP24000

#

When a summary is displayed by specifying the `-path -c` parameter and there are 11 or more characters in the summary string, any characters after the 9th character are not displayed,and ellipsis (`...`) are displayed instead.

To Display LU Information

When displaying LU information, if the `-item` parameter, `-c` parameter, or the `-c -item` parameter is specified at the same time as the `-lu` parameter, you can add and display items and display a summary of LU information. This section describes each parameter and the LU information and displayed items.

To display LU information

`-lu`

When neither the `-c` nor `-item` parameter is specified with the `-lu` parameter, the information about the LU recognized by HDLM is displayed without selecting items to be displayed or displaying a summary. The sorting key is iLU and its configuration information is displayed for each LU.

For details on the contents of each displayed item, see *Table 6-18 Displayed LU Information on page 6-65*.

The subsequent parameters are:

-pstv|-vstv

If the -pstv parameter is specified, information about the physical storage system is displayed. If the -vstv parameter is specified, information about the storage system recognized by the operating system is displayed. If neither parameter is specified, information is displayed according to the value specified in the -pstv parameter of set operations.

For information about the items that are displayed differently depending on the specified -pstv and -vstv parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

-hdev *host-device-name*|-pathid *AutoPATH_ID*

Filters the information only for the paths accessing the specified host device, if the -hdev parameter is specified.

Specify hdisk name for *host-device-name*.

If the -pathid parameter is specified, only information about the LU connected to the path with the specified *AutoPATH_ID* is displayed.

-t

Omits the title for each information item.

Example

The following example shows how to display the LU information without selecting items to be displayed:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu
Product       : USP
SerialNumber  : 0014010
LUs           : 10

iLU  HDevName OSPathID PathID Status
003A hdisk0   00000    000000 Online
              00001    000001 Online
003B hdisk1   00000    000002 Online
              00001    000003 Online
003C hdisk2   00000    000004 Online
              00001    000005 Online
003D hdisk3   00000    000006 Online
              00001    000007 Online
003E hdisk4   00000    000008 Online
              00001    000009 Online
003F hdisk5   00000    000010 Online
              00001    000011 Online
0040 hdisk6   00000    000012 Online
              00001    000013 Online
0041 hdisk7   00000    000014 Online
              00001    000015 Online
0042 hdisk8   00000    000016 Online
              00001    000017 Online
0043 hdisk9   00000    000018 Online
              00001    000019 Online
```

```
KAPL01001-I The HDLM command completed normally. Operation
name = view, completion time = yyyy/mm/dd hh:mm:ss
#
```

To display LU information (by adding items to be displayed)

```
-lu -item
```

The items specified with the `-item` option are displayed among with those displayed by the `-lu` option.

When the value of the `-item` parameter is omitted or `all` is specified, all the items, except for `DPC`, `Physical-LDEV`, Virtual-LDEV, `Physical-Product`, `Physical-SerialNumber`, `Physical-iLU`, `Physical-ChaPort`, Org-Product, Org-SerialNumber, and Org-iLU, that can be displayed are displayed.

The table below lists the correspondence between the display items that can be added by using the `-item` parameter and the parameter values that can be specified after the `-item` parameter.

Table 6-16 Items That Can Be Added by Using the -lu -item Parameter and Sub-parameters

Item that can be added	Subsequent parameter
SLPR	slpr
PathName	pn
ChaPort	cp
CLPR	clpr
Type	type
IO-Count	ic
IO-Errors	ie
DNum	dnu
IEP	iep
VG	vg
DPC	dpc
Physical-LDEV	phys
Virtual-LDEV	virt
Physical-Product	vid
Physical-SerialNumber	vid
Physical-iLU	vid
Physical-ChaPort	vid
Org-Product	ha
Org-SerialNumber	ha

Item that can be added	Subsequent parameter
Org-iLU	ha
HaStat	hastat
All items are displayed	all

For details on the contents of each displayed item, see *Table 6-18 Displayed LU Information on page 6-65*.

The sub-parameters are:

-pstv|-vstv

If the -pstv parameter is specified, information about the physical storage system is displayed. If the -vstv parameter is specified, information about the storage system recognized by the operating system is displayed. If neither parameter is specified, information is displayed according to the value specified in the -pstv parameter of set operations.

For information about the items that are displayed differently depending on the specified -pstv and -vstv parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

-hdev *host-device-name*|-pathid *AutoPATH_ID*

Filters the information only for the paths accessing the specified host device, if the -hdev parameter is specified.

Specify hdisk name for *host-device-name*.

If the -pathid parameter is specified, only information about the LU connected to the path with the specified *AutoPATH_ID* is displayed.

-t

Omits the title for each information item.

Example 1

The following example shows how to add SLPR, PathName, ChaPort, CLPR, Type, IO-Count, IO-Errors, DNum, IEP, and VG to the displayed items for LU information.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu -item slpr pn cp clpr type ic ie dnu iep vg
Product       : USP
SerialNumber  : 0014050
LUs           : 10

iLU  SLPR HDevName VG          OSPathID  PathID PathName                        ChaPort
CLPR Status     Type IO-Count   IO-Errors  DNum IEP
0150   12 hdisk0   -           00000     000000 08.11.0000000000660B00.0000     2B
1 Online     Own           0          0    0 -
                               00001     000001 08.1D.0000000000660C00.0000     3B
1 Online     Own           0          0    0 -
0151   12 hdisk1   samplevg001 00000     000002 08.11.0000000000660B00.0001     2B
1 Online     Own           0          0    0 -
                               00001     000003 08.1D.0000000000660C00.0001     3B
1 Online     Own           0          0    0 -
0152   12 hdisk2   samplevg002 00000     000004 08.11.0000000000660B00.0002     2B
1 Online     Own           0          0    0 -
                               00001     000005 08.1D.0000000000660C00.0002     3B
1 Online     Own           0          0    0 -
0153   12 hdisk3   -           00000     000006 08.11.0000000000660B00.0003     2B
1 Online     Own           0          0    0 -
                               00001     000007 08.1D.0000000000660C00.0003     3B
1 Online     Own           0          0    0 -
0154   12 hdisk4   -           00000     000008 08.11.0000000000660B00.0004     2B
1 Online     Own           0          0    0 -
                               00001     000009 08.1D.0000000000660C00.0004     3B
1 Online     Own           0          0    0 -
0155   12 hdisk5   -           00000     000010 08.11.0000000000660B00.0005     2B
1 Online     Own           0          0    0 -
                               00001     000011 08.1D.0000000000660C00.0005     3B
1 Online     Own           0          0    0 -
0156   12 hdisk6   -           00000     000012 08.11.0000000000660B00.0006     2B
1 Online     Own           0          0    0 -
                               00001     000013 08.1D.0000000000660C00.0006     3B
1 Online     Own           0          0    0 -
0157   12 hdisk7   -           00000     000014 08.11.0000000000660B00.0007     2B
1 Online     Own           0          0    0 -
                               00001     000015 08.1D.0000000000660C00.0007     3B
1 Online     Own           0          0    0 -
0158   12 hdisk8   -           00000     000016 08.11.0000000000660B00.0008     2B
1 Online     Own           0          0    0 -
                               00001     000017 08.1D.0000000000660C00.0008     3B
1 Online     Own           0          0    0 -
0159   12 hdisk9   -           00000     000018 08.11.0000000000660B00.0009     2B
1 Online     Own           0          0    0 -
                               00001     000019 08.1D.0000000000660C00.0009     3B
1 Online     Own           0          0    0 -
KAPL01001-I The HDLM command completed normally. Operation name = view, completion time =
yyyy/mm/dd hh:mm:ss
#
```

Example 2

When using Hitachi AMS2000 series, Hitachi SMS series, or HUS100 series and displaying LU information with DPC added to the display items:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu -item dpc
Product                  : HUS100
SerialNumber             : 9203008
LUs                      : 3
Dynamic I/O Path Control : on*

iLU    HDevName DPC PathID Status
000006 hdisk0   on  000000 Online
                    000003 Online
000007 hdisk1   off 000001 Online
                    000004 Online
000008 hdisk2   on  000002 Online
                    000005 Online
```

```
#
```

To display a summary of LU information

`-lu -c`

When the `-c` parameter is specified with the `-lu` parameter, a summary of LU configuration information is displayed on one line. The total number of paths recognized by HDLM and the number of online paths are displayed for each LU.

You cannot specify the `-c` parameter together with the `-hdev` or `-pathid` parameter.

For details on the contents of each display item, see *Table 6-18 Displayed LU Information on page 6-65*.

The sub-parameters are as follows:

`-pstv|-vstv`

If the `-pstv` parameter is specified, information about the physical storage system is displayed. If the `-vstv` parameter is specified, information about the storage system recognized by the operating system is displayed. If neither parameter is specified, information is displayed according to the value specified in the `-pstv` parameter of `set` operations.

For information about the items that are displayed differently depending on the specified `-pstv` and `-vstv` parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

`-t`

Does not display the title for each information item.

Example

The following example shows how to display a summary of the LU information (without selecting items to be displayed):

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu -c
Product     S/N       LUs iLU  HDevName  Paths  OnlinePaths
USP         0014010   10  003A hdisk0        2            2
                          003B hdisk1        2            2
                          003C hdisk2        2            2
                          003D hdisk3        2            2
                          003E hdisk4        2            2
                          003F hdisk5        2            2
                          0040 hdisk6        2            2
                          0041 hdisk7        2            2
                          0042 hdisk8        2            2
                          0043 hdisk9        2            2
KAPL01001-I The HDLM command completed normally. Operation
name = view, completion time = yyyy/mm/dd hh:mm:ss
#
```

To display a summary of LU information (by adding items to be displayed)

`-lu -c -item`

The items displayed when the `-item` option is added to the `-lu -c` option options.

If no value is specified for the `-item` parameter, all the items that can be added are displayed. See *Table 6-18 Displayed LU Information on page 6-65* for the contents of each displayed item.

The following table lists the correspondence between the display items that can be added by using the `-item` parameter and the parameter values that can be specified after the `-item` parameter.

Table 6-17 Items That Can Be Added by Using the -lu -c -item Parameter and Sub-parameters

Item that can be added	Sub-parameter
SLPR	slpr
VG	vg
All items	all

The sub-parameter is:

`-pstv|-vstv`

If the `-pstv` parameter is specified, information about the physical storage system is displayed. If the `-vstv` parameter is specified, information about the storage system recognized by the operating system is displayed. If neither parameter is specified, information is displayed according to the value specified in the `-pstv` parameter of `set` operations.

For information about the items that are displayed differently depending on the specified `-pstv` and `-vstv` parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

`-t`

Omits the title for each information item.

Example

The following example describes how to add and display a summary of SLPR and VG.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu -c -item
Product      S/N     LUs iLU  SLPR HDevName  VG          Paths  OnlinePaths
USP          0014050  10 0150   12 hdisk0    -               2            2
                        0151   12 hdisk1    samplevg001     2            2
                        0152   12 hdisk2    samplevg002     2            2
                        0153   12 hdisk3    -               2            2
                        0154   12 hdisk4    -               2            2
                        0155   12 hdisk5    -               2            2
                        0156   12 hdisk6    -               2            2
                        0157   12 hdisk7    -               2            2
                        0158   12 hdisk8    -               2            2
                        0159   12 hdisk9    -               2            2
KAPL01001-I The HDLM command completed normally. Operation name = view,
completion time = yyyy/mm/dd  hh:mm:ss
#
```

Displayed LU information

Table 6-18 Displayed LU Information on page 6-65 describes the displayed LU information. The following explains the table headings:

- No summary displayed: The user specifies the `-lu` parameter or `-lu -item` parameter.
- Summary displayed: The user specifies the `-lu -c` parameter or `-lu -c -item` parameter.

Table 6-18 Displayed LU Information

Displayed item		Description
No summary displayed	**Summary displayed**	
`Product`		Model ID of the storage system
`Serial number`	`S/N`	Serial number of the storage system
`LUs`		Total number of LUs managed by HDLM among the LUs in the storage system
`Dynamic I/O Path Control`	`-`	The setting information about the dynamic I/O path control function is displayed for each storage system. `on`: The dynamic I/O path control function is enabled. `off`: The dynamic I/O path control function is disabled. `-`: The dynamic I/O path control function is not supported. If an LU whose settings differ from the settings based on the system storage unit is included, an asterisk (`*`) is added after the `on` or `off` being displayed.
`iLU`		LU number in the storage system

Displayed item		Description
No summary displayed	Summary displayed	
		This number combined with the storage system name (shown in DskName) identifies the LU that is accessed by a path. • For the Hitachi NSC55, Hitachi Universal Storage Platform 100, Hitachi Universal Storage Platform 600, Hitachi Universal Storage Platform 1100, or HUS VM, indicated by a hexadecimal number. The first two characters of iLU are the CU number, and the last two characters are the internal LU number within the CU. • For SVS, indicated by a hexadecimal number. The first three characters of iLU are the CU number, and the last two characters are the internal LU number within the CU. The first character of the CU number is the value 0. • For XP20000/XP24000, P9500, or XP7, indicated by a hexadecimal number. The first two characters of iLU are 00, the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU. • For the Hitachi AMS2000/AMS/WMS/SMS series, or HUS100 series, indicated by a decimal number. The entire value of iLU is the internal LU number within the storage system. You can identify an actual LU by referencing iLU from the storage system management program. • For Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000, or VSP G200, G400, G600 indicated by a hexadecimal number. The first two characters of iLU are the number of the logical DKC (Disk Controller), the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU.
SLPR[#1]	SLPR[#2]	The number of the SLPR to which an LU belongs, indicated by a number from 0 to 31. A hyphen (–) is displayed if the storage logical partition functionality for the storage system for the target LU is not supported.
HDevName[#1]	–	Host device name. Hdisk name is displayed.
DPC	–	The setting information about the dynamic I/O path control function is displayed for each LU. on: The dynamic I/O path control function is enabled. off: The dynamic I/O path control function is disabled.

Displayed item		Description
No summary displayed	Summary displayed	
		–: The dynamic I/O path control function is not supported.
OSPathID	–	OS management path ID.
PathID	–	AutoPATH_ID indicated by a decimal number. AutoPATH_ID is assigned when the host is restarted or when a path configuration is changed. When a new LU was added and the host has not been restarted, AutoPATH_ID is assigned to each path of the LU when you execute the cfgmgr command.
PathName#1	–	The path name, which indicates a path. When you modify the system configuration or replace a hardware item, you should check the path names to identify the path that will be affected by the change. Path name consists of the following four elements, separated by periods: • HBA adapter number or adapter type (character string) • Bus number or adapter number (character string) • Target ID (hexadecimal number) • Host LU number (hexadecimal number) For details about each element of the path name and its representation in AIX, see *Table 6-14 Elements of a Path Name on page 6-56*
ChaPort#1	–	Port number of the CHA, which identifies the CHA port that is mounted on the storage system. You can identify an actual CHA port by referencing this number from the storage system management program.
CLPR#1	–	The number of the CLPR to which the CHA port belongs, indicated by a decimal number from 0 to 31. Note that a hyphen (-) is displayed if the following items are subject to display: • CHA ports in the storage system that do not support cache logical partition functionality • Paths connected to the Snapshot image of the Copy-on-write Snapshot of the Hitachi AMS2000/AMS/WMS/SMS series
Status	–	Status of the path • Online: Online • Offline(C): Offline status caused by a command operation • Offline(E): Offline due to an error • Online(E): Failure has occurred (If none of the paths accessing one LU have an Online status,

Displayed item		Description
No summary displayed	Summary displayed	
		one of those paths is changed to the Online(E) status.) • Online(S): I/O operations to the primary volume (P-VOL) in an HAM environment are suppressed. • Online(D): The paths to the primary volume (P-VOL) in an HAM environment can be recovered automatically. Paths that are Offline(E) or Online(E) require corrective action. The appropriate action can be determined by referring to *What To Do for a Path Error on page 5-3*
Type#1	–	Attribute of the path • Own: Owner path • Non: Non-owner path When connected to the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series#3, Hitachi SMS series#3, HUS100 series#3, or HUS VM, all paths are owner paths.
IO-Count#1	–	Total I/O count for a path. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O count reaches the maximum value, it is reset, and the count is re-started from 0. To reset the IO-Count value to 0, execute the dlnkmgr command's clear operation. Executing the clear operation also resets the number of I/O errors (IO-Errors) to 0. For details about the clear operation, see *clear (Returns the Path Statistics to the Initial Value) on page 6-3*.
IO-Errors#1	–	Total I/O error count for a path. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O error count reaches the maximum value, it is reset, and the count is re-started from 0. To reset the IO-Errors value to 0, execute the dlnkmgr command's clear operation. Executing the clear operation also clears the number of I/O operations (IO-Count) to 0. For details about the clear operation, see *clear (Returns the Path Statistics to the Initial Value) on page 6-3*.
DNum#1	–	Dev number, indicated by a decimal number. This item pertains to a logical volume number. There is one Dev in an LU, so the number is fixed to 0.

Displayed item		Description
No summary displayed	Summary displayed	
IEP#1	–	The displayed paths are assumed to be in an intermittent error status and checked whether those paths are to be operated for automatic failback. One of the following values is displayed for each path: • –: Indicates that intermittent error monitoring is disabled or the monitoring time for an intermittent error is out of range. • A value of at least 0: Indicates the number of errors that occurred during intermittent error monitoring. • *: Indicates that an intermittent error occurred (automatic failback does not check the path).
VG#1	VG#2	The volume group name LU is registered. When the LU is not registered as the volume group, a hyphen (-) is displayed.
Physical-LDEV	–	The model ID, serial number, and iLU number of a physical volume are separated by periods and displayed. You can identify the physical volume from this information. If the volume is not virtualized, a hyphen (–) is displayed.
Virtual-LDEV	–	Displays the model ID, serial number, and iLU number of a virtual volume, separated by periods. You can identify the virtual volume from this information. If the volume is not virtualized, a hyphen (–) is displayed.
Physical-Product	–	When a path is migrated using a virtual ID, displays model ID of the storage system that is connected by the migration-destination path. When a virtual ID is not used, a hyphen (–) is displayed.
Physical-SerialNumber	–	When a path is migrated using a virtual ID, displays serial number of the storage system that is connected by the migration-destination path. When a virtual ID is not used, a hyphen (–) is displayed.
Physical-iLU	–	When a path is migrated using a virtual ID, displays LU number in the storage system that is connected by the migration-destination path. • For Hitachi Virtual Storage Platform, indicated by a hexadecimal number. The first two characters of iLU are the number of the logical DKC (Disk Controller), the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU.

Displayed item		Description
No summary displayed	Summary displayed	
		When a virtual ID is not used, a hyphen (-) is displayed.
Physical-ChaPort	-	When a path is migrated using a virtual ID, displays port number of the CHA that is connected by the migration-destination path. When a virtual ID is not used, a hyphen (-) is displayed.
-	Paths	Total number of the paths recognized by HDLM for the LU to be displayed.
-	OnlinePaths	Number of available paths in the displayed paths, indicated by a decimal number. When the value of Paths equals the value of OnlinePaths, all paths are online. If the value of OnlinePaths is less than that of Paths, some paths are offline. In this case, you should check the offline paths and take appropriate action for any paths that have an error status.
Org-Product	-	For HAM environments, the model ID of the storage system on the secondary volume (S-VOL) is displayed. If an HAM environment is not used, a hyphen (-) is displayed.
Org-SerialNumber	-	For HAM environments, the serial number of the storage system on the secondary volume (S-VOL) is displayed. If an HAM environment is not used, a hyphen (-) is displayed.
Org-iLU	-	For HAM environments, an LU number in the storage system on the secondary volume (S-VOL) is displayed. • For HUS VM, indicated by a hexadecimal number. The first two characters of iLU are the CU number, and the last two characters are the internal LU number within the CU. • For Hitachi Virtual Storage Platform, indicated by a hexadecimal number. The first two characters of iLU are the number of the logical DKC (Disk Controller), the middle two numbers are the CU number, and the last two characters are the internal LU number within the CU. If an HAM environment is not used, a hyphen (-) is displayed.

Legend:

-: Not displayed

#1

This information is displayed when one of the following conditions exist:

- The user selected the item to be displayed by using the `-lu -item` parameter.
- `all` was specified.
- No value was specified for the parameter.

#2

This information is displayed when one of the following conditions exist:

- The user selected the item to be displayed by using the `-lu -c -item` parameter.
- `all` was specified.
- No value was specified for the parameter.

#3

This storage system applies when the dynamic I/O path control function is disabled.

To Display HBA Port Information

`-hba`

Use this parameter to display information about the paths to each HBA port. HDLM displays the unique HBA port ID assigned to each HBA port. This HBA port ID can also be used in `Offline` and `Online` operations. The following table lists and describes the displayed items.

Table 6-19 Items Displayed as HBA Port Information

Item	Description
`HbaID`	HBA port ID
`Port.Bus`	`Port` (HBA adapter number in character string) and `Bus` (bus number in character string), or adapter type and adapter number, separated by a period
`HBAPortWWN`	A 16-digit hexadecimal number indicating the WWN information for an HBA connected to the storage system. This item is displayed only if `-portwwn` is specified together with `-hba`.
`IO-Count`	Total I/O count for the displayed paths, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O count reaches the maximum value, it is reset, and the count is re-started from 0.
`IO-Errors`	Total I/O error count for the displayed paths, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O error count reaches the maximum value, it is reset, and the count is re-started from 0.
`Paths`	Total number of displayed paths, indicated by a decimal number.
`OnlinePaths`	Number of online paths in the displayed paths, indicated by a decimal number. When the value of `Paths` equals the value of `OnlinePaths`, all paths are online. If the value of `OnlinePaths` is

Item	Description
	less than that of Paths, some paths are offline. In this case, you should check the offline paths and take appropriate action for any path that has an error status.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -hba
HbaID Port.Bus  IO-Count   IO-Errors  Paths  OnlinePaths
00000 08.11        71520           0     20           20
00001 08.1D          425         100     20           10
KAPL01001-I The HDLM command completed normally. Operation
name = view, completion time = yyyy/mm/dd hh:mm:ss
#
```

The subsequent sub-parameters are:

`-srt pb`

Sorts the HBA port information by the HBA adapter number (`Port`) and bus numbers (`Bus`) (or adapter type and adapter number).

`-portwwn`

Displays port WWN information for HBAs connected to the storage system using a 16-digit hexadecimal number.

`-t`

Omits the title for each information item.

To Display CHA Port Information

`-cha`

Use this parameter to display information about the paths to each CHA port. HDLM displays the unique CHA port ID assigned to each CHA port. This CHA port ID is used in Offline and Online operations. The following table lists and describes the displayed items.

Table 6-20 Items Displayed as CHA Port Information

Item	Description
ChaID	CHA port ID
Product	Model ID of the storage system
S/N	Serial number of the storage system
ChaPort	Port number of the CHA, which identifies the CHA port that is mounted on the storage system. You can identify an actual CHA port by referencing this number from the storage system management program.
IO-Count	Total I/O count for the displayed paths, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O count reaches the maximum value, it is reset, and the count is re-started from 0.

Item	Description
IO-Errors	Total I/O error count for the displayed paths, indicated by a decimal number. The maximum value that can be displayed is 2^{32} - 1 (4294967295). If the total I/O error count reaches the maximum value, it is reset, and the count is re-started from 0.
Paths	Total number of displayed paths, indicated by a decimal number.
OnlinePaths	Number of online paths in the displayed paths, indicated by a decimal number. When the value of Paths equals the value of OnlinePaths, all paths are online. If the value of OnlinePaths is less than that of Paths, some paths are offline. In this case, you should check the offline paths and take appropriate action for any path that has an error status.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -cha
ChaID Product          S/N              ChaPort IO-Count   IO-Errors  Paths
OnlinePaths
00000 USP              1100             7A           777           0     10
10
00001 USP              1000             7B           100           0     20
20
00002 USP              1100             8A             0           0     10
10
00003 USP              1000             8B           333          77     20
10
KAPL01001-I The HDLM command completed normally. Operation name = view, completion time
= yyyy/mm/dd hh:mm:ss
#
```

The subsequent sub-parameters are:

-srt cp

Sorts the CHA port information by the storage system model IDs (Product), storage system serial numbers (S/N), and CHA port numbers (ChaPort).

-t

Does not display the title for each information item.

To Display the Correspondences Between hdisks, OS Management Path IDs, and LDEVs

-drv

Use this parameter to display the PathIDs, hdisk name, OS management path IDs, and information about the LDEVs in a storage system (identified by the storage system model ID, serial number, and LU number, separated by periods).

For details on the contents of each display item, see *Table 6-21 Items Displayed as the Correspondences Between hdisks, OS Management Path IDs, and LDEVs on page 6-74*.

The sub-parameters are as follows:

-pstv|-vstv

If the -pstv parameter is specified, information about the physical storage system is displayed. If the -vstv parameter is specified, information about the storage system recognized by the operating system is displayed. If neither parameter is specified, information is displayed according to the value specified in the -pstv parameter of set operations.

For information about the items that are displayed differently depending on the specified -pstv and -vstv parameters, see Table 6-10 Display items for which the display results of the view operation differ depending on the -pstv parameter specification on page 6-32 in Parameters on page 6-19.

-t

Does not display the title for each information item.

Table 6-21 Items Displayed as the Correspondences Between hdisks, OS Management Path IDs, and LDEVs

Item	Description
PathID	AutoPATH_ID indicated by a decimal number. AutoPATH_ID is assigned when the host is restarted or when a path configuration is changed. When a new LU was added and the host has not been restarted, AutoPATH_ID is assigned to each path of the LU, AutoPATH_ID is assigned when you execute the cfgmgr command.
HDevName	Host device name. Hdisk name is displayed.
OSPathID	OS management path ID.
LDEV	The model ID, serial number, and iLU number for the storage system, separated by periods. The information about an LDEV can physically identify an LU.

Example

To display corresponding information about PathIDs, hdisks, OSPathIDs, and LDEVs

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -drv
PathID HDevName OSPathID LDEV
000000 hdisk7   00000    HUS_VM.210945.0961
000001 hdisk7   00001    HUS_VM.210945.0961
000002 hdisk6   00000    HUS_VM.210945.0960
000003 hdisk6   00001    HUS_VM.210945.0960
000004 hdisk8   00000    HUS_VM.210945.0962
000005 hdisk8   00001    HUS_VM.210945.0962
000006 hdisk10  00000    VSP_G1000.10051.001837
000007 hdisk10  00001    VSP_G1000.10051.001837
000008 hdisk9   00000    VSP_G1000.10051.001836
000009 hdisk9   00001    VSP_G1000.10051.001836
000010 hdisk11  00000    VSP_G1000.10051.001838
000011 hdisk11  00001    VSP_G1000.10051.001838
KAPL01001-I The HDLM command completed normally. Operation
```

```
    name = view, completion time = yyyy/mm/dd hh:mm:ss
    #
```

To Display the Format of the View Operation

`-help`

Use this parameter to display the `view` operation format.

Example

The following example shows how to display the format of the `view` operation.

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -help
view:
  Format
    dlnkmgr view -sys [ -sfunc | -msrv | -adrv | -pdrv | -lic
                | -audlog | -lbpathusetimes | -expathusetimes | -
exrndpathusetimes | -pstv ] [-t]
    dlnkmgr view -path [-pstv | -vstv] [ -hdev HostDeviceName ]
[-stname] [-iem]
                                          [-srt {pn | lu | cp}] [-
hbaportwwn] [-t]
    dlnkmgr view -path
                 -item [pn] [dn] [lu] [cp] [type] [ic] [ie] [dnu]
                         [hd] [iep] [hbaportwwn] [phys] [virt]
[vid] [ha]
                   [-pstv | -vstv] [ -hdev HostDeviceName ] [-
stname] [-srt {pn | lu | cp}] [-t]
    dlnkmgr view -path -c [-pstv | -vstv] [-stname] [-srt {lu |
cp}] [-t]
    dlnkmgr view -lu [-pstv | -vstv] [ -hdev HostDeviceName | -
pathid AutoPATH_ID ] [-t]
    dlnkmgr view -lu
                 -item [ [slpr] [vg] [pn] [cp] [clpr] [type]
[ic] [ie] [dnu]
                          [iep] [dpc] [phys] [virt] [vid] [ha]
[hastat] | all ]
                           [-pstv | -vstv] [ -hdev
HostDeviceName | -pathid AutoPATH_ID ] [-t]
    dlnkmgr view -lu -c [-pstv | -vstv] [-t]
    dlnkmgr view -lu -c -item [ [slpr] [vg] | all ] [-pstv | -
vstv] [-t]
    dlnkmgr view -drv [-pstv | -vstv] [-t]
    dlnkmgr view -hba [-srt pb] [-portwwn] [-t]
    dlnkmgr view -cha [-srt cp] [-t]
KAPL01001-I The HDLM command completed normally. Operation name
= view, completion time = yyyy/mm/dd hh:mm:ss
#
```

add (Adds a Path Dynamically)

The `dlnkmgr` command's `add` operation batch-adds paths that are connected to the host and not configured on the host. You can execute this command dynamically without any effects on existing paths.

Format

To Add a Path Dynamically

```
/usr/DynamicLinkManager/bin/dlnkmgr add -path [-s]
```

To Display the Format of the add Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr add -help
```

Parameters

To Add a Path Dynamically

`-path`

Indicates that the target of the operation is a path managed by HDLM.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr add -path
KAPL01161-I This operation will change the path configuration.
Do you want to continue? [y/n]:y
KAPL01162-I A path was added. (path ID = 00010, storage =
HITACHI.HUS100.9100163, iLU = 0030)
        :
KAPL01159-I Paths were added. (number of paths added = 2,
completion time = yyyy/mm/dd hh:mm:ss)
```

`-s`

Executes the command without displaying the message asking for confirmation of command execution from the user. Specify this parameter if you want to skip the response to the confirmation message: for example, when you want to execute the command in a shell script or batch file.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr add -path -s
KAPL01162-I A path was added. (path ID = 00010, storage =
HITACHI.HUS100.9100163, iLU = 0030)
        :
KAPL01159-I Paths were added. (number of paths added = 2,
completion time = yyyy/mm/dd hh:mm:ss)
```

To Display the Format of the add Operation

`-help`

Use this parameter to display the `add` operation format.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr add -help
add:
  Format
```

```
    dlnkmgr add -path [-s]
KAPL01001-I The HDLM command completed normally. Operation name
= add, completion time = yyyy/mm/dd hh:mm:ss
#
```

delete (Deletes a Path Dynamically)

The `dlnkmgr` command's `delete` operation batch-deletes paths whose statuses are `Offline(C)` from the HDLM-management targets. You can execute this command dynamically without any effects on existing paths.

Format

To Delete a Path Dynamically

```
/usr/DynamicLinkManager/bin/dlnkmgr delete -path [-s]
```

To Display the Format of the delete Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr delete -help
```

Parameters

To Delete a Path Dynamically

`-path`

Indicates that the target of the operation is a path managed by HDLM.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr delete -path
KAPL01161-I This operation will change the path configuration.
Do you want to continue? [y/n]:y
KAPL01165-I A path was deleted. (path ID = = 00010, storage =
HITACHI.HUS100.9100163, iLU = 0030)
        :
KAPL01164-I Paths were deleted. (number of paths deleted = 2,
completion time = yyyy/mm/dd hh:mm:ss)
```

`-s`

Executes the command without displaying the message asking for confirmation of command execution from the user. Specify this parameter if you want to skip the response to the confirmation message: for example, when you want to execute the command in a shell script or batch file.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr delete -path -s
KAPL01165-I A path was deleted. (path ID = = 00010, storage =
HITACHI.HUS100.9100163, iLU = 0030)
        :
```

```
KAPL01164-I Paths were deleted. (number of paths deleted = 2,
completion time = yyyy/mm/dd hh:mm:ss)
```

To Display the Format of the delete Operation

`-help`

Use this parameter to display the `delete` operation format.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr delete -help
delete:
  Format
    dlnkmgr delete -path [-s]
KAPL01001-I The HDLM command completed normally. Operation name
= delete, completion time = yyyy/mm/dd hh:mm:ss
#
```

refresh (Applies Storage System Settings to HDLM)

The refresh operation applies the storage system settings to HDLM.

Format

To Apply Storage System Settings to HDLM

```
/usr/DynamicLinkManager/bin/dlnkmgr refresh -gad
```

To Display the Format of the refresh Operation

```
/usr/DynamicLinkManager/bin/dlnkmgr refresh -help
```

Parameters

To Apply Storage System Settings to HDLM

`-gad`

The non-preferred path option that is set to the paths to global-active device pair volumes is applied to the HDLM path attribute. A path for which the non-preferred path option is set becomes a non-owner path, and a path for which the non-preferred path option is not set becomes an owner path.

If you specify the `-gad` parameter for the `refresh` operation, make sure the statuses of all paths to global-active device pair volumes are `Online`.

If you restart the host, the settings at the time of restart are applied to the HDLM path attribute.

Example

To apply the attribute of a path to a global-active device volume:

```
# /usr/DynamicLinkManager/bin/dlnkmgr view -lu -item type phys
Product : VSP_G1000
SerialNumber : 10051
LUs : 1

iLU    HDevName OSPathID PathID Status Type Physical-LDEV
001910 hdisk1   00000    000000 Online Own
VSP_G1000.10051.001910
                00001    000001 Online Own
VSP_G1000.10051.001910
                00002    000002 Online Own
VSP_G1000.10057.001A10
                00003    000003 Online Own
VSP_G1000.10057.001A10
KAPL01001-I The HDLM command completed normally. Operation
name = refresh, completion time = yyyy/mm/dd  hh:mm:ss
#

# /usr/DynamicLinkManager/bin/dlnkmgr refresh -gad
KAPL01001-I The HDLM command completed normally. Operation
name = refresh, completion time = yyyy/mm/dd  hh:mm:ss
#

# /usr/DynamicLinkManager/bin/dlnkmgr view -lu -item type phys
Product : VSP_G1000
SerialNumber : 10051
LUs : 1

iLU    HDevName OSPathID PathID Status Type Physical-LDEV
001910 hdisk1   00000    000000 Online Own
VSP_G1000.10051.001910
                00001    000001 Online Own
VSP_G1000.10051.001910
                00002    000002 Online Non
VSP_G1000.10057.001A10
                00003    000003 Online Non
VSP_G1000.10057.001A10
KAPL01001-I The HDLM command completed normally. Operation
name = refresh, completion time = yyyy/mm/dd  hh:mm:ss
#
```

To Display the Format of the refresh Operation

`-help`

Use this parameter to display the format of the `refresh` operation.

Example

```
# /usr/DynamicLinkManager/bin/dlnkmgr refresh -help
refresh:
  Format
    dlnkmgr refresh -gad
KAPL01001-I The HDLM command completed normally. Operation
name = refresh, completion time = yyyy/mm/dd  hh:mm:ss
#
```

7

Utility Reference

This chapter explains the utilities used by HDLM.

- installux.sh Utility for HDLM Common Installer

Overview of the Utilities

HDLM provides the following utilities:

- The `DLMgetras` utility for collecting HDLM error information

  When an error occurs, this utility collects the files that contain information to be submitted to your HDLM vendor or maintenance company. For details about the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
- The `dlmchpdattr` utility for changing HDLM default settings

  This utility changes the default value for the hdisk attribute. For details about the `dlmchpdattr` utility, see *dlmchpdattr Utility for Changing HDLM Default Settings on page 7-13*.
- The `dlmgetrasinst` utility for collecting HDLM installation error information

  When an error occurs, this utility collects the files that contain information to be submitted to your HDLM vendor or maintenance company. For details about the `dlmgetrasinst` utility, see *dlmchpdattr Utility for Changing HDLM Default Settings on page 7-13*.
- HDLM component installation utility (`dlminstcomp`)

  If you installed HDLM in an environment that does not satisfy the JDK version requirement indicated in *JDK required for linkage with Global Link Manager* section in *Host and OS Support for HDLM on page 3-3*, execute this utility to complement the HDLM installation.

  For details about the `dlminstcomp` utility, see *dlminstcomp Utility for HDLM Component Installation on page 7-19*.
- The `dlmmigsts` utility for assisting HDLM migration

  When migrating from HDLM version 5.8.1 or earlier to version 5.9, the ODM and HDLM settings can be inherited by executing this utility. For details about this utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
- The `dlmodmset` utility for setting the HDLM execution environment ODM.

  This utility sets and displays ODM to define HDLM operations. For details about the `dlmodmset` utility, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*.
- The HDLM restoration support utility (`dlmpostrestore`)

  This utility updates HDLM information to match that of the target system environment when a system replication (clone) is created from an `mksysb` image that includes HDLM-managed devices.

  For details about the `dlmpostrestore` utility, see *dlmpostrestore Utility for HDLM Restoration Support on page 7-25*.
- The `dlmpr` utility for clearing HDLM persistent reservation

  The persistent reservation of a logical unit (LU) may not be canceled due to some reason when multiple hosts share a volume group rather than making up a cluster configuration using PowerHA. In this case, this utility clears the Reservation Key to cancel the persistent reservation. For details

about the dlmpr utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.

- The dlmpremkcd utility for preparing for a system backup

  Execute this utility if the error message KAPL09292-W was output during HDLM installation. For details about the dlmpremkcd utility, see *dlmpremkcd Utility for Preparing for a System Backup on page 7-28*.

- The dlmpreremove utility executed before removing HDLM

  This utility excludes the hdisk recognized as a boot disk from being an HDLM management target. Execute this utility before removing HDLM. For details about the dlmpreremove utility, see *dlmpreremove Utility for Executed Before Removing HDLM on page 7-29*.

- The dlmrmdev utility for removing HDLM devices

  This utility deletes hdisks according to the parameter settings. When all the hdisks recognized as HDLM management-target devices have been successfully deleted, the HDLM manager stops. The hdisk recognized as a boot disk is not deleted. For details about the dlmrmdev utility, see *dlmrmdev Utility for Deleting HDLM Drivers on page 7-30*.

- The dlmrmprshkey utility for clearing HDLM persistent reservation (shared-host methodology)

  The dlmrmprshkey utility cancels persistent reservation (shared-host methodology) on a specified volume. For details about the dlmrmprshkey utility, see *dlmrmprshkey Utility for Clearing HDLM Persistent Reservation (Shared-Host Methodology) on page 7-31*.

- The installhdlm utility for installing HDLM

  The installhdlm utility is used to execute an unattended installation when a new installation, upgrade installation, or re-installation of HDLM is being performed. For details about the installhdlm utility, see *installhdlm Utility for Installing HDLM on page 7-32*. For details about how to perform an unattended installation, see *Performing an Unattended Installation of HDLM on page 3-78*.

- The installux.sh utility for HDLM Common Installer

  HDLM will be installed on, and installs the corresponding version of HDLM from the DVD-ROM. This utility can also perform unattended installations via a parameter specification. For details about the installux.sh utility, see *installux.sh Utility for HDLM Common Installer on page 7-43*. For details about how to use this utility to install HDLM, see *Performing a New Installation of HDLM on page 3-27*, *Performing an Upgrade Installation or Re-installation of HDLM on page 3-39*, or *Performing an Unattended Installation of HDLM on page 3-78*.

Note

- The utilities must be executed by a user with root permissions.
- The starting time of the host and execution time of the utility depend on the number of LUs and paths.

The following table lists examples of the starting time of the host and the execution time of the HDLM utilities.

Table 7-1 Examples of the Starting Time of the Host and the Execution Time of the Utilities

Operation	Number of paths for an LU/ Total number of paths[#2]	Execution time[#1, #3]
Execution time of the device configuration on starting the host (when HDLM is installed)	4/1024	42 seconds
	8/2048	42 seconds
	16/4096	43 seconds
Execution time of the device configuration on starting the host (when HDLM is not installed)	4/1024	32 seconds
	8/2048	38 seconds
	16/4096	1 minutes 37 seconds
Executing `cfgmgr`	4/1024	53 seconds
	8/2048	1 minutes 14 seconds
	16/4096	1 minutes 51 seconds
Executing `dlmrmdev`	4/1024	1 minutes 15 seconds
	8/2048	1 minutes 27 seconds
	16/4096	1 minutes 51 seconds
Executing `view -path`	4/1024	0.42 seconds
	8/2048	1.51 seconds
	16/4096	3.41 seconds

#1

The starting time of the host and the execution time of the utilities depend on the following conditions:

- The hardware configuration (for example, whether you use Fibre Channel switches)
- The number of hdisk created under the `/dev` directory

#2

The number of LUs is 256.

#3

The execution environment is as follows:

Machine Spec: CPU: Power4 1200MHz x 2

DLMgetras Utility for Collecting HDLM Error Information

This utility collects information that is needed to analyze HDLM errors that have occurred: information such as error logs, integrated trace files, trace files, definition files, core files, system crash dump files, and libraries. The

collected information is archived in a file and saved to the directory that you specified. The following files are output:

- *Name-of-the-directory-containing-a-system-crash-dump-file/system-crash-dump-file*

  This file contains a symbolic link to the system crash dump file.
- `hbsa.tar.Z`

  This file contains compressed error information of the Hitachi Command Suite products other than HDLM.

  This file is output only when using the Hitachi Command Suite products that is the target for collecting error information.
- `getras.tar.Z`

  This file contains compressed HDLM information and system information.

For details about the information that is stored in the system crash dump file and `getras.tar.Z`, see *List of Collected Error Information on page 7-8*.

When you want to collect information other than that in *List of Collected Error Information on page 7-8*, define the information to collect in the *information- collection- definition file*. Information defined in *information-collection- definition file is compressed into* `getras.tar.Z`.

When the system is restarted, a part of the information that was collected by the `DLMgetras` utility will be cleared. If an error occurs, immediately execute this utility.

Format

```
/usr/DynamicLinkManager/bin/DLMgetras {directory-to-which-collected-information-is-output
[-f file-that-defines-information-to-be-collected] | -h}
```

You can also use lower-case characters (`dlmgetras`) as follows:

```
/usr/DynamicLinkManager/bin/dlmgetras {directory-to-which-collected-information-is-output
[-f file-that-defines-information-to-be-collected] | -h}
```

Parameters

directory-to-which-collected-information-is-output

Specify the output directory for the information that is to be collected by the `DLMgetras` utility for collecting HDLM error information. The collected information is compiled into two files shown in *Function* and output in the specified directory.

`-f` *file-that-defines-information-to-be-collected*

Use this parameter when you want to specify certain directories or files to be collected. In this parameter, specify the *file-that-defines-information-to-be-collected*, which defines the files and directories you want to collect.

Use an absolute path to specify *file-that-defines-information-to-be-collected*.

The following is an example of the coding in the file that defines the information to be collected.

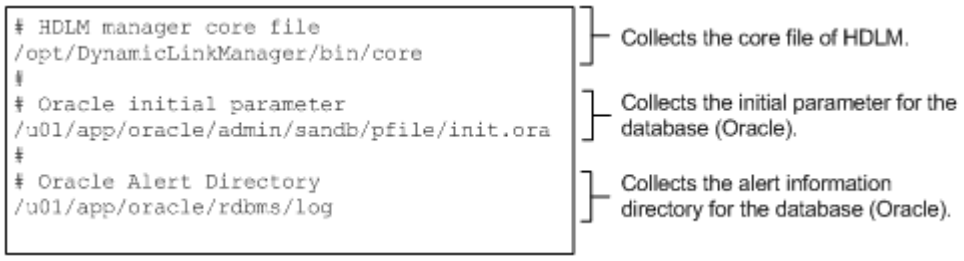


Figure 7-1 Coding Example of a File that Defines the Information to be Collected

Rules for coding a file that defines the information to be collected

- Use an absolute path to specify a directory or file whose information is to be collected. If you use a relative path to specify a directory or file, that directory or file will be searched for only within the directory in which the `DLMgetras` utility was executed, and the files found will be collected.
- Do not specify a directory that contains the directory to which the collected information is output. If you specify this directory, the `DLMgetras` utility will run indefinitely.
- Lines beginning with the hash mark (#) are handled as comment lines.
- If the hash mark (#) is encountered anywhere other than at the beginning of a line, it is assumed to be part of the path name.
- Only one file or directory can be specified per line.
- The root directory (`/`) cannot be specified.
- When a directory is specified, the `DLMgetras` utility collects all the files in that directory, including files contained in the directory's subdirectories. If no files are found in a specified directory, the utility does not perform file collection for that directory and does not create a directory for it in the destination directory.
- Set up the specified file or directory so that it can be read by users with root permissions. The `DLMgetras` utility can only obtain information for a file or directory that can be read.

`-h`

Displays the format of the `DLMgetras` utility.

Note

- Because `DLMgetras` first stores error information in the specified output directory before compressing, ensure that information collection areas allocated are of adequate size.
- If the specified directory to which collected information is output already exists, an overwrite confirmation message is displayed. Responding by

entering y instructs the DLMgetras utility to overwrite the existing files; entering n (or anything other than y) instructs the utility to terminate without executing.

In the latter case, you can either rename the existing directory before re-executing the utility, or you can execute the utility with a different directory name specified.

- If you create an archive for the system crash dump collected by the DLMgetras utility, execute the following:

```
# cd directory-to-which-collected-information-is-output
# tar cvfh archive-file-name ./var
```

List of Collected Error Information

The following illustrates the error information collected by executing the DLMgetras utility, which is explained separately in each output file.

- *Name-of-the-directory-containing-a-system-crash-dump-file/name-of-the-system-crash-dump-file*

  This file contains a symbolic link to the system crash dump file.

  The DLMgetras utility executes the sysdumpdev -l command and sets all files in the directories that are output to the copy directory value.

- hbsa.tar.Z

  This file contains compressed error information of the Hitachi Command Suite products other than HDLM.

  This file is output only when using the Hitachi Command Suite products that is the target for collecting error information.

- getras.tar.Z

  This file contains HDLM information and system information.

  When you execute the DLMgetras utility, specifying the file that defines information to be collected, the getras.tar.Z file contains the information stored in the file that defines information to be collected.

  The table below lists and describes the detailed information stored in the getras.tar.Z file.

  This table shows the information collected with or without specifying the file for defining the information to be collected.

Table 7-2 Information Stored in the getras.tar.Z File

Output directory#1	Files	Explanation
Directly under the directory to which collected information is output	getras.log	DLMgetras utility log file
var/DynamicLinkManager/log	dlmmgr[1-16].log	HDLM Manager log (including the driver log)

Output directory[#1]	Files	Explanation
	dlmwebagent[1-16].log	Hitachi Command Suite Common Agent Component log files
	dlminquiry[1-2].log dlminquiry[1-2].txt	Inquiry log
	dlmguiinst.log	Installation linkage script log used when linking with Hitachi Command Suite products other than HDLM
	hdlmtr[1-64].log	Trace file
	dlmconfig[1-2].log dlmconfig[1-2].txt	HDLM configuration log
	dlmutil[1-2].log	HDLM utility's log file
	installhdlm.log	Unattended installation execution log
var/DynamicLinkManager/log/mmap	hdlmtr.mm	Trace management file
	dlmutil.mm	HDLM utility's log trace management file
opt/hitachi/HNTRLib2/mmap	hntr2mmap.mm	Memory mapped file (HNTRLib2)
opt/hitachi/HNTRLib2/etc	D002PPName.log	Log file related to hntr2regist (HNTRLib2)
opt/hitachi/HNTRLib2/spool/setuplog	SETUP_D002.log	Log file related to D002setup (HNTRLib2)
	UPDATE_D002.log	Log file related to D002setup (HNTRLib2)
integrated-trace-file-output-directory-specified-in-the-Hitachi-Network-Objectplaza-Trace-Library-utility (Default: var/opt/hitachi/HNTRLib2/spool)	*integrated-trace-file-prefix-specified-in-the-Hitachi-Network-Objectplaza-Trace-Library-utility*2[1-64].log[#2] (default prefix: hntr)	Integrated trace file (HNTRLib2)
opt/hitachi/HNTRLib/mmap	hntrmmap.mm	Memory mapped file (HNTRLib) output
integrated-trace-file-output-directory-specified-in-the-Hitachi-Network-Objectplaza-Trace-Library-utility (Default: opt/hitachi/HNTRLib/spool)	hntr[1-16].log	Integrated trace file (HNTRLib) output

Output directory[#1]	Files	Explanation
usr/DynamicLinkManager/config	dlmmgr.xml	dlmmgr setting file
	dlmwebagent.properties	Hitachi Command Suite Common Agent Component settings file
	dlmmgr_DPC.xml	DPC option setting file
usr/lpp/bosinst	cdfs.optional.list	System backup definition file
etc	filesystems	Mount information of the file system
	inittab	inittab file
	syslog.conf	File for defining the directory for the output destination of syslog
error-log-file	*error-log-file*	Error log file obtained by /usr/lib/errdemon -1
syslog-output-directory-name	*syslog-name*	syslog files and backup files defined in /etc/syslog.conf
getrasinfo	(Not applicable)	Directory in which command execution results are stored
	.bash_history	Default history file in the Bourne Again shell (bash)
	.history	Default history file in the C shell (csh)
	.sh_history	Default history file in the Korn shell (ksh)
	alog.txt	System diagnosis message
	bootinfo-r.txt	Physical memory size
	bootinfo.txt	Information about the operation mode of the kernel (32/64 bit) and multi-CPU support
	bootlist-v.txt	List of boot devices
	Config_Rules.txt	Information of Object Database Manager
	crontab.txt	crontab information
	CuAt.txt	Information of Object Database Manager
	CuDv.txt	Information of Object Database Manager
	CuDvDr.txt	Information of Object Database Manager
	CuPath.txt	Information of Object Database Manager

Output directory[#1]	Files	Explanation
	CuPathAt.txt	Information of Object Database Manager
	CuVPD.txt	Information of Object Database Manager
	disk.txt	List of disks in the /dev directory
	dlmgetomtrace.dmp	HDLM function trace
	dlmls-la.txt	HDLM directory information file
	dlmmgr-cha.txt	CHA port information
	dlmmgr-drv.txt	hdisk information
	dlmmgr-hba.txt	HBA port information
	dlmmgr-lu.txt	HDLM LU information
	dlmmgr-lu-all.txt	HDLM LU information (including the number of times an intermittent error occurred)
	dlmmgr-path.txt	HDLM path information
	dlmmgr-path-iem.txt	HDLM path information (including the number of times an intermittent error occurred)
	dlmmgr-sys.txt	HDLM system settings
	dlmodmset.txt	HDLM execution environment ODM settings
	dlmpr-k.txt	Persistent reservation key information
	emgr.txt	emgr command
	env.txt	Environment variable file
	errpt-a.txt	Error log edit file
	errpt-t.txt	Error log entries output file
	genkex.txt	Information of loaded drivers
	hacmp.txt	Information on the PowerHA configuration
	histfile_*xxxxx*	File specified in the HISTFILE environment variable
	iotool.txt	Driver information
	lscfg.txt	Firmware version of HBA etc
	lsdev-C.txt	Kernel parameter value
	lsdev-proc.txt	CPU information
	lsfs.txt	File system information

Output directory[#1]	Files	Explanation
	lslpp.txt	List of installed packages
	lspath.txt	MPIO path information
	lsps-a.txt	Swap area, usage of swap
	lspv.txt	Physical volume information
	lsvg.txt	Information of volume groups
	Maintenance-Level.txt	Maintenance level of information, displayed when the instfix -i command was executed
	mount.txt	Mount information
	oslevel.txt	OS level information
	pagesize.txt	Memory page size
	PdAt.txt	Information of Object Database Manager
	PdAtXtd.txt	Information of Object Database Manager
	PdPathAt.txt	Information of Object Database Manager
	PdDv.txt	Information of Object Database Manager
	ps-ef.txt	Information on the executing process
	ulimit-a.txt	Limits on system resources (data segments, stack segments, file descriptors) that are available to processes
	uname-a.txt	Information on the AIX version
	viosinfo.txt	Execution result of the VIOS command
	whatlist.txt	Information output by the what command
etc/multibos/logs	op.alog	Multibos log file
etc/VRTSvcs/conf/config	main.cf	VCS configuration definition file
opt/VRTSvcs/bin/triggers	preonline	VCS trigger file
var/VRTSvcs/log	/var/VRTSvcs/*all-files-under-*log	VCS log file
hacmp.out-output-directory	hacmp.out	PowerHA execution log
/etc/vsd/	oemdisktypes.lst	VSD settings file

Output directory#1	Files	Explanation
/var/adm/csd	vsd.log	VSD execution log
var/adm/ras	boot.log	OS boot log file
	emgr.log	Log file for the emgr command

#1

An output directory is created in the specified directory when you open the getras.tar.Z file.

#2

In the actual file name, a file number is appended to *Trace-file-prefix specified-in-the-Hitachi-Network-Objectplaza-Trace-Library-utility*2. For example, the default will be hntr21.log to hntr216.log. Note that the number 2 following the integrated trace file prefix does not represent a file number.

dlmchpdattr Utility for Changing HDLM Default Settings

This utility changes the default value for the hdisk attribute.

By changing the default value, the attribute value set for an hdisk can be changed in the following cases:

- When a new hdisk is configured.
- When the chdev command is used to set as defined, and then reconfigure, an existing individual hdisk for which the attribute value has not changed.
- When deleting an existing hdisk#, and then reconfiguring it.

#

When an hdisk for which the attribute value has been defined is reconfigured without being deleted, the set attribute value is carried over.

If the attribute value for individual hdisks needs to be changed, instead of using this utility, execute the chdev command for the necessary hdisks.

Note that if the attribute value has been set for each hdisk, the set attribute values will be applied.

Supplemental Information:

For HDLM 6.2, the default value for the hdisk reservation policy was set to PR_exclusive. When the conditions listed in *Table 3-22 Reservation Policy Settings on page 3-105* in *About the Reservation Policy on page 3-104* are met, to change the reservation policy to no_reserve, the chdev command had to be executed for each hdisk.

In HDLM 6.3 or later, the default reservation policy values for multiple hdisks can be changed simultaneously by executing the `dlmchpdattr` utility.

Format

```
/usr/DynamicLinkManager/bin/dlmchpdattr
   {-a Attribute=Value [Attribute=Value ...]
   [-u { HTC | XP }] [-A] [-s]
   | -o
   | -h}
```

Parameters

`-a` *Attribute*=*Value*

Specifies one or more attribute name and attribute value pairs. If specifying multiple pairs, separate them by using a space, and enclose the list of pairs in double quotation marks (").

The following table lists the attribute names and values that can be specified.

Table 7-3 Attribute names and values that can be specified in dlmchpdattr

Attribute names that can be specified in dlmchpdattr	Values that can be specified
`reserve_policy`	Specifies the reservation policy to be used. `no_reserve`: Reservation requests are ignored, and LUs are not reserved. `PR_exclusive`: Uses persistent reservations (exclusive-host methodology) to reserve disks. `PR_shared`: Uses persistent reservations (shared-host methodology) to reserve disks. The default is `PR_exclusive`.
`max_transfer`	Specifies the maximum size of data that can be transferred to the disk. The range of specifiable values conforms to the applicable PdAt ODM rule for HTC_ODM or XP_ODM.
`queue_depth`	Specifies the maximum number of requests that the queue on the disk can hold. The range of specifiable values conforms to the applicable PdAt ODM rule for HTC_ODM or XP_ODM.
`rw_timeout`	Specifies the timeout value for a read or write operation. The range of specifiable values conforms to the applicable PdAt ODM rule for HTC_ODM or XP_ODM.

-u {HTC|XP}

Specifies the type of ODM whose default value you want to change.

HTC: Specify this if you want to change the default value for HTC_ODM.

XP: Specify this if you want to change the default value for XP_ODM.

If this parameter is omitted, the change is applied to both HTC_ODM and XP_ODM.

-A

Performs automatic hdisk reconfiguration required to reflect the changed reservation policy. If this parameter is omitted, the hdisk reconfiguration needs to be performed manually.

-s

Prevents the confirmation message from being displayed when the utility is executed.

-o

Displays the current value set for the reservation policy.

-h

Displays the format of the dlmchpdattr utility.

Notes

- Before you execute the dlmchpdattr utility, stop all application processes that access HDLM-managed devices.
- Before you execute the dlmchpdattr utility, make sure that no path errors are occurring. If there are any errors, the dlmchpdattr utility might end with an error.
- If you cancel the execution of the dlmchpdattr utility by pressing **Ctrl** + **C**, the KAPL10571-I message might be output depending on the timing of the cancellation. This message signifies that the setting change was not successful. If this message is output, re-execute the dlmchpdattr utility with the same parameters specified. To return the settings to their previous state, make sure that the above setting change was successful, and then execute the dlmchpdattr utility with the original parameters specified.

Examples

In the following example, the utility changes the default hdisk reservation policy to no_reserve:

```
# /usr/DynamicLinkManager/bin/dlmchpdattr -a
reserve_policy=no_reserve
KAPL10579-I The HDLM default values will be changed. Is this OK?
[y/n]:y
KAPL10571-I The dlmchpdattr utility completed successfully.
```

In the following example, the utility changes the default hdisk reservation policy to no_reserve, as well as changing the default number of requests that the queue on the disk can hold to 4:

```
# /usr/DynamicLinkManager/bin/dlmchpdattr -a
"reserve_policy=no_reserve queue_depth=4"
KAPL10579-I The HDLM default values will be changed. Is this OK?
[y/n]:y
KAPL10571-I The dlmchpdattr utility completed successfully.
```

In the following example, the utility displays the current default hdisk reservation policy:

```
# /usr/DynamicLinkManager/bin/dlmchpdattr -o
uniquetype = disk/fcp/Hitachi
    reserve_policy     : no_reserve
KAPL10571-I The dlmchpdattr utility completed successfully.
```

In the following example, the utility displays Help:

```
Usage : dlmchpdattr {-a Attribute=Value [Attribute=Value ...]
                     [-u { HTC | XP }] [-A] [-s] /usr/
DynamicLinkManager/bin/dlmpr -k hdisk1 hdisk2 hdisk3 hdisk4
hdisk5 h| -o | -h}
        Attributes
         reserve_policy={ PR_exclusive | PR_shared | no_reserve }
         max_transfer=Numeric
         queue_depth=Numeric
         rw_timeout=Numeric
```

dlmgetrasinst Utility for Collecting HDLM Installation Error Information

This utility collects information that is needed to analyze errors that have occurred for some reason during installation of HDLM. The collected information is archived in a file and saved to the directory that you specified. The following files are output:

- `getrasinst.tar.Z`

  This file contains compressed system information.

For details about the information that is stored in the system crash dump file and `getrasinst.tar.Z`, see *List of Collected Error Information on page 7-17*.

Format

DVD-ROM-drive-directory`/HDLM_AIX/hdlmtool/dlmgetrasinst {`*directory-to-which-collected-information-is-output* `| -h}`

Parameters

directory-to-which-collected-information-is-output

Specify the output directory for the information that is to be collected by the `dlmgetrasinst` utility for collecting HDLM installation error information. The collected information is compiled into two files shown in *Function* and output in the specified directory.

`-h`

Displays the format of the dlmgetrasinst utility.

Note

- We recommend that you execute the dlmgetrasinst utility on the HDLM installation DVD-ROM. If you use the utility by copying it to another location from the DVD-ROM, also copy the UtilAudLog file to the same directory to which you copy the dlmgetrasinst file.
- Because dlmgetrasinst first stores error information in the specified output directory before compressing, ensure that information collection areas allocated are of adequate size.
- If the specified directory to which collected information is output already exists, an overwrite confirmation message is displayed. Responding by entering y instructs the dlmgetrasinst utility to overwrite the existing files; entering n (or anything other than y) instructs the utility to terminate without executing.

  In the latter case, you can either rename the existing directory before re-executing the utility, or you can execute the utility with a different directory name specified.

List of Collected Error Information

The following table lists and describes the information collected by the dlmgetrasinst utility.

Table 7-4 Information Stored in the getrasinst.tar.Z File

Output directory#	Files	Explanation
Directly under the directory to which collected information is output	getrasinst.log	dlmgetrasinst utility log file
etc	filesystems	Mount information of the file system
	inittab	inittab file
	syslog.conf	File for defining the directory for the output destination of syslog
log	HBaseAgent_install.log	Hitachi Command Suite Common Agent Component installation log files
var/tmp	D002PPName.log	Log file related to hntr2regist
	SETUP_D002.log	Log file related to D002setup
	UPDATE_D002.log	Log file related to D002setup
var/adm/ras	nimadm.log	Log file related to nimadm
	emgr.log	Log file for the emgr command
var/adm/ras/alt_mig	*nimadm-log-file-name*	Log file related to nimadm

Output directory#	Files	Explanation
syslog-output-directory-name	*syslog-name*	syslog files and backup files defined in `/etc/syslog.conf`
`getrasinfo`	(Not applicable)	Directory in which command execution results are stored
	`.bash_history`	Default history file in the Bourne Again shell (bash)
	`.history`	Default `history` file in the C shell (csh)
	`.sh_history`	Default `history` file in the Korn shell (ksh)
	`bootlist-v.txt`	List of boot devices
	`Config_Rules.txt`	Information of Object Database Manager
	`crontab.txt`	`crontab` information
	`CuAt.txt`	Information of Object Database Manager
	`CuDv.txt`	Information of Object Database Manager
	`CuDvDr.txt`	Information of Object Database Manager
	`CuPath.txt`	Information of Object Database Manager
	`CuPathAt.txt`	Information of Object Database Manager
	`CuVPD.txt`	Information of Object Database Manager
	`disk.txt`	List of disks in the `/dev` directory
	`dlmls-la.txt`	HDLM directory information file
	`env.txt`	Environment variable file
	`errpt-a.txt`	Error log edit file
	`genkex.txt`	Information of loaded drivers
	`histfile_XXXXX`	File specified in the `HISTFILE` environment variable
	`lscfg.txt`	Firmware version of HBA etc
	`lsdev-C.txt`	Kernel parameter value
	`lsdev-proc.txt`	CPU information
	`lsfs.txt`	File system information
	`lslpp.txt`	List of installed packages
	`lspath.txt`	MPIO path information

Output directory#	Files	Explanation
	lsps-a.txt	Swap area, usage of swap
	lspv.txt	Physical volume information
	lsvg.txt	Information of volume groups
	Maintenance-Level.txt	Maintenance level of information, displayed when the instfix -i command was executed
	mount.txt	Mount information
	oslevel.txt	OS level information
	pagesize.txt	Memory page size
	PdAt.txt	Information of Object Database Manager
	PdAtXtd.txt	Information of Object Database Manager
	PdPathAt.txt	Information of Object Database Manager
	PdDv.txt	Information of Object Database Manager
	ps-ef.txt	Information on the executing process
	ulimit-a.txt	Limits on system resources (data segments, stack segments, file descriptors) that are available to processes
	uname-a.txt	Information on the AIX version
	rootvginfo.txt	rootvg information
	emgr.txt	The emgr command
	viosinfo.txt	The execution results of the VIOS command

#

An output directory is created in the specified directory when you open the getrasinst.tar.Z file

dlminstcomp Utility for HDLM Component Installation

This utility complements HDLM installation.

Execute this utility when both of the following conditions are satisfied:

- Linkage with Global Link Manager is used
- When HDLM is installed, the KAPL09241-W message is output#

#

Execute this utility after installing the JDK.

For details about the JDK version to be installed, see the *JDK required for linkage with Global Link Manager* section in *Host and OS Support for HDLM on page 3-3*.

Format

```
/usr/DynamicLinkManager/bin/dlminstcomp [-h]
```

Parameter

`-h`

Displays the format of the `dlminstcomp` utility.

dlmmigsts Utility for Assisting HDLM Migration

This utility saves HDLM program information and the HDLM execution environment ODM settings, making it possible to inherit settings information when migrating from HDLM version 5.8.1 or earlier to version 5.9. Execute this utility from the HDLM version 5.9 installation DVD-ROM.

Format

DVD-ROM-drive-directory`/HDLM_AIX/hdlmtool/dlmmigsts`

`{{{-b | -r} -odm` *odm-environment-settings-file-name* `-set` *set-environment-settings-file-name* `[-s]}`

`| -h`

`}`

Parameters

`-b`

Saves the settings files by using the names specified in the `-odm` and `-set` parameters.

Notes on specifying the `-b` parameter

- Do not save *odm-environment-settings-file* and *set-environment-settings-file* to an HDLM-related directory. If you do so, the saved file will be deleted during HDLM removal.

  The followings are HDLM-related directories:

  `/usr/DynamicLinkManager`

  `/var/DynamicLinkManager`

  `/var/DLM`

  `/opt/hitachi`

- Make sure you have write permission for *odm-environment-settings-file*, *set-environment-settings-file*, and the storage directory before executing.
- Do not change the contents of the saved *odm-environment-settings-file* and *set-environment-settings-file*.

`-r`

Restores the settings files by using the names specified in the `-odm` and `-set` parameters.

`-odm` *odm-environment-settings-file-name*

Specifies the file name in which the ODM environment settings are defined.

Specify the file path.

Specify a file name different from *set-environment-settings-file-name*.

`-set` *set-environment-settings-file-name*

Specifies the file name in which the `set` operation environment settings are defined.

Specify the file path.

Specify a file name different from *odm-environment-settings-file-name*.

`-s`

Executes the utility without displaying the overwrite confirmation message.

`-h`

Displays the format of the `dlmmigsts` utility.

Examples

In the following example, the utility saves the ODM environment settings in the `/tmp/odmset` file and the `set` environment settings in the `/tmp/dlnkset` file, when the DVD-ROM drive directory is `cdrom`:

```
# cdrom/HDLM_AIX/hdlmtool/dlmmigsts -b -odm /tmp/odmset -
set /tmp/dlnkset
KAPL13001-I The dlmmigsts utility completed successfully.
```

In the following example, the utility displays Help when the DVD-ROM drive directory is `cdrom`:

```
# cdrom/HDLM_AIX/hdlmtool/dlmmigsts -h
Usage :dlmmigsts {{{-b | -r} -odm odmsetfile -set dlnksetfile [-
s]} | -h}
```

dlmodmset Utility for Setting the HDLM Execution Environment ODM

This utility sets and displays ODM to define HDLM operations.

Format

```
/usr/DynamicLinkManager/bin/dlmodmset
   {{-r {on | off}
   | -i {on | off}
   | -v {on | off}
   | -j {on | off}} [-s]
   | -o
   | -h }
```

Parameters

`-r { on | off }`

Enables or disables the LUN RESET option.

`on`: Enable

`off`: Disable

The default is `off`.

To use GPFS, specify `on`.

You do not need to reconfigure the hdisk or restart the host when you change this parameter.

`-i { on | off }`

Prevents I/O on the Online(E) path.

`on`: Prevents I/O on the Online(E) path.

`off`: Allows I/O on the Online(E) path.

The default is `off`.

When an error (such as one that might occur in a LVM mirror configuration) is detected and I/O access for a path in the Online(E) status continues, detection of errors will continue. When this parameter is set to `on`, I/O access is suppressed until troubleshooting measures are taken. This can shorten the time needed to deal with the problem.

You do not need to reconfigure the hdisk or restart the host when you change this parameter.

Note

When this parameter is set to `on`, I/O access to the Online(E) path will be suppressed, so I/O success will automatically change the path to the Online status. To recover the path, use an `online` command or the auto failback function.

`-v { on | off }`

Enables or disables the NPIV option.

`on`: Enable

`off`: Disable

The default is `off`.

To use HDLM in a client partition to which a virtual HBA is applied by using the NPIV functionality of the virtual I/O server, specify `on`. For details, see *Notes on the Virtual I/O Server on page 3-16*.

`-j {on | off}`

Sets whether to output HDLM messages to the OS error log.

`on`: Output messages.

`off`: Do not output messages.

The default is `off`.

You do not need to reconfigure the hdisk or restart the host when you change this parameter.

In the OS error log, HDLM messages are output when an error occurs on a path or the path is recovered. You can distinguish between messages for path errors and for path recovery by using labels in the OS error log.

- Label for a path error: `HDLM_PATH_FAIL`
- Label for path recovery: `HDLM_PATH_RECOV`

The label for path recovery is output if the `Offline(E)` or the `Online(E)` paths become `Online` due to an `online` operation or automatic failback.

Take measures recommended by `Recommended Actions` in the OS error log as necessary. In addition, the detailed data in the OS error log contains maintenance information.

If a label for a path error is output, the detailed data contains the following information:

- The first information item separated by spaces shows the OSPathID (hexadecimal number) of a path with an error.
- The sixth information item separated by spaces shows the OS error code (hexadecimal number) of the cause of the path error.

If a label for path recovery is output, the detailed data contains the following information:

- The first information item separated by spaces shows the OSPathID (hexadecimal number) of a path that has recovered from an error.

If the message is output to the error log files (HDLM Manager log) at the same time, check the content of that message also.

The following shows an example of an OS error log output by HDLM when an error occurred on a path in the AIX 6.1 TL08 environment.In this example, in the detailed data, the first information item separated by spaces is `0001` indicating that OSPathID is 1, and the sixth information item separated by spaces is `0005`. Thus this OS error log indicates that the OS error code 5 (EIO) has occurred.

```
LABEL:          HDLM_PATH_FAIL
IDENTIFIER:     37269DDB

Date/Time:       WWW MMM dd hh:mm:ss TTT yyyy
Sequence Number: 3005
Machine Id:      00F8782C4C00
Node Id:         natu
Class:           U
Type:            INFO
WPAR:            Global
Resource Name:   hdisk8
Resource Class:  disk
Resource Type:   Hitachi
Location:        U78AA.001.WZSJPKR-P1-C4-T1-W50060E801082EEA0-
L5C000000000000


Description
HDLM detected a path failure.

Probable Causes
HDLM detected a path failure.

Failure Causes
A physical or logical error occurred in the path.

        Recommended Actions
        Check the path in which the error was detected.

Detail Data
Driver Information.
0001 8000 0017 0000 000A 0005 000B 0000 0000 0000 0000 0000 0000
0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 00
```

-s

Prevents the confirmation message from being displayed when the utility is executed.

-o

Displays the current setting information.

-h

Displays the format of the `dlmodmset` utility.

Examples

In the following example, the utility enables the LUN RESET option:

```
# /usr/DynamicLinkManager/bin/dlmodmset -r on
KAPL10805-I The setup of the HDLM execution environment ODM will
be changed. Lun Reset = on. Is this OK? [y/n]:y
KAPL10800-I The dlmodmset utility completed normally.
```

In the following example, the utility displays the current setting information:

```
# /usr/DynamicLinkManager/bin/dlmodmset -o
Lun Reset                                 : off
Online(E) IO Block                        : on
NPIV Option                               : off
OS Error Log Output                       : off
KAPL10800-I The dlmodmset utility completed normally.
#
```

In the following example, the utility displays Help:

```
# /usr/DynamicLinkManager/bin/dlmodmset -h
Usage : dlmodmset {{-r {on | off}
                  | -i {on | off}
                  | -v {on | off}
                  | -j {on | off}
                  }
                  [ -s ]
                  | -o
                  | -h
                 }
```

dlmpostrestore Utility for HDLM Restoration Support

This utility updates HDLM information to match that of the target system environment when a system replication (clone) is created from a `mksysb` image that includes HDLM-managed devices.

Format

```
/usr/DynamicLinkManager/bin/dlmpostrestore [-s | -h]
```

Parameters

`-s`

Suppresses display of a confirmation message when the utility executes.

`-h`

Displays the format of the `dlmpostrestore` utility.

Notes

- When the `dlmpostrestore` utility is executed in a local boot disk environment, the devices are reconfigured; when the utility is executed in a boot disk environment, the host is restarted.

- Before you execute the `dlmpostrestore` utility, stop all application processes that access HDLM-managed devices.
- Before you execute the `dlmpostrestore` utility, make sure that no path errors are occurring. If a path error occurs, release of a reservation may fail.

dlmpr Utility for Clearing HDLM Persistent Reservation

The persistent reservation of a logical unit (LU) may not be canceled due to some reason when multiple hosts share a volume group rather than making up a cluster configuration. In this case, this utility clears the Reservation Key to cancel the persistent reservation.

Format

`/usr/DynamicLinkManager/bin/dlmpr {{-k | -c} [`*hdisk-name*`] [`*hdisk-name*`] ... [-a] | -h}`

Parameters

`-k`

Specify this parameter to display the Reservation Key. The following explains the items displayed when the `-k` parameter is specified:

Reservation Key

An asterisk (`*`) is displayed at the end of the Reservation Key for a Reservation Key of another host.

If the Reservation Key is not set, `[0x0000000000000000]` is displayed.

Regist Key

The registered Keys are displayed.

Key Count

The number of registered Keys is displayed.

`-c`

Specify this parameter to clear the Reservation Key.

Note

- Do not use the `-c` parameter during normal operation.

  If you set the reservation policy to `PR_shared`, the reservation for all nodes that use the corresponding hdisk is cleared, so hosts that did not share the reservation can now access the hdisk. This might lead to data corruption. To clear only the reservation from an execution node, use dlmrmprshkey Utility for Clearing HDLM Persistent Reservation (Shared-Host Methodology) on page 7-31.

  If you set the reservation policy to `PR_exclusive`, data might become corrupted because another host can now access the specified hdisk.

- When the *hdisk-name* parameter is omitted, the Reservation Key for the hdisks that makes up rootvg will not be cleared. In this case, the KAPL10670-I message is displayed in the execution result.

hdisk-name

Specify the hdisk for which you want to display or clear the Reservation Key. You can specify more than one volume.

If you omit this parameter, the utility assumes all hdisks.

`-a`

When multiple hdisks are specified, even if an error occurs during processing, the processing continues for all hdisks.

`-h`

Displays the format of the `dlmpr` utility.

Note

- If reservation policy for the device that is managed by HDLM is set to `PR_shared`, the Key shown for `self Reservation Key` might not match the Key that is actually being used. To check which Key is actually being used, use the `lsattr` command.

  The following is an example of executing the command to check the Key for hdisk*n*.

  ```
  # lsattr -El hdisk12 | grep PR_key_value
  PR_key_value  0xaaaaaaaaaaaaaaaa    Reserve Key    TRUE
  ```

- `[0x????????????????]` appears for Reservation Key if the destination storage system does not support the persistent reservation or if a hardware error occurs.

Example

To check the Reservation Keys, and then clear the Reservation Keys other than those for the local host:

1. Execute the `dlmpr` utility to display the Reservation Keys for `hdisk1`, `hdisk2`, `hdisk3`, `hdisk4`, `hdisk5`, `hdisk6`, `hdisk7`, `hdisk8`, `hdisk9`, `hdisk10`

   ```
   # /usr/DynamicLinkManager/bin/dlmpr -k hdisk1 hdisk2 hdisk3
   hdisk4 hdisk5 hdisk6 hdisk7 hdisk8 hdisk9 hdisk10
   self Reservation Key : [0xaaaaaaaaaaaaaaaa]
   hdisk1  Reservation Key : [0x????????????????] ,
   reserve_policy : PR_exclusive
   hdisk2  Reservation Key : [0x0000000000000000] ,
   reserve_policy : no_reserve
   hdisk3  Reservation Key : [0xaaaaaaaaaaaaaaaa] ,
   reserve_policy : PR_exclusive
                Regist Key : [0xaaaaaaaaaaaaaaaa] , Key Count : 4
                Regist Key : [0xcccccccccccccccc] , Key Count : 4
   ```

```
hdisk4  Reservation Key : [0xbbbbbbbbbbbbbbbb]*,
reserve_policy : PR_exclusive
             Regist Key : [0xaaaaaaaaaaaaaaaa] , Key Count : 4
             Regist Key : [0xbbbbbbbbbbbbbbbb] , Key Count : 4
hdisk5  Reservation Key : [0xbbbbbbbbbbbbbbbb]*,
reserve_policy : no_reserve
             Regist Key : [0xbbbbbbbbbbbbbbbb] , Key Count : 4
hdisk6  Reservation Key : [0x0000000000000000] ,
reserve_policy : single_path
             Regist Key : [0xcccccccccccccccc] , Key Count : 4
hdisk7  Reservation Key : [0x????????????????] ,
reserve_policy : -
hdisk8  Reservation Key : following            ,
reserve_policy : PR_shared
             Regist Key : [0xaaaaaaaaaaaaaaaa] , Key Count : 4
             Regist Key : [0xdddddddddddddddd] , Key Count : 2
hdisk9  Reservation Key : following            ,
reserve_policy : PR_exclusive
             Regist Key : [0xdddddddddddddddd] , Key Count : 2
hdisk10 Reservation Key : [0xbbbbbbbbbbbbbbbb]*,
reserve_policy : PR_shared
             Regist Key : [0xdddddddddddddddd] , Key Count : 2
KAPL10665-I The dlmpr utility completed.
```

2. Execute the `dlmpr` utility to clear the Reservation Keys for other hosts (marked by an asterisk (*)).

```
# /usr/DynamicLinkManager/bin/dlmpr -c hdisk4 hdisk5
```

3. The confirmation message appears. Enter `y` to clear. Otherwise, enter `n`.

```
KAPL10641-I Reservation Key will now be cleared. Is this OK? [y/
n]:y
KAPL10642-I Reservation Key of hdisk4 was cleared.
KAPL10642-I Reservation Key of hdisk5 was cleared.
```

In the following example, the utility displays Help:

```
# /usr/DynamicLinkManager/bin/dlmpr -h
Usage : dlmpr {{ -k | -c } [hdisk-name...] [-a] | -h}
```

dlmpremkcd Utility for Preparing for a System Backup

When you use the `mkcd`, `mkdvd`, or `backupios` command of your OS to back up the OS (HDLM-installation environment) into CD-ROMs or DVD-ROMs, you need to use the `dlmpremkcd` utility to prepare the OS backup setting for HDLM before the backup.

Only use CD-ROMs or DVD-ROMs that are compatible with the corresponding server.

If both of the following conditions are satisfied, execute this utility:

- When you want to back up the OS (HDLM-installation environment) into CD-ROMs or DVD-ROMs by using the OS commands.

- When the error message KAPL09292-W was output during HDLM installation.

Format

```
/usr/DynamicLinkManager/bin/dlmpremkcd {-c | -u | -h}
```

Parameters

`-c`

Adds information for HDLM backup to the OS backup setting.

`-u`

Deletes the HDLM-backup information from the OS backup setting, and restore the setting to its original state.

`-h`

Displays the format of the `dlmpremkcd` utility.

Examples

In the following example, the utility adds information for HDLM backup to the OS backup setting:

```
# /usr/DynamicLinkManager/bin/dlmpremkcd -c
KAPL13145-I The dlmpremkcd utility will be executed. Is this
OK? [y/n]:y
KAPL13141-I The dlmpremkcd utility completed successfully.
```

In the following example, the utility deletes the HDLM-backup information from the OS backup setting, and restore the setting to its original state:

```
# /usr/DynamicLinkManager/bin/dlmpremkcd -u
KAPL13145-I The dlmpremkcd utility will be executed. Is this
OK? [y/n]:y
KAPL13141-I The dlmpremkcd utility completed successfully.
```

In the following example, the utility displays Help:

```
# /usr/DynamicLinkManager/bin/dlmpremkcd –h
Usage : dlmpremkcd {-c | -u | -h}
```

dlmpreremove Utility for Executed Before Removing HDLM

This utility excludes the hdisk recognized as a boot disk from being an HDLM management target. In a boot disk environment, before you remove HDLM you must exclude the hdisk recognized as a boot disk from being an HDLM management target.

Format

```
/usr/DynamicLinkManager/bin/dlmpreremove [-h | -s]
```

Parameters

-h

Displays the format of the dlmpreremove utility.

-s

Executes the command without displaying the message asking for confirmation of command execution from the user. Specify this parameter if you want to skip the response to the confirmation message (for example, when you want to execute the command in a shell script or batch file).

Examples

In the following example, the utility is executed in a boot disk environment:

```
# /usr/DynamicLinkManager/bin/dlmpreremove -s
KAPL13103-I HDLM can be removed after rebooting the host.
KAPL13101-I The dlmpreremove utility completed successfully.
```

In the following example, the utility displays Help:

```
# /usr/DynamicLinkManager/bin/dlmpreremove -h
Usage : dlmpreremove [-h | -s]
```

dlmrmdev Utility for Deleting HDLM Drivers

This utility deletes hdisks or changes the status of hdisks to Defined according to the parameter settings. When all the hdisks recognized as HDLM management-target devices have been successfully deleted or changed to Defined, the HDLM manager stops.

Note that the hdisk recognized as a boot disk will not be deleted or changed to Defined.

Format

```
/usr/DynamicLinkManager/bin/dlmrmdev [[-e | -f] [-A [-s]] | -h]
```

Parameters

-e

Changes the status of hdisks recognized as HDLM-managed devices to Defined.

-f

Deletes all hdisks recognized as devices that are either managed by HDLM or intended to be managed by HDLM.

-A

Unmounts file systems and deactivates volume groups that are being used by HDLM before deleting the hdisks that are recognized as HDLM management-target devices or changing the status of those hdisks to `Defined`.

`-s`

Prevents the confirmation message for unmounting and deactivating the volume groups, when the `-A` parameter is specified.

`-h`

Displays the format of the `dlmrmdev` utility.

Note

Before executing the `dlmrmdev` utility, stop all processes and services using the paths managed by HDLM. If you execute the `dlmrmdev` utility without stopping the processes and services that are using the paths managed by HDLM, hdisks recognized as HDLM management-target devices might not be deleted completely or changed to the `Defined` status

Examples

In the following example, the utility unmounts the file system used by HDLM, inactivates the volume group used by HDLM, and deletes all the hdisks recognized as HDLM management-target devices:

```
# /usr/DynamicLinkManager/bin/dlmrmdev -A
KAPL10528-I The volume group will be made inactive, and the file
system that is using HDLM will be unmounted. Is this OK? [y/n]:y
hdisk3 is deleted
KAPL09012-I All HDLM drivers were removed.
```

In the following example, the utility displays Help:

```
# /usr/DynamicLinkManager/bin/dlmrmdev -h
Usage : dlmrmdev [[-e | -f] [-A [-s]] | -h]
```

dlmrmprshkey Utility for Clearing HDLM Persistent Reservation (Shared-Host Methodology)

The `dlmrmprshkey` utility cancels persistent reservation (shared-host methodology) on a specified volume.

Format

```
/usr/DynamicLinkManager/bin/dlmrmprshkey {-l hdisk-name | -h}
```

Parameters

`-l hdisk-`*`name`*

Specify the name of the physical volume on which the persistent reservation you want to cancel is registered. You can specify only one name for *hdisk-name*.

`-h`

Displays the format of the `dlmrmprshkey` utility.

Notes

- Verify that the specified physical volume is not used. If it is used, the `dlmrmprshkey` utility fails with an error.
- Verify that no error has occurred on the path connected to the specified physical volume. If an error has occurred, the persistent reservation (shared-host methodology) cannot be canceled.

Examples

In the following example, the utility cancels persistent reservation (shared-host methodology) on the specified volume:

```
# /usr/DynamicLinkManager/bin/dlmrmprshkey -l hdisk8
KAPL13163-I The dlmrmprshkey utility will now be executed. Is
this OK? [y/n]:y
KAPL13157-I The dlmrmprshkey utility completed successfully.
```

In the following example, the utility displays Help:

```
# /usr/DynamicLinkManager/bin/dlmrmprshkey -h
Usage : dlmrmprshkey {-l HDLM_device_name | -h}
```

installhdlm Utility for Installing HDLM

This utility is used to execute an unattended installation when a new installation, upgrade installation, or re-installation of HDLM is being performed. You can perform an unattended installation even when you are installing HDLM in a boot disk environment. Before you perform an unattended installation, you must define the information that is required during the installation in the installation information settings file.

For details about how to perform an unattended installation, see *Performing an Unattended Installation of HDLM on page 3-78*.

Format

/directory-in-which-the-DVD-ROM-is-mounted-or-copied`/HDLM_AIX/hdlmtool/instutil/installhdlm { -f` *installation-information-settings-file-name* `| -h}`

Parameters

`-f` *installation-information-settings-file-name*

Defines the information needed for installing HDLM.

For details about the installation-information settings file, see *Items To Be Defined in an installation-information Settings File on page 7-33*.

`-h`

Displays the format of the `installhdlm` utility.

Items To Be Defined in an installation-information Settings File

The following describes the information defined in the installation information settings file.

[INSTALLATION_SETTINGS] section

This section defines information that is used when the `installhdlm` utility is executed. Specify this section name at the beginning of the installation information settings file (although an empty paragraph or comment line can be inserted above this section name).

The following table lists and describes the keys defined in the `[INSTALLATION_SETTINGS]` section.

Table 7-5 Keys in the [INSTALLATION_SETTINGS] Section

Key name#1	Description#2	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
`installfile_location`	Specify the absolute path name of the directory that contains the `DLManager.mpio.bff` file from either the directory in which the DVD-ROM was mounted or the directory in which the DVD-ROM was copied. The default is `/dev/cd0`.	Optional	Optional	60
`logdir`	Specify the absolute path name of the directory in which the file that contains log information is output. The default is `/var/tmp`. For details about the log file, see *Log file on page 7-43*.	Optional	Optional	60
`licensekeyfile`#3	Specify an absolute path to a license key file stored in the host. The file specified here is not deleted after an unattended installation is performed.	Optional#4	Optional#4	60

Key name[#1]	Description[#2]	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
	The default is `/var/tmp/hdlm_license`. If you perform an upgrade installation or re-installation without updating the license, delete the `licensekeyfile` key and value.			
`licensekey`[#3]	Specify the absolute path name of the file that records the license key stored on the host. The file specified here is not deleted after an unattended installation is performed. The default is `/var/DLM/dlm.lic_key`. If you perform an upgrade installation or re-installation without updating the license, delete the `licensekey` key and value.	Optional[#4]	Optional[#4]	60
`driver_config`	Specify one of the following values to indicate whether to configure the HDLM driver: `y`: Configure the HDLM driver (default). `n`: Do not configure the HDLM driver. In a boot disk environment, the HDLM driver is not configured, regardless of the value specified here.	Optional	Optional	1
`restart`	Specify whether to restart the host after installation. Specify either of the following values: `y`: Restart. `n`: Do not restart (default).	Optional	Optional	1

Legend:

Optional: If a key and its setting are not specified, the default value will be used.

However, for an upgrade installation or re-installation, the previous license information will be inherited for the `licensekeyfile` and `licensekey` keys.

#1

Enter one key and one setting per line.

#2

If the value is not of an allowable type, an error will occur.

#3

You need to delete the `licensekeyfile` key if you specify the `licensekey` key. However, you do not need to delete the `licensekey` key if you specify the `licensekeyfile` key.

If no value is specified for either of these keys, the files below are read in the order listed:

a. License key file (`/var/tmp/hdlm_license`)

b. File containing the license key (`/var/DLM/dlm.lic_key`)

If none of these files exist when you attempt to perform a new installation, unattended installation ends with an error.

#4

When you perform a new installation of HDLM, or when you perform an upgrade installation while the license is expired, prepare the license key or the license key file.

[DISK_DEFAULT_SETTINGS] section

This section defines operation information for the HDLM default settings modification utility (`dlmchpdattr`). This section can be omitted. If the section name is omitted, or the section contains no defined keys, the `dlmchpdattr` utility cannot be used to specify settings.

For details about the `dlmchpdattr` utility, see *dlmchpdattr Utility for Changing HDLM Default Settings on page 7-13*.

The following table lists and describes the keys defined in the `[DISK_DEFAULT_SETTINGS]` section.

Table 7-6 Keys in the [DISK_DEFAULT_SETTINGS] Section

Key name#1	Description#2	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
reserve_policy	Specify the disk reservation policy. no_reserve: Reservation requests are ignored, and no LU is reserved. PR_exclusive: Uses persistent reservations (exclusive-host methodology) to reserve disks (default). PR_shared: Uses persistent reservations (shared-host methodology) to reserve disks.	Optional	Optional	12

Legend:

Optional: If a key and its setting are not specified, one of the following values will be used:

- For a new installation:
  The default value will be used.
- For an upgrade installation or re-installation:
  The previous setting will be inherited.

#1

Enter one key and one setting per line.

#2

If the value is not of an allowable type, an error will occur.

[ODM_SETTINGS] section

Defines information used when the dlmodmset utility is executed. This section is optional. If this section name is omitted, or if any of the keys in the section are not defined, setup by means of the dlmodmset utility will not be executed.

For details about the dlmodmset utility, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*.

The following table lists and describes the keys defined in the [ODM_SETTINGS] section.

Table 7-7 Keys in the [ODM_SETTINGS] Section

Key name[#1]	Description[#2]	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
odm_lun_reset	Specify one of the following values to indicate whether to enable or disable the LUN RESET option: on: Enabled off: Disabled (default)	Optional	Optional	3
odm_online_e_io_block	Specify one of the following values to indicate whether to enable or disable suppression of I/O access on the Online(E) status path: on: Enabled off: Disabled (default)	Optional	Optional	3
odm_npiv_option	Specify one of the following values to indicate whether to enable or disable the NPIV option: on: Enabled off: Disabled (default)	Optional	Optional	3
odm_os_error_log	Specify one of the following values to indicate whether to output HDLM messages to the OS error log: on: Output messages. off: Do not output messages. (default)	Optional	Optional	3

Legend:

Optional: If a key and its setting are not specified, one of the following values will be used:

- For a new installation:
  The default value will be used.
- For an upgrade installation or re-installation:
  The previous setting will be inherited.

#1

Enter one key and one setting per line.

#2

If the value is not of an allowable type, an error will occur.

For details about the functions set by these keys, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*.

[ENVIRONMENT_SETTINGS] section

This section defines information that is used when the `set` operation of the HDLM command is executed. This section is optional. If this section name is omitted, or if any of the keys in the section are not defined, setup by means of the `set` operation of the HDLM command will not be executed.

For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.

The following table lists and describes the keys defined in the `[ENVIRONMENT_SETTINGS]` section.

Table 7-8 Keys in the [ENVIRONMENT_SETTINGS] Section

Key name#1	Description#2	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
`load_balance`	Specify one of the following values to indicate whether to enable or disable the load balancing function: `on`: Enabled (default) `off`: Disabled	Optional	Optional	3
`load_balance_type`	Specify one of the following values to indicate the load balancing algorithm: `rr`: The Round Robin algorithm `exrr`: The Extended Round Robin algorithm `lio`: The Least I/Os algorithm `exlio`: The Extended Least I/Os algorithm (default) `lbk`: The Least Blocks algorithm `exlbk`: The Extended Least Blocks algorithm	Optional	Optional	5
`load_balance_same_path_use_times`	Specify the number of times the same path can be used for I/O operations when the Round Robin	Optional	Optional	6

Key name[#1]	Description[#2]	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
	(rr), Least I/Os (lio), or Least Blocks (lbk) algorithm is used for load balancing. You can specify a value from 0 to 999999. The default is 20.			
lbex_usetimes_limit	Specify the number of times the same path can be used for sequential I/O operations when the extended Round Robin (exrr), Least I/Os (exlio), or Least Blocks (exlbk) algorithm is used for extended load balancing. You can specify a value from 0 to 999999. The default is 100. Specify 0 to not set a limit (that is, to not switch paths).	Optional	Optional	6
lbex_random_io_usetimes_limit	Specify the number of times the same path can be used for random I/O operations when the extended Round Robin (exrr), Least I/Os (exlio), or Least Blocks (exlbk) algorithm is used for extended load balancing. You can specify a value from 0 to 999999. The default is 1. Specify 0 to not set a limit (that is, to not switch paths).	Optional	Optional	6
error_log_level	Set the level of error information that is collected as error logs. You can set a level from 0 to 4. The default is 3.	Optional	Optional	1
error_log_size	Set the size of the error log files (dlmmgr[*1-16*].log) in kilobytes. You can set a size from 100 to 2000000. The default is 9900.	Optional	Optional	7
error_log_number	Set the number of error log files (dlmmgr[*1-16*].log). You can set a value from 2 to 16. The default is 2.	Optional	Optional	2

Key name[#1]	Description[#2]	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
trace_level	Set the trace output level. You can set a level from 0 to 4. The default is 0.	Optional	Optional	1
trace_file_size	Set the size of the trace files (hdlmtr[*1-64*].log) in kilobytes. You can set a size from 100 to 16000. The default is 1000.	Optional	Optional	5
trace_file_number	Set the number of trace files (hdlmtr[*1-64*].log). You can set a value from 2 to 64. The default is 4.	Optional	Optional	2
path_health_check	Specify one of the following values to indicate whether to enable or disable the path health check function: on: Enabled (default) off: Disabled	Optional	Optional	3
path_health_check_interval	Specify the interval in minutes at which the path health check is performed. You can specify a check interval from 1 to 1440. The default is 30.	Optional	Optional	4
auto_failback	Specify one of the following values to indicate whether to enable or disable the automatic failback function for failed paths: on: Enabled (default) off: Disabled	Optional	Optional	3
auto_failback_interval	Specify the interval in minutes from the time the previous path status check finished until the time the next path status check started. You can specify a check interval from 1 to 1440. The default is 60.	Optional	Optional	4
intermittent_error_monitor[#3, #4]	Specify one of the following values to indicate whether to enable or disable intermittent error monitoring:	Optional	Optional	3

Key name[#1]	Description[#2]	Necessity of definition		Maximum number of characters
		New installation	Upgrade installation or re-installation	
	on: Enabled off: Disabled (default)			
intermittent_error_monitor_interval[#4]	Specify the interval in minutes that monitoring for intermittent errors is performed. You can specify a check interval from 1 to 1440. The default is 210.	Optional	Optional	4
intermittent_error_monitor_number[#4]	Specify the number of times an error (that is assumed to be an intermittent error) occurs. You can specify a value from 1 to 99. The default is 3.	Optional	Optional	2
dynamic_io_path_control	Specify whether to enable or disable the dynamic I/O path control function by using the values below. Note that, if this function is set, the setting for each storage system or LU is cleared. on: Enabled off: Disabled (default)	Optional	Optional	3
dynamic_io_path_control_interval	For the dynamic I/O path control function, specify the checking interval (in minutes) for reviewing the information about the switching of controllers performed by the storage system.[#5] You can set the checking interval from 1 to 1440. The default is 10.	Optional	Optional	4

Legend:

Optional: If a key and its setting are not specified, one of the following values will be used:

- For a new installation
  The default value will be used.
- For an upgrade installation or re-installation:
  The previous setting will be inherited.

Note:

Setting of audit logs is not supported.

#1

Enter one key and one setting per line.

#2

If the value is not of an allowable type, an error will occur.

For details about the functions set by these keys, see *set (Sets Up the Operating Environment) on page 6-18*.

#3

You can specify this key only in the following cases:

- For a new installation:

  When `on` is specified for the `auto_failback` key in the installation information settings file
- For an upgrade installation or re-installation:

  When `on` is specified for the `auto_failback` key in the installation information settings file, or when automatic failback is enabled in the installation pre-settings

#4

If you want to enable intermittent error monitoring, specify this key after specifying the `auto_failback` and `auto_failback_interval` keys.

#5

The checking interval can be set regardless of whether the dynamic I/O path control function is enabled or disabled.

The following shows an example of an edited installation information settings file.

```
[INSTALLATION_SETTINGS]
 installfile_location=/dev/cd0
 logdir=/var/tmp
 licensekeyfile=/var/tmp/hdlm_license
 licensekey=/var/DLM/dlm.lic_key
 driver_config=y
 restart=n
[DISK_DEFAULT_SETTINGS]
 reserve_policy=PR_exclusive
[ODM_SETTINGS]
 odm_lun_reset=off
 odm_online_e_io_block=off
 odm_npiv_option=off
 odm_os_error_log=off
[ENVIRONMENT_SETTINGS]
 load_balance=on
 load_balance_type=exlio
 load_balance_same_path_use_times=20
 lbex_usetimes_limit=100
 lbex_random_io_usetimes_limit=1
 error_log_level=3
 error_log_size=9900
 error_log_number=2
 trace_level=0
 trace_file_size=1000
```

```
 trace_file_number=4
 path_health_check=on
 path_health_check_interval=30
 auto_failback=on
 auto_failback_interval=60
 intermittent_error_monitor=off
# intermittent_error_monitor_interval=210
# intermittent_error_monitor_number=3
 dynamic_io_path_control=off
 dynamic_io_path_control_interval=10
```

Note:

- If a hash mark (#) is placed at the beginning of a line in the installation information settings file, that line is assumed to be a comment.
- If you do not want to specify a key, enter a hash mark (#) at the beginning of the line that defines that key.

Log file

A log file (installhdlm.log) is output after an unattended installation of HDLM.

The following explains the installhdlm.log file.

- installhdlm.log is created in the folder whose path is specified by the logdir key in the installation-information settings file. Do not share the log file output directory among the hosts on which unattended installation is being performed. If no value is specified for logdir key, the log file is output to the /var/tmp directory.
- If installhdlm.log already exists, log information is added to this log file. For details about the unused capacity required for the log output directory, see *Performing an Unattended Installation of HDLM on page 3-78*.

Note

- Note that installhdlm.log is not deleted after HDLM is removed. Therefore, delete the original installhdlm.log manually if it is no longer required.
- If the installhdlm.log file cannot be output for some reason, such as there being insufficient capacity on the output disk, a message is output to this effect immediately before the installhdlm utility ends.

installux.sh Utility for HDLM Common Installer

This utility determines what OS HDLM will be installed on, and installs the corresponding version of HDLM from the DVD-ROM. This utility can also perform unattended installations via a parameter specification.

For details about how to use this utility to install HDLM, see *Performing a New Installation of HDLM on page 3-27*, *Performing an Upgrade Installation or Re-installation of HDLM on page 3-39*, or *Performing an Unattended Installation of HDLM on page 3-78*.

Format

/directory-in-which-the-DVD-ROM-is-mounted-or-copied`/installux.sh [ -f` *installation-information-settings-file-name* `| -h]`

Parameters

`-f` *installation-information-settings-file-name*

Defines the information needed for an unattended installation.

For details about installation-information settings files, see *Items To Be Defined in an installation-information Settings File on page 7-33*.

`-h`

Displays the format of the `installux.sh` utility.

Log file

The `installux.sh` utility outputs execution information to the log file `/var/tmp/hdlm_installux_sh.log`. If the `hdlm_installux_sh.log` log file already exists, the utility appends execution information onto the end of the log file.

If the size of the log file is equal to or greater than 1 MB when the utility is executed, the log file is renamed to `hdlm_installux_sh2.log`, and a new log file is created and named `hdlm_installux_sh.log`, to which the execution information is output.

Note

The `hdlm_installux_sh.log` and `hdlm_installux_sh2.log` log files are not deleted when HDLM is removed. Manually delete the log files, if they are no longer required.

8

Messages

This chapter describes the format and meaning of the message IDs, and also the terms used in the messages and message explanations. For details on the meaning of the return codes output by HDLM when it receives a request from Global Link Manager and measures to take for them, see *Return Codes for Hitachi Command Suite Common Agent Component on page 8-113*.

- Return Codes for Hitachi Command Suite Common Agent Component

Before Viewing the List of Messages

This section explains the following information that is needed to locate messages and understand the explanations in the sections from *KAPL01001 to KAPL02000 on page 8-4*.

- Format and meaning of the message IDs
- Terms used in the messages and message explanations

This information is explained below.

Format and Meaning of Message IDs

Each message has a message ID. The following table shows the format and meaning of message IDs.

Table 8-1 Format and Meaning of the Message ID KAPL*nnnnn-l*

Format	Meaning
KAPL	Indicates that the message is an HDLM message.
nnnnn	Message serial number for the module
l	Message level C: Critical E: Error W: Warning I: Information

Terms Used in Messages and Message Explanations

The following table shows the terms that appear in messages and the terms that are used for explanation (meaning, description, and handling) of the messages.

Table 8-2 Terms Used in the Messages and Message Explanations

Terms	Meaning
aa...aa	Variable (if there are multiple variables in a message, *aa...aa* is followed by *bb...bb*, *cc...cc*, and so on)
CS	Cluster support
FO	Failover
LB	Load balancing
Operation name	The operation name that is input after `dlnkmgr` in the command.

Components that Output Messages to syslog

Some messages for the following components are output to syslog:

- HDLM manager
- HDLM driver (filter component)
- HDLM alert driver
- HDLM management target

KAPL01001 to KAPL02000

Message ID	Message Text	Explanation
KAPL01001-I	The HDLM command completed normally. Operation name = *aa...aa*, completion time = *bb...bb*	Details The HDLM command completed successfully. When the `view -path`, `view -lu`, or `view -drv` operation is executed, `view`(`-pstv`) is displayed if the Physical Storage View is disabled, and `view`(`-vstv`) is displayed if the Physical Storage View is disabled. *aa...aa*: Specified operation name *bb...bb*: Year/month/day hour:minute:second Action None.
KAPL01002-I	The HDLM command started. Operation name = *aa...aa*	Details The HDLM command was executed. *aa...aa*: Specified operation name Action None.
KAPL01003-W	No operation name is specified.	Details An operation name is missing. Action Specify the operation name, and then retry.
KAPL01004-W	The operation name is invalid. Operation name = *aa...aa*	Details *aa...aa*: Specified operation name Action Execute the `help` operation of the HDLM command (`dlnkmgr`) to check the operation name, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01005-W	A parameter is invalid. Operation name = *aa...aa*, parameter = *bb...bb*	Details *aa...aa*: Specified operation name

Message ID	Message Text	Explanation
		bb...bb: Specified parameter Action Execute `help` *operation-name* of the HDLM command (`dlnkmgr`) to check the parameter, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01006-W	A necessary parameter is not specified. Operation name = *aa...aa*	Details The specified operation does not contain the necessary parameter. *aa...aa*: Specified operation name Action Execute `help` *operation-name* of the HDLM command (`dlnkmgr`) to check the parameter. Specify the correct parameter, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01007-W	A duplicate parameter is specified. Operation name = *aa...aa*, parameter = *bb...bb*	Details *aa...aa*: Specified operation name *bb...bb*: Duplicate parameter Action Delete the duplicate parameter, and then retry.
KAPL01008-W	A necessary parameter value is not specified. Operation name = *aa...aa*, parameter = *bb...bb*	Details *aa...aa*: Specified operation name *bb...bb*: Parameter name Action Specify the parameter value, and then retry.
KAPL01009-W	A parameter value is invalid. Operation name = *aa...aa*, parameter = *bb...bb*, parameter value = *cc...cc*, Valid value = *dd...dd*	Details *aa...aa*: Specified operation name *bb...bb*: Parameter name *cc...cc*: Specified parameter value *dd...dd*: Specifiable parameter value range Action Specify a correct value for the parameter, and then retry.
KAPL01012-E	Could not connect the HDLM manager. Operation name = *aa...aa*	Details In the `view -sys -sfunc` operation, information must be collected from the HDLM manager

Message ID	Message Text	Explanation
		but the manager cannot be accessed. *aa...aa*: `view` Action Execute the `view` operation of the HDLM command (`dlnkmgr`) to check whether the HDLM manager has started. Start the HDLM manager if it has not started, and then retry the HDLM command. For details on the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01013-E	An error occurred in internal processing of the HDLM command. Operation name = *aa...aa* details = *bb...bb*	Details An error unrelated to a user operation occurred during command processing. *aa...aa*: Specified operation name *bb...bb*: The name of the function and processing on which the error occurred Action Execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL01014-W	No authority to execute the HDLM command. Operation name = *aa...aa*	Details You do not have the administrator permissions necessary to execute the HDLM command. *aa...aa*: Specified operation name Action Execute the command as a user with root permissions.
KAPL01015-W	The target HBA was not found. Operation name = *aa...aa*	Details No path was found with the port number and path number, or the adapter type and adapter number, specified for the `-hba` parameter. *aa...aa*: `offline` or `online` Action Execute the `view` operation of the HDLM command (`dlnkmgr view -`

Message ID	Message Text	Explanation
		path) and check the value displayed in PathName. Use the two leftmost digits of PathName for the relevant HBA port, and then retry. For details on the view operation, see *view (Displays Information) on page 6-34*.
KAPL01016-W	The target CHA port was not found. Operation name = *aa...aa*	Details The path ID of the path management path (Path_ID) specified in the -pathid option required by the -cha parameter could not be found, or the CHA that has the channel ID (CHA_ID) specified in the -chaid parameter could not be found. *aa...aa*: offline or online Action ◦ If the path ID of the path management path was specified in -pathid Execute the view operation of the HDLM command (dlnkmgr view -path), and check the value of the target CHA port and the path ID of the path management path that passes through that CHA port. Then, specify the applicable path management path ID, and retry the operation. For details about the view operation, see *view (Displays Information) on page 6-34*. ◦ If the channel ID (CHA_ID) was specified in -chaid Execute the view operation of the HDLM command (dlnkmgr view -cha), and check the target CHA port and the CHA ID of that CHA port. Then, specify the applicable CHA ID, and retry the operation. For details about the view operation, see *view (Displays Information) on page 6-34*.
KAPL01018-W	The target device was not found. Operation name = *aa...aa*	Details The specified host device name could not be found. *aa...aa*: view Action

Message ID	Message Text	Explanation
		Execute the `view` operation of the HDLM command (`dlnkmgr view -path`) to check the value displayed in `HDevName`. Specify a host device for the value of `HDevName`, and then retry. For details on the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01019-W	The target path was not found. Operation name = *aa...aa*	Details *aa...aa*: `offline`, `online`, or `view` ○ `offline`/`online` operation The specified path does not exist. ○ `view` operation The paths have not been configured because creation of the HDLM environment or configuration changes to the HDLM operating environment have not finished. Action ○ `offline`/`online` operation Use the `view` operation of the HDLM command (`dlnkmgr`) to check the settings, and then retry. For details on the `view` operation, see *view (Displays Information) on page 6-34*. ○ `view` operation Refer to *Chapter 3, Creating an HDLM Environment on page 3-1*. Creating an HDLM Environment or *Changing the Configuration of the HDLM Operating Environment on page 4-15*, and then configure any paths that exist. If the same message appears again, execute the `DLMgetras` utility for collecting HDLM error information, acquire the error information, and then contact your HDLM vendor or the company for which you have a service contract. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

Message ID	Message Text	Explanation
KAPL01021-E	Cannot execute the HDLM command due to insufficient memory.	Details Memory required for HDLM command processing could not be allocated. Action Terminate unneeded applications to increase the amount of free memory, and then retry.
KAPL01023-W	The last Online path for the device cannot be placed Offline(C).	Details The path specified in the `offline` operation cannot be placed in the `Offline(C)` status because it is the last path for the applicable logical unit. Action Use the `view` operation of the HDLM command (`dlnkmgr`) to check the status of the paths. For details on the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01024-W	The specified parameters cannot be specified at the same time. Operation name = *aa...aa*, parameters = *bb...bb*	Details *aa...aa*: Specified operation name *bb...bb*:Parameters that cannot be specified at the same time Action Execute `help` operation of the HDLM command (`dlnkmgr`) to check which parameters can be specified at the same time, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01036-E	The Offline path cannot be placed online. PathID = *aa...aa*	Details *aa...aa*: Path ID (decimal (base-10) number) Action Remove the error in the path, and then retry.
KAPL01039-W	During the online operation processing of the HDLM command, a path that cannot be placed in the Online status was detected. PathID = *aa...aa* Would you like to continue the processing of the online operation? [y/n]:	Details A path that cannot be placed Online was detected during multipath online processing. To ignore this path and perform online processing for the next path, enter `y`. To cancel processing, enter `n`.

Message ID	Message Text	Explanation
		aa...aa: Path ID (decimal (base-10) number) Action If you want to continue processing of the `online` operation of the HDLM command for other paths, enter `y`. If you want to terminate processing, enter `n`. For details on the `online` operation, see *online (Places Paths Online) on page 6-12*.
KAPL01040-W	The entered value is invalid. Re-enter [y/n]:	Details A value other than y and n was entered. Enter y or n. Action Enter `y` or `n`.
KAPL01041-E	The entered value is invalid. The operation stops. Operation name = *aa...aa*	Details Command processing will be aborted because an incorrect value was entered three times in a row for a request. *aa...aa*: `clear`, `offline`, `online`, or `set` Action Check the correct value, and then re-execute the HDLM command.
KAPL01044-W	A duplicate parameter value is specified. Operation name = *aa...aa*, parameter = *bb...bb*, parameter value = *cc...cc*	Details *aa...aa*:`view` *bb...bb*: Parameter name *cc...cc*: Duplicate parameter value Action Delete the duplicate parameter value, and then retry.
KAPL01045-W	Too many parameter values are specified. Operation name = *aa...aa*, parameters = *bb...bb*, parameter value = *cc...cc*	Details *aa...aa*: `offline`, `online`, `set`, or `view` *bb...bb*: Parameter name *cc...cc*: Parameter value Action Execute `help` *operation-name* of the HDLM command (`dlnkmgr`) to check the parameter value, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.

Message ID	Message Text	Explanation
KAPL01048-W	Help information cannot be found. Operation name = *aa...aa*.	Details The specified operation is not an operation of the HDLM command. *aa...aa*: Specified operation name Action Use the `help` operation of the HDLM command (`dlnkmgr`) to check the operation name. And then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01049-I	Would you like to execute the operation? Operation name = *aa...aa* [y/n]:	Details The `clear`/`set` operation will be started. To continue the operation, enter `y`. To cancel the operation, enter `n`. *aa...aa*: `clear` or `set` Action If you want to execute the operation, enter `y`. If you want to terminate processing, enter `n`. For details on the `clear` operation, see *clear (Returns the Path Statistics to the Initial Value) on page 6-3*. For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.
KAPL01050-I	The currently selected paths will be changed to the Online status. Is this OK? [y/n]:	Details The `online` operation will be started. To continue the `online` operation, enter `y`. To cancel the operation, enter `n`. Action If you want to execute `online` processing, enter `y`. If you want to terminate processing, enter `n`. For details on the `online` operation, see *online (Places Paths Online) on page 6-12*.
KAPL01051-I	Because no path has been selected among the currently displayed paths, the paths in the Offline(C), Offline(E), and Online(E) statuses will be changed to the Online status. Is this OK? [y/n]:	Details All the paths will be placed Online because the path selection parameter is not specified for the `online` operation. To place all the paths Online, enter `y`. To cancel the operation, enter `n`. Action

Message ID	Message Text	Explanation
		If you want to execute `online` processing, enter `y`. If you want to terminate processing, enter `n`. Before you execute the processing, be sure to execute the `view` operation of the HDLM command (`dlnkmgr`) to check the path status. For details on the `view` operation, see *view (Displays Information) on page 6-34*. For details on the `online` operation, see *online (Places Paths Online) on page 6-12*.
KAPL01052-I	The currently selected paths will be changed to the Offline(C) status. Is this OK? [y/n]:	Details The `offline` operation will be started. To continue the `offline` operation, enter `y`. To cancel the operation, enter `n`. Action If you want to execute the offline processing, enter `y`. If you want to terminate processing, enter `n`. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.
KAPL01053-I	If you are sure that there would be no problem when the path is placed in the Offline(C) status, enter y. Otherwise, enter n. [y/n]:	Details The `offline` operation will be started. To continue the `offline` operation, enter `y`. To cancel the operation, enter `n`. Action If you want to execute `offline` processing, enter `y`. If you want to terminate processing, enter `n`. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.
KAPL01054-W	During the offline operation processing of the HDLM command, a path that cannot be placed in the Offline(C) status was detected. PathID = *aa...aa* Would you like to continue the processing of the offline operation? [y/n]:	Details A path that cannot be set to Offline(C) was detected during multipath offline processing. To ignore this path and perform offline processing for the next path, enter `y`. To cancel offline processing, enter `n`. *aa...aa*: Path ID (decimal (base-10) number) Action

Message ID	Message Text	Explanation
		If you want to continue processing the `offline` operation of the HDLM command for other paths, enter `y`. If you want to terminate processing, enter `n`. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.
KAPL01055-I	All the paths which pass the specified *aa...aa* will be changed to the Offline(C) status. Is this OK? [y/n]:	Details Multiple paths will be collectively set to Offline(C) because the `-hba` or `-cha` parameter was specified. To collectively set place multiple paths to Offline(C), enter `y`. To cancel the operation, enter `n`. *aa...aa*: `CHA port`, `HBA` Action If you want to execute `offline` processing for the paths that meet the specified requirements, enter `y`. If you want to terminate processing, enter `n`.
KAPL01056-I	If you are sure that there would be no problem when all the paths which pass the specified *aa...aa* are placed in the Offline(C) status, enter y. Otherwise, enter n. [y/n]:	Details This message re-asks the user whether they want to set place all the paths to Offline(C). To set all the paths to Offline(C), enter y. To cancel the operation, enter n. *aa...aa*: `CHA port`, `HBA` Action If you want to execute `offline` processing for the paths that meet the specified requirements, enter `y`. If you want to terminate processing, enter `n`.
KAPL01057-I	All the paths which pass the specified *aa...aa* will be changed to the Online status. Is this OK? [y/n]:	Details Multiple paths will all be placed in `Online` status because the `-hba` or `-cha` parameter was specified. To continue the operation, enter `y`; to cancel the operation, enter `n`. *aa...aa*: `CHA port`, `HBA` Action If you want to execute `online` processing for the paths that meet the specified requirements, enter `y`. If you want to terminate processing, enter `n`.

Message ID	Message Text	Explanation
KAPL01058-W	The specified parameter value is not needed. Operation name = *aa...aa*, parameter = *bb...bb*, parameter value = *cc...cc*	Details A parameter value was specified in a parameter that does not need a any parameter value. *aa...aa*: Specified operation name *bb...bb*: Parameter name *cc...cc*: Parameter value Action Execute `help` *operation-name* of the HDLM command (`dlnkmgr`) to check the parameter and parameter value, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01059-W	Cannot specify the parameter *aa...aa* at the same time if you specify parameter *bb...bb* and parameter value *cc...cc*. Operation name = *dd...dd*	Details A parameter value is conflicting with the value of another parameter. *bb...bb*: Parameter name *cc...cc*: Parameter value *aa...aa*: Parameter name *dd...dd*: `view` or `set` Action Execute `help` *operation-name* of the HDLM command (`dlnkmgr`) to check the parameter and parameter value, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01060-I	The user terminated the operation. Operation name = *aa...aa*	Details Command processing will be aborted because n was entered for a required confirmation. *aa...aa*: `online`, `offline`, `set`, or `clear` Action None.
KAPL01061-I	*aa...aa* path(s) were successfully placed *bb...bb*; *cc...cc* path(s) were not. Operation name = *dd...dd*	Details This message indicates the number of the paths processed in an `online`/`offline` operation. *aa...aa*: Number of paths where the `online`/`offline` operation was successful (decimal (base-10) number)

Message ID	Message Text	Explanation
		bb...bb: `Online, Online(S), Online(D) or Offline(C)` *cc...cc*: Number of paths where the `online`/`offline` operation was unsuccessful (decimal (base-10) number) *dd...dd*: `online`, or `offline` Action None. For details on the `online` operation, see *online (Places Paths Online) on page 6-12*. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*.
KAPL01063-I	The target path(s) are already *aa...aa*.	Details As a result of a previous `online`/`offline` operation, the specified path has already been set to `Online/Online(S)/Online(D)/Offline(C)`. *aa...aa*: `Online, Online(S), Online(D), or Offline(C)` Action Use the `view` operation of the HDLM command (`dlnkmgr`) to check the status of the path. For details on the `view` operation, see *view (Displays Information) on page 6-34*. For details on the `online` operation, see *online (Places Paths Online) on page 6-12*. For details on the `offline` operation, see *offline (Places Paths Offline) on page 6-6*. For `Online(S)` or `Online(D)` paths: To change the status of a path from `Online(S)` or `Online(D)` to `Online`, re-execute the HDLM command using the -hapath parameter.
KAPL01068-I	Enter a license key:	Details The license key will now be renewed. Enter a license key. Action None.
KAPL01069-W	The entered license key is invalid.	Details The entered license key is invalid. Action

Message ID	Message Text	Explanation
		Enter a valid license key.
KAPL01070-E	The entered license key is invalid. Renewal of the license key will now stop.	Details The license key renewal processing will be aborted because an invalid license key was entered three times in a row. Action Obtain a valid license key, and then retry.
KAPL01071-I	The permanent license was installed.	Details The license was renewed and is registered as a permanent license. Action None.
KAPL01072-I	The emergency license was installed. The license expires on *aa...aa*.	Details A license was renewed and is registered as an emergency license. *aa...aa*: Year (4 digits)/month (01-12)/day (01-31) Action Install a permanent license by the expiration day.
KAPL01073-E	The temporary license expired.	Details The temporary license has expired. Register a permanent license. Action Register a permanent license.
KAPL01074-E	The emergency license expired.	Details The emergency license has expired. Register a permanent license. Action Register a permanent license.
KAPL01075-E	A fatal error occurred in HDLM. The system environment is invalid.	Details The license information file is missing. Action Re-install HDLM.
KAPL01076-I	The permanent license has been installed.	Details You need not install a license because a permanent license has already been installed. Action

Message ID	Message Text	Explanation
		None.
KAPL01078-W	The operation terminated because the path configuration changed during execution of the HDLM command. Operation name = *aa...aa*	Details *aa...aa*:`offline`, `online`, `view` Action After the processing to change the path configuration has finished, retry.
KAPL01079-W	The intermittent error monitoring function cannot be set up because automatic failback is disabled.	Details The intermittent error monitoring function cannot be set up because automatic failbacks are disabled. Action Enable automatic failbacks, and then re-execute.
KAPL01080-W	The error monitoring interval and the number of times that the error is to occur conflict with the automatic failback checking interval.	Details An intermittent error cannot be detected by using the values specified for the following: the checking interval for automatic failbacks, the error-monitoring interval, and the number of times the error needs to occur. Action Set the intermittent error-monitoring interval to a value that is equal to or greater than (*automatic-failback-checking-interval* x *number-of-times-error-is-to-occur-for-intermittent-error-monitoring*).
KAPL01081-E	The license key file is invalid. File name = *aa...aa*	Details The format of the license key file is invalid. *aa...aa*: `/var/tmp/hdlm_license` Action Save the correct license key file in the designated, and then re-execute. `/var/tmp/hdlm_license`
KAPL01082-E	There is no installable license key in the license key file. File name = *aa...aa*	Details There is no useable license key for HDLM in the license key file. *aa...aa*: `/var/tmp/hdlm_license` Action Make sure that the license key file is correct, and then re-execute. `/var/tmp/hdlm_license`

Message ID	Message Text	Explanation
KAPL01083-I	There is no license key file. File name = *aa...aa*	Details There is no license key file in the designated directory: *aa...aa*: `/var/tmp/hdlm_license` Action When the message that prompts you to enter the license key is displayed, enter the license key. Alternatively, cancel the HDLM command, save the correct license key file in the designated directory, and then re-execute the HDLM command. *aa...aa*: `/var/tmp/hdlm_license`
KAPL01084-W	An attempt to delete the license key file has failed. File name = *aa...aa*	Details *aa...aa*: `/var/tmp/hdlm_license` Action If a license key file exists, delete it. *aa...aa*: `/var/tmp/hdlm_license`
KAPL01088-W	The specified parameter values cannot be specified at the same time. Operation name = *aa...aa*, parameter = *bb...bb*, parameter values = *cc...cc*	Details *aa...aa*:`view` *bb...bb*: Parameter name *cc...cc*: Parameter values that cannot be specified at the same time Action Execute `help` *operation-name* of the HDLM command (`dlnkmgr`) to check which parameter can be specified, and then retry. For details on the `help` operation, see *help (Displays the Operation Format) on page 6-4*.
KAPL01089-E	One of the following was executed at the same time as an HDLM command set -lic operation: another set -lic operation, or an update of the license for an update installation.	Action Check the license by using the HDLM command's `view -sys -lic` operation. If necessary, re-execute the HDLM command's `set -lic` operation. If the same error message is output again, contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. Do not perform the following operations: ∘ Simultaneously execute the HDLM command's `set -lic`

Message ID	Message Text	Explanation
		operation with the `view -sys -lic` operation. ○ Execute the HDLM command's `set -lic` operation while the license for an upgrade or re-installation is being updated.
KAPL01095-E	An attempt to acquire the HDLM version information has failed. details = *aa...aa*	Details *aa...aa*: Code showing the reason for the error Action Re-execute the command. If the same error occurs again, execute the `DLMgetras` utility for collecting HDLM error information, acquire the error information, and then contact your HDLM vendor or the company for which you have a service contract.
KAPL01096-E	An attempt to acquire the Service Pack version information has failed. details = *aa...aa*	Details *aa...aa*: Code showing the reason for the error Action Re-execute the command. If the same error occurs again, execute the `DLMgetras` utility for collecting HDLM error information, acquire the error information, and then contact your HDLM vendor or the company for which you have a service contract.
KAPL01097-W	All the current trace files will be deleted. Is this OK? [y/n]	Details If you set a value that is less than the current value of the trace file size or number of trace files, all the current trace files will be deleted. To continue the operation, enter `y`. To cancel the operation, enter `n`. Action If you want to execute the operation of the HDLM command, enter `y`. If you want to terminate processing, enter `n`.
KAPL01100-I	*aa...aa*	Details This message indicates the executed command line. *aa...aa*: Name of the executed command. Action

Message ID	Message Text	Explanation
		None.
KAPL01101-W	The target HBA port was not found. Operation name = *aa...aa*	Details The HBA having the HBA_ID specified in the `-hbaid` parameter could not be found. *aa...aa:* : `offline`, `online` Action Use the view operation of the HDLM command (`dlnkmgr view -hba`) to check the target HBA port and the HBA_ID of the target HBA port. After that, specify the appropriate HBA_ID, and then retry.
KAPL01102-I	All the paths which pass the specified *aa...aa* port will be changed to the Offline(C) status. Is this OK? [y/n]:	Details Multiple paths will be collectively placed Offline(C) because the `-hbaid` or `-chaid` parameter was specified. To collectively place multiple paths Offline(C), enter `y`. To not collectively place them Offline(C), enter `n`. *aa...aa*:CHA, HBA Action If you want to execute the offline processing for the paths which pass the specified target, enter `y`. If you want to terminate the processing, enter `n`.
KAPL01103-I	If you are sure that there would be no problem when all the paths which pass the specified *aa...aa* port are placed in the Offline(C) status, enter y. Otherwise, enter n. [y/n]:	Details This message re-asks the user whether to place all the paths Offline(C). To place all the paths Offline(C), enter `y`. To not place them Offline(C), enter `n`. *aa...aa*:CHA, HBA Action If you want to execute the offline processing for the paths which pass the specified target, enter `y`. If you want to terminate the processing, enter `n`.
KAPL01104-I	All the paths which pass the specified *aa...aa* port will be changed to the Online status. Is this OK? [y/n]:	Details Multiple paths will be collectively placed Online because the `-hbaid` or `-chaid` parameter was specified. To collectively place multiple paths Online, enter `y`. To

Message ID	Message Text	Explanation
		not collectively place them Online, enter `n`. *aa...aa*:CHA, HBA Action If you want to execute the Online processing for the paths which pass the specified target, enter `y`. If you want to terminate the processing, enter `n`.
KAPL01112-E	An attempt to connect to the HDLM driver has failed. Operation name = *aa...aa*	Details HDLM driver information must be collected to execute the given HDLM command, but the HDLM driver cannot be accessed. *aa...aa*: Specified operation name Action Perform one of the following procedures. When performing an installation See *Installing HDLM on page 3-19*, and then complete the installation. When performing an remove See *Removing HDLM on page 3-112*, and then complete the remove. When performing neither of the above, or if the same error continues to occur even after one of the above procedures is performed, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL01114-W	The audit log configuration file does not exist. Restart the HDLM Manager, and execute the "dlnkmgr view -sys -audlog" command and check the setting.	Details The audit log configuration file does not exist. Action Restart the HDLM Manager, and execute the `dlnkmgr view -sys -audlog` command, and then specify the desired setting by using the `dlnkmgr set -audlog`

Message ID	Message Text	Explanation
		command or the `dlnkmgr set -audfac` command as necessary.
KAPL01115-W	The audit log configuration file cannot be opened. Execute the "dlnkmgr view -sys -audlog" command and check whether a normal result is displayed.	Details The audit log configuration file cannot be opened. Action If the `dlnkmgr view -sys -audlog` command does not display a normal result, contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.
KAPL01116-W	The audit log configuration file is invalid. Restart the HDLM Manager, and execute the "dlnkmgr view -sys -audlog" command and check the setting.	Details The audit log configuration file is invalid. Action Restart the HDLM Manager, and execute the `dlnkmgr view -sys -audlog` command, and then specify the desired setting by using the `dlnkmgr set -audlog` command or the `dlnkmgr set -audfac` command as necessary.
KAPL01117-W	An error occurred during processing to read the audit log configuration file.	Details An internal error occurred while reading the audit log configuration file. Action Contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.
KAPL01118-W	An error occurred during processing to output the audit log configuration file.	Details An internal parameter error when the audit-log data was output. Action Contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.
KAPL01119-W	An error occurred during processing to output the audit log configuration file.	Details An internal parameter error when the audit-log data was output. Action Contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.

Message ID	Message Text	Explanation
KAPL01120-W	A storage system model ID could not be displayed. Details = *aa...aa*, *bb...bb*	Details A storage system model ID could not be displayed. *aa...aa*: Storage recognition information *bb...bb*: Error code Action Execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL01121-W	HNTRLib2 initialization failed. Integrated trace information cannot be collected.	Action Execute the HDLM command as a user who has root permissions. If neither of above are the source of the problem, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL01133-I	*aa...aa* path(s) were successfully placed *bb...bb*; *cc...cc* path(s) were successfully placed *dd...dd*; *ee...ee* path(s) were not. Operation name = *ff...ff*	Details The number of paths processed by an online operation is shown. *aa...aa*: The number of paths which changed to the `Online` status *bb...bb*: `Online` or `Online(S)` *cc...cc*: The number of paths which changed to the `Online(S)` or `Online(D)` status *dd...dd*: `Online(S)`, `Online(D)` or `Online(S)`/`Online(D)` *ee...ee*: The number of paths which failed to change to either the `Online`, `Online(S)` or `Online(D)` status *ff...ff*: `online` Action None.
KAPL01134-I	The target paths are already `Online` or `Online(S)`.	Details

Message ID	Message Text	Explanation
		The specified paths are already in the `Online` or `Online(S)` status as a result of an online operation. Action Check path status by using the view operation.. For details on the `view` operation, see *view (Displays Information) on page 6-34*. For Online(S) paths: To change the status of a path from `Online(S)` to `Online`, re-execute the HDLM command using the -hapath parameter.
KAPL01154-W	The dynamic I/O path control function is already set to *aa...aa* for the system.	Details *aa...aa*: "on" or "off" Action Use the view operation of the HDLM command (dlnkmgr) to check the setting for the host, storage, and LUs. For details on the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01155-W	The dynamic I/O path control function is already set to *aa...aa* for storage.	Details *aa...aa*: "on" or "off" Action Use the view operation of the HDLM command (dlnkmgr) to check the setting for storage. For details on the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01156-I	The dynamic I/O path control function was set to *aa...aa* for storage.	Details *aa...aa*: "on" or "off" Action Use the view operation of the HDLM command (dlnkmgr) to check the setting for storage and LUs. For details on the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01157-I	The dynamic I/O path control function was set to *aa...aa* for the system.	Details *aa...aa*: "on" or "off" Action Use the view operation of the HDLM command (dlnkmgr) to check the setting for the host, storage, and LUs. For details on

Message ID	Message Text	Explanation
		the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01158-E	Dynamic I/O path control cannot be applied to the specified storage.	Action Use the view operation of the HDLM command (dlnkmgr) to check the path ID. For details on the `view` operation, see *view (Displays Information) on page 6-34*.
KAPL01159-I	Paths were added. (number of paths added = *aa...aa*, completion time = *bb...bb*)	Details This message indicates that an `add` operation succeeded. *aa...aa*: number of paths added *bb...bb*: year (4 digits)/month/date hour:minute:second Action Use the `view` operation of the HDLM command (dlnkmgr) to verify information about the added paths.
KAPL01160-W	The path configuration was not changed.	Details If an `add` operation was executed This message indicates that no paths were added. If a `delete` operation was executed This message indicates that no paths were deleted. Action If an `add` operation was executed - Execute an OS command, and check whether the addition of paths is recognized by the OS. - Use the `view` operation of the HDLM command (dlnkmgr) to check whether the paths have already been added to HDLM. If a `delete` operation was executed - Check whether the paths to be deleted are in the Offline(C) status. - Use the `view` operation of the HDLM command (dlnkmgr) to check whether

Message ID	Message Text	Explanation
		the paths have already been deleted from HDLM.
KAPL01161-I	This operation will change the path configuration. Do you want to continue? [y/n]:	Details This message confirms whether to perform a path configuration change by using an `add` operation or `delete` operation. Action Enter `y` to change the path configuration, or enter `n` to cancel the operation.
KAPL01162-I	A path was added. (path ID = *aa...aa*, storage = *bb...bb*, iLU = *cc...cc*)	Details This message displays information about a path added as the result of an `add` operation. *aa...aa*: path ID of the added path *bb...bb*: storage (vendor ID.product ID.serial number) to which the added path is connected *cc...cc*: LU number to which the added path is connected Action Use the `view` operation of the HDLM command (dlnkmgr) to verify information about the added paths.
KAPL01163-E	The path configuration change failed. (details = *aa...aa*)	Details This message indicates that an `add` operation or `delete` operation failed. *aa...aa*: code indicating the content of the error Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or, if you have a maintenance contract for HDLM, the maintenance company.
KAPL01164-I	Paths were deleted. (number of paths deleted = *aa...aa*, completion time = *bb...bb*)	Details This message indicates that a `delete` operation succeeded. *aa...aa*: number of paths deleted *bb...bb*: year (4 digits)/month/date hour:minute:second Action

Message ID	Message Text	Explanation
		Use the `view` operation of the HDLM command (dlnkmgr) to verify that the paths were deleted.
KAPL01165-I	A path was deleted. (path ID = *aa...aa*, storage = *bb...bb*, iLU = *cc...cc*)	Details This message displays information about a path deleted as the result of a `delete` operation. *aa...aa*: path ID of the deleted path *bb...bb*: storage (vendor ID.product ID.serial number) to which the deleted path was connected *cc...cc*: LU number to which the deleted path was connected Action Use the `view` operation of the HDLM command (dlnkmgr) to verify that the paths were deleted.
KAPL01166-I	If you execute this operation, the specified number of times that the same path can be used for individual LUs will become invalid. Do you want to execute the operation anyway? Operation name = set [y/n]:	Details The specified number of times that the same path can be used for individual LUs will become invalid. To continue the operation, enter `y`. To cancel the operation, enter `n`. Action If you want to change the number of times that the same path can be used for the system, enter `y`. To cancel the operation, enter `n`.
KAPL01167-I	All paths will be set to Online or Online(D). Is this OK? [y/n]:	Details All paths will be set to `Online` or `Online(D)` because no path is specified. To continue, enter `y`. To cancel the operation, enter `n`. Action To set all paths to `Online` or `Online(D)`, enter y. To cancel the operation, enter n. Before you execute the processing, you must check the path status by executing the view operation of the HDLM command dlnkmgr.
KAPL01168-I	All P-VOL paths that are connected to the LU that has the specified path ID will be set to Online(D). Is this OK? [y/n]:	Details All paths for each specified LU will be set to `Online` or `Online(D)`. To continue, enter `y`. To cancel the operation, enter `n`.

Message ID	Message Text	Explanation
		Note: All paths of the LU, including non-P-VOL paths, will be set to Online or Online(D). Action To set to Online or Online(D) all paths that are connected to the LU that has the specified path ID, enter y. To cancel the process, enter n.
KAPL01169-I	All Online(S) or Online(D) paths will be set to Online. Is this OK? [y/n]:	Details All paths in the Online(S) or Online(D) status will be set to Online because no path is specified. To continue, enter y. To cancel the operation, enter n. Action To execute online processing, enter y. To cancel the operation, enter n. Before you execute the processing, you must check the path status by executing the view operation of the HDLM command dlnkmgr.
KAPL01170-I	All Online(S) or Online(D) paths that are connected to the LU that has the specified path ID will be set to Online. Is this OK? [y/n]:	Details All paths in the Online(S) or Online(D) status for each specified LU will be set to Online. To continue, enter y. To cancel the operation, enter n. Action To set to online the all Online(S) or Online(D) paths that are connected to the specified LU with path ID, enter y. To cancel the operation, enter n.
KAPL01171-I	The target paths are already *aa...aa* or *bb...bb*.	Details The specified paths are already in the Online, Online(S), or Online(D) status as a result of an online operation. *aa...aa*: Online or Online(S) *bb...bb*: Online(D) or Online(S)/Online(D) Action Check path status by using the view operation. For Online(S) or Online(D) paths: To change the status of a path from Online(S) or Online(D) to Online, re-

Message ID	Message Text	Explanation
		execute the HDLM command with the -hapath parameter specified.
KAPL01172-I	There are no Online(S)/ Online(D) paths among the target paths.	Details An online operation was executed using the -hapath parameter, but there are no paths with the `Online(S)`/`Online(D)` status among the specified paths. Action Use the view operation of the HDLM command (dlnkmgr) to check the status of the path.
KAPL01173-W	The target CHA port was constructed from multiple physical CHA ports. Operation name = *aa...aa*. Specify a physical CHA port by using the "-cha -pathid" parameter.	Details In an environment where storage systems are virtualized, when you specify a CHA port by using the `-chaid` parameter of the offline or online operation, the CHA port might be constructed from multiple CHA ports of the physical storage system. In such a case, you cannot execute the offline or online operation with the `-chaid` parameter specified. *aa...aa*: `offline` or `Online` Action Specify a physical CHA port by using the `-cha -pathid` parameter, and then re-execute the `offline` or `online` operation.
KAPL01174-W	If the Physical Storage View is disabled, the parameter value *aa...aa* cannot be specified for the -item parameter.	Details If the Physical Storage View is disabled, the parameter value shown cannot be specified. *aa...aa*: `virt` Action When specifying virtual storage information as a display item, enable the Physical Storage View.
KAPL01175-W	If the Physical Storage View is enabled, the parameter value *aa...aa* cannot be specified for the -item parameter.	Details If the Physical Storage View is enabled, the parameter value shown cannot be specified. *aa...aa*: `phys`, `vid`, `ha`, or `hastat` Action When specifying physical storage information as a display item, disable the Physical Storage View.

Message ID	Message Text	Explanation
KAPL01176-I	Some of the target paths are in the offline status. Storage system settings are not refreshed for offline paths.	Details HDLM cannot refresh storage system settings for offline paths, because HDLM cannot acquire the settings. Action Place online the paths for which HDLM will refresh storage system settings, and execute the refresh operation.
KAPL01177-W	HDLM failed to acquire storage system settings for some paths.	Details HDLM failed to acquire storage system settings for some paths. Action If this message is output when path errors occur during a refresh operation, recover from the path errors, place the paths online, and then re-execute the refresh operation. If this message is output when there are no offline paths, execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company.
KAPL01178-E	HDLM failed to refresh the storage system settings. Details = *aa...aa*, *bb...bb*	Details *aa...aa*: Detailed information 1 *bb...bb*: Detailed information 2 Action Execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company.

KAPL03001 to KAPL04000

Message ID	Message Text	Explanation
KAPL03001-I	HDLM API information - *aa...aa*	Details This information is required for resolving problems. *aa...aa*: Trace information Action None.
KAPL03003-E	HDLM API Error information - *aa...aa*	Details This information is required for resolving problems.

Message ID	Message Text	Explanation
		aa...aa: API trace error information Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL03004-C	A critical error occurred in the HDLM API. (*aa...aa*)	Details This information is required for resolving problems. *aa...aa*: API trace error information Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL03006-E	An access to the HDLM driver causes an error. (*aa...aa*)	Details This information is required for resolving problems. *aa...aa*: API trace error information Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL03007-E	An error occurred during communication with the HDLM manager. (*aa...aa*)	Details This information is required for resolving problems. *aa...aa*: API trace error information

Message ID	Message Text	Explanation
		Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL03008-E	An error occurred during log input to the HDLM alert driver. (*aa...aa*)	Details This information is required for resolving problems. *aa...aa*: API trace error information Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL03999-E	An unexpected error occurred.	Details Conflicting versions of HDLM modules are being used. Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

KAPL04001 to KAPL05000

Message ID	Message Text	Explanation
KAPL04001-I	HDLM manager started.	Action None.

Message ID	Message Text	Explanation
KAPL04002-E	Could not start the HDLM manager.	Details The HDLM manager failed to start because the current environment is unsuitable for the HDLM manager to run in. Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04003-E	The startup parameter is invalid.	Details The HDLM manager internal parameter is invalid. Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04004-I	HDLM manager will now terminate.	Action None.
KAPL04008-E	Cannot open the option definition file (*aa...aa*).	Details HDLM manager could not start normally because it was unable to open the option definition file. *aa...aa*: Option definition file name Action Check whether another program is currently using this file (for example, the file is being opened in a text editor), or whether the file has been inadvertently deleted.
KAPL04009-E	The option definition is invalid.	Details HDLM manager could not start normally because some of the definitions in the option definition file were invalid.

Message ID	Message Text	Explanation
		Action If the KAPL04033-W message is output after this message, execute the `dlnkmgr view -sys -sfunc` command, and then check the option settings. For options with setting values that have returned to default values, use the `dlnkmgr set` operation to reset the values. If the KAPL04033-W message is not output, restart HDLM manager. If the same error occurs, re-install HDLM. For details on the `view` operation, see *view (Displays Information) on page 6-34*. For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.
KAPL04010-E	Could not open the error log file.	Details HDLM manager cannot start normally (unable to open the error log file `/var/opt/DynamicLinkManager/log/dlmmgr[1-16].log`). Action Check whether another program is using the file (or has opened the file with Notepad), or whether the error log file has been deleted inadvertently.
KAPL04011-E	Could not output the error log file.	Details The log information could not be output to the error log file `/var/DynamicLinkManager/log/dlmmgr[1-16].log`. Action Make sure that the disk has enough unused capacity.
KAPL04012-E	Could not create a communication pipe. RC = *aa...aa*	Details HDLM manager could not start normally because it was unable to create a pipe file, which is used in communication with HDLM commands. *aa...aa*: OS error code (decimal (base-10) number) Action

Message ID	Message Text	Explanation
		Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04013-E	Input is impossible via the communication pipe. RC = *aa...aa*	Details Data could not be read from the pipe file while communicating with an HDLM command. *aa...aa*: OS error code (decimal (base-10) number) Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04014-E	Output is impossible via the communication pipe. RC = *aa...aa*	Details Data could not be written to the pipe file while communicating with an HDLM command. *aa...aa*: OS error code (decimal (base-10) number) Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04019-E	Could not collect the error information. RC = *aa...aa*	Details An attempt to read the log information from the alert driver failed. *aa...aa*: API return code (decimal (base-10) number) Action

Message ID	Message Text	Explanation
		Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04021-I	HDLM manager information - *aa...aa*	Details This information is required for resolving problems. *aa...aa*: HDLM manager trace information Action None.
KAPL04022-W	HDLM manager warning information - *aa...aa*	Details This information is required for resolving problems. *aa...aa*: HDLM manager trace warning information Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04023-E	HDLM manager error information - *aa...aa*	Details This information is required for resolving problems. *aa...aa*: HDLM manager trace error information Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

Message ID	Message Text	Explanation
KAPL04024-C	A critical error occurred in the HDLM manager. (*aa...aa*)	Details This information is required for resolving problems. *aa...aa*: HDLM manager trace error information Action Execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04025-C	A memory shortage occurred in the HDLM manager.	Details There was not enough memory to run the HDLM manager processes. Action Increase the amount of memory available for the process.
KAPL04026-I	The temporary license is valid. The license expires in *aa...aa* days on (*bb...bb*).	Details *aa...aa*: Expiration day *bb...bb: The year of grace* (4 numeric characters)/Month (01-12)/Day (01-31) Action Install a permanent license by the expiration day.
KAPL04027-I	The emergency license is valid. The license expires in *aa...aa* days on (*bb...bb*).	Details *aa...aa*: Expiration day *bb...bb: The year of grace* (4 numeric characters)/Month (01-12)/Day (01-31) Action Install a permanent license by the expiration day.
KAPL04028-E	The temporary license expired.	Action Install a permanent license.
KAPL04029-E	The emergency license expired.	Action Install a permanent license.
KAPL04030-E	The temporary license has already expired.	Action Install a permanent license.

Message ID	Message Text	Explanation
KAPL04031-E	The emergency license has already expired.	Action Install a permanent license.
KAPL04032-C	A fatal error occurred in HDLM. The system environment is invalid	Details A part of the HDLM configuration file is missing. Action Re-install HDLM.
KAPL04033-W	The option definition file was re-created.	Details When an existing option definition file cannot be read, a new option definition file will be re-created by using the default values. If some of the options can be read, those values can be used. As for any remaining values, the default values will be used. Action For any non-defaults options, use the `dlnkmgr set` operation to set the options again. For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.
KAPL04034-E	An attempt to create the option definition file has failed.	Details An attempt to re-create an option definition file (/usr/DynamicLinkManager/config/dlmmgr.xml) using the default values has failed. Action Remove unnecessary files and secure unused capacity on the file system, Check the write permissions for the directory and file.
KAPL04035-I	The path health check will now start. Total number of paths = *aa...aa*	Details *aa...aa*: Total number of paths Action None.
KAPL04036-I	The path health check for the path *aa...aa* was executed. Number of error paths = *bb...bb*	Details The path health check has completed normally. *aa...aa*: Number of paths targeted for path health checking. *bb...bb*: Number of paths determined to have an error by path health checking.

Message ID	Message Text	Explanation
		Action None.
KAPL04037-I	The path health check completed normally. Path ID = *aa...aa*	Details All the paths that path health checking examined are fine. *aa...aa*: Path ID for the path examined by path health checking. Action None.
KAPL04042-I	HDLM SNMP TRAP information - *aa...aa*	Details All the paths that path health checking examined are fine. *aa...aa*: Start or stop Action None.
KAPL04045-I	HDLM SNMP TRAP was sent. Trap ID = *aa...aa*, IP Address = *bb...bb*, Port Number= *cc...cc*, Community = *dd...dd*, Trap Data = *ee...ee*	Details SNMP TRAP was sent. *aa...aa*: Trap ID *bb...bb*: Destination IP address of the trap *cc...cc*: Destination port number of the trap *dd...dd*: Community name given to the trap *ee...ee*: Transmission data Action None.
KAPL04046-E	An attempt to connect to the HDLM alert driver has failed. RC = *aa...aa*. The HDLM manager will now terminate.	Details An attempt to connect to the HDLM alert driver during HDLM manager startup has failed. The HDLM manager will now terminate. *aa...aa*: OS error code (decimal number) Action See *Installing HDLM on page 3-19*, and then complete the installation. If the same error continues to occur even after the procedure is performed, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.

Message ID	Message Text	Explanation
		For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL04053-W	The option definition file was recovered from a work file.	Action Execute the `dlnkmgr view -sys` command to check whether the settings are recovered. If the settings are not recovered, execute the `dlnkmgr set` operation to recover the settings. For details on the `view` operation, see *view (Displays Information) on page 6-34*. For details on the `set` operation, see *set (Sets Up the Operating Environment) on page 6-18*.
KAPL04054-I	The owner controller will now be revised. (number of LUs = *aa...aa*)	Details *aa...aa*: number of targeted LUs Action None.
KAPL04055-I	The owner controller was revised. (number of changed LUs = *aa...aa*)	Details *aa...aa*: number of changed LUs Action None.
KAPL04056-W	The owner controller cannot be revised because no paths are in the Online status. (LU = *aa...aa*)	Details *aa...aa*: ID (serial number + iLUN) of the LU that was not revised Action Recover the paths from the failure, and then place them in the Online status, or exclude the LU from dynamic I/O path control.

KAPL05001 to KAPL06000

Message ID	Message Text	Explanation
KAPL05003-I	The HDLM driver (filter component) was successfully attached to Disk (*aa...aa*), Partition (*bb...bb*).	Details The path corresponding to `Disk` (*aa...aa*: Disk sequence number) and `Partition` (*bb...bb*: Fixed at 0) was successfully registered in the core logic. Action None.

Message ID	Message Text	Explanation
KAPL05008-E	Could not allocate memory. (*aa*:*bb*) Execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details The OS memory allocation function was started but an error was returned from the memory allocation function. *aa...aa*: Number of program lines *bb...bb*: Memory capture size Action Check whether the HDLM driver has started normally. If it has not started or contains an error, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL05011-E	Could not attach the HDLM driver (filter component) to Disk (*aa*), Partition (*bb*). (*cc*:*dd*) Execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details Registration of the path corresponding to `Disk` (*aa...aa*: physical volume (hdisk) decimal sequence number) and `Partition` (*bb...bb*: Partition decimal number) failed in the core logic. *cc...cc*: Error code (hexadecimal number) *dd...dd*: Filter driver management table address (hexadecimal number) Action Check whether the HDLM driver has started normally. If it has not started or contains an error, contact your HDLM vendor or the maintenance company, if there is a maintenance contract for HDLM, and report the error and detail code.
KAPL05014-I	The device object (*aa...aa*) was registered as the path (*bb...bb*).	Details The path (*bb...bb*: Core logic path identifier) of the device object (*aa...aa*: Filter driver management table address) was successfully registered into the core logic. Action None.

Message ID	Message Text	Explanation
KAPL05018-W	The FO processing in the path (*aa*) failed. (*bb*:*cc*) Check the connection status of the path %x. If there is no problem with the connection status, execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details FO processing failed in the path (*aa...aa*: Identifier of the core logic path where FO processing failed (hexadecimal number)). *bb...bb*: Error code (hexadecimal number) *cc...cc*: Fixed at 0 Action The I/O being processed is discarded. Check the status of the device path and take an appropriate action. If there is no problem with the connection status of the path, execute the DLMgetras utility for collecting error information, and then contact the HDLM vendor or the maintenance company if you have a maintenance contract for HDLM
KAPL05021-I	Processing of IOCTL (*aa...aa*) completed normally.	Details The processing for the requested IOCTL operation was successful. *aa...aa*: IOCTL code (hexadecimal number) Action None.
KAPL05023-E	Could not process the IOCTL(*aa*). (*aa*:*cc*) Check the message of the HDLM command or the HDLM manager, and then take the appropriate action. If you do not know the appropriate action, execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details Processing corresponding to the requested IOCTL (*aa...aa*: IOCTL code (hexadecimal number)) is unsuccessful. *bb...bb*: Fixed at 0 *cc...cc*: Fixed at 0 Action Check the message of the HDLM command (`dlnkmgr`) or the HDLM manager, and then take the appropriate action. If you do not know the appropriate action, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM and report the error and detail code. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting*

Message ID	Message Text	Explanation
		HDLM Error Information on page 7-5.
KAPL05501-E	The path could not be created. (*aa...aa*, *bb...bb*, *cc*) Execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details The driver instance could not be registered in the kernel side. *aa...aa*: HDLM driver instance name *bb...bb*: Logical device file name of `hdisk` *cc...cc*: Error code (decimal number) Action Contact your HDLM vendor or maintenance company if you have a maintenance contract for HDLM.
KAPL05508-I	Data for maintenance(PathCheck): Error Code = *aa...aa*, Status Validity = *bb...bb*, Status Code = *cc...cc*, Sense Code = *dd...dd*	Details This message outputs the details of a path check error. *aa...aa*: Error code *bb...bb*: Status Validity *cc...cc*: Status code *dd...dd*: Sense code Action None.
KAPL05509-I	Data for maintenance(Adapter): Error Code = *aa...aa*, Buffer Flag = *bb...bb*, Adapter Status = *cc...cc*, Add Adapter Status = *dd...dd*	Details This message outputs the details of a path failure. *aa...aa*: Error code *bb...bb*: Buffer flag *cc...cc*: Adapter status *dd...dd*: Additional adapter status Action None.
KAPL05510-I	Data for maintenance(SCSI): Error Code = *aa...aa*, Buffer Flag = *bb...bb*, SCSI Status = *cc...cc*, Add SCSI Status = *dd...dd*	Details This message outputs the details of a path failure. *aa...aa*: Error code *bb...bb*: Buffer flag *cc...cc*: SCSI status *dd...dd*: Additional SCSI status Action None.
KAPL05511-I	Data for maintenance(Other): Error Code = *aa...aa*, Buffer	Details

Message ID	Message Text	Explanation
	Flag = *bb...bb*, Status Validity = *cc...cc*	This message outputs the details of a path failure. *aa...aa*: Error code *bb...bb*: Buffer flag *cc...cc*: Status Validity Action None.
KAPL05512-I	Data for maintenance(SenseData): Sense Key = *aa...aa*, Sense Code = *bb...bb*	Details This message outputs the details of a path failure. *aa...aa*: Sense Key *bb...bb*: Sense Code Action None.
KAPL05819-I	Data for maintenance: *aa...aa bb...bb cc...cc dd...dd*.	Details The filter driver outputs this message for maintenance. *aa...aa*: Device minor number *bb...bb*: Message output location information *cc...cc*: Detailed information 1 *dd...dd*: Detailed information 2 Action None.

KAPL06001 to KAPL07000

Message ID	Message Text	Explanation
KAPL06003-I	Initialization of the HDLM alert driver (*aa...aa*) was successful.	Details Initialization of the alert driver (*aa...aa*: alert driver management table address (hexadecimal number)) completed normally. Action None.
KAPL06004-E	Could not allocate memory. (*aa...aa*:*bb...bb*)	Details An attempt to reserve memory to save alert information has failed. *aa...aa*: Program line (hexadecimal number) *bb...bb*: Target memory size (hexadecimal number) Action

Message ID	Message Text	Explanation
		Check whether the HDLM driver has started normally. If it has not started or contains an error, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM and report the error and detail code. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL06009-I	Invalid IOCTL (*aa...aa*) was received. The processing is canceled.	Details A request having an invalid IOCTL code (*aa...aa*: IOCTL code (hexadecimal number)) was issued to the alert driver. Action None.
KAPL06010-E	Could not process the IOCTL (*aa...aa*). (*bb...bb*:*cc...cc*)	Details Although the IOCTL request (*aa...aa*: code (hexadecimal number)) from the HDLM manager or API was accepted, it is not one of the requests expected to be processed by the alert driver. *bb...bb*: error code (hexadecimal number) *cc...cc*: 0 (fixed) Action Check the message of the HDLM command (dlnkmgr) or HDLM manager, and then take the appropriate action. If you do not know the appropriate action, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM and report the error and detail code. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL06013-E	Could not write log information into the log buffer. (*aa...aa*:*bb...bb*)	Details When a log output request was made from the filter driver, the

Message ID	Message Text	Explanation
		log information was discarded because of a memory allocation failure. Alternatively, although an HDLM driver message or HDLM alert driver message, or a non-emergency message (C/I) by the core logic was generated, its log information was discarded by the HDLM alert driver. *aa...aa*: log message code (hexadecimal number) *bb...bb*: log area size (hexadecimal number) Action Check whether any other error occurred. The information that could not be written is discarded. Review the actual memory size when another error does not occur. When the actual memory size is insufficient, increase the actual memory size. When the actual memory size is sufficient, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL06014-E	Could not write emergency information into the emergency information buffer. (*aa...aa*:*bb...bb*)	Details When a log output request was made from the filter driver, the log information was discarded because of a memory allocation failure. Alternatively, although an emergency message (such as a path error message) detected by the core logic was generated as an output message, its log information was discarded by the HDLM alert driver. *aa...aa*: Message code (hexadecimal number) *bb...bb*: Buffer size (hexadecimal number) Action

Message ID	Message Text	Explanation
		Check whether any other error occurred. The information that could not be written is discarded. Review the actual memory size if another error does not occur. If the actual memory size is insufficient, increase the actual memory size. If the actual memory size is sufficient, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.

KAPL07001 to KAPL08000

Message ID	Message Text	Explanation
KAPL07819-I	Data for maintenance: *aa...aa bb...bb cc...cc dd...dd*.	Details This message is generated by the core logic for maintenance. *aa...aa*: Detailed information 1 (decimal (base-10) number) *bb...bb*: Internal function number of the core logic (decimal (base-10) number) *cc...cc*: Detailed information 2 (decimal (base-10) number) *dd...dd*: Detailed information 3 (decimal (base-10) number) Action None.
KAPL07824-I	The owner controller of the LU connected to the path (*aa...aa*) was changed to (*bb...bb*).	Details The owner controller of the LU connected to the path with the ID shown in the message was changed. *aa...aa*: Path ID of the changed LU. (same as PathID of `view -path`) (Decimal number) *bb...bb*: Owner controller ID after the change. (Hexadecimal number)

Message ID	Message Text	Explanation
		Action None.
KAPL07825-I	The owner core of the LU connected to the path (*aa...aa*) was changed to (*bb...bb*).	Details The owner core of the LU connected to the path with the ID shown in the message was changed. *aa...aa*: Path ID of the changed LU. (same as PathID of `view -path`) (Decimal number) *bb...bb*: Owner core ID after the change. (Hexadecimal number) Action None.

KAPL08001 to KAPL09000

Message ID	Message Text	Explanation
KAPL08019-E	The path (*aa...aa*) detected an error (*bb...bb*). (*cc...cc*)	Details An error occurred in the path. The error is most likely due to a disconnected cable. *aa...aa*: Path identifier (hexadecimal number) *bb...bb*: Error code (hexadecimal number) ∘ When the path error is detected by a path health checking or the `online` operation Displays 0x000F0000 (Fixed). ∘ When a path error is detected through an I/O error The OS error code is displayed. *cc...cc*: 0x00000000 (fixed) Action Check the path in which the error was detected.
KAPL08022-E	A path error occurred. ErrorCode = *aa...aa*, PathID = *bb...bb*, PathName = *cc...cc.dd...dd.ee...ee.ff...ff*, DNum = *gg...gg*, HDevName = *hh...hh*	Details A physical or logical error occurred in the path. *aa...aa*: Error code (hexadecimal number)

Message ID	Message Text	Explanation
		∘ When the path error was detected by a path health checking or the `online` operation Displays 0x000F0000 (Fixed). ∘ When the path error was detected through an I/O error Displays the OS error code. *bb...bb*: Path ID (same as PathID of `view -path`) (decimal number) *cc...cc*: HBA adapter number or Adapter type (same as PathName of `view -path`) (character string) *dd...dd:* Bus number or Adapter number (character string) *ee...ee*: Target ID (hexadecimal number) *ff...ff*: Host LU number (same as PathName of `view -path`) (hexadecimal number) *gg...gg*: Dev number (same as DNum of `view -path`) (decimal number) *hh...hh*: Host device name Action There could be an error in the path. See *What To Do for a Path Error on page 5-3* and restore the path displayed in the message to running status.
KAPL08023-I	A path was recovered. PathID = *aa...aa*, PathName = *bb...bb.cc...cc.dd...dd.ee...ee*, DNum = *ff...ff*, HDevName = *gg...gg*	Details The path has been recovered. *aa...aa*: Path ID (same as PathID of `view -path`) (decimal number) *bb...bb*: HBA adapter number or Adapter type (same as PathName of `view -path`) (character string) *cc...cc*: Bus number or Adapter number (character string) *dd...dd*: Target ID (hexadecimal number) *ee...ee*: Host LU number (same as PathName of `view -path`) (hexadecimal number) *ff...ff*: Dev number (same as DNum of `view -path`) (decimal number) *gg...gg*: Host device name Action

Message ID	Message Text	Explanation
		None.
KAPL08026-E	An error occurred on all the paths of the LU. PathID = *aa...aa*	Details An error occurred in the last, remaining path of an LU. (This is most likely as a result of a disconnection.) *aa...aa*: Path ID (same as PathID of `view -path`) (decimal (base-10) number) Action Errors are detected in all the paths connected to the LUs. See *What To Do for a Path Error on page 5-3* to make the path shown in the error message or the paths connected to the target LU.
KAPL08027-E	A path was excluded from the items subject to automatic failback. PathID = *aa...aa*	Details A path was excluded from being subject to automatic failbacks because the system judged that an intermittent error was occurring in that path. *aa...aa*: Path ID (same as PathID of `view -path`) (decimal (base-10) number) Action An intermittent error has occurred. Check the path for any possible problems. For details on what to do, see *What To Do for a Path Error on page 5-3*, and switch the path shown in the message into Online.
KAPL08032-I	A path was recovered. (PathID = *aa...aa*)	Details The path has changed to an online status. *aa...aa*: Path ID (same as PathID of `view -path`) (decimal (base-10) number) Action None.
KAPL08033-E	No path connected to the LU that connects to Path ID (*aa...aa*) is in the `Online(D)` status.	Details Due to path failure, path deletion, or offline operation, no path connected to the LU that connects to Path ID (*aa...aa*) is in the `Online(D)` status.

Message ID	Message Text	Explanation
		aa...aa: Path ID (same as PathID of `view -path`) (decimal (base-10) number) Action To return a path to the `Online(D)` status, resolve the path failure, and then execute the "`dlnkmgr online -dfha`" command.
KAPL08036-W	Failed to get Inquiry Page.E2h(00h) in path (*aa...aa*).	Details Failed to obtain the Inquiry data of the path to show in a message. *aa...aa*: Path ID (same as PathID of `view -path`) (decimal (base-10) number) Action Confirm the state of the path. After having removed an obstacle, and then execute the "`dlnkmgr refresh`" command.
KAPL08037-W	Failed to get Inquiry Page.E2h(01h) in path (*aa...aa*).	Details Failed to obtain the Inquiry data of the path to show in a message. *aa...aa*: Path ID (same as PathID of `view -path`) (decimal (base-10) number) Action Confirm the state of the path. After having removed an obstacle, and then execute the "`dlnkmgr refresh`" command.
KAPL08038-W	Failed to get Inquiry Page.E2h(02h) in path (*aa...aa*).	Details Failed to obtain the Inquiry data of the path to show in a message. *aa...aa*: Path ID (same as PathID of `view -path`) (decimal (base-10) number) Action Confirm the state of the path. After having removed an obstacle, and then execute the "`dlnkmgr refresh`" command.

KAPL09001 to KAPL10000

Message ID	Message Text	Explanation
KAPL09003-E	Cannot install in this system. Install HDLM on a supported OS.	Details Installation of HDLM failed because the OS is not supported. Make sure that you are using a supported OS. Also make sure that the OS is not installed with the Secure by Default functionality enabled. Action See *Host and OS Support for HDLM on page 3-3* and install HDLM on a supported OS.
KAPL09011-E	Cannot find a license key file "/var/DLM/dlm.lic_key".	Details The license key file`/var/DLM/dlm.lic_key` is not in the specified directory. Action Create a license key file, and re-execute the installation program.
KAPL09012-I	All HDLM drivers were removed.	Details All the HDLM drivers were successfully removed, the HDLM manager was successfully stopped, and HDLM was stopped. Action None.
KAPL09013-E	Some HDLM drivers could not be removed.	Details The `dlmrmdev` command was run, but HDLM drivers could not be removed. Action Check the HDLM driver status and remove the drivers.
KAPL09019-E	An attempt to cancel the registration of the bundle PP name of Hitachi Network Objectplaza Trace Library 2 failed. Remove Hitachi Network Objectplaza Trace Library 2 by referring to HDLM User's Guide section "Removing Hitachi Network Objectplaza Trace Library (HNTRLib2)".	Action Manually cancel the PP name registration, and then remove Hitachi Network Objectplaza Trace Library 2. If the attempt to cancel the registration of the PP name and to remove Hitachi Network Objectplaza Trace Library 2 fails again, contact your HDLM vendor or the maintenance company if there is a maintenance contact of HDLM.

Message ID	Message Text	Explanation
KAPL09020-E	An attempt to remove Hitachi Network Objectplaza Trace Library 2 failed.	Details An attempt to remove HNTRLib2 has failed. Action Manually remove Hitachi Network Objectplaza Trace Library 2. If the attempt to remove Hitachi Network Objectplaza Trace Library 2 fails again, contact your HDLM vendor or the maintenance company if there is a maintenance contact of HDLM.
KAPL09022-E	HDLM cannot be removed. *aa...aa* is running.	Details HDLM cannot be removed because the HDLM manager, HDLM driver is running. *aa...aa*: HDLM manager, HDLM driver Action Execute the `dlmrmdev` utility, and then re-execute the remove program.
KAPL09023-E	A file or directory related to HDLM could not be found. Re-install HDLM.	Details A target file to copy to the directory of Hitachi Command Suite products other than HDLM could not be found among the files related to HDLM Action Re-install HDLM.
KAPL09024-E	An attempt to copy a file or directory related to HDLM has failed. Refer to the Messages section of the HDLM User's Guide for instructions to correct this problem.	Details An attempt to copy a file related to HDLM to the directory of Hitachi Command Suite products other than HDLM has failed. Action If this message is output while installing HDLM, re-install HDLM. If this message is output while installing a Hitachi Command Suite product other than HDLM, re-install that product.
KAPL09025-W	An attempt to delete a file or directory has failed.	Details An attempt to delete a file related to HDLM from the directory of Hitachi Command Suite products other than HDLM has failed. Action

Message ID	Message Text	Explanation

		If the following files or directories are on the host, remove them manually.
		`/usr/HDVM/agent/classes/com/Hitachi/soft/HiCommand/DVM/agent/module/HDLMWebAgent.class`
		`/usr/HDVM/agent/classes/jp`
		`/usr/HDVM/agent/classes/com/Hitachi/soft/HiCommand/DVM/agent/module/hdlm`
		`/usr/HDVM/HBaseAgent/agent/classes/com/Hitachi/soft/HiCommand/DVM/agent/module/HDLMWebAgent.class`
		`/usr/HDVM/HBaseAgent/agent/classes/jp`
		`/usr/HDVM/HBaseAgent/agent/classes/com/Hitachi/soft/HiCommand/DVM/agent/module/hdlm`

KAPL09029-E	This version of HDLM cannot be updated by installation. Remove the already installed version of HDLM.	Action Remove the HDLM that has already been installed.
KAPL09047-E	Downgrading from *aa...aa* to *bb...bb* is not supported.	Details Downgrade installation is not supported. *aa...aa* : DLManager.mpio.rte *Level-of-the-fileset* (character string) *bb...bb* : DLManager.mpio.rte *Level-of-the-fileset* (character string) Action Remove HDLM, and then re-execute the installation program.
KAPL09048-E	HDLM cannot be installed. *aa...aa* is running.	Details An attempt to install HDLM failed because either of *aa...aa* is running. *aa...aa*: HDLM manager, HDLM driver Action Execute the `dlmrmdev` utility, and then re-execute the installation program.
KAPL09076-I	The permanent license was installed.	Details

Message ID	Message Text	Explanation
		The permanent license was installed. Action None.
KAPL09077-I	The temporary license was installed. The license expires on *aa...aa*.	Details A temporary license was installed. *aa...aa*: Year (4 digits)/month (01-12)/day (01-31) Action Install a permanent license by the expiration day.
KAPL09078-I	The emergency license was installed. The license expires on *aa...aa*.	Details An emergency license was installed. *aa...aa*: Year (4 digits)/month (01-12)/day (01-31) Action Install a permanent license by the expiration day.
KAPL09079-I	The permanent license has been installed.	Action None.
KAPL09080-I	The temporary license has been installed. The license expires on *aa...aa*.	Details The temporary license has been installed. *aa...aa*: Year (4 digits)/month (01-12)/day (01-31) Action Install a permanent license by the expiration day.
KAPL09081-I	The emergency license has been installed. The license expires on *aa...aa*.	Details The emergency license has been installed. *aa...aa*: Year (4 digits)/month (01-12)/day (01-31) Action Install a permanent license by the expiration day.
KAPL09082-W	The temporary license expired.	Action Enter a permanent license key.
KAPL09083-W	The emergency license expired.	Action Install a permanent license.
KAPL09087-E	The entered license key is invalid. Renewal of the license	Details

Message ID	Message Text	Explanation
	key will now stop. Obtain a valid license key, and then re-install HDLM.	The renewal of the license key will be aborted because an invalid license key was entered. Action Obtain a valid license key, and then re-install HDLM.
KAPL09088-E	The entered license key is invalid. The HDLM installation will now terminate. Obtain a valid license key, and then re-install HDLM.	Action Obtain a valid license key, and then re-install HDLM.
KAPL09090-W	This operation will now be continued without updating the license.	Details This operation will continue without updating the license. Action Install a permanent license at a later time.
KAPL09091-E	A fatal error occurred in HDLM. The system environment is invalid. Contact your HDLM vendor or the maintenance company if there is a maintenance contract of HDLM.	Details A part of the HDLM configuration file is missing. Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract of HDLM.
KAPL09100-E	Installation is not possible because *aa...aa* is already installed.	Details Installation is not possible because the fileset that was output in the message is installed. *aa...aa*: DLManager.rte or AutoPath.rte (character string) Action Re-install after removing the fileset that was output in the message.
KAPL09112-E	The license key file is invalid. File name = *aa...aa* Place the correct license key file in the designated directory, and then re-install HDLM.	Details The format of the license key file is invalid. *aa...aa* : `/var/tmp/hdlm_license` Action Place the correct license key file in the designated directory, and then re-install HDLM. `/var/tmp/hdlm_license`
KAPL09113-E	There is no installable license key in the license key file. File name = *aa...aa*	Details There is no HDLM-installable license key in the license key file.

Message ID	Message Text	Explanation
	Make sure that the license key file is correct, and then re-install HDLM.	*aa...aa* : /var/tmp/hdlm_license Action Make sure that the license key file is correct, and then re-install HDLM. /var/tmp/hdlm_license
KAPL09114-I	There is no license key file. File name = *aa...aa*	Details There is no license key file in the designated directory. *aa...aa* : /var/tmp/hdlm_license Action When the message that prompts you to enter the license key is displayed, enter the license key. Alternatively, cancel the installation, save the correct license key file in the designated directory, and then re-execute the installation. /var/tmp/hdlm_license
KAPL09115-W	An attempt to delete the license key file has failed. File name = *aa...aa*	Details An attempt to delete the license key file has failed. *aa...aa* : /var/tmp/hdlm_license Action If a license key file exists, delete it. /var/tmp/hdlm_license
KAPL09116-W	The command could not be installed. (command = *aa...aa*)	Details The output HDLM command cannot be used. *aa...aa*: Command name Action The output command can be executed by using a different name. If you want to use the output name, use the output command to overwrite or re-install.
KAPL09135-E	One of the following was executed at the same time as an HDLM command set -lic operation: another set -lic operation, or an update of the license for an update installation.	Action Check the license by using the HDLM command's view -sys -lic operation. Then, if necessary, update the license by using the set -lic operation during or after installation. If the same error message is output, contact your HDLM vendor or the maintenance

Message ID	Message Text	Explanation
		company if there is a maintenance contract for HDLM. Do not perform the following operation: Execution of the HDLM command's `set -lic` operation simultaneously with an update of the license for an upgrade installation
KAPL09142-E	HDLM *aa...aa* cannot be performed. Wait a while, and then perform *aa...aa* again. Error Code =*bb...bb*	Details HDLM cannot be installed or removed. *aa...aa*: "installation" or "remove" *bb...bb*: Internal code (decimal (base-10) number) Action Wait a while, and then reperform the installation or remove. After the installation or remove has finished, use the backup acquired in advance and specify the HDLM settings.
KAPL09143-E	HDLM *aa...aa* cannot be performed. Error Code = *bb...bb*	Details HDLM cannot be installed or removed. *aa...aa*: "installation" or "remove" *bb...bb*: Internal code (decimal number) Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL09171-E	An internal error occurred in the installation of the HDLM. Error Code = *aa...aa bb...bb*	Details A system-based error, not caused by the user, occurred during installation of HDLM processing. *aa...aa*:The error number which specifies the performed processing (decimal number) *bb...bb*:Return value of the executed processing (decimal number) Action If the error code is `3`,*nnnn*: ODM is being used. Wait a while, and then try again. If any other error code is output:

Message ID	Message Text	Explanation
		Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL09172-E	Installation is not possible because an hdisk exists.	Action Delete the hdisk, and then re-execute the installation program.
KAPL09179-I	Data for maintenance: *aa...aa bb...bb*	Details *aa...aa*: Message output location information (decimal (base-10) number) *bb...bb*: Detailed information (character string) Action None.
KAPL09183-I	HDLM version *aa...aa* is installed. This version will now be overwritten with version *bb...bb*.	Details *aa...aa*: Installed version number of HDLM *bb...bb*: Version number of HDLM you attempted to install Action None.
KAPL09187-W	No parameter is specified.	Details No installation-information settings file has been specified in the `installhdlm` utility for installing HDLM. Action Make sure that an actual installation-information settings file for the `installhdlm` utility is appropriate, and then try again.
KAPL09188-W	Too many parameters are specified.	Details More than two parameters have been specified for the `installhdlm` utility for installing HDLM. Action Make sure that the parameters for `installhdlm` are appropriate, and then try again.
KAPL09190-W	The installation information settings file is not specified.	Details The installation information settings file is not specified for the second parameter in the `installhdlm` utility for installing HDLM.

Message ID	Message Text	Explanation
		Action Make sure that the parameters in the `installhdlm` utility are appropriate, and then try again.
KAPL09191-W	The installation information settings file does not exist.	Details The installation information settings file specified for the second parameter does not exist. Action Make sure that the path name of the installation-information settings file is appropriate, and then try again.
KAPL09210-I	*aa...aa* will now start.	Details *aa...aa* has just started. *aa...aa*: `installhdlm`, `installp`, `cfgmgr`, `dlmodmset`, `dlnkmgr`, or `dlmrmdev` Action None.
KAPL09211-I	*aa...aa* completed successfully.	Details *aa...aa* completed successfully. *aa...aa*: `installhdlm`, `installp`, `cfgmgr`, `dlmodmset`, `dlnkmgr`, or `dlmrmdev` Action None.
KAPL09212-E	*aa...aa* ended abnormally.	Details *aa...aa* ended abnormally. *aa...aa*: `installhdlm`, `installp`, `cfgmgr`, `dlmodmset`, `dlnkmgr`, or `dlmrmdev` Action Check the error message that was output just before this message, and then perform the action indicated in that error message.
KAPL09213-W	An error occurred during *aa...aa* processing.	Details Although the *aa...aa* processing has ended, an error occurred during the processing. *aa...aa*: `installhdlm`, `installp`, `cfgmgr`, `dlmodmset`, `dlnkmgr`, or `dlmrmdev` Action

Message ID	Message Text	Explanation
		Check the error message that was output just before this message, and then perform the action indicated in that error message.
KAPL09214-W	A parameter is invalid. parameter = *aa...aa*	Details A parameter is invalid. *aa...aa*: The specified parameter (character string) Action Specify the `-h` parameter for the `installhdlm` utility, confirm the parameter that should be specified, and then retry the operation.
KAPL09215-E	The system environment is invalid. Error Code = *aa...aa*	Details The system environment is not valid as an environment for executing the `installhdlm` utility. *aa...aa*: Error number (decimal number) that specifies the executed processing Action If the error code is `1`: The `/tmp` directory does not exist. Prepare the `/tmp` directory, and then retry the operation. If the error code is `2`: You do not have write permission for the /`tmp` directory. Make sure that you have access permissions for the `/tmp` directory. If the error code is `3` : You do not have write permission for the file system of the `/tmp` directory. Make sure you have access permissions for the storage location of the `/tmp` directory. If the error code is `4`: The `/var/tmp` directory does not exist. Prepare the `/var/tmp` directory, and then retry the operation. If the error code is `5`: You do not have write permission for the `/var/tmp` or `/var/DLM` directory. Make

Message ID	Message Text	Explanation
		sure you have access permissions for these directories. If the error code is 6: You do not have write permission for the file system of the /var/tmp or /var/DLM directory. Make sure you have access permissions for the storage location of these directories. If the error code is 7: There is not enough unused capacity for the file system of the /var/tmp or /var/DLM directory. Make sure there is enough unused capacity for these directories. If the error code is 8: The /var directory does not have enough unused capacity, or the user does not have write permission for it. Make sure there is enough unused capacity and that the user has write permission for this directory, and then try again. If the error code is 9: The status of the installed HDLM is BROKEN. Please remove HDLM. If the error code is 10: The cfgmgr command is not in the correct location, or you do not have a required permission. Check the state of the cfgmgr command. If the error code is 11: The shutdown command is not in the correct location, or you do not have a required permission. Check the state of the shutdown command.
KAPL09216-E	An error occurred during I/O of a file that installhdlm uses. Error Code = *aa...aa*,*bb...bb*	Details An error occurred during I/O of a file that installhdlm uses.

Message ID	Message Text	Explanation
		aa...aa: Error number that indicates the executed processing (decimal (base-10) number) *bb...bb*: Return value of the executed processing (decimal (base-10) number) Action Make sure that sufficient unused capacity exists for the `/tmp` directory. If the capacity is insufficient, allocate the required amount of capacity, and then retry the operation. For details about how to determine the amount of capacity that is required, see *Performing an Unattended Installation of HDLM on page 3-78*.
KAPL09217-E	An error occurred during reading of the installation information settings file. Error Code = *aa...aa*,*bb...bb*	Details An error occurred while reading the installation information settings file. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing Action If the error code is`9001 ,-1`: You do not have read permissions for the installation information settings file. Make sure that you have access permissions. If any other error code is output: Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL09218-E	*aa...aa* cannot be executed.	Details A utility or command that `installhdlm` uses was not in the correct location, or you do not have a required permission. *aa...aa*: `installhdlm_analysis`, `dlmodmset`, `dlnkmgr`, or `dlmrmdev` Action If *aa...aa* is `dlmodmset` or `dlnkmgr` :

Message ID	Message Text	Explanation
		The correct location of `dlmodmset` and `dlnkmgr` is `/usr/DynamicLinkManager/bin`. If `dlmodmset` or `dlnkmgr` was not in the correct location, or you did not have a required permission, re-execute `installhdlm` If *aa...aa* is `dlmrmdev` or `installhdlm_analysis`: The correct location of `dlmrmdev` and `installhdlm_analysis` is the same directory as `installhdlm`. Make sure that the utility you want to execute is in the correct location and that you have the required permissions. If a utility is not in the correct location, copy the required files to the correct location, and then retry the operation. If you do not have a required permission, grant required permissions to yourself, and then retry the operation.
KAPL09219-E	An internal error occurred in the installhdlm_analysis. Error Code = *aa...aa*,*bb...bb*	Details An internal error occurred in the `installhdlm_analysis`. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL09220-W	The composition of the installation information settings file is invalid. Error Code = *aa...aa*,*bb...bb*	Details In the installation information settings file, the length of a single line exceeds 1,023 characters, or the first non-whitespace, non-comment line that appears is not `[INSTALLATION_SETTINGS]`. *aa...aa*: Error number (decimal number) that specifies the executed processing

Message ID	Message Text	Explanation
		bb...bb: Return value (decimal number) of the executed processing Action Specify the revised installation information settings file, and then retry the operation.
KAPL09221-W	The definition of the installation information settings file includes an unusable character. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details A character that cannot be used in a non-comment line was used. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing *cc...cc*: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file, and then retry the operation.
KAPL09227-W	The definition of the installation information settings file includes an invalid key. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details A key that does not exist is included. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing *cc...cc*: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file and then retry the operation.
KAPL09228-W	The definition of the installation information settings file includes an invalid key value. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details The format of a key value is invalid. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing

Message ID	Message Text	Explanation
		cc...cc: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file and then retry the operation.
KAPL09229-W	The definition of the installation information settings file includes an invalid section name. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details A section that does not exist is included. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing *cc...cc*: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file and then retry the operation.
KAPL09230-W	The definition of the installation information settings file includes a duplicated section name. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details A duplicated section name is included. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing *cc...cc*: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file and then retry the operation.
KAPL09231-W	The definition of the installation information settings file includes a duplicated key. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details A duplicated key is included. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing

Message ID	Message Text	Explanation
		cc...cc: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file and then retry the operation.
KAPL09232-W	The composition of the definition of the installation information settings file is invalid. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details A key, key value, or equal sign (=) is missing. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing *cc...cc*: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file and then retry the operation.
KAPL09233-W	The definition of the installation information settings file is too long. Error Code = *aa...aa*,*bb...bb*, line = *cc...cc*	Details The length of a single line of the definition exceeds 1023 characters. *aa...aa*: Error number (decimal number) that specifies the executed processing *bb...bb*: Return value (decimal number) of the executed processing *cc...cc*: Line number (decimal number) of an installation information settings file. Action Specify the revised installation information settings file and then retry the operation.
KAPL09234-W	A folder or file specified by the installation information settings file does not exist. Name = *aa...aa*	Details A folder or file specified by the installation information settings file does not exist. *aa...aa*: Name of the folder or file that does not exist. Action

Message ID	Message Text	Explanation
		Specify the revised installation information settings file and then retry the operation.
KAPL09235-E	The log file cannot be output to its destination because the environment is invalid. Error Code = *aa...aa*	Details The log file cannot be output in this environment, because certain environment settings are invalid. *aa...aa*: Error number (decimal number) that specifies the executed processing. Action If the error code is `1`: The log file destination directory does not exist. Prepare the directory, and then retry the operation. If the error code is `2`: You do not have write permission for the log file destination directory. Modify your access permissions as necessary, and then retry the operation. If the error code is `3`: You do not have write permission for the file system of the log file. Modify your access permissions as necessary, and then try again. If the error code is `4`: You do not have write permission for the `installhdlm.log` file. Modify your access permissions as necessary, and then retry the operation.
KAPL09236-W	An error occurred during the output of a log file.	Details A memory shortage occurred at the output destination of the log file. Action Check the error message output before this message, and then perform the action indicated in that error message.
KAPL09237-I	A user operation ended installhdlm.	Details The process has been terminated by an operation such as Ctrl+C.

Message ID	Message Text	Explanation
		Action Check the status of HDLM by executing `lslpp -la DLManager.mpio.rte`. If HDLM is not installed: Re-execute `installhdlm`. If the status of HDLM is `COMMITTED`: Perform the following procedures according to the installation status: • If installing HDLM by using the `installhdlm` utility has already finished, setting up HDLM might have not completed. You need to manually set up the values that are not set up, or re-execute `installhdlm`. • If HDLM before the upgrade or re-installation still exists, re-execute `installhdlm`. If the status of HDLM is not `COMMITTED`: Perform remove or cleanup according to the displayed status. If an remove or cleanup attempt fails, contact either your HDLM vendor or the maintenance company (if an HDLM maintenance contract exists).
KAPL09238-W	The specified file is not a normal one. Fail name = *aa...aa*	Details A file other than a normal one (for example, a directory file or a special file.) is specified. *aa...aa*: Specified file name (character string) Action Specify the correct file, and then retry the operation.
KAPL09239-I	The system will now restart.	Details The host will restart because restart was specified in the installation information settings file. Action

Message ID	Message Text	Explanation
		none.
KAPL09241-W	An attempt to install an HDLM component failed. Error Code = *aa...aa*	Details An attempt to install an HDLM component failed. *aa...aa*: Error number that identifies the executed processing Action If there is no need to access the Hitachi Command Suite products that use HDLM remote access interface, no action is required. Note that this requires no particular action, because HDLM operation is not affected when linkage with Global Link Manager is not used. If the error code is `3` or `100`: Wait a while, and then execute `dlminstcomp` utility. If the error code is `5`: Install a prerequisite JDK version, and then re-execute `dlminstcomp` utility. If the error code is `200`: Execute `dlminstcomp` utility. If any other error code is output: Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL09242-E	No usable JDK or JRE exists.	Details No prerequisite JDK version is installed in the system. Action Install a prerequisite JDK version, and then re-execute `dlminstcomp` utility.
KAPL09243-I	dlminstcomp completed successfully.	Details `dlminstcomp` utility completed successfully. Action None.
KAPL09246-E	An attempt to install an HDLM component failed because an HDLM component was operating. Error Code = *aa...aa*	Details An attempt to install an HDLM component failed because an HDLM component was operating.

Message ID	Message Text	Explanation
		aa...aa: Error number that identifies the executed processing Action Wait a while, and then re-execute `dlminstcomp` utility.
KAPL09247-E	An attempt to install an HDLM component failed. Error Code = *aa...aa*	Details An attempt to install an HDLM component failed. *aa...aa*: Error number that identifies the executed processing Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL09248-W	A parameter is invalid. parameter = *aa...aa*	Details An invalid parameter is specified. *aa...aa*: The specified parameter (character string) Action With the `-h` parameter specified, execute the `dlminstcomp` utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL09292-W	Execution of the dlmpremkcd utility during installation failed.	Details Execution of the dlmpremkcd utility during installation failed. Action Take action according to the dlmpremkcd utility message output to the HDLM utility log during HDLM installation. If no dlmpremkcd utility messages were output to the HDLM utility log, execute the dlmpremkcd utility with the -c parameter. If you are not planning to back up the OS backup of the HDLM installation environment to a CD or DVD, no action is required because this error does not affect HDLM operation.
KAPL09293-W	An attempt to add an HDLM entry to the Error Record Template Repository failed.	Details An attempt to add an HDLM entry to the Error Record Template Repository failed. Action If HDLM messages are not output to the OS error log, no action is

Message ID	Message Text	Explanation
		required because this message does not affect HDLM operations. If HDLM messages are output to the OS error log, execute the following command: `/usr/bin/errupdate -q -f /usr/DynamicLinkManager/common/.dlmfdrv_err_template` If the message is output after command execution is complete, resolve the problem according to the message, and then re-execute the `errupdate` command.

KAPL09311-W	An attempt to install Hitachi Network Objectplaza Trace Library 2 failed. Code = *aa...aa*,*bb...bb*	Details
		An attempt to install Hitachi Network Objectplaza Trace Library 2 failed.
		aa...aa: Number (a decimal number) that identifies the executed processing.
		bb...bb: Return value (decimal number) of the executed processing
		Action
		If the *aa...aa* is `1`, `2`, or `3`:
		Install Hitachi Network Objectplaza Trace Library according to the installation procedure for Hitachi Network Objectplaza Trace Library.
		If the *aa...aa* is `4`:
		Execute the following commands:
		`# /opt/hitachi/HNTRLib2/etc/hntr2setup 1`
		`# /usr/sbin/lsitab hntr2mon`
		Verify that the exit value of the `/usr/sbin/lsitab hntr2mon` command is `0`.
		If the *aa...aa* is `5`:
		Execute the following command:
		`# /opt/hitachi/HNTRLib2/bin/hntr2mon -d`
		Verify that the exit value of the command is `0`.

KAPL09312-W	After HDLM is installed, immediately restart the host.	Details

Message ID	Message Text	Explanation
	Functions such as HDLM commands and path health checking cannot be executed until the host restarts.	This message prompts you to restart the host after HDLM is installed. Action After HDLM is installed, immediately restart the host.
KAPL09504-E	The language environments of HDLM and the Service Pack are different.	Details The Japanese Service Pack was applied to the English edition of HDLM, or vice versa. Action Acquire the Service Pack that has the same language as the installed HDLM, and then try again.
KAPL09601-E	Cannot install in this system. Install HDLM on a supported OS.	Details HDLM cannot be installed on this system. Action Execute the installation in a supported OS.
KAPL09602-E	The installation will now stop because a file or directory is missing. Confirm that the file or directory (*aa...aa*) exists.	Details *aa...aa*: Name of the missing file or directory Action If an installation is performed from the DVD-ROM, confirm that the DVD-ROM is not damaged. If an installation is performed by using files copied from the DVD-ROM, re-copy all of the DVD-ROM files.
KAPL09603-E	The installation will now stop because a command or utility cannot be executed. Confirm that the command or utility (*aa...aa*) exists, and that you have the proper permission.	Details *aa...aa*: Name of the command or utility that cannot be executed. Action When the output information is an HDLM utility: ∘ If an installation is performed from the DVD-ROM, confirm that the DVD-ROM is not damaged. ∘ If an installation is performed by using files copied from the DVD-ROM, re-copy all of the DVD-ROM files. After that, confirm the permission of the HDLM utility that caused the error.

Message ID	Message Text	Explanation
		When the output information is an OS command: ∘ Confirm that the OS command exists, and that you have the proper permission.
KAPL09604-E	A system error occurred. The installation will now stop. (command = *aa...aa*, error code = *bb...bb*)	Details *aa...aa*: Command that failed *bb...bb*: Return value Action Acquire the log `/var/tmp/hdlm_installux_sh.log`, and then contact your HDLM vendor or, if you have a maintenance contract, contact the maintenance company.

KAPL10001 to KAPL11000

Message ID	Message Text	Explanation
KAPL10001-W	No parameter has been specified.	Details No directory to which the collected information will be output has been specified. Action Check the parameters of the `DLMgetras` utility for collecting HDLM error information, and then retry. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10002-W	Too many parameters have been specified.	Details Four or more parameters have been specified. Action Check the parameters of the `DLMgetras` utility for collecting HDLM error information, and then retry. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10003-W	The first parameter has not been set to a directory. Value = *aa...aa*	Details The first parameter must be set to a directory to which collected information is output.

Message ID	Message Text	Explanation
		aa...aa: First parameter Action Check the parameters of the DLMgetras utility for collecting HDLM error information, and then retry. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10004-W	The parameter contains an incorrect value. Value = *aa...aa*	Details The first parameter must be a directory. The second parameter must be -f. *aa...aa*: Invalid parameter Action Check the parameters of the DLMgetras utility for collecting HDLM error information, and then retry. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10005-W	The number of parameters is insufficient.	Details The -f parameter exists but the file for defining the information to be collected does not exist. Action Check the parameters of the DLMgetras utility for collecting HDLM error information, and then retry. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10006-W	The file for defining the information to be collected does not exist, or cannot be read. Value = *aa...aa*	Details The file for defining the information to be collected does not exist, or the specified file exists but the permission to read the file is missing. *aa...aa*: Name of the file for defining the information to be collected Action Check whether the specified file for defining the information to be collected exists, and check whether you have access permission for the specified file.

Message ID	Message Text	Explanation
KAPL10007-W	A directory has been specified in the third parameter. Value = *aa...aa*	Details The `-f` parameter is specified to a directory. *aa...aa*: Third parameter Action Check the parameters of the `DLMgetras` utility for collecting HDLM error information, and then retry. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10008-W	You lack write permission for the specified directory. Value = *aa...aa*	Details You do not have write permission for the specified directory, or the creation of a subdirectory of the specified directory failed. *aa...aa*: first parameter Action Check the following. a. Check whether you have access permission for the specified directory. b. Check whether the specified directory name is correct. c. Check that the disk has sufficient unused capacity.
KAPL10009-W	The specified directory already exists. Do you want to overwrite it? [y/n]:	Details The specified directory already exists. Enter `y` to overwrite it, or `n` to cancel. Action The specified directory already exists. Enter `y` to overwrite the existing file. Enter `n` or press any other key to terminate the `DLMgetras` utility for collecting HDLM error information without executing it. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10010-W	A root directory has been specified. Line = *aa...aa*	Details The root "/" has been specified as a directory to be collected in the file for defining the information to be collected.

Message ID	Message Text	Explanation
		aa...aa: Line number of the file for defining information to be collected (decimal number) Action Delete the coding of the root directory from the specified file. The displayed directory will be ignored and the DLMgetras utility for collecting HDLM error information will continue. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10011-W	More than one file or directory has been specified on one line. Line = *aa...aa,* Value = *bb...bb*	Details Two or more file names or directory names exist in the file for defining the information to be collected. *aa...aa*: Line number of the file for defining information to be collected (decimal number) *bb...bb*: Indicated contents in a line Action After the DLMgetras utility for collecting HDLM error information terminates, check the contents of the file for defining the information to be collected. This file is shown in the message. If the contents of the file are incorrect, correct them and then try to collect error information again. The DLMgetras utility for collecting HDLM error information will ignore the specified file or directory and continue processing. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10012-W	The specified file or directory does not exist. Line = *aa...aa,* Value = *bb...bb*	Details The specified file or directory does not exist in the file for defining the where information is to be collected. *aa...aa*: Line number of the file for defining which information to be collected (decimal (base-10) number)

Message ID	Message Text	Explanation
		bb...bb: Indicated contents of a line Action After the DLMgetras utility for collecting HDLM error information terminates, check the contents of the file for defining which information to be collected. This file is shown in the message. If the contents of the file are incorrect, correct them, and then try to collect error information again. The DLMgetras utility will ignore the specified file or directory and continue processing. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10013-W	You lack read permission for the specified file. Line = *aa...aa,* Value = *bb...bb*	Details You lack read permission for the specified file in the file for defining information to be collected. *aa...aa*: Line number of the file for defining information to be collected (decimal number) *bb...bb*: Indicated contents in a line Action After the DLMgetras utility for collecting HDLM error information terminates, check the contents of the file for defining the information to be collected. This file is shown in the message. If the contents of the file are incorrect, correct them and then try to collect error information again. The DLMgetras will ignore the specified file and continue processing. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10014-W	You lack read permission for the specified directory. Line = *aa...aa,* Value = *bb...bb*	Details You lack read permission for the specified directory in the file for defining information to be collected. *aa...aa*: Line number of the file for defining information to be collected (decimal number)

Message ID	Message Text	Explanation
		bb...bb: Indicated contents in a line Action After the DLMgetras utility for collecting HDLM error information terminates, check the contents of the file for defining the information to be collected. This file is shown in the message. If the contents of the file are incorrect, correct them and then try to collect error information again. The DLMgetras will ignore the specified file and continue processing. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10015-W	The file format is invalid. Value = *aa...aa*	Details The file format in the file for defining information to be collected is not a text file. *aa...aa*: Third parameter Action After the DLMgetras utility for collecting HDLM error information terminates, check whether the file for defining the information to be collected is a text file. The file is shown in the message. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10016-W	The root directory has been specified in the first parameter.	Details A root "/" cannot be specified in a directory to which collected information is output. Action Check the parameters of the DLMgetras utility for collecting HDLM error information, and then re-execute. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10017-W	You lack privileges for executing the utility for collecting HDLM error information.	Details The DLMgetras utility for collecting HDLM error information must be executed by a user with root permissions.

Message ID	Message Text	Explanation
		Action Re-execute as a user with root permissions. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10020-I	The file has been obtained successfully. File = *aa...aa*, Collection time = *bb...bb*(GMT:*bb...bb*)	Details The file to be collected has been obtained. *aa...aa*: Collected file name *bb...bb*: Year/month/day hour:minute:second Action None.
KAPL10021-I	Processing terminated before completion because a signal was received.	Details The process has been terminated by an operation such as Ctrl+C. Action The utility for collecting HDLM error information terminated before completion. If the directory is unnecessary, delete directory. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10022-I	The utility for collecting HDLM error information completed normally.	Details Error information has been collected. Action None. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10030-I	A user terminated the utility for collecting HDLM error information.	Details Processing of the DLMgetras utility for collecting HDLM error information has been terminated because the user replied to the confirmation with an n response. Action None. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10031-W	The entered value is invalid. Continue operation ? [y/n]:	Details

Message ID	Message Text	Explanation
		A value other than y or n has been entered for a [y/n] request. Enter `y` or `n`. Action Enter `y` or `n`.
KAPL10032-W	The entered value is invalid. The utility for collecting HDLM error information stops.	Details Processing of the `DLMgetras` utility for collecting HDLM error information will terminate because an invalid response was sent three times in a row to a request. Action Re-execute the `DLMgetras` utility. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL10033-W	The file does not exist. Filename = *aa...aa*	Details No file to collect information exists. *aa...aa*: File to collect Action None.
KAPL10034-E	The file could not be copied. Filename = *aa...aa*, Details = *bb...bb*	Details Execution of the `cp` command failed. *aa...aa*: File name you tried to copy *bb...bb* : `cp` command output message Action An error occurred while the information collection file was being copied. The error might be a result of an unstable user environment. Check the system configuration.
KAPL10035-E	An attempt to archive the error information failed. Details = *aa...aa*	Details Execution of the `tar` command failed. *aa...aa* : `tar` command output message Action See the details in the message, and then remove the cause of the error. For information about the error, collect the archive in the output directory specified at the

Message ID	Message Text	Explanation
		time of execution, and then contact your HDLM vendor or your maintenance company if you have a maintenance contract for HDLM.
KAPL10036-E	An attempt to compress the error information failed. Details = *aa...aa*	Details Execution of the `compress` command failed. *aa...aa* : `compress` command output message Action See the details in the message, and then remove the cause of the error. For information about the error, collect the archive in the output directory specified at the time of execution, and then contact your HDLM vendor or the maintenance company if you have a maintenance contract for HDLM.
KAPL10049-I	Error information collection command = *aa...aa*, Return value = *bb...bb*, Execution time = *cc...cc*	Details A command was executed to collect information targeted for collection. *aa...aa*: Executed command *bb...bb*: Return value of the executed command *cc...cc*: year (4 digits)/month/date hour:minute:second Action None.
KAPL10050-I	The utility for collecting HDLM error information started. Start time = *aa...aa* (GMT *aa...aa*)	Details The utility for collecting HDLM error information started. *aa...aa*: year (4 digits)/month/ date hour:minute:second Action None.
KAPL10521-W	A parameter is invalid. (parameter = *aa...aa*)	Details *aa...aa*: invalid parameter (character string) Action Execute help of the `dlmrmdev` utility to check the parameters that can be specified, and then retry. For details on the `dlmrmdev` utility, see *dlmrmdev Utility for Deleting HDLM Drivers on page 7-30*.

Message ID	Message Text	Explanation
KAPL10523-E	An attempt to unmount the file system has failed. (file system = *aa...aa*)	Details *aa...aa*: failed file system (character string) Action Make sure of the status of the failed file system and then re-execute the program. Unmount the failed file system manually and re-execute the program. For details on the `dlmrmdev` utility, see *dlmrmdev Utility for Deleting HDLM Drivers on page 7-30*.
KAPL10524-E	An attempt to inactivate the volume group has failed. (volume group = *aa...aa*)	Details An attempt to inactivate the volume group has failed. *aa...aa*: failed volume group (character string) Action Make sure of the status of failed volume group and then re-execute the program. Inactivate the failed volume group manually and re-execute the program. For details on the `dlmrmdev` utility, see *dlmrmdev Utility for Deleting HDLM Drivers on page 7-30*.
KAPL10525-E	An internal error occurred in the dlmrmdev utility. (error code = *aa...aa*)) Execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details In the `dlmrmdev` utility an error not caused by a user occurred. *aa...aa*: error code (decimal number) Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL10526-I	An attempt to unmount the file system has succeeded. (file system = *aa...aa*)	Details *aa...aa*: file system succeeded (character string) Action None.
KAPL10527-I	An attempt to inactivate the volume group has succeeded. (volume group = *aa...aa*)	Details *aa...aa*: volume group succeeded (character string) Action None.
KAPL10528-I	The volume group will be made inactive, and the file system	Details

Message ID	Message Text	Explanation
	that is using HDLM will be unmounted. Is this OK? [y/n]:	Notice unmount of the file system used by HDLM or inactivation of the volume group to prompt the users to make sure of the status. Action Type in "y" to continue the operation, or type "n" to stop the operation.
KAPL10529-I	All hdisks to be deleted were deleted successfully.	Details All hdisks for deletion were successfully removed. If the HDLM driver was configured, the HDLM manager has successfully stopped, and HDLM has stopped. Action None.
KAPL10530-E	Some hdisks could not be deleted.	Details The `dlmrmdev` command was executed, but some hdisks could not be deleted. Action Check the hdisk status and re-execute the `dlmrmdev` utility.
KAPL10531-I	The status of all of the HDLM drivers was changed to "Defined".	Action None.
KAPL10532-E	The status of one or more HDLM drivers could not be changed to "Defined".	Action Check the hdisk status and re-execute the `dlmrmdev` utility.
KAPL10551-I	The dlmpostrestore utility completed successfully.	Action None.
KAPL10552-I	Executing the dlmpostrestore utility will reconfigure the device. Is this OK? [y/n] :	Details Executing the `dlmpostrestore` utility will reconfigure the device. Action To execute dlmpostrestore utility, enter `y`. If you do not want to execute dlmpostrestore utility, enter `n`.
KAPL10553-W	Too many parameters have been specified.	Action With the `-h` parameter specified, execute the `dlmpostrestore` utility. Make sure that the format of the utility is correct, and then re-execute it.

Message ID	Message Text	Explanation
KAPL10554-W	A parameter is invalid. parameter = *aa...aa*	Details An invalid parameter is specified. *aa...aa*: The specified parameter Action With the `-h` parameter specified, execute the `dlmpostrestore` utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10555-I	Executing the dlmpostrestore utility will reboot the host. Is this OK? [y/n] :	Details Executing the `dlmpostrestore` utility will reboot the host. Action To execute `dlmpostrestore` utility, enter `y`. If you do not want to execute `dlmpostrestore` utility, enter `n`.
KAPL10556-W	The entered value is invalid. Re-enter. [y/n]:	Details A value other than y or n has been entered for a [`y`/`n`] request. Action Enter either `y` or `n`.
KAPL10557-I	The user stopped the operation.	Details The `dlmpostrestore` utility has been terminated because `n` was sent to a request. Action None.
KAPL10558-E	The entered value is invalid. The operation will now stop.	Details The `dlmpostrestore` utility has been stopped because an invalid response was sent three times consecutively to a request. Action To execute dlmpostrestore utility again, enter either `y` or `n`.
KAPL10559-E	An internal error occurred in the dlmpostrestore utility. Error Code = *aa...aa*, *bb...bb*	Details A system-based error, not caused by the user, occurred during `dlmpostrestore` utility processing. *aa...aa*: Error number (decimal number) *bb...bb*: Return code (decimal number)

Message ID	Message Text	Explanation
		Action If the error code is 3 or 1: Stop all of the processes and services that access the HDLM management-target device, and then restart the `dlmpostrestore` utility. Any other error code: Contact your HDLM vendor or the maintenance company, if you have an HDLM maintenance contract.
KAPL10560-E	The system environment is invalid. Error Code = *aa...aa*	Details The system environment is not valid as an environment for executing the `dlmpostrestore` utility. *aa...aa*: Error number (decimal number) Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL10561-I	A user operation ended dlmpostrestore utility.	Details The `dlmpstrestore` process has been terminated by an operation such as Ctrl+C. Action None.
KAPL10571-I	The dlmchpdattr utility completed successfully.	Action None.
KAPL10572-W	No parameter has been specified.	Action With the `-h` parameter specified, execute the `dlmchpdattr` utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10573-W	A parameter is invalid. parameter = *aa...aa*	Details An invalid parameter is specified. *aa...aa*: The specified parameter Action With the `-h` parameter specified, execute the `dlmchpdattr` utility. Make sure that the format of the utility is correct, and then re-execute it.

Message ID	Message Text	Explanation
KAPL10574-W	The specified parameters cannot be specified at the same time. parameter = *aa...aa*	Details *aa...aa*: The specified parameter Action With the -h parameter specified, execute the dlmchpdattr utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10575-W	No parameter value has been specified.	Action With the -h parameter specified, execute the dlmchpdattr utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10576-W	A parameter value is invalid. parameter value = *aa...aa*	Details An invalid parameter value has been specified. *aa...aa*: The specified parameter value Action With the -h parameter specified, execute the dlmchpdattr utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10577-W	An attribute is invalid. attribute = *aa...aa*	Details An invalid attribute has been specified. *aa...aa*: The specified attribute Action With the -h parameter specified, execute the dlmchpdattr utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10578-W	An attribute value is invalid. attribute value = *aa...aa*	Details An invalid attribute value is specified. *aa...aa*: The specified attribute Action With the -h parameter specified, execute the dlmchpdattr utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10579-I	The HDLM default values will be changed. Is this OK? [y/n]:	Details

Message ID	Message Text	Explanation
		This message confirms whether it is okay to execute the dlmchpdattr utility. Action With the -h parameter specified, execute the dlmchpdattr utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL10580-W	The entered value is invalid. Re-enter. [y/n]:	Details A value other than y or n has been entered for a [y/n] request. Action Enter either "y" or "n".
KAPL10581-I	The user stopped the operation.	Details The dlmchpdattr utility was terminated because the response to a request was "n". Action None.
KAPL10582-E	The entered value is invalid. The operation will now stop.	Details The dlmchpdattr utility has been stopped because an invalid response was sent three times consecutively to a request. Action To execute dlmchpdattr utility again, enter either "y" or "n".
KAPL10583-E	An internal error occurred in the dlmchpdattr utility. Error Code = *aa...aa*,*bb...bb*	Details A system-based error, not caused by the user, occurred during dlmchpdattr utility processing. *aa...aa*: Error number (decimal number) *bb...bb*: Return code (decimal number) Action If the error code is 9,1: Confirm that all of the processes and services that use HDLM managed paths have stopped, and then restart them. If the error code is 19,1: Check for path errors. If there is a path error, restore the path status and then retry.

Message ID	Message Text	Explanation
		Contact your HDLM vendor or the maintenance company, if you have an HDLM maintenance contract. Any other error code:
KAPL10584-E	The system environment is invalid. Error Code = *aa...aa*,*bb...bb*	Details The system environment is not valid as an environment for executing the `dlmchpdattr` utility. *aa...aa*: Error number (decimal number) *bb...bb*: Return code (decimal number) Action If the error code is `3`,`2` or `4`,`-1`: The `dlmrmdev` utility is not in the default location, or the user does not have execution permissions for the `dlmrmdev` utility. Check the status of the `dlmrmdev` utility. If the error code is `6`,`2` or `7`,`-1`: The `bosboot` command is not in the default location, or the user does not have execution permissions for the `bosboot` command. Check the status of the `bosboot` command. If the error code is `9`,`2` or `10`,`-1`: The `dlmpr` utility is not in the default location, or the user does not have execution permissions for the `dlmpr` utility. Check the status of the `dlmpr` utility. If the error code is `11`,`2` or `12`,`-1`: The `mkdev` command is not in the default location, or the user does not have execution permissions for the `mkdev` command. Check the status of the `mkdev` command. Any other error code: Contact your HDLM vendor or the maintenance company, if you have an HDLM maintenance contract.
KAPL10585-I	Reboot the host.	Details

Message ID	Message Text	Explanation
		Reboot the host to apply the changes to the settings. Action None.
KAPL10586-I	Processing terminated before completion because a signal was received.	Details The `dlmchpdattr` process has been terminated by an operation such as Ctrl+C. Action None.
KAPL10587-W	The specified ODM is not installed. parameter value = *aa...aa*	Details The specified ODM is not installed. *aa...aa*: Specified parameter value Action Specify an ODM that has been installed, and then retry the operation.
KAPL10588-W	A duplicate attribute has been specified. attribute = *aa...aa*	Details A duplicate attribute has been specified. *aa...aa*: Specified attribute Action Delete the duplicate attribute, and then retry the operation.
KAPL10641-I	Reservation Key will now be cleared. Is this OK? [y/n]:	Details Enter `y` to clear and `n` to not clear the Reservation Key. Action Enter `y` or `n`.
KAPL10642-I	Reservation Key of *aa...aa* was cleared.	Details The Reservation Key has been cleared. *aa...aa*: logical device file name for the HDLM management-target device Action None.
KAPL10643-W	A necessary parameter is not specified.	Details A parameter is not specified for the `dlmpr` utility. Action Execute the `dlmpr -h` utility to check the parameter, and then retry execution. For details on the `dlmpr` utility, see *dlmpr Utility for*

Message ID	Message Text	Explanation
		Clearing HDLM Persistent Reservation on page 7-26.
KAPL10644-W	The specified parameters cannot be specified at the same time. parameter = *aa...aa*	Details The specified parameters cannot be specified for the `dlmpr` utility at the same time. *aa...aa*: specified parameter (character string) Action Execute the `dlmpr -h` utility to check the parameter, and then retry execution. For details on the `dlmpr` utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.
KAPL10645-W	A parameter value is invalid. parameter = *aa...aa*	Details An invalid parameter value has been specified for the `dlmpr` utility. *aa...aa*: specified parameter (character string) Action Specify the correct value for the parameter, and then retry. For details on the `dlmpr` utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.
KAPL10646-W	A parameter is invalid. parameter = *aa...aa*	Details An invalid parameter has been specified for the `dlmpr` utility. *aa...aa*: specified parameter (character string) Action Execute help of the `dlmpr` utility to check the parameters that can be specified, and then retry. For details on the `dlmpr` utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.
KAPL10648-E	An internal error occurred in the dlmpr utility. Error Code = *aa...aa*	Details An error not caused by the user has occurred in the `dlmpr` utility. *aa...aa*: error number (decimal number) Action

Message ID	Message Text	Explanation
		If a message with `Error Code = 35` is output, check for the hdisk was deleted. If the hdisk was deleted, recover the state of the hdisk and then retry. If the KAPL10648-E message has been issued but the hdisk was not deleted, contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. If a message with `Error Code = 36` is output, check for a path error. If there is a path error, restore the path status and then retry. If the KAPL10648-E message has been issued but there is no path error, contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL10649-E	*aa...aa*: An attempt to perform Reservation Key clear processing has failed. Make sure that an error has not occurred in the HDLM-management target device, and that the device can be managed by HDLM. If either of the above conditions are not met, execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details An attempt to perform Reservation Key clear processing has failed. *aa...aa*: Hdisk name Action Make sure that an error has not occurred in the HDLM-management target device, and that the device can be managed by HDLM. If either of the above conditions are not met, contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL10650-I	*aa...aa*: NO RESERVATION	Details A LU has not been reserved. *aa...aa*: Hdisk name Action None.
KAPL10651-I	The user terminated the operation.	Details The `dlmpr` utility has been terminated because `n` was sent to a request. Action None.
KAPL10652-E	The entered value is invalid. The operation stops.	Details

Message ID	Message Text	Explanation
		An invalid response was sent three times consecutively to a request. Action Re-execute the dlmpr utility.
KAPL10653-W	The entered value is invalid. Please re-enter it [y/n]:	Details A value other than y or n has been entered for a [y/n] request. Action Enter y or n.
KAPL10665-I	The dlmpr utility completed.	Details The dlmpr utility completed normally. Action None. For details on the dlmpr utility, see *dlmpr Utility for Clearing HDLM Persistent Reservation on page 7-26*.
KAPL10670-I	*aa...aa*: The HDLM driver's hdisk, which is the boot disk, was excluded from the hard disks subject to the clear operation.	Details *aa...aa*: Hdisk name Action If you want to clear the Reservation Key of the HDLM driver's hdisk, which is t he boot disk, specify and execute the dlmpr utility to clear the HDLM persistent reservation.
KAPL10800-I	The dlmodmset utility completed normally.	Details The dlmodmset utility completed normally. Action None. For details on the dlmodmset utility, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*.
KAPL10801-W	No parameter has been specified. operation = *aa...aa*	Details No parameter has been specified. *aa...aa*: Specified operation (character string) Action Execute help of the dlmodmset utility to check the parameters that can be specified, and then retry. For details on the

Message ID	Message Text	Explanation
		dlmodmset utility, see KAPL08001 to KAPL09000 on page 8-48.
KAPL10802-W	A parameter is invalid. operation = *aa...aa*, parameter = *bb...bb*	Details The specified parameter is invalid. *aa...aa*: Specified operation (character string) *bb...bb*: invalid parameter (character string) Action Execute help of the dlmodmset utility to check the parameters that can be specified, and then retry. For details on the dlmodmset utility, see KAPL08001 to KAPL09000 on page 8-48.
KAPL10804-E	An internal error occurred in the dlmodmset utility. Error Code = *aa...aa* Execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Details An error not caused by the user has occurred in the dlmodmset utility. *aa...aa*: Error Code (character string) Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM. For details on the dlmodmset utility, see KAPL08001 to KAPL09000 on page 8-48.
KAPL10805-I	The setup of the HDLM execution environment ODM will be changed. *aa...aa* = *bb...bb*. Is this OK? [y/n]:	Details We recommend that you report the setup of the HDLM execution environment ODM that you want to change to the user for confirmation. *aa...aa*: Lun Reset, Online(E) IO Block (character string) *bb...bb*: on, off (character string) Action Enter y to execute setup, or enter n to cancel.
KAPL10806-W	The entered value is invalid. Re-enter [y/n]:	Details A value other than y or n has been entered for a [y/n] request. Enter [y/n]. Action Enter y or n.

Message ID	Message Text	Explanation
KAPL10807-E	The entered value is invalid. The operation stops.	Details An invalid response was sent three times consecutively to a request. Action Re-execute the `dlmodmset` utility.
KAPL10808-I	The user terminated the operation.	Details The utility has been terminated because n was sent to a request. Action None.
KAPL10809-W	No operation has been specified.	Details No operation has been specified. Action Execute help of the `dlmodmset` utility to check the operations that can be specified, and then retry. For details on the `dlmodmset` utility, see *KAPL08001 to KAPL09000 on page 8-48*.
KAPL10810-W	An operation is invalid. operation = *aa...aa*	Details The specified operation is invalid. *aa...aa*: invalid operation (character string) Action Execute help of the `dlmodmset` utility to check the operations that can be specified, and then retry. For details on the `dlmodmset` utility, see *KAPL08001 to KAPL09000 on page 8-48*.

KAPL11001 to KAPL12000

Message ID	Message Text	Explanation
KAPL11901-I	*aa...aa* has started.	Details The operation has started on the host. *aa...aa*: Operation (character string) ◦ Get Path Information ◦ Get Option Information ◦ Set Option Information ◦ Clear Data

Message ID	Message Text	Explanation
		○ Get HDLM Manager Status ○ Get HDLM Driver Status ○ Get HDLM Alert Driver Status ○ Get SNMP Trap Information ○ Set SNMP Trap Information ○ Set LU Load Balance ○ Get Path Status Log Information ○ Get Local Time ○ Add Path Information ○ Delete Path Information ○ Set Storage Identification Information Action None.
KAPL11902-I	*aa...aa* has started. PathID = *bb...bb*	Details The operation has started on the management-target host. *aa...aa*: Operation (character string) ○ Online ○ Offline *bb...bb*: The Path ID of the target path (decimal number) Action None.
KAPL11903-I	*aa...aa* has completed normally.	Details The operation has completed normally on the host. *aa...aa*: Any of the following operations (character string) ○ Get Path Information ○ Get Option Information ○ Set Option Information ○ Clear Data ○ Get HDLM Driver Status ○ Get HDLM Manager Status ○ Get HDLM Alert Driver Status ○ Online ○ Offline ○ Get SNMP Trap Information ○ Set SNMP Trap Information ○ Set LU Load Balance

Message ID	Message Text	Explanation
		○ Get Path Status Log Information ○ Get Local Time ○ Add Path Information ○ Delete Path Information ○ Set Storage Identification Information Action None.
KAPL11904-E	*aa...aa* has completed abnormally. Error status = *bb...bb*	Details The operation has completed abnormally on the host. *aa...aa*: Operation (character string) ○ Get Path Information ○ Get Option Information ○ Set Option Information ○ Clear Data ○ Get HDLM Driver Status ○ Get HDLM Manager Status ○ Get HDLM Alert Driver Status ○ Online ○ Offline ○ Get SNMP Trap Information ○ Set SNMP Trap Information ○ Set LU Load Balance ○ Get Path Status Log Information ○ Add Path Information ○ Delete Path Information ○ Set Storage Identification Information *bb...bb*: Error status returned from API (character string) Action Execute the `DLMgetras` utility for collecting HDLM error information to collect the error information, and then contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL11905-E	An unexpected error occurred.	Details

Message ID	Message Text	Explanation
		An exception occurred during processing on the host. Action Execute the DLMgetras utility for collecting HDLM error information to collect the error information, and then contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
KAPL11906-I	GUI information - *aa...aa*	Details This information is required for resolving problems. *aa...aa*: Trace information Action None.
KAPL11907-I	XML reception - *aa...aa*	Details This information is required for resolving problems. *aa...aa*: XML information Action None.
KAPL11908-I	XML transmission - *aa...aa*	Details This information is required for resolving problems. *aa...aa*: XML information Action None.

KAPL13001 to KAPL14000

Message ID	Message Text	Explanation
KAPL13001-I	The dlmmigsts utility completed successfully.	Action None.
KAPL13002-E	The dlmmigsts utility ended abnormally.	Action Refer to action of the message outputted just before this message.
KAPL13003-I	The specified file already exists. Do you want to overwrite it? [y/n]:	Action

Message ID	Message Text	Explanation
		To overwrite the specified file, enter `y`. To stop execution, enter `n`.
KAPL13004-W	The entered value is invalid. Re-enter. [y/n]:	Action Enter either `y` or `n`.
KAPL13005-E	The entered value is invalid. The operation will now stop.	Action To execute `dlmmigsts` again, re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13006-I	The user stopped the operation.	Action To execute `dlmmigsts` again, re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13007-W	No parameter has been specified.	Action Specify the `-h` option in the HDLM migration support utility, confirm the option that should be specified, and then re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13008-W	A parameter is invalid. parameter = *aa...aa*	Details *aa...aa*: Parameter (character string) Action Specify the `-h` option in the HDLM migration support utility, confirm the option that should be specified, and then re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13009-W	No parameter value has been specified. parameter = *aa...aa*	Details *aa...aa*: Parameter (character string) Action Specify the `-h` option in the HDLM migration support utility, confirm the option that should be specified, and then re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for*

Message ID	Message Text	Explanation
		Assisting HDLM Migration on page 7-20.
KAPL13010-W	The specified file does not exist. parameter = *aa...aa*, Filename = *bb...bb*	Details *aa...aa*: Parameter (character string) *bb...bb*: Filename (character string) Action If parameter = `-odm`, specify odmsetfile in `dlmmigsts` again, and then re-execute.If parameter = `-set`, specify dlnksetfile in `dlmmigsts` again, and then re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13011-W	The number of parameters is insufficient.	Action Specify the `-h` option in the HDLM migration support utility, confirm the option that should be specified, and then re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13012-W	Too many parameters have been specified.	Action Specify the `-h` option in the HDLM migration support utility, confirm the option that should be specified, and then re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13013-E	The directory for storing the specified file could not be created. Filename = *aa...aa*	Details *aa...aa*: Filename (character string) Action There is not enough capacity to store the specified file in the directory. Make sure there is enough capacity, and then try again. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*.
KAPL13014-E	An internal error occurred in the dlmmigsts utility. Error Code = *aa...aa* Execute the DLMgetras	Details *aa...aa*: Error Code (decimal number)

Message ID	Message Text	Explanation
	utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL13015-E	There is an invalid character in the file. parameter = *aa...aa*, Filename = *bb...bb*	Details *aa...aa*: Parameter (character string) *bb...bb*: Filename (character string) Action If parameter = `-odm`, execute `dlmodmset` one after another, or specify the modified `odmsetfile` in `dlmmigsts` again, and then re-execute. For details about the `dlmmigsts` utility, see *dlmmigsts Utility for Assisting HDLM Migration on page 7-20*. For details on the `dlmodmset` utility, see *dlmodmset Utility for Setting the HDLM Execution Environment ODM on page 7-22*. If parameter = `-set`, execute `dlnkmgr set` one after another, or specify the modified `dlnksetfile` in `dlmmigsts` again, and then re-execute.
KAPL13016-E	The backup operation cannot be performed because DLManager.rte is not installed.	Action Execute the `dlmmigsts` utility in an environment where `DLManager.rte` is installed.
KAPL13017-E	The restoration operation cannot be performed because DLManager.mpio.rte is not installed.	Action Install `DLManager.mpio.rte`, and then execute the `dlmmigsts` utility again.
KAPL13018-E	The backup operation cannot be performed because there is no /usr/DynamicLinkManager/config/dlmmgr.xml file. Execute the DLMgetras utility to collect error information, and then contact your vendor or maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL13019-E	The same file name was specified for odmsetfile and	Details

Message ID	Message Text	Explanation
	dlnksetfile. Filename = *aa...aa*, *bb...bb*	*aa...aa*: odmsetfile Filename *bb...bb*: dlnksetfile Filename Action Check file name, and then try again.
KAPL13020-E	The file odmsetfile was not restored.	Action Check file name, and then try again.
KAPL13021-E	The file dlnksetfile was not restored.	Action Check file name, and then try again.
KAPL13101-I	The dlmpreremove utility completed successfully.	Action None.
KAPL13102-I	HDLM can now be removed.	Action None.
KAPL13103-I	HDLM can be removed after rebooting the host.	Action None.
KAPL13104-I	The settings will be changed so that the HDLM driver is not configured on the hdisk. Is this OK? [y/n]	Action To execute `dlmpreremove`, enter `y`. If you do not want to execute `dlmpreremove`, enter `n`.
KAPL13105-W	The entered value is invalid. Re-enter. [y/n]:	Action Enter either `y` or `n`.
KAPL13106-E	The entered value is invalid. The operation will now stop.	Details The `dlmpreremove` utility has been stopped because an invalid response was sent three times consecutively to a request. Action To execute `dlmpreremove` again, enter either `y` or `n`.
KAPL13107-I	The user stopped the operation.	Details The `dlmpreremove` utility has been terminated because `n` was sent to a request. Action None.
KAPL13108-E	An internal error occurred in the dlmpreremove utility. Error Code = *aa...aa*, *bb...bb* Execute the DLMgetras utility to collect error information, and then contact your vendor or	Details A system-based error, not caused by the user, occurred during `dlmpreremove` utility processing.

Message ID	Message Text	Explanation
	maintenance company. Refer to the HDLM User's Guide for instructions how to execute the DLMgetras utility.	*aa...aa*: The error number which specifies the performed processing (decimal number) *bb...bb*: Return value of the executed processing (decimal number) Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL13109-W	A parameter is invalid. parameter = *aa...aa*	Details An invalid parameter is specified. *aa...aa*: The specified parameter (character string) Action With the `-h` parameter specified, execute the HDLM pre-remove utility (`dlmpreremove`). Make sure that the parameters that should be specified are correct, and then re-execute. For details about the `dlmpreremove` utility, see *dlmpreremove Utility for Executed Before Removing HDLM on page 7-29*.
KAPL13110-E	The dlmpreremove utility cannot be executed because the HDLM driver is running. Execute the dlmrmdev utility, and then re-execute the dlmpreremove utility.	Action Execute the `dlmrmdev` command, and then re-execute the `dlmpreremove`. For details about the `dlmrmdev` utility, see *dlmrmdev Utility for Deleting HDLM Drivers on page 7-30*.For details about the `dlmpreremove` utility, see *dlmpreremove Utility for Executed Before Removing HDLM on page 7-29*.
KAPL13141-I	The dlmpremkcd utility completed successfully.	Details The dlmpremkcd utility completed successfully. Action None.
KAPL13142-W	No parameters were specified.	Details No parameters were specified. Action With the -h parameter specified, execute the dlmpremkcd utility. Make sure that the format of the utility is correct, and then re-execute it.

Message ID	Message Text	Explanation
KAPL13143-W	A parameter is invalid. parameter = *aa...aa*	Details An invalid parameter is specified. *aa...aa*: The specified parameter Action With the -h parameter specified, execute the dlmpremkcd utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL13144-W	The specified parameters cannot be specified at the same time. parameter = *aa...aa*	Details The specified parameters cannot be specified at the same time. *aa...aa*: The specified parameter Action With the -h parameter specified, execute the dlmpremkcd utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL13145-I	The dlmpremkcd utility will be executed. Is this OK? [y/n]:	Details This message confirms whether it is okay to execute the dlmpremkcd utility. Action To execute the dlmpremkcd utility, enter "y". If you do not want to execute the dlmpremkcd utility, enter "n".
KAPL13146-W	The entered value is invalid. Re-enter. [y/n]:	Details A value other than y or n has been entered for a [y/n] request. Action Enter either "y" or "n".
KAPL13147-I	The user stopped the operation.	Details The dlmpremkcd utility was terminated because the response to a request was "n". Action None.
KAPL13148-E	The entered value is invalid. The operation will now stop.	Details The dlmpremkcd utility has been stopped because an invalid response was sent three times consecutively to a request. Action

Message ID	Message Text	Explanation
		To execute dlmpremkcd utility again, enter either "y" or "n".
KAPL13149-E	An internal error occurred in the dlmpremkcd utility. Error Code = *aa...aa*,*bb...bb*	Details A system-based error, not caused by the user, occurred during dlmpremkcd utility processing. *aa...aa*: Error number (decimal number) *bb...bb*: Return code (decimal number) Action Contact your HDLM vendor or the maintenance company, if you have an HDLM maintenance contract.
KAPL13150-E	The system environment is invalid. Error Code = *aa...aa*,*bb...bb*	Details The system environment is not valid as an environment for executing the dlmpremkcd utility. *aa...aa*: Error number (decimal number) *bb...bb*: Return code (decimal number) Action Contact your HDLM vendor or the maintenance company, if you have an HDLM maintenance contract.
KAPL13151-I	Processing terminated before completion because a signal was received.	Details The dlmpremkcd process has been terminated by an operation such as Ctrl+C. Action None.
KAPL13157-I	The dlmrmprshkey utility completed successfully.	Details The dlmrmprshkey utility completed successfully. Action None.
KAPL13158-W	No parameter has been specified.	Details No parameter has been specified. Action With the -h parameter specified, execute the dlmrmprshkey utility. Make sure that the format of the utility is correct, and then re-execute it.

Message ID	Message Text	Explanation
KAPL13159-W	A parameter is invalid. parameter = *aa...aa*	Details An invalid parameter is specified. *aa...aa*: The specified parameter Action With the -h parameter specified, execute the dlmrmprshkey utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL13160-W	The specified parameters cannot be specified at the same time. parameter = *aa...aa*	Details The specified parameters cannot be specified at the same time. *aa...aa*: The specified parameter Action With the -h parameter specified, execute the dlmrmprshkey utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL13161-W	No parameter value has been specified.	Details No parameter value has been specified. Action With the -h parameter specified, execute the dlmrmprshkey utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL13162-W	A parameter value is invalid. parameter value = *aa...aa*	Details An invalid parameter value has been specified. *aa...aa*: The specified parameter value Action With the -h parameter specified, execute the dlmrmprshkey utility. Make sure that the format of the utility is correct, and then re-execute it.
KAPL13163-I	The dlmrmprshkey utility will now be executed. Is this OK? [y/n]:	Details This message confirms whether it is okay to execute the dlmrmprshkey utility. Action To execute the dlmrmprshkey utility, enter "y". If you do not

Message ID	Message Text	Explanation
		want to execute the dlmrmprshkey utility, enter "n".
KAPL13164-W	The entered value is invalid. Re-enter. [y/n]:	Details A value other than y or n has been entered for a [y/n] request. Action Enter either "y" or "n".
KAPL13165-I	The user stopped the operation.	Details The dlmrmprshkey utility was terminated because the response to a request was "n". Action None.
KAPL13166-E	The entered value is invalid. The operation will now stop.	Details The dlmrmprshkey utility has been stopped because an invalid response was sent three times consecutively to a request. Action To execute dlmrmprshkey utility again, enter either "y" or "n".
KAPL13167-E	An internal error occurred in the dlmrmprshkey utility. Error Code = *aa...aa*,*bb...bb*	Details A system-based error, not caused by the user, occurred during dlmrmprshkey utility processing. *aa...aa*: Error number (decimal number) *bb...bb*: Return code (decimal number) Action When the error code is 21,N, 24,N, 26,N, or 28,N: Check for path errors. If there is a path error, recover the path from the error, and then retry the operation. When the error code is 30,N; The target device might not be using persistent reservations (shared-host methodology). Use the dlmpr utility to check whether the target device is using persistent reservations (shared-host methodology). All other error codes: Contact your HDLM vendor or, if you have an HDLM maintenance contract, the maintenance company.

Message ID	Message Text	Explanation
KAPL13168-E	The system environment is invalid. Error Code = *aa...aa*,*bb...bb*	Details The system environment is not valid as an environment for executing the dlmrmprshkey utility. *aa...aa*: Error number (decimal number) *bb...bb*: Return code (decimal number) Action Contact your HDLM vendor or the maintenance company, if you have an HDLM maintenance contract.
KAPL13169-W	The specified device is not targeted for processing. device name = *aa...aa*	Details A device not targeted for processing was specified. *aa...aa*: Specified device name Action None.
KAPL13170-I	Processing terminated before completion because a signal was received.	Details The dlmrmprshkey process has been terminated by an operation such as Ctrl+C. Action None.
KAPL13171-I	If you execute the dlmrmprshkey utility and the server on which the specified key value has been registered attempts to access an LU, the attempt might fail with an error.	Details This message is a warning to users before they execute the dlmrmprshkey utility. Action None.
KAPL13601-W	The audit log configuration file does not exist. Restart the HDLM Manager, and execute the "dlnkmgr view -sys -audlog" command and check the setting.	Details The audit log configuration file does not exist. Action Restart the HDLM manager, execute the "`dlnkmgr view -sys -audlog`" command, and then specify any desired settings by using the "`dlnkmgr set -audlog`" command or the "`dlnkmgr set -audfac`" command as necessary.
KAPL13602-W	The audit log configuration file cannot be opened. Execute the "dlnkmgr view -sys -audlog"	Details The audit log configuration file cannot be opened.

Message ID	Message Text	Explanation
	command and check whether a normal result is displayed.	Action If the "dlnkmgr view -sys -audlog" command does not display a normal result, contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM.
KAPL13603-W	The audit log configuration file is invalid. Restart the HDLM Manager, and execute the "dlnkmgr view -sys -audlog" command and check the setting.	Details The audit log configuration file is invalid. Action Restart the HDLM Manager, and execute the "dlnkmgr view -sys -audlog" command, and then specify the desired setting by using the "dlnkmgr set -audlog" or the "dlnkmgr set -audfac" command as necessary.
KAPL13604-W	An error occurred during processing to read the audit log configuration file.	Details An internal error occurred during processing to read the audit log configuration file. Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL13605-W	An error occurred during processing to output the audit log configuration file.	Details An internal parameter error occurred during output of the audit log data. Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL13606-W	An error occurred during processing to output the audit log configuration file.	Details An internal error occurred during output of the audit log data. Action Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.

KAPL15001 to KAPL16000

Message ID	Message Text	Explanation
KAPL15001-I	The registered value of ReserveKey was successfully displayed. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15002-E	An attempt to display the registered value of ReserveKey has failed. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15005-I	Information of HDLM execution environment ODM was successfully displayed. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15008-I	ReserveKey was cleared successfully on *aa...aa* hdisk(s) and failed on *bb...bb* hdisk(s). Command Line =*cc..cc*	Details *aa...aa*: Number of hdisks for which ReserveKey was cleared successfully. *bb...bb*: Number of hdisks for which ReserveKey was not cleared. *cc...cc*: Name of the utility that the user executed
KAPL15009-E	An attempt to clear ReserveKey has failed on *aa...aa* hdisk(s). Command Line = *bb...bb*	Details *aa...aa*: Number of hdisks for which ReserveKey was not cleared. *bb...bb*: Name of the utility that the user executed
KAPL15010-W	The HDLM utility was executed by the user who does not have the authority. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15060-I	DLMgetras was invoked. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15061-I	DLMgetras successfully executed. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15080-I	The information about the HDLM default configuration ODM was displayed successfully. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15081-E	An attempt to display the information about the HDLM default configuration ODM has failed. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed

Message ID	Message Text	Explanation
KAPL15082-I	The information about the HDLM default configuration ODM was changed successfully. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15083-E	An attempt to change the information about the HDLM default configuration ODM has failed. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15084-I	dlmgetrasinst was invoked. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15085-I	dlmgetrasinst successfully executed. Command Line = *aa...aa*	Details *aa...aa*: Name of the utility that the user executed
KAPL15088-I	Addition processing completed successfully. Command line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15089-E	Addition processing ended abnormally. Command line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15090-I	Deletion processing completed successfully. Command line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15091-E	Deletion processing ended abnormally. Command line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15092-I	The command execution server was cleared from the PR_shared reservation for the target device. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15093-I	The server on which the specified key has been registered was cleared from the PR_shared reservation for the target device. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15094-E	An attempt to clear the server from the PR_shared reservation for the target device has failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15101-I	Clear operation was completed successfully. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15102-E	Clear operation has failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed

Message ID	Message Text	Explanation
KAPL15103-I	*aa...aa* path(s) were successfully placed *bb...bb*. *cc...cc* path(s) were not. Command Line = *bb...bb*	Details *aa...aa*: Number of paths where online/offline is successful *bb...bb*: `Online`, `Online(S)`, `Online(D)` or `Offline(c)` *cc...cc*: Number of paths where online/offline is unsuccessful
KAPL15104-W	*aa...aa* path(s) were failed to place *bb...bb*. Command Line = *cc...cc*	Details *aa...aa*: Number of paths that failed to be placed online or offline *bb...bb*: `Online` or `Offline(c)` *cc...cc*: Command that the user executed
KAPL15105-I	Setting up the operating environment succeeded. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15106-E	Setting up the operating environment failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15107-I	Program information was successfully displayed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15108-E	An attempt to display program information has failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15109-I	Information about HDLM-management targets was successfully displayed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15110-E	An attempt to display information about HDLM-management targets has failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15111-W	The HDLM command was started or stopped by the user who does not have the authority. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15116-I	*bb...bb* path(s) were successfully placed *aa...aa*. *dd...dd* path(s) were successfully placed *cc...cc*. *ee...ee* path(s) were not. Command Line = online	Details *aa...aa*: `Online` or `Online(S)` *bb...bb*: The number of paths which changed to the `Online` or `Online(S)` status *cc...cc*: `Online(S)`, `Online(D)` or `Online(S)`/`Online(D)`

Message ID	Message Text	Explanation
		dd...dd: The number of paths which changed to the `Online(S)` or `Online(D)` status *ee...ee*: The number of paths which failed to change to either the `Online`, `Online(S)` or `Online(D)` status
KAPL15117-I	Addition of path(s) succeeded. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15118-W	Addition of path(s) failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15119-I	Deletion of path(s) succeeded. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15120-W	Deletion of path(s) failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15121-I	The storage system settings were successfully refreshed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15122-W	The refresh of the storage system settings failed. Command Line = *aa...aa*	Details *aa...aa*: Command that the user executed
KAPL15401-I	HDLM Manager successfully started.	
KAPL15402-E	Could not start the HDLM manager.	
KAPL15403-I	HDLM Manager successfully stopped.	
KAPL15404-W	The HDLM Manager was executed by the user who does not have the authority.	

Return Codes for Hitachi Command Suite Common Agent Component

When an operation requested of HDLM from Global Link Manager terminates abnormally, or terminates normally with a warning, HDLM outputs one of the return codes described below.

Message ID	Explanation
1002	Details There is no path on which the operation can be performed. Action Refresh the host information, check the path status, and then perform the operation again.
1003	Details No path was detected. Action Check whether a path between the host and the storage system is connected. If a path is connected, check whether HDLM is configured correctly.
1004	Details Memory required for HDLM internal processing could not be allocated. Action Terminate unnecessary applications to increase free memory, or restart the host.
1006	Details An Offline path cannot be placed Online. Action Remove the error in the path, and then retry.
1007	Details The target path of the offline operation is the last, remaining path connected to the device and therefore, cannot be placed in the offline status. Action Click Refresh to update the host information, check the path status, and then retry the offline operation.
1015	Details The Offline path cannot be placed Online. Action Remove the error in the path, and then retry.
1016	Details The target path(s) are already Online. Action Update the host information, and then check the path status.
1017	Details The target path(s) are already Offline(C). Action Update the host information, and then check the path status.
1019	Details

Message ID	Explanation
	An error occurred during HDLM internal processing. Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if you have a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1020	Details An unexpected error occurred during HDLM internal processing. Action Execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or the maintenance company if you have a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1025	Details A parameter value is invalid. Action Refresh the host information, and then perform the operation again. If the same error occurs again, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if you have a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1026	Details The acquisition of path information has been aborted, because the path configuration was changed while the system was attempting to acquire the path information. Action Refresh the host information, check the path status, and then perform the operation again.
1027	Details The error monitoring interval and the number of times that the error needs to occur are conflicting with the automatic failback-checking interval. Action Set the intermittent error-monitoring interval to a value that is equal to or greater than (automatic- failback-checking-interval x number-of-times-*error-is-to-occur-for-intermittent-error-monitoring*).
1033	Details An attempt to acquire the HDLM version information failed. Action

Message ID	Explanation
	Re-execute the command. If the same error occurs again, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1034	Details An attempt to acquire information about the HDLM version or SP version has failed. Action Re-execute the command. If the same error occurs again, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1035	Details An attempt to acquire information about the HDLM version or SP version has failed. Action Re-execute the command. If the same error occurs again, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1036	Details An attempt to acquire information about the HDLM version or SP version has failed. Action Re-execute the command. If the same error occurs again, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if there is a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1037	Details A parameter is invalid. Action Refresh the host information, and then perform the operation again. If the same error occurs again, execute the DLMgetras utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if you have a maintenance contract for HDLM. For details on the DLMgetras utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1041	Details An attempt to communicate with the HDLM manager has failed.

Message ID	Explanation
	Action Check whether the HDLM manager is running on the host. If it is not running, start the HDLM manager.
1042	Details Information about the path configuration on the specified LU does not match the path configuration information held by HDLM. Action Refresh the host information, check the path status, and then perform the operation again.
1045	Details A parameter is invalid. Action Refresh the host information, and then perform the operation again. If the same error occurs even again, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if you have a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1046	Details A parameter is invalid. Action Refresh the host information, and then perform the operation again. If the same error occurs again, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if you have a maintenance contract for HDLM. For details on the `DLMgetras` utility, see *DLMgetras Utility for Collecting HDLM Error Information on page 7-5*.
1063	Details An attempt to update `global-active device non-preferred path option` failed. Action If a path error occurs during an update operation and this message is output, perform recovery for the path error to return the path to the online status, and then try the operation again. If this message is output when there are no offline paths, execute the `DLMgetras` utility for collecting HDLM error information, and then contact your HDLM vendor or maintenance company if you have a maintenance contract for HDLM.

A

Functional Differences Between Versions of HDLM

This section explains the functional differences between newer and older versions of HDLM.

Functional Differences Between Version 6.2 and Versions Earlier than 6.2

- In HDLM version 6.1.0 or earlier, when you create a system replication (clone) on another LPAR or host from an mksysb image by using the `mksysb` command provided by the OS, you needed to remove HDLM before executing the `mksysb` command.

  In HDLM version 6.2.0 or later, you do not need to remove HDLM before executing the `mksysb` command. You can now execute the HDLM restoration support utility (`dlmpostrestore`) after creating a system replication, so that HDLM information can now be updated according to the destination system's environment.
- For HDLM 6.1.0 or earlier, a physical volume (hdisk) might have been changed during an unattended upgrade installation or re-installation of HDLM. For HDLM 6.2.0, a physical volume (hdisk) is not changed during an upgrade installation or re-installation of HDLM.

Functional Differences Between Version 6.1 and Versions Earlier than 6.1

- In a new installation of HDLM, the default load balancing algorithm has been changed from the Round Robin algorithm to the Extended Least I/Os algorithm.

Functional Differences Between Version 6.0 or Later and Versions Earlier than 6.0

- The HDLM installation function provided by the `dlmsetup` utility for HDLM installation configuration support has been integrated into the `installhdlm` utility for HDLM installation.
- The way the HDLM version is displayed in execution results of HDLM commands or utilities has been changed.
- In a new installation of HDLM, the default value for the automatic failback function has been changed from `off` to `on`.

B

Differences Between HDLM Version 5.9 or Later and Version 5.8.1 or Earlier

HDLM version 5.9 or later supports MPIO used by AIX 5L V5.2 or later, which has improved compatibility with the OS. The items explained in the following subsections represent the changes from HDLM version 5.8.1 or earlier.

- Add-in HDLM Driver Module
- Simplifying the HDLM Environment Configuration and Operation Procedures by Changes to the Logical Device Files
- Changing the HDLM Environment Configuration and Operation Procedures by Changes to the Logical Device Files
- Migrating Reservation Control Settings
- Support for a Boot Disk Environment
- About Settings when Upgrading the OS
- Changing a Virtual I/O Server's Method of Recognizing Virtual SCSI Disks

Add-in HDLM Driver Module

HDLM version 5.9 or later supports MPIO used by AIX 5L V5.2 or later. This has improved compatibility with the OS because users can use standard OS commands to manage paths on HDLM management-target devices. As compared to HDLM version 5.8.1 or earlier, HDLM version 5.9 or later differs in terms of the HDLM driver structure, environment configuration, and HDLM operation procedures. The following figure shows the differences between the HDLM driver for HDLM EX and the HDLM drivers for HDLM version 05-63 or earlier and HDLM version 05-80 or later.

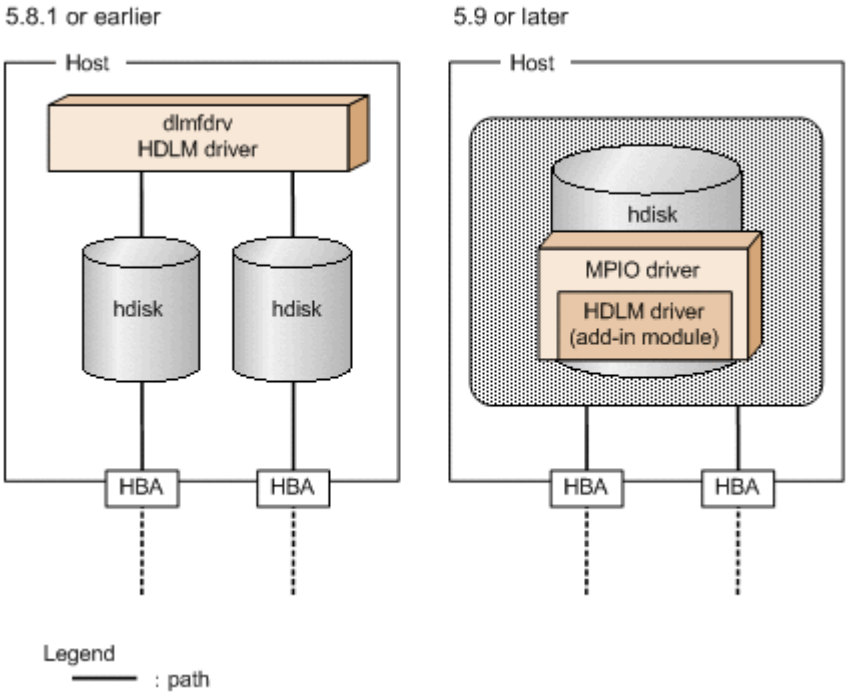


Figure B-1 Differences in the HDLM drivers between HDLM version 5.8.1 or earlier and HDLM version 5.9 or later

Simplifying the HDLM Environment Configuration and Operation Procedures by Changes to the Logical Device Files

- The logical device files that can be controlled by the HDLM driver have been unified from HDLM devices (`dlmfdrv`*n*) to the hdisk provided by the OS. Therefore, logical device files controlled by HDLM can be configured by AIX's standard `cfgmgr` command.

  Both the file that defines non-HDLM-managed disks (`/usr/DynamicLinkManager/drv/dlmfdrv.unconf`) and the file that defines the HDLM driver configuration (`/usr/DynamicLinkManager/drv/dlmfdrv.conf`) are no longer used. After installing HDLM, all devices shown in *Devices that HDLM can manage* in *Devices Managed by HDLM on page 2-3* will be managed. You cannot exclude physical volumes from HDLM-managed targets.

- Eliminating the `rc.shutdown` file

  HDLM version 5.8.1 or earlier provided an `rc.shutdown` file in order to avoid having physical volumes already defined when a host is started. Because this situation does not occur in HDLM version 5.9 or later, the `rc.shutdown` file is no longer provided. For this reason, the manual has been changed as follows:

  - The portion of the procedure related to the `rc.shutdown` file has been deleted from the explanation of removing HDLM.
  - The `rc.shutdown` file has been deleted from the files collected by the `DLMgetras` utility for collecting HDLM error information.
- The content displayed for `HDevName` in the HDLM `view` command operation has been changed from the HDLM device (`dlmfdrv`*n*) to hdisk. Accompanying this change, `Device` for displaying hdisk name when `view -lu` or `view -drv` is executed in HDLM version 5.8.1 or earlier has been removed.
- Because `dlmfdrv` was deleted, the following HDLM utilities are no longer provided and the descriptions related to them have been deleted from the manual:

  - Utilities for operating HDLM volume groups

    HDLM version 5.9 or later uses standard AIX commands that correspond to the commands for utilities for operating HDLM volume groups. The following table lists the correspondence between the commands for the utilities for operating HDLM volume groups and the standard AIX commands.

Table B-1 Commands of the utilities for operating HDLM volume groups, and corresponding AIX commands

Commands of the utilities for operating HDLM volume groups	Corresponding AIX commands
dlmchvg	chvg
dlmexportvg	exportvg
dlmextendvg	extendvg
dlmimportvg	importvg
dlmlistvgbackup	listvgbackup
dlmlsvg	lsvg
dlmmirrorvg	mirrorvg
dlmmkvg	mkvg
dlmrecreatevg	recreatevg
dlmreducevg	reducevg
dlmreorgvg	reorgvg
dlmrestorevgfiles	restorevgfiles

Commands of the utilities for operating HDLM volume groups	Corresponding AIX commands
dlmrestvg	restvg
dlmsavevg	savevg
dlmsyncvg	syncvg
dlmunmirrorvg	unmirrorvg
dlmvaryoffvg	varyoffvg
dlmvaryonvg	varyonvg

- dlmcfgmgr utility for managing the HDLM configuration
  In HDLM version 5.9 or later, the AIX cfgmgr command is used.
- dlmchkdev utility for checking the HDLM device configuration
- dlmHBAdel utility for changing the HDLM HBA

Also, the execution target of the dlmrmdev utility for removing HDLM drivers has been changed from dlmfdrv to hdisk.

Changing the HDLM Environment Configuration and Operation Procedures by Changes to the Logical Device Files

For the same reason explained in *Simplifying the HDLM Environment Configuration and Operation Procedures by Changes to the Logical Device Files on page B-2*, the following HDLM environment configuration and operation procedures have been changed:

- New installation and update installation of HDLM#
- Settings when GPFS is used
- Replacement of HBA
- Changing HDLM management-target devices
- Replacement of fiber cables
- Replacement of fibre channel switches

#

An *update installation* refers to upgrading HDLM whose version is 5.9 or later. Therefore, it does not include a migration from HDLM version 5.8.1 or earlier to HDLM version 5.9 or later. It also does not include a migration from HDLM version 5.9 or later to HDLM version 5.8.1 or earlier. For such installations, you must first remove the existing HDLM and then install HDLM version 5.9 or later. To migrate from HDLM version 5.8.1 or earlier to HDLM version 5.9 or later, you can use the dlmmigsts utility for assisting HDLM transitions to inherit the existing HDLM settings. For details, see *Migrating from HDLM Version 5.8.1 or Earlier to Version 5.9 or Later on page 3-69*.

Migrating Reservation Control Settings

In HDLM version 5.8.1 or earlier, the *reservation control setting* is called the *reservation level* and is specified by using the `set` operation with the `-rsv on` parameter. The target of the reservation level was every LU in an HDLM management-target device. However, you can set the reservation policy specification on each LU if the AIX version is AIX 5L V5.2 or later. The reservation control setting is specified by using the `chdev` command in HDLM version 5.9 or later. Therefore, the `-rsv on` parameter for the `set` operation is no longer provided. The following table lists the correspondence of the setting values between the reservation level and the reservation policy.

Table B-2 The correspondence of the setting values between the reservation level and reservation policy

Reservation Level	Reservation Policy
`0`: Ignoring the reservation	`no_reserve`
`2`: Persistent reservation	`PR_exclusive`

Support for a Boot Disk Environment

A storage system disk can now be used for the boot disk. Accompanying this, the `dlmpreremove` utility that is executed before removing HDLM has been provided. The `dlmpreremove` utility excludes, before you remove HDLM, the hdisk recognized as a boot disk from being an HDLM management-target device.

About Settings when Upgrading the OS

Eliminating Settings when Upgrading the OS

There is no required procedure in HDLM when the OS is upgraded.

Eliminating Settings when Changing the Kernel Mode

In HDLM version 5.9 or later, both 32-bit and 64-bit versions are installed. When the 32-bit kernel is in use, the 32-bit version of HDLM is used automatically, and when the 64-bit kernel is in use, the 64-bit HDLM is used automatically.

Because of the changes explained in *Eliminating Settings when Upgrading the OS on page B-5* and *Eliminating Settings when Changing the Kernel Mode on page B-5*, the `dlmchenv` utility for modifying the HDLM execution environment is no longer necessary and has been deleted.

Changing a Virtual I/O Server's Method of Recognizing Virtual SCSI Disks

In HDLM version 5.8.1 or earlier, either PVID or `unique_id` can be selected as the method used by a virtual I/O server for recognizing virtual SCSI disks. In HDLM version 5.9 or later, only `unique_id` can be used because of the MPIO specification. Also, the `-u` and the `-e` parameters of the `dlmodmset` utility for setting the HDLM execution environment ODM are no longer provided because they are also not necessary.

Acronyms and abbreviations

The following acronyms and abbreviations might be used in this guide.

A

AL
Arbitrated Loop

API
Application Programming Interface

ASM
Automatic Storage Management

C

CHA
Channel Adapter

CHRP
Common Hardware Reference Platform

CLPR
Cache Logical Partition

CPU
Central Processing Unit

CU
Control Unit

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

D

DBMS
Database Management System

Dev
Device

DNS
Domain Name Server

F

FC
Fibre Channel

FC-SP
Fibre Channel Security Protocol

FO
Failover

FQDN
Fully Qualified Domain Name

G

GMT
Greenwich Mean Time

GUI
Graphical User Interface

H

HBA
Host Bus Adapter

HDev
Host Device

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

HLU
Host Logical Unit

HTTP
Hypertext Transfer Protocol

I

I/O
Input/Output

IP
Internet Protocol

iSCSI
Internet Small Computer System Interface

L

LAN
Local Area Network

LDAP
Lightweight Directory Access Protocol

LDEV
Logical Device

LPAR
Logical Partition

LU
Logical Unit

LUN
Logical Unit Number

LVM
Logical Volume Manager

M

MPIO
Multipath I/O

N

NAS
Network Attached Storage

NIM
Network Installation Management

NPIV
N-Port ID Virtualization

NTP
Network Time Protocol

O

ODM
Object Data Manager

OS
Operating System

P

P
Port

PCI
Peripheral Component Interconnect

PVID
Physical Volume Identifier

R

RADIUS
Remote Authentication Dial in User Service

S

SAN
Storage Area Network

SCSI
Small Computer System Interface

SLPR
Storage Logical Partition

SMIT
System Management Interface Tool

SMTP
Simple Mail Transfer Protocol

SNMP
Simple Network Management Protocol

SP
Service Pack

SSL
Secure Sockets Layer

SVP
Service Processor

V

VG
Volume Group

W

WWN
World Wide Name

Glossary

This glossary explains the terms used in this manual.

A

automatic failback
A function for checking the status of paths at regular intervals, and automatically placing the status of a path recovered from an error into the Online status.
If a path with an Offline(E) or Online(E) status recovers from an error, an automatic failback will place the path Online.
Automatic failbacks check the status of paths that were placed in the Offline(E) or Online(E) status because of an error, but do not check the status of paths that were placed in the Offline(C) status by executing an `offline` operation. For details on `offline` operations, see *offline (Places Paths Offline) on page 6-6*.

AutoPATH_ID
An ID which HDLM assigns to a path when the system is started or when path configuration is performed. Every path has a unique AutoPATH_ID.
(See also: *path*)

B

boot disk environment
An environment in which the startup disk is in a storage system instead of in the host.

C

CHA (Channel Adapter)
An adapter for controlling the channels of a storage system.

CLPR(Cache Logical Partition)
A function supported by the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000/AMS/WMS/SMS series, HUS100 series, and HUS VM for logically splitting up a cache. This function can splits up a cache into parity groups in the storage system, so that other parity groups do not affect the cache performance.

cluster
A system of connecting multiple hosts with the same OS or platform (essentially, an environment in which the same application can run) and treating them as one system.

D

Dev (Device)
A logical division of an LU that HDLM controls and operates. A Dev is equivalent to a *logical volume* in AIX.
In an AIX environment, each LU has only one Dev.
Each Dev has a *Dev number*.
Depending on the access method, Devs are classified into two types: block devices and character devices.
(See also: *Dev number*)

Dev number
A number that is assigned to a device within an LU. The device numbers are assigned sequentially from 0. A Dev number is called a *logical volume number* in AIX.
HDLM operates assuming that one LU has one Dev, so the device number is fixed to `0`.
(See also: *Dev*)

E

emulation type
An LU type that is accessible from a host. Since an HDLM management-target host is an open-system host such as a PC or a UNIX computer, the HDLM management-target host can access only the LUs that have open-system emulation types.
For details on emulation types supported by a storage system, see the maintenance manual for that particular storage system.

F

failback
A function for placing the status of a path recovered from an error into the Online status, and then switching the access path to the path that was just recovered.

failover
A function for switching to another normal path if there is an error in the current access path, thereby enabling the system to continue to operate.

H

HAM environment
An environment in which volume pairs that are synchronized between two storage systems are created by HAM (High Availability Manager), and hosts are configured to recognize these volumes as one volume. An HAM environment consists of the primary volume (P-VOL) in the primary site and the secondary volume (S-VOL) in the secondary site. When an error occurs on one of the volumes, the path can be switched to the other volume by using HDLM.

HBA (Host Bus Adapter)
Device that functions as an interface connecting a host with external devices.
In this manual, the term *HBA* refers to an interface card installed in a host, in configurations where the host and storage units are connected via a FC connection.

HDLM alert driver
A program that receives information about an error detected by the HDLM driver, and then reports the error information to the HDLM manager.

HDLM driver
A program that controls all the HDLM functions, manages paths, and detects errors.

HDLM manager
A program that manages error information. The HDLM manager receives error information from the HDLM alert driver and then collects error logs.

host
A generic term for both servers and clients.

host device
A logical area in a host LU.
(See also: *host LU*, *host device name*)

host device name
A name assigned to a host device. The hdisk is assigned.
(See also: *host device*)

host LU
An LU that a host recognizes. The actual HDev entity is a Dev in the storage system. Each host LU has a *host LU number*.
(See also: *LU*, *host LU number*, *host device*)

host LU number
A number assigned to a host LU. The host LU number is part of a path name.
(See also: *host LU*, *path name*)

I

intermittent error
An error that occurs irregularly due to, for example, a loose cable connection.

L

LDEV (Logical Device)
A combination of the storage system's product name, serial number, and an internal LU. HDLM uses this value to identify a particular LU.

load balancing
A function for distributing the load across all the paths that are accessing the logical areas within an LU. To distribute the load, load balancing uses multiple paths to perform I/O operations.
HDLM uses the following six algorithms for load balancing:
- The Round Robin algorithm
- The Extended Round Robin algorithm
- The Least I/Os algorithm
- The Extended Least I/Os algorithm
- The Least Blocks algorithm
- The Extended Least Blocks algorithm

logical device file
`/dev/hdisk`*n*, and `/dev/rhdisk`*n*. A *logical device* of this term is not an LDEV. The logical device file name can be changed by using the `rendev` command.

LU (Logical Unit)
A logical unit that is a logical volume defined in the storage system, and with which the host can perform input or output operations.
(See also: *host LU*)

N

node
A server in a cluster.

non-owner controller
A controller other than an owner controller.

Non-owner controllers exist only in when the Hitachi AMS/WMS series.
(See also: *owner controller*, *non-owner path*)

non-owner path
A path that passes through a non-owner controller.
Non-owner paths exist only in when the Hitachi AMS/WMS series.
(See also: *owner path*, *non-owner controller*)

O

ODM (Object Data Manager)
An AIX-dedicated database for managing system information. HDLM uses ODM to add or delete drivers.

owner controller
A controller that has been set as an owner controller for an LU. Owner controllers are only in the Hitachi AMS/WMS series. A controller other than an owner controller is called a *non-owner controller*.
When using the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series, Hitachi SMS series, HUS100 series, or HUS VM, all controllers are owner controllers.
(See also: *owner path*, *non-owner controller*)

owner path
A path that passes through an owner controller for an LU in the Hitachi AMS/WMS series. A path that passes through a controller other than an owner controller is called a *non-owner path*.
When using the Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, VSP G1000 series, VSP G200, G400, G600, Hitachi AMS2000 series#, Hitachi SMS series#, HUS100 series#, or HUS VM, all paths are owner paths.
(See also: *owner controller*, *non-owner path*)
#: This storage system applies when the dynamic I/O path control function is disabled.

P

path
An access path from a host to a storage system. Access to a logical area within an LU in a storage system is made via a cable connecting the HBA on the host and the CHA on the storage system. This cable is a path. Each path has an `AutoPATH_ID`.
(See also: *AutoPATH_ID*)

path health checking
A function for checking the status of paths at regular intervals.

When an error occurs on a path that was in the Online status, path health checking changes the status of the path to the Offline(E) status.
Path health checking checks only those paths that have the Online status.

path name

The path name consisting of the following four elements, separated by periods:
- HBA adapter number or adapter type (character string)
- Bus number or adapter number (character string)
- Target ID (hexadecimal number)
- Host LU number (hexadecimal number)

A path name is used to identify a path.
(See also: *host LU number*)

persistent reservation

Similar to *reservations*, persistent reservations enable a server to declare that it has exclusive rights to use an LU, and prevents other servers from accessing that LU. Note, however, that while reservations allows a server to have exclusive use of only one path to the LU, persistent reservations allow a server to have exclusive rights to use multiple paths.
If persistent reservations are used in HDLM, a host can have exclusive use of multiple paths to an LU, so that load balancing among these paths is possible.
(See also: *reservation*)

R

reservation

The reservation function enables a host to declare that it has exclusive rights to use a particular LU, and prevents other hosts from accessing that LU. Access permission for an LU that has been reserved is given only to the host that issued the reservation, so the LU cannot be accessed from multiple paths (coming from multiple hosts) simultaneously. However, because of this, load balancing is not possible.
(See also: *persistent reservation*)

S

SAN (Storage Area Network)

A high-speed network connecting hosts to and storage systems. This network is independent of a LAN and is dedicated to data transfers. A SAN provides faster access to storage systems, and prevents the transfer of high-volumes of data from deteriorating LAN performance.

SCSI device

A SCSI disk device

slot number

A value indicating the location of a slot on which a HBA is mounted.

SLPR (Storage Logical Partition)

A function supported by Hitachi USP series, Universal Storage Platform V/VM series, Virtual Storage Platform series, and VSP G1000 series for logically splitting up a storage system. This function splits up the resources, such as ports, CLPR, and volumes, in the storage system, so that the user can manage each resource independently.

Index

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

W

Hitachi Data Systems

Corporate Headquarters
2845 Lafayette Street
Santa Clara, California 95050-2639
U.S.A.
www.hds.com

Regional Contact Information

Americas
+1 408 970 1000
info@hds.com

Europe, Middle East, and Africa
+44 (0)1753 618000
info.emea@hds.com

Asia Pacific
+852 3189 7900
hds.marketing.apac@hds.com

Hitachi Data Systems

MK-92DLM111-32