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Hitachi Freedom Storage™
Hitachi Dynamic Link Manager (HDLM)
for Sun™ Solaris™ Systems
User's Guide

HDLM for Solaris™ Version 4.1

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Document Revision Level

Revision	Date	Description
MK-92DLM114-P	February 2002	Preliminary Release
MK-92DLM114-P1	March 2002	Revision 1 of Preliminary Release, supersedes and replaces MK-92DLM114-P
MK-92DLM114-0	April 2002	Initial release, supersedes and replaces MK-92DLM114-P1
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MK-92DLM114-3	January 2003	Revision 3, supersedes and replaces MK-92DLM114-2
MK-92DLM114-4	April 2003	Revision 4, supersedes and replaces MK-92DLM114-3

Source Documents for this Revision

- *Hitachi Dynamic Link Manager User's Guide*, 3020-3-C87(E), Oct 2002
- *Release Notes* for HDLM for Solaris 04-01, Appendix A of ECN SSD-HDLM-029 (28 Feb 2003)

Changes in this Revision

- Updated device names to reflect formats for Solaris™ 2.6/7 and Solaris™ 8/9.
- Updated HDLM installation instructions (section 3.2).
- Changes in version 4.1 of HDLM for Solaris:
  - Added support for Solaris version 9.
  - Added support for Solaris Volume Manager 1.0.
  - Added new release 2.0 of Hitachi Network Objectplaza Trace Library (HNTRLib2). HNTRLib2 is automatically removed during HDLM 4.1 uninstallation.
  - Changed output directory of error log files to **/var/opt/DynamicLinkManager/log** (was **/opt/DynamicLinkManager/log**).
  - Added support for installation update for upgrading from HDLM 4.0 to 4.1.
  - Added new HDLM messages (Chapter 8).

Preface

The *Hitachi Freedom Storage™ Hitachi Dynamic Link Manager (HDLM) User's Guide* describes and provides instructions for installing and using the HDLM for Solaris™ software for the Hitachi Freedom Storage™ Series disk array subsystems. This document is intended for system administrators who use HDLM to operate and manage storage.

This document assumes that:

- the user has a background in data processing and understands storage subsystems and their basic functions,
- the user is familiar with the Hitachi Freedom Storage™ subsystem(s): Lightning 9900™ V Series, Hitachi Lightning 9900™, Thunder 9500™ V Series, Thunder 9200™, array subsystems, Freedom Storage 5800, Freedom Storage 5700E, and
- the user is familiar with the Sun™ Solaris™ operating system, file system, system commands, and utilities.

For further information on the Hitachi storage subsystems, please refer to the user's guide for the subsystem (e.g., *Hitachi Lightning 9900™ User and Reference Guide*, MK-90RD008). For further information on Hitachi Data Systems products and services, please contact your Hitachi Data Systems account team, or visit Hitachi Data Systems online at http://www.hds.com.

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HDLM for Solaris™ Software Version

This document revision applies to HDLM for Solaris™ version 4.1.

COMMENTS

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Make sure to include the document title, number, and revision.
Please refer to specific page(s) and paragraph(s) whenever possible.

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

Thank you!

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1.1 Hitachi Dynamic Link Manager (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 subsystems.

The HDLM software manages access paths to storage subsystems. HDLM 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 reliability.

Figure 1.1 illustrates the connections between hosts and storage subsystems. HDLM supports the following Hitachi Freedom Storage™ disk array subsystems:

Hitachi Lightning 9900™ V Series
Hitachi Lightning 9900™
Hitachi Freedom Storage™ 7700E
Hitachi Thunder 9500™ V Series
Hitachi Thunder 9200™
Hitachi Freedom Storage™ 5800
Hitachi Freedom Storage™ 5700E

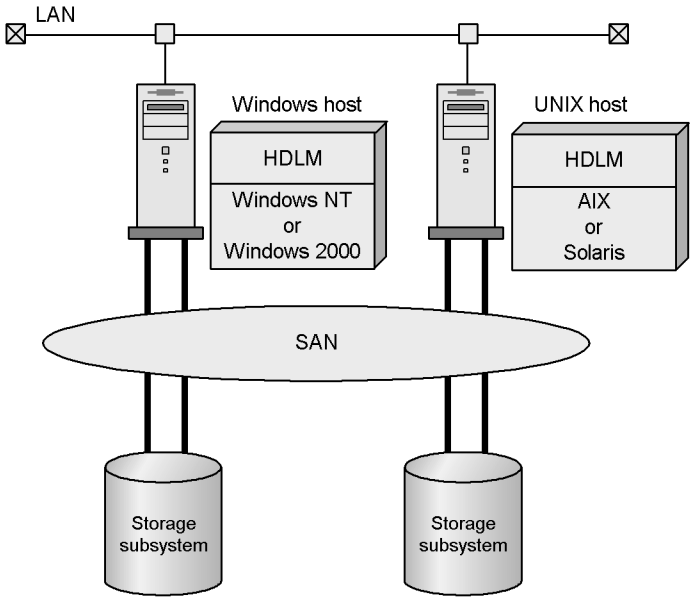

Figure 1.1 Connection Between Hosts and Storage Subsystems

1.2 HDLM Functions

The major functions of HDLM are:

- **Load balancing:** When multiple paths connect a host and storage, HDLM distributes the load across multiple paths to prevent a heavily loaded path from affecting processing speed.

  For details on load balancing, see section 2.4.

- **Path Failover:** When multiple paths connect a host and storage, HDLM switches to an alternate path if a failure occurs on the active path, allowing processing to continue without interruption.

  For details on failover, see section 2.5.

- **Failback:** When a previously failed path becomes available, HDLM places the recovered path back online. This ensures that the maximum number of paths is always available for load balancing and failover. Both failover and failback using path switching.

  For details on failback, see section 2.5.

- **Path health checking:** HDLM automatically checks the path status at regular intervals specified by the user, eliminating the need to repeatedly perform manual path status checks.

  For details on path health checking, see section 2.6.

- **Error management:** HDLM has an error management function that can filter error information according to the error level and collect error information into logs.

  For details on error management, see section 2.7.

Note: Alternate path (failover, failback, path health checking) is not supported for Hitachi RapidXchange (HRX) multiplatform devices (e.g., OPEN-***x***-FMT, 3390-3A, 3390-3B, 3390-3C).

Chapter 2 HDLM Configuration

2.1 System Configuration and Components

In a large-scale storage system, fiber cables or SCSI cables connect hosts and storage subsystems. The cable port on the host is a *host bus adapter* (HBA). The cable port on the storage subsystem is a *port* (P) on a *channel adapter* (CHA). A *logical unit* (LU) contained in a storage subsystem is the target of input to, or output from, the host. The LU can also be divided into *devices* (Dev). The connection path between the host and device is simply called a *path*. In the descriptions of how HDLM operates and how to use it, the connection path between a host and an LU is called a *physical path*. HDLM manages paths, so paths are sometimes referred to as *management targets*.

Figure 2.1 shows the HDLM system configuration. Table 2.1 describes the HDLM system components.

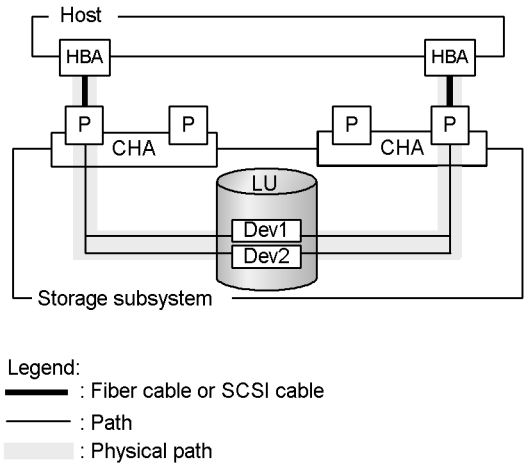

Figure 2.1 HDLM System Configuration

Table 2.1 HDLM System Components

Component	Description
Dev	A device that is a logical division of an LU. This device is called a *slice* in Solaris.
CHA	Channel adapter.
HBA	Host bus adapter. This serves as a cable port on the host.
LU	A logical unit that is accessible from the network, and with which the host can perform input/output operations.
P	A port on a channel adapter. This serves as a cable port on a storage subsystem.
Path	A connection path between the host and a device.
Physical path	A connection path between the host and an LU.

2.2 LU Configuration

The host OS recognizes an LU for each path. Such an LU recognized by an OS is called a *host LU* (HLU). The devices of a host LU correspond to the devices in the storage subsystem LU. These devices of a host LU are called *host devices* (HDev). Even if multiple host devices actually point to the same device in a storage subsystem, the user sees independent host devices.

Figure 2.2 shows the relationships between the LU configuration in a storage subsystem and the LU configuration that users see. Table 2.2 shows the components of the host. Table 2.3 specifies the maximum number of LUs and paths that can be managed by HDLM.

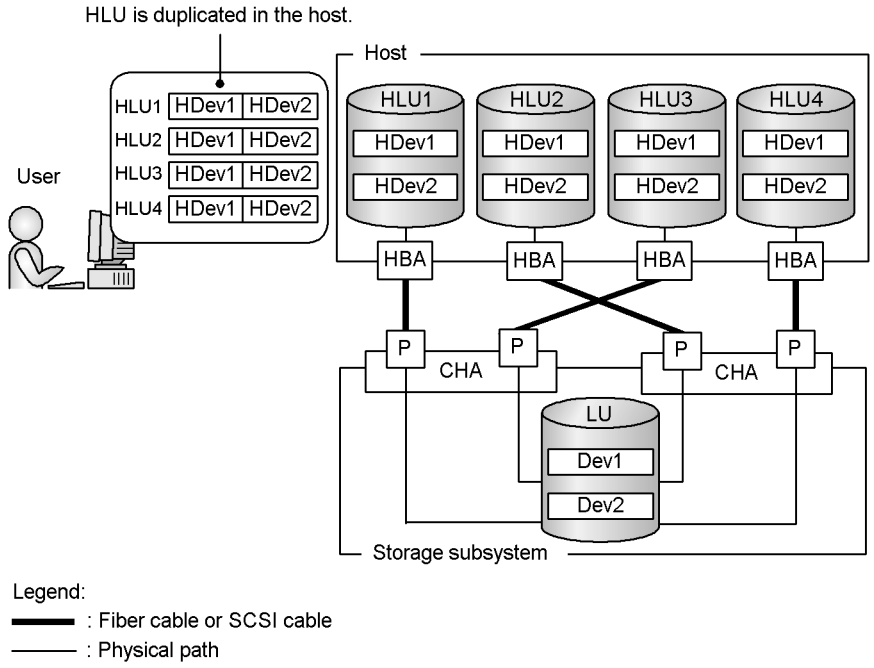

Figure 2.2 LU Configuration Without HDLM

Table 2.2 Components and Descriptions

Component	Description
HDev	Host device, a device within a host LU. The actual HDev entity is a device in storage subsystem.
HLU	Host LU, an LU that the host recognizes. The actual HLU entity is an LU in storage subsystem.

Table 2.3 Maximum Number of LUs and Paths Supported by HDLM

Management Target	Maximum Number
LUs	256
Paths for one LU	16
Total paths	4096

2.3 HDLM Program Configuration

HDLM runs as a combination of programs. Because these programs correspond to the HDLM operations, you need to understand the name, position, and role of each program.

Figure 2.3 shows the HDLM program configuration. Table 2.4 lists and describes the functionality of these programs.

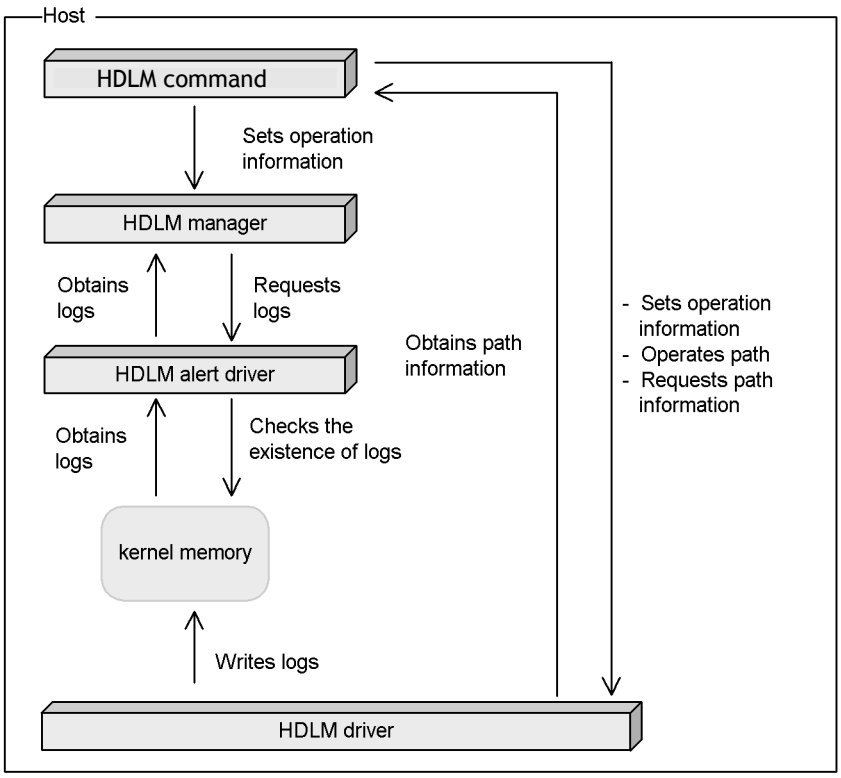

Figure 2.3 HDLM Program Configuration

Table 2.4 Functions of HDLM Programs

Program Name	Function
HDLM command	Provides the **dlnkmgr** command to enable you to: Manage paths Display error information Set up the HDLM operating environment
HDLM manager	Configures the operating environment, requests the execution of path health checks and automatic failback, and collects error log data.
HDLM alert driver	Reports the error information detected by the HDLM driver to the HDLM manager.
HDLM driver	Controls HDLM functionality, manages paths, and detects errors. The HDLM driver consists of the *core logic component* that controls the HDLM basic functionality, and the *filter component* that sends and receives I/O.

2.4 Load Distribution Using Load Balancing

When the system contains multiple paths to each device within an LU, HDLM can distribute the load across the paths by using multiple paths for I/O. This functionality is called load balancing and prevents a heavily loaded path from affecting the performance of the entire system. You can specify the load balancing function by the **dlnkmgr** command together with the **set** operation. For details on the **set** operation, see section 5.6.

- When the 9500V, 9200, 5800, or 5700E is being used, HDLM performs load balancing between owner paths or between non-owner paths. An *owner path* is a path that uses the channel adapter that provides the fastest access to the LU. This channel adapter providing fast access is called an *owner controller*. A *non-owner path* is a path that uses a channel adapter other than the owner controller (a *non-owner controller*). Since the owner controller varies depending on the LU, the owner path also varies depending on the LU. To prevent a possible decrease in performance in the entire system, HDLM does not perform load balancing between owner paths and non-owner paths.
- When the 9900V, 9900, or 7700E is being used, all paths are owner paths. Therefore, HDLM performs load balancing among all paths accessing the same device.

Figure 2.4 shows an example of load balancing. In this example, for the 9500V, 9200, 5800, or 5700E, the owner controller for LU0 is CHA0. When a device within LU0 is accessed, HDLM performs load balancing between the paths that access the device via physical paths (1) and (2) (that is, between owner paths), or between the paths that access the device via physical paths (3) and (4) (that is, between non-owner paths). For the 9900V, 9900, or 7700E, HDLM would perform load balancing among all paths: physical paths (1), (2), (3), and (4).

Note: Some I/Os managed by HDLM cannot be distributed in units of paths. Therefore, I/Os may not be equally allocated to each path, even though load balancing is used.

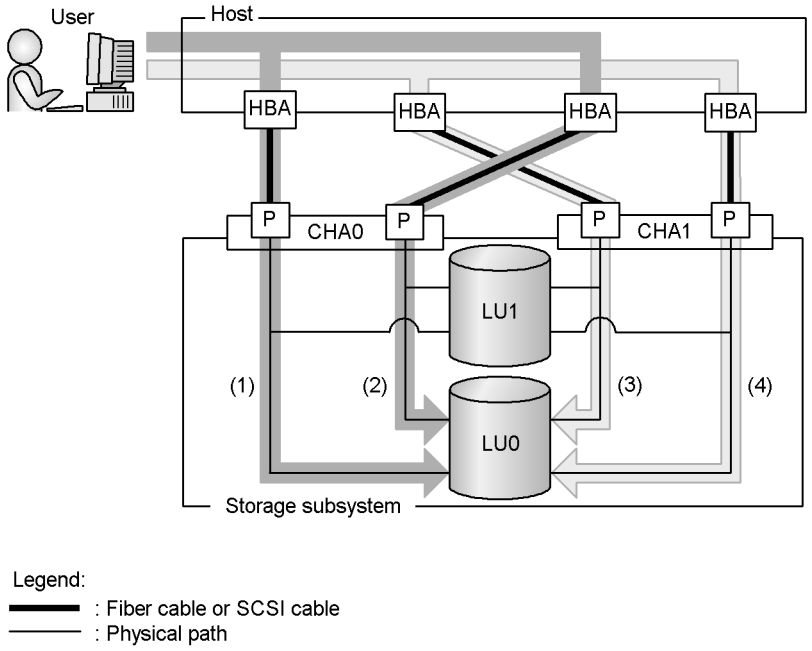

Figure 2.4 Load Balancing

2.5 Failover and Failback Using Path Switching

When the system contains multiple paths to each device within an LU and an error occurs in the path being used, HDLM can switch to another normal path to allow the system to continue to operate. This functionality is called *failover*.

When the path in which an error occurred recovers from the error, HDLM can switch to the recovered path. This functionality is called *failback*.

Two types of failover and failback are available:

- Automatic path switching
- Manual path switching

Note: When using the 9500V, 9200, 5800, or 5700E, make sure to set the data share mode to **ON (Used)**. For details on setting the data share mode, see the User's Guide for the array.

Failover and failback change the path statuses and switch the paths. Path statuses are classified into *online* statuses and *offline* statuses. Online statuses allow the path to normally receive I/Os. Offline statuses prevent the path from receiving I/Os for the following reasons:

- An error occurred in the path.
- A user executed the **dlnkmgr** command together with the **offline** operation.

For details of path statuses and the status transitions, see section 2.5.3.

Note: Alternate path (path switching) is not supported for Hitachi RapidXchange (HRX) multiplatform devices (e.g., OPEN-*x*-FMT, 3390-3A, 3390-3B, 3390-3C).

2.5.1 Automatic Path Switching

If an error occurs in a path, *automatic failover* automatically places the error path offline to allow the system to continue to operate using another online path. Automatic failover is applicable to the following levels of errors that occur in a management target:

- **Critical:** A fatal error that may stop the system.
- **Error:** A high-risk error that can be avoided by using failover or other countermeasures.

For details on error levels, see section 2.7.2.

When using the 9500V, 9200, 5800, or 5700E, HDLM selects the switching destination from the paths that access the same device, in the order of owner paths and non-owner paths. For example, in Figure 2.5, the owner disk controller for LU0 is CHA0, and access to a device within LU0 is made only by the path that is via physical path (1). After the path being used is placed offline, as the first candidate for the switching destination, HDLM selects the path that accesses the same device, via physical path (2). As the second candidate, HDLM selects the path that accesses the same device via physical path (3) or (4).

When the 9900V, 9900, or 7700E is being used, all the paths are owner paths. This means all the paths accessing the same device can be possible switching destinations. For example, in Figure 2.5, if a device within LU0 is accessed using only the path that is via physical path (1) and the path being used is placed offline, as the switching destination HDLM selects one of the paths that access the same device via physical path (2), (3), or (4).

All paths that use the same physical path are switched at the same time. Therefore, if an error occurs in a path, HDLM switches all the other paths that are via the same physical path.

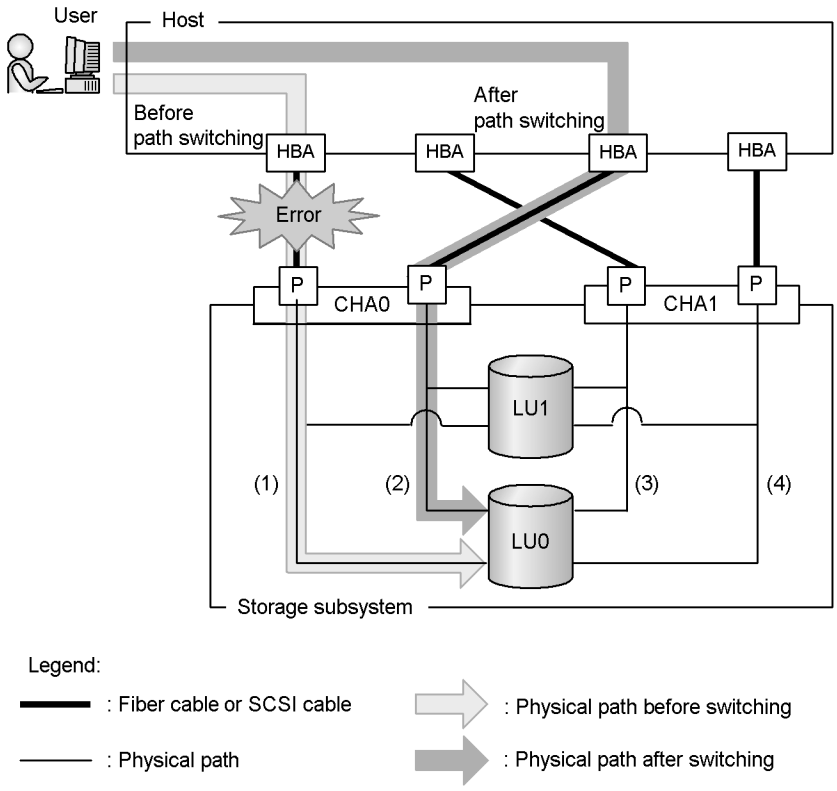

Figure 2.5 Path Switching

After a path recovers from an error, HDLM automatically places the recovered path online. This functionality is called *automatic failback*.

When using the 9500V, 9200, 5800, or 5700E, HDLM selects the path to use from online owner paths, and then from online non-owner paths. Therefore, if an owner path recovers from an error and HDLM automatically places the recovered path online while any non-owner path is in use, the path to use is switched to the owner path.

When the 9900V, 9900, or 7700E 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.

You can specify the automatic failback function by the **dlnkmgr** command together with the **set** operation. The default is off. Therefore, to use automatic failback, specify **on** by the **set** operation (see section 5.6).

2.5.2 Manual Path Switching

You can switch a path by manually placing a path offline. Manually switching a path temporarily is useful for maintenance of the system. You can manually place a path offline by executing the **dlnkmgr** command together with the **offline** operation.

HDLM selects the switching destination path the same way as for automatic path switching. When using the 9500V, 9200, 5800, or 5700E, HDLM selects the switching destination path from owner paths and then from non-owner paths. When the 9900V, 9900, or 7700E is being used, all the paths accessing the same device can be the possible switching destination at the same time.

All paths that use the same physical path are switched at the same time. Therefore, if a path is placed offline, HDLM switches all the other paths that are via the same physical path.

Executing the **online** operation places the offline path online. After the path status is changed to online (by executing the **dlnkmgr online** command), HDLM selects the path to use in the same way as for automatic path switching, which is described in section 2.5.1. When using the 9500V, 9200, 5800, or 5700E, HDLM selects the path to use from online owner paths, and then from online non-owner paths. When the 9900V, 9900, or 7700E is being used, the path to use is not switched after changing the path status to online by using the **online** operation.

For details on the **offline** and **online** operations, see sections 5.4 and 5.5.

2.5.3 Path Status Transition

There are two types of path status: *online* and *offline*. Online means the status in which I/O can normally be issued to the path. Offline means the status in which I/O cannot be issued to the path for the following reasons:

- An error occurred in the path.
- A user executed the **dlnkmgr** command together with the **offline** operation.

Furthermore, the online and offline statuses are divided depending on whether the status has a normal attribute, error (E) attribute, or command (C) attribute. The following explains the two online path statuses and the two offline statuses.

The online path statuses are as follows:

- **Online:** The status in which I/O can normally be issued to the path.
- **Online(E):** The status in which an error occurred in the last online path for each device. The (E) indicates the error attribute, which indicates that an error occurred in the path.

The offline path statuses are as follows:

- **Offline(C):** The status in which I/O cannot be issued because the **offline** operation was executed. The (C) indicates the command attribute, which indicates that an I/O cannot be issued to the path because of an offline operation of a command.
- **Offline(E):** The status in which I/O cannot be issued because an error occurred in the path. The (E) indicates the error attribute, which indicates that an error occurred in the path.

Figure 2.6 shows the status transition of a path.

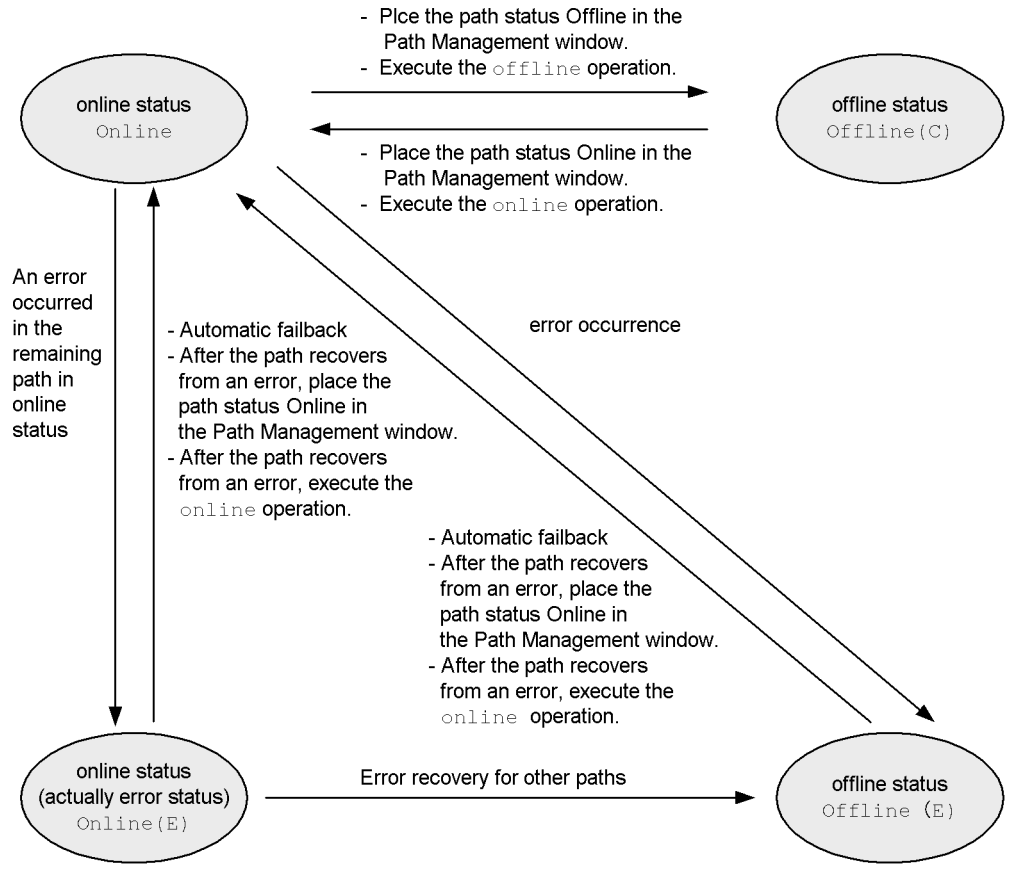

Figure 2.6 Path Status Transition

The last online path for each device is not placed offline, even if an error occurs or even if the user executes the **offline** operation. This ensures access to the LU.

If an error occurs in the last online path for each device, the path status becomes **Online(E)**. Also, HDLM checks the status of other paths that are already offline. If any path can be placed online, HDLM places that path online and switches to it.

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

2.6 Path Health Checking

HDLM can check the status of paths at regular intervals, and detect errors. This functionality 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 is not performed on the paths of the standby host in the cluster configuration or on the non-owner paths (that is, some of the paths that access the storage subsystem for 9500V, 9200, 5800, and 5700E subsystems). Because of this, for the standby host or 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 recent path-status information when selecting the switching destination.

You can configure path health checking by executing the **dlnkmgr set** command. For details on the **set** operation, see section 5.6.

Note: In previous versions of HDLM, executing a batch file that defined the **online** operation performed path health checking. With the current version, executing the **set** operation performs path health checking; **do not** execute the batch file. If the **set** operation is executed, the result will be duplicate instances of path health checking running simultaneously.

2.7 Error Management

HDLM can filter error information according to the error level and collect the information into logs. Figure 2.7 shows the data flow when collecting error information.

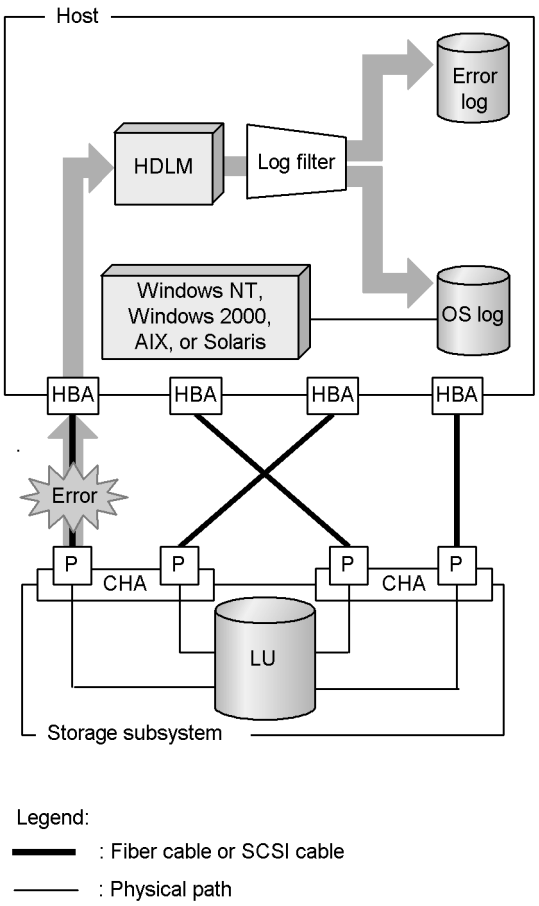

Figure 2.7 Data Flow When Collecting Error Information

2.7.1 Logs Collected

HDLM collects the following error information: *trace file*, *error logs*, and *syslogs*. You can use the error information to examine the status of an error and analyze the cause of the error. Table 2.5 describes the types of error information. For details on error levels, see section 2.7.2.

Table 2.5 Log Descriptions

Log Name	Description	Output Destination
Trace file	Trace information for the user-defined level is collected. By default, trace information is not collected. If an error occurs, you may need to change the setting to collect trace information.	The default file path is **/var/opt/hitachi/HNTRLib2/spool/hntr2{1|2|...|16}.log**.To specify the output destination directory and the file prefix, use the Hitachi Network Objectplaza Trace Library utility (see section 4.3.2).
Error log	Error information for the user-defined level is collected from detected errors. By default, HDLM collects all detected error information.	HDLM Manager logs: **/var/opt/DynamicLinkManager/log/dlmmgr1.log** **/var/opt/DynamicLinkManager/log/dlmmgr2.log**
Syslog	Information about highly dangerous errors (Critical or Error level) is collected from detected errors. Syslogs can be checked using a text editor (see ***Note 1***).	The default file path is **/var/adm/messages**. The syslog file path is specified in the file **/etc/syslog.conf**.

2.7.2 Error Information Filtering

Errors that HDLM detects are classified into error levels. Table 2.6 shows the error levels, listed in order of adverse effect on the system.

Table 2.6 Error Descriptions

Error Level	Meaning	OS Log
Critical	Fatal errors that may stop the system.	Error
Error	Errors that crucially affect the system. This type of error can be avoided by using failover or other countermeasures.	Error
Warning	Errors that enable the system to continue but, if left, might cause the system to operate improperly.	—
Information	Information that indicates the operating history when the system operates normally.	—

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

The syslog collects the error information at the Error level or higher.

The error information in error logs, in trace files, and in the logs collected by a Device manager client is collected based on a user-defined collection level. The collection levels for error logs are as follows:

- 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 (that is, all levels).

For details about how to set the logging level, see section 4.3.

The collection levels for log information in trace files are as follows:

- Outputs no trace information
- Outputs trace information on major program operations
- Outputs trace information on detailed program operations
- Outputs trace information on all operations

Note: The HDLM DLMgetras utility collects HDLM error information. By executing this utility, you can simultaneously collect all the information required for analyzing errors: information such as trace files, definition files, core files, system crash dump files, and libraries. You can use the collected information when you contact your service representative. For details on the utility for collecting HDLM error information, see section 6.1.

2.8 Cluster Support

In Solaris version 2.6, 7, or 8, HDLM is also available for cluster configurations.

Table 2.7 lists the cluster software supported by HDLM, the supporting Solaris version, usable volume management software, and availability of HDLM load balancing functionality in a cluster configuration that uses the cluster software.

Table 2.7 Cluster Software Supported by HDLM

Cluster Software	Solaris Version	Volume Management Software	Load Balancing
SUN Cluster 3.0 (5/02)	Solaris 8, 9	Solstice DiskSuite 4.2.1	Available
VERITAS Cluster Server	Solaris 2.6, 7, 8	VERITAS Volume Manager	Available

HDLM uses multiple physical paths of the active host, and accesses devices within an LU by the paths that go through those physical paths.

Paths are switched in units of physical paths. Therefore, if an error occurs in a path, all the other paths that run through the same physical path are switched. The switching destination is a physical path of the active host.

The details of node switching depend on the application.

Note: To use HDLM in a cluster configuration, HDLM must be installed in both the active host and standby host.

Chapter 3 Installation Requirements and Procedures

3.1 System Requirements

Important: Read the **Release Notes** and **Hardware Notes** prior to installation (on the HDLM CD-ROM). The Release Notes contain important information on supported hardware and software (e.g., server machines, HBAs, drivers, required OS patches) and HDLM usage precautions. The Hardware Notes contain important information on storage subsystem setup.

HDLM operations involve the HDLM software on the host server(s), the LUNs on the storage array(s), and the physical path hardware (HBAs, cables, ports, channel adapters, etc.).

The system requirements for HDLM for Solaris™ are:

- **HDLM software product.** HDLM for Solaris™ is supplied on CD-ROM. For information on the memory and disk space requirements for the HDLM software, see the Release Notes.

  Note: You must have a valid license key to install HDLM. Please contact your Hitachi Data Systems account team for information on license keys.

- **Storage arrays.** HDLM for Sun™ Solaris™ supports the following disk array subsystems. Read the HDLM Hardware Notes for important information on subsystem setup.

  Hitachi Lightning 9900™ V Series (9980V, 9970V)
  Hitachi Lightning 9900™ (9960, 9910)
  Hitachi Thunder 9500™ V Series (9570V, 9530V)
  Hitachi Freedom Storage™ 7700E
  Hitachi Thunder 9200™
  Hitachi Freedom Storage™ 5800
  Hitachi Freedom Storage™ 5700E

- **Host server machine.** HDLM for Solaris™ supports the Sun™ Sparc™ series server machine. See the HDLM Release Notes for information on host server machines.

- **Host operating system.** HDLM supports Solaris™ versions 2.6, 7, 8, and 9. See the HDLM Release Notes for important information and required patches for each OS version.

  Note: Administrator (root) access to the host is required to perform HDLM operations.

  Important: Operations of some Solaris™ commands are restricted for HDLM special files and for disk devices being managed by HDLM. For details, see the HDLM Release Notes.

- **Physical path hardware.** HDLM supports industry-standard HBAs, switches, etc. Discuss your hardware configuration with your Hitachi Data Systems team to ensure efficient installation and proper functionality. See the HDLM Release Notes for requirements and information on path hardware. During HDLM installation and configuration, refer to the user documentation for the hardware, or contact the vendor's technical support.

  Caution: If different types of HBAs are used, HDLM may not be able to switch the path.

- **Cluster environment.** HDLM for Solaris™ supports the VERITAS Cluster Server™ (VCS) and Sun™ Cluster products. For details on versions and required patches, see section 2.8.

- **Volume manager environment.** HDLM for Solaris™ supports VERITAS™ Volume Manager (VxVM), Solstice DiskSuite (SDS), and Solaris Volume Manager (SVM). For details on versions and required patches, see section 2.8.

3.2 Installation

This section describes HDLM installation for the Sun™ Solaris™ operating system. When you install HDLM, you can set up the hardware, cluster environment, and volume manager either before or after installing HDLM. This section also describes these procedures, as applicable.

Note: To update your HDLM installation from version 4.0 to 4.1, see section 3.3.

HDLM is installed from a CD-ROM. The Hitachi Network Objectplaza Trace Library (HNTRLib2 for HDLM 4.1) is installed concurrently.

Important: Read the **Release Notes** prior to installation (included on the HDLM CD-ROM). The Release Notes contain important information on supported hardware and software (e.g., HBAs, drivers, required OS patches) and HDLM installation and usage precautions.

HDLM installation includes:

- Preparing for HDLM installation (see section 3.2.1)
- Installing HDLM in a non-Sun Cluster environment (see section 3.2.2)
- Installing HDLM in a Sun Cluster environment (see section 3.2.3)
- Performing setup for use with a storage subsystem (see section 3.2.4)
- Setting up SDS and HDLM on the same host (see section 3.2.5)
- Setting up VxVM and HDLM on the same host (see section 3.2.6)

3.2.1 Preparing for HDLM Installation

Perform the following preparations before installing HDLM:

1. **Set up the storage subsystem**. For details on the storage subsystem setup, see the Hardware Notes document provided with HDLM.
2. **Set up the HBAs and switches** (if used). Make sure that all HBAs in a host are the same type and use the same microprogram version. For details on HBA and switch requirements, see the HDLM Release Notes. For details on HBA and switch setup, see the documentation for the HBA or switch.

   If fibre-channel connects are used, make sure to check the connection method (e.g., fabric, AL) and match the settings with the connection method.
3. **Configure kernel parameters**. Some kernel parameters may need to be set to the **/etc/system** file. For details, see the HDLM Release Notes.
4. **Back up data**. Back up the contents of the disk(s) for HDLM management (tape, etc.).
5. **Record device names**. Record the logical device names of the disks used (i.e.: **/dev/dsk/cWtXdYsZ**), and the corresponding subsystem-internal LDEV/LU numbers.
6. **Clear application/mount settings**. Installing HDLM may change the logical device file name of the disks for HDLM management. Clear the disk's registration to applications if the disk for HDLM management is registered to applications such as volume manager. Do not access these disks during HDLM installation. Also clear the setting of automatic mount function if these disks are set to mount automatically during boot time.
7. **Use of the sd driver**. To use the sd driver, edit the **/kernel/drv/sd.conf** file so that all the connected disks can be accessed through all the paths. For example, to add disks with host LUNs 5 and 6 and target IDs 16 and 17:

   ```
   name="sd" class="scsi" target=16 lun=5;
   name="sd" class="scsi" target=16 lun=6;
   name="sd" class="scsi" target=17 lun=5;
   name="sd" class="scsi" target=17 lun=6;
   ```

   When the ssd driver is used, the connected disks are automatically recognized.
8. **Set up SDS**. When you use HDLM and SDS on the same host, create three local state database replicas on the disk (slice). Create the state database replicas on a disk that is owned by the host and that is not managed by HDLM.

   To create state database replicas, execute the **metadb** command as follows:

   ```
   # metadb -a –f c0t0d0s3 c0t1d0s3 c0t2d0s3
   ```
9. **Set up VxVM**. To set up VxVM when using VxVM and HDLM on the same host:
   a) Create **rootdg** in a disk that is not managed by HDLM.
   b) Deactivate the DMP function of VxVM. For VxVM 3.0.4, see the documentation provided with VxVM for details on deactivating DMP. For VxVM 3.1.3 or 3.2, specify a disk that is managed by HDLM as a disk that is not managed by DMP: specify the parameter **Prevent multipathing/Suppress devices from VxVM's view** for the **vxdiskadm** command of VxVM.
10. Reboot the host system.

3.2.2 Installing HDLM in a Non-Sun Cluster Environment

For a new installation, the process of HDLM driver configuration (executing **dlmsetconf**) erases all of the sd or ssd device files which HDLM manages. Therefore, you need to back up the logical device files under the **/dev/dsk** and **/dev/rdsk** directories to another directory.

To install HDLM for Solaris™ in a non-Sun Cluster environment:

1. Log on as a user with **root** permission.
2. Insert the HDLM CD-ROM into the drive. The CD-ROM is automatically mounted in several seconds, and the mount point of the CD-ROM is indicated in the file list.

   If the CD-ROM is not mounted automatically, enter the following command to mount it:

   ```
   # mount mount-point-of-CD-ROM
   ```

   Note: You must have a valid license key to install HDLM for Solaris™. Please contact your Hitachi Data Systems account team for information on license keys.
3. Enter the following installation command:

   ```
   # pkgadd –d mount-point-of-CD-ROM DLManager
   ```
4. Follow the instructions and messages on screen to complete HDLM installation.
5. When installation is complete, execute the following command to confirm that the package has been successfully installed:

   ```
   # pkginfo -l DLManager
   ```
6. For an update installation, skip this step. Use the existing **/kernel/drv/dlmfdrv.conf** file.

   For a new installation, create the **/kernel/drv/dlmfdrv.conf** file by executing the HDLM **dlmsetconf** utility:

   ```
   # /opt/DynamicLinkManager/bin/dlmsetconf
   ```

   For Solaris™ 8 and 9 systems, the KAPL10242-I message appears and asks you to confirm the removal of all of the sd or ssd device files which HDLM manages. If you already backed up these files, enter **y**. If not, enter **n**, back up the files, and rerun **dlmsetconf**.
7. Reboot the system:

   ```
   # reboot -- -r
   ```

3.2.3 Installing HDLM in a Sun Cluster Environment

For a Sun Cluster environment, you need to install HDLM to all nodes in status with Quorum device reset in the following procedure.

To install HDLM for Solaris™ in a non-Sun Cluster environment:

1. Start all nodes before installation.
2. After checking the device ID of the Quorum device, delete Quorum device configuration. The following shows an example for a Quorum device ID = 4.

```
# scconf -pv | grep -i Quorum                    ← Obtain Quorum device ID
# scdidadm –L
node1:/dev/rdsk/c0t6d0       /dev/did/rdsk/d1
node1:/dev/rdsk/c1t1d0       /dev/did/rdsk/d2
node1:/dev/rdsk/c1t0d0       /dev/did/rdsk/d3
...
node1:/dev/rdsk/c2t7d16      /dev/did/rdsk/d4      ← device ID=4
node1:/dev/rdsk/c3t7d16      /dev/did/rdsk/d4      ← device ID=4
node2:/dev/rdsk/c2t7d16      /dev/did/rdsk/d4
node2:/dev/rdsk/c3t7d16      /dev/did/rdsk/d4
node3:/dev/rdsk/c2t7d16      /dev/did/rdsk/d4
node3:/dev/rdsk/c3t7d16      /dev/did/rdsk/d4
```

   For a two-node structure, you need to execute the following command to change the installation mode on the cluster before clearing the last Quorum device configuration:

```
# scconf -c -q installmode    ← Change to Installation mode (2-node structure)
```

   Clear the Quorum device configuration:

```
# scconf -r -q globaldev=d4                      ← Clear Quorum device configuration
```

3. Insert the HDLM CD-ROM into the drive. The CD-ROM is automatically mounted in several seconds, and the mount point of the CD-ROM is indicated in the file list.

   If the CD-ROM is not mounted automatically, enter the following command to mount it:

```
# mount mount-point-of-CD-ROM
```

   Note: You must have a valid license key to install HDLM for Solaris™. Please contact your Hitachi Data Systems account team for information on license keys.

4. Enter the following installation command:

```
# pkgadd –d mount-point-of-CD-ROM DLManager
```

5. Follow the instructions and messages on screen to complete HDLM installation.
6. When installation is complete, execute the following command to confirm that the package has been successfully installed:

```
# pkginfo -l DLManager
```

7. If you are updating an existing HDLM installation, skip this step and use the existing **/kernel/drv/dlmfdrv.conf** file.

   Run the **dlmsetconf** utility to create the **/kernel/drv/dlmfdrv.conf** file:

```
# /opt/DynamicLinkManager/bin/dlmsetconf
```

   For Solaris™ 8 and 9 systems, the KAPL10242-I message appears and asks you to confirm the removal of all of the sd or ssd device files which HDLM manages. If you already backed up these files, enter **y**. If not, enter **n**, back up the files, and retry **dlmsetconf**.

8. Reboot all machines specifying the reconfiguration option at the same time:

```
# reboot -- -r
```

9. After rebooting, reconfigure the device construction and synchronize DID information in all nodes. ***Note:*** The device ID of each disk may be changed.

```
# scdidadm –C                    ← Delete nonexistent device ID
# scdidadm –r                    ← Reconfigure device ID
# scdidadm –ui                   ← Inform new device ID to Server
# scgdevs                        ← Synchronize DID information
```

10. After confirming HDLM device ID using as Quorum device, set the Quorum device configuration at one of the cluster nodes.

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -path   ← Display HDLM device
# scdidadm –L                                      ← Confirm device ID
# scconf -a -q globaldev=d4                        ← Set Quorum device
```

3.2.4 Performing Setup for Use with a Storage Subsystem

To use a storage subsystem, you need to set up the device on a host for use as a file system or as a character file (i.e., raw device).

1. Execute the **dlnkmgr view** command, and refer to the **HDevName** and the **iLU** output (see section 5.7), and check the relationship of the logical device file name of HDLM device and the inner LU number. After that, register the HDLM logical device file name again, comparing it with the environment information before the HDLM Installation. However, the HDLM logical device file name that is the same as the sd or ssd logical device file names before installation may represent a different LU for Solaris™ 8 or 9 after HDLM installation.
2. To use the HDLM device as a raw device, use the device file (**/dev/rdsk/ch*WtX*d*Y*s*Z*** or **/dev/rdsk/c*V*t*X*d*Y***) (e.g., ch2t7d16s0).

   To use the HDLM device as a file system, perform the following steps:

   a) If there is no file system, create a file system, for example:

```
# newfs /dev/rdsk/c2t7d16s0          ← Specify logical device file name
# newfs /dev/global/rdsk/d5s0        ← Specify device ID (cluster only)
```

   b) Create a directory to mount the file system, for example:

```
# mkdir /mntpt                       ← Specify logical device file name
# newfs /global/mntpt                ← Specify device ID (cluster only)
```

   c) Mount the file system, for example:

```
# mount -F ufs /dev/dsk/c2t7d16s0 /mntpt  ← Specify logical device file name
# mount -g /dev/global/dsk/d5s0 /global/mntpt          ← Specify device ID
                                                        cluster only)
```

3. Add **/opt/DynamicLinkManager/bin** to the environment variable PATH.

3.2.5 Setting Up SDS and HDLM on the Same Host

Important: See the HDLM Release Notes for requirements and important information for SDS.

Note: You cannot use the DiskSuite tool (metatool) for this operation. Use the command line utility instead.

Note: Shared disksets are not supported.

To set up SDS and HDLM on the same host:

1. Create a local metadevice: Use the HDLM devices (slices) to create a local metadevice (logical disk). The types of metadevice are *concatenated*, *striped*, *mirrored*, *RAID5*, and *trans*. The following example shows a local striped metadevice (**d0**) configured with two HDLM devices (slices):
   ```
   # metainit d0 1 2 ch4t1ds2 ch4t2d0s2
   ```
2. Execute the following command to create a file system on the local metadevice (**d0**):
   ```
   # newfs /dev/md/rdsk/d0
   ```
3. Execute the following command to mount the file system to a mount point:
   ```
   # mkdir /mount-point
   # mount /dev/md/dsk/d0 /mount-point
   ```

3.2.6 Setting Up VxVM and HDLM on the Same Host

Important: See the HDLM Release Notes for requirements and important information for VxVM.

To set up an HDLM device:

1. Create the link to the HDLM device file.

   Note: When using VxVM 3.0.4, you do not have to create the link.

   Note: When using VxVM 3.1.1 or VxVM 3.2, execute the following command to create the link to the HDLM device file in the **/dev/vx/dmp** and **/dev/vx/rdmp** directories:

   ```
   # /opt/DynamicLinkManager/bin/dlmvxlink.sh
   ```

   When you execute the above command, links to the HDLM device file that are in the **/dev/dsk** and **/dev/rdsk** directories are created in the **/dev/vx/dmp** and the **/dev/vx/rmp** directories.
2. Execute the following command to add HDLM devices as VxVM disks:

   ```
   # vxdisk [-f] init ChWtXdYsZ
   ```
3. Specify the device that has an owner-path, and whose instance number is the smallest among the devices connected to the LU. The instance number is the value of the instance parameter as given in the **/kernel/drv/dlmfdrv.conf** file.
4. Add the HDLM device to VxVM as a simple type disk. ***Note:*** Add the HDLM device on a slice basis. When using the entire disk, add the HDLM device as slice 2.

To create a VxVM volume:

Note: Do not use the vxassist command to create a VxVM volume. This command will not be processed normally, and the following message will be displayed:

```
vxvm:vxassist: ERROR: c3t0d7s0 not a valid dmpnode disk access name.
```

1. Execute the following command to create a disk group:

   ```
   # vxdg init disk-group-name media-name=cWtXdYsZ
   ```
2. Execute the following command to create a subdisk:

   ```
   # vxmake -g disk-group-name sd subdisk-name cWtXdYsZ, offset, size
   ```
3. Execute the following command to create a Plex:

   ```
   # vxmake -g disk-group-name plex plex-name sd=subdisk-name
   ```
4. Execute the following command to create a volume:

   ```
   # vxmake -g disk-group-name -U usage-type vol volume-name
   plex=plex-name
   ```
5. Execute the following command to initialize a volume:

   ```
   # vxvol start volume-name
   ```
6. When using a VxVM volume as a file system, initialize the file system. When using a VxVM volume as a character device, use **/dev/vx/rdsk/disk-group-name/volume-name**. Skip steps 6 and 7. The command to initialize the file system is shown below:

   ```
   # newfs /dev/vx/rdsk/disk-group-name/volume-name
   ```
7. Execute the following command to mount the file system:

   ```
   # mount /dev/vx/dsk/disk-group-name/volume-name mount-point
   ```

3.3 Update Installation

Caution: HDLM for Solaris supports update installation from version 4.0 to 4.1 only. If you have HDLM version 3.2 or earlier, you must uninstall HDLM before installing version 4.1.

To update your installation of HDLM from version 4.0 to version 4.1:

1. Back up the contents of the disk(s) for HDLM management on tape etc., if needed.
2. Record the logical device names of the disks used (i.e.: /dev/dsk/cWtXdYsZ), and the corresponding subsystem-internal LDEV/LU numbers.
3. Log on as a user with **root** permission.
4. Insert the HDLM CD-ROM into the drive. The CD-ROM is automatically mounted in several seconds, and the mount point of the CD-ROM is indicated in the file list.

   If the CD-ROM is not mounted automatically, enter the following command to mount it:
   ```
   # mount mount-point-of-CD-ROM
   ```

   Note: You must have a valid license key to install HDLM for Solaris™. Please contact your Hitachi Data Systems account team for information on license keys.
5. For update installation on Solaris™ 2.6 or 7, enter the following install command:
   ```
   # cp mount-point-of-CD-ROM/DLManager/install/update /tmp
   # pkgadd -a /tmp/update -d mount-point-of-CD-ROM DLManager
   # rm /tmp/update
   ```

   For update installation on Solaris™ 8 or 9, enter the following install command:
   ```
   # pkgadd -a mount-point-of-CD-ROM/DLManager/install/update
            -d mount-point-of-CD-ROM> DLManager
   ```
6. Follow the instructions and messages on screen to complete HDLM installation.
7. When installation is complete, execute the following command to confirm that the package has been successfully installed:
   ```
   # pkginfo -l DLManager
   ```
8. Reboot the system without specifying the reconfiguration option:
   ```
   # reboot
   ```

Note: HNTRLib is not uninstalled during update installation. If no other programs use release 1.0 of HNTRLib, you can remove it, since HDLM 4.1 uses HNTRLib2. To remove HNTRLib, launch the HNTRLib utility (**/opt/hitachi/HNTRLib/etc/hntrsetup**), and select option 9.

3.4 Uninstallation

When using SDS or VxVM, uninstall the SDS or VxVM settings first, and then uninstall HDLM.

(1) Uninstalling SDS settings

Delete the local metadevice as follows:

1. Unmount the file system:
   ```
   # umount /mount-point
   ```
2. Delete the local metadevice that is using the HDLM device as follows:
   ```
   # metaclear d0
   ```

(2) Uninstalling VxVM settings

Delete the HDLM device as follows:

1. Execute the following command to unmount the file system that mounted the VxVM volume:
   ```
   # umount /mount-point
   ```
2. Execute the following command to delete the volume:
   ```
   # vxedit -r -f rm volume-name
   ```
3. Execute the following command to delete the disk group:
   ```
   # vxedit destroy disk-group-name
   ```
4. Execute the following command to delete the HDLM device:
   ```
   # vxdisk rm chWtXdYsZ
   ```

(3) Uninstalling HDLM

When using SDS or VxVM, uninstall the SDS or VxVM settings first as described above, and then uninstall HDLM. To uninstall HDLM for Solaris:

1. Log on to Solaris as a user with root privileges.
2. Stop all processes and services that use the HDLM management-target host. Stop the DBMS and all application processes/services that use HDLM management-target paths.
3. Execute the following command to stop the HDLM manager:
   ```
   # /etc/init.d/DLMManager stop
   ```
4. Execute the following command to unmount all mount points that use HDLM:
   ```
   # umount /mount-point
   ```
5. Execute the following command to uninstall HDLM:
   ```
   # pkgrm DLManager
   ```
6. When you are asked to confirm the HDLM uninstallation, enter **y** to start uninstallation (or enter **n** to cancel your request to uninstall HDLM).

   Note: HDLM 4.1 uninstallation automatically uninstalls HNTRLib2.
7. When uninstallation is complete, execute the following command to restart the host:
   ```
   # reboot -- -r
   ```

Chapter 4 Operating the HDLM Software

4.1 Starting and Stopping the HDLM Manager

To use HDLM, you need to start the HDLM manager. This section describes how to start and stop the HDLM manager.

4.1.1 Starting the HDLM Manager

The HDLM manager is started using the startup script that was set up when HDLM was installed. This means that when Solaris starts, the HDLM manager also starts automatically.

If, for some reason, the HDLM manager has not started, log in to Solaris™ as a user with root privileges, and then execute the following command:

```
# /etc/init.d/DLMManager start
```

This starts the startup script that was set up when HDLM was installed.

To confirm that the HDLM manager is active, execute the following command, and make sure that the HDLM Manager column displays **Alive**:

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -sys -msrv
HDLM Manager Ver      WakeupTime
Alive        04-01    2002/12/16 11:37:56
KAPL01001-I HDLM command completed successfully. Operation name = view
#
```

4.1.2 Stopping the HDLM Manager

When you uninstall HDLM, the HDLM manager automatically stops.

If, for some reason, the HDLM manager does not automatically stop, log in to Solaris™ as a user with root privileges, and then execute the following command:

```
# /etc/init.d/DLMManager stop
```

This starts the stop script that was set up when HDLM was installed.

To confirm that the HDLM manager has stopped, execute the following command, and make sure that the HDLM Manager column displays **Dead**:

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -sys -msrv
HDLM Manager Ver      WakeupTime
Dead         04-01    2002/12/16 11:37:56
KAPL01001-I HDLM command completed successfully. Operation name = view
#
```

4.2 Checking Path Information

You can use the HDLM load balancing and failover functions when there is more than one online path for a single device. After installing HDLM and after changing the hardware configuration, you need to check the path information, including the configuration of paths and their status. You can check the path information by executing the **dlnkmgr** command together with the **view** operation.

Note: HDLM operates by reading the hardware configuration recognized by the host at startup. Therefore, after changing the hardware configuration of the system, make sure to restart the host. This allows HDLM to recognize the changes in the hardware configuration.

Note: Make sure to start the storage subsystem before starting the host. This allows the operating system to detect the storage subsystem.

To check the path information using the **dlnkmgr** command together with the **view** operation:

1. To display the path information, execute the **dlnkmgr** command together with the **view** operation. Enter the command as follows:

   ```
   # /opt/DynamicLinkManager/bin/dlnkmgr view -path > pathinfo.txt
   ```

   pathinfo.txt indicates the name of the redirection-output file. Use a file name that matches your environment.

   Executing this command displays information about all paths. For details on the items that the **view** operation displays, see section 5.7.

2. Open the redirection-output file (**pathinfo.txt** in step 1), and check the following:
   - LUs that physical paths access: **PathName** identifies a physical path. A combination of **DskName** and **iLU** identifies the LU that a physical path accesses.
   - Whether the physical paths access the same LU via different host bus adapters. Make sure that:

     The number from the beginning to the first period in **PathName** (port number of the host bus adapter) differs among the physical paths accessing the same LU.

     There are as many port numbers for the separate HBAs as there are physical HBAs.
   - Whether the physical paths access the same LU via different channel adapters. Make sure that:

     Multiple channel adapters are physically mounted.

     The **ChaPort** label (port number of the channel adapter) differs among the physical paths accessing the same LU, and indicates the port number of a different channel adapter.
   - Path status: Make sure that the **Status** conditions are all **Online**.

4.3 Using the Error Management Functions

HDLM has error management functions for logging, displaying error information, and path health checking. This section describes setting up the error management functions (see section 4.3.1), changing the trace file settings (see section 4.3.2), and path health checking (see section 4.3.3).

4.3.1 Setting the Error Management Functions

The *error logging level* refers to the level of error information to collect for the error log. Table 4.1 describes the HDLM error logging levels. Likewise, the *trace level* refers to the output level of the trace. Table 4.2 describes the HDLM trace levels. The *log file size* refers to the size of the error log file. For further information on the log files, see section 2.7.1.

To check the settings for the error logging level, trace level, and log file size, you can execute the **dlnkmgr** command with the **view** operation.

Table 4.1 Error Logging Levels

Logging Level	Description
0	Does not collect an error log.
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 (all levels). This is the default logging level setting.

Table 4.2 Trace Levels

Trace Level	Description
0	Does not output any trace. This is the default trace level setting.
1	Outputs error information only.
2	Outputs a summary of program operation.
3	Outputs the details of program operation.
4	Outputs all information (error information, summary of program operation, and details of program operation).

To set up the error management functionality using the **dlnkmgr set** command:

- **Setting the error logging level.** To set the error logging level, execute the **dlnkmgr** command with the **set** operation. The following example sets the logging level to **2**:

  ```
  # /opt/DynamicLinkManager/bin/dlnkmgr set -ellv 2
  ```

  Refer to Table 4.1 for a description of the error logging levels.

- **Setting the trace level.** To set the trace level, execute the **dlnkmgr** command with the **set** operation. The following example sets the trace level to **1**:

  ```
  # /opt/DynamicLinkManager/bin/dlnkmgr set -systflv 1
  ```

  Refer to Table 4.2 for a description of the trace levels.

  The trace file used is a Hitachi Network Objectplaza Trace Library (HNTRLib2) file, which is common to all Hitachi products.

  Setting a higher value increases the quantity of log data that is output, which reduces the period it takes for file-writing to wrap around and overwrite existing log data. As a result, setting a higher value reduces the period during which old log data is retained.

  For information and instructions on changing the trace file size, see section 4.3.2.

  Note that the history and results of user-issued commands are output to the trace files regardless of the trace level.

- **Setting the log file size.** To set the log file size, execute the **dlnkmgr** command with the **set** operation. The range is 100 KB to 9900 KB, and the default size is 1000 KB.

  ```
  # /opt/DynamicLinkManager/bin/dlnkmgr set -elfs 3000
  ```

  The log files are **dlmmgr*n*.log** (***n*** = log file number from 1 to 10). When all the log files reach the specified size, the file-writing wraps around and writes new data over any existing log data in the oldest log file.

4.3.2 Changing the Trace File Settings

The HDLM trace files are the Hitachi Network Objectplaza Trace Library (HNTRLib2) log files. The HNTRLib2 utility displays and allows you to change the log/trace file settings as needed for your operational environment.

If you output large amounts of trace information, information in the file may be quickly deleted because the file-writing frequently wraps around. If you concurrently output too much trace information, part of the activity log data for the HDLM commands may not be taken into the buffer. This activity log data is not saved in the trace file. To save the necessary information, you can:

- Increase the trace file size and/or the buffer size, and/or
- Adjust the amount of trace information to be output during a given monitoring interval. Reducing the amount of such trace information reduces the frequency of wrap-around, thus preventing quick deletion of trace information.

Note: The settings take effect only for the integrated trace information files **/var/opt/hitachi/HNTRLib2/spool/hntr2*n*.log** (where ***n*** stands for the number of the integrated trace information file).

To view and/or change the HDLM trace file settings using the HNTRLib2 utility:

1. Log in as a user with **root** privileges.
2. Execute the following command to launch the HNTRLib2 utility:
   ```
   # /opt/hitachi/HNTRLib2/bin/hntr2util
   ```
   The HNTRLib2 setup menu appears and displays the current settings (see Figure 4.1).
3. To change a setting:
   a) Type the number for the desired setting, and then press the **Enter** key. The screen for changing the selected setting appears (see Figure 4.2).
   b) Type the desired setting in the entry field (e.g., **New size(KB)** in Figure 4.2). If you do not want to change the setting, leave the entry field blank, and type **!**.
      Table 4.3 lists and describes the trace file settings.
   c) Press the **Enter** key. The setup menu now displays the new setting. The new setting will not take effect until you exit the HNTRLib2 utility and confirm your change(s).
4. Repeat step (3) as needed to change the desired settings.
5. After making the desired changes, type **e** and then press the **Enter** key to exit the HNTRLib2 utility.
6. If you changed any settings, a message appears asking whether you want to save the new settings. Enter **Yes** to save your changes, or enter **No** to exit without saving changes.

```
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>
```

Figure 4.1 Hitachi Network Objectplaza Trace Library - Configuration Utility

```
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):
```

Figure 4.2 Example of Changing a Trace File Setting (trace file size shown)

Table 4.3 Trace File Settings

Setting	Range	Default	Description and Notes
1. Size of a log file (KB)	8 – 8192	256	This must be greater than or equal to the buffer size. If you increase the trace file size, you should also increase the number of trace files.
2. Number of log files	1 – 16	4	The specified value is reflected in the ***n*** in **/var/opt/hitachi/HNTRLib2/spool/hntr2*n*.log**
3. Name of log files	--	/var/opt/hitachi/HNTRLib2/spool/hntr2*.log	***Caution:*** If you change the name of the trace file, the error information collection utility (DLMgetras) will not be able to find the trace file. You must add the new file name to the file that defines the information to be collected. For details on the error information collection utility, see section 6.1.
4. Size of buffer (KB)	8 – 2048	64	This is the buffer size for a monitoring interval. This must be less than or equal to the trace file size. If you increase the buffer size, you should also increase the number of trace files.
5. Interval timer (sec)	1 – 300	10	This is the monitoring cycle for the monitor. If you increase the trace file size and buffer size, you should also decrease the monitoring cycle.
6. Lookout span (sec)	0 or 1 – 3600	0	This is the interval for monitoring the number of messages output to the trace file. If you increase the trace file size and buffer size, you should also increase the monitoring interval. If you set the lookout span to 0, you cannot adjust the max messages per span.
7. Max messages per span	0 – 500	0	This is the maximum number of messages output during a monitoring interval. If you set the lookout span to 0, the system ignores the setting of New Max. If you specify 0 for the max messages per span, you cannot adjust the lookout span.

4.3.3 Path Health Checking

HDLM provides the path health checking functionality for checking the path status at regular intervals. Path health checking checks paths that have the **Online** status. When an error occurs in a path that is in the **Online** status, the path health checking places the path in the **Offline(E)** or **Online(E)** status.

If the path health checking functionality is disabled, HDLM does not detect errors in paths in which no I/O occurs. The path health checking functionality enables the system to detect errors in paths in which no I/O occurs, such as non-owner paths and paths in the standby host in a cluster configuration (i.e., passive node paths).

You can set up the path health checking functionality by executing the **dlnkmgr set** command (see section 5.6).

Caution: In previous versions of HDLM, path health checking was performed by executing a batch file that defined the **online** operation. Do not execute this batch file. With the current version, executing the **set** operation performs path health checking.

Notes for the 9900V, 9900, and 7700E subsystems:

1. If load balancing is ON, all paths send I/O signals, so HDLM can detect all online and offline events immediately. Path health checking is therefore not needed.
2. For cluster configurations: passive node paths do not send I/O signals. In this case, it is advantageous to enable the path health checking function set, so HDLM can immediately detect any problem on those paths. In addition, if the automatic failback function is also enabled, HDLM will change the path status to **Online** automatically.
3. If load balancing is ON and automatic failback is also ON, the total number of working paths will not change after a path fails. If automatic failback is ON, a failed path is automatically set to ONLINE, and total number of working paths increases. The interval time set will depend upon your individual system configuration and your current storage workload.

Notes for the 9500V, 9200, 5800, and 5700E subsystems:

1. When path health checking ON, HDLM can detect non-owner path errors.
2. When automatic failback is ON, I/O signals are sent through a non-owner path when an error occurs on an owner path. Once the owner path recovers from the error, the I/O signals are sent back to an owner path automatically.

Chapter 5 HDLM Commands

This chapter describes the HDLM **dlnkmgr** command and its options, which are called *operations* in HDLM. Note that the term *HDLM command* can refer to the **dlnkmgr** command together with an operation (e.g., the **dlnkmgr set** command).

5.1 Overview of the dlnkmgr Command

5.1.1 dlnkmgr Command Format

When you are using HDLM for Solaris™ systems, execute the command as a user with root permissions. Enter the **dlnkmgr** command using the following format:

```
dlnkmgr operation-name [parameter[parameter-value]]
```

dlnkmgr: The command name.

operation-name: The type of HDLM operation to be performed (see Table 5.1 in the next section).

parameter: The value/setting required for an operation.

parameter-value: The value/setting required for a parameter. ***Note:*** To specify a value which contains a space, enclose the entire value in double quotes (").

5.1.2 Operations of the HDLM Command

Table 5.1 shows the operations of the HDLM **dlnkmgr** command and their functions.

Table 5.1 HDLM Command Operations and Functions

Operation	Function	Section
clear	Clears the statistics (I/O counts and I/O errors) of all paths managed by the HDLM system to 0.	5.2
help	Displays the format of the operation used for HDLM.	5.3
offline	Places an online path offline.	5.4
online	Places one or all offline paths online.	5.5
set	Sets the HDLM operating environment.	5.6
view	Displays HDLM program information, path information, and information about the correspondence between an HDLM driver and a disk device.	5.7

5.2 Clear Operation

Format:

```
/opt/DynamicLinkManager/bin/dlnkmgr clear -pdst [-s]
```

Description: The **clear** operation together with the **dlnkmgr** command clears the statistics (I/O count and I/O errors) of all paths that are managed by HDLM to 0.

Parameters:

-pdst: Clears statistics such as the path error count.

-s: Executes the command without displaying user confirmation message. Specify this parameter if you want to skip the user confirmation message for a shell script or batch file.

Examples: Figure 5.1 shows how to clear the statistics to 0 after asking for confirmation of command execution from the user. Figure 5.2 shows how to clear the statistics to 0 without asking for confirmation of command execution from the user.

```
# /opt/DynamicLinkManager/bin/dlnkmgr clear –pdst
KAPL01049-I Would you like to execute the operation?
Operation name = clear [y/n]:y          ← Enter y to execute the command.
KAPL01001-I The HDLM command completed successfully. Operation name = clear
#
```

Figure 5.1 Example of the Clear Command with User Confirmation

```
# /opt/DynamicLinkManager/bin/dlnkmgr clear –pdst –s
KAPL01001-I The HDLM command completed successfully. Operation name = clear
#
```

Figure 5.2 Example of the Clear Command with no User Confirmation

5.3 Help Operation

Format:

```
/opt/DynamicLinkManager/bin/dlnkmgr help [operation-name]
```

Description: The **help** operation together with the **dlnkmgr** command displays the list of operations available for the HDLM command, or the format of individual operations.

Parameter:

operation-name: Specify the name of the operation used in HDLM. If you do not specify the operation name, the command displays all the operations that can be used in HDLM.

Examples: Figure 5.3 shows how to display the names of all operations available in HDLM. Figure 5.4 shows how to display the format of the **online** operation. ***Note:*** Typing **-help** following the operation name will display the format of that operation (see Figure 5.5).

```
# /opt/DynamicLinkManager/bin/dlnkmgr help
dlnkmgr { clear | help | offline | online | set | view }
#
```

Figure 5.3 Example of the Help Command for all Operations

```
# /opt/DynamicLinkManager/bin/dlnkmgr help online
Format
    dlnkmgr online [-path] [-pathid AutoPATH_ID] [-s]
Valid value
    AutoPATH_ID    {000000 - 999999}(Decimal)
#
```

Figure 5.4 Example of the Help Command for an Operation

```
# /opt/DynamicLinkManager/bin/dlnkmgr clear –help
dlnkmgr clear -pdst [-s]
#
```

Figure 5.5 Example of the *-help* Option for an Operation

5.4 Offline Operation

Format:

```
/opt/DynamicLinkManager/bin/dlnkmgr offline [-path] –pathid AutoPATH_ID [-s]
```

Description: The **offline** operation together with the **dlnkmgr** command places an online path offline. Use the **-pathid** parameter to specify the path that you want to place offline. The last path accessing each device cannot be placed offline.

Note: Placing too many paths offline may prevent path switching if an error occurs. Before placing a path offline, use the **view** operation to check how many online paths remain.

Parameters:

-path: Specifies that the target of the operation is a path managed by HDLM. This parameter is optional because the offline operation is only effective on paths. Make sure, however, that you specify the target path in the subsequent parameter.

-pathid *AutoPATH_ID*: Specify the AutoPATH_ID that HDLM assigned to the path during system startup. The command will place this path offline. Use the view operation to find out the AutoPATH_ID. Leading zeros in the AutoPATH_ID can be omitted when it is specified as the parameter value.

-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: Figure 5.6 shows how to place a path, whose AutoPATH_ID is 000001, offline without asking for confirmation of command execution from the user.

```
# /opt/DynamicLinkManager/bin/dlnkmgr offline -pathid 1 –s
KAPL01022-I 1 path(s) were processed. Operation name = offline
KAPL01001-I The HDLM command completed successfully. Operation name = offline
#
```

Figure 5.6 Example of the Offline Operation With No User Confirmation

5.5 Online Operation

Format:

```
/opt/DynamicLinkManager/bin/dlnkmgr online [-path] [-pathid AutoPATH_ID] [-s]
```

Description: The **online** operation together with the **dlnkmgr** command places one or all offline paths online. Use the **-pathid** parameter to specify the path that you want to place online.

Parameters:

-path: Specifies that the target of the operation is a path managed by HDLM. This parameter is optional because the **online** operation is only effective on paths.

Make sure, however, that you specify the target path in the subsequent parameter. If you do not specify the subsequent parameter, the command places 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**.

-pathid *AutoPATH_ID*: Specify the AutoPATH_ID that HDLM assigned to the path during system startup. The command will place this path online. Use the **view** operation to find out the AutoPATH_ID. Leading zeros in the AutoPATH_ID can be omitted when it is specified as the parameter value.

-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: Figure 5.7 shows how to place a path, whose AutoPATH_ID is 000002, online without asking for confirmation of command execution from the user.

```
# /opt/DynamicLinkManager/bin/dlnkmgr online -pathid 2 -s
KAPL01022-I 1 path(s) were processed. Operation name = online
KAPL01001-I The HDLM command completed successfully. Operation name = online
#
```

Figure 5.7 Example of the Online Operation With No User Confirmation

5.6 Set Operation

Format:

```
/opt/DynamicLinkManager/bin/dlnkmgr set
            {-lb {on|off}
            |-ellv log-level
            |-elfs log-size
            |-systflv trace-level}
            |-pchk {on [-intvl execution-interval]|off}
            |-afb {on [-intvl execution-interval]|off}}
            [-s]
```

Description: The **set** operation together with the **dlnkmgr** command sets the HDLM operating environment.

Parameters: Table 5.2 lists the parameters for the **set** operation and their default values. If you change a parameter using the **set** operation, the new value takes effect immediately.

Table 5.2 Default Settings

Parameter	Description	Default
-lb	Load balancing function	on: Enabled
-ellv	Log level	3: Collect error information for Information or higher level (that is, all levels).
-elfs	Log size	1000 (Kbytes)
-systflv	Trace level	0: Do not output any trace.
-pchk	Path health checking function	off: Disabled
-afb	Automatic failback	off: Disabled

-lb {on|off}: Enables (on) or disables (off) load balancing. The default is on.

-ellv *log-level*: Specifies the level of error information you want to collect for an error log (refer to Table 4.1). The default is 3.

-elfs *log-size*: Specifies in kilobytes the size of the error log files. Use a value between 100 and 9900. The default is 1000.

The error log files are dlmmgr1.log and dlmmgr2.log. If the sizes of both error log files reach the specified value, the older log file is wrapped around and is overwritten by the new log information.

-systflv *trace-level*: specify the trace output level (refer to Table 4.2). The default is 0.

The larger the trace level value, the larger the amount of log information that is output. When a large amount of log information is output, the time taken for the file to wrap around and delete an old log is reduced.

The file used in this case is a Hitachi Network Objectplaza Trace Library (HNTRLib2) file, which is a trace file common to all Hitachi products.

Note that the history and results of user-issued commands are output to the trace files regardless of the trace level.

-pchk {on [-intvl *execution-interval*]|off}: Enables (on) or disables (off) path health checking. The default is off.

Path health checking checks the paths that have the Online status.

When you specify **on**, specify the execution interval of path health checking by specifying the parameter immediately following on. If you do not specify an execution interval, path health checking is executed every 30 minutes.

-intvl *execution-interval*: Specify the interval between path health checks (in minutes). Use a value between 1 and 1440. The default is 30.

Once this parameter is set, the value of this parameter is stored, and the setting of this parameter takes effect after the OS or the HDLM manager is restarted. If the OS or the HDLM manager is restarted, the first path health check is executed after the specified execution interval has elapsed (starting from the time the HDLM manager restarted).

When you change the execution interval, the new setting takes effect immediately. When the execution interval is short and the execution interval after the change (from the end of the previous path health check) has already elapsed, the path health check will start immediately.

After this parameter is set, even if you specify the **-pchk off** parameter to disable path health checking, the setting for the interval between path health checks remains stored in the system. Therefore, when you enable path health checking again, path health checking is executed at the interval stored in the system.

Caution: In previous versions of HDLM, path health checking was performed by executing a batch file that defined the **online** operation. Do not execute this batch file. With the current version, executing the **set** operation performs path health checking.

-afb {on [-intvl *execution-interval*]|off}: Enables (on) or disables (off) automatic failback. The default is off.

Automatic failback is executed in the following paths:
Path where an error occurred and for which the KAPL08022-E message was displayed
Path where an error occurred at the startup of the HDLM manager.

When you specify on, specify the interval between path status checks by specifying the parameter immediately following on. If you do not specify an execution interval, HDLM checks the path status every 30 minutes.

-intvl execution-interval: Specify the interval between path status checks (in minutes). Use a value between 1 and 1440. The default is 1.

Once this parameter is set, the value of this parameter is stored, and the setting of this parameter takes effect after the OS or the HDLM manager is restarted. If the OS or the HDLM manager is restarted, the first path health check is executed after the specified execution interval has elapsed (starting from the time the HDLM manager restarted).

When you change the execution interval, the new setting takes effect immediately. When the execution interval is short and the execution interval after the change (from the end of the previous path status check) has already elapsed, the path status check will start immediately.

-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: Figure 5.8 shows how to set the log level after asking for confirmation of command execution from the user.

```
# /opt/DynamicLinkManager/bin/dlnkmgr set -ellv 1
dlnkmgr set -ellv 1
Execute command? [y/n]: y                ← Enter y to execute the command.
KAPL01001-I The HDLM command completed successfully. Operation name = set
#
```

Figure 5.8 Example of Set Operation with User Confirmation

5.7 View Operation

Format:
To display program information:

```
/opt/DynamicLinkManager/bin/dlnkmgr view –sys
     [-sfunc|-msrv|-adrv|-pdrv]
     [-t ]
```

To display path information when you do not select a display item:

```
/opt/DynamicLinkManager/bin/dlnkmgr view –path
     [-c|-hdev host-device-name]
     [-t]
```

To display path information when you select one or more display items:

```
/opt/DynamicLinkManager/bin/dlnkmgr view -path –item
     [pn] [dn] [lu] [cp] [type] [ic] [ie] [dnu] [hd]
     [-hdev host-device-name]
     [-t]
```

To display the correspondence information about each instance of an HDLM driver to a disk device (for UNIX®-based systems only):

```
/opt/DynamicLinkManager/bin/dlnkmgr view -drv [-t]
```

Description: The **view** operation together with the **dlnkmgr** command displays HDLM program information, path information, and relationships between HDLM drivers and SCSI drivers.

Parameters:

-sys [-sfunc|-msrv|-adrv|-pdrv]: Displays the HDLM program information. In the subsequent parameter, specify the program for which you want to display information. If you do not specify the subsequent parameter, the command displays all program information. Table 5.3 shows the parameters and the displayed information.

Table 5.3 View -sys Operation Parameters and Displayed Information

Parameter	Displayed Information
-sfunc	Information about the HDLM function settings
-msrv	Information about the HDLM manager
-adrv	Information about the HDLM alert driver
-pdrv	Information about the HDLM driver

-path: Displays information about the paths that HDLM manages. In the sub-parameters that follow this parameter, you can specify that the path information is to be displayed in abbreviated format, or you can specify the path for which you want to display information by specifying the host device that the path accesses. If you do not specify a sub-parameter, the command displays information for all the paths.

The sub-parameters for the **-path** parameter are:

-c: Abbreviates the display of path information by reducing the display of some items. The PathID, DskName, iLU, CP, Status, and Type are displayed. ChaPort is abbreviated to CP only when you specify the **-c** sub-parameter. For details on what is displayed in each item, see Table 5.9.

When you specify the **-c** parameter, up to 10 characters of the product ID can be displayed in the DskName field. When there are 11 or more characters in the product ID, the 8th and following characters are abbreviated to ellipses (...). If you would like to display the full name of the product ID, execute the **view** operation without specifying the **-c** sub-parameter.

-hdev ***host-device-name***: Filters the information only for the paths accessing the specified host device. For Solaris 2.6 or 7, specify ch*W*t*X*d*Y*s*Z* for the HDLM device to indicate the desired host device. For Solaris 8 or 9, specify c*V*t*X*d*Y* for the HDLM device to indicate the desired host device. Displays information about all the paths accessing the specified host device.

You cannot specify the **-c** sub-parameter and the **-hdev** sub-parameter at the same time. If you specify them at the same time, the KAPL01024-W message is displayed and an error occurs.

-item: Among the information on the paths that HDLM manages, this parameter only displays the items specified by the value of the **-item** parameters. When you execute this operation without specifying any value for the **-item** parameter, only the PathID and Status fields are displayed.

Table 5.4 lists and describes the items displayed by the **dlnkmgr view -path -item** command for each value of the **-item** parameter.

-hdev ***host-device-name***: The **-hdev** sub-parameter follows the **-item** parameter to enable you to specify the path for which you want to display information by specifying the host device that the paths access. If you do not specify this sub-parameter, the **-item** command displays information for all the paths.

When you specify the **-hdev** sub-parameter, HDevName is displayed even if you do not specify **hd** for the value of the **-item** parameter.

-drv: Displays the correspondence between PathID, HDLM driver, and the SCSI driver that corresponds to the HDLM driver. This parameter displays PathID, HDevName, and Device. For details on the contents of each display item, see Table 5.10.

-t: Does not display the title for each information item.

Table 5.4 Values of the -item Parameter for the dlnkmgr view -path -item Command

Value of the -item Parameter	Description
None	PathID*
None	Status*
pn	PathName
dn	DskName
lu	iLU
cp	ChaPort
type	Type
ic	IO-Counts
ie	IO-Errors
dnu	DNum
hd	HDevName

* PathID and Status are always displayed regardless of the setting. You do not have to specify any value for the **-item** parameter to display PathID and Status.

Examples:

HDLM function settings. Figure 5.9 shows how to display information about the HDLM function settings. Table 5.5 describes the displayed items.

HDLM manager. Figure 5.10 shows how to display information about the HDLM manager. Table 5.6 describes the displayed items.

HDLM alert driver. Figure 5.11 shows how to display information about the HDLM alert driver. Table 5.7 describes the displayed items.

HDLM driver. Figure 5.12 shows how to display information about the HDLM driver. Table 5.8 describes the displayed items.

Paths that access a host device. Figure 5.13 shows how to display information about the paths that access the host device whose name is **f**. Items from PathID to HDevName are displayed for the number of paths. Table 5.9 describes the displayed items.

Abbreviated path information. Figure 5.15 shows how to abbreviate the display of path information. For details on the displayed items, refer to Table 5.9 (CP = ChaPort).

Specifying path info. Figure 5.16 shows how to specify the items to display in an execution result. In this example, the user specified PathName, ChaPort, IO-Counts, and IO-Errors (Path ID and Status are always displayed). For details on the displayed items, refer to Table 5.9.

HDLM driver instances and disk devices. Figure 5.17 shows how to display information about the correspondence between each instance of an HDLM driver and a disk device. For details on the displayed items, refer to Table 5.10.

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -sys -sfunc
HDLM Version : 04-01
Load Balance : on
Support Cluster :
Elog Level : 3
Elog File Size(KB) : 1000
Trace Level : 1
Path Health Checking : on(30)
Auto Failback : on(1)
Reservation Status :
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.9 Displaying Information on the HDLM Function Settings

Table 5.5 Description of HDLM Function Settings

Function Setting	Description
HDLM Version	HDLM version number
Load Balance	Setting for load balancing: on: Enabled off: Disabled
Support Cluster	Setting of the cluster support function: on: Enabled off: Disabled Type of the cluster server (e.g., VERITAS Cluster Server) When you use HDLM for Solaris™ systems in a cluster configuration, **off** is displayed in this field; however, the cluster support function operates normally.
Elog Level	Logging level: 0: Do not collect an error log. 1: Collect error information for the Error or higher level. 2: Collect error information for the Warning or higher level. 3: Collect error information for the Information or higher level (that is, all levels).
Elog File Size (KB)	Size of the error log file in kilobytes.
Trace Level	Trace output level: 0: Do not output any trace. 1: Only output error information. 2: Output a summary of program operation. 3: Output details of program operation. 4: Output all information.
Path Health Checking	Setting for path health checking: on: Enabled off: Disabled When path health checking is **on**, the execution interval (in minutes) of path health checking is displayed in parentheses (refer to Figure 5.9).
Auto Failback	Setting for automatic failback: on: Enabled off: Disabled When automatic failback is **on**, the execution interval (in minutes) of automatic failback is displayed in parentheses (refer to Figure 5.9).

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -sys –msrv
HDLM Manager Ver    WakeupTime
Alive        04-01  2002/07/16 11:37:56
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.10 Displaying Information on the HDLM Manager

Table 5.6 Description of HDLM Manager Information

Item	Description
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

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -sys –adrv
HDLM Alert Driver  Ver    WakeupTime           Elog Mem Size
Alive              04-01  2002/07/16 11:28:34  128
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.11 Displaying Information on the HDLM Alert Driver

Table 5.7 Description of the HDLM Alert Driver Information

Item	Description
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
Elog Mem Size	Size of error log memory for the HDLM alert driver

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -sys -pdrv
HDLM Driver  Ver      WakeupTime
Alive        04-01    2002/07/16 11:28:34
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.12 Displaying Information on the HDLM Driver

Table 5.8 Description of the HDLM Driver Information

Item	Description
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

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -path -hdev ch2t58d5s0
Paths:000002 OnlinePaths:000002
PathStatus   IO-Counts  IO-Errors
Online       1332       0

PathID  PathName                          DskName               iLU   ChaPort  Status
000005  0003.0004.0000000000000027.0002  HITACHI .DF400  .1234  0010  0B      Online
Type   IO-Counts   IO-Errors   DNum  HDevName
Non           0           0      1  ch2t32d11s2
PathID  PathName                          DskName               iLU   ChaPort  Status
000011 0008.0030 000000000000004A.0015   HITACHI .DF400  .1234  0010  1B      Online
Type   IO-Counts   IO-Errors   DNum  HDevName
Own         1332           0      1  ch3t32d11s2
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Note: The column headings in these figures have been modified for improved readability: bold has been applied, spacing has been adjusted, and the headings are repeated for each path. The actual display is different than these figures.

Figure 5.13 Displaying Information on the Host Device Path (Solaris 2.6 or 7)

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -path -hdev c2t58d5
Paths:000002 OnlinePaths:000002
PathStatus   IO-Counts  IO-Errors
Online       1332       0

PathID  PathName                          DskName               iLU   ChaPort  Status
000005  0003.0004.0000000000000027.0002  HITACHI .DF400  .1234  0010  0B      Online
Type   IO-Counts   IO-Errors   DNum  HDevName
Non           0           0      1  c2t32d11
PathID  PathName                          DskName               iLU   ChaPort  Status
000011 0008.0030 000000000000004A.0015   HITACHI .DF400  .1234  0010  1B      Online
Type   IO-Counts   IO-Errors   DNum  HDevName
Own         1332           0      1  c3t32d11
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.14 Displaying Information on the Host Device Path (Solaris 8 or 9)

Table 5.9 Description of the Host Device Path Information

Item	Description
Paths	Sum of the number of displayed paths, indicated by a decimal number.
OnlinePaths	Number of available paths in the displayed paths, indicated by a decimal number. When the value of **Paths** is equal to the value of **OnlinePaths**, all paths are online. If the value of **OnlinePaths** is less than the value of **Paths**, some paths may be in error status, in which case you should check the status of individual paths and take appropriate action for any paths that are in error status.
PathStatus	Status of the displayed paths **Online**: All paths are available. **Reduced**: Some paths are not available. If **Reduced** is displayed, check the situation, and take appropriate action if any path has an error.
IO-Count	The total number of I/O operations for connected paths. The maximum value is 2^{32} - 1 (4294967295). When this value is exceeded, the count is initialized to 0.
IO-Errors	The total number of I/O errors for connected paths. The maximum value is 2^{32} - 1 (4294967295). When this value is exceeded, the count is initialized to 0.
PathID	The ID assigned to a path. This ID is called the **AutoPATH_ID**, and it is re-assigned each time the management-target host or the HDLM Manager is started.
PathName	Path name is composed of the following four elements separated by periods: Host port number (hexadecimal) (example: 0000). A unique number in a host: HDLM assigns this unique number to each HBA port. When two HBAs that have two ports are installed on the host, a value from 0000 to 0003 is assigned to each port. Bus number (hexadecimal), set to 0 (constant) for Solaris™ systems (example: 0000). Target ID (char. string) (example: 000000000000003A). The **target** clause of the **/kernel/drv/sd.conf** file. Host LU number (hexadecimal) (example: 0005). The **lun** clause of the **/kernel/drv/sd.conf** file. ***Note:*** Whenever you modify the system configuration or replace a hardware item, you should check the path names to determine if any of the physical paths are affected by the configuration or hardware change.
DskName	The name of the storage subsystem that you use to specify the storage subsystem for access via a path. A storage subsystem name consists of the following three elements, separated by periods: Vendor ID (e.g., HITACHI). Product ID: subsystem emulation type, product ID (e.g., 9500V, 5800), or model name. For the 9900V, 9900, or 7700E, the CU emulation mode is displayed in the product ID field. Serial number (decimal number, e.g., 15001). You can physically specify a storage subsystem by referencing these elements of information from the storage subsystem management program.
iLU	The number assigned to the LU that is managed within the storage subsystem. This number combined with the storage subsystem name (indicated in **DskName**) identifies the LU that is accessed by a path. In the case of the 9900V, 9900, or 7700E, the first two characters of **iLU** are the CU number, and the last two characters are the internal LU number within the CU. In the case of the 9500V, 9200, 5800, or 5700E, the entire **iLU** is the internal LU number within the storage subsystem. You can physically specify an LU by referencing the iLU from the storage subsystem management program.
ChaPort	The CHA port number, which indicates the CHA that is mounted on the storage subsystem. You can physically specify a CHA by referencing this number from the storage subsystem management program. (ChaPort is abbreviated as “CP”.)
Status	Status of the path: **Online**: Online **Offline(C)**: Command-initiated offlinestatus **Offline(E)**: Error-initiated offline status **Online(E)**: An error has occurred on the last active path for a device, and the last path is offline. Paths that have the **Offline(E)** and **Online(E)** status require corrective action (see section 7.2).

Table 5.9 Description of the Host Device Path Information (Continued)

Item	Description
Type	The path type (owner or non-owner) for a path to the 9500V, 9200, 5800, or 5700E array: **Own**: Owner path (provides faster access to an LU than a non-owner path). **Non**: Non-owner path. For the 9900V, 9900, and 7700E, all paths are owner paths.
IO-Count	The total number of I/O operations on a physical path (in decimal). The maximum value is 2^{32} - 1 (4294967295). When this value is exceeded, the count is initialized to 0. To reset the **IO-Count** value to zero, execute the **dlnkmgr clear** command. Executing the **clear** operation also resets the number of I/O errors (IO-Errors) to zero.
IO-Errors	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 is reset, and the count is restarted from 0. To reset the **IO-Errors** value to zero, execute the **dlnkmgr clear** command. Executing the **clear** operation also resets the number of I/O operations (IO-Count) to zero.
DNum	The device number. A slice number is displayed in the case of Solaris 2.6 or Solaris 7. A hyphen (-) is displayed in the case of Solaris 8 or Solaris 9.
HDevName	Name of the host device. For Solaris 2.6 or 7: Logical device file name (**ch*W*t*X*d*Y*s*Z***) of the HDLM device. ***W***: Controller number of the sd or ssd device for the HDLM device ***X***: Target ID or WWN (World Wide Name) of the sd or ssd device for the HDLM device ***Y***: LUN of the sd or ssd device for the HDLM device ***Z***: Slice number of the sd or ssd device for the HDLM device For Solaris 8 or 9: Logical device file name (minus the slice number, in **c*V*t*X*d*Y*** format) for the HDLM device to indicate the desired host device. ***V***: Controller number assigned by Solaris exclusively for HDLM ***X***: Target ID or WWN (World Wide Name) of the sd or ssd device for the HDLM device ***Y***: LUN of the sd or ssd device for the HDLM device

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -path –c
Paths:000006 OnlinePaths:000006
PathStatus   IO-Counts  IO-Errors
Online       424        0

PathID DskName                              iLU             CP Status     Type
000000 HITACHI .OPEN-3    .15001             0140             0A Online     Own
000001 HITACHI .OPEN-3    .15001             0141             0A Online     Own
000002 HITACHI .OPEN-3    .15001             0142             0A Online     Own
000003 HITACHI .OPEN-3    .15001             0140             1A Online     Own
000004 HITACHI .OPEN-3    .15001             0141             1A Online     Own
000005 HITACHI .OPEN-3    .15001             0142             1A Online     Own
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.15 Displaying Abbreviated Path Information

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -path –item pn cp ic ie
Paths:000008 OnlinePaths:000008
PathStatus   IO-Counts  IO-Errors
Online       4          0

PathID PathName                          ChaPort Status    IO-Counts  IO-Errors
000000 0000.0000.0000000000000000.0000 0A      Online            0          0
000001 0001.0000.0000000000000002.0000 1A      Online            0          0
000002 0000.0000.0000000000000000.0001 0A      Online            0          0
000003 0001.0000.0000000000000002.0001 1A      Online            0          0
000004 0000.0000.0000000000000000.0002 0A      Online            0          0
000005 0001.0000.0000000000000002.0002 1A      Online            0          0
000006 0000.0000.0000000000000000.0003 0A      Online            0          0
000007 0001.0000.0000000000000002.0003 1A      Online            0          0
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.16 Displaying Specific Items of Path Information

```
# dlnkmgr view –drv
PathID HDevName         Device
000000 ch2t32d11s2     c2t32d11s2                          ← Solaris 2.6 or 7
000001 ch3t32d11s2      c3t32d11s2
...
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
# dlnkmgr view -drv
PathID HDevName         Device
000000 c2t32d11        --                                  ← Solaris 8 or 9
000001 c3t32d11         --
...
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 5.17 Displaying Correspondence between HDLM Driver Instances and Disk Devices

Table 5.10 Correspondence between HDLM Driver Instances and Disk Devices

Item	Description
PathID	AutoPATH_ID indicated by a decimal number
HDevName	In Solaris 2.6/7, logical device file name of a DLM driver. In Solaris 8/9, the value of logical device file name without a slice number of HDLM driver.
Device	In Solaris 2.6/7, device name (sd or ssd device name) that corresponds to each instance of a HDLM driver. In Solaris 8/9, it is not output because there is no device name corresponding to each instance of the HDLM driver.

Chapter 6 HDLM Utilities

The HDLM for Solaris™ product includes the following utilities:

- The HDLM error information collection utility (**DLMgetras**) (see section 6.1).

  When an error occurs, you need to execute this utility right away (before restarting) to collect the information that should be given to maintenance personnel.

- The HDLM driver configuration definition utility (dlmsetconf) (see section 6.2).

  This utility enables you to create the configuration definition file (**dlmfdrv.conf**).

The user must have **root** privileges to execute the HDLM utilities.

6.1 HDLM Error Information Collection Utility (DLMgetras)

Important: Execute DLMgetras immediately after an error occurs, since restarting the machine may delete information collected by DLMgetras.

Format:

```
# /opt/DynamicLinkManager/bin/DLMgetras
{destination-directory-for-collected-information [-f
file-for-defining-the-information-to-be-collected]| -h}
```

Description: The error information collection utility collects information, such as trace files, definition files, core files, and libraries, required for analyzing errors that occur in HDLM. Table 6.1 lists and describes the information automatically collected by the error information collection utility, if you do not specify the information to be collected. If desired, you can specify the files to be collected by defining them in a special file (see section 6.1.1).

Parameters:

destination-directory-for-collected-information: Specify the directory to which the collected information is output. The directories to be output are created in the specified directory, and error information is collected in the created directories.

-f *file-for-defining-the-information-to-be-collected*: Specify this parameter when you want to specify the directories or the files to be collected. Specify the directories or the files in the file for defining the information to be collected, and then specify this parameter. Use an absolute path to specify the *file-for-defining-the-information-to-be-collected*. For details on this file, see section 6.1.1.

-h: Displays the format of the issued command.

Important: A large amount of data is stored in core files and OS crash files. Therefore, ensure that sufficient space is available in the area for collecting error information.

Important: If the specified output directory already exists, a message confirming the overwrite of the directories and files is displayed. If you enter y, the file is overwritten. If you enter *n*, the utility is terminated without being executed.

Table 6.1 Error Information to be Collected by the DLMgetras Utility

Directory	File	Description
/var/opt/DynamicLinkManager/log	dlmmgr1.log	HDLM manager log file (driver logs are included)
	dlmmgr2.log	
/opt/hitachi/HNTRLib2/mmap	hntr2*host-name*.mm	Memory mapped file
/var/opt/hitachi/HNTRLib2/spool	hntr2*.log (* = 1,2,3…16)	Trace files
/kernel/drv	sd.conf	sd (SCSI driver) configuration file
	dlmfdrv.conf	HDLM drivers configuration file
	dlmadrv.conf	HDLM alert driver configuration file
	fca-pci.conf, fcaw.conf, lpfc.conf, qla2300.conf, jnic.conf, jnic146x.conf, qlc.conf, fjpfca.conf, or fjfcif.conf	HBA configuration file (file name depends on the installed HBA driver)
	md.conf	Limit number of volumes (metadevices, metaset)
/etc	coreadm.conf	Configuration definition file for the core file (Solaris 7 or later)
	dumpadm.conf	Configuration definition file for the OS crash dump (Solaris 7 or later)
	syslog.conf	File for defining the directory for the output destination of syslog
	system	Kernel patch file
	vfstab	Information for automatic mount of file system at startup
	mnttab	Mount information of file system
/etc/dfs	fstypes	File for setting the default system type (NFS) and other file system types
	dfstab	File for setting the command to be executed at the boot of the system

Table 6.1 Error Information to be Collected by the DLMgetras Utility (Continued)

Directory	File	Description
/OS-crash-file-directory	OS-crash-file-name	For Solaris 2.6: All files in the **/var/crash/*host-name*** directory are collected. For Solaris 7 or later: All files in the following directory are collected: the directory specified in the **DUMPADM_SAVDIR** parameter in the **/etc/dumpadm.conf** file.
/directory-for-the-output-destination-of-syslog	syslog-name	The file path depends on the settings in the **/etc/syslog.conf** file
/getrasinfo	(Not applicable)	Directory for collecting the command execution results
	dev_dsk.txt	List of disks that are treated as block devices
	dev_rdsk.txt	List of disks that are treated as character devices
	devices.txt	List of device special file entities
	df-k.txt	Mount information
	pagesize.txt	Memory page size
	uname-a.txt	OS version
	isainfo-b.txt	OS type (32 bit or 64 bit) Collected for Solaris 7 or later
	ulimit-a.txt	Limit of the system resources (data segment, stack segment and file descriptor) available for the processes
	pkginfo.txt	List of installed packages
	showrev-p.txt	List of installed patches
	prtconfMemory.txt	Physical memory size
	psrinfo-v.txt	CPU information
	sysdef.txt	Kernel parameter value
	swap-l.txt	Information of swap area
	swap-s.txt	Usage of swap
	modinfo.txt	Information of loaded drivers
	dmesg.txt	System diagnosis message
	dlmmgr-path.txt	HDLM path information
	dlmmgr-sys.txt	HDLM system information
	format.txt	format command output

Table 6.1 Error Information to be Collected by the DLMgetras Utility (Continued)

Directory	File	Description
/VXVM	(Not applicable)	Directory for collecting VxVM information
	VXVM_pkginfo.txt	Package information for VxVM
	VXVM_vxdmp.txt	List of **/dev/vx/dmp** directories
	VXVM_vxrdmp.txt	List of **/dev/vx/rdmp** directories
	VXVM_vxdsk.txt	List of **/dev/vx/dsk** directories
	VXVM_vxrdsk.txt	List of **/dev/vx/rdsk** directories
	VXVM_vxdisklist.txt	List of VxVM disks
	VXVM_vxdisklist-s.txt	**vxdisk -s** list output
	VXVM_vxdglist.txt	List of disk groups
	VXVM_vxprint.txt	**vxprint** output
/SDS	(Not applicable)	Directory for collecting Solstice DiskSuite information
	SDS_pkginfo.txt	Package information for SDS
	SDS_metadb.txt	Information of a state database
	SDS_metastat.txt	Metadevice information
	SDS_metaset.txt	Disk set information
/etc/lvm	devpath	Common files of Solstice DiskSuite and Solaris Volume Manager
	lock	
	md.ctlrmap	
	runtime.cf	
	mddb.cf	File recording the locations of state database replicas
	mdlogd.cf	Log file (only for SDS)
	md.tab	Input parameter file for SDS
	md.cf	A backup file for the DiskSuite configuration

Table 6.1 Error Information to be Collected by the DLMgetras Utility (Continued)

Directory	File	Description
/VCS	(Not applicable)	Directory for collecting VERITAS Cluster Server information
	VCS_pkginfo.txt	Package information for VCS
	VCS_hastatus-summary.txt	Status information for VCS
	VCS_haclus-display.txt	Information about the VCS cluster
	VCS_hasys-list.txt	List of systems in the cluster
	VCS_hagrp-resources.txt	List of service group's resources
	VCS_hagrp-display.txt	Information of service groups
	VCS_hares-display.txt	Information of resources

6.1.1 File for Defining the Information to be Collected

Figure 6.1 shows an example of a file that defines the information to be collected by the error information collection utility (**DLMgetras**). If you do not specify the information to be collected, refer to Table 6.1 for details on the information that is collected.

```
# DLM manager core file
/opt/DynamicLinkManager/bin/core                    ← Collects the core file of HDLM.
#
# Oracle initial parameter
/u01/app/oracle/admin/sandb/pfile/init.ora    ← Collects the initial parameter file
#                                                      for the database (Oracle).
# Oracle Alert Directory
/u01/app/oracle/rdbms/log                  ← Collects the alert information directory
                                                       for the database (Oracle).
```

Figure 6.1 Example of File for Defining the Information to be Collected

The coding rules and notes for the file that defines the information to be collected are:

- Use absolute paths to specify the directories or files. If you use relative paths to specify the directories or the files, the specified directories and files are searched in the directory where the error information collection utility was executed, and then the found directories and files are collected.
- Do not specify directories that contain the directory to which the collected information is output. If you do specify a directory containing such a directory, the error information collection utility will never complete.
- If there is a sharp character (#) at the beginning of a line, the line is considered to be a comment.
- If there is a sharp character (#) somewhere other than at the beginning of a line, the sharp character is considered to be part of a file path.
- Specify one file or one directory in one line.
- Do not specify the root directory (/).
- If you specify a directory, all files in the specified directory are collected. The files in the subdirectories in the specified directory are also collected. If the specified directory does not contain any files, no files in the specified directory are collected. The specified directory is not created in the directory to which the collected information is output.

6.2 HDLM Driver Configuration Definition File Utility (dlmsetconf)

Format:

```
/opt/DynamicLinkManager/bin/dlmsetconf [-d
name-of-directory-at-output-destination]
                                       [-r]
```

Description: The HDLM driver configuration definition file (**dlmfdrv.conf**) is created according to special device files in the **/dev/dsk** directory.

Parameters:

-d *name-of-directory-at-output-destination*: Specify the name of the directory in which the **dlmfdrv.conf** file is to be stored. Use an absolute path to specify the directory name. If you do not specify a name for the directory at the output destination, the **dlmfdrv.conf** file is created in the **/kernel/drv** directory. Create the directory and then execute the utility.

-r: Specify this option to create a new **dlmfdrv.conf** file. Any existing file will be overwritten.

If you omit this option, the definition information in the existing file will be inherited, any new definitions will be added, and definitions that have become unnecessary will be deleted.

Do not specify the **-r** parameter when SDS is in use. The metadevice cannot be used if the instance number (the minor number of the HDLM device) is changed when the disk configuration is changed.

Example 1:

When no options are specified, a configuration definition file (**dlmfdrv.conf**) will be created in the **/kernel/drv** directory. If the **dlmfdrv.conf** file already exists in this directory, the existing definition information will be inherited, any new definitions will be added, and definitions that have become unnecessary will be deleted.

```
# /opt/DynamicLinkManager/bin/dlmsetconf
```

Example 2:

When the **-d** option is specified, the configuration definition file (**dlmfdrv.conf**) will be created in the **/tmp** directory.

```
# /opt/DynamicLinkManager/bin/dlmsetconf -d /tmp
```

Example 3:

When the **-r** option is specified, a new configuration definition file (**dlmfdrv.conf**) will be created in the **/kernel/drv** directory. The definition information in the existing file will not be inherited.

```
# /opt/DynamicLinkManager/bin/dlmsetconf -r
```

Notes:

- If the **dlmfdrv.conf** file exists in the **/kernel/drv** or specified directory, change the file's name to **dlmfdrv.conf.bak**, and make sure that the backup from the previous generation exists.
- Even if you specify the **-d** option, the existing definition information will be read from the **/kernel/drv/dlmfdrv.conf** file, not from the specified **dlmfdrv.conf** file.
- If a new disk is added while the **dlmsetconf** command is executing, the definition of entry with path addition is added in the LU. If a disk is deleted, the disk will be deleted from the definition. In any cases, the existing instance number is inherited.
- If the **dlmfdrv.conf** file does not exist, it will be created (the **-r** option will be ignored).
- If an old link file remains after changing the storage configuration, delete the unnecessary link file, and then execute the **dlmsetconf** command.
- The **dlmsetconf** command outputs the message to syslog. If you want to output this message at the Warning level or Information level, add the text **user.warning;user.info** to the **var/adm/**messages line in the **/etc/syslog.conf** file.

  The following shows an example of editing the **/etc/syslog.conf** file, with the added line highlighted. You can also add the **user.warning;user.info** text after the **crit;** in the first line. For further information, see the output results of the **man syslog.conf** command.

```
*.err;kern.debug;daemon.notice;mail.crit;          /var/adm/messages
user.warning;user.info                             /var/adm/messages
```

- For Solaris 8 or 9, the response message (KAPL10242-I) is displayed before deleting link files of the sd or ssd device managed by HDLM. If you respond **y**, link files of the sd or ssd device are deleted. If you respond **n**, the procedure stops.

  When **dlmsetconf** is executed and HDLM devices are opened exclusively, the device information cannot be referred. In this case, if there are entries in the existing configuration file, the existing definition is valid. If there is no entry, the error occurs, and the entry is not defined.

Chapter 7 Troubleshooting

This chapter describes how to check information in case of an error (see section 7.1) and the actions you should take when HDLM detects a path error (see section 7.2), or when an error occurs in an HDLM program (see section 7.3). For details on hardware maintenance, see the **Hardware Notes** document that is supplied with the HDLM product.

Note: Execute the error information collection utility (**DLMgetras**) immediately after an error occurs, since restarting the machine may delete information collected by **DLMgetras**.

If you need to call the Hitachi Data Systems Support Center, please refer to section for instructions.

7.1 Error Information Checking

You can check for an error by referring to:

- The information displayed by the **dlnkmgr** command with the **view** operation, and/or
- The message that is output when an error occurs.

Note: The error information collection utility (**DLMgetras**) collects detailed internal program information for use by Hitachi Data Systems maintenance personnel in troubleshooting HDLM program errors (see section 7.3).

7.1.1 Information Displayed by the View Command

You can use the **dlnkmgr** command together with the **view** operation to check error information. For example, specify **-path** parameter of the **view** operation to display the path information (see Figure 7.1). ***Note:*** Equipment that is not mounted is also displayed when the **-hdev** parameter is not used.

```
# /opt/DynamicLinkManager/bin/dlnkmgr view -path -hdev c2t58d5
Paths:000002 OnlinePaths:000002
PathStatus   IO-Counts  IO-Errors
Online       1332       0

PathID  PathName                          DskName               iLU   ChaPort  Status
000005  0003.0004.0000000000000027.0002  HITACHI .DF400  .1234  0010  0B
Online
Type   IO-Counts   IO-Errors   DNum  HDevName
Non            0           0      1  c2t58d5
PathID  PathName                          DskName               iLU   ChaPort  Status
000011 0008.0030 000000000000004A.0015   HITACHI .DF400  .1234  0010  1B
Online
Type   IO-Counts   IO-Errors   DNum  HDevName
Own         1332           0      1  c2t58d5
KAPL01001-I The HDLM command completed successfully. Operation name = view
#
```

Figure 7.1 Displaying the Path Information

Check the following items in the display for path errors:

- **PathID**: ID that HDLM assigned to the path at system startup, also called the *AutoPATH_ID*.
- **PathName**: Path name that identifies a physical path. A path name consists of four items separated by periods. Table 7.1 shows these items and their representation in Solaris™ systems.

Table 7.1 Physical Path Representation in Solaris™ Systems

Items in PathName	Representation in Solaris™ Systems
Port number of the host bus adapter (example in Figure 7.129: 0003)	HBA port number. The value that follows the **c** in the device name. See the instance number of the corresponding HBA defined in the **/etc/path_to_inst** file.
Bus number (example in Figure 7.129: 0004)	0 (constant)
Target ID (example in Figure 7.129: 00027)	Target ID. The value that follows **t** in the device name. See the target clause in the **/kernel/drv/sd.conf** file.
Host LU number (example in Figure 7.129: 0002)	Logical Unit ID (LUN). The value that follows **d** in the device name. See the LUN clause in the **/kernel/drv/sd.conf** file.

- **DskName**: Storage subsystem name identifying the storage subsystem. A storage subsystem name consists of three items separated by periods:

  Vendor ID: Vendor ID (name) of the storage subsystem (example shown: HITACHI).

  Product ID: Product ID of the storage subsystem (example shown: DF400) (see Table 7.2). For the 9900V, 9900, or 7700E, the CU emulation mode (e.g., 3990-6) is also displayed.

  Serial number: Serial number of the storage subsystem (example shown: 1234).

  Note: To physically identify the storage subsystem, use the management program for the storage subsystem to reference these information items.

Table 7.2 Product IDs of the Storage Subsystems Supported by HDLM for Solaris™

Model Name	Product ID	Alternate Product ID
Lightning 9900 V Series	9970/9980	RAID450
Lightning 9900 Series	9910/9960	RAID400
Freedom Storage 7700E	7700E	RAID300
Thunder 9500 V Series	953*x* / 957*x*	DF600
Thunder 9200	9200	DF500
Freedom Storage 5800	5800	DF400
Freedom Storage 5700E	5700E	DF-350

- **iLU**: The number assigned to the LU that is managed within the storage subsystem. This number combined with the subsystem name (indicated in **DskName**) identifies the LU that is accessed by a path. Use the management program for the subsystem to physically identify the LU.

  For the 9900V, 9900, or 7700E, the first two letters of the **iLU** indicate the **CU** number, and the last two letters indicate the internal **LU** number in the CU. For the 9500V, 9200, 5800, and 5700E, the entire **iLU** indicates the internal LU number in the subsystem.

- **ChaPort**: Port number of CHA mounted on the storage subsystem. (ChaPort is abbreviated as "CP".) To physically identify the channel adapter, use the management program for the subsystem to reference this port number.

- **Status**: Status of the path
  Online: path is online
  Offline(C): Path is offline due to a user-issued command.
  Offline(E): Path is offline due to an error.
  Online(E): The last online path to a device is offline.

- **I/O-Count**: Total I/O count for the paths, displayed in decimal format.

- **I/O-Errors**: Total I/O error count for the paths, displayed in decimal format.

- **Dnum**: The device number. A slice number is displayed in the case of Solaris 2.6 or Solaris 7. A hyphen (-) is displayed in the case of Solaris 8 or Solaris 9.

- **HdevName**: Host device name. For Solaris 2.6 or 7: Logical device file name (**ch*W*t*X*d*Y*s*Z***) of the HDLM device. For Solaris 8 or 9: Logical device file name (minus the slice number, in **c*V*t*X*d*Y*** format) for the HDLM device.

7.1.2 Message that is Output When an Error Occurs

Examining the output message in the OS log allows you to check the information about the error. Figure 7.2 shows an error message that is output if a path error occurs.

```
KAPL08022-E
        A path error occurred.
        ErrorCode=%d, PathID=%d, PathName=%x.%x.%x.%x, DNum=%d, HDevName=%s
```

Note: *%d* is a decimal number, *%**x*** is a hexadecimal number, and *%**s*** is a character string.

Figure 7.2 Sample Error Message

Check the following items in the display for path errors:

- **ErrorCode**: The error number when the OS detected the path error.
- **PathID**: The ID that HDLM assigned to the path at system startup, also called *AutoPATH_ID*. ***Note:*** This is the same as *PathID* displayed by the **view** operation.
- **PathName**: The physical path. A path name consists of four items separated by periods. ***Note:*** This is the same as *PathName* displayed by the **view** operation (refer to Table 7.1).
- **Dnum**: The device number. A slice number is displayed in the case of Solaris 2.6 or Solaris 7. A hyphen (-) is displayed in the case of Solaris 8 or Solaris 9.
- **HdevName**: Host device name. For Solaris 2.6 or 7: Logical device file name (**ch*W*t*X*d*Y*s*Z***) of the HDLM device. For Solaris 8 or 9: Logical device file name (minus the slice number, in **c*V*t*X*d*Y*** format) of the HDLM device. ***Note:*** This is the same as *HDevName* displayed by the **view** operation.

7.2 Actions Taken for a Path Error

When a path error is detected, HDLM performs failover for the path and outputs the KAPL08022-E message.

To perform troubleshooting for a path error:

1. **Examine the messages:** See the KAPL08022 message output to the OS log. For details about the contents of the message, see section 7.1.2 and Chapter 8.
2. **Obtain path information:** Execute the following command:
   ```
   # /opt/DynamicLinkManager/bin/dlnkmgr view –path
   ```
   For details on the path information, refer to Table 5.9.
3. **Identify the error path:** Check the obtained path information to find the error path. The path whose Status indication is **Offline(E)** or **Online(E)** is the error path.
4. **Narrow down the hardware that may have the error:** Check the **DskName**, **iLU**, and **ChaPort** of the error path to narrow down the hardware that may have the error. To physically identify the hardware, you can use the management program for the storage subsystem to check the **DskName**, **iLU**, and **ChaPort**.
5. **Identifying the error location and correct the error:** Use the administrative tools for the OS and hardware to identify the error section, and then take corrective action.
6. **Place the path online:** After recovery from the error, place the paths online that were placed offline due to the error. Execute the following command:
   ```
   # /opt/DynamicLinkManager/bin/dlnkmgr online
   ```
   This command places all the offline paths online.

   When you attempt to place all offline paths online, but there is a path whose status cannot be changed, the KAPL01039-W message is displayed. To ignore a path whose status cannot be changed and continue processing, type **y**. To cancel the processing, type **n** or another character.

Note: Even if you execute the **dlnkmgr** command with the **online** operation (with the **-path** parameter specified), sometimes the Offline(E) paths cannot be placed in Online status. In this case, place the status of the paths Offline(C) using the **dlnkmgr** command together with the **online** operation. Then re-execute the **online** operation. When the online operation is executed, the availability of paths that are targets of the online processing is automatically checked. Available paths are placed Online, and unavailable paths are placed Offline(E). If any paths exist whose statuses were changed to Offline(E), this means that these paths have not recovered from errors. Remove these errors, and then re-execute the online operation.

7.3 Actions Taken for a Program Error

To perform troubleshooting for an HDLM program error:

1. **Examine the message:** If an error occurs in the HDLM program, a message whose message ID is other than KAPL08xxx is output to the OS log. Check the output message. Messages with error level E (Error) or higher require corrective action.
2. **Take action for the error:** Take the action according to the information in Chapter 8, Messages. If the same error occurs again after you take the action, check the status of the HDLM program by executing the following command:

   ```
   # /opt/DynamicLinkManager/bin/dlnkmgr view –sys
   ```

   If the KAPL01013-E message is displayed, execute the following commands:

   ```
   # /opt/DynamicLinkManager/bin/dlnkmgr view -sys –msrv
   # /opt/DynamicLinkManager/bin/dlnkmgr view -sys -adrv
   # /opt/DynamicLinkManager/bin/dlnkmgr view -sys -pdrv
   ```

   These commands display information about the HDLM manager, HDLM alert driver, and HDLM driver. Check the indications for HDLM Manager, HDLM Alert Driver, and HDLM Driver, and then take any of the following actions:

   — When **HDLM Manager** shows **Dead,** start the HDLM manager service (see section 4.1.1).

   — When the **HDLM Alert Driver** shows **Dead,** restart the host.

   — When the **HDLM Driver** shows **Dead,** restart the host.

   Note: If the same error occurs again after you take the above action, obtain the information necessary for contacting maintenance personnel.
3. **Obtain program information:** Obtain the information you should report to maintenance personnel. For Solaris™ systems, HDLM provides a utility for collecting error information that should be reported to maintenance personnel (see section 6.1).
4. **Contact maintenance personnel:** Contact maintenance personnel and report the obtained information.

7.4 Calling the Hitachi Data Systems Support Center

If you need to call the Hitachi Data Systems Support Center, make sure to provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure,
- The exact content of any error messages displayed on the host system(s),
- The HDLM program information collected as described in section 7.1, and
- For 9900V, 9900, or 7700E, the remote service information messages (R-SIMs) logged on the Remote Console PC and the reference codes and severity levels of the recent R-SIMs.

The worldwide Hitachi Data Systems Support Centers are:

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

Chapter 8 HDLM Messages

Table 8.3 – Table 8.11 list the HDLM messages by message ID and provide recommended actions for the messages, if appropriate. HDLM issues the following types of messages:

- HDLM command messages (see Table 8.3)
- HDLM API messages (see API documentation)
- HDLM manager messages (see Table 8.4)
- HDLM driver (filter component) messages (see Table 8.5)
- HDLM alert driver messages (see Table 8.6)
- HDLM driver (core logic component) messages (see Table 8.7)
- HDLM management target messages (see Table 8.8)
- HDLM installation program messages (see Table 8.9)
- Messages from the error information collection utility (see Table 8.10)
- Messages from the driver configuration definition utility (see Table 8.11)

Message ID. Each message has a message ID. The format of the message ID is: **KAPL*mmnnnl***. Table 8.1 describes the message ID format. Table 8.2 describes the terms that may appear in HDLM messages or message descriptions. The term "HDLM" in Table 8.2 below may be replaced by "DLM" or "Dynamic Link Manager" in the actual message displayed by HDLM.

Table 8.1 Message ID Format

Format	Meaning
KAPL	Indicates that the message is an HDLM message.
mm	Number of the HDLM module that issued the message. 01: HDLM command 02: HDLM GUI (not applicable to HDLM for Solaris v4.1) 03: HDLM API (see API documentation) 04: HDLM manager 05: HDLM driver (filter component) 06: HDLM alert driver 07: HDLM driver (core logic component) 08: HDLM management target 09: HDLM installation program 10: HDLM error information collection utility, HDLM driver configuration definition file utility
nnn	Message serial number for the module
l	Message level C: Critical E: Error W: Warning I: Information

Table 8.2 Terms in Messages

Term	Description
%d	Decimal number
%s	Character string
%x	Hexadecimal number
CS	Cluster support
FO	Failover
LB	Load balancing
Operation name	Type of the operation that is entered after **dlnkmgr** in the command.
Service status	Running status of the service
Mounted drive	A drive that the file system recognizes

Table 8.3 HDLM Command Messages (dlnkmgr and operations)

Message ID	Message	Recommended Action
KAPL01003-W	No operation name is specified.	Specify the operation name, and then retry.
KAPL01004-W	The operation name is invalid. Operation name = %s	Execute the help operation of the HDLM command (dlnkmgr) to check the operation name, and then retry.
KAPL01005-W	A parameter is invalid. Operation name = %s, parameter = %s	Execute help operation-name of the HDLM command (dlnkmgr) to check the parameter, and then retry.
KAPL01006-W	A necessary parameter is not specified. Operation name = %s	Execute help operation-name of the HDLM command (dlnkmgr) to check the parameter. Specify the correct parameter, and then retry.
KAPL01007-W	A duplicate parameter is specified. Operation name = %s, parameter = %s	Delete the duplicate parameter, and then retry.
KAPL01008-W	A necessary parameter value is not specified. Operation name = %s, parameter = %s	Specify the parameter value, and then retry.
KAPL01009-W	A parameter value is invalid. Operation name = %s, parameter = %s, parameter value = %s, Valid value = %s	Specify the correct value for the parameter, and then retry.
KAPL01011-E	An invalid interrupt was received during processing of the HDLM command. Operation name = %s	Check whether you executed the interrupt.
KAPL01012-E	Could not connect the HDLM manager. Operation name = %s	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.
KAPL01013-E	An error occurred in internal processing of the HDLM command. Operation name = %s details = %s	Collect the error information (HDLM command log), and then contact maintenance personnel.
KAPL01014-W	No authority to execute the HDLM command. Operation name = %s	Execute the command as a user with root privileges.
KAPL01015-W	The target HBA was not found. Operation name = %s	Use the view operation of the HDLM command (dlnkmgr) to check the specification, and then retry.
KAPL01016-W	The target CHA was not found. Operation name = %s	Use the view operation of the HDLM command (dlnkmgr) to check the specification, and then retry.
KAPL01017-W	The target LU was not found. Operation name = %s	Use the view operation of the HDLM command (dlnkmgr) to check the specification, and then retry.
KAPL01018-W	The target device was not found. Operation name = %s	Use the view operation of the HDLM command (dlnkmgr) to check the specification, and then retry.

Table 8.3 HDLM Command Messages (dlnkmgr and operations) (Continued)

Message ID	Message	Recommended Action
KAPL01019-W	The target path was not found. Operation name = %s	Use the view operation of the HDLM command (dlnkmgr) to check the specification, and then retry.
KAPL01021-E	Cannot execute the HDLM command due to insufficient memory.	Terminate unnecessary applications to increase the amount of free memory. Alternatively, restart the computer.
KAPL01023-W	The last online path for the device cannot be placed offline.	Use the view operation of the HDLM command (dlnkmgr) to check the status of the path.
KAPL01024-W	Cannot specify the parameters of the HDLM command at the same time. Operation name = %s, parameter = %s	Execute help operation-name of the HDLM command (dlnkmgr) to check the parameter that can be specified, and then retry.
KAPL01025-W	Range of dates is invalid.	Specify the correct value in the parameter, and then retry.
KAPL01026-E	A registry access error occurred. Operation name = %s	The contents of the managed registry may be damaged. Restart the computer. If the error occurs again after you restart the computer, terminate and then uninstall HDLM, and then reinstall it.
KAPL01027-E	Cannot collect log information. Operation name = %s	Check the free space in the disk. If the disk has sufficient free space, check whether you have write permission for the log file directory and registry. Also check whether the log file is set to read-only mode.
KAPL01028-E	An unexpected error occurred. Processing is canceled. Operation name = %s	Collect the error information (HDLM command log), and then contact maintenance personnel.
KAPL01029-E	A fatal error occurred. Details = Hcc, %s	Take the following actions according to the Details information. HccCoOutOfMemoryException=A memory shortage occurred. Terminate unnecessary applications to increase the amount of free memory, or restart the computer. Other indication= An internal conflict occurred. Collect the error information (HDLM command log), and then contact maintenance personnel.
KAPL01030-E	A fatal error occurred. Details = Ansi, %s	Collect the error information (HDLM command log), and then contact maintenance personnel.
KAPL01031-E	A %s message was received.	Collect the error information (HDLM command log), and then contact maintenance personnel.
KAPL01032-E	A fatal error occurred. Details = Unexpected exception, %s	Collect the error information (HDLM command log), and then contact maintenance personnel.
KAPL01036-E	The offline path cannot be placed online. PathID=%d	Remove the error in the path, and then retry.
KAPL01037-W	Too many parameters are specified. Operation name = %s, parameters = %s	Execute help operation-name of the HDLM command (dlnkmgr) to check the parameter, and then retry.
KAPL01039-W	During the online operation processing of the HDLM command, a path that cannot be placed in the Online status has been detected. PathID = %d Would you like to continue the processing of the online operation? [y/n]:	If you want to continue processing of the online operation of the HDLM command (dlnkmgr) for other paths, enter y. If you want to terminate the processing, enter n.
KAPL01040-W	The entered value is invalid.	Enter y or n.
KAPL01041-W	The entered value is invalid. Command processing stops.	Execute the HDLM command again.
KAPL01043-W	A duplicate operation name is specified. Operation name = %s	Delete the duplicate operation name, and then retry.
KAPL01044-W	A duplicate parameter value is specified. Operation name = %s, parameter = %s, parameter value = %s	Delete the duplicate parameter value name, and then retry.
KAPL01045-W	Too many parameter values are specified. Operation name = %s, parameters = %s, parameter value = %s	Execute help operation-name of the HDLM command (dlnkmgr) to check the parameter value, and then retry.

Table 8.3 HDLM Command Messages (dlnkmgr and operations) (Continued)

Message ID	Message	Recommended Action
KAPL01046-I	An Offline request was registered in a batch job. PathID = %d	None.
KAPL01047-W	Only one Offline request can be registered in a batch job.	Wait until the Offline request registered in the batch job finishes, and then retry.

Table 8.4 HDLM Manager Messages

Message ID	Message	Recommended Action
KAPL04002-E	Could not start the HDLM manager.	Check for any other error.
KAPL04003-E	The startup parameter is invalid.	Check the specification of the startup parameter.
KAPL04005-E	Cannot connect the service control manager.	See section 4.1 on starting and stopping the HDLM manager.
KAPL04006-E	Cannot register the service control handler function. Return value=%d	Contact maintenance personnel.
KAPL04007-E	Cannot register the service status. Return value=%d	Contact maintenance personnel.
KAPL04008-E	Cannot open the option definition file (%s).	Check whether another program is using the file (or has opened the file with Notepad), or whether the file has been deleted inadvertently.
KAPL04009-E	The option definition is invalid.	If you edited the option definition file, check the contents of the file. If you did not, check the file for damage. After the check, restart the HDLM manager. If the same error occurs again, reinstall HDLM.
KAPL04010-E	Could not open the error log file.	Check whether another program is using the file (or has opened the file with Notepad), or whether the file has been deleted inadvertently.
KAPL04011-E	Could not output the error log file.	Check that the disk has sufficient free space.
KAPL04012-E	Could not create a communication pipe. RC=%d	Contact maintenance personnel.
KAPL04013-E	Input is impossible via the communication pipe. RC=%d	Contact maintenance personnel.
KAPL04014-E	Output is impossible via the communication pipe. RC=%d	Contact maintenance personnel.
KAPL04016-E	The option is invalid.	Specify the correct option.
KAPL04017-E	Output of the option definition file was impossible.	Check that the disk has sufficient free space.
KAPL04018-E	Could not close the option definition file.	Check that the disk has sufficient free space.
KAPL04019-E	Could not collect the error information. RC=%d	Check that the HDLM driver (alert component) is running.
KAPL04022-W	HDLM manager warning information - %s	See the contents of the warning.
KAPL04023-E	HDLM manager error information - %s	See the error information.
KAPL04024-C	A critical error occurred in the HDLM manager. (%s)	Examine the error for the cause of the trouble.
KAPL04025-C	A memory shortage occurred in the HDLM manager.	Increase the amount of memory available for the process.

Table 8.5 HDLM Driver (Filter Component) Messages

Message ID	Message	Recommended Action
KAPL05003-I	The HDLM driver (filter component) is successfully attached to Disk (%d), Partition (%d).	None.
KAPL05004-I	Initialization of the filtering function (%x) for the HDLM driver (filter component) was successful.	None.
KAPL05005-I	Initialization of the control function (%x) for the HDLM driver (filter component) was successful.	None.
KAPL05006-I	Connection with the HDLM alert driver was successful.	None.
KAPL05007-E	Could not connect the HDLM alert driver. (%x:%x)	Check whether the HDLM alert driver has started. If it has stopped, restart the computer. If this message frequently appears when the HDLM alert driver has started, contact maintenance personnel.
KAPL05008-E	Could not allocate memory. (%x:%x)	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL05009-E	Could not start the thread (%x). (%x:%x)	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL05010-E	Could not initialize the HDLM driver (filter component). (%x:%x)	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL05011-E	Could not attach the HDLM driver (filter component) to Disk (%d), Partition (%d). (%x:%x)	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL05012-I	The device (%x) for Disk (%d), Partition (%d) is selected for a mounted drive.	None.
KAPL05013-I	The device (%x) for Disk (%d), Partition (%d) is removed from the mounted drives.	This is normal operation. If the target drive cannot be referenced, check the disk configuration.
KAPL05014-I	The device object (%x) is registered as the path (%x).	None.
KAPL05018-W	The FO processing in the path (%x) failed. (%x:%x)	The I/O being processed is discarded. Check the status of the path and take an appropriate action.
KAPL05019-I	The FO processing in the path (%x) finished. The I/O request is processed in the path (%x).	None.
KAPL05022-I	An invalid IOCTL (%x) was received. The processing is canceled.	None.
KAPL05023-E	Could not process the IOCTL (%x). (%x:%x)	Check the message of the HDLM command (dlnkmgr) or HDLM manager. If this message frequently appears, contact maintenance personnel and report the error and detail code.
KAPL05024-E	Could not output a log to the HDLM alert driver. (%x:%x)	Check whether the HDLM alert driver has started. If it has stopped, restart the computer. If this message frequently appears when the HDLM alert driver has started, contact maintenance personnel.
KAPL05026-E	An error occurred when the HDLM driver (filter component) terminated. (%x:%x)	Check that the HDLM driver completed normally. If you find any problem, contact maintenance personnel and report the error and detail code.
KAPL05027-I	The HDLM driver (filter component) (%x) received an UNLOAD request. The request was canceled.	None. You cannot stop the HDLM driver.
KAPL05028-C	Invalid processing (%x) was detected. The HDLM driver (filter component) will now terminate abnormally. (%x:%x)	Since an unrecoverable error was detected, the HDLM driver terminated. Contact maintenance personnel and report the error and detail code.

Table 8.5 HDLM Driver (Filter Component) Messages (Continued)

Message ID	Message	Recommended Action
KAPL05029-I	The MajorFunction (%x) that the HDLM driver (filter component) does not handle was received. The request was transferred to the disk class driver.	None.
KAPL05030-W	An unsupported MajorFunction (%x) was requested. The request was canceled.	None. If this message frequently appears, check whether an invalid program is running.
KAPL05031-W	Disk(%d) is not a target disk system for HDLM.(%x,%x)	If this message is displayed for a disk that is not supported by HDLM, there is no problem. If this message is displayed for a disk that is supported by HDLM, contact maintenance personnel.
KAPL05032-I	The path health checking for the path (%x) completed normally. (%d,%x)	None.
KAPL05033-W	The path health checking for the path (%x) failed. (%d,%x,%x)	Check the path for which the path health checking failed. If this message is displayed for an unexpected path, contact maintenance personnel.
KAPL05034-I	Disk(%d) is a target disk system for HDLM. (%x,%x)	None.
KAPL05035-I	The HDLM driver (filter component (%x)) is successfully attached to the device object (%d).	None.
KAPL05036-E	Failed to attach the HDLM driver (filter component (%x)) to the device object (%d).	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL05037-W	The disk does not support persistent reservation, so the reservation for the LUs could not be set. dlmfdrv%d	Check if the disk is supported by HDLM. If the disk is supported by HDLM and the message returns, contact maintenance personnel.
KAPL05901	Failed to open %s directory. errno = %d	Follow the direction of the errno.
KAPL05902-E	Failed to allocate memory. errno=%d	Check if the available memory is sufficient.
KAPL05903-E	Failed to search %s directory.	Check the privileges of the directory.
KAPL05904-E	Failed to set device name.	Check that the HDLM driver has started normally.
KAPL05905-E	No authority to execute the dlmsetdevname command.	Do not execute using other than the starting script.
KAPL05038-E	The contents of the configuration definition file (dlmfdrv.conf) are invalid. Instance=%d Reboot after executing dlmsetconf command. (%x:%x)	Check whether the pass is connected to the disk correctly. Reboot after executing dlmsetconf command.
KAPL05039-W	Received the IOCTL error from Disk Driver. Errno=%d (%x:%x)	Check whether the pass is connected to the disk correctly.

Table 8.6 HDLM Alert Driver Messages

Message ID	Message	Recommended Action
KAPL06003-I	Initialization of the HDLM alert driver (%x) was successful.	None.
KAPL06004-E	Could not allocate memory. (%x:%x)	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL06005-E	Could not initialize the HDLM alert driver. (%x:%x)	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL06006-E	Could not start the thread (%x). (%x:%x)	Check whether the HDLM driver has started normally. If it has not started or contains an error, contact maintenance personnel and report the error and detail code.
KAPL06009-I	Invalid IOCTL (%x) was received. The processing is canceled.	None.

Table 8.6 HDLM Alert Driver Messages (Continued)

Message ID	Message	Recommended Action
KAPL06010-E	Could not process the IOCTL (%x). (%x:%x)	Check the message of the HDLM command (dlnkmgr) or HDLM manager. If this message frequently appears, contact maintenance personnel and report the error and detail code.
KAPL06011-W	Old log information was discarded because the log buffer did not have enough free space. (%x:%x)	Check that the HDLM manager is running. If it is not, start the HDLM manager.
KAPL06012-W	Old emergency information was discarded because the emergency information buffer did not have enough free space. (%x:%x).	Check that the HDLM manager is running. If it is not, start the HDLM manager.
KAPL06013-E	Could not write log information into the log buffer. (%x:%x)	Check whether any other error occurred. The log information that could not be written is discarded.
KAPL06014-E	Could not write emergency information into the emergency information buffer. (%x:%x)	Check whether any other error occurred. The log information that could not be written is discarded.
KAPL06015-W	The contents of the log buffer are discarded.	The HDLM manager could not correctly save the log information in the file during termination. Check whether any other error occurred.
KAPL06016-W	The contents of the emergency information buffer are discarded.	The HDLM manager could not correctly save the log information in the file during termination. Check whether any other error occurred.
KAPL06018-W	An unsupported MajorFunction (%x) was requested. The request was canceled.	None. If this message frequently appears, check for an invalid program running.
KAPL06019-E	An error occurred during termination of the HDLM alert driver. (%x:%x)	Check that the HDLM driver completed normally. If you find any problem, contact maintenance personnel and report the error and detail code.
KAPL06020-I	The HDLM alert driver (%x) received an UNLOAD request. The request was canceled.	None. You cannot stop the HDLM alert driver.
KAPL06021-C	Invalid processing (%x) was detected. The HDLM alert driver will now terminate abnormally. (%x:%x)	Since an unrecoverable error was detected, the HDLM alert driver terminated. Contact maintenance personnel and report the error and detail code.

Table 8.7 HDLM Driver (Core Logic Component) Messages

Message ID	Message	Recommended Action
KAPL07000-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07002-C	Could not enlarge the memory area for the HDLM driver.	Restart the computer.
KAPL07050-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07054-E	Could not create an HDLM driver table. Stage%d	Restart the computer.
KAPL07100-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07150-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07151-I	The error path was recovered successfully.	None.
KAPL07152-I	The error path and offline path were recovered successfully.	None.
KAPL07153-W	The request was ignored because access to the path at the media level was impossible.	None.
KAPL07154-W	Could not recover the error path.	Check the specified path again. If the specification is correct, you need to investigate further.
KAPL07155-W	Could not recover the error path and offline path.	Check the specified paths again. If the specification is correct, you need to investigate further.

Table 8.7 HDLM Driver (Core Logic Component) Messages (Continued)

Message ID	Message	Recommended Action
KAPL07157-W	Could not recover some of the paths related to the specified device.	Check the specified paths again. If the specification is correct, you need to investigate further.
KAPL07158-W	Could not recover the paths related to the specified device.	Check the specified paths again. If the specification is correct, you need to investigate further.
KAPL07200-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07201-W	The configuration does not contain a standby path.	Check the configuration.
KAPL07203-W	A nonexistent path is specified for the main path.	None.
KAPL07204-W	Although an owner path exists, a non-owner path is selected for the main path.	Check the specification.
KAPL07208-E	There is no standby path. ID%d	Check the specification.
KAPL07250-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07251-W	The configuration is not applicable to LB.	Check the configuration.
KAPL07254-W	A path that cannot be a target of LB is specified. ID%d	Check the specification.
KAPL07255-W	An attempt was made to remove the last LB target from the LB target path. ID%d	Check the specification.
KAPL07258-E	There is no path-switching destination. ID%d	Check the specification.
KAPL07300-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07304-E	An error in the standby path cancels the CS function forcibly.	Check the cause of the error.
KAPL07307-E	The CS function could not retry.	Check the cause of the error.
KAPL07350-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07355-W	An attempt to place the last path offline was rejected. ID%d	Check the specification.
KAPL07357-C	Could not place the path offline. ID%d	Check the specified path again. If the specification is correct, you need to investigate further.
KAPL07360-C	Could not release the offline path. ID%d	Check the specified path again. If the specification is correct, you need to investigate further.
KAPL07372-C	Could not place all the paths offline.	Check the specified paths again. If the specification is correct, you need to investigate further.
KAPL07374-C	Could not make some of the paths related to the specified device offline.	Check the specified paths again. If the specification is correct, you need to investigate further.
KAPL07375-I	The Offline request was executed. ID%d	None.
KAPL07376-W	The Offline request was canceled because of a path error. ID%d	Re-register the Offline requirement in a batch job.
KAPL07377-W	The last online path cannot be placed offline. ID%d	None.
KAPL07378-I	The specified paths are already in the offline status. ID%d	None.
KAPL07379-W	The specified paths cannot be found. ID%d	Check the specified paths again. If the specification is correct, you need to investigate further.
KAPL07400-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07404-I	The processor reduction for defusing an error is enabled.	None.
KAPL07405-I	A request was made to enable the processor reduction for defusing an error when it was already enabled.	None.
KAPL07406-I	A request was made to disable the processor reduction for defusing an error when it was already disabled.	None.
KAPL07407-I	The processor reduction for defusing an error is disabled.	None.

Table 8.7 HDLM Driver (Core Logic Component) Messages (Continued)

Message ID	Message	Recommended Action
KAPL07442-W	The path is not the target of management for the specified LU/ device. ID%d, ID%d	Check the specification.
KAPL07443-W	An error path was specified. ID%d, ID%d	Check the specification.
KAPL07453-W	The target of the CS function is not a single LU containing a single device. ID%d, ID%d	Check the specification.
KAPL07550-C	An internal conflict occurred in the HDLM driver (core logic component). Stage%d	Restart the computer.
KAPL07551-W	Recovery instruction was made in response to the error report.	None.
KAPL07552-W	Recovery instruction was made in response to an unknown error report.	Investigate the cause of the error.

Table 8.8 HDLM Management Target Messages

Message ID	Message	Recommended Action
KAPL08019-E	The path (%x) detected an error (%x). (%s)	Check the path in which the error was detected.
KAPL08020-E	I/O processing in the path (%x) terminated with error (%x). (%s)	Check the path in which the error was detected.
KAPL08021-E	I/O processing in the path (%x) in Disk (%d), Partition (%d) failed due to an error (%x). Failover is performed.	The failover function has no effect if there is only one online path in the path class. Check the error in the path and take an appropriate action.
KAPL08022-E	A path error occurred. ErrorCode=%d, PathID=%d, PathName=%x.%x.%x.%x, DNum=%d, HDevName=%s	The hardware targeted to be controlled may have a problem. For details on the action to be taken, see 3.9.1 Actions taken for a path error.
KAPL08023-E	A path was recovered. PathID=%d, PathName=%x.%x.%x.%x, DNum=%d, HDevName=%s	None.

Table 8.9 HDLM Installation Program Messages

Message ID	Message	Recommended Action
KAPL09001-E	There is no system management permission.	Execute the command as a user with root privileges.
KAPL09002-E	The disk does not have sufficient free space.	Change the installation destination or delete unnecessary files to increase the amount of free space, and then retry.
KAPL09003-E	Cannot install in this system.	Make sure that the system on which you are installing HDLM is supported by HDLM. For details on supported hardware and software, see section 3.1 and the HDLM Release Notes. If this error recurs, contact the Support Center.
KAPL09005-E	Could not stop the HDLM manager.	Stop the HDLM manager manually, and then re-execute the installation program or the uninstallation program.
KAPL09006-E	Could not install HDLM.	If installation was interrupted, incomplete files and directories may remain. Delete such files and directories.
KAPL09008-W	The license code is invalid.	Check the license code, and then re-enter it.
KAPL09009-E	The license code is invalid. The HDLM installation program will now terminate.	Check the license code, and then re-execute the installation program.
KAPL09012-I	All HDLM drivers were removed.	None.
KAPL09013-E	Some HDLM drivers could not be removed.	Check HDLM driver status, and remove drivers.
KAPL09014-E	The OS must be restarted before you install HDLM. The HDLM installation program will now terminate.	Restart the OS before you install HDLM.
KAPL09015-E	HDLM cannot be installed. A newer version of HDLM is already installed.	Uninstall HDLM, and then restart the installation program.

Table 8.9 HDLM Installation Program Messages (Continued)

Message ID	Message	Recommended Action
KAPL09016-E	Because HDLM has been installed in another system, HDLM cannot be installed in this system.	Uninstall the HDLM that has been installed for another OS in the same drive, and then restart the installation program.
KAPL09017-E	Prerequisite patch is not applied.	Please restart the installation program after applying prerequisite patch according to the manual.
KAPL09029-E	This version of HDLM cannot be updated by installation. Uninstall the already installed version of HDLM.	Uninstall the already installed version of HDLM.
KAPL09030-E	The installed version of HDLM is not supported for the present OS version. Uninstall the already installed version of HDLM.	Uninstall the already installed version of HDLM.
KAPL09031-E	A version of HDLM with a different language environment is already installed. Uninstall the already installed version of HDLM.	Uninstall the already installed version of HDLM.
KAPL09031-I	Update installation completed normally. Reboot the machine to enable the new HDLM modules.	Reboot the machine.

Table 8.10 Messages from the Error Information Collection Utility

Message ID	Message	Recommended Action
KAPL10001-W	No parameter has been specified.	Check the parameters of the error information collection utility, and then retry.
KAPL10002-W	Too many parameters have been specified.	Check the parameters of the error information collection utility, and then retry.
KAPL10003-W	The first parameter has not been set to a directory. Value = %s	Check the parameters of the error information collection utility, and then retry.
KAPL10004-W	The parameter contains an incorrect value. Value = %s	Check the parameters of the error information collection utility, and then retry.
KAPL10005-W	The number of parameters is insufficient.	Check the parameters of the error information collection utility, and then retry.
KAPL10006-W	The file for defining the information to be collected does not exist, or cannot be read. Value = %s	Check whether the specified file for defining the information to be collected exists, and check whether you have access permission for the specified file.
KAPL10007-W	A directory has been specified in the third parameter. Value = %s	Check the parameters of the error information collection utility, and then retry.
KAPL10008-W	You lack write permission for the specified directory. Value = %s	Check whether you have access permission for the specified directory. Also, check whether the specified directory name is correct.
KAPL10009-W	The specified directory already exists. Do you want to overwrite it? ‘y/n’	The specified directory already exists. Enter y to overwrite the existing file. Enter n or press any other key to terminate the error information collection utility without executing it.
KAPL10010-W	A root directory has been specified. Line = %d	Delete the coding of the root directory from the specified file. The displayed directory will be ignored and the error information collection utility will continue.
KAPL10011-W	More than one file or directory has been specified on one line. Line = %d Value = %s	After the error information collection utility terminates, check the contents of the file for defining the information to be collected shown in the message. If the contents of the file are incorrect, correct them and then retry. The displayed file or directory will be ignored and the error information collection utility will continue.

Table 8.10 Messages from the Error Information Collection Utility (Continued)

Message ID	Message	Recommended Action
KAPL10012-W	The specified file or directory does not exist. Line = %d Value = %s	After the error information collection utility terminates, check the contents of the file for defining the information to be collected shown in the message. If the contents of the file are incorrect, correct them and then retry. The displayed file or directory will be ignored and the error information collection utility will continue.
KAPL10013-W	You lack read permission for the specified file. Line = %d Value = %s	After the error information collection utility terminates, check the contents of the file for defining the information to be collected shown in the message. If the contents of the file are incorrect, correct them and then retry. The displayed file will be ignored and the error information collection utility will continue.
KAPL10014-W	You lack read permission for the specified directory. Line = %d Value = %s	After the error information collection utility terminates, check the contents of the file for defining the information to be collected shown in the message. If the contents of the file are incorrect, correct them and then retry. The displayed directory will be ignored and the error information collection utility will continue.
KAPL10015-W	The file format is invalid.	After the error information collection utility terminates, make sure that the file for defining the information to be collected shown in the message is a text file.
KAPL10016-W	The root directory has been specified in the first parameter.	Check the parameters of the error information collection utility, and then retry.
KAPL10017-W	You lack privileges for executing the utility for collecting HDLM error information.	Retry as a user with root privileges.
KAPL10020-I	The file has been obtained successfully. File = %s	None.
KAPL10021-I	Processing terminated before completion because a signal was received.	The error information collection utility terminated before completion. If the directory is unnecessary, delete it and all files it contains.
KAPL10022-W	The utility for collecting HDLM error information completed normally.	None.
KAPL10030-I	A user terminated the utility for collecting HDLM error information.	The error information collection utility did not collect files because of a user specification.
KAPL10031-W	The entered value is invalid. Continue operation? [y/n]:	Enter y or n.
KAPL10032-W	The entered value is invalid. The utility for collecting HDLM error information stops.	Execute the error information collection utility again.
KAPL10033-W	The file does not exist. Filename = %s	The file to be required in the usual management didn't exist. It might be managed with irregular environment.
KAPL10034-E	The file could not be copied. Filename = %s	An error occurred while the collected files were copied. A user environment might not be stable.
KAPL10035-E	An attempt to archive the error information failed. details = %s	Eliminate the cause of the error by following the detailed information given in the message. Collect error information, including the output directory specified when the command was executed, in an archive or other file, and contact maintenance personnel.
KAPL10036-E	An attempt to compress the error information failed. details = %s	Eliminate the cause of the error by following the detailed information given in the message. Collect error information, including the output directory specified when the command was executed, in an archive or other file, and contact maintenance personnel.

Table 8.11 Messages from the Driver Configuration Definition Utility

Message ID	Message	Recommended Action
KAPL10201-W	usage: dlmsetconf [-d output-directory-name] [-r]	Specify appropriate parameters, and then re-execute the command.
KAPL10202-W	Could not change off backup file[%s]. Errno = %d	Check the capacity of the root file system or the file system including the directory specified by the -d option. Check the memory capacity which can be used.
KAPL10203-E	The output file(%s) could not be opened. Errno = %d(%s)	Check the permission for the current directory.
KAPL10204-I	dlmsetconf terminated normally.	None.
KAPL10206-E	Data count exceeded the limit(%d). Line=%d	Check the instance number not to exceed the limit instance number (8192).
KAPL10207-E	A duplicate instance number exists.	Check the instance parameter in the configuration definition file (dlmfdrv.conf), and then retry.
KAPL10208-E	The %s parameter could not be found. Line=%d	Check name, parent, instance, ControllerNum, or FilterPath parameter names in the configuration definition file (dlmfdrv.conf), and then specify the nonexistent parameters.
KAPL10209-E	The value for the %s parameter could not be found. Line=%d	Check the parameter values in the configuration definition file (dlmfdrv.conf), and then specify the values for unspecified parameters.
KAPL10210-E	The %s parameter are duplicated. Line=%d	Check the parameter values in the configuration definition file (dlmfdrv.conf). Semi-colon may not exist at the end of definitions.
KAPL10211-E	The %s parameter is unknown. Line=%d	Check the parameter names in the configuration definition file (dlmfdrv.conf), and then remove the unknown parameter names.
KAPL10212-E	The end code "=' is missing in the dlmfdrv.conf file. Line=%d	Check the parameters in the configuration definition file (dlmfdrv.conf), and then add an equal character after the parameter name.
KAPL10213-E	The value for the %s parameter is invalid. Line=%d	Check the parameters in the configuration definition file (dlmfdrv.conf). If users cannot fix the errors, remove dlmfdrv.conf file and use dlmsetconf command to recreate the dlmfdrv.conf file.
KAPL10214-E	The %s parameter is invalid. Line=%d	Check the values of name, parent, instance, ControllerNum, or FilterPath parameters in the configuration definition file (dlmfdrv.conf), and then fix the invalid parameter values.
KAPL10215-E	The contents of the configuration definition file (dlmfdrv.conf) are invalid. Line=%d	Check the parameters in the configuration definition file (dlmfdrv.conf). If users cannot fix the errors, remove dlmfdrv.conf file and use dlmsetconf command to recreate the dlmfdrv.conf file.
KAPL10216-E	The number of characters coded in one line of the configuration definition file (dlmfdrv.conf) exceeds the permitted maximum number. Line = %d	Check the parameter values in the configuration definition file (dlmfdrv.conf). Semi-colon may not exist at the end of definitions.
KAPL10217-E	The character(s) to be searched for, which are coded in the configuration definition file (dlmfdrv.conf), could not be found. Line = %d	Check the parameters in the configuration definition file (dlmfdrv.conf). Double quotation mark may not exist for parameter values.
KAPL10218-E	The /kernel/drv/dlmfdrv.conf file could not be opened. Errno=%d(%s)	Remove the error by referencing Errno.
KAPL10219-E	The /kernel/drv/dlmfdrv.conf file does not exist.	Check whether configuration definition file (dlmfdrv.conf) exists. If not, create new dlmfdrv.conf file.

Table 8.11 Messages from the Driver Configuration Definition Utility (Continued)

Message ID	Message	Recommended Action
KAPL10220-E	An error occurred when collecting the HDLM support disk information.	Check the system configuration.
KAPL10221-E	An error occurred when creating the configuration definition file (dlmfdrv.conf).	Check the system configuration.
KAPL10222-E	An error occurred when removing a link file. Dir = %s	Check the system configuration.
KAPL10223-E	An error occurred when releasing the memory.	Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM if this error occurs a number of times.
KAPL10224-E	An error occurred when creating the configuration definition information.	Check the system configuration.
KAPL10225-W	The existing configuration definition file could not be opened. Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10227-E	The text %s could not be found in the existing configuration definition file (dlmfdrv.conf).	Check the existing dlmfdrv.conf file.
KAPL10228-W	The HDLM support disk information does not exist.	Check the system configuration.
KAPL10229-E	Internal processing error.	Internal processing error. Contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL10230-E	The %s directory could not be opened. Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10231-W	The %s file could not be deleted. Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10234-W	The stat (%s) operation failed. Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10235-W	The lstat (%s) operation failed. Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10236-E	Could not allocate memory. Errno = %d (%s)	Check memory usage, and then restore unnecessary memory space.
KAPL10237-E	The property information (%s) on a device (%s) could not be collected.	Check whether the sd or ssd driver is attached. If there is no problem, contact your HDLM vendor or the maintenance company if there is a maintenance contract for HDLM.
KAPL10238-W	The device (%s) could not be opened. Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10239-W	The ioctl() operation failed. FD = %d, Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10240-E	The directory specified by the -d option does not exist.	Check whether the specified directory exists.
KAPL10241-E	An error occurred when collecting the catalog message. Errno = %d (%s)	Remove the error by referencing Errno, and then retry.
KAPL10242-I	To configure HDLM, device files of sd/ssd devices managed by HDLM need to be removed. Do you want to continue? [y/n]	If you want to configure HDLM, enter y to remove the sd or ssd device files. If you do not want to configure HDLM, enter n.
KAPL10243-W	An error occurred on the exclusive open process of the physical path(%s).	Comply with the following KAPL10244-I messages.
KAPL10244-I	The definition of the physical path was reconfigured since the same physical path existed in the configuration definition file (dlmfdrv.conf).	Remove the physical path that was shown in the above KAPL10243-W messages from the configuration definition file if that physical path is not needed.

Table 8.11 Messages from the Driver Configuration Definition Utility (Continued)

Message ID	Message	Recommended Action
KAPL10245-E	The definition of the physical path was not added to the configuration definition file since the same physical path did not exist in the configuration definition file (dlmfdrv.conf).	Remove the physical path that was shown in the above KAPL10243-W messages from the configuration definition file if that physical path is not needed.
KAPL10246-E	Could not acquire the information on a device (%s) since exclusion opening is carried out.	Retry the same command after checking the system configuration if the physical path that was shown in the above KAPL10243-W messages is needed.

Acronyms and Abbreviations

AL	arbitrated loop
API	application program interface
Cha	channel adapter
CU	control unit
FC	fibre channel
FD	floppy disk
GB	gigabytes (1 GB = 1024 MB)
HBA	host bus adapter
HDev	host device
HDLM	Hitachi Dynamic Link Manager
HLU	host LU
JRE	Java™ Runtime Environment
KB, kB	kilobytes (1 kB = 1024 bytes)
LDEV	logical device
LU	logical unit
LUN	logical unit number
LVM	Logical Volume Manager
MB	megabytes (1 MB = 1024 kB)
OPEN-*x*	standard LU type, e.g., OPEN-3, OPEN-9
OS	operating system
SAN	storage-area network
SCSI	small computer system interface
SDS	Solstice DiskSuite
SVM	Solaris™ Volume Manager
TB	terabytes (1 TB = 1024 GB)
TID	target ID
VCS	VERITAS™ Cluster Server
VxVM	VERITAS™ Volume Manager