High Availability FailOver/iX Manual

HP e3000 MPE/iX Computer Systems

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Preface

This manuial documents the High Availability FailOver/iX (HAFO) utilities for the HP e3000 systems.

Each chapter of this manual is described briefly.

Chapter 1 , “Introduction.” Contains a brief description of the HAFO utility concept.

Chapter 2 , “Product Description.” Describes how a failover works, including the triggers and a generalized sequence of events after a failover. Each of the four major components is listed and described.

Chapter 3 , “Installation.” Explains how the installation of the HAFO utilities occurs.

Chapter 4 , “Configuration.” Provides some general information necessary to determine how best to implement the HAFO and its hardware requirements. A configuration checklist is provided to help gather the necessary information needed for HAFO configuration. This chapter documents how to access the configuration commands. An overview of configuration steps is provided, along with detailed command descriptions and syntaxes.

Chapter 5 , “Monitoring Status.” Explains how to generate and interpret the failover status report. Each possible primary path status is listed and described. Sample reports are provided.

Chapter 6 , “Recovering From a Failover.” Describes the failover state, describes each failover status, and notes general repair recommendations. Instructions are provided to return the I/O data flow to the primary data path.

Appendix A , “Sample Failover and Recovery.” Presents a sample failover scenario, troubleshooting, and recovery.

Appendix B , “Error Messages.” Lists HAFO error messages, their cause, and suggested action.

1 Introduction

This manual documents the High Availability FailOver/iX (HAFO) utilities for the HP e3000 systems. HAFO works in a manner similar to UNIX dual PVLINKS.

Once installed and configured, these utilities provide continued data access on the XP 256 high availability disk array.

There are five “points of failure” in any I/O subsystem. They are:

1. Disk drive mechanisms
2. Power supply
3. Disk controller
4. I/O host adapter card
5. Cabling and terminators

High availability arrays protect against the first two points of failure by having:

- Redundant power supplies
- RAID configured disk drives

The HAFO utilities provide protection for the remaining three points of failure:

- SCSI bus cabling and terminators
- I/O host adapter card
- Array controller

Protection against array controller failure is accomplished with HAFO software working in conjunction with a special array hardware configuration. The array hardware itself allows for two controllers to be configured to talk to the same ldevs. These can then be configured in HAFO to be the primary and alternate path to the same ldev. When there is a failure, the HAFO software detects it and transparently reroutes I/O to the alternate path.

2 Product Description

How Failover Works

Once installed and configured, the HAFO utilities continually monitor SCSI reply messages for failed SCSI data path components. This adds minimal overhead to the I/O subsystem operation.

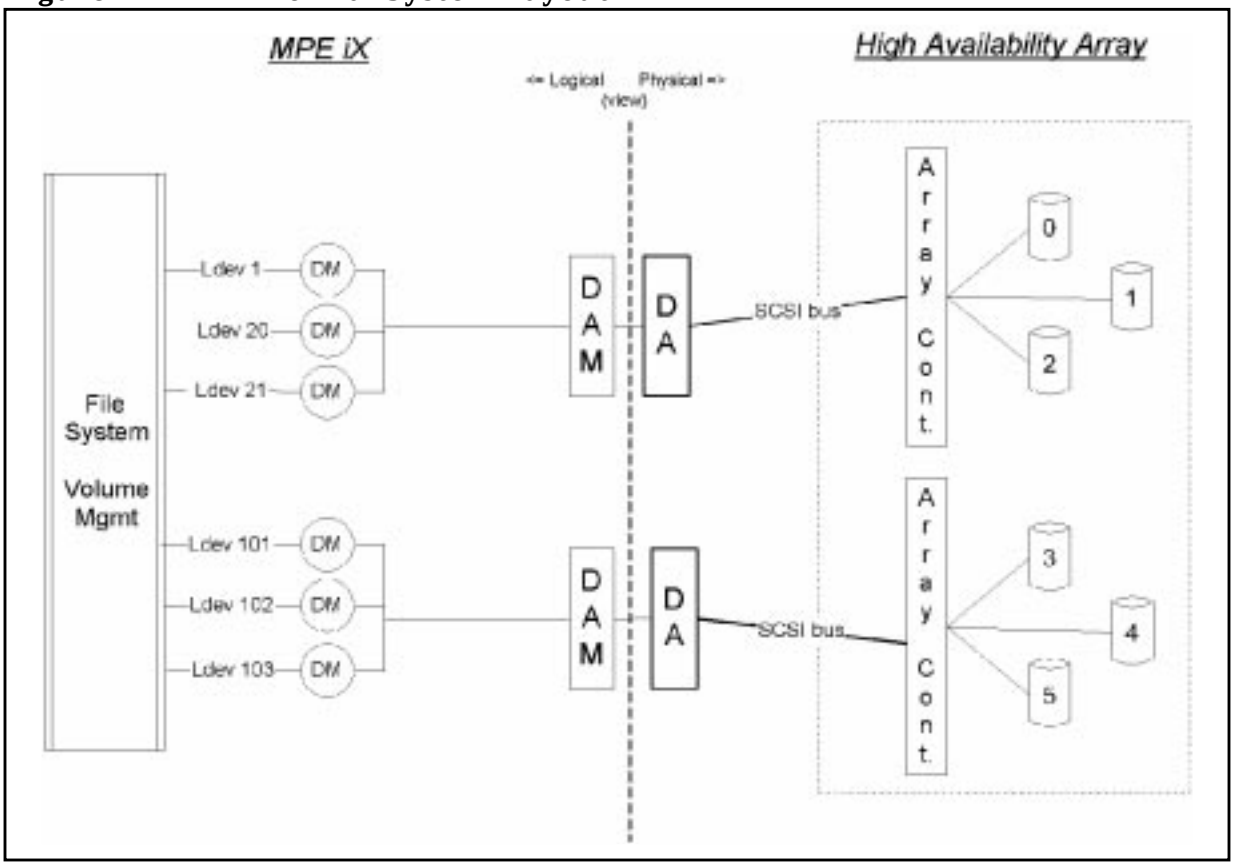
HAFO event information and data structures are memory resident. This eliminates the need for disk file access to perform high availability failover. This is an advantage especially if a SCSI path failure to LDEV#1 should occur.

There is a new section of the SYSGEN program for HAFO called (ha). It is entered by running SYSGEN, by typing `io` at the SYSGEN prompt, then typing `ha` at the “io” prompt. No failover action is taken until the ldevs are configured for HAFO in the “ha” section of SYSGEN. Device data path and alternate data path information is entered and saved in SYSGEN’s HAFOCONF configuration file. HAFOCONF configurations are read and validated during each system boot.

Specific configuration information is provided in the Chapter 4 , “Configuration.”

Figure 2-1 illustrates a sample configuration. This figure can be compared against Figure 2-2, which illustrates a failover of the same system.

Figure 2-1 Normal System Layout



Triggering a Failover

HAFO only acts on specific error types that indicate a data path failure. Any of these three occurrences will generate a failover:

- Hung I/O
- Failed high availability array controller (communicated by a SCSI reply status)
- Failed host device adapter card

If any other error type occurs (such as a data transmission or device error), the I/O subsystem will manage the error and perform corrective action. HAFO will remain idle and not participate. In addition, HAFO remains idle when error types are received from non-high availability devices.

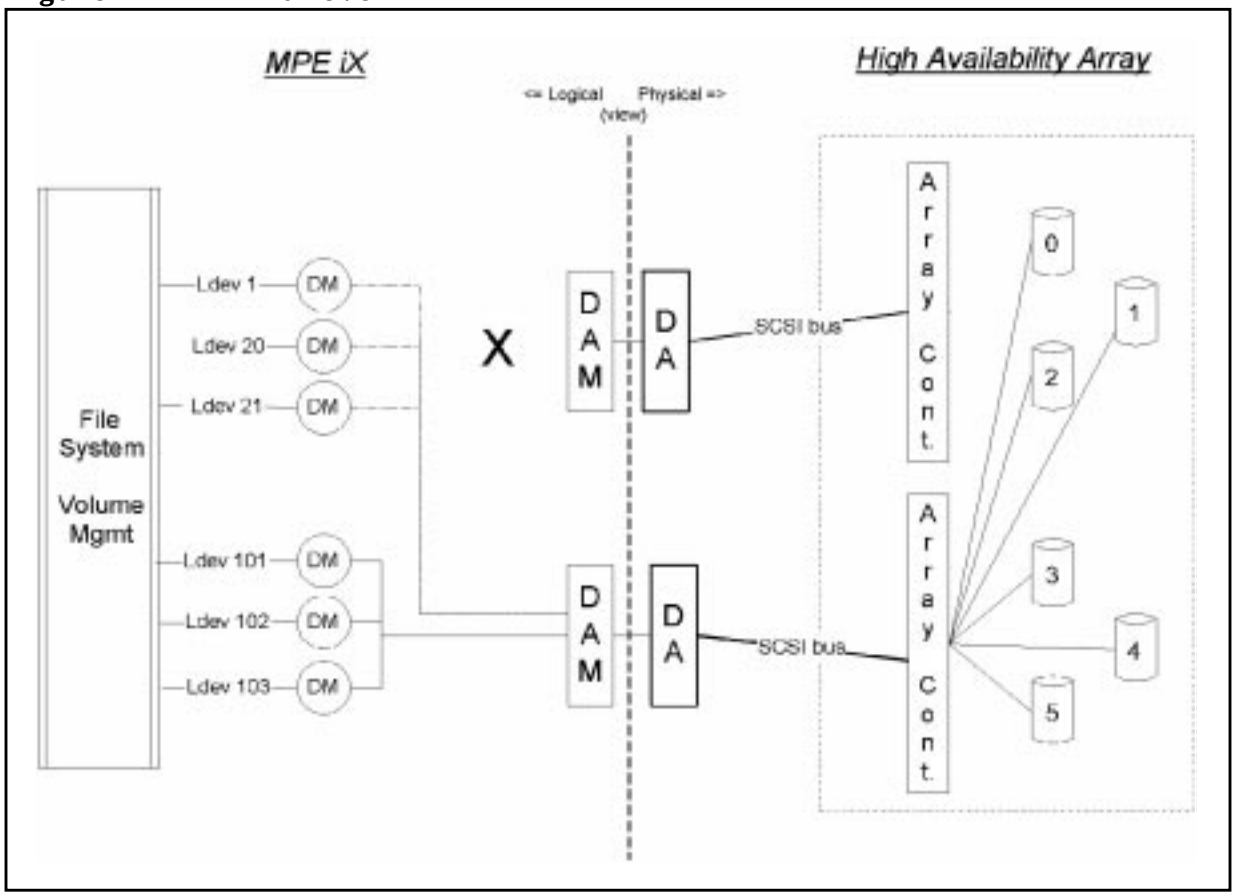
Executing a Failover

When a trigger status is received, HAFO will immediately begin the failover sequence. This sequence activates the alternate data path and reroutes I/O to it. Failover occurs on a per ldev basis. Each device manager (the piece of the I/O subsystem that manages a specific ldev)

learns of the data path failure during a subsequent I/O to its ldev. For example, if three ldevs on a fast-wide SCSI bus experience an array controller failure, the associated three device managers will perform a HAFO failover event independently.

Figure 2-2 illustrates a failover event in a sample system.

Figure 2-2 Failover



No application or higher level MPE/iX operation system will experience an abnormal event. All I/Os complete as normal using the alternate data path and alternate array controller. For example, file subsystem, database management, or memory management subsystem.

User Notification of Failover

The I/O and system logs will document the failover event. In addition, the following console error message will be displayed upon failover and every five minutes thereafter. The repeating message can be turned off with a **[CTRL] [A]** reply.

```
HIGH AVAILABILITY FAILOVER IS STARTED FOR LDEV# IN DISK ARRAY. NO DATA LOSS
OR CORRUPTION. SYSTEM OPERATION WILL CONTINUE.PLEASE PLACE SERVICE CALL SOON.

ACKNOWLEDGE HAFO FAILOVER IN DISK ARRAY FOR LDEV# (Y/N)?
```

Once a Failover Has Occurred

After an HAFO event, system I/O activity will resume via the alternate data path. There are no limits to the kinds of normal I/O that can be processed on the alternate data path. Throughput may be affected since I/O is shared with bus activities from other ldevs configured for that bus.

For additional information, see the Chapter 6 , “Recovering From a Failover.”

Components

The HAFO product has multiple components:

- System Boot Failover Initialization Utility
- SYSGEN HAFO commands
- HASTAT HAFO status report
- HAFOCONF configuration file

Each of these components are briefly described.

System Boot Failover Initialization Utility

During system boot, the HAFO configuration utility reads the HAFOCONF configuration file and arms HAFO. The alternate path information becomes frozen in memory and is available to any configured devices when needed to complete an HAFO event.

High Availability Failover Commands

The following commands are used to configure and maintain the HAFOCONF configuration file

- `addconf` (ad) — adds high availability device configuration
- `delconf` (de) — deletes high availability device configuration
- `listconf` (li) — lists high availability device configurations
- `doha` — validates high availability device configurations, and activates the HAFO configuration
- `goback` (go) — instructs device manage to use the primary data path
- `help` — get help on HAFO commands
- `exit` — exit the “ha” section and return to the “io” section of SYSGEN.

These commands, located in SYSGEN, are documented in the Chapter 4 , “Configuration.” Goback is documented in more detail in the Chapter 6 , “Recovering From a Failover.”

High Availability Failover Status

With the installation of HAFO, a new reporting command, HASTAT, is supplied. The report lists each configured LDEV, its primary and alternate paths, and their status. This feature is documented in detail in the Chapter 5 , “Monitoring Status.”

HAFOCONF Configuration File

Each configured HAFO ldev will have a record entry in the HAFOCONF configuration file. This file will reside in SYSGEN's CONFIG groups. The HAFO information configured or modified using the HAFO commands resides in this file. HASTAT displays the High Availability FailOver/iX Status information available from this file.

3 Installation

HAFO requires no subsystem product installation. It is an enhancement to MPE/iX and is installed via an Operating System patch on MPE 6.5.

Use the installation process of the release vehicle to install the patch, using the Read Before Installing document that comes with the release.

With correct installation, HAFO becomes active, requiring only HAFO configuration. The HAFO configuration commands are available in SYSGEN. The HASTAT command will generate a HAFO status report for each configured HAFO ldev.

Device configuration using the SYSGEN commands is documented in Chapter 4 , “Configuration.” The HASTAT HAFO status report is documented in the Chapter 5 , “Monitoring Status.”

System Requirements

HAFO is supported *only* with the SureStore E Disk Array XP256.

4 Configuration

Once HAFO is installed, the core components are active. This means HAFO is monitoring the SCSI reply messages as documented in Chapter 2 , “Product Description.” However, for a failover event to occur, the ldevs must be configured for HAFO and the configuration must be activated.

Configuring an ldev creates an entry in the HAFO configuration file, HAFOCONF. The HAFOCONF file resides in the configuration group on LDEV1. It contains one record for each ldev configured for FAILOVER.

Configuration Planning

Detailed planning of the hardware configuration of the array itself and the actual HAFO configuration (in SYSGEN) is required. Before taking any action on the array or in SYSGEN, the user should have a complete map and plan for the setup. The path layout and primary and alternate paths for all the ldevs to be covered by HAFO must be determined in advance. Both user and system volumes may be configured for high availability failover, but all ldevs covered by HAFO must be in the XP256 array.

Before beginning HAFO configuration in SYSGEN, the array must already be cabled and the hardware configured to work with the HAFO utilities. As mentioned previously, the array hardware itself allows for two controllers to be configured to talk to the same ldevs.

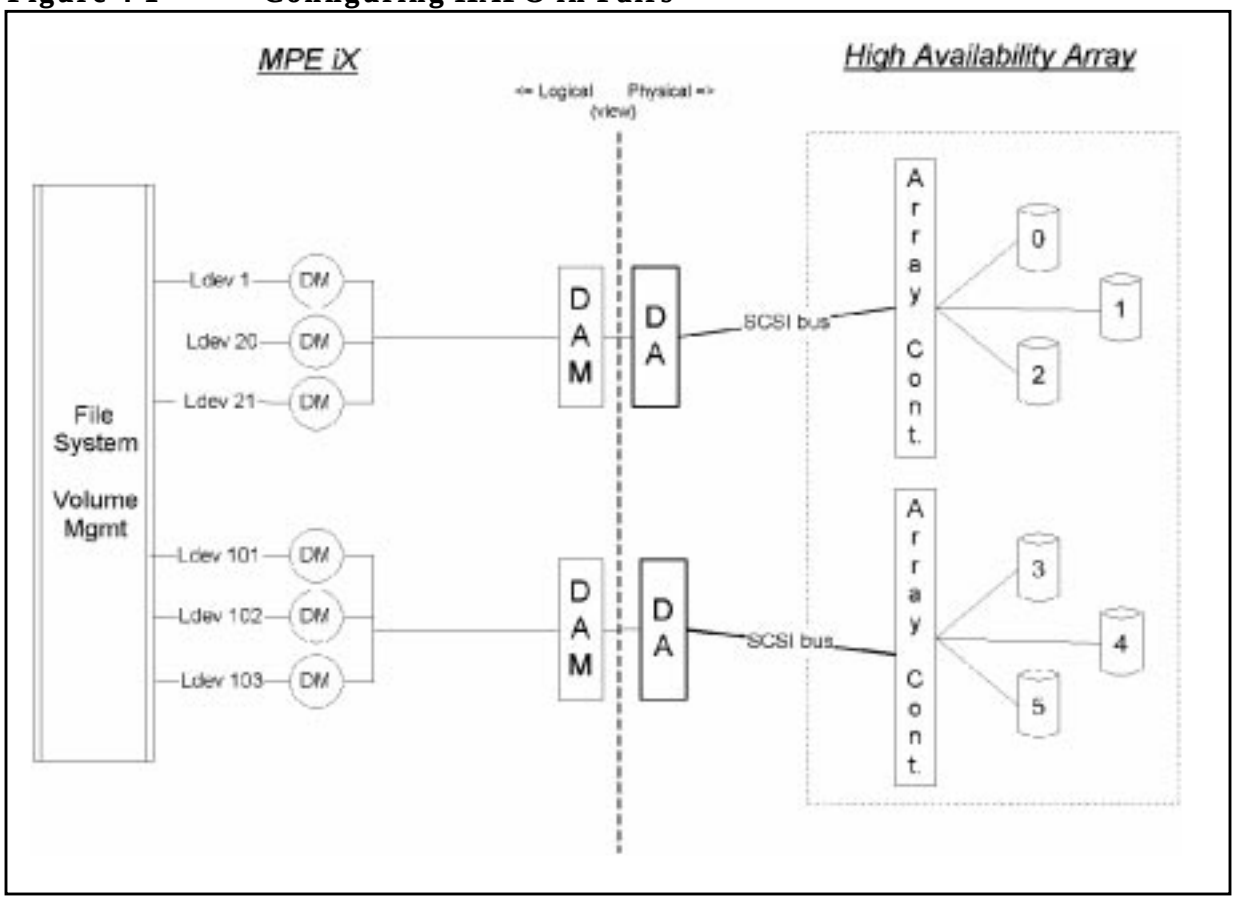
HAFO Configuration Restrictions

1. **HAFO works with pairs of controllers.** That is, all ldevs on a given primary path/controller, for example (path A) must be configured to fail over to the same alternate path (path B). By the same token, any ldevs that happen to have path B as their primary path, must be configured to have path A as their alternate path.
2. **All ldevs on a given path must be configured the same.** That is, if any ldev on a path is configured for failover, then all ldevs on the path must be configured for failover to the *same alternate path*.
3. **The maximum number of ldevs supported is seven ldevs per path.** That is, one path in the pair can have seven ldevs and the other path in the pair can have seven ldevs. This limits the configuration to a total of 14 ldevs on a single path should a failover event occur. *However, this may have negative performance implications.*

Configuring HAFO in Pairs

Figure 4-1 shows the ldevs in the top path could be configured to failover to the bottom path. If any of the ldevs 1, 20, or 21 are configured to failover to the bottom path, then all must be configured to failover to the bottom path. Further, since in this example, some ldevs indeed exist on the bottom path, they *must* all (ldevs 101, 102 and 103) be configured to failover to the *top path*.

Figure 4-1 Configuring HAFO in Pairs



NOTE The SYSGEN (io) configured SCSI target (id) that is being used on a primary path cannot be configured in the (io) section of SYSGEN on the alternate path. For example, if the path for ldev 1 were 8.0.0, and the alternate path were 48, then one should not use 48.0.0 for any of the ldevs on that path. None of the ldevs 101-103 could be configured as 48.0.0. A correct configuration would to make ldevs 1, 20, and 21 be 8.0.0, 8.1.0, and 8.2.0. Then make ldevs 101, 102, 103 be 48.3.0, 48.4.0, and 48.5.0. Now ldevs 1, 20, and 21 can failover to path 48 and ldevs 101–103 can failover to path 8 with no conflicts.

Again, HAFO does not address the hardware configuration of the array itself. In the example above, the array itself would have to be pre-configured to allow the top controller to talk to the ldevs on the bottom and to allow the bottom controller to talk to the ldevs on the top.

Each controller on the array that is to be used must be connected to a single host adapter card. All host adapters to be used in HAFO configuration must be configured in SYSGEN and initialized during boot.

Configuration Map

Creation of a configuration map is crucial. Proper planning, mapping, and maintenance of the map are critical to the successful use of HAFO. Without a proper plan and up-to-date map, troubleshooting will be difficult and system availability will not be optimized.

The following is a checklist of the steps required to enable HAFO:

1. Select the array and volume-set(s) to be configured for HAFO. Ldev 1 and the system volume set can be configured for HAFO.
2. Identify the logical data paths of the fast-wide SCSI Host adapters for each pair of controllers in the array. One path will be the primary path, fully qualified, and the other will be the alternate data path.
3. Ensure that all paths (I/O adapter cards and ldevs) are configured and recognized when the system is booted.
4. Create a map of exactly how the layout will look, including the path pairs and each ldev on each path. Include the addresses of each card and ldev, and clearly show the failover scheme.
5. Ensure that the array itself is configured to allow each primary path controller to talk to the ldevs on its corresponding alternate path.
6. When the entire plan and map are complete, configure the primary and alternate data paths in SYSGEN.

CAUTION Mirrored disk/iX and HAFO products cannot be used together for the same volume set.

Mirrored disk and HAFO can be used on the same system with multiple volumes and multiple arrays. However, these products must NOT be used simultaneously on the same user-volume set. For example, HAFO could be configured for the system volume set (which is on an array), and a user-volume of the same or different array. Mirrored disk/iX could be used on standalone disks in towers or in enclosures.

Accessing the HAFO Configuration Commands

HAFO configuration is a sub-menu of SYSGEN. The sub-menu, HAFO(ha), is found under the (io) sub-menu of SYSGEN.

1. Start SYSGEN.
2. At the sysgen> prompt, type io.
3. At the io> prompt, type ha. Several **high availability** configuration commands are listed.
4. Addconf (ad) to add each ldev's configuration path to the HAFO configuration file.
5. Listconf (li) to display configurations.
6. Doha to verify and activate the configuration.
7. Deconfigure (de) any mistakes or to delete the entry for an ldev.
8. Exit (ex).

Each of these **high availability** configuration commands is documented in the following sections. Goback is used after a failover event and is documented in Chapter 6 , "Recovering From a Failover."

WARNING

HAFO configuration commands should only be executed when there are no broken paths or ldevs that have failed over. All ldevs must be operating on their primary path.

ADDCONF (ad)

Once the configuration file is built for a specific SYSGEN base configuration, the ldevs must be configured for HAFO with their primary and alternate paths. Fully qualified paths are required. Research and obtain this information prior to configuration. The syntax is:

```
AD  <LDEV> <LDEV primary device path> <alternate device adapter card path>
```

A data path consists of the fast-wide host adapter and fast-wide SCSI bus connected to the high-availability array. For example:

```
ha> ad 90 8.0.1 16
```

NOTE The second parameter is the fully qualified ldev path while the third parameter is only the path of the device adapter card itself.

The hardware must be in place, configured through SYSGEN, and initialized at system boot time before issuing this command. The ldev specified must be mounted in the MEMBER or MASTER state.

Once added using addconf, the primary and alternate paths are checked for availability against internal system I/O tables. If the ldev cannot be accessed through both paths specified, then an error will be issued and the ldev will NOT be added to the configuration. Although this makes it much more difficult to make configuration mistakes, it also prohibits the creation of HAFO configurations for other systems that are different than the present system.

The example paths are simple. Actual paths in your environment are probably more complicated. (See the Configuration Checklist section of this chapter.) Any omission or error in the path could result in an error during the doha command.

NOTE Because HAFO works in pairs, the very first successful ADDCONF command that is entered (and applied, see the doha command) links all the ldevs on those two paths. All ldevs on the primary path specified must be configured to failover to the alternate path specified. Further all the ldevs on the alternate path specified, if any exist, must be configured to failover to the primary path specified in the first ADDCONF command specifying these paths. See Figure 4-1 for more information.

LISTCONF (li)

LISTCONF displays the entire configuration in the HAFOCONF file or the configuration for a specific ldev. The syntax is:

```
LI  <LDEV>
```

The <LDEV> is optional. For example:

```
ha> li
```

The LI command without any qualifier lists all LDEVs configured with their primary and alternate paths.

```
    LDEV    Primary   Alternate
            Path      Path
==================================
      80    8.0.0     16
      90    8.0.1     16
     100    8.0.2     16
     110    8.0.3     16
     120    8.0.4     16
```

The LI command with the LDEV number lists the LDEV and its configured primary and alternate paths. For example:

```
ha> li 168

    LDEV    Primary   Alternate
            Path      Path
==================================
     168    8.0.2     16
```

Listing the configuration for an ldev just added using addconf:

- Confirms it is in the temporary HAFOCONF file
- Allows you to recheck the accuracy of the paths

NOTE The listconf command lists the contents of the *temporary* HAFOCONF file. The temporary file is an exact copy of the permanent file when you first enter the ha> section. Any adds or deletes of ldevs will be shown by listconf, but they will not be in the permanent file until you have done a hold and keep.

DOHA

The HAFO configurations may be activated on-line.

NOTE In most cases, HAFO configurations can be activated on-line, with the DOHA command. The exception to this is when one has issued a DELCONF command. Deletes of ldevs that have been previously activated, cannot be de-activated on-line, and a reboot is necessary.

The following sequence is mandatory for on-line activation:

```
do any addconf commands needed


     ha> exit
     io> hold
     io> exit
sysgen> keep
sysgen> io
    io> ha
    ha> doha
```

The point is that you must do a “hold” and “keep” after the addconf commands, and then return to the ha> section and execute the doha command. This is because addconf adds records to the temporary HAFOCONF file, and then the permanent file is used to do the activation.

Using addconf, you supply the LDEV number, LDEV (primary) path, and alternate device adapter manager (DAM) path. The doha command will then perform the following functions:

- Read each entry in the permanent HAFOCONF file
- Confirm the existence of the LDEV, primary, and alternate paths
- Verifies the paths by reading ldev volume labels on both paths

The syntax is:

```
    ha> doha
```

This command validates all configured ldevs (even if they’ve already been validated). In the example, two ldevs, LDEV 50 and 51, have been added, then a “hold” and “keep” were done. Doha is performed:

```
ha> doha
```

```
Start of validation for all HAFO configured devices.
=====================================================



VALIDATING ** Ldev: 50  Pri path: 8.15.0  Alt path: 48
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

LDEV 50 configuration Validated Successfully



VALIDATING ** Ldev: 51  Pri path: 8.15.1  Alt path: 48
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

LDEV 51 configuration Validated Successfully



End of validation for all HAFO configured devices.
=====================================================
```

Using the doha command checks each HAFO configured ldev in the following ways:

1. The configured LDEV and primary path are compared against internal system I/O tables. This confirms that the LDEV and paths exist.
2. The alternate path is confirmed against internal system I/O tables. This confirms that the path existed at boot time.
3. Using the primary path, the ldev volume label is read. This confirms that the primary path is working and does, in fact, connect to the appropriate ldev.
4. The device manager connects to the alternate path. This confirms it exists.
5. Using the alternate path, the ldev volume label is read. This confirms that the alternate path is working and does connect to an ldev.

6. Ldev volume labels are compared. This confirms that the two paths can access the same ldev.

A full six-step validation is always performed in the following situations:

- On system boot
- Executing the doha command
- By each device manager during a failover event

Troubleshooting a Validation Error

If doha returns an error state, check Appendix B , “Error Messages.” Double check for SYSGEN configuration errors or HAFO configuration errors.

If the LDEV, primary path, or alternate path needs to be changed, delete the configured ldev using delconf, add the ldev back in using addconf, do a hold and keep, and then reboot the system.

Execute an addconf command, hold and keep, and execute the doha command.

Validation Errors Displayed

Validation errors will be displayed after a HAFO event has occurred.

If a HAFO event has occurred, there will be errors displayed upon the issuance of the doha command. HAFO configuration commands should only be issued when there are no broken paths and all HAFO ldevs are operating on their primary paths.

DELCONF (de)

To remove a configuration that is incorrect or is no longer desired, use the delconf command. The syntax is:

```
DE  <LDEV>
```

For example:

```
ha> de 100


ha> li


    LDEV    Primary   Alternate
            Path      Path
==================================
      80    8.0.0     16
      90    8.0.1     16
     110    8.0.3     16
     120    8.0.4     16
```

NOTE Reboot is required after a DELCONF command.

If a delconf is issued against a ldev that was previously activated with the doha command, a hold and keep must be performed, and the system rebooted to deactivate that ldev. (The doha command can be used to activate ldevs for HAFO but cannot be used to de-activate ldevs.

GOBACK (go)

The GOBACK command reinstates the primary data path after the data path failure has been remedied, for example, a controller “hot swap.” This command is fully documented in Chapter 6 , “Recovering From a Failover.”

REDO (re)

This is the standard MPE `redo` command that re-displays the last command entered. This command may be edited using the standard line editing commands.

HELP (he)

To get online help on one of the listed HAFO commands, type help and the command desired. For example, to get help for the ADDCONF command:

```
ha> he ad

        addconf (ad)      <ldev>  <path>  <altpath>

        Add LDEV Primary path alternate (DAM) paths to HAFO Configuration
```

For a full list of HAFO commands and help text:

```
ha> he all
```

EXIT (ex)

To exit the HAFO command menu:

```
ha> ex
```

Special Considerations

Rebooting After a HAFO Event

Rebooting the system after a HAFO event has occurred is a special situation, especially if the event occurred on the path for ldev 1.

HAFO is not active during boot, and the boot process has no knowledge of HAFO. This means that the *system* will attempt to mount ldev 1 based on the *system* primary path, and all other disk volumes based on the configuration of the ldevs done in the `io>` section of SYSGEN. (i.e., NOT based on anything done in the `ha>` section of SYSGEN.)

If the primary path to any of the ldevs is broken, then those ldevs will NOT mount at boot time and will NOT be available after the system is up.

For information on how to deal with these types of situations, please see the Special Considerations for Failed Paths section in Chapter 6 , "Recovering From a Failover."

NOTE All primary and alternate paths are validated near the end of the boot process. If any paths are broken, an error message will be issued.

Corrupt or Problem HAFOCONF File

If the HAFOCONF file becomes corrupt, there are two ways to deal with it. One way to fix it is to purge the file and restore a good file from a backup. Another way is to purge it, then enter SYSGEN. If there is no HAFOCONF file when SYSGEN is entered, it will build a new (empty) one automatically. Use `addconf` to configure ldevs for HAFO.

Do not perform HAFO configuration when a path is broken. No HAFO configuration changes should be made unless all paths are functioning properly and all ldevs are operating on their primary path.

5 Monitoring Status

Failover is automatic and will allow applications to continue uninterrupted. In the event of failover, repeated warnings appear on the system console indicating a failover event has occurred. The warning specifies which high availability array ldev has experienced a failover event.

```
HIGH AVAILABILITY FAILOVER IS STARTED FOR LDEV# IN DISK ARRAY. NO DATA LOSS
OR CORRUPTION. SYSTEM OPERATION WILL CONTINUE.PLEASE PLACE SERVICE CALL SOON.

ACKNOWLEDGE HAFO FAILOVER IN DISK ARRAY FOR LDEV# (Y/N)?
```

The warning message will be displayed on the console every five minutes until the operator does a **[CTRL] [A]** reply. In addition to the console warning message, a failover generates entries in the I/O and system logs.

The HAFO console message allows you to monitor the failure event. There is also a new command HASTAT, that allows you to display status for all HAFO configured ldevs at anytime. HASTAT displays the following information:

- LDEV # of arrays configured for failover
- Primary and alternate path information
- Status of primary and alternate data path for doing I/O (failover and possible cause of data path failure)

NOTE The HASTAT command only reports on ldevs that are in the HAFOCONF file in the group from which the system was booted.

Failver Status Report

A sample report is shown here.

```
:HASTAT


  High Availability Failover Device Status

 LDEV PRIMARY   ALTERNATE PRIMARY         ALTERNATE
      PATH      PATH      STATUS          STATUS
----- --------- --------- -------------  --------------

   80 8.0.0     16        Ready           Ready
   90 8.0.1     16        Ready           Ready
  100 8.0.2     16        Ready           Ready
  110 8.0.3     16        Ready           Ready
  120 8.0.4     16        Ready           Ready
  210 32.0.3    40        Ready           Ready
  220 40.0.4    32        Ready           Ready
  520 40.0.5    32        Ready           Ready
```

All primary path statuses are explained in the following section. Appendix A , “Sample Failover and Recovery,” provides a sample failover scenario and documents how to recover.

Failover Status Descriptions

The following is a complete list of the failover statuses which may appear in the HASTAT HAFO Status Report:

- Array Failure
- Failover Failed
- GOBack started
- Not HAFO dev
- Ready
- Unknown failure
- Unknown status

Each status is described in the sections below.

Array Failure

When this status is generated, the device adapter reported its failure via a SCSI message that was monitored and acted upon by HAFO. Failover occurred and data requests to the high availability array have been rerouted to the alternate data path. Normal system I/O activity continues.

Failover Failed

This status means a failure has occurred on the primary path. When failover was attempted, the alternate path was unavailable.

The alternate path has failed due to a data path fault or misconfiguration. Troubleshoot this instance by repairing the failure on the primary and alternate paths.

GOBack Started

This message appears only after the goback command has been executed. If goback is still running when a HAFO device status report is run (highly unlikely), this message will appear.

Run the HAFO device status report again. The “Goback started” message should be replaced by the actual status.

Not HAFO dev

This status message indicates that the ldev on the path is not a high availability array. High availability failover is available only with the XP256.

Ready

The Ready status shown for LDEV 102 in the sample report (above) indicates that I/O is being processed via the primary path. No failure or failover has occurred.

The Ready status is shown for all alternate paths in the sample report. This indicates that no change has occurred in the status of the alternate path since the doha command was last executed.

Unknown Failure

This state reflects the fact that the path not functioning due to a condition that could not be determined. Possible causes for this are:

- The hose adapter is not responding
- Cabling is broken or not carrying data
- Array controller not responding

Unknown Status

The I/O subsystem has sent an unknown path status. Contact your HP Support representative to report the problem.

6 Recovering From a Failover

Once high availability failover to the alternate data path has engaged, users continue to access data on that high availability array ldev with no restrictions. I/Os outstanding during the failure and those after the failover will be processed on the alternate data path without interruption.

NOTE HAFO does *not* protect against multiple failures. It is imperative that the broken path be repaired as soon as possible.

Repairs

Repairs to the failed component in the data path should be performed as soon as possible to avoid a double failure on the HA array. The more ldevs routed through a single device adapter card, the greater the I/O workload and possible I/O performance degradation.

High availability arrays like the HP XP256 have many redundant subsystems including dual controllers. If an array controller is the source problem for data path failure, the controller can be replaced “hot swapped” while the system and array are online.

Other data path components, such as SCSI bus cabling and device adapter cards, cannot be replaced online and require the system be shut down and powered off for repairs.

Rerouting to the Primary Path After Failover

If a repair does not require re-booting, such as after a “hot swap” replacement of the array controller, the goback command should be invoked. Goback reroutes I/O to the primary path.

If a repair requires the system be shut down and re-booted, I/O will be routed to all available configured primary paths. Goback does not need to be invoked in this scenario.

The six-step validation process documented in the DOHA section of Chapter 4 , “Configuration,” occurs when goback is invoked or when the system is re-booted.

GOBACK (go)

To execute goback:

1. Start SYSGEN.
2. At the sysgen> prompt, type io.
3. At the io> prompt, type ha.
4. Execute the goback (go) command using the syntax.

```
go <LDEV>
```

For example,

```
ha> go 8
```

In this example, all I/Os for LDEV 8 will be rerouted to the primary path configured. Should this attempt fail, you will be notified and the I/Os will continue on the alternate data path.

Appendix A , “Sample Failover and Recovery,” provides a sample failover scenario and documents how to recover.

Special Considerations for Failed Paths

HAFO is not active during system boot. When the system boots, it always mounts all disk volumes using ONLY the primary path. This means that if a primary path is broken, the ldevs on that path WILL NOT MOUNT, and will not be available for access after the system is up.

Rebooting With a Failed Primary Path

In order to mount these ldevs when their primary path is broken, the user must use the io> section of SYSGEN (NOT the ha> section) to specify the alternate path as the actual path for these ldevs. The system must then be rebooted.

Consider the following sample output from the HASTAT command:

```
:HASTAT


  High Availability Failover Device Status

 LDEV PRIMARY   ALTERNATE PRIMARY        ALTERNATE
      PATH      PATH      STATUS         STATUS
----- --------- --------- -------------  --------------

   80 8.0.0     16        Ready          Ready
   90 8.0.1     16        Ready          Ready
  100 8.0.2     16        Ready          Ready
  110 8.0.3     16        Ready          Ready
  120 8.0.4     16        Ready          Ready
  210 32.0.3    40        Ready          Ready
  220 40.0.4    32        Ready          Ready
  520 40.0.5    32        Ready          Ready
```

If there were an array failure on the path for ldev 210, the output of the HASTAT command would be as follows:

```
:HASTAT


  High Availability Failover Device Status

 LDEV PRIMARY   ALTERNATE PRIMARY        ALTERNATE
      PATH      PATH      STATUS         STATUS
----- --------- --------- -------------  --------------

   80 8.0.0     16        Ready          Ready
   90 8.0.1     16        Ready          Ready
  100 8.0.2     16        Ready          Ready
  110 8.0.3     16        Ready          Ready
  120 8.0.4     16        Ready          Ready
  210 32.0.3    40        Array Failure  Ready
  220 40.0.4    32        Ready          Ready
  520 40.0.5    32        Ready          Ready
```

This indicates that ldev 210 has failed over to path 40. Because path 32 has suffered a hardware failure, ldev 210 will NOT mount if the system is rebooted before the hardware is repaired. If the system must be rebooted before the hardware is repaired, then there must be some changes made in the “io” section of SYSGEN. Ldev 210 must be configured onto path 40. For example:

```
    io> mdev 210 path=40.0.6
    io> hold
    io> e
sysgen> keep
```

Now when the system is rebooted, ldev 210 will mount on path 40 and will be available for access.

NOTE Near the end of the boot process, there will be an error message stating:

```
Invalid Primary Path for this LDEV. - (HAFOERR 500)
```

This is because ldev 210 is still configured in the HAFOCONF file as having 32 as it’s primary path. In this special case this error can be

ignored. However, ldev 210 is not covered by HAFO and path 32 should be repaired as soon as possible. (Note also that ldevs 220 and 520 are also not covered by HAFO since path 32 is physically broken.)

Rebooting With a Failed Primary Path for ldev 1

Ldev 1 can be configured for HAFO just as any other ldev in the XP256. It is, however, a very special situation when the system needs to be rebooted while the primary path for ldev 1 is broken.

The user will need to make adjustments at the ISL prompt (ISL>) before booting the system. If the primary path for ldev 1 is broken, the system primary path will need to be adjusted to be alternate path for ldev 1.

The following example illustrates how to handle ldev 1.

Suppose that HASTAT shows the following on your system:

```
:HASTAT


  High Availability Failover Device Status


 LDEV PRIMARY   ALTERNATE PRIMARY        ALTERNATE
      PATH      PATH      STATUS         STATUS
----- --------- --------- -------------  --------------

    1 8.0.0     15        Ready          Ready
   90 15.0.1     8        Ready          Ready
  100 15.0.2     8        Ready          Ready
  110 15.0.3     8        Ready          Ready
  120 15.0.4     8        Ready          Ready
```

Now suppose that there is a hardware failure on path 8. The system would continue to function, and HASTAT would show something like:

```
:HASTAT


  High Availability Failover Device Status

 LDEV PRIMARY   ALTERNATE PRIMARY        ALTERNATE
      PATH      PATH      STATUS         STATUS
----- --------- --------- -------------  --------------

    1 8.0.0     15        Array Failure  Ready
   90 15.0.1     8        Ready          Ready
  100 15.0.2     8        Ready          Ready
  110 15.0.3     8        Ready          Ready
  120 15.0.4     8        Ready          Ready
```

If for some reason the system must be rebooted before path 8 can be repaired, special action must be taken before entering the `start` command.

Each MPE system has what is known as the system primary path, which has nothing to do with the primary path concept in HAFO. Ldev 1 is always on the system primary path. Since, in this example, the system primary path is broken, ldev1 will not be found and the system will not boot.

In order to remedy this, you must change the system primary path from 8 to 15. Please refer to the *System Startup, Configuration, and Shutdown Reference Manual* for information on changing the system primary path.

After the system primary path is changed to 15.0.0, the system can find ldev 1 and boot.

NOTE In the previous example, there was only one ldev on the broken *system primary path*. If there had been other ldevs on path 8, then in order to ensure that all the volumes mounted, the actions described in "Rebooting With a Failed Primary Path" would also have to be taken.

It is recommended that the user creates and maintains an alternate configuration group that has the alternate paths for the system volume ldevs configured to be their primary path. That is in the `io>` section of SYSGEN and NOT in the `ha>` section. This is so that in the case where

the system volume set's path goes bad and you need to reboot, you can use this alternate configuration group to ensure that the system volume set mounts properly. (This assumes that all the system volumes are on the same path. If they are not, then you may want to create multiple alternate configuration groups, one for each path that contains system volumes.)

Performance Considerations

It is recommended that the user understand the performance characteristics of the current system before making any non-HAFO configuration changes (i.e., changes in the `io>` section of SYSGEN) to accommodate HAFO. These changes may need to be carefully planned in order to maintain system performance.

Also be aware that a HAFO event can greatly increase the I/O load on a given path and can cause significant performance degradation. Actual performance is dependent on the capabilities of a host device adapter card and the load. We normally recommend no more then eight ldevs on a host device adapter card for "best" performance. If the load on the host device adapter card is relatively low then the difference between eight ldevs and fourteen ldevs will not effect performance. If the load on a host device adapter is "high" then when other ldevs have failed over to this host device adapter, performance degradation could occur.

A Sample Failover and Recovery

The following scenario illustrates a possible HAFO situation.

Sample Scenario

The following is a sample HAFO status report extracted from a HASTAT display. The report shows several failover statuses which are explained in succeeding sections of this appendix. Troubleshooting advice for this sample scenario is also provided.

```
  High Availability Failover Device Status

 LDEV PRIMARY   ALTERNATE PRIMARY         ALTERNATE
      PATH      PATH      STATUS          STATUS
----- --------- --------- -------------   ---------------

   80 8.0.0     16        Unknown Failure Ready
   90 8.0.1     16        Unknown Failure Ready
  100 8.0.2     16        Unknown Failure Ready
  110 8.0.3     16        Unknown Failure Ready
  120 8.0.4     16        Unknown Failure Ready
  210 32.0.3    40        Ready           Ready
  220 40.0.4    32        Array Failure   Ready
```

Incidents Summary

SCSI bus path “8” has failed and all configured HAFO ldevs (LDEV 80, 90, 100, 110, 120) have detected the path failure and have successfully failed over to the alternate path “16”.

LDEV 210 is still operating using its primary path and requires no action.

LDEV 220 has detected an array failure, probably the array controller attached to SCSI path “40”. LDEV 220 device manager successfully has done a failover to its alternate path of “32”.

Corrective Action: Failure on System Path “8”

The system needs to be shutdown with diagnostics used to isolate the failing component in bus path “8”. Failing candidates are: host device adapter card, SCSI cable, or array controller. Each component needs to be verified.

Corrective Action: Failure on LDEV 220

As indicated by the primary path status for LDEV 220, it’s possible that the array controller has failed. This should be verified by an HP support representative, and the system diagnosed to verify the actual broken component. If it is the array controller then in most cases, array controllers can be replaced on-line with host powered-up and array powered-up. After the array controller has been replaced, the primary path can be used again for optimal system I/O performance. Use `SYSGEN > IO > HA > GO 220` command to force LDEV 220’s device manager to try the primary path after online repairs.

B Error Messages

Command Input Errors (HAFOERR — 1...27)

1 **MESSAGE: Invalid Hautil Command — (HAFOERR 1)**

CAUSE: Command entered is not a valid command.

ACTION: Enter valid command.

3 **MESSAGE: Missing LDEV parameter — (HAFOERR 3)**

CAUSE: Parameter 1 for command is missing.

ACTION: Input Parameter 1 value with command.

4 **MESSAGE: Missing Primary Path parameter — (HAFOERR 4)**

CAUSE: Parameter 2 for command is missing.

ACTION: Input Parameter 2 value with command.

5 **MESSAGE: Missing Alternate Path parameter — (HAFOERR 5)**

CAUSE: Parameter 3 for command is missing.

ACTION: Input Parameter 3 value with command.

6 **MESSAGE: Not a valid Primary path format — (HAFOERR 6)**

CAUSE: Parameter 2 has an invalid value.

ACTION: Input correct Parameter 2 value with command.

7 **MESSAGE: Not a validate Alternate path format — (HAFOERR 7)**

CAUSE: Parameter 3 has an invalid value.

ACTION: Input correct Parameter 3 value with command.

8 **MESSAGE: Invalid character in LDEV parameter — (HAFOERR 8)**

CAUSE: Parameter 1 has an invalid value.

ACTION: Input correct Parameter 1 value with command.

9 **MESSAGE: Invalid character in Primary path parameter — (HAFOERR 9)**

CAUSE: Parameter 2 has an invalid value.

ACTION: Input correct Parameter 2 value with command.

10 **MESSAGE: Invalid character in Alternate path parameter — (HAFOERR 10)**

CAUSE: Parameter 3 has an invalid value.

ACTION: Input correct Parameter 3 value with command.

11 **MESSAGE: LDEV parameter too long — (HAFOERR 11)**

CAUSE: Parameter 1 has an invalid value.

ACTION: Input correct Parameter 1 value with command.

12 **MESSAGE: Primary Path parameter too long — (HAFOERR 12)**

CAUSE: Parameter 2 has an invalid value.

ACTION: Input correct Parameter 2 value with command.

13 **MESSAGE: Alternate Path parameter too long — (HAFOERR 13)**

CAUSE: Parameter 3 has an invalid value.

ACTION: Input correct Parameter 3 value with command.

14 **MESSAGE: Invalid Primary path for this LDEV — (HAFOERR 14)**

CAUSE: Parameter 2 has an invalid value.

ACTION: Input correct Parameter 2 value with command.

15 **MESSAGE: Primary DAM and Alternate DAM paths are same — (HAFOERR 15)**

CAUSE: Parameters 2 and 3 have the same value.

ACTION: Input correct Parameters 2 and 3 values with command.

16 **MESSAGE: Invalid Alternate path for this LDEV — (HAFOERR 16)**

CAUSE: Parameter 3 has an invalid value.

ACTION: Input correct Parameter 3 value with command.

17 **MESSAGE: Not an valid LDEV — (HAFOERR 17)**

CAUSE: LDEV input was not valid.

ACTION: Input correct LDEV with command.

18 **MESSAGE: LDEV not mounted as MASTER or MEMBER — (HAFOERR 18)**

CAUSE: The volume associated with specified LDEV has not mounted as a master or member.

ACTION: Check the state of the volume set using “DSTAT”. The volume must be mounted as a master or member. If not, use the “VOLUTIL” utility to change to the appropriate state or remove LDEV from HAFO configuration.

19 **MESSAGE: LDEV does not exist — (HAFOERR 19)**

CAUSE: LDEV input was not valid.

ACTION: Input correct LDEV with command.

20 **MESSAGE: Goback failed — LDEV <ldev #> has not Failed over — (HAFOERR 20)**

CAUSE: GOBACK was attempted on an LDEV that has not failed over or GOBACK was attempted on a primary path that is broken.

ACTION: Run HASTAT utility and check status of LDEV's paths.

21 **MESSAGE: No devices to list — (HAFOERR 21)**

CAUSE: No devices have been configured for HAFO.

ACTION: None.

22 **MESSAGE: Device not configured — (HAFOERR 22)**

CAUSE: The device specified to be displayed has not been configured for HAFO.

ACTION: None.

23 **MESSAGE: LDEV does not exist in HAFO configuration file — (HAFOERR 23)**

CAUSE: HAFOCONF file record associated with specified LDEV was not found.

ACTION: None.

24 **MESSAGE: LDEV already configured for HAFO — (HAFOERR 24)**

CAUSE: LDEV specified has previously been configured for HAFO.

ACTION: None.

25 **MESSAGE: The path format for this LDEV is not correct — (HAFOERR 25)**

CAUSE: The path format for this LDEV is not correct.

ACTION: Check for too many periods or missing periods in path specification.

26 **MESSAGE: No devices are configured for HAFO — (HAFOERR 26)**

CAUSE: No devices have been configured for HAFO.

ACTION: Verify changes made to HAFO configuration have been made permanent then try again.

27 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 27)**

CAUSE: Primary path is already configured.

ACTION: None.

Configuration File Access Errors (HAFOERR — 200...207)

200 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 200)**

CAUSE: The HAFOCONF file in the specified configuration group exists but cannot be opened because of insufficient capabilities or improper access privileges.

ACTION: Make sure the group you're executing from has PM capability and the user has SM capability.

201 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 201)**

CAUSE: Either the user is not logged on to the SYS account, or the HAFOCONF file does not exist.

ACTION: Make sure you are logged onto the SYS account, or restore the HAFOCONF file from a backup. (A new (empty) HAFOCONF file can be generated by exiting SYSGEN and then running SYSGEN again.))

202 **MESSAGE: File close error on < file name > — (HAFOERR 202)**

CAUSE: The file system was unable to close the specified file.

ACTION: Call your HP Support Representative for assistance.

203 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 203)**

CAUSE: An End Of File condition was encountered while reading the HAFOCONF file. The HAFOCONF file is a pre-formatted file and an End Of File in this context is not a normal Condition and may indicate corruption.

ACTION: Call your HP Support Representative for assistance.

204 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 204)**

CAUSE: An error occurred while executing an FREAD intrinsic call.

ACTION: Call your HP Support Representative for assistance.

205 **MESSAGE: Maximum number of HAFO devices configured. Cannot add to HAFO configuration — (HAFOERR 205)**

CAUSE: All entries in the HAFOCONF configuration file have been allocated.

ACTION: List the entries in the HAFOCONF file and delete any entries not needed.

206 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 206)**

CAUSE: An End Of File condition was encountered during the execution of an FUPDATE intrinsic call.

ACTION: Call our HP support representative for assistance.

207 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 207)**

CAUSE: An error occurred during the execution of an FUPDATE intrinsic call.

ACTION: Call your HP support representative for assistance.

PPT ACCESS ERRORS (HAFOERR — 500...503)

500 **MESSAGE: Invalid Primary Path for this LDEV. — (HAFOERR 500)**

CAUSE: The primary path specified for this LDEV is not correct.

ACTION: Check the path specified for validity and try again.

501 **MESSAGE: Invalid Alternate Path for this LDEV. — (HAFOERR 501)**

CAUSE: The alternate path specified for this LDEV is not correct.

ACTION: Check the path specified for validity and try again.

502 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 502)**

CAUSE: The Physical Path Table entry for this device was not found.

ACTION: Call your HP Support Representative for assistance.

503 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 503)**

CAUSE: The Physical Path Table entries are not linked.

ACTION: Call your HP Support Representative for assistance.

PORT ACCESS ERRORS (HAFOERR — 1000...1017)

1000 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1000)**

CAUSE: An error occurred while attempting to create HAFO Utilities/Device Manager communications Port.

ACTION: Call your HP Support Representative for assistance.

1001 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1001)**

CAUSE: An error occurred while attempting to create internal HAFO Utilities buffer object.

ACTION: Call your HP Support Representative for assistance.

1002 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1002)**

CAUSE: An error occurred while attempting to return HAFO Utilities buffer to the operating system.

ACTION: Call your HP Support Representative for assistance.

1003 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1003)**

CAUSE: An error occurred while attempting to freeze HAFO Utilities buffer in memory.

ACTION: Call your HP Support Representative for assistance.

1004 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1004)**

CAUSE: An error occurred while attempting to unfreeze HAFO Utilities buffer.

ACTION: Call your HP Support Representative for assistance.

1005 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1005)**

CAUSE: An error occurred while attempting to allocate a message frame for HAFO Utilities.

ACTION: Call your HP Support Representative for assistance.

1006 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1006)**

CAUSE: An error occurred while attempting to release a message frame allocated for HAFO Utilities.

ACTION: Call your HP Support Representative for assistance.

1007 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1007)**

CAUSE: An error occurred while attempting to send an I/O Request to the Device Manager.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section) configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1008 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1008)**

CAUSE: An error occurred while waiting for an I/O request to the Device Manager to complete.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1009 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1009)**

CAUSE: An error occurred while attempting to send a message to Device Manager.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1010 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1010)**

CAUSE: An I/O request sent to the Device Manager caused a message to be sent to the wrong port.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io section) configuration and the HAFO (ha section) configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1011 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1011)**

CAUSE: Failover to Alternate path during Volume Label Verification failed.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io section) configuration and the HAFO (ha section) configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1012 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1012)**

CAUSE: Failover failed — Volume label verification failed.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary

path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1013 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1013)**

CAUSE: Failover failed — Mounted Volume Table inconsistent.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1014 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1014)**

CAUSE: The Device Manager is in the wrong state for the command being executed.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1015 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1015)**

CAUSE: A message was sent to the Device Manager with an invalid function.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1016 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1016)**

CAUSE: A message was received from the Device Manager with an invalid function.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

1017 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1017)**

CAUSE: A message was received from the Device Manager with an invalid class.

ACTION: Check to make sure that there are no mismatches between the SYSGEN (io) section configuration and the HAFO (ha) section configuration.

All HAFO (ha) configured primary paths must match the SYSGEN (io) path configuration for all HAFO ldevs.

Check that there are no hardware problems and make sure no failover events have occurred. If a failover event has occurred, fix the primary path and make sure all HAFO ldevs are operating on their primary path.

If the HAFO primary and SYSGEN (io) paths are in sync and all HAFO ldevs are operating on their primary paths, then call your HP Support Representative for assistance.

GENERAL USER STATUS MESSAGES (HAFOERR — 1500...1505)

1500 **MESSAGE: HAFO configuration file does not exist — (HAFOERR 1500)**

CAUSE: The HAFO configuration file HAFOCONF cannot be opened.

ACTION: Run SYSGEN and the HAFOCONF should be built.

1501 **MESSAGE: HAFO configuration file is corrupt — (HAFOERR 1501)**

CAUSE: The HAFO configuration has an incorrect record size or has been incorrectly formatted or does not have a correct checksum.

ACTION: Purge the file and run SYSGEN again.

1502 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1502)**

CAUSE: An unknown error has occurred in the HAFO utility.

ACTION: Call your HP support representative for assistance.

1503 **MESSAGE: HAFO INTERNAL ERROR — (HAFOERR 1503)**

CAUSE: An unknown error has occurred in the HASTAT Utility.

ACTION: Call your HP support representative for assistance.

1504 **MESSAGE: **warning** Information display mode only — (HAFOERR 1504);**

CAUSE: User does not have “save” capability. You may continue but only with display capability.

ACTION: User must have System Manager capability to make any configuration changes.

1505 **MESSAGE: Need System Manager capability to make configuration changes — (HAFOERR 1505)**

CAUSE: The user attempted to make changes to the HAFOCONF configuration file without having the proper capabilities.

ACTION: The user must System Manager capabilities to be able make changes to the HAFOCONF configuration file.