

Chapter 3

Hard Drive Subsystems

This chapter answers the most frequently asked hard drive subsystem questions, including required device drivers, optimization, support for third-party hard drives and controllers, hard drive failure notification, and hard drive replacement.

Hard Disk Device Drivers

Compaq and Novell both provide hard disk device drivers with NetWare. Which device drivers should I use?

When you configure a server hard drive subsystem, regardless of the manufacturer, use the hard disk device driver shipped with your controller to ensure you are using the latest, best-performing device driver for your server. Most manufacturers provide customized device drivers for their hard drive subsystems. These customized device drivers might include optimization parameters or management features that are not included with other device drivers.

Compaq device drivers include optimization and enhancement features that are specific to Compaq hard drive controllers. Compaq distributes its NetWare device drivers using several different media. They are:

- *NetWare Programs from Compaq (NPFC)* diskette
(available with all Compaq server products)
- *NetWare Programs from Compaq Supplement* diskette
- *Compaq Support Software* compact disc
- *Compaq SmartStart* compact disc
- Online services
 - CompuServe
 - Internet at [FTP.COMPAQ.COM](ftp://ftp.compaq.com) or [WWW.COMPAQ.COM](http://www.compaq.com)

Compaq distributes all of these NetWare device drivers. A list of where they can be found is located at the beginning of this section.

Compaq provides multi-layered device drivers for servers with SCSI-2 hard drive configurations. These device drivers include the following NLMs:

- *CPQSDISK.DSK* - disk driver
- *CPQS710.DSK* - interface driver
- *CPQS94.DSK* - interface driver
- *CPQSXPT.DSK* - transport driver that loads automatically with *CPQSDISK.DSK*

The NPFC diskette also provides sample *STARTUP.NCF* to assist you in loading these device drivers. You can use the appropriate *.NCF* file, based on your server hard drive configuration, as your NetWare *STARTUP.NCF* file.

- *SU001.NCF* - 32-Bit Fast-SCSI-2 Controller
- *SU002.NCF* - Compaq drive array and 32-Bit Fast-SCSI-2 Controller
- *SU003.NCF* - Compaq Systempro/XL with Integrated SCSI-2 Options Port enabled and Compaq drive array
- *SU004.NCF* - Compaq Systempro/XL with Integrated SCSI-2 Options Port enabled, 32-Bit Fast-SCSI-2 Controller, and Compaq drive array
- *SU005.NCF* - Compaq Systempro/XL with Integrated SCSI-2 Options Port enabled and 32-Bit Fast-SCSI-2 Controller
- *SU006.NCF* - Compaq Systempro/XL with Integrated SCSI-2 Options Port enabled

For example, if your Compaq ProLiant 2000 includes a tape drive connected to the Integrated Fast SCSI-2 Controller and a Compaq drive array subsystem, the *SU002.NCF* file is the appropriate file to use as your *STARTUP.NCF* file.

NOTE: For more information on SCSI support for NetWare, refer to the README file *SCSI.RDM* on the NPFC diskette.

[illegible]

Regardless of the hard drive subsystem you are configuring, always ensure that the device driver is the latest version available. Compaq updates its device drivers to ensure support of new or enhanced hardware products. These updated drivers might also include optimization features or server management features that support current hardware. For example, the Fast-SCSI-2 device driver includes performance enhancement features that take advantage of the Fast-SCSI-2 subsystem.

The following Compaq TechNotes for NetWare provide detailed information on optimizing hard drive subsystem performance:

- *NetWare 4 Performance Management*
- *Performance Management in a NetWare v3.1x Environment*

The latest drivers are available online on CompuServe and on the Internet at [FTP.COMPAQ.COM](ftp.compaq.com) or [WWW.COMPAQ.COM](http://www.compaq.com). If you do not have access to these online services, you can call the Compaq Bulletin Board at (713) 378-1418 or call your Authorized Compaq Service Provider, Reseller, or Distributor. In the United States, call the Compaq Customer Support Center at 1-800-345-1518.

NOTE: For more information on Compaq Customer Support, refer to Appendix A, “Compaq Technical Support Overview.” For more information on Compaq TechNotes, refer to Appendix B, “Multivendor Integration From Compaq.”

RAID Implementations

What is the difference between the various RAID levels and how can I take advantage of them using Compaq disk controllers and drives?

In the late 1980s, a group of researchers at the University of California at Berkeley developed a set of five disk array models that they called Redundant Arrays of Inexpensive Disks (RAID). These five models, noted as RAID 1 through RAID 5, form the foundation for a wide range of disk products in the market today.

RAID 0

RAID 0 or data striping without parity was not included in the original RAID specifications and is technically not a RAID implementation since it provides no data redundancy. RAID 0 is the striping blocks of data across all drives in the array. Although this implementation does not provide fault tolerance, it does provide a performance advantage over single disks.

The Compaq SMART Array Controller does support RAID 0 technology. To configure a SMART Array Controller to support RAID 0, run the Compaq System Configuration Utility and configure multiple disks as a logical volume with no fault tolerance.

RAID 1

RAID 1, mirrored disk array, provides excellent fault tolerance by completely mirroring the contents of each physical disk in the array to another drive. Although this model provides high reliability, it uses 50 percent of the installed disk capacity. Some mirrored configurations also provide performance enhancement by allowing split reads. With split reads, read requests alternate between the two drives comprising the mirrored pair allowing some operations to occur in parallel.

The Compaq SMART Array Controller also supports RAID 1 technology. Controller duplexing, a variation of RAID 1, enhances a mirrored configuration by placing each disk in a mirrored pair on a separate controller. To implement controller duplexing, you must use NetWare's disk mirroring, have two separate disk controllers, and install similar disk devices on each controller. Use NetWare's *INSTALL.NLM* to mirror a disk on one controller to the similar disk installed on the other controller. You can implement controller duplexing using the Compaq SMART Array Controller, Fast SCSI-2 Controller or Integrated Fast SCSI-2 controller combined with NetWare's disk mirroring.

RAID 2 and RAID 3

In RAID 2 and RAID 3, the controller stripes data across the array on the bit or byte level. To write or read data reliably, it is critical the rotation of each individual disk be precisely synchronized. In RAID 2 the controller writes an error correcting code to the disk along with the data while in RAID 3 one drive in the array is dedicated to parity. These implementations tend to be highly hardware dependent because of required disk synchronization. Neither of these RAID levels is supported by Compaq hardware.

RAID 4

RAID 4, data guarding, stripes blocks of data across the drives in the array and reserves one drive for parity information. This model provides data redundancy at a significantly lower cost than mirrored solutions but can have poor write performance due to the time required to generate parity information. In Compaq's SMART Array Controller, this potential performance problem is addressed by placing dual on-board Intelligent Array Engines (IAE) and 4 megabytes of mirrored cache (battery backed) on the controller board. The dual array engines divide the processing of array operations intelligently; therefore, providing enhanced performance. One IAE generates fault tolerant parity information and manages the flow of data throughout the drive array while the other IAE prepares and sorts each batch of array storage commands.

RAID 5

RAID 5, distributed data guarding, is similar to RAID 4, but with one exception. The controller distributes parity among the drives in the array so that each drive will contain both data and parity information. Distributed Data Guarding has better performance than RAID 4 implementations because it eliminates the performance restrictions associated with a dedicated parity drive.

When implementing either Distributed Data Guarding or Data Guarding, you can use as few as three disks or as many as fourteen. In either case, parity is reserved only for a single drive. SMART Array Controller performance also improves as additional drives are added to a logical volume.

SMART Array Controller Fault Tolerance

What is the difference between the capabilities of the SMART Array Controller and other Compaq drive array controllers?

The SMART Array Controller provides enhanced functionality over other Compaq drive array controllers. Key features include:

- Dual on-board Intelligent Array Engines that can divide array operations.
- A 4-Megabyte Mirrored Array Accelerator Write Cache.
- Support for up to 14 hard drives using a combination of internal and external drives. With current hard drive offerings from Compaq, you can configure up to 29.4 gigabytes of hard disk space on a single SMART Array Controller and up to 8 logical drives.
- Fly-by-Parity, which includes a special firmware algorithm that computes parity information as data is transferred to the buffer.
- Support for an online spare hard drive that will automatically replace a failing disk in the array.

Enhanced data guarding and distributed data guarding implementation. The SMART Array Controller supports data guarding and distributed data guarding using as few as 3 hard drives or as many as 14 hard drives. The implementation is called "N+1."

Under data guarding using the N+1 parity scheme, one hard drive is allocated as the parity drive, regardless of the total number of hard drives installed. For example, a six-drive array configured for data guarding uses one hard drive of the array for fault tolerance. Under distributed data guarding, the same amount of hard disk space is allocated for parity as for data guarding, but this parity space is distributed over all the hard drives.

When planning hard disk space requirements for your server configuration with the SMART Array Controller, plan for one additional hard drive for data guarding or distributed data guarding.



IMPORTANT: The SMART Array Controller supports only Fast-SCSI-2 hard drives.

SMART Array Controller Optimization

How do I optimize the performance of my SMART subsystem?

Optimizing the performance of a server begins at server configuration and NetWare installation. One way of optimizing the SMART subsystem, as well as all Compaq drive array subsystems, is to align the NetWare partition on a stripe boundary on the logical drive. This reduces the number of disk accesses needed to complete an I/O operation. To align the NetWare partition on the stripe boundary, you must adjust the size of the Hot Fix Redirection Area by specifying the value for the number of Hot Fix Redirection Area blocks. If you do not specify a value and accept the NetWare default, the NetWare partition might be misaligned.

To calculate the correct number of Hot Fix Redirection Area blocks, ensure that this alignment occurs, use *CPQDAOPT.NLM* on the *NetWare Programs from Compaq* (NPFC) diskette. *CPQDAOPT.NLM* assists you in optimizing the performance of a NetWare volume that is configured with a Compaq drive array controller. It provides you with a recommendation, based on your drive array subsystem configuration, for setting the number of Hot Fix Redirection Area blocks.



IMPORTANT: Compaq SmartStart automatically optimizes all NetWare partitions during the install process. If you utilize SmartStart to install NetWare on your server, you do not need to run *CPQDAOPT.NLM*.

You normally use *CPQDAOPT.NLM* before you install NetWare and create partitions, since you define the size of the Hot Fix Redirection Area during partition creation. However, you can also use *CPQDAOPT.NLM* on existing partitions when you want to check data alignment or when you must change the cache buffer size to a point where the NetWare partition falls out of alignment.

NOTE: The installation process for *CPQDAOPT.NLM* differs based on the NetWare version you are installing.

Installing CPQDAOPT.NLM for NetWare 4.x

To install *CPQDAOPT.NLM* for NetWare 4.x, perform the following:

1. After configuring your server hardware with the Compaq System Configuration Utility and creating a DOS partition, copy the CD-ROM support files from the NPFC diskette to the server DOS partition. This configures the CD-ROM drive as a DOS drive (for example, drive D).

```
COPY A:\SCSI\DOS\*. * C:\
```

NOTE: The support files on the NPFC diskette include *AUTOEXEC.BAT* and *CONFIG.SYS* files that will load the CD-ROM driver automatically at server startup.

2. Copy the Microsoft CD-ROM support driver *MSCDEX.EXE* from the support diskette (supplied with the CD-ROM drive) to the server DOS partition.

```
COPY A:\MSCDEX.EXE C:\
```

3. Remove the diskette and reboot the server.
4. Use the NetWare *NWXTRACT* utility to copy the library files (*CLIB.NLM* and *STREAMS.NLM*) from the NetWare CD-ROM to the server DOS partition:

```
NWXTRACT D: CLIB.NLM C:\
NWXTRACT D: STREAMS.NLM C:\
```

The *NWXTRACT* utility locates the library files on the CD-ROM, extracts them, then copies them to the root directory of the server DOS partition.

5. Start NetWare by entering the following from the DOS prompt:

```
SERVER
```

6. From the NetWare prompt, load *INSTALL.NLM* as follows:

```
LOAD INSTALL
```

[illegible]

- LOAD CPQDA386

- LOAD C:\CLIB.NLM

NOTE: *STREAMS.NLM* loads automatically when you load *CLIB.NLM*.

- LOAD A:\DRV_ARRAY\CPQDAOPT.NLM

The CPQDAOPT - Hot Fix Configuration screen is displayed.

- through 11.

Installing *CPQDAOPT.NLM* for NetWare 3.1x

When installing *CPQDAOPT.NLM* for NetWare 3.1x with *CLIB.NLM* dated prior to 11/11/1992 (*CLIB.NLM* v3.11c), you must also load *CPQCPAT.NLM* before you load *CPQDAOPT.NLM*. If you load *CPQCPAT.NLM* on a server that does not require it, the following message is displayed:

```
Symbol already defined: Import Symbol
Load file defines a public variable that has already been define
Module CPQCPAT.NLM NOT loaded.
```

To install *CPQDAOPT.NLM* for NetWare 3.1x, perform the following:

1. After configuring your server hardware with the Compaq System Configuration Utility, create a DOS partition on the server hard drive, then copy the following files from NetWare Operating System diskettes 1, 2 and 3 to the partition:
 - *SERVER.EXE*
 - *INSTALL.NLM*
 - *VREPAIR.NLM*
 - *CLIB.NLM*
 - *MONITOR.NLM*
 - *STREAMS.NLM*
2. Start NetWare by entering the following from the DOS prompt:


```
SERVER
```
3. From the NetWare prompt, load *INSTALL.NLM*.


```
LOAD INSTALL
```
4. Verify that *CPQDA386.DSK* is loaded. If not, press the **ALT+ESC** keys to toggle to the NetWare prompt, then load *CPQDA386.DSK* as follows:


```
LOAD CPQDA386
```

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5. From the NetWare prompt, load *CPQCPAT.NLM* from the NPFC diskette as follows (only if using *CLIB.NLM* v3.11c or earlier):

LOAD A:\DRV_ARRAY\CPQCPAT.NLM

6. From the NetWare prompt on the System Console screen, load *CPQDAOPT.NLM* from the NPFC diskette to display the CPQDAOPT - Hot Fix Configuration screen.

LOAD A:\DRV_ARRAY\CPQDAOPT.NLM

7. *CPQDAOPT.NLM* analyzes the server configuration and displays all registered hard disk devices. Use the arrow keys to select the device to be optimized, then press the **ENTER** key.
8. *CPQDAOPT.NLM* analyzes the selected device and determines whether optimization is needed. If optimization is needed, it provides a recommendation. Record this recommendation and use it when creating NetWare partitions.
9. In some cases, adjusting the size of the Hot Fix Redirection Area alone cannot fully align the NetWare partition on the stripe boundary. *CPQDAOPT.NLM* might recommend creating a DOS partition on the device. If this happens, exit from NetWare, use the FDISK Utility to create the smallest allowable DOS partition, then repeat steps 2 through 8.

You can run *CPQDAOPT.NLM* to check data alignment of existing devices. *CPQDAOPT.NLM* might recommend changes that require you to delete volumes on the hard drive. To make the recommended changes on an existing volume, perform the following:

1. Perform a complete backup of the volumes on that partition.



CAUTION: The following procedure requires you to delete existing NetWare partitions. When you delete a partition, all data on that partition is lost. Always perform a complete backup before performing this procedure.

2. Load *INSTALL.NLM* by entering the following:

LOAD INSTALL

3. Dismount the volumes on the partition.
4. Delete the partition.

5. Recreate the partition and change the size of the Hot Fix Redirection Area in the Disk Options screen, based on the recommendations provided by *CPQDAOPT.NLM*.
6. Mount the volumes.
7. Restore the data from the backup.

Fast-SCSI-2 Optimization

How do I optimize the performance of my Fast-SCSI-2 subsystem for NetWare?

Use the information in the following sections to optimize disk I/O performance of the Fast-SCSI-2 subsystem.

- Volume block size and cache buffer size
- Multiple hard drives
- Read-after-write verification

Volume Block Size and Cache Buffer Size

NetWare 4.x uses a default volume block size of 64 kilobytes with block suballocation enabled. This setting will yield optimum performance in a NetWare 4 environment. However, when configuring Compaq servers to run NetWare 3.1x, setting the volume block size is one of the few exceptions where default settings provide adequate performance.

The NetWare 3.1x default volume block size is 4 kilobytes, but you can change the volume block size using *INSTALL.NLM*. When configuring the Fast-SCSI-2 subsystem, increasing the volume block size to 8 kilobytes can substantially increase disk I/O performance.

As you increase the volume block size, however, you increase the potential for wasted disk space if your environment primarily consists of files that are smaller than the volume block size. For example, if you set the volume block size to 8 kilobytes, a 4 kilobyte file uses only half of the volume block, wasting the remaining space.

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To help you judge whether or not to increase the volume block size, note the size of the files that your server volumes include. Typical productivity software stores files that generally exceed 8 Kilobytes. Use an 8 Kilobyte volume block size as a starting point. This gives you a higher level of performance without wasting disk space when running today's common applications.



CAUTION: You set the volume block size when you create each volume. Changing it can result in loss of all data in that volume. Before changing the volume block size, perform a complete backup of the volume.

After you define the volume block size, set the cache buffer size using the NetWare 3.1x SET parameter SET CACHE BUFFER SIZE to be equal to or less than the volume block size. Matching the volume block size and the cache buffer size is optimal. For example, if you select an 8 Kilobyte volume block size, set the cache buffer size to 8192 (8 kilobytes). If you set the volume block size to 8 kilobytes and the cache buffer size to 4096 (4 kilobytes), each I/O request requires two cache operations.



IMPORTANT: If the cache buffer size is larger than the volume block size, NetWare cannot mount the volume.

Use Table 3-2 to set the volume block size and the cache buffer size.

Table 3-2
Recommended Volume Block and Cache Buffer Sizes
for Fast-SCSI-2 Optimization

Volume Block Size (KBytes)	Cache Buffer Size
4	4096(Provides best use of storage)
*8	*8192(Provides best balance between performance and storage in most NetWare 3.1x environments)
16	16384(Provides best performance)
32	16384(Provides best performance)
64	16384(Provides best performance)

* Recommended size.

Include the SET CACHE BUFFER SIZE parameter in the *STARTUP.NCF* file as follows, so it loads automatically when the server initializes:

SET CACHE BUFFER SIZE = 8192

! **IMPORTANT:** If you configure multiple volumes with different volume block sizes, set the cache buffer size to a value *no larger than the smallest* volume block size. If the cache buffer size is larger than the volume block size, NetWare 3.1x cannot mount the volume.

Multiple Hard Drives

You can increase your server performance by configuring multiple hard drives to obtain the same amount of disk space. Compaq integration testing, using a server with an 8 kilobyte volume block size, 8 kilobyte cache buffer size, and a single NetWare volume with multiple drives, indicated that adding hard drives to the server increased the throughput performance. The most dramatic increase occurred when the second hard drive was added to the server, with additional drives affecting the performance less dramatically.

Configuring multiple hard drives, however, to improve server performance and acquire the same amount of disk space, limits the total internal disk capacity. For example, if you are planning a server (with a minimum of 1 gigabyte of hard disk space) to achieve better performance, you can add two 550 megabyte hard drives rather than a single 1050 megabyte hard drive. Using seven 550 megabyte hard drives (the maximum number of hard drives supported in the Compaq ProSignia) provides only 3.85 gigabytes of available internal disk space. You can obtain approximately the same amount of disk space (4.2 gigabytes) by configuring four 1050 megabyte hard drives, with available hard drive bays for future hard disk expansion. You must consider the trade-off between throughput performance and total internal disk capacity.

Read-After-Write Verification

In the Fast-SCSI-2 subsystem, read-after-write verification is supported at the hardware level only. The Compaq Fast-SCSI-2 device driver disregards the NetWare SET ENABLE DISK READ AFTER WRITE VERIFY parameter in favor of performing this task at the hard drive subsystem level.

! **IMPORTANT:** Read-after-write verification, whether it is hardware-based or software-based, is independent of the Hot Fix Redirection feature of NetWare. If read-after-write verification is disabled, the NetWare Hot Fix feature remains enabled.

The performance impact of read-after-write verification is significant. The default setting for read-after-write verification is *disabled*. Enabling read-after-write verification yields about a 50 percent decrease in throughput. Leaving it disabled is recommended for the following reasons:

- Built-in Fast-SCSI-2 intelligence
- Existing NetWare Hot Fix Redirection feature

Most available hard drive subsystems, including Compaq Fast-SCSI-2 subsystems and Compaq drive array subsystems, have "built-in" intelligence to determine if a write operation completes successfully. If the operation does not complete successfully, the device driver and NetWare flag the sector on the disk as faulty and remap the sector to an available sector in the Hot Fix Redirection Area. Since these hard drive subsystems include this "built-in" intelligence and since NetWare provides the Hot Fix Redirection feature, the read-after-write verification process becomes unnecessary.

To support NetWare compatibility, the Fast-SCSI-2 subsystem includes hardware read-after-write verification capability. You can enable hardware read-after-write verification by using one of two methods:

- Use the `-V` parameter when you load the *CPQSDISK.DSK*
- Use *MONITOR.NLM*

NOTE: The text file *SCSI.RDM* on the *NetWare Programs from Compaq* diskette provides information for enabling hardware read-after-write verification.

! **IMPORTANT:** Both of these methods enable hardware read-after-write verification via the hard disk device driver. They do *not* enable the NetWare SET ENABLE DISK READ AFTER WRITE VERIFY parameter.

Third-Party SCSI Hard Drives and Controllers

Can I configure third-party SCSI hard drives and/or third-party SCSI controllers in Compaq servers?

Compaq products are based on open systems architecture, so most industry-standard third-party options can be configured with Compaq products. Compaq engineers test a variety of the most popular third-party options for compatibility with Compaq products; however, it is impossible for Compaq engineers to test every available third-party option.

When you use third-party SCSI hard drives or controllers, use all third-party products, rather than a mix of Compaq hard drives/controllers and third-party hard drives/controllers, to reduce the configuration confusion. To further reduce the confusion, use third-party hard drives and controllers from the same manufacturer. If you have difficulties configuring your SCSI hard drive subsystem, you can call the hard drive subsystem vendor to resolve the problem. If the problem cannot be resolved by the hard drive subsystem vendor, you can call your Authorized Compaq Service Provider for assistance.

Since Compaq offers a wide variety of products that can support many networking environments, it is highly recommended that you use Compaq hard drives and controllers for Compaq servers. Compaq servers purchased after December 1, 1992 come standard with a three-year on-site limited warranty. Should your server experience a hardware failure, Compaq can call an Authorized Compaq Service Provider to dispatch a representative to service your system on site.

All Compaq components are thoroughly tested, and Compaq hard disk device drivers are written for optimum system performance. Because these components are thoroughly tested and guaranteed, Compaq Technical Support Engineers can better support configurations that include these components. If you have difficulties with your Compaq hard drive subsystem or any Compaq product, one of the following contacts can help you resolve the problem:

- Authorized Compaq Reseller
- Authorized Compaq Service Provider
- Compaq Technical Support Engineer

Support for Third-Party Controllers

Do Compaq servers support third-party controllers? How do you configure them with the Compaq System Configuration Utility?

Compaq EISA-based servers support both 8 and 16 bit ISA and 32 bit EISA controllers; however, for best performance, use 32 bit EISA bus-master controllers in your Compaq EISA-based server.

To configure controllers in a Compaq server, perform the following steps:

1. Install all controllers in the server.
 - a. Install 32 bit EISA bus-master controllers in 32 bit EISA slots.
 - b. Install hard drive controllers in the closest available slot to the hard drives to ensure the cables reach the controller.
 - c. Ensure all hard drives are set with a unique SCSI ID for servers with Fast-SCSI-2 subsystems, preferably with the SCSI ID matching the drive bay number for easy server management.
2. Boot the server with the *Compaq System Configuration* diskette in the diskette drive to execute the Compaq System Configuration Utility.
3. Select *NetWare* from the Primary Operating System menu.

- d. Highlight the newly added controller from the View or Edit Details screen, press the **F6** key for Edit Resources.
 - e. Select the appropriate resources, then press the **ESCAPE** key.
 - f. Press the **F7** key from the View or Edit Details screen for Advanced Configuration.
 - g. Select *Lock/Unlock Boards* to lock the definition to ensure that other controllers do not use these dedicated resources.
7. Return to the Steps in Configuring Your Computer menu, then select Step 5, *Save Changes and Exit*.

The System Configuration Utility checks for conflicts among the expansion boards in the server. If there are conflicts, turn off the server, remove the conflicting boards and change the switch settings to eliminate the conflicts. Replace the boards in the server and restart the server.

Drive Failure Notification

If I have a hard drive failure in my Compaq server, how can I tell which internal hard drive has failed?

Since hard drive failures can be catastrophic in some environments, Compaq servers include a number of methods for notifying you immediately of a failed hard drive.

Each Compaq server provides a hardware method (visual, audible, or both) of drive failure notification either from the system board or the hard drive controller. NetWare can also warn you of a failed hard drive by providing a warning message at the network server console. Furthermore, server management tools like Compaq Insight Manager and Server Manager/R provide drive performance degradation and/or drive failure notification. Table 3-4 lists the different methods of drive failure notification and the component responsible for the notification.

Table 3-4
Methods of Drive Failure Notification

Component	Notification Method
Compaq ProLiant Family	LEDs on front panel of the unit.
Compaq ProSignia Family	Error message at POST.
Compaq Systempro/XL	LEDs on front panel of the unit.
SMART Array Controller	Error message at POST. LEDs on the controller.
Integrated Fast-SCSI-2 and Fast-SCSI-2 Controller Board	Error message at POST.
Intelligent Array Expansion System	Alarm that beeps until Alarm Mute button is pushed. Amber LEDs on Activity Panel of the unit.
IDA-2 Controller	Alarm that beeps until Alarm Mute button is pushed or until <i>CPQMUTE.NLM</i> is loaded. LEDs on the back panel of the controller.
IDA Controller	Alarm that beeps until <i>CPQMUTE.NLM</i> is loaded. LED on the back panel of the controller.
NetWare 3.1x and NetWare 4.0	Warning message at server console.
Compaq Insight Manager	Red band around the Disk Storage button in the Main System view, an alert at the management PC, and an Alert Log entry.
Server Manager/R	Physical Disk icon in the Server Manager/R Facility (SMF) software. Out-of-band alert via telephone or pager.

For all Compaq servers, the Power-On Self-Test (POST) detects the failed drive at server startup and notifies you by one of the following methods:

- POST displays a message similar to the following:

1787 - Slot x Drive Array Operating in Interim Recovery Mode

Physical drive replacement needed: Drive 2

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- POST displays a map indicating which drive has failed. For example, if drives 2 and 8 have failed in the Compaq Systempro/XL, POST displays a map similar to the following:

1	XX	5	6
3	4	7	XX

Identifying a Failed Drive

The Compaq ProLiant has three LEDs on the front panel that identify power, aggregate drive activity, and service required. Three LEDs on each drive tray indicate drive status, activity, and failure. Figure 3-1 illustrates the location of drive tray LEDs.

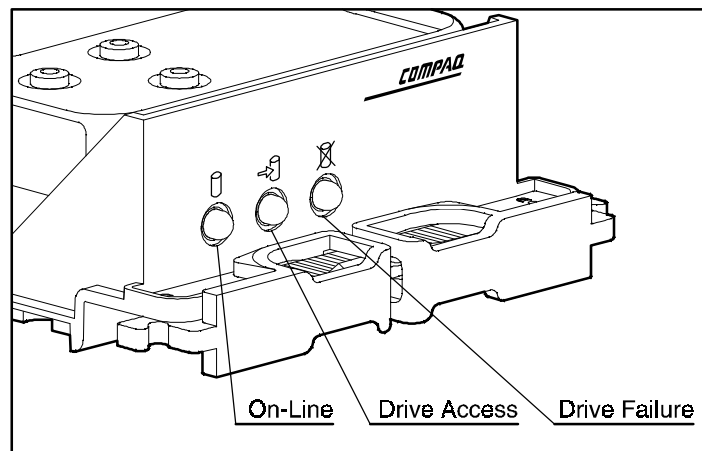


Figure 3-1. Drive Tray LEDs in the Compaq ProLiant

The Compaq SMART SCSI Array Controller provides two sets of LEDs mounted on the controller board. Figure 3-2 illustrates the location and identification of the 12 LEDs on the SMART Array Controller.

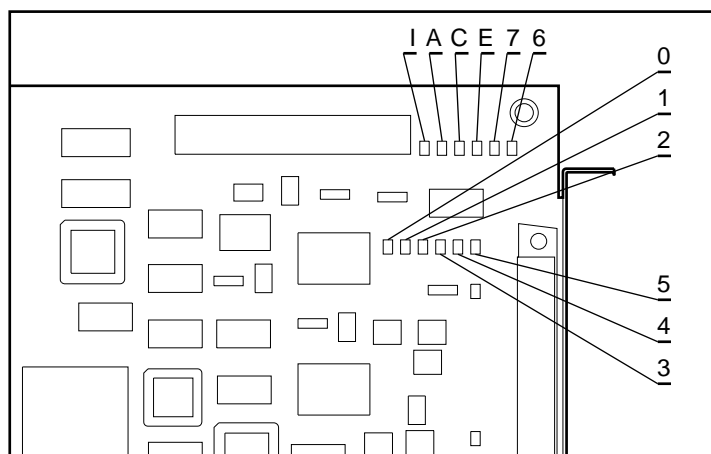


Figure 3-2. SMART Array Controller LEDs

The LEDs on the SMART Array Controller provide multiple functions. During Power-On Self-Test (POST), LEDs 0 through 7 indicate successful completion of POST function tests, and LEDs I, A, C, and E are not used. During normal operation, the 12 LEDs indicate hardware activity and possible hardware failure.

LEDs 0 through 7, during normal operation, indicate drive activity. For LEDs 0 through 6, the SCSI ID matches the LED. For example, activity of a hard drive with SCSI ID=5 illuminates LED 5. LED 7 indicates drive activity for SMART Array Controller Port 2. If any external hard drive (for example, a hard drive in a Compaq ProLiant connected to Port 2) fails, LED 7 illuminates. Table 3-5 defines LED functions.

Table 3-5
SMART Array Controller LEDs

LED	Function	Description
0 through 7 (green)	Drive Activity	Flashing indicates activity on internal hard drives or on Compaq ProLiant connected to Port 2. SCSI ID matches drive ID.
I (amber)	Controller Operation	Flashing indicates that the controller is operating in "normal" mode. Solid illumination may indicate a failed controller.
A (amber)	Controller Activity	Flashing indicates that the controller is active and processing I/O requests.
C (amber)	Cache Activity/ Cache Error	Flashing indicates posted-write cache activity. Solid illumination indicates possible cache error.
E (amber)	Drive Error	Solid illumination indicates external drive failure (connected to Port 2).

The Compaq Systempro/XL includes a set of eight LEDs (two rows of four) on the front panel that are arranged in the same configuration as the hard drives in the unit. They indicate drive activity and failure. Green LEDs indicate active drives. Amber LEDs indicate failed drives (Figure 3-3).

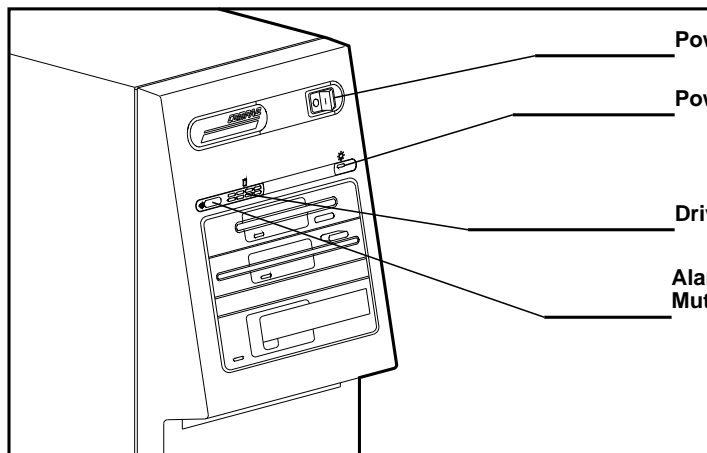


Figure 3-3. Compaq Systempro/XL Front Panel LEDs

The IDA-2 Controller and 32 Bit IDA Controller provide an LED on the back panel of the controller that indicates drive failure. When a hard drive fails, this LED blinks a number of times to identify the failed drive. For example, three flashes in a sequence indicate that drive 3 has failed. If multiple drives fail, this LED alternates between a series of flashes for one failed drive and a series of flashes for the other failed drive.

Additional LEDs on the IDA-2 Controller indicate hard drive activity, controller activity, and Array Accelerator status. Figure 3-4 illustrates the location of the IDA-2 Controller LEDs.

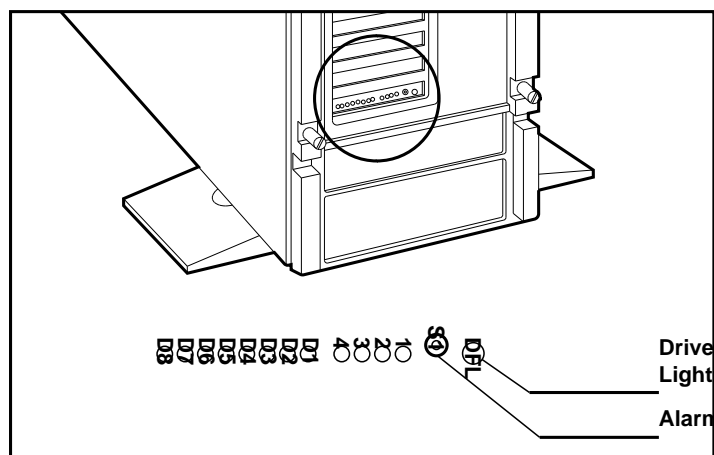


Figure 3-4.IDA-2 Controller LEDs

Hard Drive Replacement

What do I do when I suspect a hard drive failure?

A suspected hard drive failure might not always be a failed drive. Power cables or signal cables could be disconnected from the drive, broken wires can cause a disconnection, or a cable could be faulty.

When you suspect a hard drive failure, perform the following before you replace the hard drive:

1. Ensure that the power and signal cables are not at fault.

The Compaq server configuration, including the method of fault tolerance, determines the drive replacement procedure. When you configure your server with a hardware method of fault tolerance, use the following paragraphs to replace the hard drive for your Compaq server configuration. The procedure described in the following paragraphs works only for servers configured with a hardware method of fault tolerance.

! IMPORTANT: If your server is configured with a software method of fault tolerance (for example, NetWare drive mirroring) or with no fault tolerance, print and read the README file *ARRAY.RDM* carefully on the *NetWare Programs from Compaq* diskette. The process for preparing the server for hard drive replacement, replacing the hard drive, and restoring the data on the hard drive subsystem is complex and is dependent upon the type of server hard drive subsystem installed. The procedure described in this section does not work if your server is configured for no fault tolerance or for a software method of fault tolerance.

The Compaq ProLiant Family includes a range of servers in both tower and rack-mountable models as well as the Compaq ProLiant Storage System. All of these products support any of the following half-height Fast-SCSI-2 drives: 330 megabytes, 550 megabytes, 1.05 gigabytes and 2.1 gigabytes. The Compaq ProLiant Storage System provides additional external SCSI hard disk space for network server implementations that require large amounts of hard disk capacity. It supports the Compaq ProLiant, Compaq ProSignia, and Compaq Systempro Family of Servers as well as the Deskpro/M Family of Servers.

An important feature of the Compaq ProLiant is "hot pluggable drives." In a fault tolerant configuration, if a drive fails, you do not have to turn off the Compaq ProLiant server to replace the failed drive. You can replace it while the server operates. Furthermore, using hot pluggable drives, if your server requires additional hard disk space, you can add more hard drives to the Compaq ProLiant without bringing down the server or dismounting the NetWare volumes.

The hard drives include levers that secure the drives in the Compaq ProLiant drive bays without the use of drive cables or screws. When you install and lock each hard drive in a drive tray, the server automatically assigns a SCSI ID for each drive. This eliminates the need to set SCSI jumpers and prevents SCSI ID conflicts. The server determines the SCSI IDs by the location of each hard drive, beginning at the bottom of the unit (SCSI ID=0).

! **IMPORTANT:** Each hard drive on the SCSI bus must have a unique SCSI ID from 0 to 6. When you configure a hard drive inside your server with hard drives in the Compaq ProLiant Storage System on the *same* SCSI bus, you must be careful to ensure that you do not duplicate SCSI IDs. Compaq ProLiant hard drives are automatically assigned a SCSI ID based on the bay the drive is installed. Other server platforms will require manual verification of SCSI ID jumpers.

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3-30 Hard Drive Subsystems

Use the following procedure as a guideline for removing a hard drive from the Compaq ProLiant. For more detailed instructions, refer to the *Hard Drive Installation Card* that ships with the Compaq ProLiant.

1. Remove the front panel of the Compaq ProLiant unit.
2. Identify the failed drive by finding the drive tray with the drive failure light illuminated as shown in Figure 3-5.
3. Unlock the hard drive tray by releasing the two drive retaining clips, then slide the drive tray from the Compaq ProLiant.

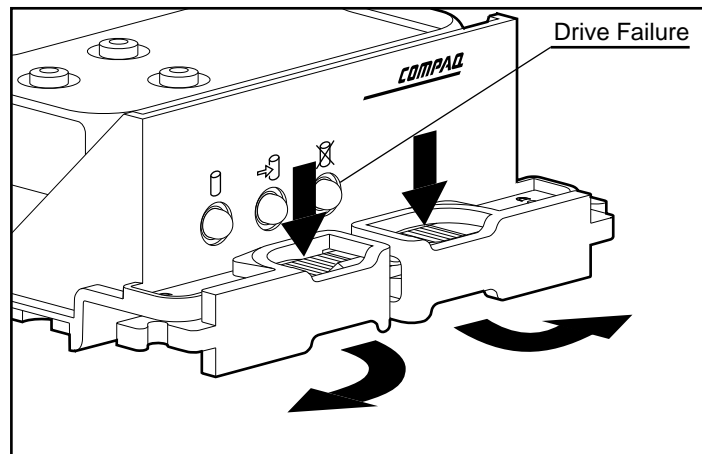


Figure 3-5.Compaq ProLiant Hard Drive

4. Remove the hard drive from the tray and detach all power and signal cables.

Use the following procedure as a guideline for installing a hard drive in the Compaq ProLiant. For more detailed instructions, refer to the *Hard Drive Installation Card* that came with the Compaq ProLiant.

1. Remove the jumper from the SCSI ID=0 position on the replacement hard drive.
 2. Attach the SCSI ID jumper block cable from the Compaq ProLiant with the dark blue wire of the cable in pin position #1. This connection allows the Compaq ProLiant to assign the SCSI ID to the hard drive automatically. The SCSI ID of your replacement hard drive will match the drive bay number.
-

3. Connect the power and signal cables.
4. Place the hard drive in the tray, then anchor the drive with short ground screws.
5. Slide the drive tray into the drive bay of the Compaq ProLiant.
6. Lock the tray into place by closing the drive retaining clips.
7. Verify the hard drive is receiving power by checking the On-Line LED (Figure 3-1).
8. Replace the front panel of the Compaq ProLiant unit.

Hard Drive Replacement for the Compaq ProSignia

The Compaq ProSignia provides a hard drive configuration that is different from the Compaq Systempro Line of servers. It supports up to seven hard drives, or three drive array pairs.

The Compaq ProSignia does not support side-by-side drive array pairs. The System Configuration Utility identifies the drive number by the cable connection of the drive to the controller, thus the drive number configuration shown in Figure 3-6.

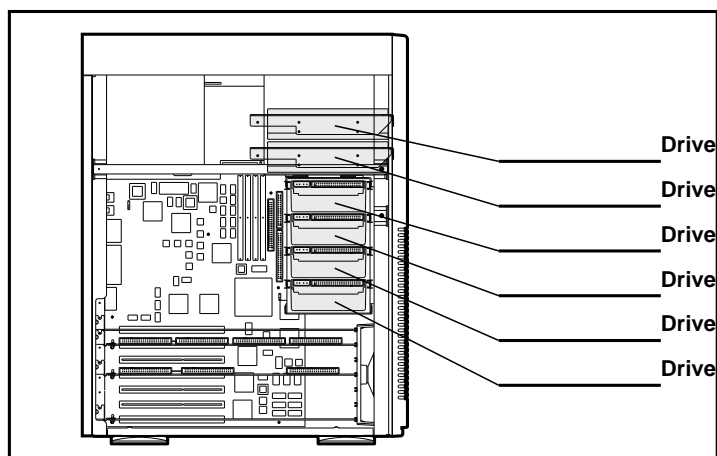


Figure 3-6. Drive Numbers for Three Drive Array Pairs in the Compaq ProSignia

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3-32 Hard Drive Subsystems

The Compaq ProSignia also supports up to seven SCSI hard drives, illustrated in Figure 3-7. For ease of maintenance, assign each SCSI ID to match the number of the physical drive bay in which the SCSI device resides.

For example, drive bay 0 should include a Fast-SCSI-2 hard drive with SCSI ID=0, and drive bay 1 should include a Fast-SCSI-2 hard drive with SCSI ID=1. When a drive failure occurs, the SCSI ID identifies it. If you do not match the SCSI ID to the drive bay number and the drive fails, you cannot identify the failed drive, unless you remove each drive from the drive bay and check the jumper settings for the SCSI ID.

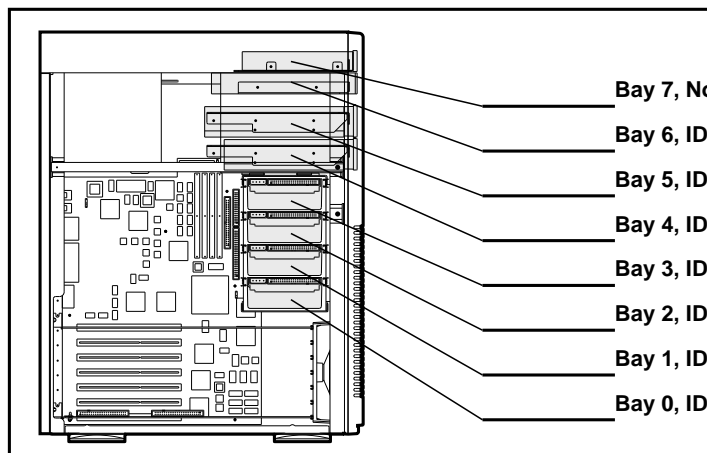


Figure 3-7. Drive Numbers for Seven Fast-SCSI-2 Hard Drives

To replace a failed hard drive in a Compaq ProSignia server, perform the following procedures:

1. Perform a complete backup if a method of fault tolerance is implemented and the server is still operating.
 2. Bring down the server by entering the following at the NetWare prompt:
DOWN
 3. Exit NetWare by entering the following at the NetWare prompt:
EXIT
 4. Turn off the server and remove the unit cover.
 5. Disconnect the power and signal cables from the drive.
-

6. Remove the drive by grasping the rail clips and pulling the drive out of the bay.

NOTE: Remember the hard drives for the Compaq ProSignia (Figure 3-7) slide into drive bays 0 through 3 individually from the side of the unit. They slide into drive bays 4, 5, and 6 from the front of the unit.

7. Use a Torx screwdriver to remove the rail clips from the failed drive and install the rail clips on the replacement drive. This only applies if the replacement drive does not already have rail clips.
8. Slide the replacement drive into the drive bay.
9. Reconnect the power and signal cables.
10. Perform data recovery procedures as discussed in the "Data Recovery" section found later in this chapter.

Hard Drive Replacement for the Compaq Systempro

The Compaq Systempro line of servers includes eight internal drive bays for a maximum of four internal drive array pairs or eight internal hard drives. You can add or replace hard drives via the side panel of the Compaq Systempro/XL and the Enhanced Compaq Systempro. You can add or replace hard drives via the front access panel or the rear access panel of the Compaq Systempro and the Compaq Systempro/LT.

When you install or replace hard drives, the Compaq System Configuration Utility identifies the drive number by the cable connection between the drive and the controller. The method of configuring the drive array pairs in the Compaq Systempro Line is using side-by-side pairs, thus the drive number configuration. Figure 3-8 illustrates this concept.

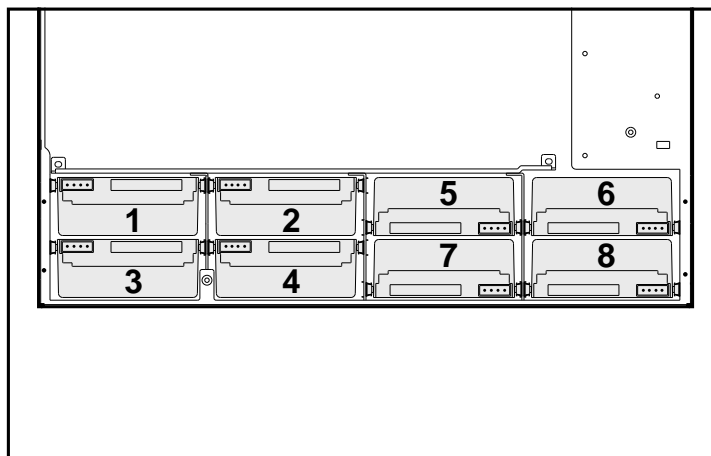


Figure 3-8. Drive Bays in the Compaq Systempro Line of Servers

Replacing the Compaq Systempro/XL or the Enhanced Compaq Systempro Hard Drives

To replace a failed hard drive in a Compaq Systempro/XL or an Enhanced Compaq Systempro, perform the following procedures:

1. Perform a complete backup if a method of fault tolerance is implemented and the server is still operating.
2. Bring down the server by entering the following at the NetWare prompt:

DOWN
3. Exit NetWare by entering the following at the NetWare prompt:

EXIT
4. Turn off the server and remove the unit cover.
5. Disconnect the power and signal cables from the drive.
6. Remove the drive by grasping the rail clips and pulling the drive out of the bay.

NOTE: Remember the hard drives for the Compaq Systempro/XL (Figure 3-9) and Enhanced Compaq Systempro slide into the drive bays individually from the side.

7. Use a Torx screwdriver to remove the rail clips from the failed drive and install the rail clips on the replacement drive. This only applies if the replacement drive does not already have rail clips.
8. Slide the replacement drive into the drive bay.
9. Reconnect the power and signal cables.
10. Perform data recovery procedures as discussed in the "Data Recovery" section found later in this chapter.

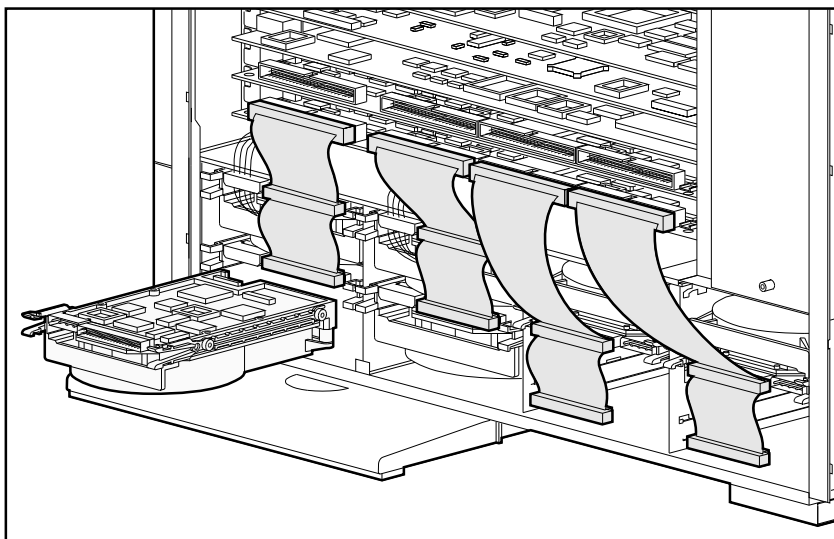


Figure 3-9.Replacing the Compaq Systempro/XL Hard Drive

Replacing the Compaq Systempro/LT or the Compaq Systempro Hard Drives

The Compaq Systempro/LT and Compaq Systempro use drive array pairs that slide in from the front or back panel. To replace a failed drive in the Compaq Systempro/LT or Compaq Systempro, perform the following procedures:

1. Disconnect the power and signal cables from both the failed drive and the other drive in the pair.

For example, if drive 5 failed, disconnect the power and signal cables from drives 5 and 6. (See Figure 3-10 for drive locations.)

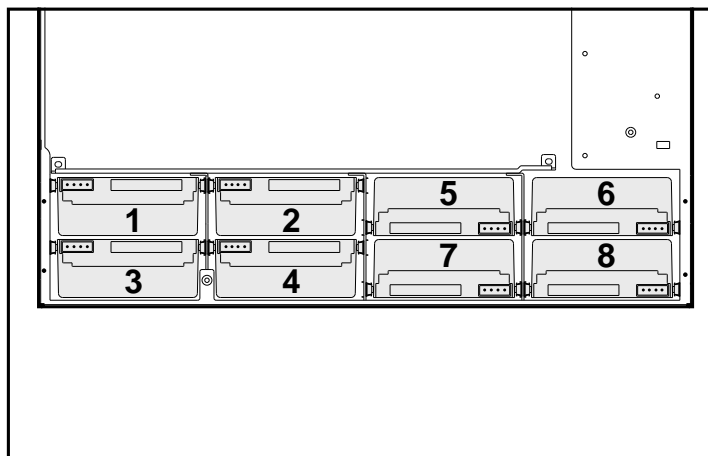


Figure 3-10. Drive Bay Numbers

2. Slide the drive array pair out of the front or rear of the unit.
3. Use a Torx screwdriver to disassemble the bracket only if one drive in the pair has failed, then reassemble the bracket using the replacement drive.
4. Slide the replacement drive array pair into the unit.
5. Reconnect the power and signal cables.
6. Perform data recovery procedures as discussed in the "Data Recovery" section found later in this chapter.

Figure 3-11 illustrates location of hard drives in the Compaq Systempro/LT.

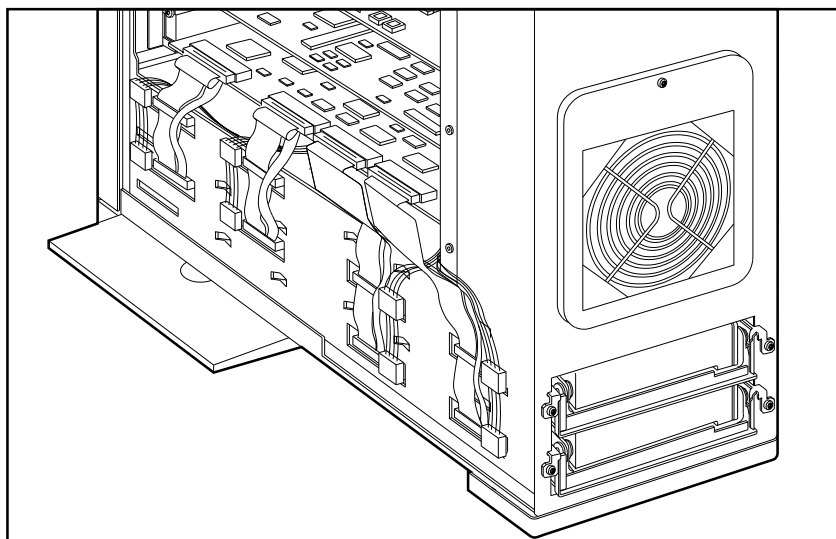


Figure 3-11. Compaq Systempro/LT Hard Drive Location

Data Recovery

How do I recover my data after I replace a failed hard drive?

Data recovery includes restoring the data on the hard drive and, if the server is configured for drive mirroring or controller duplexing, resynchronizing the mirrored partitions. The following sections provide guidelines for both of these procedures.

Restoring Data on the Hard Drive

If the server is configured for no fault tolerance, restore the data from a tape backup or archive.

If your server is configured for a *software* method of fault tolerance for NetWare 3.11, use the Compaq *SYNCPTCH.NLM* to resynchronize mirrored partitions. Refer to the following section titled "Resynchronizing Mirrored Partitions Using *SYNCPTCH.NLM*" for more information.

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3-38 Hard Drive Subsystems

If your server is configured for a hardware method of fault tolerance, perform the following procedure:

1. Replace the cover of the server unit and restart the server once you replace the hard drive. POST displays a message similar to the following:

1786 - Slot 1 Drive Array Recovery Needed
The following drive(s) need Automatic Data Recovery: Drive 2
Select "F1" to continue with recovery of data to drive(s)
Select "F2" to continue without recovery of data to drive(s)
(RESUME = "F1" OR "F2" KEY)

2. Perform one of the following when POST prompts you.

Press F1 - to recover data now
Press F2 - to recover the data in the background

If you press the **F1** key, the server rebuilds the information onto the replacement drive. The server does not continue with the boot process until all of the data is rebuilt.

If you press the **F2** key, the server continues with the boot process and rebuilds the data on the replacement drive as a background process.

! **IMPORTANT:** If the system loses power during the recovery process, the drive array controller automatically restarts the recovery process when system power is restored.

Resynchronizing Mirrored Partitions Using *SYNCPTCH.NLM*

The *SYNCPTCH.NLM* is a NetWare 3.11 NLM developed by Compaq that reduces the amount of time and CPU cycles needed to resynchronize mirrored NetWare partitions. Reduction in remirroring time and in CPU utilization is advantageous when you remirror large NetWare partitions or Compaq drive array subsystems that use the *CPQDA386.DSK* device driver. The *SYNCPTCH.NLM* and a README file (*SYNCPTCH.RDM* file) are on the *NetWare Programs from Compaq* (NPFC) diskette.

! **IMPORTANT:** *SYNCPTCH.NLM* only supports NetWare 3.11.

You can use the *SYNCPTCH.NLM* when you configure the server in the following fault tolerance configurations, regardless of the hard drive subsystem used:

- NetWare drive mirroring
- NetWare controller duplexing

For the best results, load the *SYNCPTCH.NLM* before any mirrored partition resynchronization begins. Since NetWare begins resynchronization when it detects partitions that are not synchronized, you can add the following **LOAD SYNCPTCH** statement to the *AUTOEXEC.NCF* file. This ensures that *SYNCPTCH.NLM* loads each time the server initializes.

LOAD [path] SYNCPTCH

NOTE: Where *path* represents the partition, volume, and subdirectory of the location of the NLM. If you load the NLM from the DOS partition, include the drive and subdirectory. If you load the NLM from the NetWare partition, include the volume name and path.

You can also load the *SYNCPTCH.NLM* during mirror resynchronization to improve performance. The *SYNCPTCH.NLM* can improve performance of the remainder of the resynchronization process. To do this, perform the following procedures:

1. Enter the following from the NetWare prompt to load *INSTALL.NLM*:

LOAD INSTALL

2. Select *Disk Options* at the Installation Options menu.
3. Select *Mirroring* at the Available Disk Options menu
4. Select each logical partition, and press the **ENTER** key to view mirrored partitions. When you press the **ENTER** key, the Mirrored NetWare Partitions screen should display all mirrored devices and indicate whether they are "In Sync" or "Out of Sync."
5. Identify any partitions that are "Out of Sync," and note the associated device numbers.

6. Exit *INSTALL.NLM*.
7. Enter the following from the NetWare prompt to load *MONITOR.NLM*:

LOAD MONITOR
8. Select *Disk Information* from the main menu.
9. Select the device number that corresponds to the "Out of Sync" partition and deactivate the partition to halt resynchronization of the logical partition.
10. Enter the following from the NetWare prompt to load *SYNCPTCH.NLM*:

LOAD [path] SYNCPTCH

NOTE: Where *path* represents the partition, volume, and subdirectory of the location of the NLM. If loading the NLM from the DOS partition, include the drive and subdirectory. If loading the NLM from the NetWare partition, include the volume name and path.

11. Reactivate the device from the Disk Information option of *MONITOR.NLM*.

With the *SYNCPTCH.NLM* loaded, the resynchronization process automatically continues from where the device was deactivated.

Mismatched File Allocation Tables (FAT)

When moving a drive array pair from one server to another for added disk space, NetWare indicates a FAT mismatch. Why does this happen and how can I make the FATs match?

! **IMPORTANT:** Before making any changes to your hardware configuration, always perform a complete backup.

Some instances, including brown-outs, ungraceful shutdown of the server, or moving hard drives from one system to another, can cause FAT mismatches.

You can run *VREPAIR.NLM* to make the FATs match. NetWare keeps multiple copies of the FAT. *VREPAIR.NLM* compares the FAT copies, checks them for errors, and writes the most correct copy over the other copies. *VREPAIR.NLM* includes options for pausing after each error, for logging errors in a text file, and for halting the repair process.

When moving a hard drive with data from one server to another, the Compaq System Configuration Utility, under some circumstances, does not respect the data on the hard drive, making the data unusable. For example, when the additional hard drive is configured for drive mirroring or controller duplexing, the original data on the mirrored hard drive becomes unusable. However, you can move hard drive data from one server to another if the hard drive and the data have been configured as a single logical drive and a separate volume.