COMPAQ
Integration Note

October 1998
ECG1040998

Prepared by Novell Integration

Compaq Computer Corporation

Contents

PCI Hot Plug Expand and Fibre Channel Migration in Novell NetWare Environments

Abstract: The rate at which data storage requirements are increasing demands innovative products and procedures that guarantee an investment's longevity. Compaq and Novell have brought NetWare users a revolutionary environment in which storage systems can be repaired, replaced, or augmented without interrupting client access to the server.

By combining Fibre Channel (FC) technology with PCI Hot Plug, Compaq servers increase availability and provide plenty of room for your data storage to grow. In terms of expandability, Fibre Channel allows up to 1.6 TB per FC Adapter. With PCI Hot Plug, new adapters can be added without interrupting access and allowing your network to meet storage demands without downing the server. In terms of performance, Fibre Channel provides 100 MB/s of bandwidth with up to 10km between the FC Arrays and your server.

This paper illustrates using PCI Hot Plug Expand to migrate an existing Smart-2 Array to a new Fibre Channel Array, without disruption to clients.

Help us improve our technical communication. Let us know what you think about the technical information in this document. Your feedback is valuable and will help us structure future communications. Please send your comments to: Novell.Feedback@Compaq.com

Notice

The information in this publication is subject to change without notice and is provided "AS IS" WITHOUT WARRANTY OF ANY KIND. THE ENTIRE RISK ARISING OUT OF THE USE OF THIS INFORMATION REMAINS WITH RECIPIENT. IN NO EVENT SHALL COMPAQ BE LIABLE FOR ANY DIRECT, CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER DAMAGES WHATSOEVER (INCLUDING WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION OR LOSS OF BUSINESS INFORMATION), EVEN IF COMPAQ HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

The limited warranties for Compaq products are exclusively set forth in the documentation accompanying such products. Nothing herein should be construed as constituting a further or additional warranty.

This publication does not constitute an endorsement of the product or products that were tested. The configuration or configurations tested or described may or may not be the only available solution. This test is not a determination or product quality or correctness, nor does it ensure compliance with any federal state or local requirements.

PCI Hot Plug Expand and Fibre Channel Migration in Novell NetWare Environments
Integration Note prepared by Novell Integration

First Edition (October 1998)
Document Number ECG1040998

Growing Storage at the Speed of Light

Invariably, servers outgrow their storage systems, not only in terms of size, but also performance. Compaq Fibre Channel (FC) Arrays solve performance problems by harnessing high-bandwidth Fiber Optic technology and allow for storage growth by taking advantage of PCI Hot Plug on-the-fly upgrading. This culmination of Compaq and Novell efforts provides NetWare users with high-availability networks that are more robust than ever before.

Shedding Light on Fibre Channel

Each Compaq FC Array chassis can house eight 1.6" drives or twelve 1" disks. Using 18.2-GB drives a single FC Array can scale to 145.6 GB. By adding a Fibre Channel Storage Hub, each Fibre Channel Host Adapter can support up to eleven FC Array chassis allowing you to scale to 1.6 TB per server slot. A storage capacity of 9.6 TB can be reached by installing six FC Host Adapters attached to 66 FC Arrays. For maximum performance in all RAID configurations, Fibre Channel Arrays are equipped with Compaq SMART-2 RAID accelerator technology and two independent Wide-Ultra SCSI-3 buses. These SCSI buses then feed data into the server through a high-speed Fibre Channel cable. By using Fibre Channel and SMART-2 technology, Fibre Arrays allow

- More devices – By allowing additional drives, data may be striped across more spindles. As a result, the disk transfer time is reduced. In addition, since each array uses its own independent controller – each with two SCSI buses – Fibre Channel Arrays can perform more simultaneous transfers than conventional single-channel SCSI buses.

- Greater distance – Fibre Channel systems can maintain data integrity over an amazing 10km between Fibre Channel elements. This allows server growth to conform to the space available as well as offsite data warehousing.

- Additional caching – With 16-MB, ECC-protected read cache plus 16-MB, battery-backed, ECC-protected, user-selectable read/write cache in each Fibre Channel Array, frequently used data will be available instantly without having to access the disk drives.

- Fastest data transfers – Fiber Optics provide massive bandwidth, transmitting up to 100 MB/s data at the speed of light up to 10km (6.21 miles).

Making the Connection with PCI Hot Plug

Since Fibre Channel Adapters are PCI Hot Plug compatible, you can expand your storage without interrupting user access. PCI Hot Plug allows you to remove and insert PCI adapters, such as Network Interface Controllers (NIC), storage adapters, and Fibre Channel Array Controllers, without powering-down the server. Because NetWare 4.11 and later supports PCI Hot Plug, you can not only add, but also replace PCI devices on-the fly. In NetWare environments, migrating your PCI Hot Plug compatible server to Fibre Channel Array technology enables you to add drives, drive arrays, and even increase the space available on an existing volume without interrupting client access to the data. By combining PCI Hot Plug and Fibre Channel technologies, server downtime can become a thing of the past.

This document illustrates features of Fibre Channel and PCI Hot Plug by migrating data storage from the non-Fibre Channel SCSI storage to a remote Fibre Channel Array.

This procedure is accomplished in the following simple steps:

- Bringing the new Fibre Channel Array storage array on-line.
- Replicating the data onto the new FC Array.
- Decommissioning the old array.
- Migrating the old disks into the new FC Array.
- Expanding the array to include the older drives.
- Making the additional space available to the users.

In order to complete the migration, you will use three utilities:

- Compaq Online Configuration Manager, *CPQONLIN.NLM*

  Compaq Online Configuration Manager handles all array configuration and RAID implementation.

- Novell Configuration Manager Console, *NCMCON.NLM*

  Novell Configuration Manager Console provides real-time monitoring and status indicators for the server's PCI bus.

- Novell Server Installation Utility, *INSTALL.NLM*

  The Novell Server Installation Utility allows easy, menu-driven configuration of your NetWare server. In this document, *INSTALL* is used to manage disk partitions and mirroring.

Outline of the Procedure

The migration process is relatively simple and can be divided into four main parts:

- Hardware Installation and Configuration

  Installing a new adapter.

  Configuring the RAID level and creating a logical drive on the array.

  Creating a NetWare partition on the new drive.

- Data Migration

  Mirroring the old data onto the new partition.

  Removing the old partition from the mirror.

  Deleting the old array and logical drive.

- Array Expansion

  Physically removing the old drives and moving them into the new Fibre Channel Array.

  Expanding the array to include the old physical drives.

- Addition of New Space

  Creating new a logical drive and NetWare partition on the remaining space.

  Linking the new logical drive to the existing volume.

Detailed Procedure

The steps involved in migrating a SMART-2SL disk array system to a Fibre Channel Array are straightforward and easily performed. While this paper shows the migration from a SMART-2SL, this migration is possible with any array device. The details below illustrate the procedure outlined above in depth, showing all important screens and menus. The screens that follow were taken from a server running NetWare 4.11 with NWPA drivers. With NetWare 5, some screens and steps may vary slightly. For example, INSTALL.NLM in NetWare 5 becomes NWCONFIG.NLM.

Hardware Installation and Configuration

The first step is to insert the new storage adapter, in this case, the Fibre Channel controller.

Begin by loading the Novell Configuration Manager Console (NCM), *NCMCON.NLM*.

When NCM is first launched, you will see the screen in Figure 1, indicating that power to unpopulated slots is off and no adapters are present. In order to insert any PCI Hot Plug device, you must open the lever that covers the screw-tab of the free PCI slot.

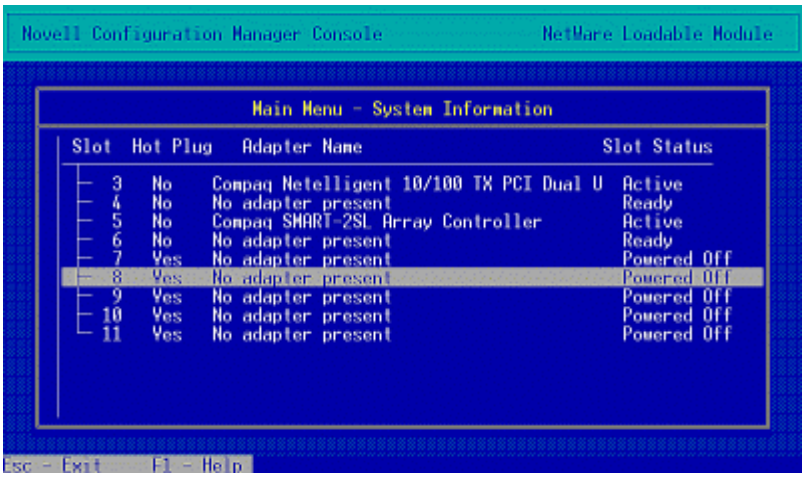

Figure 1 - Novell Configuration Manager - Main Menu

Note: In order to perform this procedure you must have a server that supports PCI Hot Plug.

If you are removing or replacing an adapter, Compaq recommends that you unload the driver and remove the power from the slot before opening the lever.

There have been two generations of Compaq servers with PCI Hot Plug technology. One of the differences in the second generation is the service request button. The service request button is located just above the slot lever that holds the PCI card in place. If you have a second-generation PCI Hot Plug server, pressing the service request button for a slot that is powered on will signal to NetWare that the driver for the device should be unloaded and the slot should be powered off for service. When power needs to be reapplied, pressing the service request button again will indicate that power can be reapplied. On the first generation servers without the service request button, *NCMCON.NLM* should be used to unload the driver and power off the slot. Highlighting an adapter and pressing **Enter** gives the option *Remove Adapter*. The *Remove Adapter* command will unload the driver and power off the slot, making it safe to remove the PCI card. Failure to follow this procedure could result in ABnormal ENDs (ABEND).

The LEDs above the adapter slot provide visual indication of the power status of the slot. As long as the green LED is illuminated, there is power to the slot and the switch lever cover should not be opened. When power is removed from that PCI slot and the green LED is no longer illuminated, it is safe to open this switch and insert any PCI Hot Plug adapters.

NCM Console will detect the opened switch and display the status, as in Figure 2.

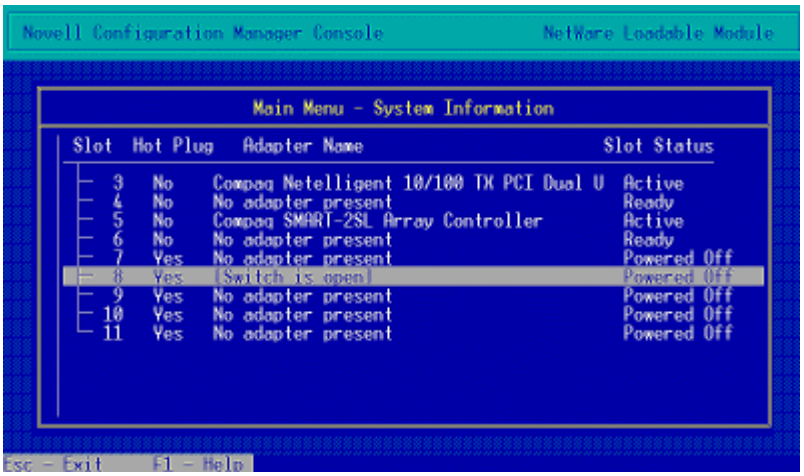

Figure 2 - Novell Configuration Manager - Switch Open

Now, insert the Fibre Channel Adapter into a PCI Hot Plug slot. Once the card is seated properly, you may close the switch.

If you did not load the NCM earlier, it will now start automatically and display Figure 3.

Figure 3 - Novell Configuration Manager – Power-on Slot

Before you apply power to the slot, please ensure that all Fibre Channel Arrays are connected properly and powered on. Refer to your specific Fibre Channel documentation for appropriate connection and installation details. See Figures 3 and 4.

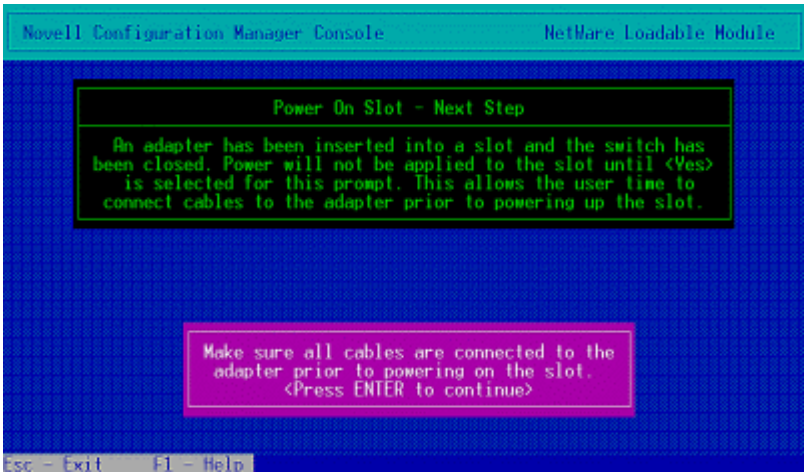

Figure 4 - Novell Configuration Manager – Connect Cables

When you have completed the previous steps, the server displays Figure 5.

The system will detect the new hardware, identify the adapter, locate the correct driver, and load the driver.

During this period of time, you will be presented with a series of rapidly flashing screens, as the system progresses through these steps. No action is required.

When the driver is installed and the new hardware is functioning, you should see the new device listed in the main menu, as in Figure 6. This shows the newly added device in PCI slot 8.

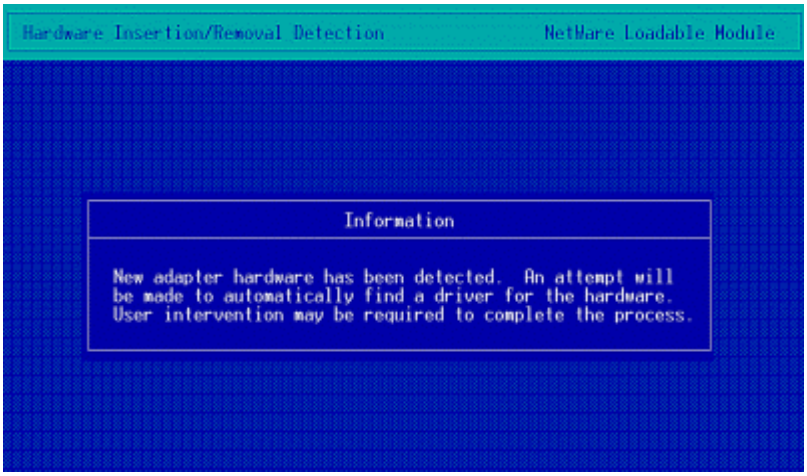

Figure 5 - Novell Configuration Manager – Hardware Detected

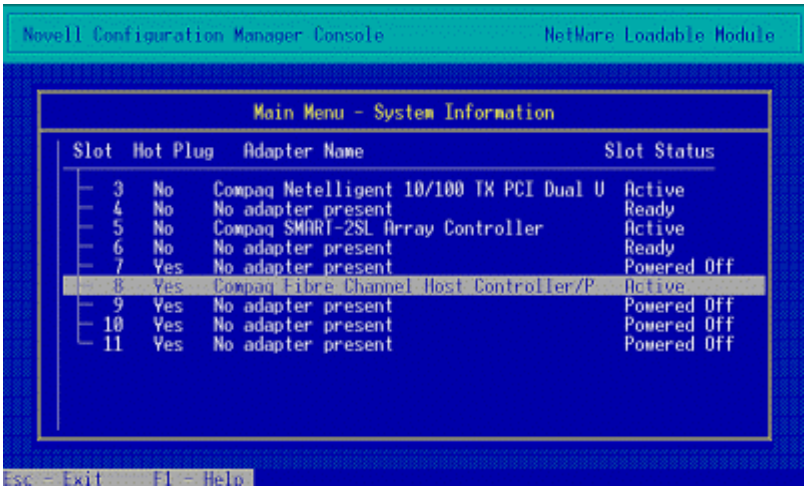

Figure 6 - Novell Configuration Manager – New Hardware Active

With the hardware physically installed and drivers loaded, you can configure the drives attached to the storage adapter into an array.

Configuration of arrays is handled by the Compaq Online Configuration Manager (*CPQONLIN.NLM*).

If you have not yet loaded CPQONLIN, do so now. If you have, press and hold **Ctrl** while pressing **Esc** to bring up the Task Manager and select *Compaq Online Configuration.*

Figure 7 shows the main menu of CPQONLIN. Highlight and select the *Array Configuration Utility*.

You will be prompted to select your controller (Figure 8) and, if applicable, the host slot on your Compaq Fibre Channel Storage Hub.

A warning that no drives have been configured on this array may also be displayed.

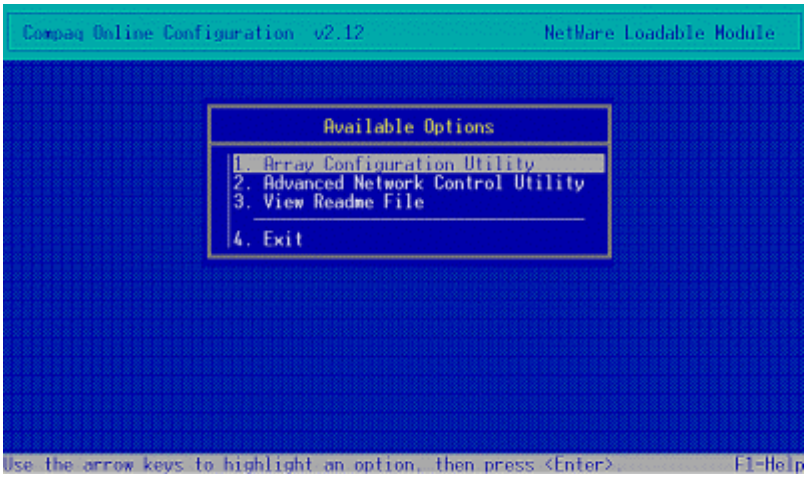

Figure 7 - Compaq Online Configuration - Main Menu

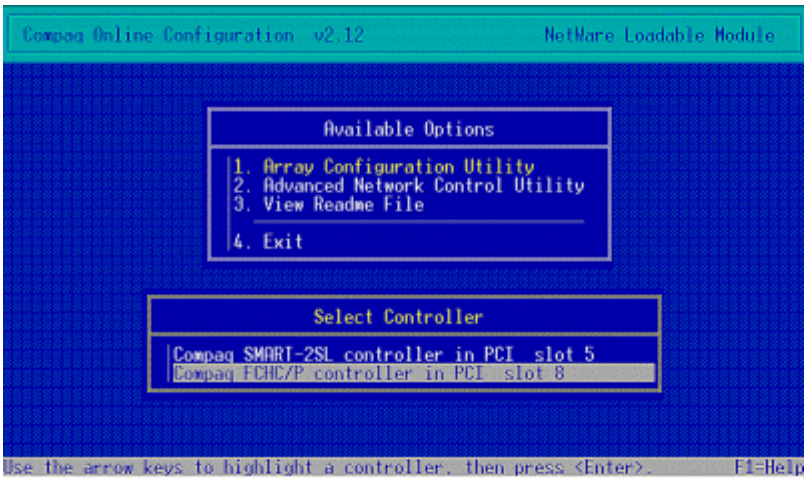

Figure 8 – Compaq Online Configuration – Select Controller

CPQONLIN then shows you a default configuration, as seen in Figure 9.

Select your desired RAID configuration. CPQONLIN creates the array and a logical drive associated with it.

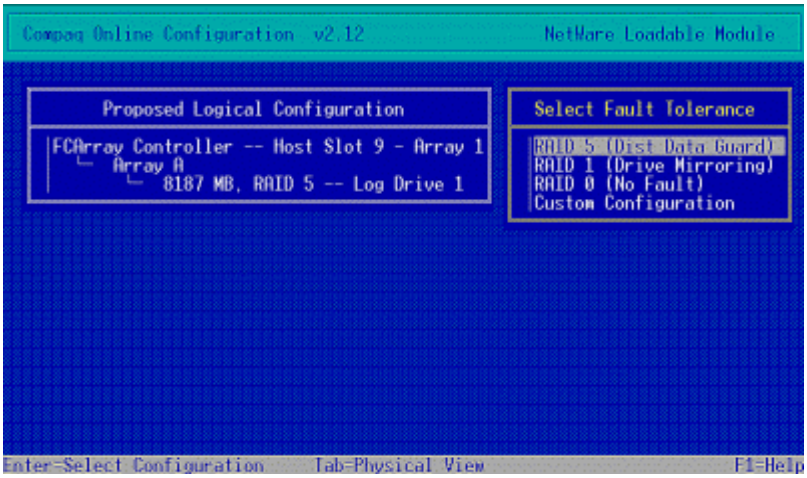

Figure 9 – Compaq Online Configuration – Proposed Configuration

Figure 10 shows the array with the attached devices set as logical drive 1, with RAID level 5.

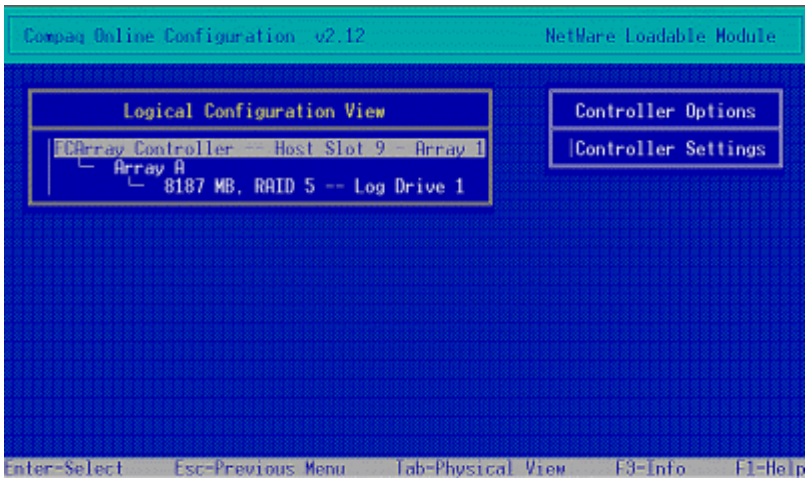

Figure 10 – Compaq Online Configuration – Logical Configuration

You have installed the hardware, created an array and a logical drive. Now, you need to prepare the new logical drive for NetWare data by making a NetWare partition.

In order to manage partitions, you must use the Novell Server Installation Utility, *INSTALL.NLM*. Once again, if you have not launched this application, do so now, otherwise, press **Ctrl**+**Esc** and select *Novell Server Installation*.

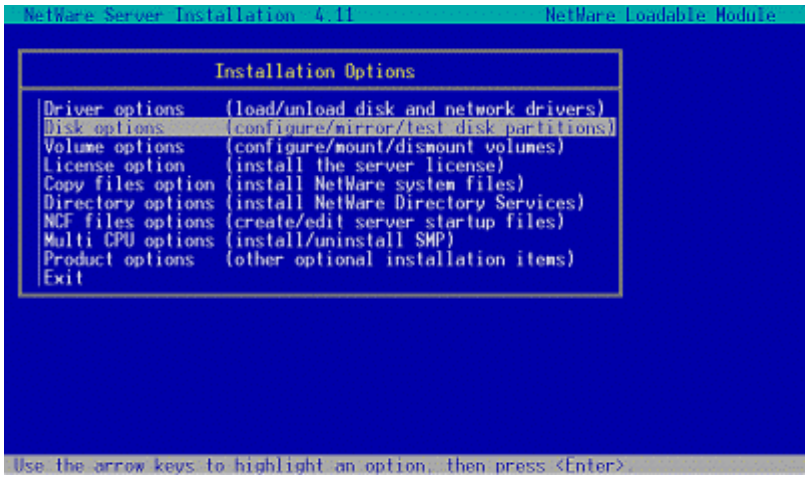

Figure 11 – NetWare Server Installation – Main Menu

Under the *Disk Options* menu, highlighted in Figure 11, you will find a *Modify disk partitions and Hot Fix* option. Selecting this option will show a list of logical drives available.

Figure 12 shows the list of drives. When you select the newly created logical drive, INSTALL will recognize the drive only as “free space.”

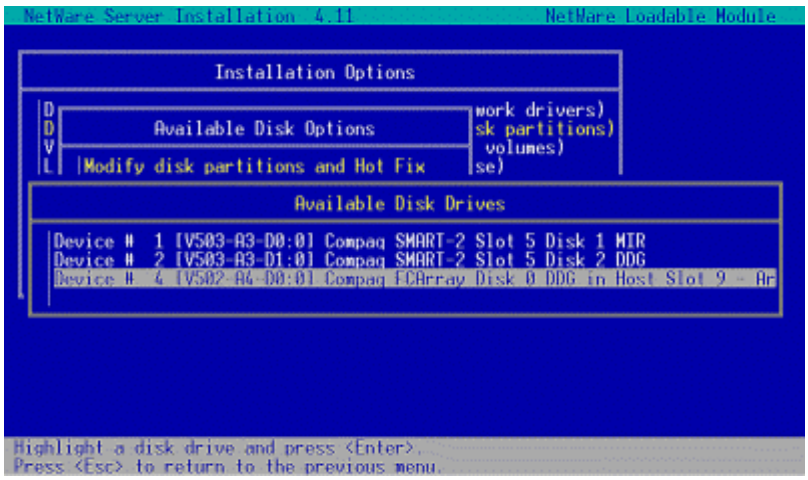

Figure 12 – NetWare Server Installation – Available Drives

As shown by Figure 13, select *Create NetWare disk partition.*

Next, you must set the amount of disk space to be used by the NetWare partition. Pressing **Esc** or **F10** will accept the proposed partition size and ask for confirmation.

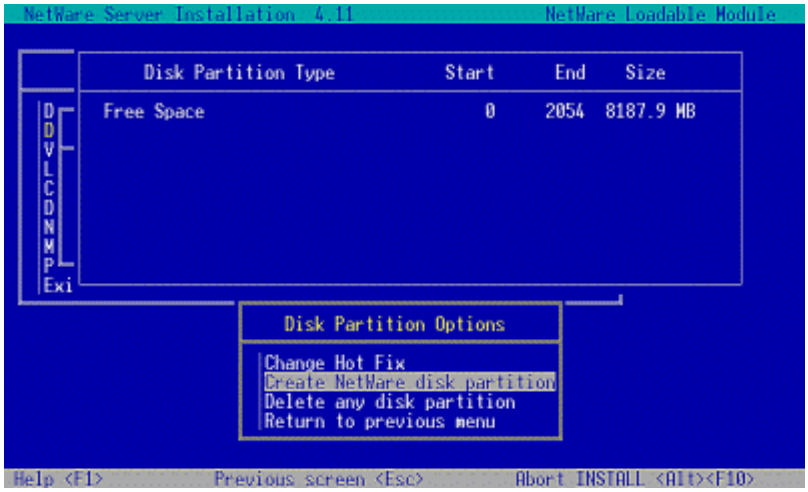

Figure 13 – NetWare Server Installation – Create a Partition

Before you go any further, let us summarize what you have done thus far and look ahead to what you are about to do.

You have:

- ✓ Installed a new storage adapter.
- ✓ Configured the RAID level and created a logical drive on the array.
- ✓ Created a NetWare partition on the new drive.

You are about to:

- □ Mirror the old data onto the new drive.
- □ Remove the old drive from the mirror.
- □ Delete the old array and logical drive.
- □ Physically remove the old drives and add them to the new array.
- □ Expand the array to include the new physical drives.
- □ Create new a logical drive and NetWare partition on the remaining space.
- □ Link the new logical drive to the existing volume.

Data Migration

With the new partition created, you need to set up mirroring onto the new drive partition from the old one.

Under the *Disk Options* menu, shown in Figure 11, select *Mirror/Unmirror disk partitions.*

Select the partition that contains the data that you wish to migrate to the new array.

With the device to be mirrored highlighted, as in Figure 14, press **Enter** to view the mirror status.

Figure 15 shows the list of partitions suitable for mirroring with the previously selected partition.

After you select the newly added partition that will receive data, the server will begin mirroring. Creating the image of the data on the new array will span a period from a few minutes to several hours depending on the size of your array and the load on the server.

When this process has finished, you will have created an exact duplicate of your server's data on the new array.

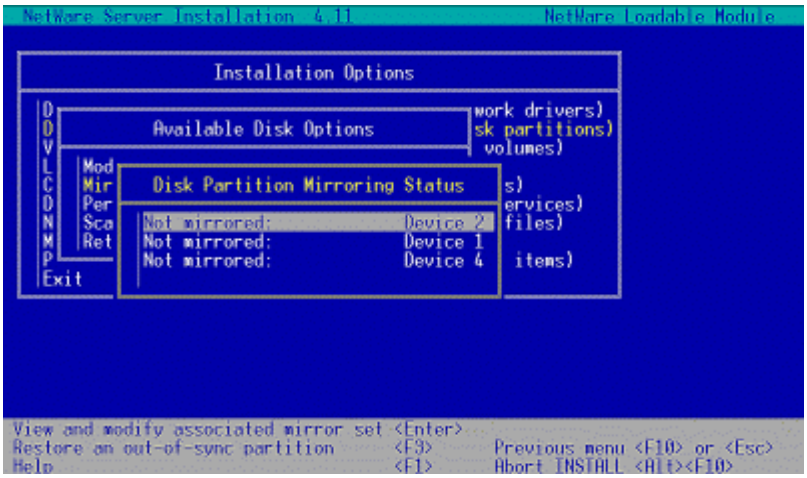

Figure 14 – NetWare Server Installation– Mirror Status

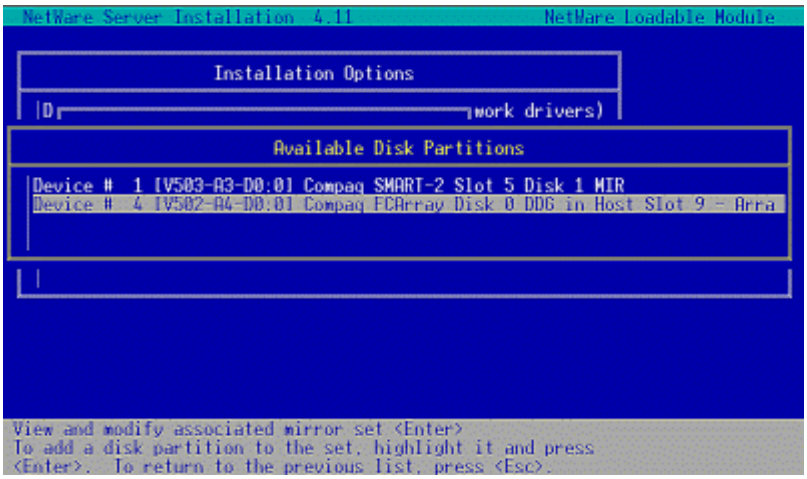

Figure 15 – NetWare Server Installation– Available Partitions

Now, in order to protect your previous investment, you would like to remove the older drives and add them to the newer Fibre Channel Array. But, before you can physically move the older drives, you must eliminate the mirror link, delete the NetWare partition that exists on the older drives, and delete the array that they comprise.

Begin by viewing the status of the mirror that you just created, as in Figure 16.

Note: Before proceeding, insure the synchronization of the data is complete.

Highlight the older partition that you previously mirrored and remove it from the mirroring by pressing **Del**.

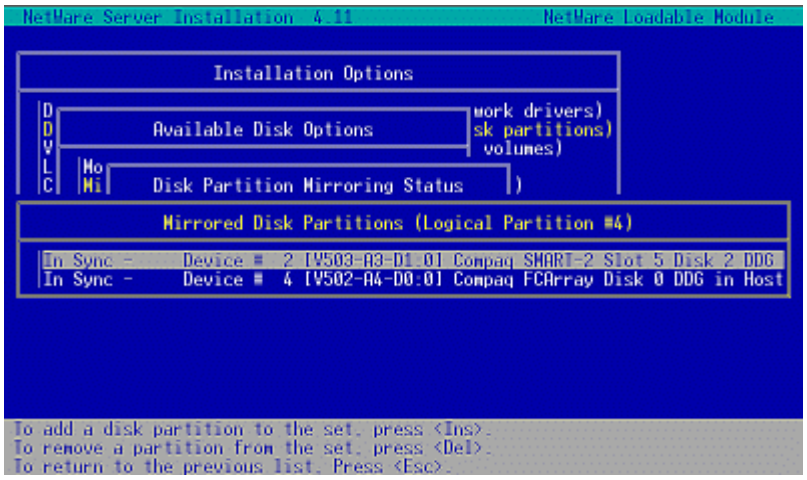

Figure 16 – NetWare Server Installation – Mirrored Partitions

Figure 17 shows warning indicating that this device contains data that may be affected by removing it from the mirror.

Immediately after the warning, you are asked if you want to salvage the volume information. Since you have made a copy of the data on this drive by mirroring it onto the array, you do not need to salvage the volume information.

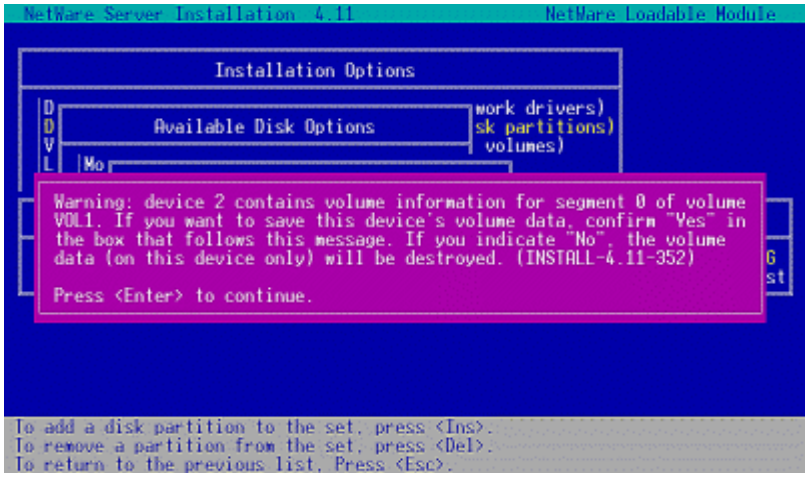

Figure 17 – NetWare Server Installation – Data Loss Warning

Now that the mirror link is broken, select *Disk Options* from the main menu of the NetWare Server Installation Utility, then select *Modify Disk Partitions and Hot Fix*. Here you should highlight the original logical drive, whose data has already been mirrored, press **Enter** to select, then choose to *Delete any disk partition.* After asking for confirmation, this will convert what was a NetWare partition into free space on a logical drive.

The final step that must be done before you can safely remove the older disks is to delete the array.

As mentioned before, all array configuration is handled within the Compaq Online Configuration Manager (*CPQONLIN.NLM*).

Therefore, use **Ctrl**+**Esc** to bring up the CPQONLIN window and select, as before, the *Array Configuration Utility*.

Also as before, you will need to select the older controller that contains the array you need to delete.

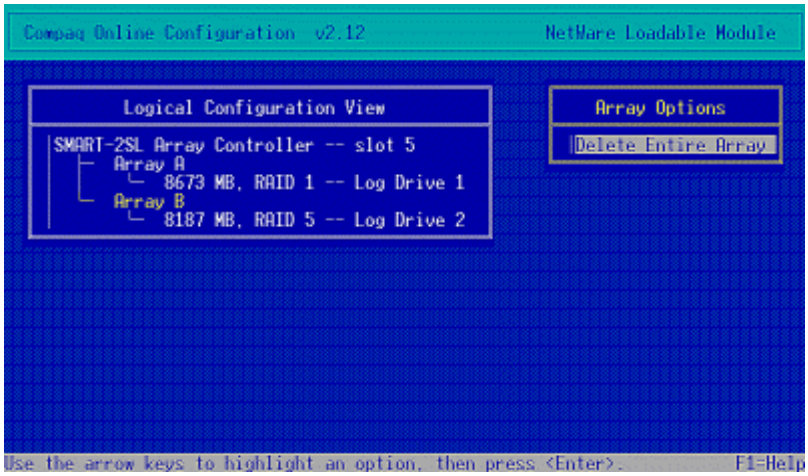

Figure 18 – Compaq Online Configuration – Deleting an Array

Figure 18 illustrates deleting an array. In CPQONLIN, highlight the array and to the right, in the Array Options box, select *Delete Entire Array* by highlighting it and pressing **Enter**. As usual you will be prompted for confirmation before the array is deleted.

At this point, it is safe to remove any hot-swappable drives and insert them into the Fibre Channel Array chassis. When all the older drives have physically been moved, you are ready to use the expand feature to distribute the data and reclaim the old drives.

For the sake of clarity, lets review the steps you have taken and what will follow.

You have:

- ✓ Installed a new adapter.
- ✓ Configured the RAID level and created a logical drive on the array.
- ✓ Created a NetWare partition on the new drive.
- ✓ Mirrored the old data onto the new partition.
- ✓ Removed the old partition from the mirror.
- ✓ Deleted the old array and logical drive.
- ✓ Physically removed the old drives and moved them into the new Fibre Channel Array.

You are about to:

- □ Expand the array to include the old physical drives.
- □ Create new a logical drive and NetWare partition on the remaining space.
- □ Link the new logical drive to the existing volume.

Array Expansion

When the older drives have been inserted into the Fibre Channel Array chassis, select once again the *Array Configuration Utility* option from the main menu of the Compaq Online Configuration program, CPQONLIN.

Select the newer FC Adapter and you should see the drives you just added to the FC Array listed as *Unassigned*, as in Figure 19.

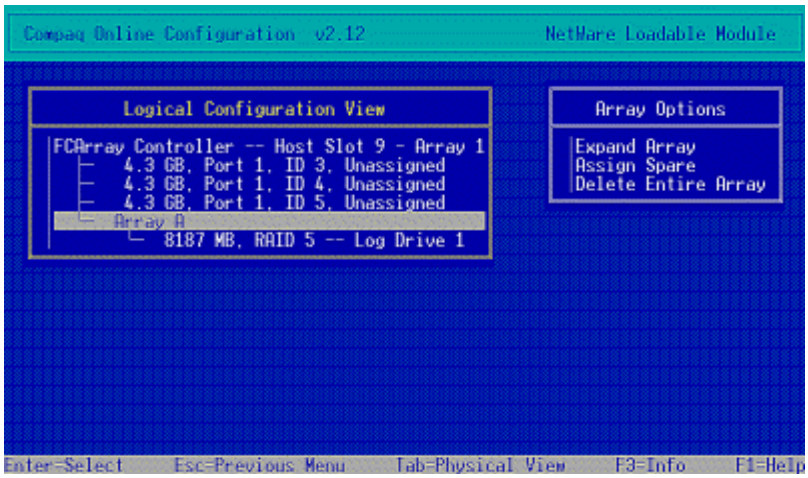

Figure 19 – Compaq Online Configuration – Logical Configuration

Highlight the existing array and press **Enter** to access the Array Options menu. Figure 20 shows the Array Options menu and the *Expand Array* option highlighted.

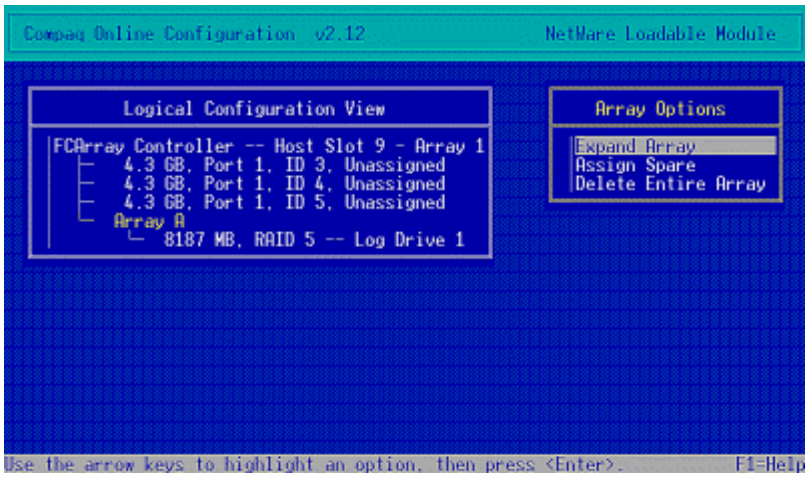

Figure 20 – Compaq Online Configuration – Expand Array

At this point, we will expand the array. If expanding your array to include your original drive would mix slower drives with newer, faster drives, you may not want to expand the array. You could perform the migration by simply moving the original drives to the Fibre Channel chassis and creating a separate array.

If you would like to expand the array to include the original drives, you should highlight *Expand Array* and press **Enter**.

When presented the menu shown in Figure 21, select *Assign Drive to Existing Array*, then highlight a drive from the list and press **Enter**.

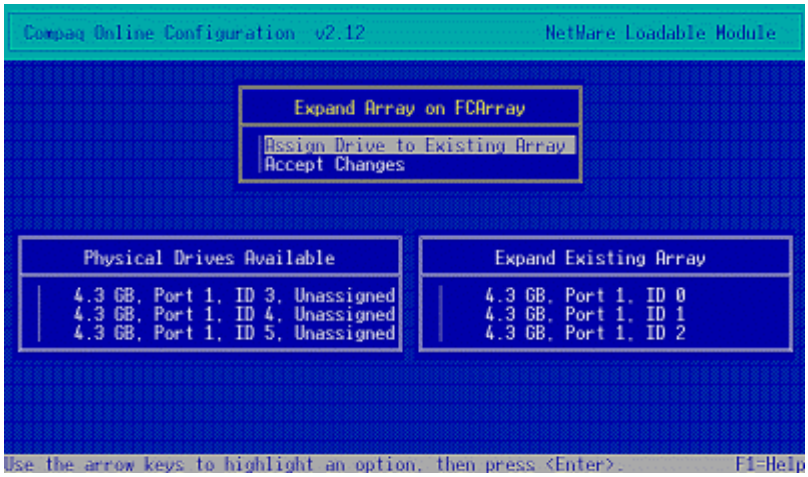

Figure 21 – Compaq Online Configuration – Add Drives to an Array

Continue this process until all drives have been added to the existing array, then accept the changes.

You should see Figure 22, and then a confirmation screen to create the new logical drive.

Upon accepting the new drive, return to the logical configuration view where a new logical drive will be listed and the array status will display *EXPANDING*. See Figure 23.

When the array is finished expanding, your data will be distributed across all of the drives in the Fibre Channel Array chassis. At this point, a part of each drive in the physical array contains some of the data from the volume that had existed on the original server.

The remaining space on each drive is not yet available to the server.

As before, when you created the new logical drive for the FC array, you must make a NetWare partition and assign the partition as a volume or add to an existing volume.

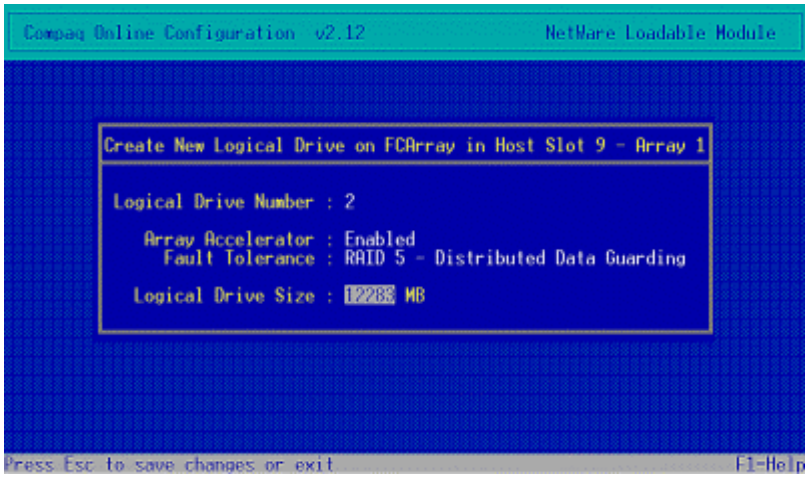

Figure 22 – Compaq Online Configuration – Create Logical Drive

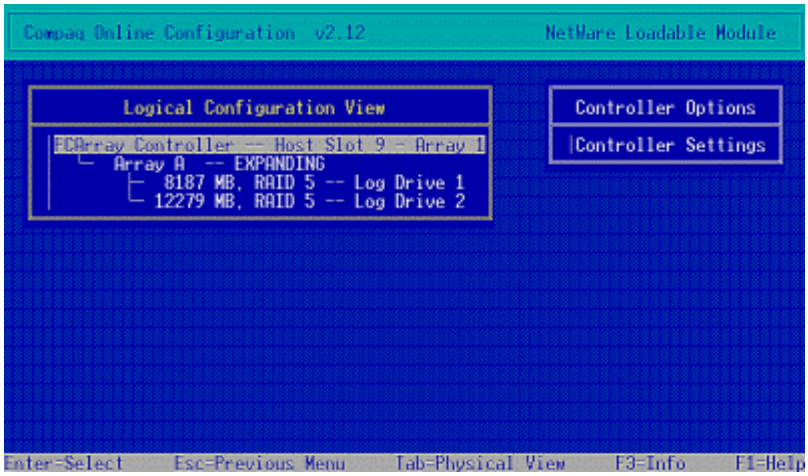

Figure 23 – Compaq Online Configuration – Expanding Array

Addition of New Space

With the new logical drive created from the expansion, return to the NetWare Server Installation Utility, *INSTALL.NLM*.

The steps here are the same as before, when you created a NetWare partition.

From the INSTALL main menu, select *Disk Options* then *Modify disk partitions and Hot Fix.*

This time, you should see another drive listed in the *Available Drives* list, as in Figure 24.

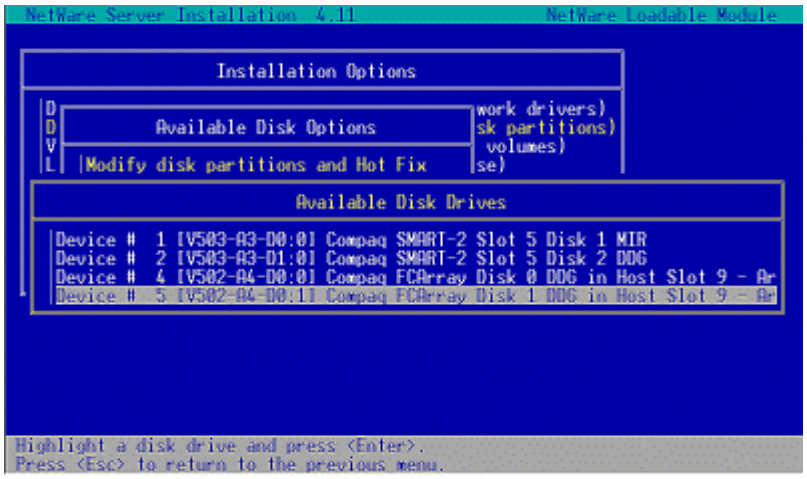

Figure 24 – NetWare Server Installation – Available Drives

Selecting the new drive should bring a warning that the drive has no partition table. Pressing **Enter** shows the confirmation that is illustrated in Figure 25.

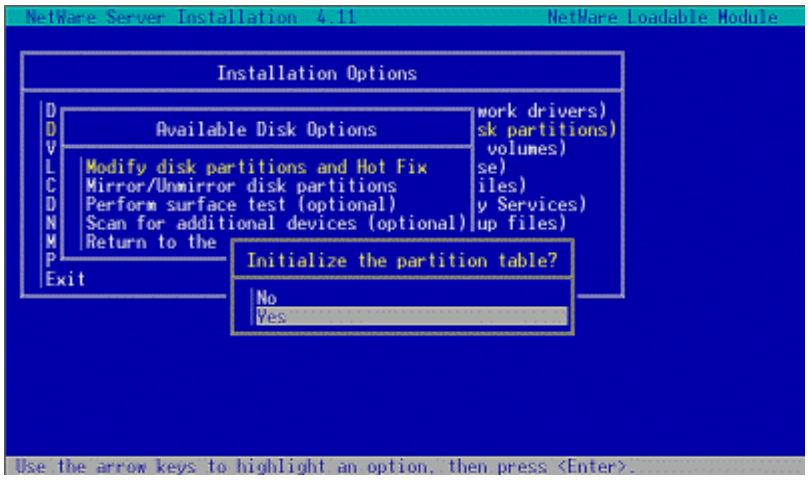

Figure 25 – NetWare Server Installation – Initialize Partition

You should choose *Yes* to initialize the partition table. Doing so will make the logical drive available as free space.

In order to make the drive space available to the system, you need to create a NetWare partition.

Select *Create a NetWare disk partition* from the *Disk partition Options* menu. Figure 26 shows the *Disk Partition Information* screen where you can set the size of the partition. If you would like to use all of the space available, press **F10** or **Esc**.

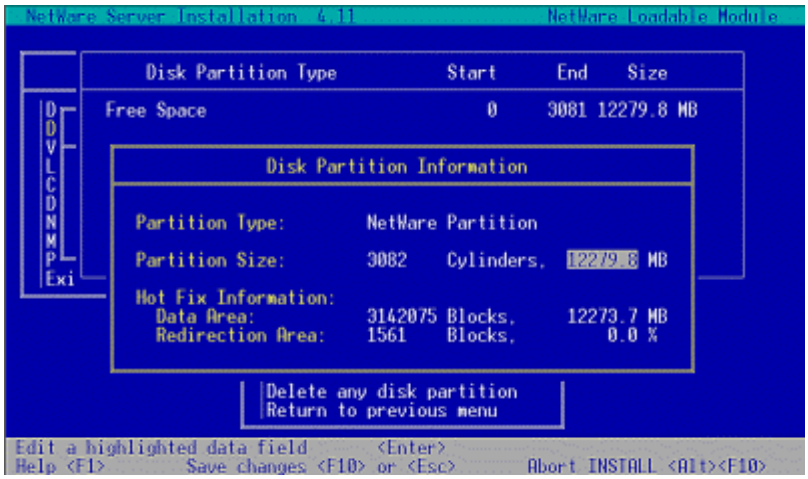

Figure 26 – NetWare Server Installation – Partition Information

After you confirm your selection, INSTALL will create the NetWare partition.

Return to the previous menu and select *Volume Options*. Figures 27 and 28 show the main menu and the *Volume Options* menus.

In the *Volume Options* menu, highlight the volume to which you would like to add the additional storage space.

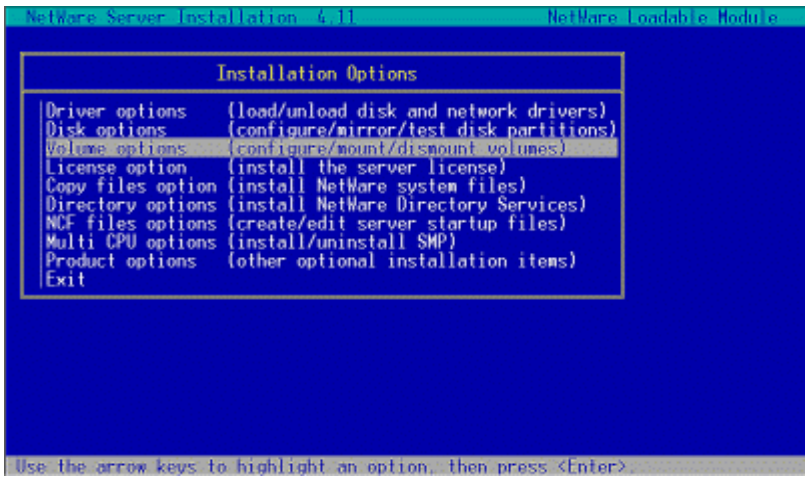

Figure 27 – NetWare Server Installation – Main Menu

As indicated by Figure 28, you should press **Ins** to display the list of available volume segments shown in Figure 29.

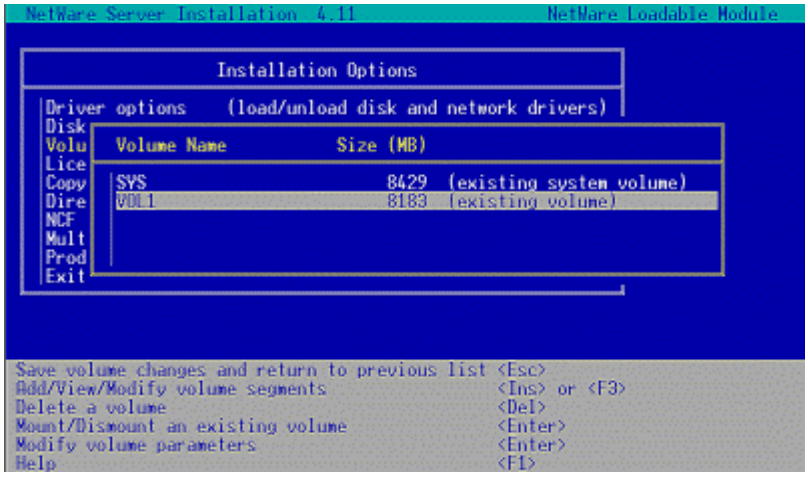

Figure 28 – NetWare Server Installation – Volume Options

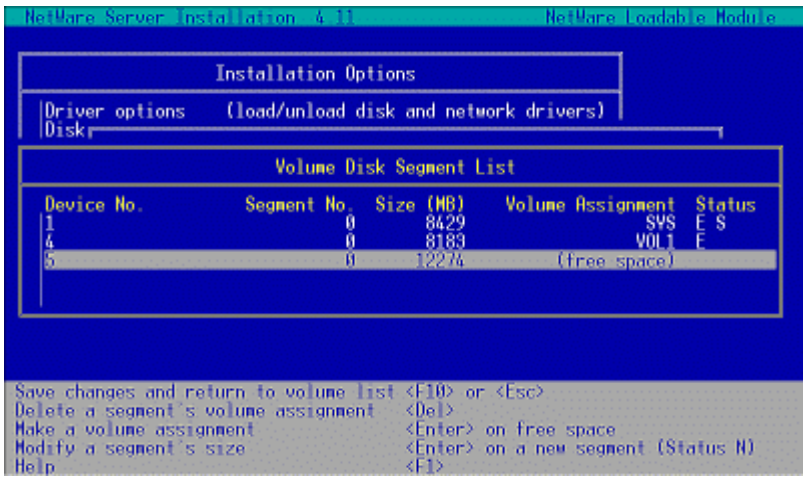

Figure 29 – NetWare Server Installation – Volume Segment List

Highlight the volume assigned as free space, press **Enter**, and from the menu that appears, shown in Figure 30, select *Make this segment part of an existing volume*.

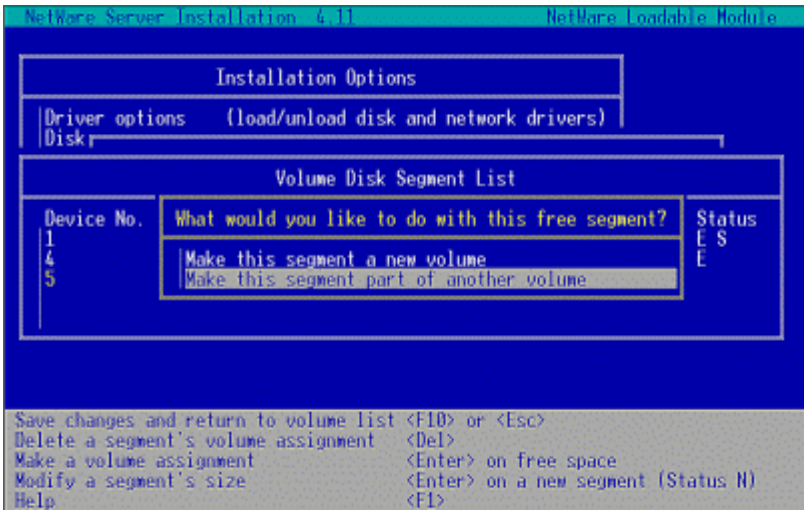

Figure 30 – NetWare Server Installation – Combining Segments

Pressing **Enter** will bring up Figure 31 that shows a list of possible partitions to which the free space can be added.

Highlight and select the volume to which you want to attach the free space. You will then be returned to list of available partitions. To leave this menu and save your changes, press **F10** or **Esc**. Once again, press **Esc** to save volume changes and return to *Available Disk Options*.

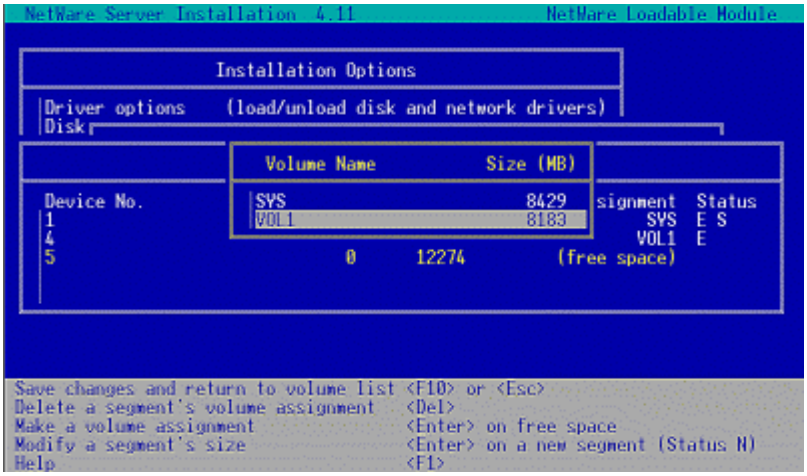

Figure 31 – NetWare Server Installation – Select Volume

After you accept the volume changes, you will be presented with one last set of options. Figure 32 shows the last options screen in the procedure. Select *Mount all volumes.*

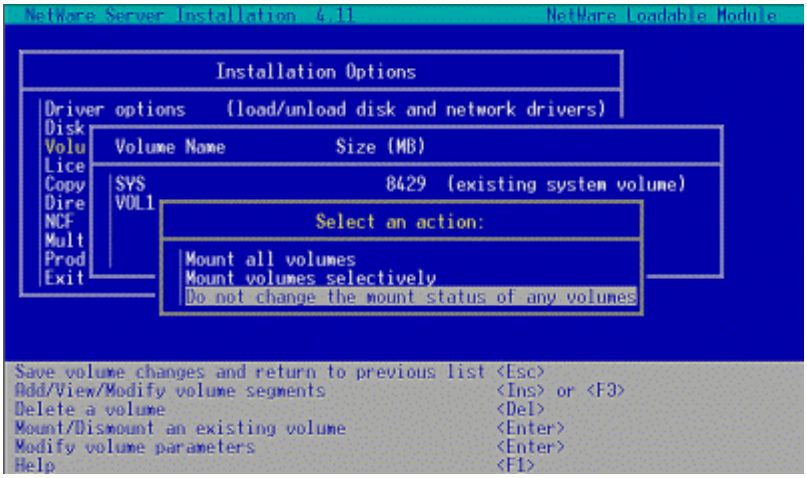

Figure 32 – NetWare Server Installation – Mount Volumes

At this point, your migration is complete. You can exit CPQONLIN and INSTALL. You have successfully installed new hardware and increased available space on a volume without downing the server or interrupting user access.

Conclusion

By migrating to the Fibre Channel Array, you have enhanced the performance, expandability, and flexibility of your data storage and – thanks to PCI Hot Plug – you have not interrupted access to the server's data.

By taking advantage of PCI Hot Plug, you were able to complete the entire migration on the fly. In the future, you can add an additional Fibre Channel Adapter at any time to increase the storage potential by another 1.6 TB. In fact, by following the procedure used to hot plug the FC Adapter you can add additional NICs and SCSI controllers to scale your server to your growing needs. When new PCI Hot Plug adapters are released, you can expect integrating these new devices to be just as seamless.

With the addition of the Fibre Channel technology, your Compaq server is already equipped to respond to future storage demands. In this example, you have even protected a prior investment by incorporating the older drives into the new FC Array and, at the same time, made data access faster by distributing the data which decreases access time. The savings do not end at migration, however. The distance between server and drives afforded by Fibre Channel allows you to make more efficient use of available space without having to reconfigure layouts to accommodate the relatively short SCSI cables. As a result, you will spend less time finding new space and decommissioning your server to be relocated.

With these cost-effective features, Fibre Channel and PCI Hot Plug enable NetWare to offer your growing network a well-paved migration path for the needs of tomorrow.