

WHITE PAPER

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Windows NT Integration

Compaq Computer
Corporation

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Compaq Advanced Network Error Correction Support using PCI Hot Plug with Microsoft Windows NT ®

This document discusses the Compaq solution designed to ensure network availability by combining Network Interface Controller redundancy with Compaq PCI Hot Plug technology in a Microsoft Windows NT environment.

This document also provides information on network configuration, network fault protection, and network monitoring. The intended audience for this White Paper is system engineers and network administrators who install, configure, and maintain server networks in a Microsoft Windows NT Server environment.

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Compaq Advanced Network Error Correction Support using PCI Hot Plug Technology in a Microsoft Windows NT Server Environment

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OVERVIEW OF NETWORK AVAILABILITY SOLUTION FROM COMPAQ

Compaq has implemented a three-part solution to ensure network availability on Compaq server networks. The first part of the solution is provided by the Compaq NetFlex-3 device driver, which is hot plug aware and includes built-in network fault protection features, such as recovery from hardware failure events, network status events, and errors.

The Compaq Advanced Network Control Utility provides the second part of the solution. This hot plug aware utility allows you to designate a secondary controller that acts as a standby and assumes network responsibilities if the primary controller fails. This secondary controller is on standby until a failure occurs with the primary controller. The Advanced Network Control Utility will also reflect the PCI Hot Plug status of controller pairs and stand-alone controllers.

The third part of the solution is provided by Compaq PCI Hot Plug technology. This technology allows you to replace a failed PCI controller while the server is operating. Implementation of PCI Hot Plug technology involves a combination of the hot plug system hardware and software. PCI Hot Plug software for Windows NT includes hot plug aware device drivers, operating system support, and the PCI Hot Plug Utility. Together with the Advanced Network Control Utility, PCI Hot Plug technology greatly enhances the fault tolerance of the system.

Figure 1 illustrates how the NetFlex-3 driver, the Advanced Network Control Utility, and PCI Hot Plug technology provide network fault protection in Windows NT.

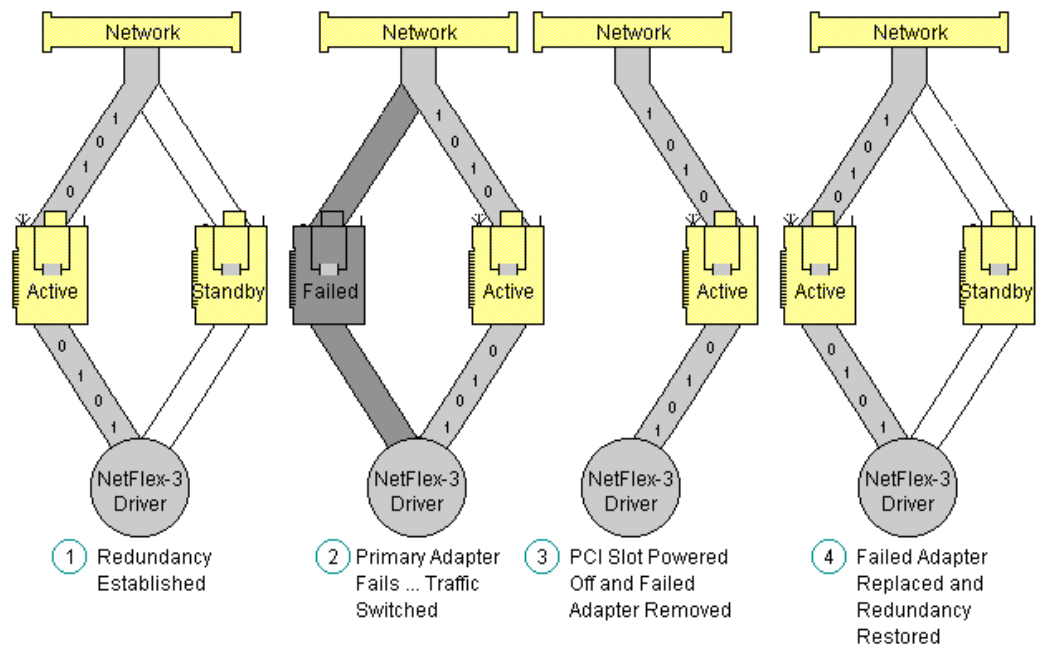


Figure 1. Recovering from network controller failure using network controller redundancy and PCI Hot Plug technology.

NOTE: This paper will focus on using the Advanced Network Control Utility in conjunction with PCI Hot Plug technology. For information about using the Advanced Network Control Utility to monitor and configure EISA adapters, please refer to the Compaq Advanced Error Support in a Microsoft Windows NT Server Environment white paper.

PCI Hot Plug Terminology

Table 1 lists terms related to PCI Hot Plug technology.

Table 1 PCI Hot Plug Technology Standard Terms	
PCI	Peripheral Component Interconnect refers to a bus based on the PCI Local Bus Specification, through which industry standard peripheral controllers connect to computer systems.
PCI Hot Plug	The ability to physically insert or remove industry-standard PCI adapters without disrupting the operation of other devices in the system. This allows the same functionality to continue after you replace the adapter.
Hot Plug Aware	Indicates that a piece of software, such as a device driver, can take advantage of the PCI Hot Plug capabilities of a system.
Hot Plug Slot	A PCI slot capable of being powered down without interfering with the other slots in the system, and without shutting the system down.
Hot Replacement	The ability to remove PCI controllers from a system while the system is running and replace them with equivalent PCI controllers, without removing power to the server and without reconfiguring or reloading software support.
Compaq Remote Monitor Service	Software (CPQRCMC) which has control of overall hot plug operations, also known as the "hot plug service".
System Management Driver	Software driver (SYSMGMT.SYS) which monitors the health of the system and provides the primary interface between the hot plug service and the hot plug system hardware.

Advanced Network Control Terminology

Table 2 lists terms used to describe the main features of the Advanced Network Control Utility.

Table 2 Advanced Network Control Utility Standard Terms	
ThunderLAN-based Network Controller	Compaq network controller containing the TLAN (ThunderLAN) chip set. The Compaq Netflex-3 and Netelligent controllers are ThunderLAN-based. The Advanced Network Control Utility supports only these types of network controllers.
Controller Pair	Two Compaq ThunderLAN-based network controllers configured so that network connectivity is maintained, even if it loses a connection or a controller fails. The controller pair is installed with one NetFlex-3 driver instance, which means they are recognized by the network as only one controller.
Network Interface Controller Redundancy	Two Compaq ThunderLAN-based network controllers configured as a controller pair.
Primary Controller	The network interface controller initially configured as the active network controller in a controller pair.
Secondary Controller	The network interface controller initially designated as the standby network controller in a controller pair.
Active Controller	The currently operational network interface controller in a controller pair.
Standby Controller	The non-active network interface controller in a controller pair.

NOTE: This White Paper uses the words "controller" and "adapter" interchangeably.

HARDWARE AND SOFTWARE SUPPORT REQUIREMENTS

The following hardware and software requirements must be met to use the Advanced Network Control Utility in conjunction with PCI Hot Plug technology:

Software Requirements

- Microsoft Windows NT 4.0
- RPC (Remote Procedure Call) Network Service
- Compaq Support Software for Microsoft Windows NT 4.0 (SSD), Version 2.00 or later to install:
 - NetFlex-3 device driver
 - Advanced Network Control Utility
 - Compaq System Management device driver (SYSMGMT.SYS)
 - Compaq Remote Monitor Service (CPQRCMC.EXE)
 - Compaq PCI Hot Plug Utility
- A routable network protocol, such as TCP/IP

Hardware Requirements

- Compaq PCI Hot Plug systems, such as the Compaq ProLiant 6500 server
- Compaq ThunderLAN-based network controller which includes:
 - The Netflex-3/P controller configured with one of the following option modules:
 - 100VG Module
 - 10/100 TX Module
 - 100Base-FX Module
 - 10Base-T UTP/BNC Module
 - Also includes support for the following Netelligent non-modular controllers:
 - Compaq Netelligent 10/100TX PCI UTP Controller
 - Compaq Netelligent 10T PCI UTP Controller
 - Compaq Netelligent 10 T/2 PCI UTP/Coax Controller
 - Compaq Netelligent Dual 10/100TX PCI UTP Controller

Hardware and Software Support Limitations

The Advanced Network Control Utility can provide monitoring capabilities to more than one network segment in a Compaq server. Each segment requires a separate instance of the NetFlex-3 driver for each controller pair or stand-alone controller.

The Advanced Network Control Utility does not provide support for non-ThunderLAN-based networks and network controllers such as:

- NetFlex-2 Controllers
- Token Ring networks

PCI Hot Plug technology allows you to remove and replace a failed controller with minimal interruption to the system. The replacement controller and the controller being replaced must be of the same device type and revision, and have the same option module type installed.

The Advanced Network Control Utility and the PCI Hot Plug Utility can be installed on any Compaq system running Windows NT 4.0. A non-PCI Hot Plug system can be used to remotely monitor a PCI Hot Plug system. This is discussed further in the “Monitoring Controllers on a Remote System” section.

NOTE: A routable network protocol is required if you want to use the network to manage remote systems.

Advanced Network Control Utility

The Advanced Network Control Utility includes support for PCI Hot Plug technology and extends and enhances the built-in recovery features of the Compaq NetFlex-3 device driver in a Windows NT 4.0 environment.

Network Fault Protection

When you configure a controller pair on a Compaq PCI Hot Plug server, you are providing an added level of network fault tolerance protection. A single NetFlex-3 driver instance controls both the primary and secondary controllers when you install the Advanced Network Control Utility. When the driver detects failures on the primary controller and the secondary controller has a valid link, network traffic is switched to the secondary controller. The switch occurs without any interruption to the operating system or network services.

If a primary network controller fails, the Media Access Control (MAC) address of the primary controller transfers to the secondary controller. The MAC address is a unique address assigned to a particular network controller, which identifies that controller on the network. The secondary controller automatically becomes the active controller and takes control of the traffic on the network. The entire process occurs without the intervention of network protocols or operating system applications.

You can further increase the network fault protection provided with the NetFlex-3 driver and the Advanced Network Control Utility by adding another hub to the configuration. You accomplish this by connecting each controller in the controller pair to a separate hub as illustrated in Figure 2.

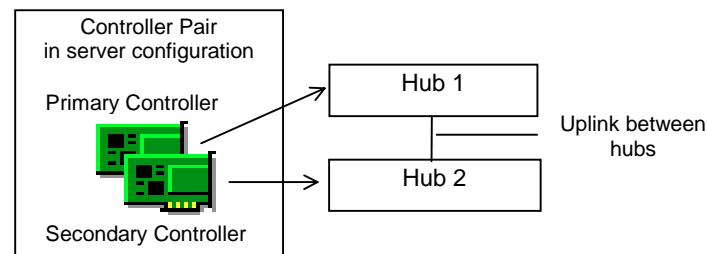


Figure 2. Primary controller and secondary controller connected to two separate network hubs with the hubs linked together.

The two hubs must be linked together for the Advanced Network Control Utility to provide switchover fault protection to the configuration described above. Network traffic will continue in the event of hub power loss or hub failure.

NOTE: Using TCP/IP as an example, a unique IP address or DHCP supplied address identifies a particular controller on a network. The Advanced Network Control Utility supports unique IP addresses and DHCP supplied addresses.

NOTE: More information on errors can be found in the "Network Status Change and Error Reporting" section of this document.

The Advanced Network Control Utility detects, corrects, and reports failures from:

- A network controller failing or being unplugged from the hub
- A network controller powered off using the PCI Hot Plug Utility
- A network controller failing due to unexpected slot power loss
- Loose cable connections or frayed wires
- User requested failure of network controller via the PCI Hot Plug Utility
- Most invalid settings or incompatible controller and hub combinations

When the NetFlex-3 driver detects a problem, it generates an event which is reported in the Windows NT System Event Log and the Compaq Integrated Management log. Compaq Insight Manager also receives alert messages under certain conditions. They are:

- During controller switch overs
- During controller failures
- Reporting network interface controller (NIC) "OK" status
- Reporting a controller removed from a hot plug slot
- Reporting a controller inserted into a hot plug slot
- Reporting a controller in a hot plug slot failed to power up

When Insight Manger issues an alert condition about the controller, use the Windows NT Event Viewer to identify and resolve the issues that are reported.

Network Monitoring

The Advanced Network Control Utility gives you the ability to monitor your network controller configuration. If necessary, you can easily modify the controller installation with this utility. The utility allows you to:

- Reconfigure the way the controller is installed
- Install and uninstall a controller pair on your local system
- Install and uninstall a stand-alone controller on your local system
- Set up controller pairs, as well as stand-alone NetFlex-3 and Netelligent Controllers listed in the "Hardware and Software Support Requirements" section
- Monitor status and configure (stand-alone and controller pair(s)) NetFlex-3 Controllers and Netelligent Controllers
- Track and display Adapter Statistics, Hardware Information, and Adapter Settings
- Detect the PCI Hot Plug state of a controller
- Reset a controller and switch a controller to an active controller setting instantaneously
- Change the controller pair(s) operating mode and primary controller settings instantaneously
- Manage controllers on a remote system accessible over the network

The Advanced Network Control Utility is accessible from the Windows NT Control Panel, and provides functionality and monitoring information about the NetFlex-3 controller and device driver by way of the System Management driver and the Compaq Remote Monitor Service. This means that it does not rely on any other applications and is protocol independent when operating on the local system. When operating with a remote system, the Advanced Network Control Utility uses RPC services over a routable protocol (such as TCP/IP) to get data and send commands.

Controller Pairing

A controller pair consists of two Compaq NetFlex-3 or Netelligent Controllers which share a single instance of the device driver. For this reason, the two network controllers must be of the same type. The paired controller configuration provides connectivity over the network so that the network maintains operation even if a controller connection is lost or if one of the controllers fails.

Although a controller pair configuration is installed and monitored with one instance of the NetFlex-3 driver, the driver is always aware that there are two physical controllers. One controller is active and the other controller is a backup (standby). The NetFlex-3 driver controls both controllers and can automatically switch traffic if one controller fails. The operating system views the controller pair as a single controller. The switch over from one physical controller to the other is completely transparent to the operating system and any application programs.

Each controller pair consists of a primary and a secondary physical controller. When the system starts up, the driver tries to direct network traffic over to the primary controller, so the primary controller is usually the *active* controller.

To create a controller pair on a Compaq PCI Hot Plug server, you must use a combination of two of the following NetFlex-3 Controllers and/or Netelligent Controllers:

- Compaq NetFlex-3/P Controller
- Compaq Netelligent 10/100TX PCI UTP Controller
- Compaq Netelligent 10T PCI UTP Controller
- Compaq Netelligent 10 T/2 PCI UTP/Coax Controller
- Compaq Netelligent Dual 10/100 TX PCI UTP Controller

Once you have physically installed the controllers in the server you can merge them into a controller pair using the Advanced Network Control Utility.

Figure 3 shows an example of a configured controller pair.

NOTE: If you are pairing controllers with different media speeds, configure the controller with the faster speed as the primary controller.

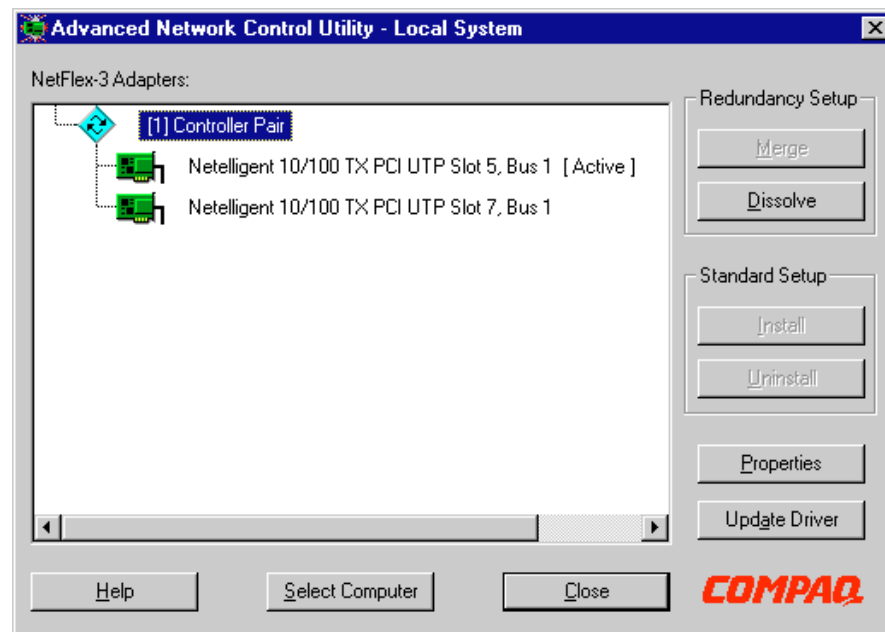


Figure 3. Illustration of a controller pair.

Notice that the controller pair icon shown in Figure 3 has a [1] next to it. This number indicates the instance of the NetFlex-3 driver. If the screen showed more than one controller pair, each pair would have a different NetFlex-3 driver instance number.

Controller Pair Operating Modes

A controller pair can be in one of three switch control modes:

In **Manual Mode** the driver does not automatically switch controllers if the active controller fails. You can switch controllers by clicking the *Switch Now!* button.

In **Switch on Fail Mode** the driver switches controllers whenever the active controller fails or when there is cable fault. Compaq recommends this mode of operation if both controllers in a controller pair are placed in hot plug slots. This is the default mode.

In **Smart Switch Mode**, like *Switch on Fail* mode, the driver switches controllers whenever the active controller fails. However, if a previously failed primary controller becomes operational again, the NetFlex-3 driver switches control back to the primary controller. Compaq recommends this mode in a mixed-media speed environment, or when only one controller in a controller pair is placed in a hot plug slot.

Figure 4 illustrates the operating mode options included under the *Properties* button. The Redundancy Controls screen is accessible once you have merged two controllers. You can modify this setting to meet your networking requirements.

NOTE: The primary controller is the controller initially configured as the active network controller in the controller pair.

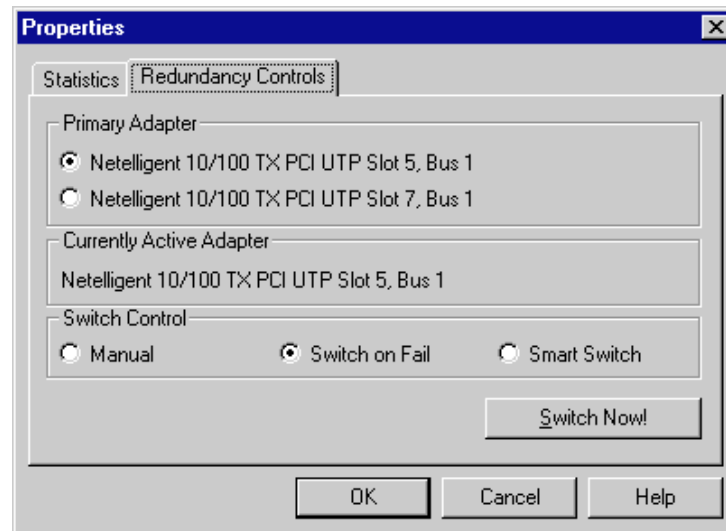


Figure 4. Illustration of the controller pair redundancy switch modes.

Stand-Alone Controllers

The Advanced Network Control Utility also includes install and uninstall features on stand-alone Compaq network controllers. The Advanced Network Control Utility allows you to install another instance of the NetFlex-3 driver for each uninstalled controller in a server. Once you install the driver and restart the server, the utility begins actively monitoring the controller. As with a controller pair, you can view the Windows NT Event Log Viewer, Compaq Integrated Management Log and Compaq Insight Manager Alarms for error detection information.

Figure 5 illustrates a stand-alone controller and a controller pair in the Advanced Network Control Utility view window.

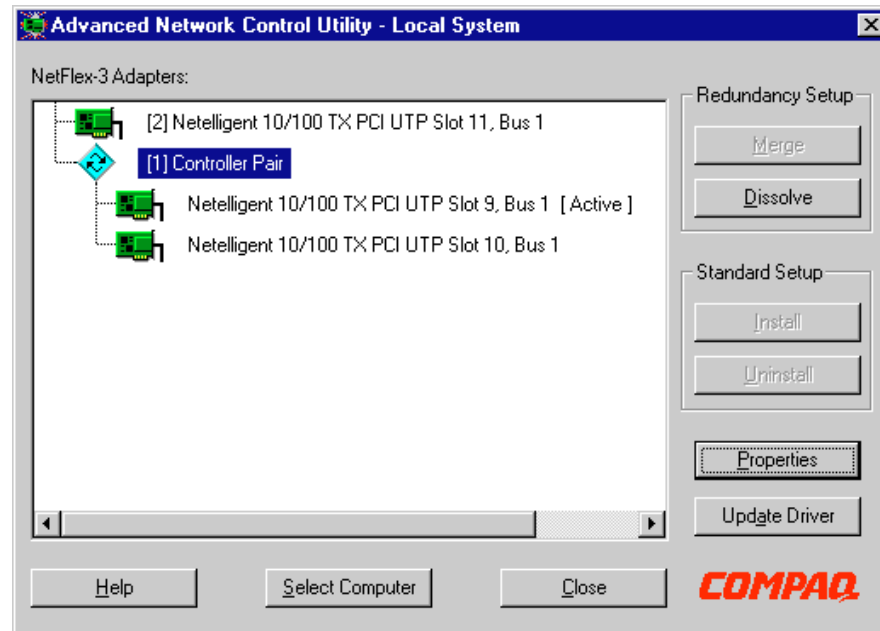




Figure 5. Illustration of an active stand-alone controller in slot 11 of the server.


Paired controllers and stand-alone controllers appear in the same window view. The blue diamond indicates a controller pair. The icon next to the controller indicates the current state of the controller.


Adapter States


You can determine the current state of an adapter by the appearance of the icon associated with a particular adapter. For example:

 When the adapter appears green on the screen it indicates the adapter status is “OK.” The driver is installed and loaded. To uninstall the adapter, select the *Remove* button.

 When the adapter appears gray on the screen it indicates the adapter is “Uninstalled” and the driver is not loaded. To install the driver, select the *Install* button.

 Yellow indicates the adapter is “Unknown.” The adapter is installed, but the driver is not loaded. If you installed the adapter without installing the driver, the adapter remains in this state until the server is restarted. However, if the adapter is in this state after the system is restarted, the driver might not have loaded properly, or the Advanced Network Control Utility is unable to communicate with the driver.

 A green adapter with a red ‘X’ on the cable indicates there is a “Wire Fault” detected. The adapter is installed in the registry and the driver is loaded, but the broken cable indicator means the cable might be unplugged, loose, broken, or the hub might be defective. If you see the broken cable icon next to the adapter, recheck the network connections and make sure the hub is working properly. Once the connection is restored the icon should change to the “OK” status in a few seconds, but it can take up to one minute in some cases.

 Red indicates the adapter has “Failed.” The adapter is installed and the driver is loaded. The driver is reporting a hardware problem with the adapter. This indicates a serious problem. ‘Contact your service provider.

NOTE: The last two icons indicate the PCI Hot Plug status of a network controller.

NOTE: Compaq PCI Hot Plug technology and the PCI Hot Plug Utility are described in more detail in the Deploying PCI Hot Plug on Compaq Servers in a Microsoft Windows NT Environment white paper.



A red adapter with a user icon indicates the adapter was “User-Failed”. The user has requested that the adapter be failed via the Compaq PCI Hot Plug Utility. The “Failed” status can only be removed using the PCI Hot Plug Utility.



A transparent gray adapter indicates the adapter “Power On/Off” status. The adapter is being powered on or off via the Compaq PCI Hot Plug Utility.

PCI Hot Plug Technology

Compaq PCI Hot Plug technology defines a new standard for fault tolerance by allowing the removal and replacement of PCI controllers without shutting down the system. This technology consists of hot plug system hardware and hot plug aware software. It is designed to use existing industry-standard PCI adapters, requiring only hot plug aware drivers to take full advantage of the hot plug capability.

PCI Hot Plug systems include the following features which differentiate them from conventional systems:

- Advanced system circuitry that permits software control of the PCI Hot Plug slots.
- LED status indicators for each PCI Hot Plug slot that indicate if a slot has power, and if the device driver reported a fault condition.
- Slot release levers that automatically disable power to the hot plug slot when opened.
- Wider PCI slot spacing and plastic slot separators that permit safe insertion and removal of controllers, while avoiding contact with active adjacent PCI options.

Compaq provides operating system support for Windows NT through the Compaq Remote Monitoring service and the System Management driver. These operating system support elements enable control of the hot plug hardware using the Compaq PCI Hot Plug Utility.

The PCI Hot Plug Utility provides a means for managing the PCI Hot Plug slots in local and remote nodes. The utility provides information about the controllers plugged into the hot plug slots, such as card location, manufacturer-supplied board specific information, driver name, and board status. When invoked, the PCI Hot Plug Utility displays the primary screen, as shown in Figure 7.

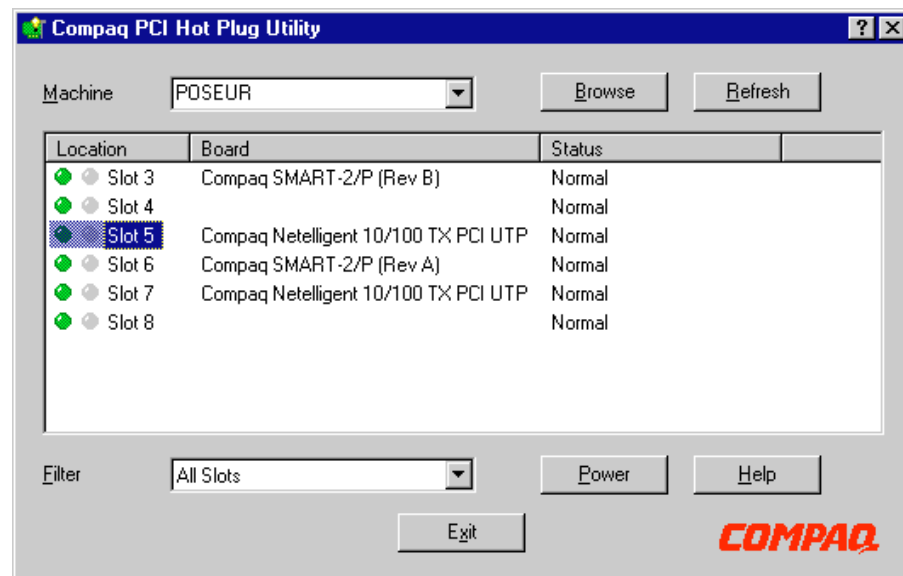


Figure 7. Compaq PCI Hot Plug Utility displaying network controllers in slot 5 and slot 7.

The primary screen displays all controllers in hot plug slots. Information about the individual controllers, such as whether it is part of a controller pair, can be found in the Status Properties page or the Devices Properties page. For dual controllers, you can enable *Paired* and *Driver* information columns in the Devices Properties page, by clicking the right mouse button in the column headings and selecting columns to enable or disable. This is discussed further in the “Properties Pages” section of this document.

You can use the Compaq PCI Hot Plug Utility to perform the following maintenance tasks:

- Turn the power to individual slots off and on to permit controller replacement
- View the properties for the controllers
- Force devices to be marked as Failed when they are suspect and remove that status once repaired

Along with the controls available on the primary screen, the Compaq PCI Hot Plug Utility provides a secondary set of controls available by highlighting one of the hot plug slots and clicking the right mouse button. The following functions are available through the right-click menu: *Power*, *Fail/Unfail*, and *Properties*.

Properties Pages

Figure 8 illustrates one of the pages that display general and status information about a controller, or specific device information in the case of a dual controller.

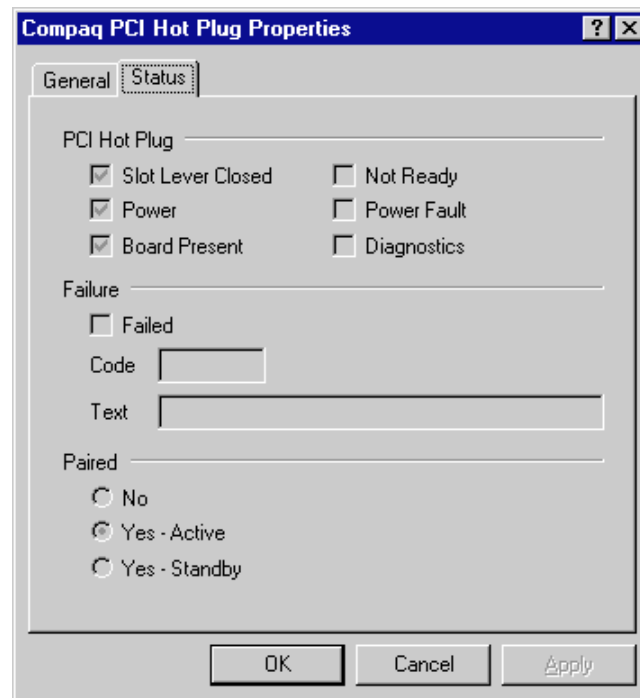


Figure 8. Example of the information available on the Status Properties Page.

This screen is displayed by highlighting a particular hot plug slot on the PCI Hot Plug Utility, then clicking the right mouse button, and selecting *Properties* on the pop-up menu.

In the case of a dual controller, a third tab is displayed, as shown in Figure 9.

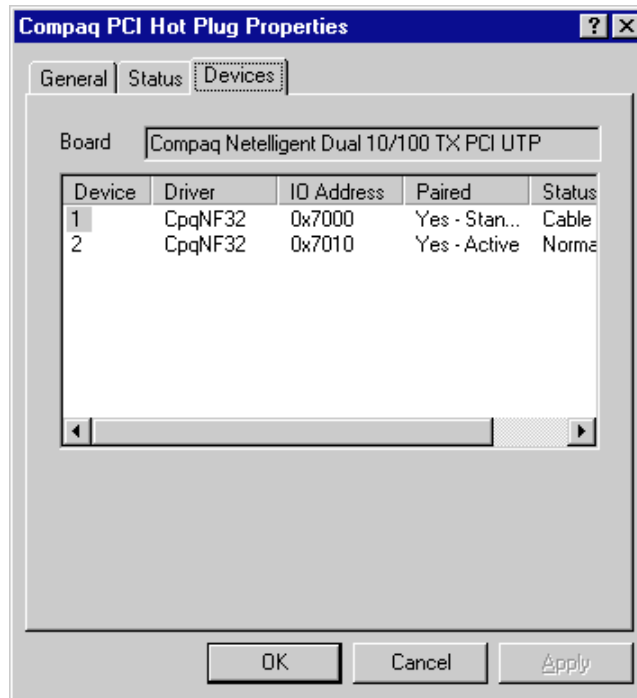


Figure 9. Example of the information available on the Devices Properties Page.

The Devices Properties page appears only when a single PCI adapter contains multiple devices. The Compaq Netelligent Dual Network Interface Controller is an example of a single PCI adapter that contains two devices.

USING THE ADVANCED NETWORK CONTROL UTILITY AND PCI HOT PLUG UTILITY

The information included in this section presumes that you have performed the following steps:

1. Physically installed the Compaq NetFlex-3 and/or Netelligent Controller in hot plug slots in the server.
2. Physically connected the controllers to a hub or hubs.
3. Installed/updated the server with the Compaq SSD for Windows NT 4.0, Version 2.00 or later. To ensure that all the appropriate drivers are installed, Compaq recommends selecting the *Express Setup* option.

Once you complete the above steps, the Advanced Network Control Utility icon *Compaq Net*, and the PCI Hot Plug Utility icon *Compaq PCI Hot Plug*, are both loaded in the Windows NT Control Panel. The PCI Hot Plug Utility may also be accessed through the Compaq System Tools folder in the start menu.

The topics that follow outline the steps necessary to configure, monitor and hot replace network controllers.

NOTE: To simplify network setup, only one network adapter should be attached to the network during Windows NT installation. This avoids a conflict during the network setup phase when two adapters attempt to claim the same node name on the same network using two different addresses (IP address or DHCP supplied address when using TCP/IP).

NOTE: If the two controllers that you want to merge into a pair are both currently installed, you must first remove a NetFlex-3 driver instance for one of them. Refer to “Uninstalling a Standard Controller as a Stand-Alone” procedures later in this section.

Merging Two Controllers to Create a Controller Pair

Merging two controllers with the Advanced Network Control Utility creates a controller pair. The steps that follow outline how to merge network controllers into controller pairs.

1. Click on: *Start* → *Settings* → *Control Panel*.
2. Select the *Compaq Net* icon to launch the Advanced Network Control Utility and view the installed controllers in the utility.
3. Highlight the two controllers you want to merge into a pair.
4. Select the *Merge* button under the “Redundancy Setup” option.

The two merged controllers are represented as a controller pair with the primary controller (listed first) as the active controller. Refer to the “Configuration Verification” section of this document to help you verify the installation.

Dissolving a Controller Pair

To separate two controllers that have been paired, you must uninstall the NetFlex-3 driver instance for the controller pair. The separation process is referred to as *Dissolving*. To dissolve network controllers that are currently configured as a controller pair, follow these steps:

1. Click on: *Start* → *Settings* → *Control Panel*.
2. Select the *Compaq Net* icon to launch the Advanced Network Control Utility.
3. Highlight the *Controller Pair* that you want to dissolve and select the *Dissolve* button.

A status box displays indicating the Dissolve request is complete. The changed configuration is immediately written to the registry. You must restart the server for the changes to take effect.

You can now install the secondary controller as a stand-alone controller. Refer to the procedures in the next section, “Installing and Uninstalling a Standard Controller as Stand-Alone.”

Installing a Standard Controller as Stand-Alone

Each NetFlex-3 or Netelligent network controller that you install as stand-alone must have a separate NetFlex-3 driver instance. To install network controllers that are configured with a standard controller set up, follow these steps:

1. Click on: *Start* → *Settings* → *Control Panel*.
2. Select the *Compaq Net* icon to launch the Advanced Network Control Utility.
3. Highlight the controller that you want to install and select the *Install* button. A message status box displays indicating the request is complete.
4. Select the *Close* button when finished.

The changed configuration is immediately written to the registry. You must restart the server for the changes to take effect.

NOTE: Windows NT might ask you to enter protocol information. If necessary, enter the appropriate information and select OK to exit the Windows NT Network Information screen.

Uninstalling a Standard Controller as Stand-Alone

To uninstall network controllers that are configured as a standard controller set up, follow these steps:

1. Click on: *Start* → *Settings* → *Control Panel*.
2. Select the *Compaq Net* icon to launch the Advanced Network Control Utility.

If you plan on reinstalling the same controller at a later time, record all pertinent protocol information such as IP address, subnet mask, SNMP settings, and so on. You will be requested to enter the protocol information again at the time of a new install.

3. Highlight the controller that you want to uninstall and select the *Uninstall* button. A message status box displays indicating the request is complete.

The changed configuration is immediately written to the registry. You must restart the server for the changes to take effect.

Failing and Unfailing a Controller

When a controller is suspect of a failure, you can mark the device as *Failed*. Once the fault condition has been repaired, the failed status can be removed. To mark a controller as *Failed*, follow these steps:

1. Click on: *Start* → *Settings* → *Control Panel*.
2. Select the *Compaq PCI Hot Plug* icon to launch the PCI Hot Plug Utility.
3. Locate the controller you wish to mark as *Failed* and highlight the hot plug slot it occupies.
4. Click the right mouse button and select *Fail* on the pop-up menu.

The failed status will be reflected on the PCI Hot Plug Utility and the Advanced Network Control Utility.

To *Unfail* a controller that has been previously marked as *Failed*, follow these steps within the PCI Hot Plug Utility:

1. Highlight the hot plug slot with the failed controller.
2. Click the right mouse button and select *Unfail* on the pop-up menu.

The repaired status will be reflected on the PCI Hot Plug Utility and the Advanced Network Control Utility.

Hot Replacing a Controller

To replace a PCI Hot Plug controller that has failed, follow these steps:

1. Click on: *Start* → *Settings* → *Control Panel*.
2. Select the *Compaq PCI Hot Plug* icon to launch the PCI Hot Plug Utility.
3. Locate the controller you wish to remove and highlight the slot it occupies.
4. Click the *Power* button in the PCI Hot Plug Utility to remove power from the PCI Hot Plug slot.
5. Wait for the green LED associated with that slot to turn off on the utility and on the machine. This indicates the power is off for that slot.

IMPORTANT: When you uninstall a network controller, all protocol-related information for the controller that you are disconnecting is lost.

6. Disconnect all cables attached to the card.
7. Open the slot release lever.
8. Remove the adapter, being careful not to touch adjacent adapters.
9. Insert the replacement adapter of the same device type and revision, and the same option module type as the adapter being replaced, being careful not to touch adjacent adapters.
10. Attach the appropriate cables before closing the slot release lever.
11. Close the slot release lever.
12. Click the *Power* button in the PCI Hot Plug Utility to restore power to the slot.

The replacement module is detected automatically by the device driver without interruption to your network connection.

Monitoring Controllers on a Remote System

The Advanced Network Control Utility and the PCI Hot Plug Utility give you the ability to monitor the status of controllers in remote systems as well as in the local system. With the Advanced Network Control Utility, you can remotely view controller pair and standalone controller information, and perform any function available locally except install, uninstall, merge or dissolve controllers. The PCI Hot Plug Utility provides a common point for managing the PCI Hot Plug slots on remote nodes accessible over the network.

To monitor network interface controllers on remote systems, launch the Advanced Network Control Utility and press the *Select Computer* button on the primary screen. This will present you with a graphical view of the network similar to the Network Neighborhood browser. The *Browse* facility on the primary screen of the PCI Hot Plug Utility will present you with a similar browser screen.

The browser screens will display all systems on the network, but there are specific criteria for systems managed by both the Advanced Network Control Utility and the PCI Hot Plug Utility. The following must be true for a system monitored by the Advanced Network Control Utility and PCI Hot Plug Utility:

- The system must have hot plug system hardware
- The system must have the CPQRMC service running
- The system must have the System Management driver loaded
- The user must have an account with appropriate privileges on the selected system
- The system must have RPC services and a routable protocol (such as TCP/IP) loaded

The Advanced Network Control Utility and PCI Hot Plug Utility do not require hot plug hardware or software on a local system monitoring remote systems. In this case, only the remote systems need to satisfy the criteria mentioned above.

Configuration Considerations

Consider the following items before configuring your Compaq server with the Advanced Network Control Utility and PCI Hot Plug Utility:

- You do not have to create the controller pair with two controllers of the same media settings or network topologies. For example, a primary controller can be running in 100-TX full-duplex mode with a Compaq Netelligent Controller and the secondary controller can be set for 10Base-T half-duplex mode. However, the two controllers must be on the same network segment.
- You can include two linked hubs in your controller pair installation, which adds another level of fault tolerance to mission-critical network configurations.
- You can configure the server with many combinations of controller pair(s) and stand-alone controller(s). You are only limited by the number of slots in the server.
- Reserve the hot plug slots for hot plug aware controllers. If the system contains a full complement of hot plug aware PCI adapters, place the standby controllers in the non-hot plug slots. This leaves the active controllers in hot plug slots, preserving the ability to replace a failed controller pair without shutting down the system.
- Merging both devices on a dual controller is not recommended, because if one of the devices on the controller fails, then the entire controller must be replaced.

Configuration Verification

After each configuration update that requires you to restart the server follow these steps in the Advanced Network Control Utility to verify that the network controllers are active and functioning properly:

1. Select the controller pair configuration in the primary screen of the Advanced Network Control Utility. Click on the *Properties* button.
2. Select the *Redundancy Controls* tab.
3. Select the *Switch Now* button. Operation should switch to the secondary controller within a few seconds.
4. Select the *Switch Now* button to return operation to the primary controller. Operation should switch back to the primary controller within a few seconds.
5. Select the desired operation mode after you have verified the configuration.

To verify controller functionality using the PCI Hot Plug Utility, select the *Smart Switch* Mode in the Advanced Network Control Utility and follow these steps:

1. Highlight the hot plug slot with the primary controller in the PCI Hot Plug Utility.
2. *Fail* the primary controller. Operation should switch to the standby controller within a few seconds.
3. *Unfail* the controller. Operation should switch back to the primary controller within a few seconds.
4. Select the desired operation mode after you have verified the configuration.

You can verify the configuration of network controllers in hot plug slots by using the PCI Hot Plug Utility. You can view the configuration information in the Status Properties page, or the Devices Properties page in the case of a dual controller.

Examples of Configurations Monitored in the Advanced Network Control Utility and PCI Hot Plug Utility

This section contains examples of several types of network configurations that can be monitored and managed by the Advanced Network Configuration Utility and the PCI Hot Plug Utility. The examples demonstrate the fault tolerance capabilities built into the NetFlex-3 driver and the configuration and monitoring capabilities of the Advanced Network Configuration Utility and the PCI Hot Plug Utility.

The following types of configurations are illustrated:

- Controller pair configuration with one hub
- Controller pair configuration with two hubs
- Controller pair configuration using a dual NIC
- Controller pair configuration using a dual NIC and a single controller
- Controller pair configuration using two dual NICs
- Two controller pair configuration using a dual NIC and two single controllers
- Two controller pair configuration using two dual NICs

Your network(s) configurations are not limited to these examples. You may include many combinations of controller pairs and stand-alone controllers, depending on the number of hot plug and non-hot plug slots available on your system.

Controller Pair Configuration with One Hub

The configuration illustrated in Figure 10 provides the security of a redundant secondary controller connected to the network with one hub. At minimum, the primary controller should be placed in a hot plug slot. The secondary controller can be placed in a non-hot plug slot to maximize the number of hot-plug slots available to other hot plug aware controllers. In this case, the mode of operation should be set to *Smart Switch*.

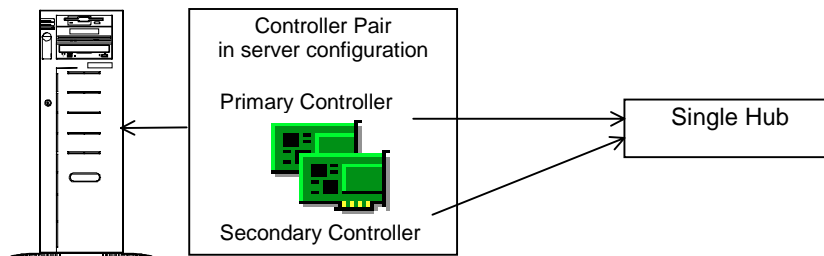


Figure 10. Controller pair configured with a single hub on a network segment.

This example is a basic configuration using controller network redundancy in conjunction with PCI Hot Plug technology. The examples that follow build on the configuration in this example.

Figure 11 illustrates the configuration as it appears in the Advanced Network Control Utility.

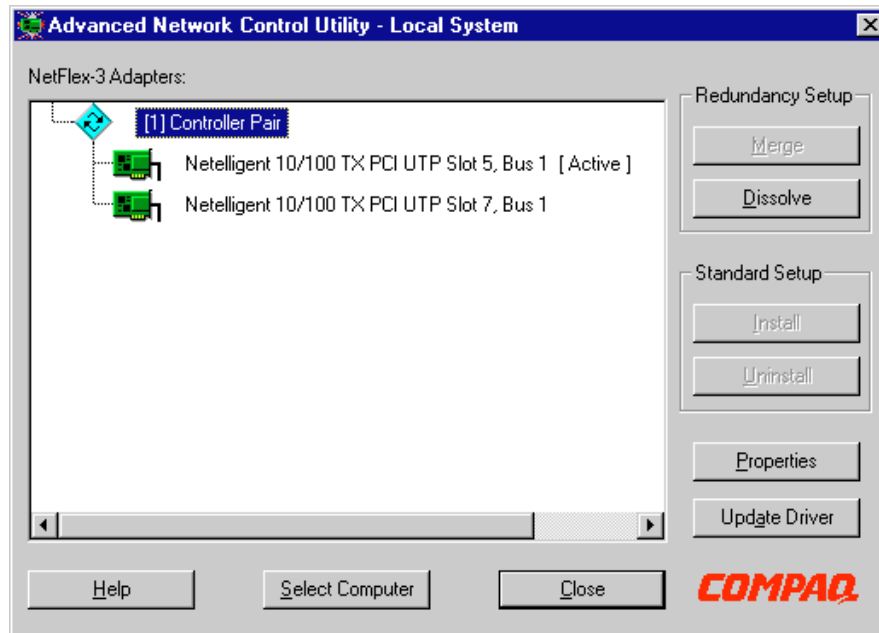


Figure 11. Controller pair with one active and one redundant controller as described in the configuration.

Figure 12 illustrates the configuration of the active controller in slot 5 as it appears in the PCI Hot Plug Utility.

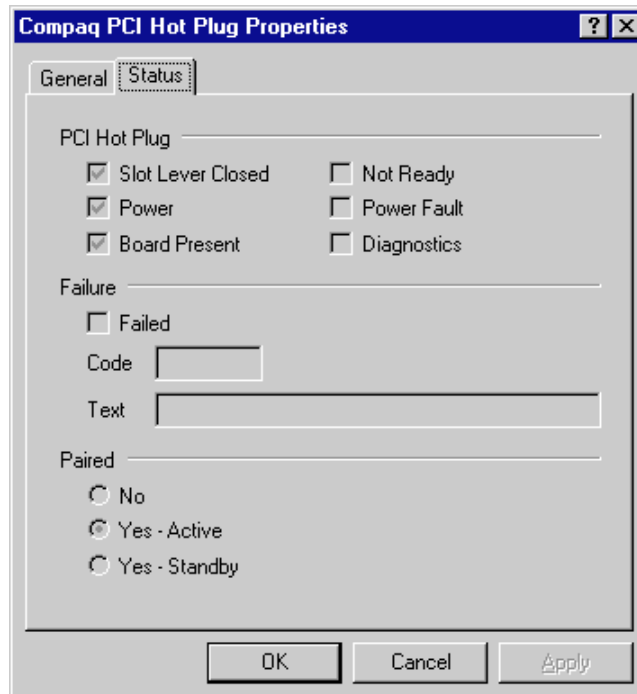


Figure 12. Properties for the active controller in slot 5.

The PCI Hot Plug Utility displays information about individual controllers in the Status Properties page. This Status Properties page displays whether a controller is paired, and if it is active or standby. It also includes information specific to the hot plug slot.

Table 3 describes the advantages and disadvantages with the first configuration.

Table 3
Configuration Summary

Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> Controller redundancy Failed primary controller can be hot replaced Use of only one hot plug slot is necessary 	<ul style="list-style-type: none"> Network connectivity is lost if hub fails Secondary controller cannot be hot replaced 	Yes

Controller Pair Configuration with Two Hubs

This configuration provides your network with the security of a redundant secondary controller and the support of two hubs. As with the first configuration, the primary controller should be placed in a hot plug slot, the secondary controller can be placed in a non-hot plug slot. The mode of operation should be set to *Smart Switch*.

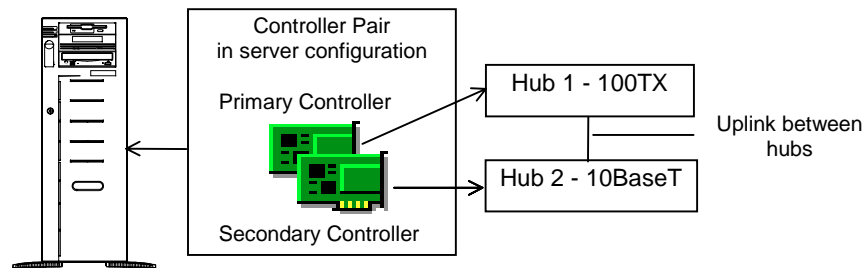


Figure 13. Controller pair connected and linked to two hubs on a network segment.

This configuration not only provides your network with the security of a secondary controller, but each controller is connected to a different hub. In this configuration both hubs must reside on the same network segment and must be linked together to provide redundant support. The second hub adds another level of fault tolerance. Should Hub 1 supporting the primary controller lose connection; the secondary controller on Hub 2 switches over to the active status. Notice that the configuration in Figure 13 includes hubs capable of different media speeds. This flexibility in the configuration allows you to provide protection without requiring two high-speed media devices.

Table 4 describes the advantages and disadvantages with this configuration.

Table 4
Configuration Summary

Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> Controller redundancy Partial hub redundancy Use of only one hot plug slot is necessary Support of two hubs on same network segment Cost advantage with hubs of different media speeds 	<ul style="list-style-type: none"> Small performance hit if higher speed hub fails Secondary controller cannot be hot replaced 	Yes

The next configurations add more variation to the monitoring capabilities provided by the NetFlex-3 driver, the Advanced Network Control Utility and PCI Hot Plug technology.

Controller Pair Configuration Using a Dual Network Controller

This configuration uses both devices on a dual controller to form a controller pair. The controller pair is linked to a single hub on a network segment. The dual controller should be placed in a hot plug slot. The mode of operation for the controller pair can be set to *Switch on Fail*.

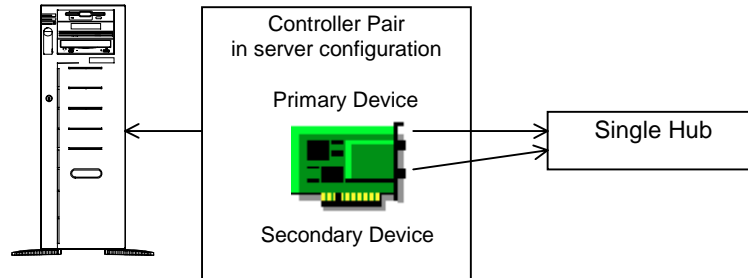


Figure 14. Controller pair formed with both devices on Compaq Netelligent Dual 10/100 PCI UTP controller.

This configuration is not recommended because if the primary device on the controller fails, then the controller would have to be replaced, controller redundancy would be dissolved and connectivity to the network segment would be lost, thus defeating the purpose of controller redundancy and PCI Hot Plug technology. Table 5 describes the advantages and disadvantages with this configuration.

NOTE: Failure of some parts of the controller, such as the PCI to PCI bridge, would cause both devices on the dual controller to fail.

Table 5
Configuration Summary

Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> Use of only one hot plug slot 	<ul style="list-style-type: none"> Network connectivity lost if controller requires hot replacement 	No

Controller Pair Configuration Using a Dual Network Controller and a Single Network Controller

This configuration provides connectivity to two separate networks. It includes a controller pair and a device on a dual controller configured independently. The independent device provides connectivity to a smaller less-critical network segment. The controller pair is performing a mission critical operation and requires the added level of fault protection.

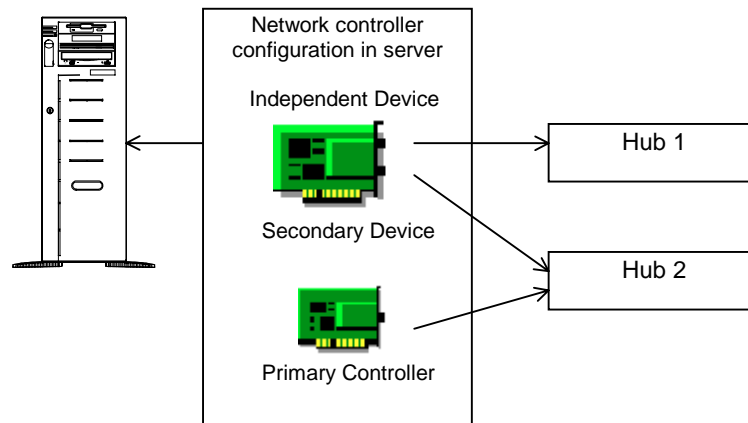


Figure 15. Controller pair formed with a device on the dual controller and a stand-alone network controller.

The separate network adapter is configured as the primary controller. The dual controller in this configuration contains the less critical secondary and independent devices. The primary controller can be hot replaced without affecting the secondary and independent devices on the dual controller.

The primary controller should be placed in a hot plug slot. If possible, the dual controller should also be placed in a hot plug slot to avoid shutting down the system if the independent device fails and the dual controller requires a replacement. The mode of operation for the controller pair should be set to *Smart Switch*.

Figure 16 illustrates how this configuration appears in the Advanced Network Control Utility. Notice that the independent controller and the controller pair display a number bracketed [1] and [2] before the controller name, respectively. Each number indicates a different instance of the Netflex-3 device driver.

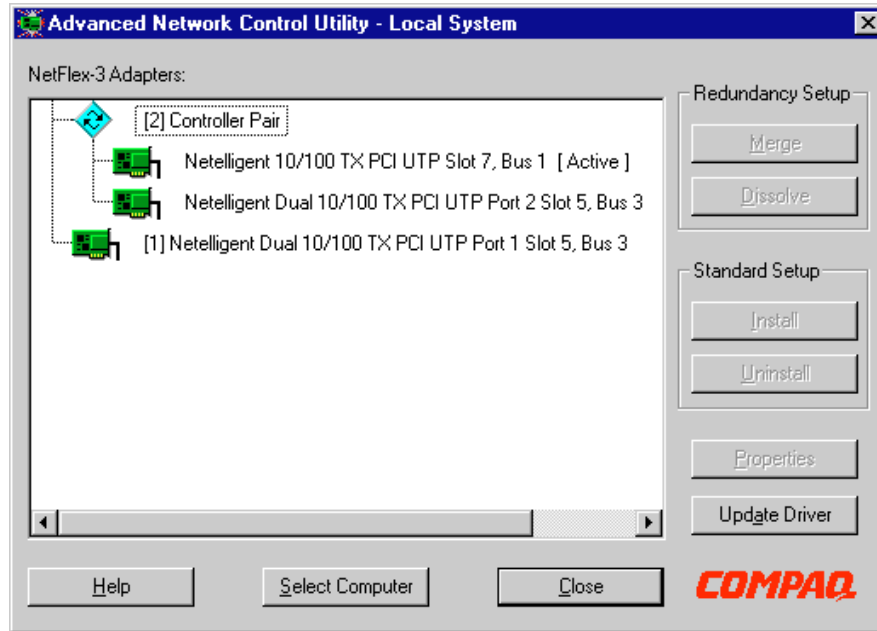


Figure 16. Controller pair and independent controller in a server configuration.

The Advanced Network Control Utility includes the ability to monitor independent network controllers in the server that do not require the protection of a controller pair. The PCI Hot Plug Utility provides the same capability as long as the controllers are placed in hot plug slots.

Figure 17 illustrates how the dual controller configuration appears in the PCI Hot Plug Utility, under the Devices Properties page.

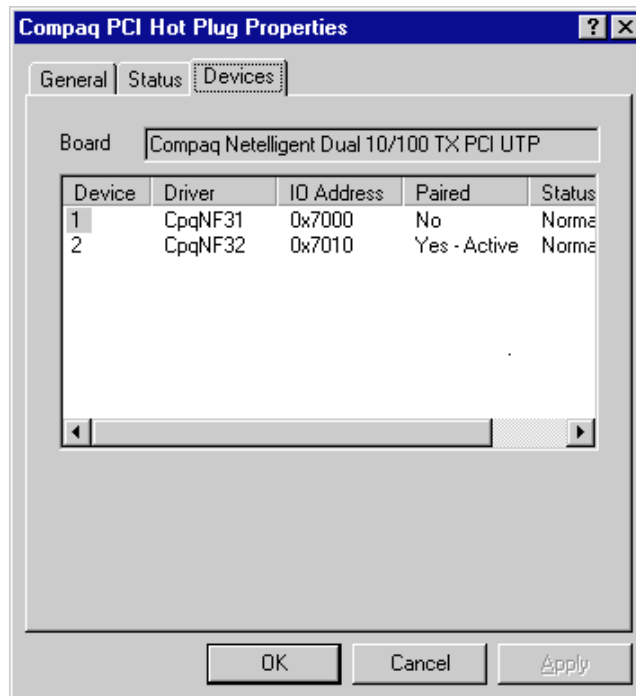


Figure 17. Dual controller configuration in the PCI Hot Plug Utility.

The advantage in using this configuration is conserving one extra slot in your system. This configuration replaces the use of three separate adapters to form the controller pair and independent network controller. Also, there is a performance advantage by using a dedicated NIC as the primary controller.

Table 6 describes the advantages and disadvantages with this configuration.

Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> • Support of two separate network segments • Use of only two slots • Controller redundancy for one network segment • Network load separated on two different controllers 	<ul style="list-style-type: none"> • Network connectivity with independent device lost if dual controller requires hot replacement 	Yes

The next configuration is similar to this configuration, but it adds support for an extra network segment with the use of only two dual controllers.

Controller Pair Configuration Using Two Dual Network Controllers

This configuration provides connectivity to three separate networks. It includes a controller pair and a device on each of the dual controllers configured independently. The independent devices provide connectivity to smaller less-critical network segments. The controller pair is performing a mission critical operation and requires the added level of fault protection.

In this configuration, the controller with the primary device should be placed in a hot plug slot, and if possible, the controller with the secondary device should also be placed in a hot plug slot. This avoids shutting down the system if an independent device fails and one of the dual controllers requires a replacement. The mode of operation can be set to *Switch on Fail*.

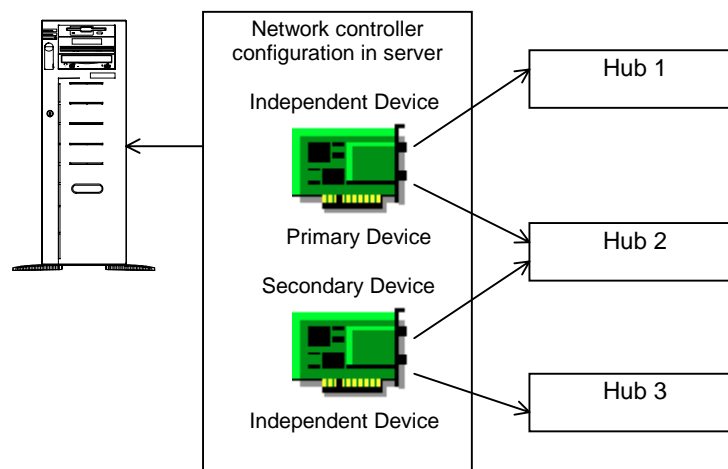


Figure 18. Controller pair formed with a device on each of the dual controllers.

With only two controllers, this configuration provides support for three separate network segments, one of them with controller redundancy. The advantage in this configuration is the minimal number of slots used.

Table 7 describes the advantages and disadvantages with this configuration.

Table 7
Configuration Summary

Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> • Support for three separate network segments • Use of only two slots • Controller redundancy for one network segment 	<ul style="list-style-type: none"> • Network connectivity with independent device lost if a dual controller requires hot replacement 	Yes

Two Controller Pair Configuration Using a Dual Network Controller and Two Single Controllers

This configuration provides connectivity to two separate networks. It includes two controller pairs with the devices on the dual controller configured as standbys to the primary controllers. The controller pairs are performing mission critical operations and require the added level of fault protection.

The primary controllers should be placed in hot plug slots. The dual controller may be placed in a non-hot plug slot. The mode of operation should be set to *Smart Switch* for both controller pairs.

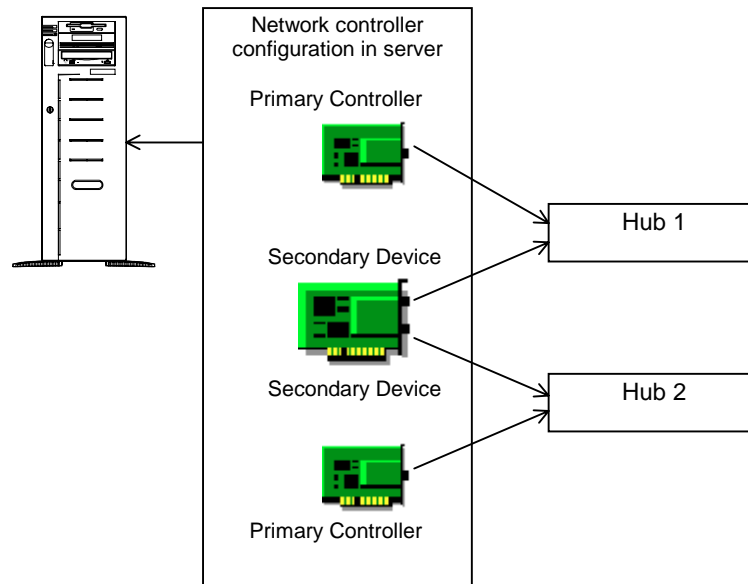


Figure 19. Controller pairs formed with the devices on the dual controller and two separate network controllers.

The separate network adapters are configured as the primary controllers. The dual controller in this configuration contains the less critical secondary devices. The primary controllers can be hot replaced without affecting the secondary devices on the dual controller.

The advantage in using this configuration is conserving the use of one extra slot in your system. This configuration replaces the use of four separate adapters to form two controller pairs.

Table 8 describes the advantages and disadvantages with this configuration.

Table 8 Configuration Summary		
Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> • Support for two separate network segments • Use of only three slots • Controller redundancy for two network segments 	<ul style="list-style-type: none"> • Dual controller cannot be hot replaced 	Yes

The next configuration is similar to the example illustrated in Figure 19, but makes use of only two network controllers.

Two Controller Pair Configuration Using Two Dual Network Controllers (Primaries on One Controller)

This configuration provides connectivity to two separate networks. It includes two controller pairs with the devices on one dual controller configured as primary, and the devices on the other dual controller configured as secondary. The controller pairs are performing mission critical operations and require the added level of fault protection.

The dual controller configured with the primary devices should be placed in a hot plug slot. The dual controller configured with the secondary devices can be placed in a non-hot plug slot. The mode of operation for both controller pairs should be set to *Smart Switch*.

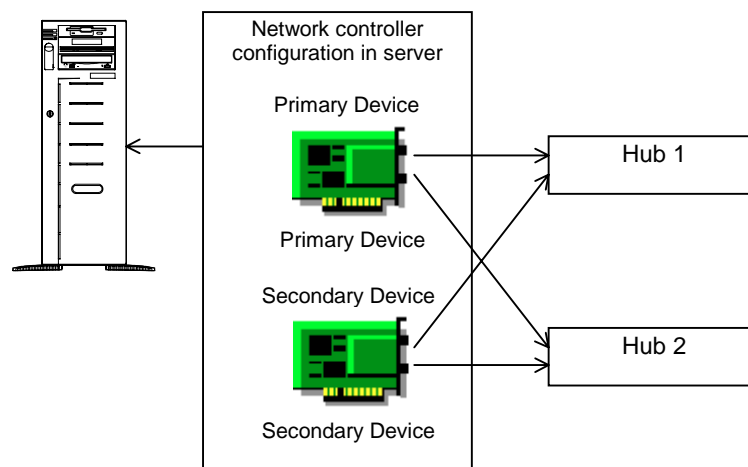


Figure 20. Two controller pairs formed with the devices on the dual controllers.

If one of the primary devices fail, then a switchover to the secondary device will occur automatically. To hot replace the controller with the failed device, first perform a manual switch of the remaining functional primary device to its secondary so that both secondary devices are active. After replacing the failed dual controller, controller redundancy for both network segments will once again be established.

Figure 21 illustrates how this configuration appears in the Advanced Network Control Utility.

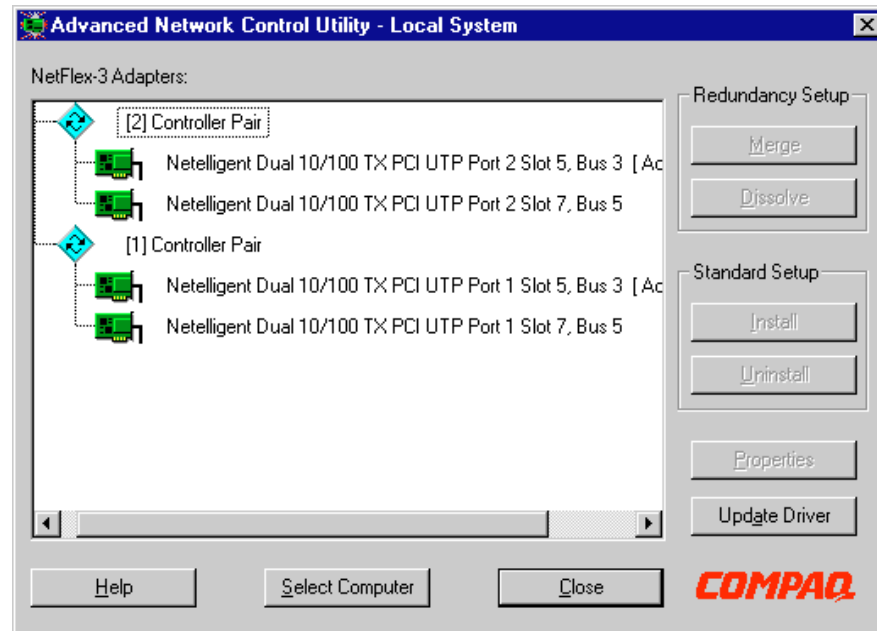


Figure 21. Two controller pairs formed with two dual network controllers.

This example illustrates an efficient way to configure two network controllers with controller redundancy. This configuration conserves the use of two extra slots in your system. Instead of using four separate adapters to form two controller pairs, this is done with only two dual network controllers.

Table 9 describes the advantages and disadvantages with this configuration.

Table 9 Configuration Summary		
Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> Support for two separate network segments Use of only two slots Controller redundancy for two network segments 	<ul style="list-style-type: none"> Network traffic only to one NIC Dual controller with secondary devices cannot be hot replaced 	Yes

The next example is similar to this example, but it separates the primary devices so that each dual controller contains a primary and secondary device.

Two Controller Pair Configuration Using Two Dual Network Controllers (Primaries on Separate Controllers)

This configuration provides connectivity to two separate networks. It includes two controller pairs with each dual controller configured with a primary and a secondary device. The controller pairs are performing mission critical operations and require the added level of fault protection.

In this configuration, both controllers should be placed in a hot plug slot. The mode of operation for both controller pairs should be set to *Smart Switch*.

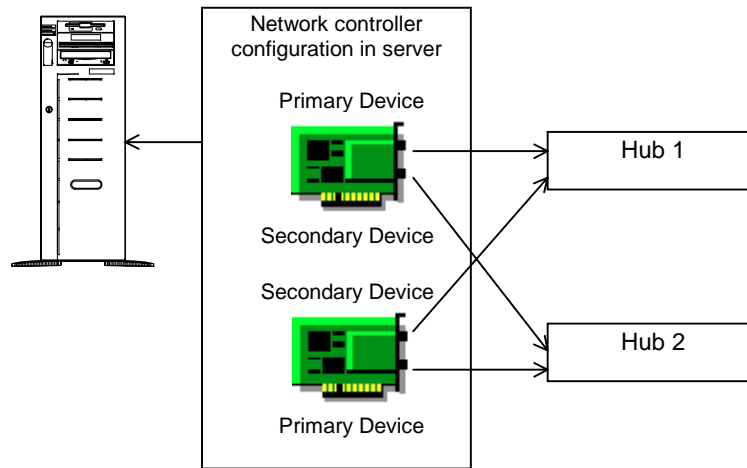


Figure 22. Two controller pairs formed with the devices on the dual controllers

NOTE: *Smart Switch* is used in this example to insure load balancing.

This example illustrates the most efficient way to configure two network controllers with controller redundancy. The main advantage in this configuration is the load balancing. Network traffic on the primary devices is distributed over separate controllers.

Table 10 describes the advantages and disadvantages with this configuration.

Table 10
Configuration Summary

Advantages	Disadvantages	Recommended
<ul style="list-style-type: none"> Support for two separate network segments Use of only two hot plug slots Controller redundancy for two network segments Load balancing of network traffic 		Yes

CONTROLLER SWITCH-OVER EVENTS

The Compaq ThunderLAN (TLAN)-based network controllers (Compaq NetFlex-3 and Compaq Netelligent Controllers) and associated device driver (NETFLX3.SYS) have internal diagnostic and analysis capabilities that detect and report errors. These features provide a fault detection and recovery mechanism to increase network availability.

There are five known conditions which initiate a switch-over event: Cable Failure, Adapter Check - Hardware Problems (TLAN), User-Failed Controller, User-Initiated Switch, and Unexpected Slot Power Loss.

Cable Failure

This occurs when the network controller is unable to transmit data across the network. This may be due to the following conditions:

- Wire Fault/Link Failure - Cabling which is unplugged, a bad cable, or a non-functioning HUB
- Controller not transmitting - The controller is in a state where it does not send data

If any of these conditions occur, the NetFlex-3 driver will fail the active controller and start the standby controller.

Cable failures cannot always be detected. See the section entitled, “Failed or Invalid Configuration Conditions That Cannot Be Detected”, later on this page.

Adapter Check - Hardware Problems (TLAN)

If the network controller experiences a hardware error, the controller issues an interrupt to the NetFlex-3 driver to restart the controller. When a controller pair exists and a controller experiences an adapter check, the NetFlex-3 driver fails the active controller and switches over to the standby controller. The driver then tries to restart the primary controller. If the driver successfully restarts the controller and if the Switch Controller is set to Smart Switch, the NetFlex-3 driver switches back to make the primary controller active. If the Switch Controller is set to Switch on Fail, the NetFlex-3 driver will NOT switch over to the primary controller unless the standby controller fails.

User-Initiated Switch

An administrator can also initiate the switching of network traffic from the active controller to the standby controller. This can be done using the *Switch Now!* button in the Advanced Network Control Utility.

User-Failed Controller

An administrator can set the *Failed* status for an adapter in a hot plug slot using the PCI Hot Plug Utility as described earlier in the “Failing and Unfailing a Controller” section. When a controller pair exists, the NetFlex-3 driver switches over to the standby controller after the *Failed* status has been set on the primary controller. When the *Failed* status is removed, the NetFlex-3 driver will switch over to the primary controller only if the Switch Controller is set to Smart Switch.

Unexpected Slot Power Loss

Unexpected slot power loss can be caused by accidentally opening a slot lever while power is still on and the when the PCI Hot Plug hardware detects a power fault and automatically powers the slot off. When a hot plug slot experiences an unexpected power loss, the NetFlex-3 driver fails the active controller and switches over to the standby controller. The driver then tries to restart the primary controller. If power has been restored to the hot plug slot, and the driver successfully restarts the controller, then controller redundancy will be re-established. The NetFlex-3 driver will switch over to the primary controller only if the Switch Controller is set to Smart Switch.

Configuration Conditions That Cannot Be Detected

Duplex Mismatch

A Duplex Mismatch occurs when the duplex mode of the switch has a different setting than the duplex mode of the network interface controller. The network driver will not be able to detect this condition and may or may not be able to transmit data efficiently.

NOTE: This error condition may cause an Adapter Check (see, “Adapter Check - Hardware Problems (TLAN)”, below).

Network Status Change and Error Reporting

All Compaq network device drivers provide integrated error recovery that allows the device drivers to detect failure events and recover from them. The drivers can reset the NIC and continue running, usually without noticeable disturbance to normal operation. The drivers report status and recovery information to the Windows NT System Event Log, the Compaq Integrated Management log, and Insight Manager.

The sections that follow provide troubleshooting information to help understand and correct, if necessary, network status changes reported by the NetFlex-3 driver, the Advanced Network Control Utility and the Compaq Remote Monitor Service.

Insight Manager 3.40 Alarms

Insight Manager 3.40 reports events related to PCI Hot Plug technology, including status-related changes with the controllers in hot plug slots. Insight Manager notifies you when a monitored item changes. For instance, when certain controller conditions occur, a status change alarm is generated and stored in the Alarm Log. Insight Manager also generates a message or “trap” that describes the status change. Table 11 identifies the alarms generated, and trap descriptions.

Table 11
Insight Manager 3.40 Alarms and Traps for
Controller Pair Errors

Alarm Generated	Trap Description
Network Interface Card Failed	The status of a controller has changed to failed.
Network Interface Card OK	The status of the controller has changed to the OK condition.
NIC Switchover Occurred	The configured redundant controller became the active NIC.
Hot Plug Slot Board Removed	A 'Hot Plug Slot Board Removed' trap signifies that a hot plug slot board has been removed from the specified chassis and slot.
Hot Plug Slot Board Inserted	A 'Hot Plug Slot Board Inserted' trap signifies that a hot plug slot board has been inserted into the specified chassis and slot.
Hot Plug Slot Board Failed Power Up	A 'Hot Plug Slot Board Failed Power Up' trap signifies that a hot plug slot board has failed to power up in the specified chassis and slot.

If you receive any of these messages in Insight Manager, consult the Windows NT System Event Log, the Advanced Network Control Utility and the PCI Hot Plug Utility for additional information on the reported event.

Windows NT Event Viewer

The Windows NT Event Viewer, in the Administrative Tools Program Group, displays the System Event Log. This tool displays status information and errors detected by the NetFlex-3 driver and the hot plug service. The description provided in the Event Detail screen can help you monitor and troubleshoot problems reported about PCI Hot Plug slots and NetFlex-3 controllers.

Figure 23 provides an example of the events reported in the Event Viewer.

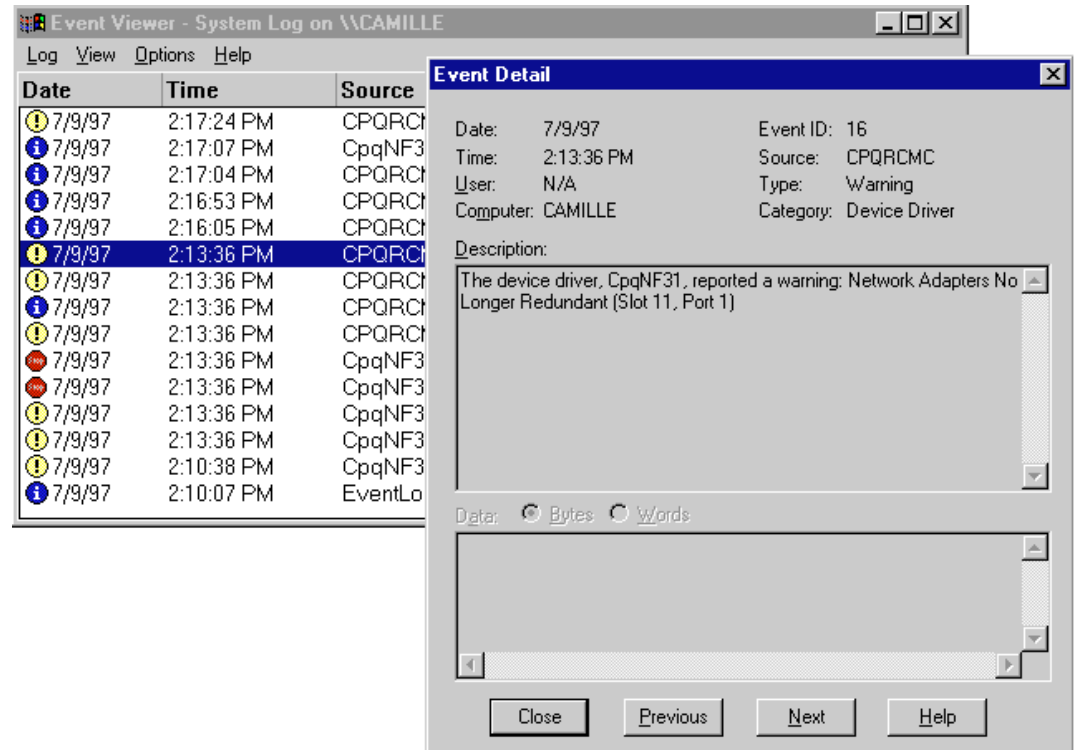


Figure 23. Example of the Windows NT Event Viewer displaying a NetFlex-3 event and the event detail.

Informational Event Reporting

The NetFlex-3 driver reports information events and descriptions of each event. Most of these events do not necessarily indicate a problem. However, if they are accompanied by other messages indicating a network problem, a further investigation is warranted. You can view PCI Hot Plug slot and controller status information in the Advanced Network Control Utility and the PCI Hot Plug Utility. You can view status and error report information in the Windows NT System Event Log and the Compaq Integrated Management log. These tools can help you monitor your network status and determine the operating state of the network.

The following table indicates where to look for information when specific events occur.

Table 12
Informational Events

Event Viewer	Insight Manager	Integrated Management log	PCI Hot Plug Utility	Advanced Network Control Utility	Description of Information Reported
✓	✓			✓	<i>User Process Switchover</i> Indicates a user request was generated. This event is reported after you select the <i>Switch Now</i> button to switch the controller from active to standby.
✓	✓			✓	<i>Switchover Auto Recover</i> Indicates the NetFlex-3 driver has initiated a switchover from the secondary to the primary controller. This event is generated after a previously failed primary controller returns to the active state.
				✓	<i>Interface Transmit Queue Depth</i> The maximum number of transmits queued to the adapter at any one time. This is provided as informational only, no corrective action is necessary.
				✓	<i>Transmit Underruns</i> Frames aborted during transmission due to frame data not being available (due to host bus latencies). This is caused by the hardware being unable to connect to the bus. The system might be overloaded.
✓		✓	✓	✓	<i>Repair to Network Adapters No Longer Redundant</i> Indicates that the previously reported failure of the Netflex-3/Netelligent controller has been repaired. No action is required.
✓		✓	✓		<i>Slot Lever Closed</i> The slot release lever for the slot specified was closed. No action is required.
✓		✓	✓		<i>Slot Lever Opened</i> The slot release lever for the specified slot was opened AFTER the slot was powered off by the PCI Hot Plug Utility. No action is required.
✓		✓	✓	✓	<i>Slot Power Off</i> The PCI Hot Plug Utility turned off the power to the specified slot. No action required.
✓		✓	✓	✓	<i>Slot Power On</i> The PCI Hot Plug Utility turned power on for the specified slot. No action required.

Troubleshooting Hardware Failure Events

The table that follows identifies hardware-related failure events and provides possible reasons for the failures. It also provides possible corrective actions. The NetFlex-3 driver switches operation from the primary controller to the secondary controller based on certain events.

You can view PCI Hot Plug slot and controller status information in the Advanced Network Control Utility and the PCI Hot Plug Utility. You can view status and error report information in the Windows NT System Event Log and the Compaq Integrated Management log.

Table 13
Hardware Failure Events

Event Viewer	Insight Manager	Integrated Management Log	PCI Hot Plug Utility	Advanced Network Control Utility	Description of Information Reported
✓			✓	✓	<p><i>Adapter Check Interrupts</i></p> <p>The driver generates this event when a hardware problem is detected. The Advanced Network Control Utility logs the number of adapter check errors detected by the driver.</p> <p>The NetFlex-3 driver tries to automatically restart the controller; if the active controller fails the standby controller starts.</p> <p>Corrective Action:</p> <p>At the next scheduled maintenance, run the Compaq Systems Configuration Utility and/or Compaq Diagnostics on the controller experiencing the errors to determine if the board should be replaced. If the error persists, contact your service provider.</p>
✓			✓	✓	<p><i>Switchover Media Failure</i></p> <p>The driver has initiated a switchover from the active to the standby adapter. A media failure initiated the switchover.</p> <p>Corrective Action:</p> <p>Check the connection to the hub. Verify that your hub has power.</p>
✓	✓		✓	✓	<p><i>Switchover Adapter Check</i></p> <p>The driver has initiated a switchover from the active to the standby adapter. The switchover was initiated due to an adapter failure. The NetFlex-3 switched control of the network to the standby controller because it detected a hardware problem.</p> <p>Corrective Action:</p> <p>At the next scheduled maintenance, run the Compaq Systems Configuration Utility and/or Compaq Diagnostics on the controller experiencing the errors to determine if the board should be replaced. If the error persists, contact your service provider.</p>
				✓	<p><i>Heartbeat Error Interrupts</i></p> <p>This is the number of times a collision pulse was not detected during the interframe gap. A malfunction in collision circuitry.</p> <p>Corrective Action:</p> <p>Check your cable and hub connections.</p> <p>Possible causes include the cable is unplugged or the connector is explicitly set to UTP. The cabling could also be loose, frayed, or damaged.</p> <p>Verify that your hub has power.</p>
✓		✓	✓		<p><i>Unexpected Slot Power Loss (Power Fault)</i></p> <p>A slot power fault was detected by the hot plug hardware.</p> <p>Corrective Action:</p> <p>Replace the controller and if the slot continues to have a power fault, reconfigure to another slot until the cause of the fault can be repaired.</p>
✓		✓	✓		<p><i>Unexpected Slot Power Loss (Slot Release Lever)</i></p> <p>The slot release lever was opened BEFORE the slot power was removed using the PCI Hot Plug Utility. Always turn off power to the PCI Hot Plug slot using the PCI Hot Plug Utility.</p> <p>Corrective Action:</p> <p>Close the slot lever. Power on the slot using the PCI Hot Plug Utility. Power off the slot before opening the slot release lever again if necessary.</p>

Network Status Change

Table 14 identifies network-related event failures and provides possible reasons for these failures. It also provides possible corrective actions. The NetFlex-3 driver switches operation from the primary controller to the secondary controller based on certain events.

You can view PCI Hot Plug slot and controller status information in the Advanced Network Control Utility and the PCI Hot Plug Utility. You can view status and error report information in the Windows NT System Event Log and the Compaq Integrated Management log.

Table 14
Network Status Change

Event Viewer	Insight Manager	Integrated Management log	PCI Hot Plug Utility	Advanced Network Control Utility	Description of Information Reported
✓				✓	<p><i>Link Status Transition Interrupts</i></p> <p>The number of times the link status has changed. Link status changes can occur when a cable is unplugged or a hub problem occurs. If a link status change occurs on the primary controller, the secondary controller assumes control of network activity. If the secondary controller is attached to the same hub as the primary controller, the problem will be resolved if the cause was related to a cabling problem. However, if the problem is related to the hub, both controllers might be marked failed and the event will be logged in the Windows NT Event Viewer.</p> <p>Corrective Action:</p> <p>If you receive an alert indicating a link failure, first check the cable connections and the seating of the failed controller to ensure that everything is properly installed.</p> <p>If you still receive errors, replace the cables attached to the failed controller. At the next scheduled maintenance, run Compaq Diagnostics on the controller. It might require replacement.</p>
				✓	<p><i>Receive Overruns</i></p> <p>Frames that could not be received due to inadequate resources (receive First In-First-Out (FIFO) full), or because their frame size exceeded the maximum allowed frame size.</p> <p>This problem can be caused by too much bus traffic, which might indicate the system is too busy.</p> <p>Corrective Action:</p> <p>You might need to increase the number of receive buffers.</p>
✓		✓	✓	✓	<p><i>Network Adapters No Longer Redundant</i></p> <p>A Netflex-3/Netelligent controller that is part of a controller pair has failed or was manually failed.</p> <p>Corrective Action:</p> <p>Check cables and look for event log entries with CPQNF3X as the source.</p>

Other Troubleshooting Tips

Here are other considerations when you are configuring a redundant controller pair:

- To simplify network setup, only one network adapter should be attached to the network during Windows NT installation. There may be a problem during the network setup phase if two adapters attempt to claim the same node name on the same network using two different addresses (IP address or DHCP supplied address in the case of TCP/IP).
- The secondary controller can be connected to a different hub. If the primary controller failure is related to a hub problem, the secondary controller will continue operation.

- A system performance impact occurs if you leave a network cable disconnected on a network controller. If you have a network controller that you do not want to connect, leave it uninstalled to avoid this situation.
- While hot replacing a failed controller, always replace the failed controller first if shutting down and restarting your server is necessary to make configuration changes. Some Compaq systems have PCI slots that span two PCI buses. Due to the nature of the PCI bus enumeration algorithm in Windows NT, removing a bridged PCI device in those systems might cause the bus numbers of other PCI slots to change. As a result, if you shutdown and restart your server after removing a failed dual controller, but before adding the replacement controller, your PCI NetFlex-3 drivers might not load properly because their corresponding PCI NetFlex-3 adapters have been assigned to a different bus than before. This may cause the currently active controller to appear with no connection to the network.

- Unbound Service

A set of registry entries for a controller does not bind to a physical piece of hardware. If any unbound services exist, the Advanced Network Control Utility detects them when the utility is started.

Here are some questions to ask yourself when trying to correct an unbound service problem and possible solutions:

- Did you physically remove a controller and not uninstall it first?
- Did you physically move an installed controller to another slot without uninstalling it first?
- Did you install a bridged PCI controller without uninstalling other PCI network controllers first?

To correct the problem, bind the registry entries to an uninstalled controller or remove the entries. Binding the service to an available controller allows the driver to install the controller and load the next time the server is restarted. You can bind or remove services when you run the Advanced Network Control Utility.

Here are some tips on resolving unbound services:

- It is best to bind adapters to controller pairs first.
 - Make sure you have enough available adapters to bind controller pairs. If controller pairs are not fully bound, and there are no more available adapters, you must remove the paired service.
 - Write down TCP/IP addresses, or other network information associated with an unbound driver service stored in the registry before removing that service.
- To achieve full-duplex, the network controllers and the network hub that you select must provide full-duplex capabilities. Check the documentation provided with the equipment.
 - Under certain specific conditions a broken cable cannot be detected. This can happen when using a controller with a version 1.0 ThunderLAN chip and receiving data from a file copy operation.

To see what version of the ThunderLAN chip a controller has, check the Hardware Information Tab for that controller.

The solution is to add the following value to the registry:

Value Name	Value Type	Value	Location
MinFrameSize	REG_DWORD	64 decimal 40 hex	HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\CpqNf3X\Parameters (where X is the instance #)

SUMMARY

Combining PCI Hot Plug technology with network interface controller redundancy offers higher availability and fault tolerance for network connectivity. Together, they allow you to maintain a continuous connection to the network while replacing a failed controller, without having to shut down the system. Compaq's network availability solution reduces unplanned downtime by allowing network administrators to perform online maintenance and monitoring, necessary in today's mission-critical environments.