

**EMULEX<sup>®</sup>**

*We network storage*

# **MultiPulse<sup>™</sup> for Linux**

*User Guide*

*Version 2.1*

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# Installation

## Introduction

MultiPulse™ for Linux is provided as an optional extension to the Emulex Linux 7.3 and 8.0.16 drivers. MultiPulse is used in active/active or active/standby storage array configurations containing multiple host bus adapters (HBAs) in the host, a switch, an array controller and a LUN or LUNs.

MultiPulse enables you to configure the following:

- LUN Migration - If all paths fail to an active array controller, MultiPulse enables you to route traffic to an inactive array controller (for active/standby storage array configurations only).
- Failover - In a primary path failure, MultiPulse enables you to define simple failover to a secondary path.
- Failback - If a failed primary path comes back online, MultiPulse enables you to route traffic back to the primary path. Automatic failback is the default setting.
- Heartbeat Monitoring/Validation (also known as Path Verification) - Monitors and validates all paths using Inquiry Serial Number.

## Supported Features

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- Installs as a loadable module
- Supports LPFC base driver features including:
  - Topology support: FC-AL, point to point, fabric with auto-topology negotiation
  - Support for 1, 2 and 4-gigabit (Gb) with auto rate negotiation
  - Support for up to 16 HBAs per host
  - Support for 256 targets per HBA port
  - Support for 256 LUNs per target
- HBAnyware™ Java-based remote management utility (packaged separately)
- Supports HP's XP 48, XP 128 active/active arrays
- Supports EVA 3000, EVA 5000 active/standby arrays
- Supports MSA 1000, MSA 1500 active/standby arrays (Only one initiator can be connected per array.)
- Simple failover - cold standby (primary/secondary routes)
- Automatic path-down recognition and failover
- Auto failback can be enabled or disabled
- End-to-end failover against HBA failure
- End-to-end failover against fabric failure (link/switch/ISL)
- End-to-end failover against failure of an HP storage controller (MSA, EVA or XP)
- Heartbeat monitoring/validation of all paths using Inquiry Serial Number
- Automatically sets up multi-path routes from all detected paths to multi-pathed devices (LUNs) at driver load time or system boot time
- Syslog message - error, alert, informational and warning log messages

- Coexistence - the MultiPulse module kit can co-exist on the same server with HP's SecurePath, EMC's PowerPath, Veritas' Dynamic MultiPathing (DMP) or the QLogic failover driver (See for the configuration rules.)
- Supports load balancing route types for creating routes

## Boot Support

MultiPulse provides boot support for the following:

- Emulex HBAs and drivers support remote boot (x86, Extensible Firmware Interface [EFI]).
- x86 boot supports a list of alternate boot devices in case a primary boot device fails.

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**Note:** The MultiPulse module is loaded after the BIOS boot sequence during kernel initialization.

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## Prerequisites

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### Hardware Architecture Support

MultiPulse supports the following architectures:

- x86\_64 architecture (AMD64 and Intel EM64T)
- IA64 architecture
- 32-bit Intel architecture (x86)

### Operating System Support

MultiPulse supports the following operating systems:

- Red Hat Enterprise Linux 3 (RHEL 3) Update 5 and above
- Red Hat Enterprise Linux 4 (RHEL 4) Update 1
- SUSE Linux Enterprise Server 8 (SLES 8) SP3 and above
- SUSE Linux Enterprise Server 9 (SLES 9) SP1 and above

## Compatibility

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- For a list of supported HBAs, refer to the Emulex Driver for Linux User Manual (version 8.0 or 7.3). The manuals are available from the Emulex Web site.

## Things to Know

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The MultiPulse module kit can co-exist on the same server with HP's SecurePath, EMC's PowerPath, Veritas' DMP or the QLogic failover driver, with the following configuration rules:

- No LUN can be configured with MultiPulse and another failover product simultaneously.
- No active/standby array can be shared between two failover products.
- Emulex recommends use of only a single failover product (or no failover) for all LUNs within a given active/active array.

# Configuration

## Introduction

This section describes how to configure MultiPulse for Linux systems with the MultiPulse module installed. You can configure separate FC paths to the same physical storage device as a MultiPulse logical device. This results in increased reliability and availability of the storage device to the host platform. Although this section refers to configuring MultiPulse on a single host platform, you can configure MultiPulse on all participating host platforms from a single host client.

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**Note:** The MultiPulse module must be installed on the system to access MultiPulse tabs.

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## Starting HBAnyware

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To start HBAnyware type:

```
/usr/sbin/hbanyware/hbanyware
```

## HBAnyware Window Element Definitions

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The **HBAnyware** window contains five basic components: the menu bar, the toolbar, the discovery-tree, the property tabs and the status bar.

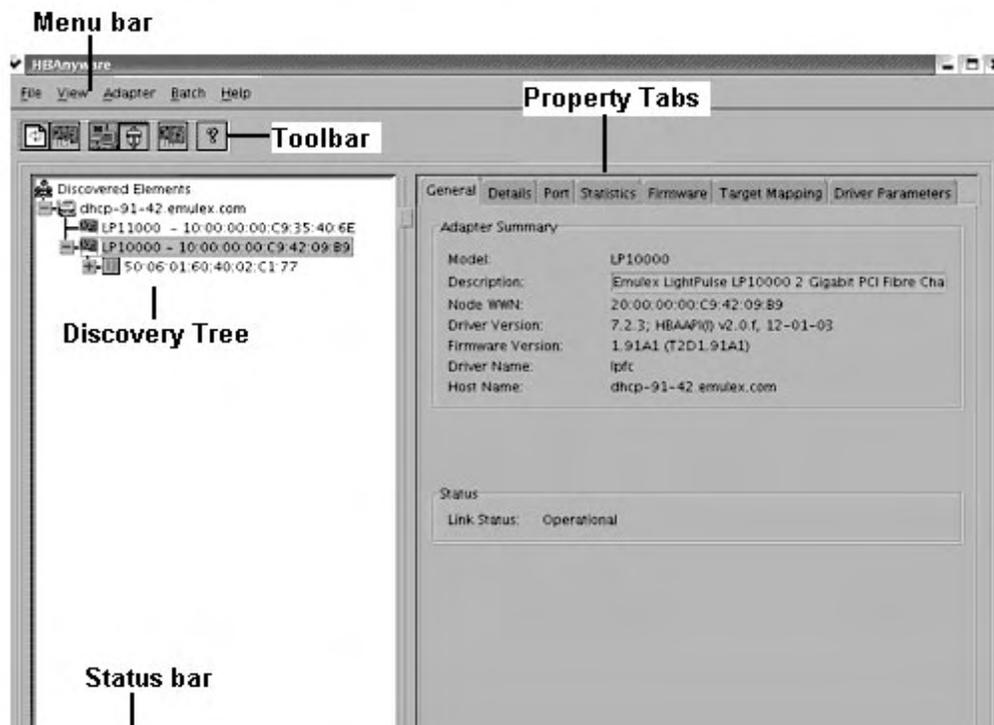


Figure 1: The HBAnyware Window with Element Call Outs

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**Note:** The element you select in the discovery-tree determines whether a menu item or toolbar icon is active. For example, if you select the local host or other system host, the Reset Adapter item on the Adapter menu is unavailable. The Reset Adapter toolbar button is unavailable as well.

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## Display Modes

You can view MultiPulse configuration data in two modes: Host Configuration Display Mode or LUN Specific Mode.

### Host Configuration Display Mode

The Host Configuration Display Mode shows all physical connections to an FC LUN between a specific HBA and a specific FC target. Figure 1 depicts the **MultiPulse Configuration** tab in Host Configuration Display Mode. The **MultiPulse Configuration** tab displays the **Route List** and **Available Path List** for the selected host. In this example, there are three routes configured on this host and four available paths.

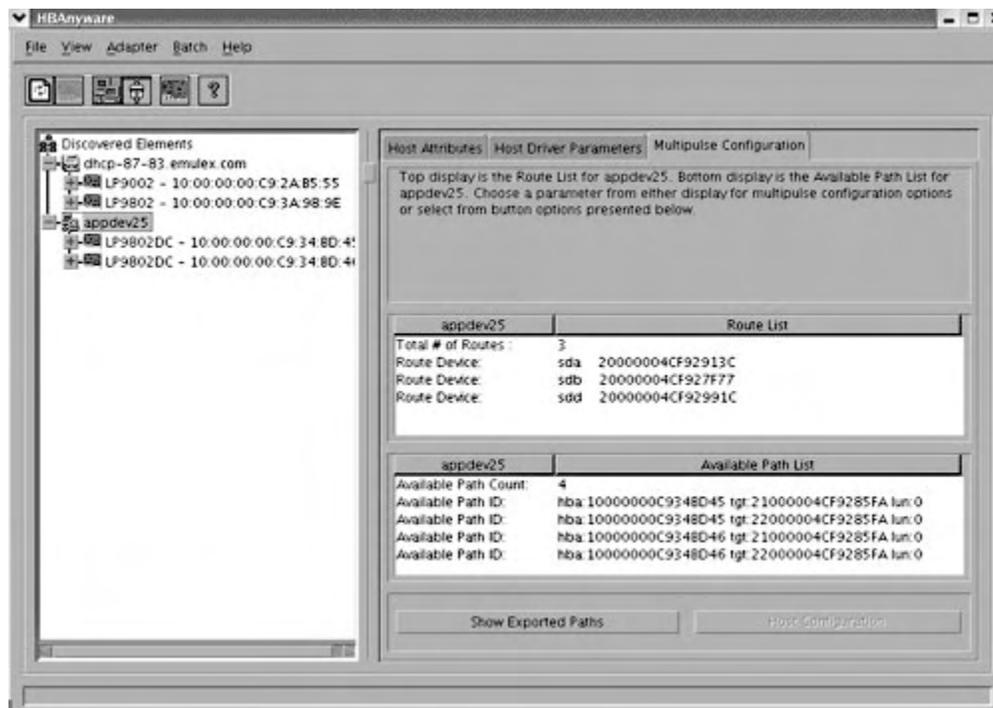


Figure 2: Host Configuration Display Mode for the Linux 2.6 Kernel Implementation

The Host Configuration Display Mode shows all the MultiPulse routes currently configured on the host platform and all paths available for MultiPulse configuration. The UDEV device names are included as part of the route name for 2.6 kernels (sda, sdb, and sdd are shown in the example).

To use Host Configuration Display Mode:

1. From the HBAnyware discovery-tree, select a specific host platform.

### LUN Display Mode

The LUN Display Mode shows a single logical connection to an FC LUN, between a specific HBA and a specific FC target. Figure 2 depicts the **MultiPulse Configuration** tab information for the selected LUN. The **MultiPulse Configuration** tab displays the **Route Path List** and **Available Path List** for the selected LUN.

To use LUN Display Mode:

1. From the HBAnyware discovery-tree, select a specific LUN.

Figure 3 depicts the LUN Display Mode as implemented on a 2.6 Linux kernel.

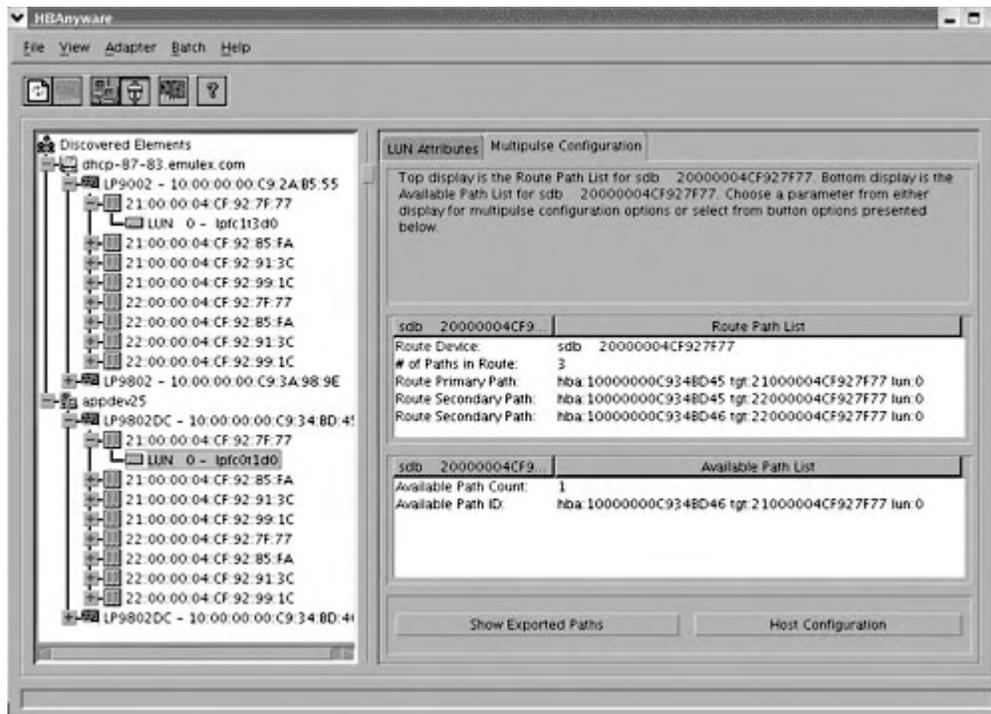


Figure 3: LUN Display Mode for the 2.6 Linux Kernel Implementation

Figure 4 is another example of LUN Display Mode except the LUN is not currently configured as part of a MultiPulse route. No route is displayed, however four available paths are shown.

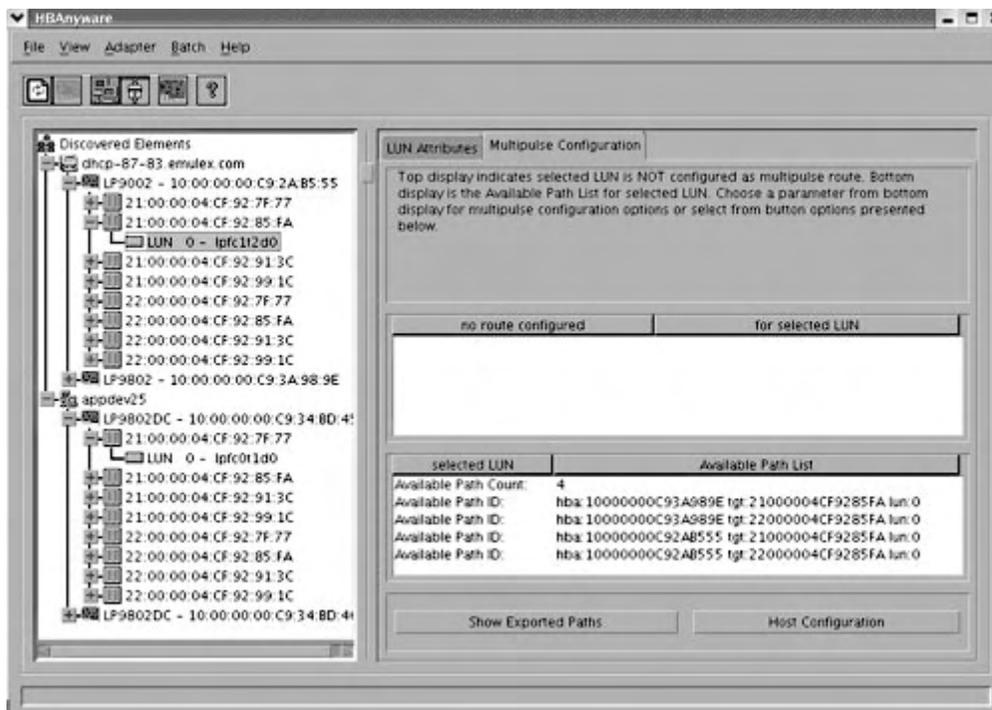


Figure 4: LUN Display Mode for the 2.6 Linux Kernel Implementation (LUN not configured)

## Configuring MultiPulse

Configure MultiPulse using the buttons located at the bottom of the **MultiPulse** tab. The type of buttons available depend on the item currently selected in the display tables.

To configure MultiPulse, use any of the following three features:

- Use the Available Path feature to create routes, add paths to routes and export paths. See page 6 for more information.
- Use the Route Device feature to edit route configurations, delete routes, view route paths and edit route paths. See page 11 for more information.
- Use the Route Path feature to remove paths from routes, view path information, make primary paths, view path status and edit path status. See page 15 for more information.

### Using the Available Path Feature

In MultiPulse, a path is a physical connection to a MultiPulse device between a specific HBA and a specific FC target. You select available paths from the **Available Path List** on the **MultiPulse Configuration** tab. When you select an available path, the **MultiPulse Configuration** tab shows three buttons: **Export Path**, **Create Route**, and **Show Exported Paths**.

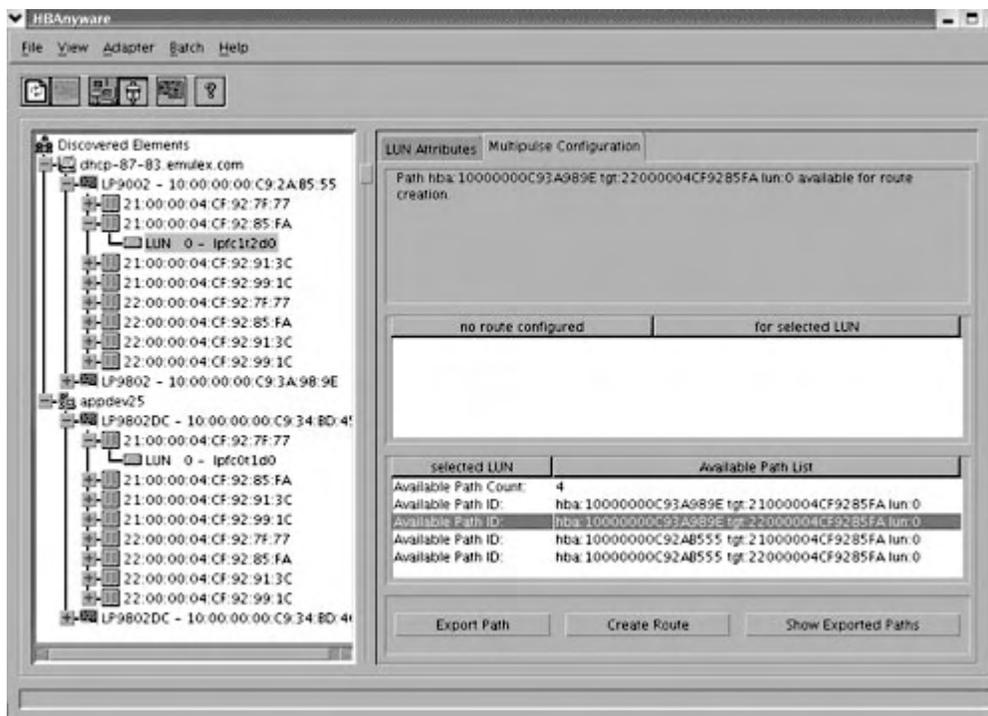


Figure 5: The MultiPulse Configuration Tab, with an Available Path selected

## Creating Routes

A route is a collection of paths to a MultiPulse device. You create routes using the **Create Failover Route** dialog box.

**Note:** If the physical device associated with this available path is already configured as a route, the **Create Route** button is replaced with the **Add Path To Route** button. See “Adding Paths to Routes” on page 9 for more information.

To create a route:

1. From the HBAnyware discovery-tree, select the device for which you want to create a route.
2. From the **MultiPulse Configuration** tab, select a path from the **Available Path List** and click **Create Route**. The **Create Failover Route** dialog box appears. The **Create Failover Route** dialog box lists all possible path candidates for inclusion in the route.
3. In the **Create Failover Route** dialog box, select at least two, but no more than four route paths. The available path selected from the **Available Path List** will typically become the primary path during route creation and appears as the first path in the **Select Route Paths** box.
4. In the **Create Failover Route** dialog box, select a route type. The default route type is FailOver. If you select the FailOver route type, select automatic or manual fallback (default is automatic).

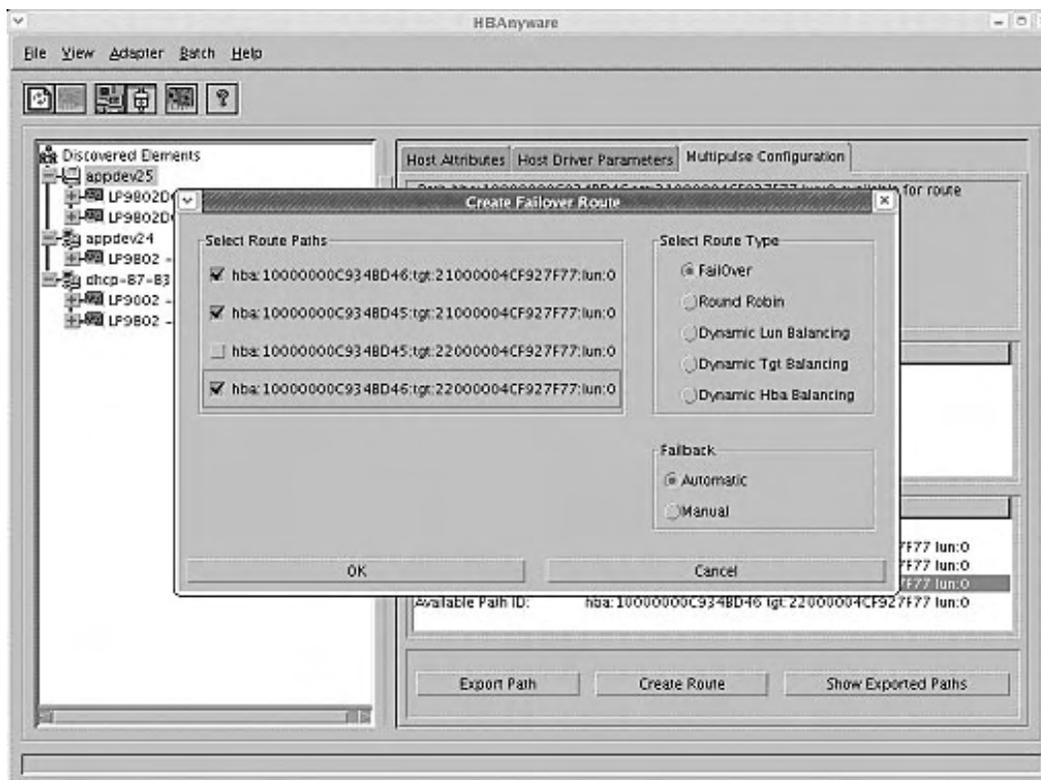


Figure 6: The Create Failover Route Dialog Box

- Click **OK**. The new route appears in the **Route Path List**.

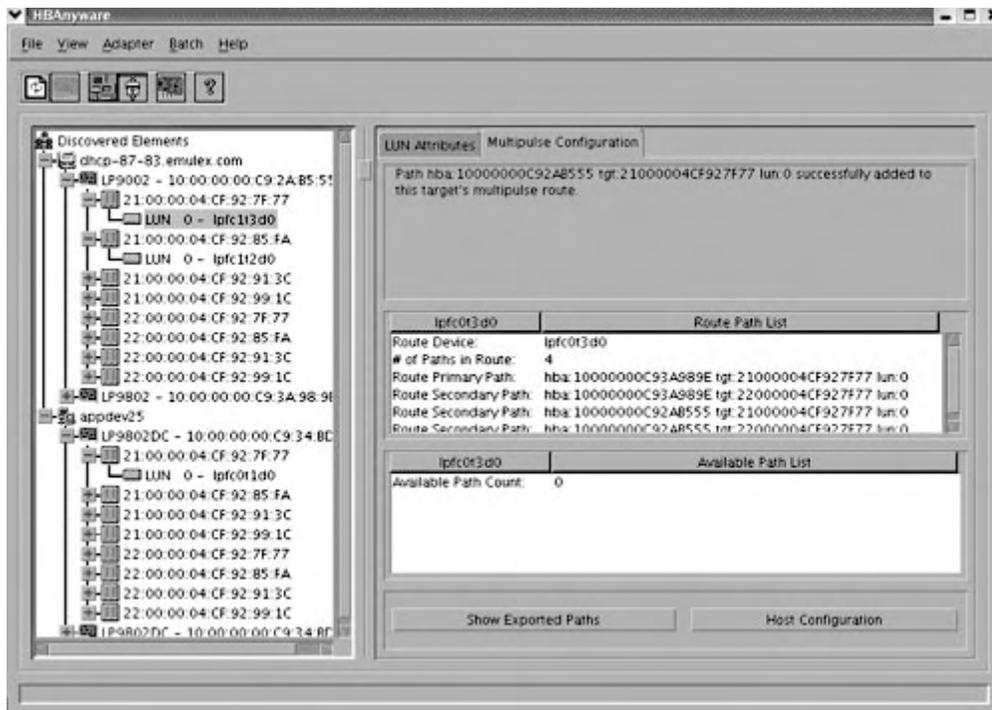


Figure 7: The New Route Appears in the Route Path List

## Adding Paths to Routes

Once you configure a MultiPulse route, you can add additional paths. If the path you selected from the **Route Path List** is associated with a configured device as a MultiPulse route, the **Add Path to Route** button replaces the **Create Route** button shown in Figure 6.

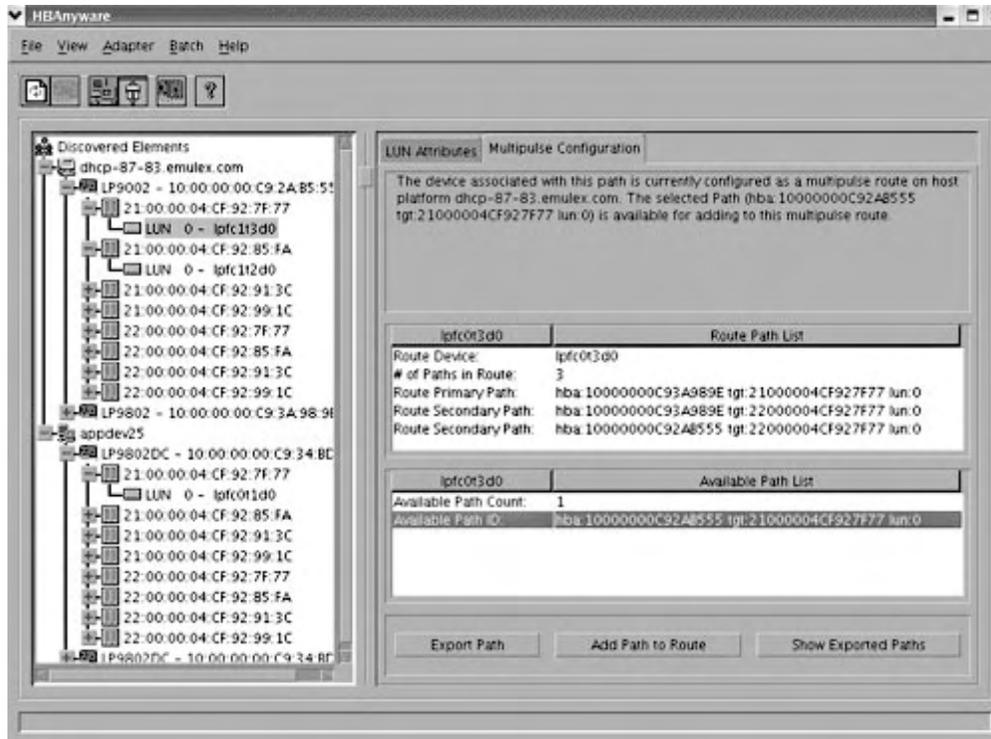


Figure 8: The MultiPulse Configuration Tab Displaying the Add Path to Route button

To add a path to the route:

1. From the HBAnyware discovery-tree, select the configured device to which you wish to add a path.
2. Click **Add to Path**. The new route appears in the **Route Path List**.

## Exporting Paths

An exported path is unavailable for MultiPulse configuration. An exported path is automatically removed from the **Available Path List** and added to the **Exported Path List**.

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**Note:** The path will only be exported from MultiPulse configuration until the module is unloaded. Exported paths do not persist across machine reboots or module loads.

---

To export a path:

1. From the HBAnyware discovery-tree, select the device whose path you wish to export.
2. From the **MultiPulse Configuration** tab, select the path you wish to export from the **Available Path List**.
3. Click **Export Path**.

## Showing Exported Paths

You can view the **Exported Path List** by clicking the **Show Exported Paths** button.

To view exported paths:

1. From the HBAnyware discovery-tree, select the device whose exported paths you wish to view.
2. From the **MultiPulse Configuration** tab, click **Show Exported Paths**. The **MultiPulse Configuration** tab displays the exported paths in the **Exported Path List**.

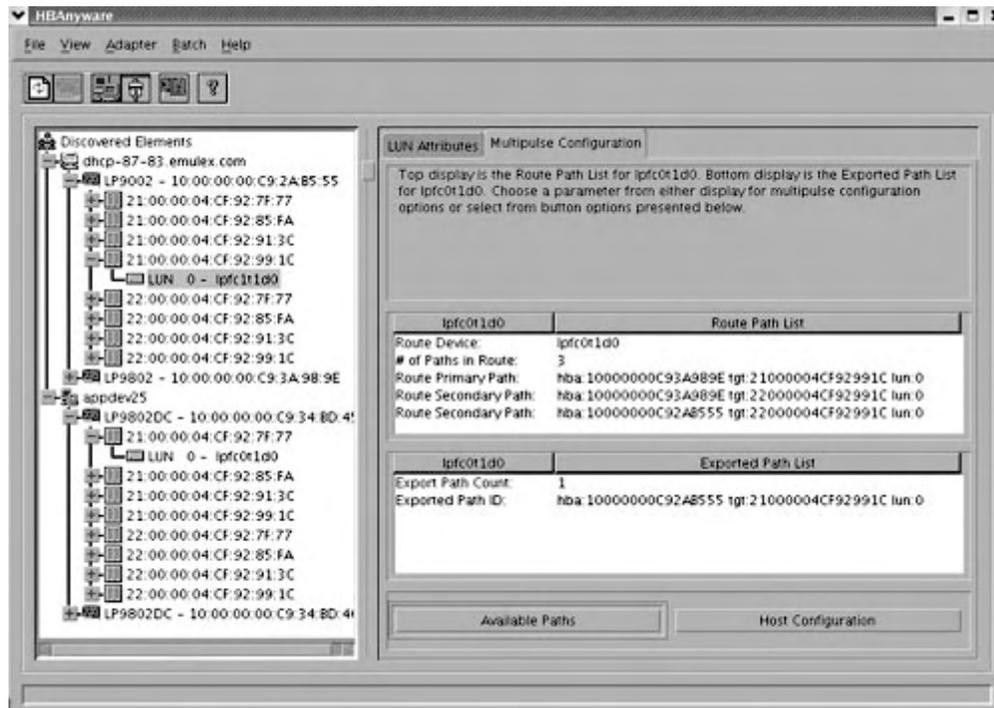


Figure 9: The MultiPulse Configuration Tab Showing the Exported Path List

## Using the Route Device Feature

Select a route device from the top table of the **MultiPulse Configuration** tab (the **MultiPulse Configuration** tab is on the right side of the HBAnyware screen with devices on the left and route paths on the right). When a route device is selected, the MultiPulse Configuration tab shows the **Configure Route**, **Delete Route**, **Host Configuration** and **Show Exported Path** buttons.

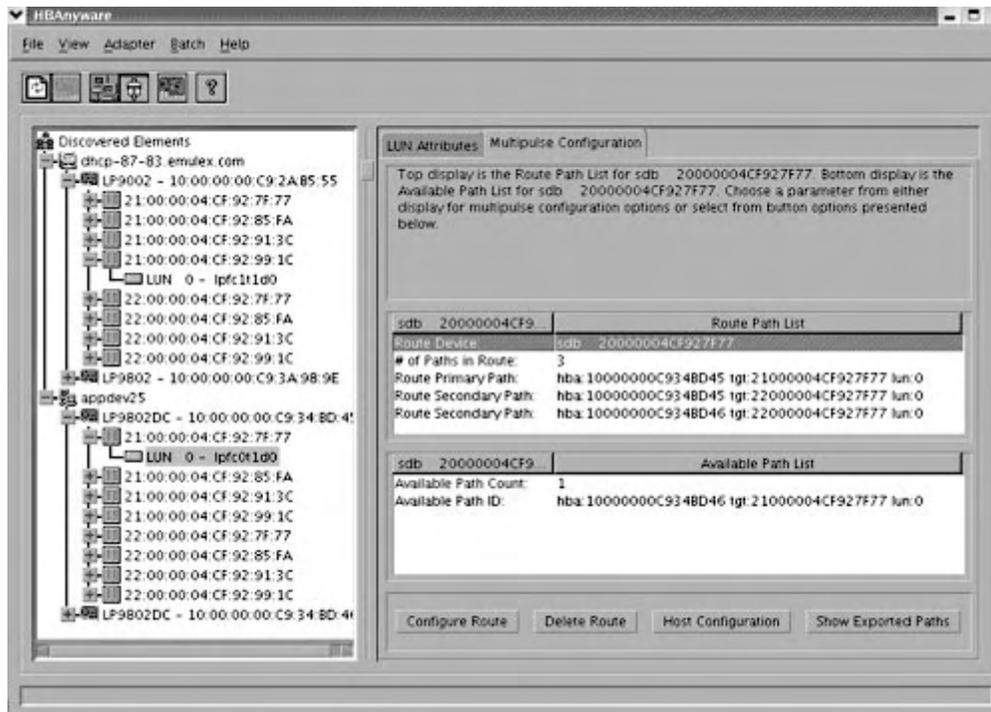


Figure 10: MultiPulse Configuration Tab, with a Route Device Selected

## Configuring Routes

After you select a device, you can configure a route for that device. To configure a route for a device, click the **Configure Route** button (see Figure 12 on page 13). The **MultiPulse Configuration** tab then shows the available route options to the left of the **Route List**. The following example depicts the **Control Type** and **Auto Failback** route options.

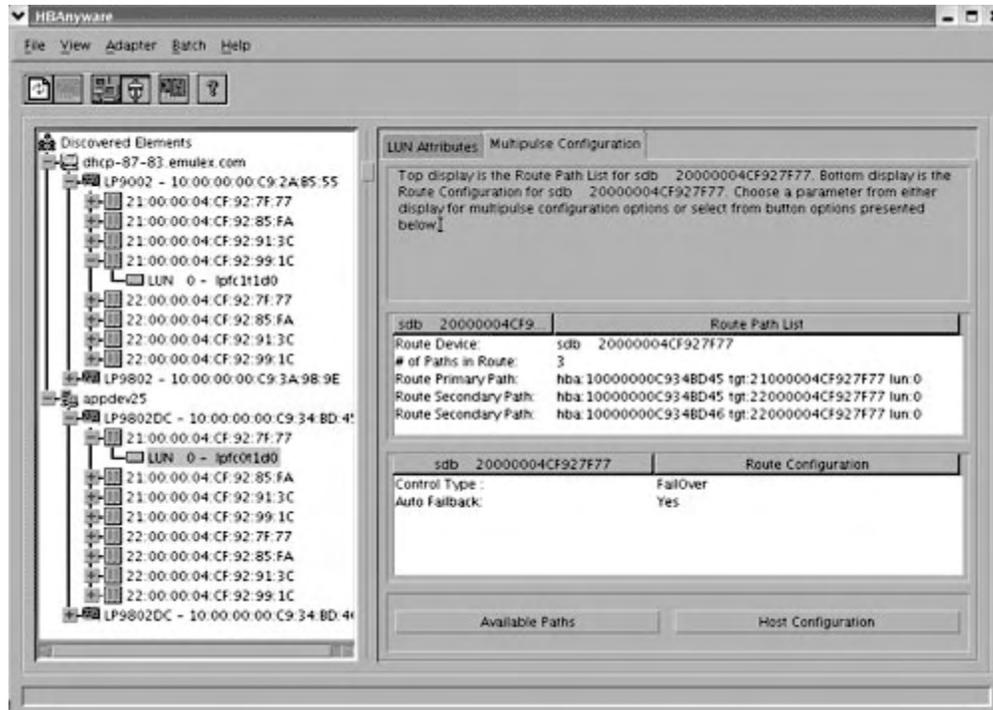


Figure 11: The MultiPulse Configuration Tab displaying Control Type and Auto Failback Route Options

When you select a route option, the **MultiPulse Configuration** tab enables you to select one of five available route configurations: **Failover**, **Round Robin**, **LUN Balance**, **Target Balance** and **HBA Balance**.

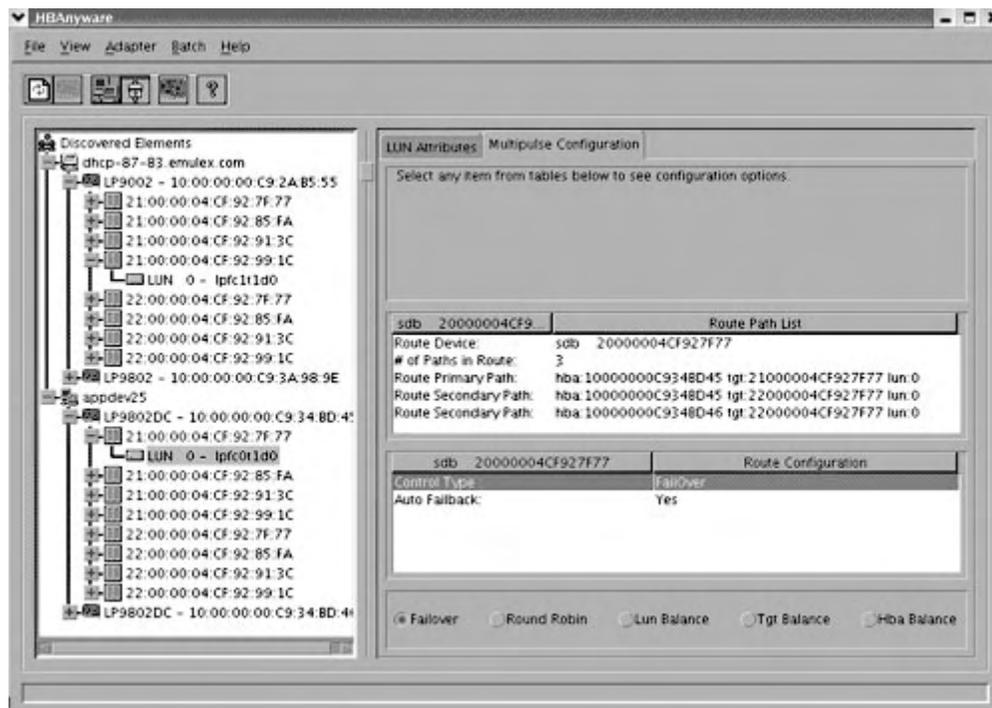


Figure 12: The MultiPulse Configuration Tab with Route Options displayed

If you select the **Failover** option at the bottom of the **MultiPulse Configuration** tab window (as above), you can also change the route's **Auto Failback** FailOver setting from either **Yes** or **No**:

- The **Yes** option causes MultiPulse to automatically route traffic back to the primary path in the event it goes down, but later comes back up.
- The **No** option prevents MultiPulse from attempting to route traffic back to the primary path in the event it goes down and comes back up.

To configure routes:

1. From the HBAAnyware discovery-tree, select the device whose route you wish to configure. Routes to that device appear in the **Route Path List**.
2. From the **MultiPulse Configuration** tab, select a **Route Device** from the list. The **MultiPulse Configuration** tab shows the available route options to the left of the **Route Configuration** List.
3. Select a route option from the bottom of the **MultiPulse Configuration** tab window.
4. Select the route configuration you want: **Failover**, **Round Robin**, **LUN Balance**, **Target Balance** or **HBA Balance**.

If you choose **Failover**, you can set the value of the route's **Auto Failback** feature by selecting **Auto Failback** from the list and checking **Yes** or **No**.

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**Note:** Only the **Failover** route type has been tested by Emulex.

---

## Deleting Routes

You can delete routes by selecting the route from the **Route Path List** on the **MultiPulse Configuration** tab and clicking the **Delete Route** button. The deleted route appears in the **Available Path List** as shown in the figure below.

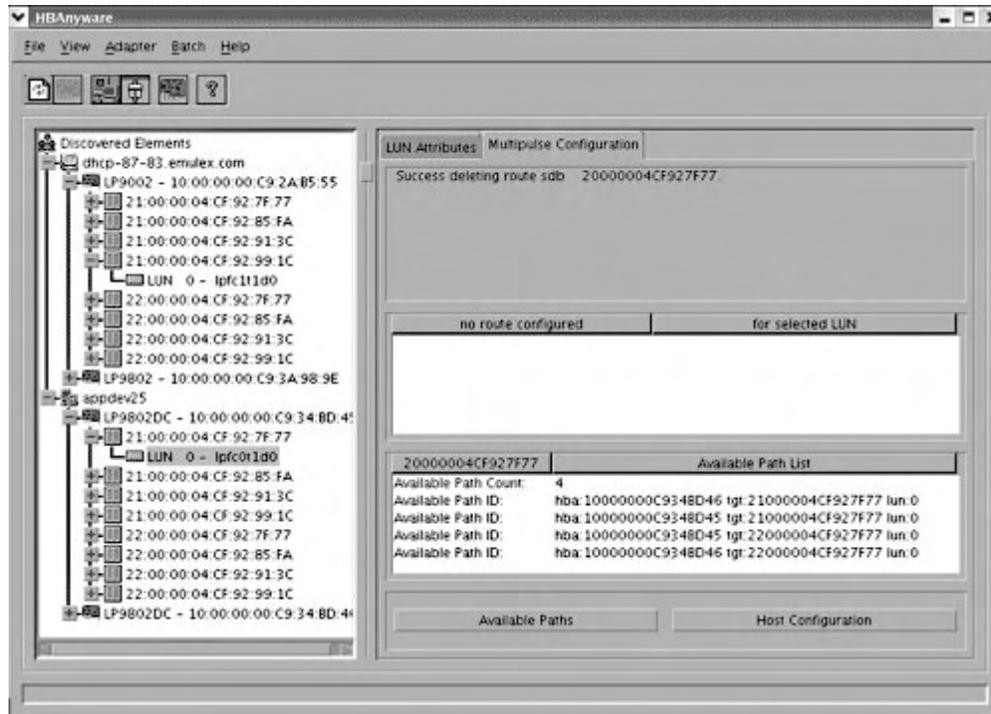


Figure 13: The MultiPulse Configuration Tab After a Route was Deleted

To delete a route:

1. From the HBAnyware discovery-tree, select the device whose route you wish to delete. Routes to that device appear in the **Route Path List**.
2. From the **Route Path List**, select the route you wish to delete.
3. Click **Delete Route**. The route appears in the **Available Path List**.

## Using the Route Path Feature

### Viewing and Editing Paths

There are two ways to view or edit the paths that comprise a route:

- Select a route from the **Route Path List**.
- Click the **Route Paths** button (available after you select a route device from the **Route Device List**).

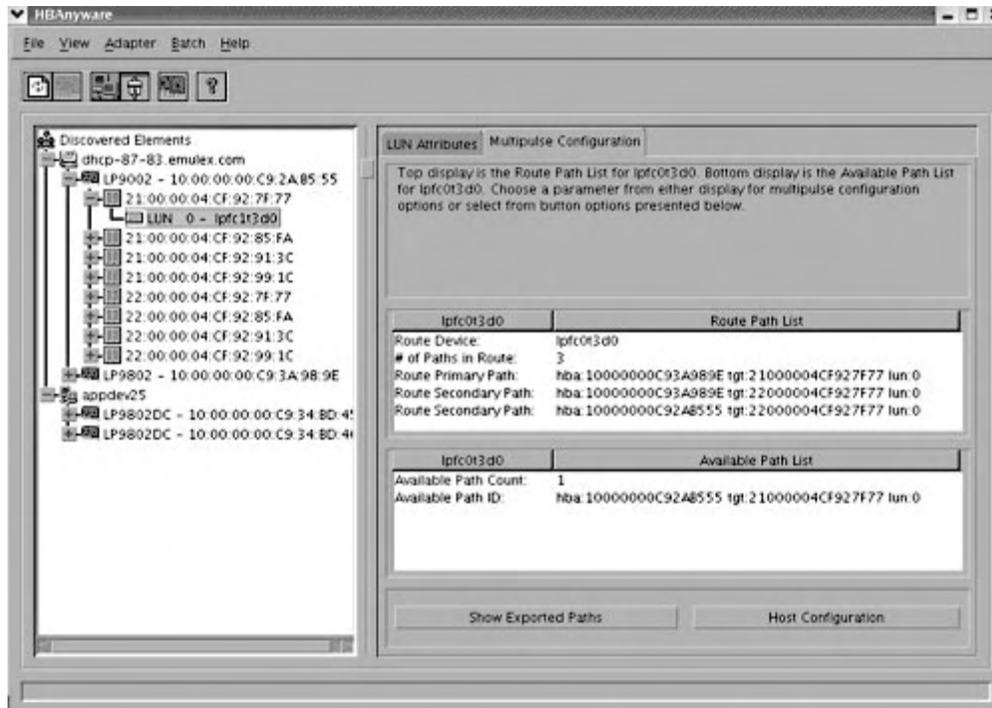


Figure 14: Select a Route from the Route Paths List to View or Edit Path Information

In either case, when you select a route the **MultiPulse Configuration** tab shows four buttons: **Remove Path**, **Make Primary**, **Path Status** and **Path Info**.

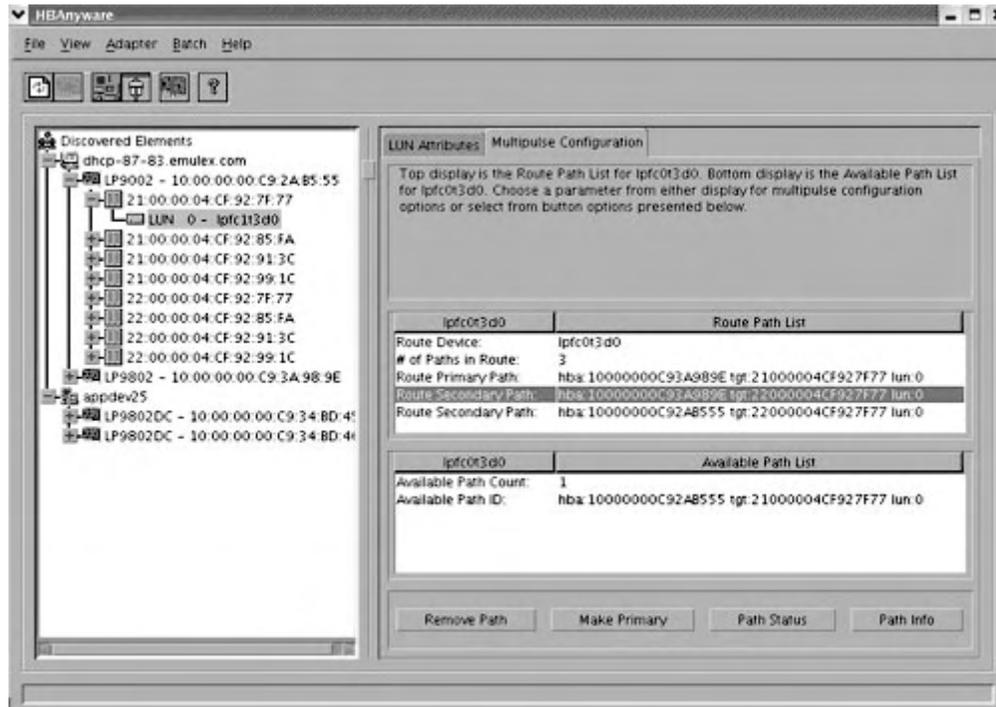


Figure 15: The MultiPulse Configuration Tab with a Route Path Selected

## Removing a Path From a Route

To remove a path from a route:

1. From the HBAAnyware discovery-tree, select the device whose path you wish to delete. Routes to that device appear in the **Route Path List**.
2. From the **Route Path List**, select the path you wish to delete.
3. Click **Remove Path**. The path then appears in the **Available Path List**.

## Making a Path a Primary Path

A primary path designates the preferred path for I/O traffic within a route.

To make a path a primary path:

1. From the HBAAnyware discovery-tree, select the device whose path you wish to configure. Routes to that device appear in the **Route Path List**.
2. From the **Route Path List**, select the path you wish to make a primary path.
3. Click **Make Primary**. This designates the path as the primary path.

## Enabling or Disabling Paths

You can enable or disable a path.

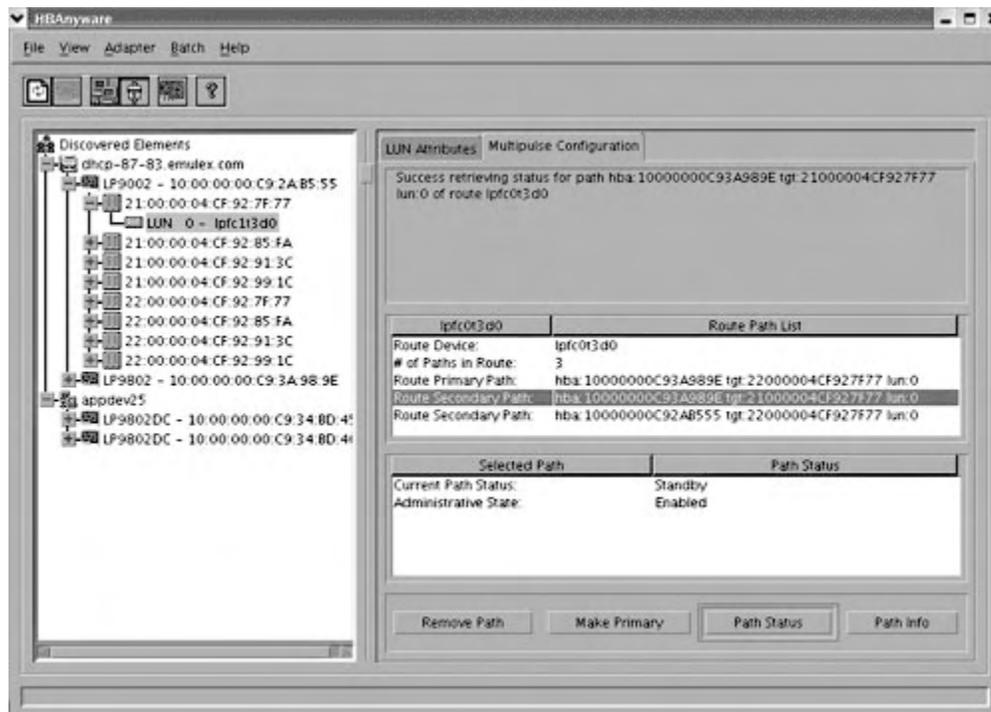


Figure 16: The MultiPulse Configuration Tab with Path Status Selected

To enable or disable a path:

1. From the HBAAnyware discovery-tree, select the device whose path you wish to enable or disable.
2. From the **Route Path List**, select the path you wish to enable or disable.
3. Click **Path Status**.
4. From the **Selected Path** list, select **Administrative State**.
5. Click **Enabled** to enable the path or **Disabled** to disable the path. When the path is set to **Disabled**, the current path status appears as "Disabled". When the **Enabled** button is selected, the current path status appears as "On-Line" (for route primary path) or "Standby" (for route secondary paths).

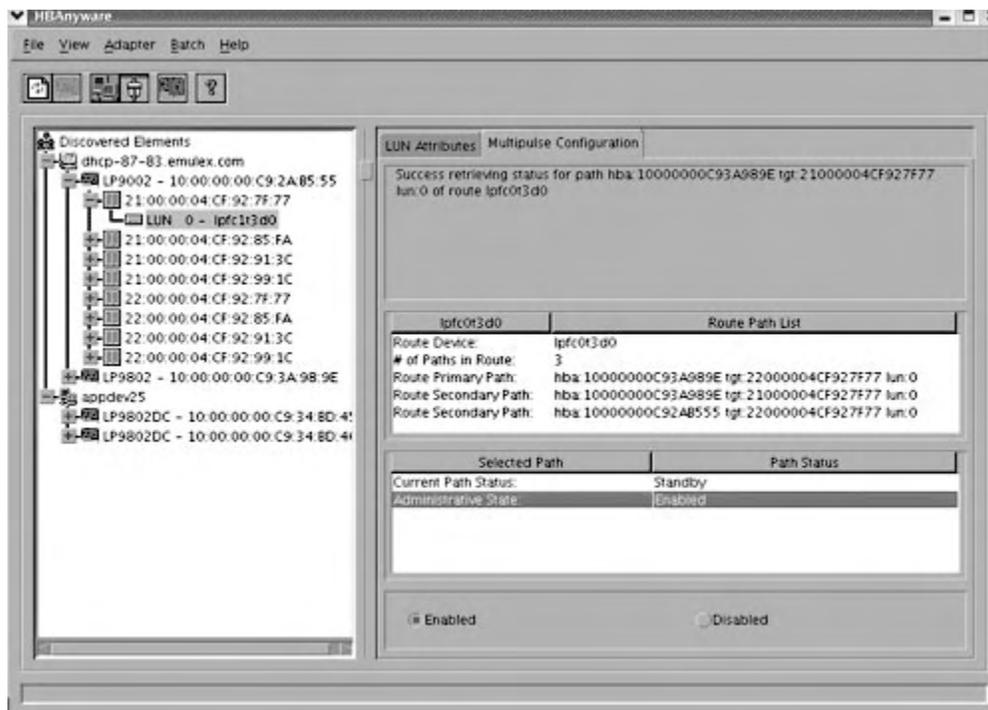


Figure 17: The MultiPulse Configuration Tab displaying the Enabled and Disabled buttons

## Viewing Path Information

You can view port, bus, target, LUN, vendor and other information for a selected path.

To view information for a selected path:

1. From the HBAnyware discovery-tree, select the device whose path information you wish to view.
2. From the **Route Path List**, select the path whose information you wish to view.
3. Click **Path Information**.

- The path information for the selected path appears in the **Path Information** column.

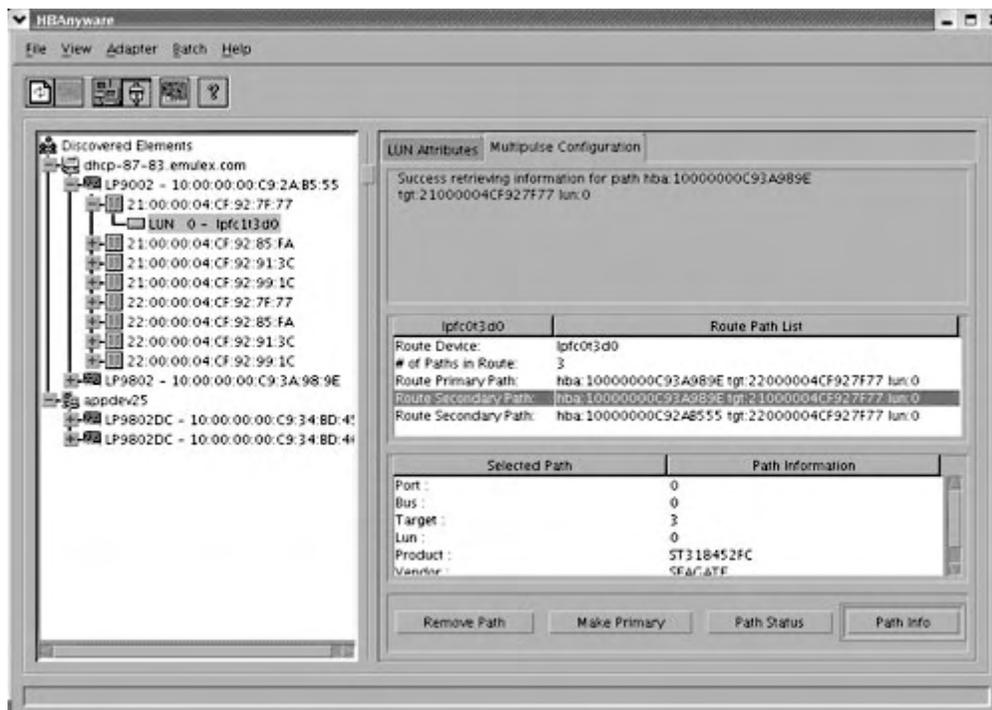
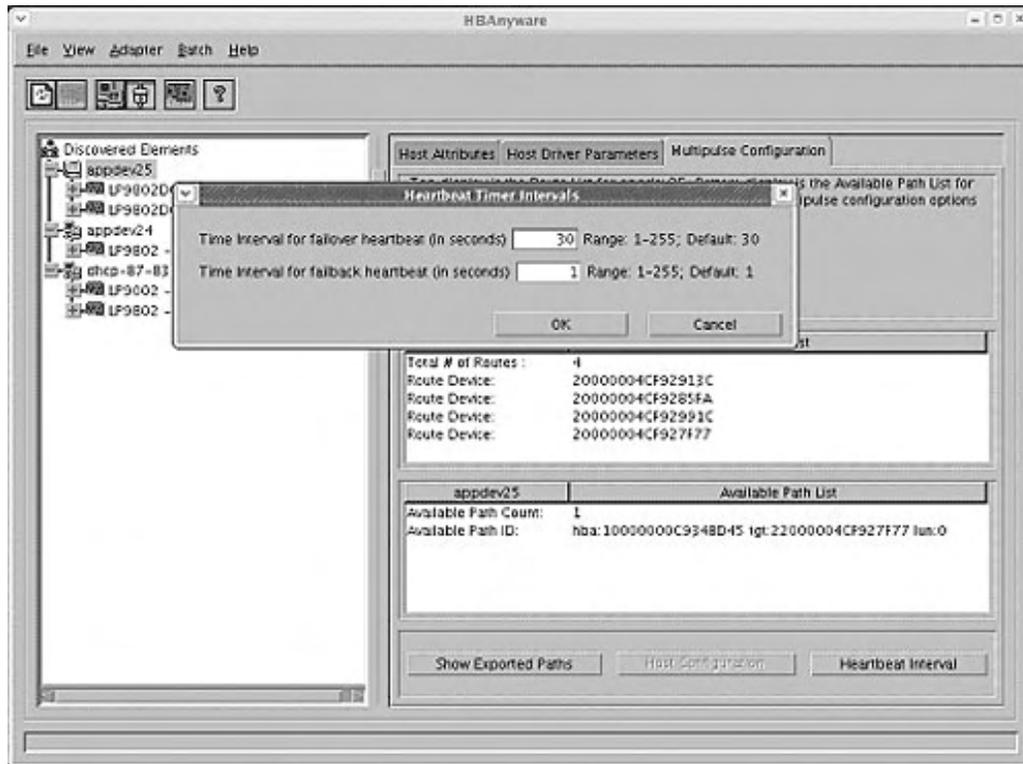


Figure 18: The MultiPulse Configuration tab displaying Path Information

## Editing Heartbeat Interval Timers

You can specify heartbeat interval timers for failover and failback heartbeat polling.



To specify heartbeat interval timers:

1. From the HBAnyware discovery-tree, select the device whose path information you wish to specify.
2. Click the **Heartbeat Interval** button. The Heartbeat Timer Interval's dialog box appears. The range is 1 - 255 seconds for both timers. The failover heartbeat time interval defaults to 30 and the failback time interval defaults to 1.
3. Specify the interval time.

---

**Note:** The failover time interval must always be larger than the failback timer interval.

---

4. Click **OK**.

## Auto-Configuration

You can configure MultiPulse devices in a number of different ways. All configurations key off of multiple paths from a server to a common storage device (or LUN). If more than one path exists to a common storage device, you can create a MultiPulse device. The MultiPulse device shows the multiple paths connected to it and also designates one of the paths as the primary path. Paths to the storage device are validated with the Inquiry Page 0x83 serial number or UID.

A MultiPulse device also has a presentation path assigned to it. The presentation path represents the SCSI host number, target ID and LUN ID used by the SCSI mid-layer to issue I/Os to the MultiPulse device. In the MultiPulse module, the presentation path of a MultiPulse device is always equal to the SCSI host number, target ID and LUN ID that the SCSI mid-layer used to send its initial inquiry for the primary path.

By default, auto-configuration is enabled. The MultiPulse module will automatically set up MultiPulse devices from the paths it detects at load time. If more than one path exists to a storage device, auto-configuration will create a MultiPulse device from one of the discovered paths.

If auto-configuration is disabled, static configuration in the `/etc/modprobe.conf` file (Linux 2.6 kernel) overrides auto-configuration.