This chapter describes how to configure trunk groups and 802.3ad link aggregation.

- Trunk groups are manually-configured aggregate links containing multiple ports.
- 802.3ad link aggregation is a protocol that dynamically creates and manages trunk groups.

**NOTE:** You can use both types of trunking on the same device. However, you can use only one type of trunking for a given port. For example, you can configure port 1/1 as a member of a static trunk group or you can enable 802.3ad link aggregation on the port, but you cannot do both.

### Configuring Trunk Groups

The Trunk Group feature allows you to manually configure multiple high-speed load-sharing links between two HP Routing Switches or between an HP Routing Switch and a server. You can configure up to 8 ports as a trunk group, supporting transfer rates of up to 8 Gbps of bi-directional traffic.

In addition to enabling load sharing of traffic, trunk groups provide redundant, alternate paths for traffic if any of the segments fail.

Figure 7.1 shows an example of a configuration that uses trunk groups.
NOTE: The ports in a trunk group make a single logical link. Therefore, all the ports in a trunk group must be connected to the same device at the other end.

Trunk Group Connectivity to a Server

To support termination of a trunk group, the server must have either multiple network interface cards (NICs) or either a dual or quad interface card installed. The trunk server is designated as a server with multiple adapters or a single adapter with multiple ports that share the same MAC and IP address. Figure 7.2 shows an example of a trunk group between a server and an HP device.
Trunk Group Rules

- You cannot configure a port as a member of a trunk group if 802.3ad link aggregation is enabled on the port.
- You can configure up to 64 trunk groups on a Chassis device.
- You can configure up to 8 ports in a trunk group on a Chassis device.
- Each trunk group must start with a primary port. The primary port is always the lowest number in the port range. For example, on the J4140A 10/100 module:
  - Ranges for four-port trunk groups: 1 – 4, 5 – 8, 9 – 15, 16 – 20, 21 – 24
  - Ranges for two-port trunk groups: 1 – 2, 3 – 4, 5 – 6, 7 – 8, 9 – 10, 11 – 12, 13 – 14, 15 – 16, 17 – 18, 19 – 20, 21 – 22, 23 – 24

**NOTE:** You can configure up to 12 trunk groups on an HP 9300 series 24-port 10/100 module. The 24-port 10/100 modules have the following primary ports: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, and 23. See Figure 7.5.

- Port assignment on a module must be contiguous. The port range on the module cannot contain gaps. For example, you can configure ports 1, 2, 3, and 4 on a module together as a trunk group but not ports 1, 3, and 4 (excluding 2).
- Port assignment cannot be across multiple trunk group boundaries.
- All the ports must be connected to the same device at the other end.
- All trunk group member properties must match the lead port of the trunk group with respect to the following parameters:
  - Port tag type (untagged or tagged port)
  - Port speed and duplex
  - QoS priority
To change port parameters, you must change them on the primary port. The software automatically applies the changes to the other ports in the trunk group.

- You can trunk two 10 Gigabit Ethernet ports together. The first port must be in an odd-numbered chassis slot and the second port must be in the following even-numbered slot. Trunking of 10-Gigabit Ethernet ports requires software release 07.6.01b or later. See “Configuring a Trunk Group of 10-Gigabit Ethernet Ports” on page 7-13.

Figure 7.3 shows an example of a valid 2-port trunk group link between devices. The trunk groups in this example are switch trunk groups, between two HP devices. Ports in a valid 2-port trunk group on one device are connected to two ports in a valid 2-port trunk group on another device. The same rules apply to 4-port trunk groups.
Figure 7.4 shows examples of two Chassis devices connected by multi-slot trunk groups.

Figure 7.4   Examples of multi-slot trunk groups
Figure 7.5 shows the valid 2-port and 4-port trunk groups on chassis 10/100 modules.

**Additional Trunk Group Rules for Multi-Slot Trunk Groups**

- You can configure a multi-slot trunk group on two Gigabit Ethernet modules.
- You can configure a maximum of eight ports in the trunk group.
- You can configure up to two groups of ports to make the trunk group and the groups must be alike. For example, you can group two sets of two ports together or two sets of four ports together but you cannot group a set of two ports with a set of four ports. Each group of ports can contain two or four ports.
- Each group of ports must begin with a primary port. On Gigabit Ethernet modules, the primary ports are 1, 3, 5, and 7.
- When you specify the ports in the trunk group, you must specify them in ascending numerical order, beginning with the primary port. For example, to specify a group containing ports 1/1 – 1/4 and 3/1 – 3/4, you must specify them in the order shown. You cannot specify 3/1 – 3/4 first.
- Port configuration for each trunk group is based on the configuration of the primary port. To change port parameters, you must change them on the primary port. The software automatically applies the changes to the other ports in the trunk group.
- If you plan to configure ports on a module into a server trunk group, use the following additional guidelines:
  - The management module(s) and the module that has the server trunk group’s ports must be in the same set of slots (slots 1 – 7 or 9 – 15). Do not place the management module(s) and the module containing the trunk ports in separate sets of slots.
  - Do not place the management module(s) or the module that has the server trunk group’s ports in slot 8.

These guidelines apply to a server trunk group that is configured on a single module or on a pair of modules (multi-slot trunk group). You do not need to follow these guidelines for a switch trunk group.
Trunk Group Load Sharing

When you configure a trunk group, you specify whether the trunk group is a “switch” trunk group or a “server” trunk group:

• Switch trunk group – Use this type of trunk group to connect one HP Routing Switch to another HP Routing Switch.

• Server trunk group – Use this type of trunk group to connect an HP Routing Switch to a file server or single host device.

The HP device load shares across the ports in the trunk group. The method used for the load sharing depends on the following:

• Traffic type – Layer 2 or Layer 3

• Trunk type – Switch or server

• For certain traffic, port type on which the traffic enters the HP device (Gigabit or 10/100)

NOTE: The port type applies only to Layer 2 traffic on a server trunk group configured on a Chassis device.

NOTE: On a device managed by a T-Flow, you can optimize server trunk load sharing on individual ports. See “Enabling Optimized Server Trunk Load Balancing (T-Flow only)” on page 7-16.

NOTE: HP devices also perform IP load sharing. See the “Configuring IP Load Sharing” section in the “Configuring IP” chapter of the Advanced Configuration and Management Guide.

Trunk Load Sharing with EP Modules

Table 7.1 lists how Enhanced Performance devices load balance traffic.

NOTE: The load sharing methods for server trunk groups also apply to trunks dynamically configured by 802.3ad link aggregation.

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>Trunk Type</th>
<th>Input Port Type</th>
<th>Load Balancing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 2</td>
<td>Switch</td>
<td>10/100 Ethernet</td>
<td>Destination MAC address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gigabit Ethernet</td>
<td>Destination MAC address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 Gigabit Ethernet</td>
<td>Destination MAC address</td>
</tr>
<tr>
<td>Server</td>
<td>10/100 Ethernet</td>
<td>Source MAC address</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gigabit Ethernet</td>
<td>Source MAC address</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 Gigabit Ethernet</td>
<td>Source MAC address</td>
<td></td>
</tr>
</tbody>
</table>
### Table 7.1: HP Trunk Group Load Sharing – EP devices (Continued)

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>Trunk Type</th>
<th>Input Port Type</th>
<th>Load Balancing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 2 IP</td>
<td>Switch</td>
<td>10/100 Ethernet</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gigabit Ethernet</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 Gigabit Ethernet</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td>Server</td>
<td>10/100 Ethernet</td>
<td>Source and destination IP addresses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gigabit Ethernet</td>
<td>Source and destination IP addresses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 Gigabit Ethernet</td>
<td>Source and destination IP addresses</td>
</tr>
<tr>
<td>Layer 3 IP</td>
<td>Switch</td>
<td>10/100 Ethernet</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gigabit Ethernet</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 Gigabit Ethernet</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td>Server</td>
<td>10/100 Ethernet</td>
<td>Source and destination IP addresses&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gigabit Ethernet</td>
<td>Source and destination IP addresses&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 Gigabit Ethernet</td>
<td>Source and destination IP addresses&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>New in 07.6.01b.
### Trunk Load Sharing with Standard (non-EP) Modules

Table 7.2 lists how Standard (non-EP) Chassis devices load balance traffic.

<table>
<thead>
<tr>
<th>Traffic Layer</th>
<th>Trunk Group Type</th>
<th>Traffic Type</th>
<th>Load-Sharing Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 2</td>
<td>Switch</td>
<td>All traffic types</td>
<td>Destination MAC address</td>
</tr>
<tr>
<td></td>
<td>Server</td>
<td>IP received on 10/100 port</td>
<td>Hash value derived from source and destination IP addresses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPX received on 10/100 port</td>
<td>Hash value derived from source and destination IPX addresses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AppleTalk received on 10/100 port</td>
<td>Hash value derived from source and destination AppleTalk addresses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other traffic types received on 10/100 port</td>
<td>Hash value derived from source and destination MAC address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All traffic types received on Gigabit port</td>
<td>Gigabit Port number on which traffic was received</td>
</tr>
<tr>
<td>Layer 3</td>
<td>Switch</td>
<td>IP</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPX</td>
<td>Destination IPX address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AppleTalk</td>
<td>Destination AppleTalk address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All other traffic types</td>
<td>Destination MAC address</td>
</tr>
<tr>
<td></td>
<td>Server</td>
<td>IP</td>
<td>Destination IP address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPX</td>
<td>Destination IPX address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AppleTalk</td>
<td>Destination AppleTalk address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All other traffic types</td>
<td>Destination MAC address</td>
</tr>
</tbody>
</table>

### Configuring a Trunk Group

1. Disconnect the cables from those ports on both systems that will be connected by the trunk group. Do not configure the trunk groups with the cables connected.
NOTE: If you connect the cables before configuring the trunk groups and then rebooting, the traffic on the ports can create a spanning tree loop.

2. Configure the trunk group on one of the two Routing Switches involved in the configuration.

3. Save the configuration changes to the startup-config file.

4. Dynamically place the new trunk configuration into effect by entering the **trunk deploy** command at the global CONFIG level of the CLI.

   **NOTE:** If you are running a software release earlier than 07.5.04, you must reload the software to place a trunk configuration change into effect.

5. If the device at the other end of the trunk group is another Routing Switch, repeat Steps 2 – 4 for the other device.

6. When the trunk groups on both devices are operational, reconnect the cables to those ports that are now configured as trunk groups, starting with the first port (lead port) of each trunk group.

7. To verify the link is operational, use the **show trunk** command.

**Example 1: Configuring the Trunk Groups Shown in Figure 7.1**

To configure the trunk groups shown in Figure 7.1, enter the following commands. Notice that the commands are entered on multiple devices.

**USING THE CLI**

To configure the trunk group link between Router1 and Router2:

   **NOTE:** The text shown in italics in the CLI example below shows messages echoed to the screen in answer to the CLI commands entered.

```
NARouter1(config)# trunk switch e 1/5 to 1/8
Trunk 2 is created for next power cycle.
Please save configuration to flash and reboot.
Router1(config)# write memory
Write startup-config in progress.
Write startup-config done.
Router1(config)# exit
Router1# reload
```

   **NOTE:** This example uses devices that are not running software release 07.5.004 or later. Devices running software earlier than 07.5.004 must be reloaded in order to place trunk configuration changes into effect. On devices running 07.5.004 or later, you can dynamically place trunk configuration changes into effect by entering the **trunk deploy** command at the global CONFIG level of the CLI.

To configure the trunk group link between Router2 and the server:

```
Router2(config)# trunk server e 1/2 to 1/4
Trunk 0 is created for next power cycle.
Please save configuration to flash and reboot.
Router2(config)# write memory
Write startup-config in progress.
Write startup-config done.
Router2(config)# exit
Router2# reload
```

You then configure the trunk group on the HP 2626 Switch.

```
HP2626(config)# trunk e 17/18 trk1 trunk
HP2626(config)# write memory
```

7 - 10
Write startup-config in progress.
Write startup-config done.
HP2626(config)# exit
HP2626# reload

You then configure the trunk group on the HP ProCurve Switch 4000M. For more information, see the documentation for the HP ProCurve Switch 4000M.

**USING THE WEB MANAGEMENT INTERFACE**

To configure ports 5 – 8 as a trunk group between two Routing Switches or a Routing Switch and a server:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Select the Trunk link.
   - If the device does not have any trunk groups configured, the Trunk configuration panel is displayed, as shown in the following example.
   - If a trunk group is already configured and you are adding a new one, click on the Add Trunk Group link to display the Trunk configuration panel, as shown in the following example.
   - If you are modifying an existing trunk group, click on the Modify button to the right of the row describing the trunk group to display the Trunk configuration panel, as shown in the following example.

   **NOTE:** This panel lists port ranges only for the slots that contain an active module. In addition, only the ranges that are valid for the module are listed.

   The port ranges listed by the panel contain four ports, but the default number of ports in a group is two. If you select a group and leave the number of ports in a group at two, the software assigns the first two ports in the group you select to the trunk group. The last two ports do not become members of the trunk group.

4. Select a port range. For example, you can select 1/5 – 1/8.
5. Select the number of ports you want to use in the trunk group. You can select 2 or 4.
6. Click in the checkbox next to Server to place a checkmark in the box if the other end of the trunk group is a server. If the other end of the connection is an HP Routing Switch, do not click this checkbox.
7. Click Apply to save the changes to the device’s running-config file.
8. Select the **Save** link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

9. Click on the plus sign next to Command in the tree view to list the command options.

10. Select the **Reload** link and select Yes when the Web management interface asks you whether you really want to reload the software.

11. If the other end of the trunk group is a Routing Switch, log in to the other device and follow the steps above.

**Example 2: Configuring a Trunk Group That Spans Multiple Gigabit Ethernet Modules in a Routing Switch**

To configure a trunk group that spans two modules in an HP 9300 series Chassis device, use one of the following methods.

**USING THE CLI**

To configure a trunk group consisting of two groups of ports, 1/1 – 1/4 on module 1 and 4/5 – 4/8 on module 4, enter the following commands:

```
HP9300(config)# trunk ethernet 1/1 to 1/4 ethernet 4/5 to 4/8
HP9300(config-trunk-1/1-4/8)# write memory
HP9300(config-trunk-1/1-4/8)# exit
HP9300(config)# trunk deploy
```

**NOTE:** The **trunk deploy** command dynamically places trunk configuration changes into effect, without a software reload. This command is supported only in software release 07.5.04 and later. If you are running a release earlier than 07.5.04, you must reload the software to place trunk configuration changes into effect.

**CLI Syntax**

**Syntax:** [no] trunk [server | switch] ethernet <primary-portnum> to <portnum> ethernet <primary-portnum> to <portnum>

**Syntax:** trunk deploy

The **server** | **switch** parameter specifies whether the trunk ports will be connected to a server or to another Routing Switch. This parameter affects the type of load balancing performed by the HP device. See “Trunk Group Load Sharing” on page 7-7. The default is **switch**.

Each **ethernet** parameter introduces a port group.

The **<primary-portnum>** to **<portnum>** parameters specify a port group. Notice that each port group must begin with a primary port. After you enter this command, the primary port of the first port group specified (which must be the group with the lower port numbers) becomes the primary port for the entire trunk group. For Gigabit Ethernet modules, the primary ports are 1, 3, 5, and 7.

To configure a trunk group consisting of two groups of two ports each, enter commands such as the following:

```
HP9300(config)# trunk ethernet 1/1 to 1/2 ethernet 3/3 to 3/4
HP9300(config)# write memory
HP9300(config)# trunk deploy
```

Notice that the groups of ports meet the criteria for a multi-slot trunk group. Each group contains the same number of ports (two) and begins on a primary port (1/1 and 3/3).

**USING THE WEB MANAGEMENT INTERFACE**

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.

2. Click on the plus sign next to Configure in the tree view to display the configuration options.

3. Select the **Trunk** link.
   - If the device does not have any trunk groups configured, the Trunk configuration panel is displayed, as shown in the following example.
Configuring Trunk Groups and Dynamic Link Aggregation

- If a trunk group is already configured and you are adding a new one, click on the Add Trunk Group link to display the Trunk configuration panel, as shown in the following example.

- If you are modifying an existing trunk group, click on the Modify button to the right of the row describing the trunk group to display the Trunk configuration panel, as shown in the following example.

4. Select a port range. For example, you can select 1/5 – 1/8.

5. Select 2 or 4 to indicate the number of ports in each group. Each group must have the same number of ports.

6. Select the port groups. Each group begins with the primary port number for that group. To select two groups, click on the first group, then hold down the CTRL key and click on the second group. Do not select more than two groups.

7. Select Server if you are connecting the trunk group ports to a server. Otherwise, the software assumes you are connecting the trunk group ports to another Routing Switch and uses the default value Switch.

8. Click Apply to save the changes to the device's running-config file.

9. Click on the plus sign next to Command in the tree view to list the command options.

10. Select the Reload link and select Yes when the Web management interface asks you whether you really want to reload the software.

11. If the other end of the trunk group is a Routing Switch, log in to the other device and follow the steps above.

NOTE: Hewlett-Packard recommends that you reload the software immediately after saving a trunk group configuration to flash memory, before making further configuration changes.

Configuring a Trunk Group of 10-Gigabit Ethernet Ports

Software release 07.6.04 enables you to configure 10 Gigabit Ethernet ports together in a trunk group (aggregate link).

To configure a trunk group containing two 10 Gigabit Ethernet ports, enter commands such as the following:

```
HP9300(config)# trunk ethernet 1/1 to 2/1
HP9300(config-trunk-1/1-2/1)# write memory
HP9300(config-trunk-1/1-2/1)# exit
HP9300(config)# trunk deploy
```
These commands configure a trunk group consisting of 10 Gigabit Ethernet ports 1/1 and 2/1, then deploy the trunk group. The trunk configuration does not take effect until you deploy it.

**Syntax:** [no] trunk [server | switch] ethernet <primary-portnum> to <secondary-portnum>

**Syntax:** trunk deploy

The `server` | `switch` parameter specifies whether the trunk ports will be connected to a server or to another Routing Switch. This parameter affects the type of load balancing performed by the HP device. See “Trunk Group Load Sharing” on page 7-7. The default is `switch`.

The `<primary-portnum>` parameter specifies the trunk group’s primary port. You must specify an odd-numbered slot. Valid primary ports are 1/1, 3/1, 5/1, 7/1, 9/1, 11/1, 13/1 and 13/1.

The `<secondary-portnum>` parameter specifies the secondary port in the trunk group. You must specify a port that is in the next slot number up from the primary port. For example, if the primary port is 1/1, specify 2/1 as the secondary port.

**NOTE:** Two-port trunk groups are supported for 10 Gigabit Ethernet. You cannot specify more than two ports.

To display configuration information and load-sharing statistics for the trunk group, enter the `show trunk` command. See “Displaying Trunk Group Configuration Information” on page 7-19.

**Additional Trunking Options**

The CLI contains commands for doing the following:

- Naming a trunk port
- Disabling or re-enabling a trunk port
- Deleting a trunk group

**NOTE:** To monitor the traffic on a trunk port, see “Monitoring an Individual Trunk Port” on page 6-53.

**Naming a Trunk Port**

To name an individual port in a trunk group, enter a command such as the following at the trunk group configuration level:

```
HP9300(config-trunk-4/1-4/4)# port-name customer1 ethernet 4/2
```

**Syntax:** [no] port-name <text> ethernet <portnum>

The `<text>` parameter specifies the port name. The name can be up to 50 characters long.

This command assigns the name “customer1” to port 4/2 in the trunk group consisting of ports 4/1 – 4/4.

**Disabling or Re-Enabling a Trunk Port**

You can disable or re-enable individual ports in a trunk group. To disable an individual port in a trunk group, enter commands such as the following at the trunk group configuration level:

```
HP9300(config-trunk-4/1-4/4)# config-trunk-ind
HP9300(config-trunk-4/1-4/4)# disable ethernet 4/2
```

**Syntax:** [no] config-trunk-ind

**Syntax:** [no] disable ethernet <portnum>

The `config-trunk-ind` command enables configuration of individual ports in the trunk group. If you do not use this command, the `disable` command will be valid only for the primary port in the trunk group and will disable all ports in the trunk group. You need to enter the `config-trunk-ind` command only once in a trunk group. After you enter the command, all applicable port configuration commands apply to individual ports only.
NOTE: If you enter `no config-trunk-ind`, all port configuration commands are removed from the individual ports and the configuration of the primary port is applied to all the ports. Also, once you enter the `no config-trunk-ind` command, the `enable`, `disable`, and `monitor` commands are valid only on the primary port and apply to the entire trunk group. 

The `disable` command disables the port. The states of other ports in the trunk group are not affected. If you have configured a name for the trunk port, you can specify the port name, as shown in the following example:

```
HP9300(config-trunk-4/1-4/4)# config-trunk-ind
HP9300(config-trunk-4/1-4/4)# disable customer1
```

**Syntax:** `disable <portname>`

To enable an individual port in a trunk group, enter commands such as the following at the trunk group configuration level:

```
HP9300(config-trunk-4/1-4/4)# config-trunk-ind
HP9300(config-trunk-4/1-4/4)# enable ethernet 4/2
```

**Syntax:** `enable ethernet <portnum>`

**Syntax:** `enable <portname>`

### Disabling or Re-Enabling a Range or List of Trunk Ports

To disable a range of ports in a trunk group, enter commands such as the following:

```
HP9300(config)# trunk switch ethernet 2/1 to 2/8
HP9300(config-trunk-2/1-2/8)# config-trunk-ind
HP9300(config-trunk-2/1-2/8)# disable ethernet 2/2 to 2/5
```

This command disables ports 2/2 – 2/5 in trunk group 2/1 – 2/8.

To disable a list of ports, enter a command such as the following:

```
HP9300(config-trunk-2/1-2/8)# disable ethernet 2/2 ethernet 2/4 ethernet 2/7
```

This command disables ports 2/2, 2/4, and 2/7 in the trunk group. You can specify a range and a list on the same command line. For example, to re-enable some trunk ports, enter a command such as the following:

```
HP9300(config-trunk-2/1-2/8)# enable ethernet 2/2 to 2/5 ethernet 2/7
```

**Syntax:** `[no] disable ethernet <portnum> [to <portnum> | ethernet <portnum>]`

**Syntax:** `[no] enable ethernet <portnum> [to <portnum> | ethernet <portnum>]`

The `to <portnum>` parameter indicates that you are specifying a range. Specify the lower port number in the range first, then `to`, then the higher port number in the range.

The `ethernet <portnum>` parameter specifies an individual port. You can enter this parameter multiple times to specify a list, as shown in the examples above.

### Deleting a Trunk Group

To delete a trunk group, use either of the following methods.

**USING THE CLI**

To delete a trunk group, use "`no`" in front of the command you used to create the trunk group. For example, to remove one of the trunk groups configured in the examples above, enter the following command:

```
HP9300(config)# no trunk ethernet 1/1 to 1/2 ethernet 3/3 to 3/4
```

**Syntax:** `no trunk ethernet <portnum> to <portnum>`
**USING THE WEB MANAGEMENT INTERFACE**

To delete a trunk group:

1. Disconnect the ports to the server or Routing Switch at the other end of the trunk.
2. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
3. Click on the plus sign next to Configure in the tree view to display the configuration options.
4. Select the Trunk link to display a table listing the configured trunk groups.
5. Click the Delete button next to the trunk group you want to delete.
6. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.
7. Click on the plus sign next to Command in the tree view to list the command options.
8. Select the Reload link and select Yes when the Web management interface asks you whether you really want to reload the software.

**NOTE:** If the other end of the trunk group is a Routing Switch, log in to the other system and follow the applicable steps above.

**Enabling Optimized Server Trunk Load Balancing (T-Flow only)**

You to optimize individual ports for server trunk load balancing. An optimized port load balances based on source and destination IP address but uses a smaller session table, which enables the port to more quickly forward traffic received on the port to the server trunk group ports.

**NOTE:** This enhancement applies only to the T-Flow.

**NOTE:** This enhancement applies to server trunk groups only, not to switch trunk groups.

Without optimization, the device performs the following types of load balancing for IP traffic.

**Layer 2**

The load balancing occurs at Layer 2 if the traffic is being forwarded in hardware. IP traffic on a server trunk group is load balanced as follows:

- On a Routing Switch:
  - IP traffic received on a 10/100 port or Gigabit port is load balanced based on destination IP address.

**Layer 3**

If any of the following features are enabled on a port, load balancing occurs in software using the entries in the session table. In this case, the IP traffic is load balanced based on source and destination IP address.

- ACLs
- Rate limiting (Fixed Rate Limiting or Adaptive Rate Limiting)
- NetFlow
- sFlow Export
- Network Address Translation (NAT)
- Policy-Based Routing (PBR)

If you do not have any of these features enabled on the port but you still want to load balance the traffic based on source and destination IP address, you can do so by enabling the server trunk load balancing optimization feature. Even if you do have one of the features above configured on the port, you can enhance load balancing
performance by enabling the optimization feature. The optimization feature uses a smaller session table, which allows forwarding to occur more quickly.

**NOTE:** When you enable the server trunk load balancing optimization feature on a port, the feature listed above are disabled on that port. This occurs because the features use the session table, but the optimization feature uses a smaller session table than the other features. The configuration information for the other features is retained in the device’s configuration file, but the features are disabled.

**Example of Server Trunk Load Balancing at Layer 3**

Figure 7.6 shows an example of how IP traffic is load balanced to server trunk ports when the traffic is forwarded at Layer 3. In this example, server trunk load balancing based on source and destination IP addresses is enabled on a Gigabit Ethernet port connected to a network containing multiple clients. Four other Ethernet ports are configured in a server trunk group that is connected to a multi-homed server. The server can have multiple network adapters or a single adapter with multiple ports that have unique MAC and IP addresses.

**Figure 7.6 Server trunk load balancing based on source and destination IP addresses**

When the port connected to the client network receives traffic that needs to be forwarded to the server, the HP device selects one of the ports in the trunk group, and forwards the traffic on the selected port.

The HP device selects the trunk port based on a hash value, which can be a number from 1 – 256. The HP device calculates a hash value for traffic that enters the device through the server trunk load balancing port and exits the device through a trunk group. The hash value is calculated based on the source and destination IP addresses in the traffic.

After the HP device calculates the hash value for the traffic, the device examines the trunk ports connected to the destination address and selects the port with the fewest hash values already assigned. After calculating a hash value and assigning the value to a port, the device always uses the same port to forward traffic for the same source and destination IP addresses.
For example, the first time the HP device receives traffic from 10.10.10.7 addressed to 20.20.20.88, the device calculates the hash value 2 for the traffic. The device then checks the trunk ports to see whether a port is assigned to hash value 2.

- If a trunk port is assigned to hash value 2, the device uses that port to forward the traffic.
- Otherwise, the device assigns hash value 2 to the trunk port with the fewest hash values already assigned to it. The device continues to use this port for traffic with hash value 2, until a state change occurs on a trunk port or a trunk port is added or removed.

Trunk ports keep the hash values that are assigned to them until a trunk port's state changes or a trunk port is added or removed. When any of these changes occurs, the HP device clears the hash values from all of the trunk ports and begins calculating and assigning hash values again for new traffic.

**Configuration Considerations**

- You can enable the server trunk load balancing optimization feature on an individual port basis only. You cannot enable the feature on a virtual routing interface basis. This is true even if you have assigned a virtual routing interface to the trunk ports.
- Each TSP CPU has a separate hash bucket for the ports managed by the CPU. The buckets are independent of one another. Thus, if you enable the feature on more than one port and the ports are not managed by the same CPU, it is possible for the same hash values to be assigned to more than one trunk port, because the values are assigned separately by each CPU.
- When you enable the server trunk load balancing optimization feature on a port, the following features are disabled on the port:
  - ACLs
  - Rate limiting (Fixed Rate Limiting or Adaptive Rate Limiting)
  - NetFlow
  - sFlow Export
  - Network Address Translation (NAT)
  - Policy-Based Routing (PBR)

  The features are disabled because the server trunk load balancing optimization feature uses a simpler session table whose forwarding entries are keyed by source and destination IP addresses only. The features listed above require use of the standard session table, which also includes keys for the IP protocol and the source and destination TCP or UDP application ports (when the IP protocol is TCP or UDP).

  The configuration information for these features remains in the device’s configuration file but the features are disabled on the port.

**Enabling Server Trunk Load Balancing Optimization (T-Flow Module Only)**

To enable server trunk load balancing optimization, you enable the feature on the ports that will receive the traffic that needs to be load balanced. To enable the optimization feature on a port, enter the following command at the configuration level for the port:

```plaintext
HP9300(config-if-e1000-1/4)# stlb
```

**Syntax:** `[no] stlb`

**Displaying Server Trunk Load Balancing Information**

To display the current hash assignments for server trunk ports, log on to the TSP CPU that is managing the ports, then enter the `show trunk` command. Here is an example.

```plaintext
HP9300# rconsole 2 1
HP93002/1 # show trunk
HP93002/1 #Number of trunk groups: 1
```

Note: Value in () is for server trunk hashing.
Configuring Trunk Groups and Dynamic Link Aggregation

TRUNK ID: 71  server:1  multi-slot:0
configured ports: 8/1  8/2  8/3  8/4
active ports : 8/1 (2)  8/2 (2)  8/3 (2)  8/4 (1)
HP93002/1 # rconsole-exit

The **rconsole 2 1** command logs on to TSP CPU 1 on the T-Flow module in slot 2.

The **show trunk** command displays the trunk information for the ports managed by the CPU. The server trunk load balancing information is shown in bold type in this example. The number in parentheses indicates how many hash values are assigned to the port. The CPU assigns the hash values evenly to the trunk ports managed by the CPU. In this example, the next time the device needs to assign a hash value, the device will assign the value to port 8/4.

The **rconsole-exit** command logs out of the TSP CPU.

**Syntax:** show trunk

For information about the T-Flow, including how the module distributes management of the ports in the chassis, see “Using the T-Flow Redundant Management Module” on page 4-1.

Displaying Trunk Group Configuration Information

To display configuration information for the trunk groups configured on the Chassis device, use one of the following methods. Each method displays information for configured trunk groups and operational trunk groups.

A configured trunk group is one that has been configured in the software but has not been placed into operation by a reset or reboot. An operational trunk group is one that has been placed into operation by a reset or reboot.

**USING THE CLI**

Enter the following command at any CLI level:

```
HP9300(config)# show trunk
```

```
Configured trunks:
Trunk Type Ports
1  Switch 1/1 1/2 1/3 1/4 2/1 2/2 2/3 2/4

Operational trunks:
Trunk Type Ports  Duplex Speed Tag Priority
1  Switch 1/1 1/2 1/3 1/4 2/1 2/2 2/3 2/4  None  None  No level0
```

**Syntax:** show trunk [ethernet <portnum> to <portnum>]

The following table describes the information displayed by the **show trunk** command.

**Table 7.3: CLI Trunk Group Information**

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk</td>
<td>The trunk group number. The software numbers the groups in the display to make the display easy to use.</td>
</tr>
<tr>
<td>Type</td>
<td>The type of trunk group, which can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• Server – The trunk group is connected to a server.</td>
</tr>
<tr>
<td></td>
<td>• Switch – The trunk group is connected to another Routing Switch.</td>
</tr>
<tr>
<td>Ports</td>
<td>The ports in the trunk group.</td>
</tr>
</tbody>
</table>
## Table 7.3: CLI Trunk Group Information (Continued)

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
</table>
| Duplex        | The mode of the port, which can be one of the following:  
|               | • None – The link on the primary trunk port is down.  
|               | • Full – The primary port is running in full-duplex.  
|               | • Half – The primary port is running in half-duplex.  
|               | **Note:** This field and the following fields apply only to operational trunk groups. |
| Speed         | The speed set for the port. The value can be one of the following:  
|               | • None – The link on the primary trunk port is down.  
|               | • 10 – The port speed is 10 Mbps.  
|               | • 100 – The port speed is 100 Mbps.  
|               | • 1G – The port speed is 1000 Mbps. |
| Tag           | Indicates whether the ports have 802.1q VLAN tagging. The value can be Yes or No. |
| Priority      | Indicates the Quality of Service (QoS) priority of the ports. The priority can be a value from 0 – 7. |
To display trunk group information for specific ports, enter a command such as the following:

HP9300(config)# show trunk ethernet 1/1 to 1/8

Configured trunks:

Trunk ID: 1
Type: Switch
Ports_Configured: 8
Primary Port Monitored: Jointly

<table>
<thead>
<tr>
<th>Ports</th>
<th>1/1</th>
<th>1/2</th>
<th>1/3</th>
<th>1/4</th>
<th>1/5</th>
<th>1/6</th>
<th>1/7</th>
<th>1/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port Names</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>longna</td>
<td>test</td>
<td>none</td>
</tr>
<tr>
<td>Port Status</td>
<td>enable</td>
<td>enable</td>
<td>enable</td>
<td>enable</td>
<td>disable</td>
<td>disable</td>
<td>enable</td>
<td>enable</td>
</tr>
<tr>
<td>Monitor on</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>Mirror Port</td>
<td>3/3</td>
<td>3/4</td>
<td>N/A</td>
<td>3/5</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Monitor Dir</td>
<td>both</td>
<td>in</td>
<td>N/A</td>
<td>out</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Operational trunks:

Trunk ID: 1
Type: Switch
Duplex: Full
Speed: 1G
Tag: No
Priority: level0
Active Ports: 6

<table>
<thead>
<tr>
<th>Ports</th>
<th>1/1</th>
<th>1/2</th>
<th>1/3</th>
<th>1/4</th>
<th>1/5</th>
<th>1/6</th>
<th>1/7</th>
<th>1/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link_Status</td>
<td>active</td>
<td>active</td>
<td>active</td>
<td>active</td>
<td>down</td>
<td>down</td>
<td>active</td>
<td>active</td>
</tr>
<tr>
<td>LACP_Status</td>
<td>ready</td>
<td>ready</td>
<td>ready</td>
<td>expired</td>
<td>down</td>
<td>down</td>
<td>ready</td>
<td>ready</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load Sharing</th>
<th>Mac Address</th>
<th>IP</th>
<th>IPX</th>
<th>Apple Talk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 2 2 2 0 0 6 1</td>
<td>0 0</td>
<td>0 2 0 0 0 0</td>
<td>1 0 0 0 1</td>
</tr>
</tbody>
</table>

The display is divided into sections for configured trunks and operational trunks. A configured trunk group is one that has not been activated yet.

Table 7.4 describes the information displayed by the `show trunk` command.

### Table 7.4: CLI Trunk Group Information

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk ID</td>
<td>The trunk group number. The software numbers the groups in the display to make the display easy to use.</td>
</tr>
<tr>
<td>Type</td>
<td>The type of trunk group, which can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>- Server – The trunk group is connected to a server.</td>
</tr>
<tr>
<td></td>
<td>- Switch – The trunk group is connected to another Routing Switch.</td>
</tr>
</tbody>
</table>
Table 7.4: CLI Trunk Group Information (Continued)

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplex</td>
<td>The mode of the port, which can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• None – The link on the primary trunk port is down.</td>
</tr>
<tr>
<td></td>
<td>• Full – The primary port is running in full-duplex.</td>
</tr>
<tr>
<td></td>
<td>• Half – The primary port is running in half-duplex.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This field and the following fields apply only to operational trunk groups.</td>
</tr>
<tr>
<td>Speed</td>
<td>The speed set for the port. The value can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• None – The link on the primary trunk port is down.</td>
</tr>
<tr>
<td></td>
<td>• 10 – The port speed is 10 Mbps.</td>
</tr>
<tr>
<td></td>
<td>• 100 – The port speed is 100 Mbps.</td>
</tr>
<tr>
<td></td>
<td>• IG – The port speed is 1000 Mbps.</td>
</tr>
<tr>
<td>Tag</td>
<td>Indicates whether the ports have 802.1q VLAN tagging. The value can be Yes or No.</td>
</tr>
<tr>
<td>Priority</td>
<td>Indicates the Quality of Service (QoS) priority of the ports. The priority can be a value from 0 – 7.</td>
</tr>
<tr>
<td>Active Ports</td>
<td>The number of ports in the trunk group that are currently active.</td>
</tr>
<tr>
<td>Ports</td>
<td>The ports in the trunk group.</td>
</tr>
<tr>
<td>Link_Status</td>
<td>The link status or each port in the trunk group.</td>
</tr>
<tr>
<td>LACP_Status</td>
<td>This field appears in software releases 07.6.04 and later. For more information about this feature, see the section “Displaying and Determining the Status of Aggregate Links” on page 7-33.</td>
</tr>
<tr>
<td></td>
<td>• Ready - The port is functioning normally in the trunk group and is able to transmit and receive LACP packets.</td>
</tr>
<tr>
<td></td>
<td>• Expired - The time has expired (as determined by timeout values) and the port has shut down because the port on the other side of the link has stopped transmitting packets.</td>
</tr>
<tr>
<td></td>
<td>• Down - The port's physical link is down.</td>
</tr>
<tr>
<td>Load Sharing</td>
<td>The number of traffic flows currently being load balanced on the trunk ports. All traffic exchanged within the flow is forwarded on the same trunk port. For information about trunk load sharing, see “Trunk Group Load Sharing” on page 7-7.</td>
</tr>
</tbody>
</table>

**USING THE WEB MANAGEMENT INTERFACE**

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Select the **Trunk** link to display a table listing the configured trunk groups.
This display shows the following information.

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Type</td>
<td>The type of trunk group, which can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• Server – The trunk group is connected to a server.</td>
</tr>
<tr>
<td></td>
<td>• Switch – The trunk group is connected to another Routing Switch.</td>
</tr>
<tr>
<td>Port Members</td>
<td>The ports in the trunk group.</td>
</tr>
</tbody>
</table>
Dynamic Link Aggregation

The software supports the IEEE 802.3ad standard for link aggregation. This standard describes the Link Aggregation Control Protocol (LACP), a mechanism for allowing ports on both sides of a redundant link to configure themselves into a trunk link (aggregate link), without the need for manual configuration of the ports into trunk groups.

When you enable link aggregation on a group of HP ports, the HP ports can negotiate with the ports at the remote ends of the links to establish trunk groups.

Usage Notes

• You cannot use 802.3ad link aggregation on a port configured as a member of a static trunk group.

• This feature is supported only for 10/100 and Gigabit Ethernet ports.

• When the feature dynamically adds or changes a trunk group, the show trunk command displays the trunk as both configured and active. However, the show running-config or write terminal command does not contain a trunk command defining the new or changed trunk group.

• If the feature places a port into a trunk group as a secondary port, all configuration information except information related to link aggregation is removed from the port. For example, if port 1/3 has an IP interface, and the link aggregation feature places port 1/3 into a trunk group consisting of ports 1/1 – 1/4, the IP interface is removed from the port.

• If you use this feature on a Routing Switch that is running OSPF or BGP4, the feature causes these protocols to reset when a dynamic link change occurs. The reset includes ending and restarting neighbor sessions with OSPF and BGP4 peers, and clearing and relearning dynamic route entries and forwarding cache entries. Although the reset causes a brief interruption, the protocols automatically resume normal operation.

• Dynamic Operation of Allocation Keys (section 43.6.2 in the 802.3ad specification) is not supported.

Configuration Rules

HP ports follow the same configuration rules for dynamically created aggregate links as they do for statically configured trunk groups. For example, each aggregate link must start on a primary port (the first port in a two- or four-port range) and can contain either two or four ports, and so on. See “Trunk Group Rules” on page 7-3 and “Trunk Group Load Sharing” on page 7-7.

Figure 7.7 on page 7-25 shows some examples of valid aggregate links.
In this example, assume that link aggregation is enabled on all of the links between the HP device on the left and the device on the right (which can be either an HP device or another vendor's device). Notice that some ports are not able to join an aggregate link even though link aggregation is enabled on them. The ports that are not members of aggregate links in this example are not following the configuration rules for trunk links on HP devices.

The HP rules apply to an HP device even if the device at the other end is from another vendor and uses different rules. See “Trunk Group Rules” on page 7-3.

The link aggregation feature automates trunk configuration but can coexist with HP’s trunk group feature. Link aggregation parameters do not interfere with trunk group parameters.
NOTE: Use the link aggregation feature only if the device at the other end of the links you want to aggregate also supports IEEE 802.3ad link aggregation. Otherwise, you need to manually configure the trunk links.

Link aggregation support is disabled by default. You can enable the feature on an individual port basis, in active or passive mode.

- **Active mode** – When you enable a port for active link aggregation, the HP port can exchange standard LACP Protocol Data Unit (LACPDU) messages to negotiate trunk group configuration with the port on the other side of the link. In addition, the HP port actively sends LACPDU messages on the link to search for a link aggregation partner at the other end of the link, and can initiate an LACPDU exchange to negotiate link aggregation parameters with an appropriately configured remote port.

- **Passive mode** – When you enable a port for passive link aggregation, the HP port can exchange LACPDU messages with the port at the remote end of the link, but the HP port cannot search for a link aggregation port or initiate negotiation of an aggregate link. Thus, the port at the remote end of the link must initiate the LACPDU exchange.

NOTE: HP recommends that you disable or remove the cables from the ports you plan to enable for dynamic link aggregation. Doing so prevents the possibility that LACP will use a partial configuration to talk to the other side of a link. A partial configuration does not cause errors, but does sometimes require LACP to be disabled and re-enabled on both sides of the link to ensure that a full configuration is used. It's easier to disable a port or remove its cable first. This applies both for active link aggregation and passive link aggregation.

### 802.3ad Enhancements in Release 07.6.04

Software release 07.6.04 contains the following enhancements to 802.3ad support:

- Adaptation to trunk disappearance. The HP device will tear down an aggregate link if the device at the other end of the link reboots or brings all the links down. Tearing the aggregate link down prevents a mismatch if the other device has a different trunk configuration following the reboot or re-establishment of the links.

- The criteria for being eligible to be in an aggregate link are more flexible. A range of ports can contain down ports and still be eligible to become an aggregate link.

### Adaptation to Trunk Disappearance

Release 07.6.04 prevents trunk mismatches caused when one device changes the number of ports in group of ports that has become part of an 802.3 aggregate link. In 07.6.04 and later, if a device changes the number of ports in an active aggregate link, the HP device on the other end of the link tears down the link. Once the other device recovers, 802.3 can renegotiate the link without a mismatch.

In previous releases, it is possible for a trunk mismatch to occur between two devices that have established an aggregate link. This can occur if one of the devices reboots or brings the trunk links down, then re-establishes the links but with a different number of trunk ports. Figure 7.8 shows an example.
Configuring Trunk Groups and Dynamic Link Aggregation

Figure 7.8  Trunk port mismatch

Four ports on each device are eligible for link aggregation. The device negotiates a four-port trunk using the ports.

One device reloads, after which only two of its ports are eligible for link aggregation. However, the first device is still configured with the four-port trunk group. The trunks are mismatched.

This type of mismatch does not occur in release 06.7.01 and later.

Flexible Trunk Eligibility

Software release 07.6.01b also increases the tolerance for down ports during link negotiation. In previous releases, all the ports in a valid trunk configuration (2-port, 4-port, or 8-port trunk starting on a valid primary port number) need to be up. Thus, in previous releases, if you enable link aggregation on four ports but one of the ports is down, the device will negotiate based only on a valid two-port trunk group consisting of two of the up ports. For example, if you enable link aggregation on ports 1/1 - 1/4 and port 1/3 is down, 802.3ad will negotiate only for a two-port link consisting of ports 1/1 and 1/2.

In release 07.6.01b and later, the device groups the device's ports into 2-port groups consisting of an odd-numbered port and the next even-numbered port. For example, ports 1/1 and 1/2 are a two-port group, as are ports 1/3 and 1/4, 9/1 and 9/10, and so on. If either of the ports in a two-port group is up, the device considers both ports to be eligible to be in an aggregate link.
Figure 7.9 shows an example of 2-port groups in a range of eight ports on which link aggregation is enabled. Based on the states of the ports, some or all of them will be eligible to be used in an aggregate link.

Figure 7.9  Two-port groups used to determine aggregation eligibility

Table 7.6 shows examples of the ports from Figure 7.9 that will be eligible for an aggregate link based on individual port states.

**Table 7.6: Port Eligibility for Link Aggregation**

<table>
<thead>
<tr>
<th>Port Group 1</th>
<th>Port Group 2</th>
<th>Port Group 3</th>
<th>Port Group 4</th>
<th>Trunk Eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link State</td>
<td>1/1</td>
<td>1/2</td>
<td>1/3</td>
<td>1/4</td>
</tr>
<tr>
<td>Up</td>
<td>Up</td>
<td>Up</td>
<td>Up</td>
<td>Up</td>
</tr>
<tr>
<td>Up</td>
<td>Up</td>
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<td>Down</td>
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<td>Down</td>
<td>Up</td>
<td>Up</td>
</tr>
<tr>
<td>Up</td>
<td>Down</td>
<td>Down</td>
<td>Down</td>
<td>Up</td>
</tr>
</tbody>
</table>
As shown in these examples, all or a subset of the ports within a port range will be eligible for formation into an aggregate link based on port states. Notice that the sets of ports that are eligible for the aggregate link must be valid static trunk configurations. For example, a 4-port link consisting of ports 1/4 – 1/7 is not valid because this port configuration is not valid for static trunk groups on the HP device.

**Enabling Link Aggregation**

By default, link aggregation is disabled on all ports. To enable the feature, use one of the following CLI methods.

**USING THE CLI**

To enable link aggregation on a set of ports, enter commands such as the following at the interface configuration level of the CLI.

**NOTE:** Configuration commands for link aggregation differ depending on whether you are using the default link aggregation key automatically assigned by the software, or if you are assigning a different, unique key. Follow the commands below, according to the type of key you are using. For more information about keys, see “Key” on page 7-30.

### Using the Default Key Assigned by the Software

```sh
HP9300(config)# interface ethernet 1/1
HP9300(config-if-e1000-1/1)# link-aggregate active
HP9300(config)# interface ethernet 1/2
HP9300(config-if-e1000-1/2)# link-aggregate active
```

The commands in this example enable the active mode of link aggregation on ports 1/1 and 1/2. The ports can send and receive LACPDU messages. Note that these ports will use the default key, since one has not been explicitly configured.

### Assigning a Unique Key

```sh
HP9300(config)# interface ethernet 1/1
HP9300(config-if-e1000-1/1)# link-aggregate configure key ... 1/2
HP9300(config-if-e1000-1/2)# link-aggregate configure key 10000
HP9300(config-if-e1000-1/2)# link-aggregate active
```

The commands in this example assign the key 10000 and enable the active mode of link aggregation on ports 1/1 and 1/2. The ports can send and receive LACPDU messages.

**NOTE:** As shown in this example, when configuring a key, it is pertinent that you assign a key prior to enabling link aggregation.

The following commands enable passive link aggregation on ports 1/5 – 1/8:

```sh
HP9300(config)# interface ethernet 1/5 to 1/8
HP9300(config-mif-1/5-1/8)# link-aggregate passive
```

The commands in this example enable the passive mode of link aggregation on ports 1/5 – 1/8. These ports wait for the other end of the link to contact them. After this occurs, the ports can send and receive LACPDU messages.

To disable link aggregation on a port, enter a command such as the following:

```sh
HP9300(config-if-e1000-1/8)# link-aggregate off
```

**Syntax:** [no] link-aggregate active | passive | off

**Syntax:** [no] link-aggregate configure [system-priority <num>] | [port-priority <num>] | [key <num>] | [type server | switch]

**NOTE:** For more information about keys, including details about the syntax shown above, see “Key” on page 7-30.
Configuring Link Aggregation Parameters
You can change the settings for the following link aggregation parameters, on an individual port basis:

- System priority
- Port priority
- Link type
- Key

**System Priority**
The system priority specifies the HP device's link aggregation priority relative to the devices at the other ends of the links on which link aggregation is enabled. A higher value indicates a lower priority. You can specify a priority from 0 – 65535. The default is 1.

**NOTE:** If you are connecting the HP device to another vendor's device and the link aggregation feature is not working, set the system priority on the HP device to a lower priority (a higher priority value). In some cases, this change allows the link aggregation feature to operate successfully between the two devices.

**Link Type**
The link type specifies whether the trunk is connecting to a server (server link) or to another networking device (switch link). The default link type is switch.

**Key**
The key identifies the group of potential trunk ports this port belongs to. The software assigns a default key based on the position of the four-port group in the chassis. The software numbers the keys in ascending order beginning with key 0 for the first group of four ports. For example, an 8-port module in chassis slot 1 contains keys 0 and 1 by default. Ports 1/1 – 1/4 have key 0 and ports 1/5 – 1/8 have key 1, and so on.

All ports within an aggregate link must have the same key. However, if the device has ports that are connected to two different devices, and the port groups allow the ports to form into separate aggregate links with the two devices, then each group of ports can have the same key while belonging to separate aggregate links with different devices. Figure 7.10 on page 7-31 shows an example.
Notice that the keys between one device and another do not need to match. The only requirement for key matching is that all the ports within an aggregate link on a given device must have the same key.

Devices that support multi-slot trunk groups can form multi-slot aggregate links using link aggregation. However, the link aggregation keys for the groups of ports on each module must match. For example, if you want to allow link aggregation to form an aggregate link containing ports 1/1 – 1/4 and 3/5 – 3/8, you must change the link aggregation key on one or both groups of ports so that the key is the same on all eight ports. Figure 7.11 on page 7-32 shows an example.
By default, the device’s ports are divided into 4-port groups. The software dynamically assigns a unique key to each 4-port group. If you need to divide a 4-port group into two 2-port groups, change the key in one of the groups so that the two 2-port groups have different keys. For example, if you plan to use ports 1/1 and 1/2 in VLAN 1, and ports 1/3 and 1/4 in VLAN 2, change the key for ports 1/3 and 1/4.

**NOTE:** If you change the key for a port group, HP recommends that you use the value 10000 or higher, to avoid potential conflicts with dynamically created keys.

**USING THE CLI**
You can configure one or more parameters on the same command line, and you can enter the parameters in any order.

**NOTE:** For key configuration only, configuration commands differ depending on whether or not link aggregation is enabled on the port(s). Follow the appropriate set of commands below, according to your system’s configuration.

For example, to change a port group’s key from the one assigned by the software to another value, enter commands such as the following:

**Configuring Link Aggregation Parameters**

**NOTE:** Use this command sequence to change the key for ports that do not have link aggregation enabled, and for all other link aggregation parameters (i.e., system priority, port priority, and link type).

```
HP9300(config)# interface ethernet 1/1 to 1/4
HP9300(config-mif-1/1-1/4)# link-aggregate configure key 10000
HP9300(config-mif-1/1-1/4)# interface ethernet 3/5 to 3/8
HP9300(config-mif-3/5-3/8)# link-aggregate configure key 10000
```

**Configuring Keys For Ports with Link Aggregation Enabled**

**NOTE:** As shown in this command sequence, to change the key on ports that already have link aggregation enabled, you must first turn OFF link aggregation, configure the new key, then re-enable link aggregation.

```
HP9300(config)# interface ethernet 1/1 to 1/4
HP9300(config-mif-1/1-1/4)# link-aggregate off
HP9300(config-mif-1/1-1/4)# link-aggregate configure key 10000
HP9300(config-mif-1/1-1/4)# link-aggregate active
HP9300(config-mif-1/1-1/4)# interface ethernet 3/5 to 3/8
```
Configuring Trunk Groups and Dynamic Link Aggregation

HP9300(config-mif-3/5-3/8)# link-aggregate off
HP9300(config-mif-3/5-3/8)# link-aggregate configure key 10000
HP9300(config-mif-3/5-3/8)# link-aggregate active

These commands change the key for ports 1/1 – 1/4 and 3/5 – 3/8 to 10000. Since all ports in an aggregate link must have the same key, the command in this example enables ports 1/1 – 1/4 and 3/5 – 3/8 to form a multi-slot aggregate link.

**Syntax:** [no] link-aggregate configure [system-priority <num>] | [port-priority <num>] | [key <num>] | [type server | switch]

The **system-priority** <num> parameter specifies the HP device's link aggregation priority. A higher value indicates a lower priority. You can specify a priority from 0 – 65535. The default is 1.

The **port-priority** <num> parameter specifies an individual port's priority within the port group. A higher value indicates a lower priority. You can specify a priority from 0 – 65535. The default is 1.

The **key** <num> parameter identifies the group of ports that are eligible to be aggregated into a trunk group. The software automatically assigns a key to each group of ports. The software assigns the keys in ascending numerical order, beginning with 0. You can change a port group's key to a value from 0 – 65535.

**NOTE:** If you change the key for a port group, HP recommends that you use the value 10000 or higher, to avoid potential conflicts with dynamically created keys.

The **type server | switch** parameter specifies whether the port group is connected to a server (server) or to another networking device (switch). The default is switch.

You can enter one or more of the command's parameters on the same command line, in any order.

**Displaying and Determining the Status of Aggregate Links**

Software release 07.6.04 and later provides the ability to determine the status of ports that are members of an aggregate link, and whether or not LACPDU messages are being transmitted between the ports. In releases prior to 07.6.04, this level of detail was not readily available. With the link aggregation enhancement, the show link-aggregation command provides the ability to view the status of dynamic links.

The following section provides details about the events that can affect the status of ports in an aggregate link and the status of LACP messages exchanged between the ports. Later sections provide instructions for viewing these status reports.

**About Blocked Ports**

HP devices can block traffic on a port or shut down a port that is part of a trunk group or aggregate link for the following reasons:

- For the purpose of link aggregation, the ports on HP devices are grouped into pairs of two; one odd-numbered port, and the next even-numbered port. When you configure link aggregation on a port (for instance, on an odd-numbered port), this port will be blocked and unable to join a trunk group until you configure the adjacent port (the even-numbered port) as part of the aggregate link. When you configure both ports with link aggregation and assign both ports the same key, both ports are able to join a trunk group. Once the ports become part of a trunk group, they can transmit and receive LACP packets.

**NOTE:** Ports that are configured as part of an aggregate link must also have the same key. For more information about assigning keys, see the section titled “Configuring Link Aggregation Parameters” in the Installation and Basic Configuration Guide.

- When a port joins a trunk group and the port on the other end of the link shuts down or stops transmitting LACP packets, the HP device blocks the port. Depending on the timeout value set on the port, the link aggregation information expires.

**NOTE:** For more information about timeout values, see the section titled “Displaying Link Aggregation Information” in the Installation and Basic Configuration Guide.
If either of these events occur, the HP device shuts down the port and notifies all the upper layer protocols that the port is down.

HP devices can also block traffic on a port that is initially configured with link aggregation. The port is blocked until it joins a trunk group. In this case, traffic is blocked, but the port is still operational.

A port remains blocked until one of the following events occur:

- Link aggregation is enabled on the adjacent port (the paired port) and both ports have the same key
- LACP brings the port back up
- The port joins a trunk group

### Displaying Link Aggregation and Port Status Information

Use the `show link-aggregation` command to determine the operational status of ports associated with aggregate links.

To display the link aggregation information for a specific port, enter a command such as the following at any level of the CLI:

```plaintext
HP9300(config-mif-1/1-1/8)# show link-aggregation ethernet 1/1
```

```
System ID: 00e0.52a9.bb00
Port  [Sys P] [Port P] [ Key ] [Act][Tio][Agg][Syn][Col][Dis][Def][Exp][Ope]
1/1   0   0   No L  No  No  No  No  No  Ope
```

The command in this example shows the link aggregation information for port 1/1.

**NOTE:** The **Ope** column displays in software releases 07.6.04 and later.

To display the link aggregation information for all ports on which link aggregation is enabled, enter the following command at any level of the CLI:

```plaintext
HP9300(config)# show link-aggregation
```

```
System ID: 00e0.52a9.bb00
Port  [Sys P] [Port P] [ Key ] [Act][Tio][Agg][Syn][Col][Dis][Def][Exp][Ope]
1/1   1   1   0   No L  Agg  Syn  No  No  Def  Exp  Ope
1/2   1   1   0   No L  Agg  Syn  No  No  Def  Exp  Ina
1/3   1   1   0   No L  Agg  Syn  No  No  Def  Exp  Ina
1/4   1   1   0   No L  Agg  Syn  No  No  Def  Exp  Blo
1/5   1   1   1   No L  Agg  No  No  No  Def  Exp  Ope
1/6   1   1   1   No L  Agg  No  No  No  Def  Exp  Ope
1/7   1   1   1   No L  Agg  No  No  No  Def  Exp  Dwn
1/8   1   1   1   No L  Agg  No  No  No  Def  Exp  Dwn
```

**NOTE:** The **Ope** column displays in software releases 07.6.04 and later.

**Syntax:** show link-aggregation [ethernet <portnum>]

Use `ethernet <portnum>` to display link-aggregation information for a specific port.

**NOTE:** Ports that are configured as part of an aggregate link must also have the same key. For more information about assigning keys, see the section titled “Configuring Link Aggregation Parameters” in the *Installation and Basic Configuration Guide*. 

---

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The `show link aggregation` command shows the following information.

### Table 7.7: CLI Display of Link Aggregation Information

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
<tbody>
<tr>
<td>System ID</td>
<td>Lists the base MAC address of the device. This is also the MAC address of port 1 (or 1/1).</td>
</tr>
<tr>
<td>Port</td>
<td>Lists the port number.</td>
</tr>
<tr>
<td>Sys P</td>
<td>Lists the system priority configured for this port.</td>
</tr>
<tr>
<td>Port P</td>
<td>Lists the port's link aggregation priority.</td>
</tr>
<tr>
<td>Key</td>
<td>Lists the link aggregation key.</td>
</tr>
<tr>
<td>Act</td>
<td>Indicates the link aggregation mode, which can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• No – The mode is passive or link aggregation is disabled (off) on the port.</td>
</tr>
<tr>
<td></td>
<td>If link aggregation is enabled (and the mode is passive), the port can send and receive LACPDU messages to participate in negotiation of an aggregate link initiated by another port, but cannot search for a link aggregation port or initiate negotiation of an aggregate link.</td>
</tr>
<tr>
<td></td>
<td>• Yes – The mode is active. The port can send and receive LACPDU messages.</td>
</tr>
<tr>
<td>Tio</td>
<td>Indicates the timeout value of the port. The timeout value can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• L – Long. The trunk group has already been formed and the port is therefore using a longer message timeout for the LACPDU messages exchanged with the remote port. Typically, these messages are used as confirmation of the health of the aggregate link.</td>
</tr>
<tr>
<td></td>
<td>• S – Short. The port has just started the LACPDU message exchange process with the port at the other end of the link. The S timeout value also can mean that the link aggregation information received from the remote port has expired and the ports are starting a new information exchange.</td>
</tr>
<tr>
<td>Agg</td>
<td>Indicates the link aggregation state of the port. The state can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• Agg – Link aggregation is enabled on the port.</td>
</tr>
<tr>
<td></td>
<td>• No – Link aggregation is disabled on the port.</td>
</tr>
</tbody>
</table>
Table 7.7: CLI Display of Link Aggregation Information (Continued)

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
</table>
| **Syn**       | Indicates the synchronization state of the port. The state can be one of the following:  
• No – The port is out of sync with the remote port. The port does not understand the status of the LACPDU process and is not prepared to enter a trunk link.  
• Syn – The port is in sync with the remote port. The port understands the status of the LACPDU message exchange process, and therefore knows the trunk group to which it belongs, the link aggregation state of the remote port, and so on. |
| **Col**       | Indicates the collection state of the port, which determines whether the port is ready to send traffic over the trunk link.  
• Col – The port is ready to send traffic over the trunk link.  
• No – The port is not ready to send traffic over the trunk link. |
| **Dis**       | Indicates the distribution state of the port, which determines whether the port is ready to receive traffic over the trunk link.  
• Dis – The port is ready to receive traffic over the trunk link.  
• No – The port is not ready to receive traffic over the trunk link. |
| **Def**       | Indicates whether the port is using default link aggregation values. The port uses default values if it has not received link aggregation information through LACP from the port at the remote end of the link. This field can have one of the following values:  
• Def – The port has not received link aggregation values from the port at the other end of the link and is therefore using its default link aggregation LACP settings.  
• No – The port has received link aggregation information from the port at the other end of the link and is using the settings negotiated with that port. |
| **Exp**       | Indicates whether the negotiated link aggregation settings have expired. The settings expire if the port does not receive an LACPDU message from the port at the other end of the link before the message timer expires. This field can have one of the following values:  
• Exp – The link aggregation settings this port negotiated with the port at the other end of the link have expired. The port is now using its default link aggregation settings.  
• No – The link aggregation values that this port negotiated with the port at the other end of the link have not expired, so the port is still using the negotiated settings. |
### Configuring Trunk Groups and Dynamic Link Aggregation

#### Table 7.7: CLI Display of Link Aggregation Information (Continued)

<table>
<thead>
<tr>
<th>This Field...</th>
<th>Displays...</th>
</tr>
</thead>
</table>
| Ope           | • Ope (operational) - The port is operating normally.  
|               | • Ina (inactive) - The port is inactive because the port on the other side of the link is down or has stopped transmitting LACP packets.  
|               | • Blo (blocked) - The port is blocked because the adjacent port is not configured with link aggregation or because it is not able to join a trunk group. To unblock the port and bring it to an operational state, enable link aggregation on the adjacent port and ensure that the ports have the same key. |

### Displaying Trunk Group and LACP Status Information

Use the `show trunk` command to determine the status of LACP. See “Displaying Trunk Group Configuration Information” on page 7-19.

### Clearing the Negotiated Link Aggregations

When a group of ports negotiates a trunk group configuration, the software stores the negotiated configuration in a table. You can clear the negotiated link aggregation configurations from the software. When you clear the information, the software does not remove link aggregation parameter settings you have configured. Only the configuration information negotiated using LACP is removed.

**NOTE:** The software automatically updates the link aggregation configuration based on LACPDU messages. However, clearing the link aggregation information can be useful if you are troubleshooting a configuration.

To clear the link aggregation information, use the following CLI method.

**USING THE CLI**

To clear the link aggregation information, enter the following command at the Privileged EXEC level of the CLI:

```
HP9300# clear link-aggregate
```

**Syntax:** clear link-aggregate