



**Hewlett Packard**  
Enterprise

# HPE 3100 v2 Switch Series

## Layer 3—IP Routing

### Configuration Guide

Part number: 5998-5993s  
Software version: Release 5213 and Release 5213P02  
Document version: 6W101-20160506

© Copyright 2016 Hewlett Packard Enterprise Development LP

The information contained herein is subject to change without notice. The only warranties for Hewlett Packard Enterprise products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. Hewlett Packard Enterprise shall not be liable for technical or editorial errors or omissions contained herein.

Confidential computer software. Valid license from Hewlett Packard Enterprise required for possession, use, or copying. Consistent with FAR 12.211 and 12.212, Commercial Computer Software, Computer Software Documentation, and Technical Data for Commercial Items are licensed to the U.S. Government under vendor's standard commercial license.

Links to third-party websites take you outside the Hewlett Packard Enterprise website. Hewlett Packard Enterprise has no control over and is not responsible for information outside the Hewlett Packard Enterprise website.

### **Acknowledgments**

Intel®, Itanium®, Pentium®, Intel Inside®, and the Intel Inside logo are trademarks of Intel Corporation in the United States and other countries.

Microsoft® and Windows® are trademarks of the Microsoft group of companies.

Adobe® and Acrobat® are trademarks of Adobe Systems Incorporated.

Java and Oracle are registered trademarks of Oracle and/or its affiliates.

UNIX® is a registered trademark of The Open Group.

# Contents

<b>IP routing basics</b> .....	<b>1</b>
Overview .....	1
Routing table .....	1
Routing preference .....	2
Route backup .....	2
Displaying and maintaining a routing table .....	2
<b>Configuring static routing</b> .....	<b>4</b>
Introduction .....	4
Static route .....	4
Default route .....	4
Static route configuration items .....	4
Configuring a static route .....	4
Displaying and maintaining static routes .....	5
<b>Configuring IPv6 static routing</b> .....	<b>6</b>
Overview .....	6
IPv6 static routes features .....	6
Default IPv6 route .....	6
Configuring an IPv6 static route .....	6
Displaying and maintaining IPv6 static routes .....	7
<b>Document conventions and icons</b> .....	<b>8</b>
Conventions .....	8
Network topology icons .....	9
<b>Support and other resources</b> .....	<b>10</b>
Accessing Hewlett Packard Enterprise Support .....	10
Accessing updates .....	10
Websites .....	11
Customer self repair .....	11
Remote support .....	11
Documentation feedback .....	11
<b>Index</b> .....	<b>13</b>

# IP routing basics

## Overview

IP routing directs the forwarding of IP packets on routers based on a routing table. This book focuses on unicast routing protocols.

The term "router" in this chapter refers to both routers and Layer 3 switches.

The types of interfaces that appear in any figures other than the network diagrams for configuration examples are for illustration only. Some of them might be unavailable on your switch.

## Routing table

A router maintains at least two routing tables: one global routing table and one forwarding information base (FIB). The FIB table contains only the optimal routes, and the global routing table contains all routes. The router uses the FIB table to forward packets. For more information about the FIB table, see *Layer 3—IP Services Configuration Guide*.

Routes can be classified by different criteria, as shown in [Table 1](#).

**Table 1 Categories of routes**

Criterion	Categories
Destination	<ul style="list-style-type: none"><li>• <b>Network route</b>—Destination is a network. The subnet mask is less than 32 bits.</li><li>• <b>Host route</b>—Destination is a host. The subnet mask is 32 bits.</li></ul>
Whether the destination is directly connected	<ul style="list-style-type: none"><li>• <b>Direct route</b>—Destination is directly connected.</li><li>• <b>Indirect route</b>—Destination is indirectly connected.</li></ul>
Origin	<ul style="list-style-type: none"><li>• <b>Direct route</b>—A direct route is discovered by the data link protocol on an interface, and is also called an "interface route."</li><li>• <b>Static route</b>—A static route is manually configured by an administrator.</li><li>• <b>Dynamic route</b>—A dynamic route is dynamically discovered by a routing protocol.</li></ul>

Static routes are easy to configure and require less system resources. They work well in small and stable networks. In networks where topology changes may occur frequently, using a dynamic routing protocol is better.

To display brief information about a routing table, use the **display ip routing-table** command:

```
<Sysname> display ip routing-table
Routing Tables: Public
      Destinations : 7          Routes : 7

Destination/Mask    Proto  Pre  Cost           NextHop         Interface
1.1.1.0/24          Direct 0    0              1.1.1.1         Vlan11
...
```

A route entry includes the following key items:

- **Destination**—IP address of the destination host or network.

- **Mask**—Mask length of the IP address.
- **Pre**—Preference of the route. Among routes to the same destination, the one with the highest preference is optimal.
- **Cost**—If multiple routes to a destination have the same preference, the one with the smallest cost is the optimal route.
- **NextHop**—Next hop.
- **Interface**—Output interface.

## Routing preference

Different routing protocols can find different routes to the same destination. However, not all of those routes are optimal. For route selection, direct routes and static routes are assigned different preferences. The route with the highest preference is preferred.

The preference of a direct route is always 0 and cannot be changed. You can manually configure preferences for any other route type. Each static route can be configured with a different preference. The following table lists the types of routes and the default preferences. The smaller the preference value, the higher the preference.

**Table 2 Route types and their default route preferences**

Routing approach	Preference
Direct route	0
Static route	60

## Route backup

Route backup can improve network availability. Among multiple routes to the same destination, the route with the highest preference is the main route and all others are backup routes.

The router forwards matching packets through the main route. When the main route fails, the route with the highest preference among the backup routes is selected to forward packets. When the main route recovers, the router uses it to forward packets.

## Displaying and maintaining a routing table

Task	Command	Remarks
Display information about the routing table.	<b>display ip routing-table</b> [ <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ]	Available in any view
Display information about routes to the specified destination.	<b>display ip routing-table</b> <i>ip-address</i> [ <i>mask</i>   <i>mask-length</i> ] [ <b>longer-match</b> ] [ <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ]	Available in any view
Display information about routes with destination addresses in the specified range.	<b>display ip routing-table</b> <i>ip-address1</i> { <i>mask</i>   <i>mask-length</i> } <i>ip-address2</i> { <i>mask</i>   <i>mask-length</i> } [ <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ]	Available in any view

Task	Command	Remarks
Display routes of a routing protocol.	<b>display ip routing-table protocol</b> <i>protocol</i> [ <b>inactive</b>   <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] ] ] ]	Available in any view
Display statistics about the routing table.	<b>display ip routing-table statistics</b> [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] ]	Available in any view
Clear statistics for the routing table.	<b>reset ip routing-table statistics protocol</b> { <i>protocol</i>   <b>all</b> }	Available in user view
Display IPv6 routing table information.	<b>display ipv6 routing-table</b> [ <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] ]	Available in any view
Display routing information for a specified destination IPv6 address.	<b>display ipv6 routing-table</b> <i>ipv6-address prefix-length</i> [ <b>longer-match</b> ] [ <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] ]	Available in any view
Display IPv6 routing information for an IPv6 address range.	<b>display ipv6 routing-table</b> <i>ipv6-address1 prefix-length1</i> <i>ipv6-address2 prefix-length2</i> [ <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] ]	Available in any view
Display IPv6 routing information of a routing protocol.	<b>display ipv6 routing-table protocol</b> <i>protocol</i> [ <b>inactive</b>   <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] ]	Available in any view
Display IPv6 routing statistics.	<b>display ipv6 routing-table statistics</b> [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ] ]	Available in any view
Clear specified IPv6 routing statistics.	<b>reset ipv6 routing-table statistics protocol</b> { <i>protocol</i>   <b>all</b> }	Available in user view

# Configuring static routing

## Introduction

### Static route

Static routes are manually configured. If a network's topology is simple, you only need to configure static routes for the network to work properly. The proper configuration and usage of static routes can improve network performance and ensure bandwidth for important network applications.

Static routes cannot adapt to network topology changes. If a fault or a topological change occurs in the network, the relevant routes will be unreachable and the network breaks. When this happens, the network administrator must modify the static routes manually.

The term "router" in this chapter refers to both routers and Layer 3 switches.

### Default route

Without a default route, a packet that does not match any routing entries is discarded.

A default route is used to forward packets that do not match any routing entry. The network administrator can configure a default route with both the destination and mask being 0.0.0.0. The router forwards any packet whose destination address fails to match any entry in the routing table to the next hop of the default static route.

## Static route configuration items

Before you configure a static route, you must know the following concepts:

- Destination address and mask

In the **ip route-static** command, an IPv4 address is in dotted decimal notation. A mask can be either in dotted decimal format or in the form of mask length—the number of consecutive 1s in the mask.

- Output interface and next hop address

When you configure a static route, specify either the output interface, next hop address, or both depending on the specific occasion. The next hop address cannot be a local interface IP address; otherwise, the route configuration will not take effect.

Each route lookup operation has to find the next hop to resolve the destination link layer address.

Follow these guidelines when you specify the output interface:

- If the output interface is a Null 0 interface, no next hop address is required.
- If you specify a broadcast interface (such as a VLAN interface) as the output interface, you must specify the corresponding next hop for the output interface.

## Configuring a static route

Before you configure a static route, complete the following tasks:

- Configure the physical parameters for related interfaces.
- Configure the link-layer attributes for related interfaces.

- Configure the IP addresses for related interfaces.

Follow these guidelines when you configure a static route:

- The next hop address cannot be the IP address of a local interface (such as a VLAN interface). Otherwise, the static route does not take effect.
- If you do not specify the preference when you configure a static route, the default preference applies. Reconfiguring the default preference applies only to newly created static routes.
- If the destination IP address and mask are both configured as 0.0.0.0 with the **ip route-static** command, then the route is the default route.

To configure a static route:

Step	Command	Remarks
1. Enter system view.	<b>system-view</b>	N/A
2. Configure a static route.	<b>ip route-static</b> <i>dest-address</i> { <i>mask</i>   <i>mask-length</i> } { <i>next-hop-address</i>   <i>interface-type interface-number</i> [ <i>next-hop-address</i> ] } [ <b>preference</b> <i>preference-value</i> ] [ <b>permanent</b> ] [ <b>description</b> <i>description-text</i> ]	Required. By default, <b>preference</b> for static routes is 60, and no description information is configured. If the output interface is down, the permanent static route is still active.
3. Configure the default preference for static routes.	<b>ip route-static default-preference</b> <i>default-preference-value</i>	Optional. 60 by default.

## Displaying and maintaining static routes

Task	Command	Remarks
Display information of static routes.	<b>display ip routing-table protocol static</b> [ <b>inactive</b>   <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ]	Available in any view
Delete all the static routes.	<b>delete static-routes all</b>	Available in system view

For more information about the **display ip routing-table protocol static** [ **inactive** | **verbose** ] [ [ { **begin** | **exclude** | **include** } *regular-expression* ] command, see *Layer 3—IP Routing Command Reference*.

# Configuring IPv6 static routing

## Overview

Static routes are manually configured. They work well in simple networks. Proper configuration and use can improve network performance and ensure enough bandwidth for important applications.

Static routes cannot adapt to network topology changes. If a fault or a topological change occurs in the network, the network administrator has to modify the static routes manually.

The term "router" in this chapter refers to both routers and Layer 3 switches.

## IPv6 static routes features

Similar to IPv4 static routes, IPv6 static routes work well in simple IPv6 network environments.

Their major difference lies in the destination and next hop addresses. IPv6 static routes use IPv6 addresses, whereas IPv4 static routes use IPv4 addresses.

## Default IPv6 route

An IPv6 static route with a destination prefix of `::/0` is a default IPv6 route. The default route is used to forward packets that match no specific routes in the routing table.

## Configuring an IPv6 static route

In small IPv6 networks, IPv6 static routes can be used to forward packets. In comparison to dynamic routes, it helps to save network bandwidth.

Before you configure an IPv6 static route, complete the following tasks:

- Configure parameters for the related interfaces.
- Configure link layer attributes for the related interfaces.
- Enable IPv6 packet forwarding.
- Make sure that the neighboring nodes can reach each other.

To configure an IPv6 static route:

Step	Command	Remarks
1. Enter system view.	<code>system-view</code>	N/A

Step	Command	Remarks
2. Configure an IPv6 static route.	<b>ipv6 route-static</b> ipv6-address prefix-length { interface-type interface-number [ next-hop-address ]   next-hop-address } [ <b>preference</b> preference-value ]	Required The default preference of IPv6 static routes is 60.

**NOTE:**

If you specify a broadcast interface, such as a VLAN interface, as the output interface for a static route, you must specify the next hop address.

## Displaying and maintaining IPv6 static routes

Task	Command	Remarks
Display IPv6 static route information.	<b>display ipv6 routing-table protocol static</b> [ <b>inactive</b>   <b>verbose</b> ] [ [ { <b>begin</b>   <b>exclude</b>   <b>include</b> } <i>regular-expression</i> ]	Available in any view
Remove all IPv6 static routes.	<b>delete ipv6 static-routes all</b>	Available in system view

To delete a single IPv6 static route, use the **undo ipv6 route-static** command. To delete all IPv6 static routes, including the default route, use the **delete ipv6 static-routes all** command.

For more information about the **display ipv6 routing-table protocol static** [ **inactive** | **verbose** ] [ [ { **begin** | **exclude** | **include** } *regular-expression* ] command, see *Layer 3—IP Routing Command Reference*.

# Document conventions and icons

## Conventions

This section describes the conventions used in the documentation.

### Port numbering in examples

The port numbers in this document are for illustration only and might be unavailable on your device.

### Command conventions

Convention	Description
<b>Boldface</b>	<b>Bold</b> text represents commands and keywords that you enter literally as shown.
<i>Italic</i>	<i>Italic</i> text represents arguments that you replace with actual values.
[ ]	Square brackets enclose syntax choices (keywords or arguments) that are optional.
{ x   y   ... }	Braces enclose a set of required syntax choices separated by vertical bars, from which you select one.
[ x   y   ... ]	Square brackets enclose a set of optional syntax choices separated by vertical bars, from which you select one or none.
{ x   y   ... } *	Asterisk marked braces enclose a set of required syntax choices separated by vertical bars, from which you select at least one.
[ x   y   ... ] *	Asterisk marked square brackets enclose optional syntax choices separated by vertical bars, from which you select one choice, multiple choices, or none.
&<1-n>	The argument or keyword and argument combination before the ampersand (&) sign can be entered 1 to n times.
#	A line that starts with a pound (#) sign is comments.

### GUI conventions

Convention	Description
<b>Boldface</b>	Window names, button names, field names, and menu items are in Boldface. For example, the <b>New User</b> window appears; click <b>OK</b> .
>	Multi-level menus are separated by angle brackets. For example, <b>File &gt; Create &gt; Folder</b> .

### Symbols

Convention	Description
 <b>WARNING!</b>	An alert that calls attention to important information that if not understood or followed can result in personal injury.
 <b>CAUTION:</b>	An alert that calls attention to important information that if not understood or followed can result in data loss, data corruption, or damage to hardware or software.
 <b>IMPORTANT:</b>	An alert that calls attention to essential information.
<b>NOTE:</b>	An alert that contains additional or supplementary information.
 <b>TIP:</b>	An alert that provides helpful information.

# Network topology icons

Convention	Description
	Represents a generic network device, such as a router, switch, or firewall.
	Represents a routing-capable device, such as a router or Layer 3 switch.
	Represents a generic switch, such as a Layer 2 or Layer 3 switch, or a router that supports Layer 2 forwarding and other Layer 2 features.
	Represents an access controller, a unified wired-WLAN module, or the access controller engine on a unified wired-WLAN switch.
	Represents an access point.
	Represents a wireless terminator unit.
	Represents a wireless terminator.
	Represents a mesh access point.
	Represents omnidirectional signals.
	Represents directional signals.
	Represents a security product, such as a firewall, UTM, multiservice security gateway, or load balancing device.
	Represents a security card, such as a firewall, load balancing, NetStream, SSL VPN, IPS, or ACG card.

# Support and other resources

## Accessing Hewlett Packard Enterprise Support

- For live assistance, go to the Contact Hewlett Packard Enterprise Worldwide website:  
[www.hpe.com/assistance](http://www.hpe.com/assistance)
- To access documentation and support services, go to the Hewlett Packard Enterprise Support Center website:  
[www.hpe.com/support/hpesc](http://www.hpe.com/support/hpesc)

### Information to collect

- Technical support registration number (if applicable)
- Product name, model or version, and serial number
- Operating system name and version
- Firmware version
- Error messages
- Product-specific reports and logs
- Add-on products or components
- Third-party products or components

## Accessing updates

- Some software products provide a mechanism for accessing software updates through the product interface. Review your product documentation to identify the recommended software update method.
- To download product updates, go to either of the following:
  - Hewlett Packard Enterprise Support Center **Get connected with updates** page:  
[www.hpe.com/support/e-updates](http://www.hpe.com/support/e-updates)
  - Software Depot website:  
[www.hpe.com/support/softwaredepot](http://www.hpe.com/support/softwaredepot)
- To view and update your entitlements, and to link your contracts, Care Packs, and warranties with your profile, go to the Hewlett Packard Enterprise Support Center **More Information on Access to Support Materials** page:  
[www.hpe.com/support/AccessToSupportMaterials](http://www.hpe.com/support/AccessToSupportMaterials)

---

### ⓘ **IMPORTANT:**

Access to some updates might require product entitlement when accessed through the Hewlett Packard Enterprise Support Center. You must have an HP Passport set up with relevant entitlements.

---

## Websites

Website	Link
<b>Networking websites</b>	
Hewlett Packard Enterprise Information Library for Networking	<a href="http://www.hpe.com/networking/resourcefinder">www.hpe.com/networking/resourcefinder</a>
Hewlett Packard Enterprise Networking website	<a href="http://www.hpe.com/info/networking">www.hpe.com/info/networking</a>
Hewlett Packard Enterprise My Networking website	<a href="http://www.hpe.com/networking/support">www.hpe.com/networking/support</a>
Hewlett Packard Enterprise My Networking Portal	<a href="http://www.hpe.com/networking/mynetworking">www.hpe.com/networking/mynetworking</a>
Hewlett Packard Enterprise Networking Warranty	<a href="http://www.hpe.com/networking/warranty">www.hpe.com/networking/warranty</a>
<b>General websites</b>	
Hewlett Packard Enterprise Information Library	<a href="http://www.hpe.com/info/enterprise/docs">www.hpe.com/info/enterprise/docs</a>
Hewlett Packard Enterprise Support Center	<a href="http://www.hpe.com/support/hpesc">www.hpe.com/support/hpesc</a>
Hewlett Packard Enterprise Support Services Central	<a href="http://ssc.hpe.com/portal/site/ssc/">ssc.hpe.com/portal/site/ssc/</a>
Contact Hewlett Packard Enterprise Worldwide	<a href="http://www.hpe.com/assistance">www.hpe.com/assistance</a>
Subscription Service/Support Alerts	<a href="http://www.hpe.com/support/e-updates">www.hpe.com/support/e-updates</a>
Software Depot	<a href="http://www.hpe.com/support/softwaredepot">www.hpe.com/support/softwaredepot</a>
Customer Self Repair (not applicable to all devices)	<a href="http://www.hpe.com/support/selfrepair">www.hpe.com/support/selfrepair</a>
Insight Remote Support (not applicable to all devices)	<a href="http://www.hpe.com/info/insightremotesupport/docs">www.hpe.com/info/insightremotesupport/docs</a>

## Customer self repair

Hewlett Packard Enterprise customer self repair (CSR) programs allow you to repair your product. If a CSR part needs to be replaced, it will be shipped directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your Hewlett Packard Enterprise authorized service provider will determine whether a repair can be accomplished by CSR.

For more information about CSR, contact your local service provider or go to the CSR website:

[www.hpe.com/support/selfrepair](http://www.hpe.com/support/selfrepair)

## Remote support

Remote support is available with supported devices as part of your warranty, Care Pack Service, or contractual support agreement. It provides intelligent event diagnosis, and automatic, secure submission of hardware event notifications to Hewlett Packard Enterprise, which will initiate a fast and accurate resolution based on your product's service level. Hewlett Packard Enterprise strongly recommends that you register your device for remote support.

For more information and device support details, go to the following website:

[www.hpe.com/info/insightremotesupport/docs](http://www.hpe.com/info/insightremotesupport/docs)

## Documentation feedback

Hewlett Packard Enterprise is committed to providing documentation that meets your needs. To help us improve the documentation, send any errors, suggestions, or comments to Documentation Feedback ([docsfeedback@hpe.com](mailto:docsfeedback@hpe.com)). When submitting your feedback, include the document title,

part number, edition, and publication date located on the front cover of the document. For online help content, include the product name, product version, help edition, and publication date located on the legal notices page.

# Index

## A C D I N O R

### A

Accessing Hewlett Packard Enterprise Support, [10](#)  
Accessing updates, [10](#)

### C

Configuring a static route, [4](#)  
Configuring an IPv6 static route, [6](#)  
Conventions, [8](#)

### D

Default IPv6 route, [6](#)  
Displaying and maintaining a routing table, [2](#)  
Displaying and maintaining IPv6 static routes, [7](#)  
Displaying and maintaining static routes, [5](#)

### I

Introduction, [4](#)  
IPv6 static routes features, [6](#)

### N

Network topology icons, [9](#)

### O

Overview, [6](#)  
Overview, [1](#)

### R

Route backup, [2](#)  
Routing preference, [2](#)  
Routing table, [1](#)