



# MPLS VPN Carrier Supporting Carrier Using LDP and an IGP

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Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) Carrier Supporting Carrier (CSC) enables one MPLS VPN-based service provider to allow other service providers to use a segment of its backbone network. This module explains how to configure the MPLS VPN CSC network using MPLS Label Distribution Protocol (LDP) to distribute MPLS labels and an Interior Gateway Protocol (IGP) to distribute routes.

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the “[Feature Information for MPLS VPN CSC with LDP and IGP](#)” section on [page 66](#).

Use Cisco Feature Navigator to find information about platform support and Cisco IOS and Catalyst OS software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

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**Americas Headquarters:**

**Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA**

- [Command Reference, page 65](#)
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## Prerequisites for MPLS VPN CSC with LDP and IGP

This feature includes the following requirements:

- The provider edge (PE) routers of the backbone carrier require 128 MB of memory.
- The backbone carrier must enable the PE router to check that the packets it receives from the customer edge (CE) router contain only the labels that the PE router advertised to the CE router. This prevents data spoofing, which occurs when a packet from an unrecognized IP address is sent to a router.

## Restrictions for MPLS VPN CSC with LDP and IGP

The following features are not supported with this feature:

- ATM MPLS
- Carrier supporting carrier traffic engineering
- Carrier supporting carrier quality of service (QoS)
- RSVP aggregation
- VPN Multicast between the customer carrier and the backbone carrier network

The following router platforms are supported on the edge of the MPLS VPN:

- Cisco 7200 series
- Cisco 7500 series
- Cisco 12000 series

See [Table 1](#) for Cisco 12000 series line card support added for Cisco IOS releases.

**Table 1** *Cisco12000 Series Line Card Support Added for Cisco IOS Releases*

Type	Line Cards	Cisco IOS Release Added
Packet over SONET (POS)	4-Port OC-3 POS	12.0(16)ST
	1-Port OC-12 POS	
	8-Port OC-3 POS	
	16-Port OC-3 POS	
	4-Port OC-12 POS	12.0(21)ST
	1-Port OC-48 POS	
	4-Port OC-3 POS ISE	
	8-Port OC-3 POS ISE	
	16 x OC-3 POS ISE	
	4 Port OC-12 POS ISE	
1-Port OC-48 POS ISE	12.0(22)S	

**Table 1** Cisco 12000 Series Line Card Support Added for Cisco IOS Releases

Type	Line Cards	Cisco IOS Release Added
Electrical Interface	6- Port DS3	12.0(16)ST
	12- Port DS3 6-Port E3	12.0(21)ST
ATM	4-Port OC-3 ATM 1-Port OC12 ATM 4-Port OC-12 ATM	12.0(22)S
Channelized Interface	2-Port CHOC-3 6-Port Ch T3 (DS1) 1-Port CHOC-12 (DS3) 1-Port CHOC-12 (OC-3) 4-Port CHOC-12 ISE 1-Port CHOC-48 ISE	12.0(22)S

## Information About MPLS VPN CSC with LDP and IGP

Before configuring MPLS VPN CSC, you should understand the following concepts:

- [MPLS VPN CSC Introduction, page 3](#)
- [Benefits of Implementing MPLS VPN CSC, page 3](#)
- [Configuration Options for MPLS VPN CSC with LDP and IGP, page 4](#)

## MPLS VPN CSC Introduction

Carrier supporting carrier is where one service provider allows another service provider to use a segment of its backbone network. The service provider that provides the segment of the backbone network to the other provider is called the backbone carrier. The service provider that uses the segment of the backbone network is called the customer carrier.

A backbone carrier offers Border Gateway Protocol and Multiprotocol Label Switching (BGP/MPLS) VPN services. The customer carrier can be either:

- An Internet service provider (ISP)
- A BGP/MPLS VPN service provider

## Benefits of Implementing MPLS VPN CSC

The MPLS VPN CSC provides the following benefits to service providers who are backbone carriers and to customer carriers.

### Benefits to the Backbone Carrier

- The backbone carrier can accommodate many customer carriers and give them access to its backbone. The backbone carrier does not need to create and maintain separate backbones for its customer carriers. Using one backbone network to support multiple customer carriers simplifies the

backbone carrier's VPN operations. The backbone carrier uses a consistent method for managing and maintaining the backbone network. This is also cheaper and more efficient than maintaining separate backbones.

- The MPLS VPN carrier supporting carrier feature is scalable. Carrier supporting carrier can change the VPN to meet changing bandwidth and connectivity needs. The feature can accommodate unplanned growth and changes. The carrier supporting carrier feature enables tens of thousands of VPNs to be configured over the same network, and it allows a service provider to offer both VPN and Internet services.
- The MPLS VPN carrier supporting carrier feature is a flexible solution. The backbone carrier can accommodate many types of customer carriers. The backbone carrier can accept customer carriers who are ISPs or VPN service providers or both. The backbone carrier can accommodate customer carriers that require security and various bandwidths.

#### Benefits to the Customer Carriers

- The MPLS VPN carrier supporting carrier feature removes from the customer carrier the burden of configuring, operating, and maintaining its own backbone. The customer carrier uses the backbone network of a backbone carrier, but the backbone carrier is responsible for network maintenance and operation.
- Customer carriers who use the VPN services provided by the backbone carrier receive the same level of security that Frame Relay or ATM-based VPNs provide. Customer carriers can also use IPSec in their VPNs for a higher level of security; it is completely transparent to the backbone carrier.
- Customer carriers can use any link layer technology (SONET, Digital Subscriber Line, Frame Relay, and so on) to connect the CE routers to the PE routers and the PE routers to the P routers. The MPLS VPN carrier supporting carrier feature is link layer independent. The CE routers and PE routers use IP to communicate, and the backbone carrier uses MPLS.
- The customer carrier can use any addressing scheme and still be supported by a backbone carrier. The customer address space and routing information are independent of the address space and routing information of other customer carriers or the backbone provider.

## Configuration Options for MPLS VPN CSC with LDP and IGP

The backbone carrier offers BGP and MPLS VPN services. The customer carrier can be one of the two types of service providers described in the following sections, which explain how the backbone and customer carriers distribute IPv4 routes and MPLS labels.

- [Customer Carrier Is an ISP, page 4](#)
- [Customer Carrier Is a BGP/MPLS VPN Service Provider, page 7](#)

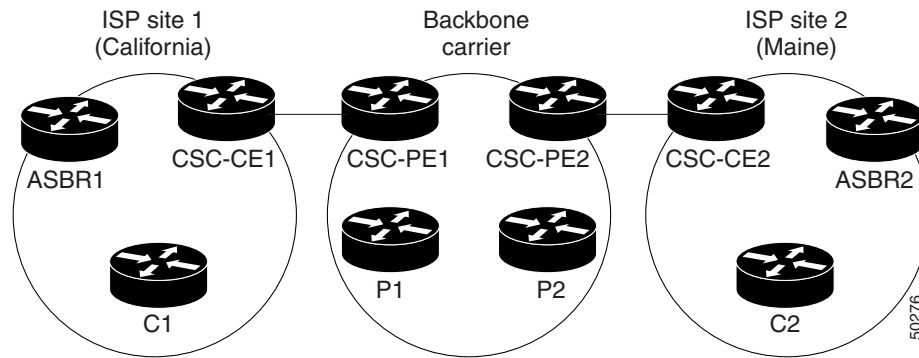
### Customer Carrier Is an ISP

This section explains how a BGP/MPLS VPN service provider (backbone carrier) can provide a segment of its backbone network to a customer who is an ISP.

Consider the following example:

An ISP has two sites: one in California, the other in Maine. Each site is a point of presence (POP). The ISP wants to connect these sites using a VPN service provided by a backbone carrier. [Figure 1](#) illustrates this situation.

**Figure 1** Sample BGP/MPLS Backbone Carrier Supporting an ISP



**Note**

The CE routers in the figures are CE routers to the backbone carrier. However, they are PE routers to the customer carrier.

In this example, only the backbone carrier uses MPLS. The customer carrier (ISP) uses only IP. As a result, the backbone carrier must carry all the Internet routes of the customer carrier, which could be as many as 100,000 routes. This poses a scalability problem for the backbone carrier. To solve the scalability problem, the backbone carrier is configured as follows:

- The backbone carrier allows only internal routes of the customer carrier (IGP routes) to be exchanged between the CE routers of the customer carrier and the PE routers of the backbone carrier.
- MPLS is enabled on the interface between the CE router of the customer carrier and the PE router of the backbone carrier.

Internal and external routes are differentiated this way:

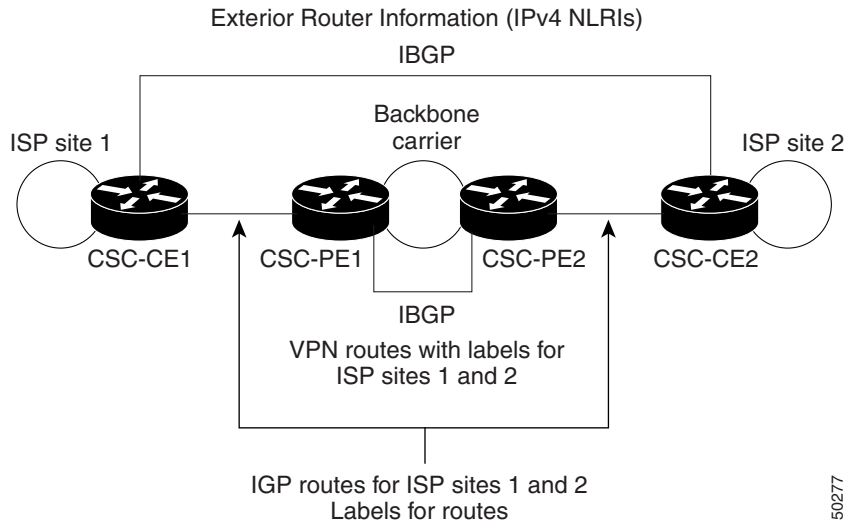
- Internal routes go to any of the routers within the ISP.
- External routes go to the Internet.

The number of internal routes is much lower than the number of external routes. Restricting the routes between the CE routers of the customer carrier and the PE routers of the backbone carrier significantly reduces the number of routes that the PE router needs to maintain.

Because the PE routers do not have to carry external routes in the VRF routing table, they can use the incoming label in the packet to forward the customer carrier Internet traffic. Adding MPLS to the routers provides a consistent method of transporting packets from the customer carrier to the backbone carrier. MPLS allows the exchange of an MPLS label between the PE and the CE routers for every internal customer carrier route. The routers in the customer carrier have all the external routes either through internal Border Gateway Protocol (iBGP) or route redistribution to provide Internet connectivity.

[Figure 2](#) shows how information is exchanged when the network is configured in this manner.

**Figure 2** Backbone Carrier Exchanging Routing Information with a Customer Carrier Who Is an ISP



In Figure 3, routes are created between the backbone carrier and the customer carrier sites. ASBR2 receives an Internet route that originated outside the network. All routers in the ISP sites have all the external routes through IBGP connections among them.

**Figure 3** Establishing a Route Between a Backbone Carrier and a Customer Carrier Who Is an ISP

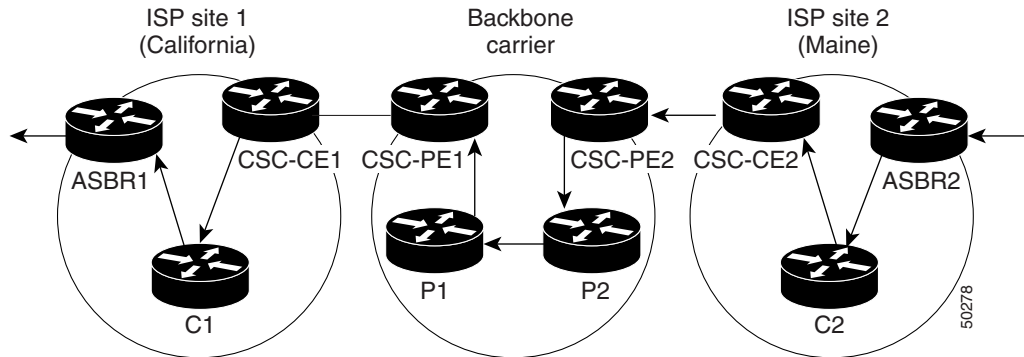


Table 2 describes the process of establishing the route, which can be divided into two distinct steps:

- The backbone carrier propagates the IGP information of the customer carrier, which enables the customer carrier routers to reach all the customer carrier routers in the remote sites.
- Once the routers of the customer carriers in different sites are reachable, external routes can be propagated in the customer carrier sites, using IBGP without using the backbone carrier routers.

**Table 2**      **Establishing a Route Between the Backbone Carrier and the Customer Carrier ISP**

Step	Description
1	CSC-CE2 sends the internal routes within site 2 to CSC-PE2. The routes include the route to ASBR2.
2	CSC-PE2 sends the routing information for site 2 to CSC-PE1, using MPLS VPN processes. CSC-PE1 gets one label (called L3), which is associated with the route to the VPN-IP address for ASBR2. CSC-PE1 gets another label (called L2), which is associated with the route to CSC-PE2.
3	CSC-PE1 sends the routing information associated with internal routes from site 2 to CSC-CE1. CSC-PE1 also sends the label binding information. As a result, CSC-CE1 gets the route to ASBR2 with CSC-PE1 as the next hop. The label associated with that route is called L1.
4	CSC-CE1 distributes the routing information through site 1. Every router in site 1 gets a route for every internal destination in site 2. Therefore, every router in site 1 can reach routers in site 2 and learn external routes through IBGP.
5	ASBR2 receives an Internet route.
6	The IBGP sessions exchange the external routing information of the ISP, including a route to the Internet. Every router in site 1 knows a route to the Internet, with ASBR2 as the next hop of that route.

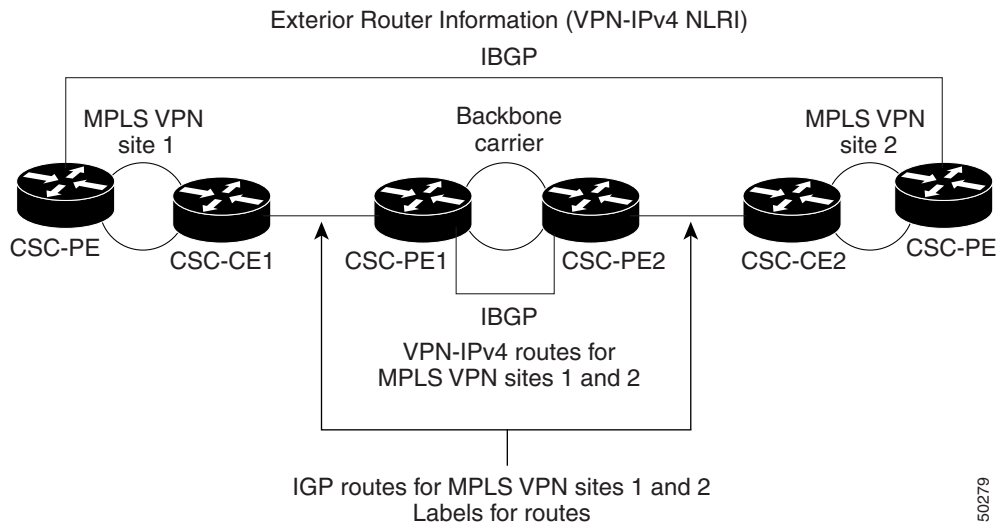
## Customer Carrier Is a BGP/MPLS VPN Service Provider

When a backbone carrier and the customer carrier both provide BGP/MPLS VPN services, the method of transporting data is different from when a customer carrier provides only ISP services. The following list highlights those differences:

- When a customer carrier provides BGP/MPLS VPN services, its external routes are VPN-IPv4 routes. When a customer carrier is an ISP, its external routes are IP routes.
- When a customer carrier provides BGP/MPLS VPN services, every site within the customer carrier must use MPLS. When a customer carrier is an ISP, the sites do not need to use MPLS.

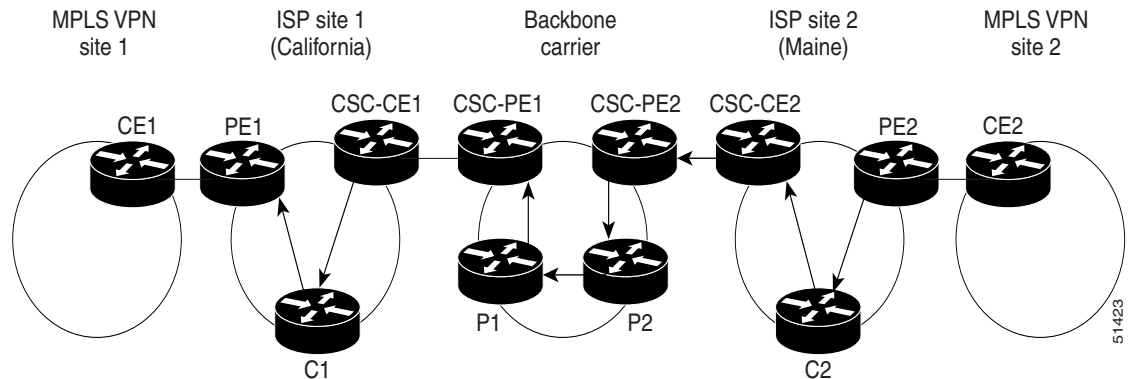
[Figure 4](#) shows how information is exchanged when MPLS VPN services reside on all customer carrier sites and on the backbone carrier.

**Figure 4** Backbone Carrier Exchanging Information with a Customer Carrier Who Is an MPLS VPN Service Provider



In the example shown in [Figure 5](#), routes are created between the backbone carrier and the customer carrier sites.

**Figure 5** Establishing a Route Between a Backbone Carrier and a Customer Carrier Who Is an MPLS VPN Service Provider



[Table 3](#) describes the process of establishing the route.

**Table 3** Establishing a Route Between the Backbone Carrier and Customer Carrier Site

Step	Description
1	CE2 sends all the internal routes within site 2 to CSC-PE2.
2	CSC-PE2 sends the routing information for site 2 to CSC-PE1, using MPLS VPN processes. CSC-PE1 gets one label (called L3), which is associated with the route to the VPN-IP address for PE2. CSC-PE1 gets another label (called L2), which is associated with the route to CSC-PE2.



**Table 3**      *Establishing a Route Between the Backbone Carrier and Customer Carrier Site*

Step	Description
3	CSC-PE1 sends the routing information associated with internal routes from site 2 to CSC-CE1. CSC-PE1 also sends the label binding information. As a result, CSC-CE1 gets the route to PE2 with CSC-PE1 as the next hop. The label associated with that route is called L1.
4	CE1 distributes the routing and labeling information through site 1. Every router in site 1 gets a route for every internal destination in site 2. Therefore, PE1 can establish an MP-IBGP session with PE2.
5	CE2 advertises the internal routes of MPLS VPN site 2 to PE2.
6	PE2 allocates labels for all the VPN routes (regular MPLS VPN functionality) and advertises the labels to PE1, using MP-IBGP.
7	PE1 can forward traffic from VPN site 1 that is destined for VPN site 2.

## How to Configure MPLS VPN CSC with LDP and IGP

This section contains the following procedures:

- [Configuring the Backbone Carrier Core, page 9](#) (required)
- [Configuring the CSC-PE and CSC-CE Routers, page 15](#) (required)
- [Verifying the Carrier Supporting Carrier Configuration, page 17](#) (optional)

### Configuring the Backbone Carrier Core

Configuring the backbone carrier core requires configuring connectivity and routing functions for the CSC core and the CSC-PE routers.

Configuring and verifying the CSC core (backbone carrier) involves the following tasks:

- [Verifying IP Connectivity and LDP Configuration in the CSC Core, page 9](#) (optional)
- [Configuring VRFs for CSC-PE Routers, page 11](#) (required)
- [Configuring Multiprotocol BGP for VPN Connectivity in the Backbone Carrier, page 13](#) (required)

### Prerequisites

Before you configure a backbone carrier core, configure the following on the CSC core routers:

- An IGP routing protocol—BGP, OSPF, IS-IS, EIGRP, static, and so on. For information, see [Configuring a Basic BGP Network](#), [Configuring OSPF](#), [Configuring a Basic IS-IS Network](#), and [Configuring EIGRP](#).
- Label Distribution Protocol (LDP). For information, see [MPLS Label Distribution Protocol](#).

### Verifying IP Connectivity and LDP Configuration in the CSC Core

Perform this task to verify IP connectivity and LDP configuration in the CSC core. For a configuration example for this task, see the [“Verifying IP Connectivity and LDP Configuration in the CSC Core” section on page 9](#).

## SUMMARY STEPS

1. **enable**
2. **ping** [*protocol*] {*host-name* | *system-address*}
3. **trace** [*protocol*] [*destination*]
4. **show mpls forwarding-table** [*network* {*mask* | *length*} | **labels** *label* [- *label*] | **interface** *interface* | **next-hop** *address* | **lsp-tunnel** [*tunnel-id*]] [**vrf** *vrf-name*] [**detail**]
5. **show mpls ldp discovery** [**vrf** *vrf-name* | **all**]
6. **show mpls ldp neighbor** [[**vrf** *vrf-name*] [*address* | *interface*] [**detail**] | **all**]
7. **show ip cef** [**vrf** *vrf-name*] [*network* [*mask*]] [**longer-prefixes**] [**detail**]
8. **show mpls interfaces** [[**vrf** *vrf-name*] [*interface*] [**detail**] | **all**]
9. **show ip route**
10. **disable**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>ping</b> [ <i>protocol</i> ] { <i>host-name</i>   <i>system-address</i> }  <b>Example:</b> Router# ping ip 10.0.0.1	(Optional) Diagnoses basic network connectivity on AppleTalk, Connectionless Network Service (CLNS), IP, Novell, Apollo, VINES, DECnet, or Xerox Network System (XNS) networks. <ul style="list-style-type: none"> <li>• Use the <b>ping ip</b> command to verify the connectivity from one CSC core router to another.</li> </ul>
Step 3	<b>trace</b> [ <i>protocol</i> ] [ <i>destination</i> ]  <b>Example:</b> Router# trace ip 10.0.0.1	(Optional) Discovers the routes that packets will actually take when traveling to their destination. <ul style="list-style-type: none"> <li>• Use the <b>trace</b> command to verify the path that a packet goes through before reaching the final destination. The <b>trace</b> command can help isolate a trouble spot if two routers cannot communicate.</li> </ul>
Step 4	<b>show mpls forwarding-table</b> [ <i>network</i> { <i>mask</i>   <i>length</i> }   <b>labels</b> <i>label</i> [- <i>label</i> ]   <b>interface</b> <i>interface</i>   <b>next-hop</b> <i>address</i>   <b>lsp-tunnel</b> [ <i>tunnel-id</i> ]] [ <b>vrf</b> <i>vrf-name</i> ] [ <b>detail</b> ]  <b>Example:</b> Router# show mpls forwarding-table	(Optional) Displays the contents of the MPLS label forwarding information base (LFIB). <ul style="list-style-type: none"> <li>• Use the <b>show mpls forwarding-table</b> command to verify that MPLS packets are being forwarded.</li> </ul>
Step 5	<b>show mpls ldp discovery</b> [ <b>vrf</b> <i>vrf-name</i>   <b>all</b> ]  <b>Example:</b> Router# show mpls ldp discovery	(Optional) Displays the status of the LDP discovery process. <ul style="list-style-type: none"> <li>• Use the <b>show mpls ldp discovery</b> command to verify that LDP is operational in the CSC core.</li> </ul>

	Command or Action	Purpose
Step 6	<pre>show mpls ldp neighbor [[vrf vrf-name] [address   interface] [detail]  all]  Example: Router# show mpls ldp neighbor</pre>	(Optional) Displays the status of LDP sessions. <ul style="list-style-type: none"> <li>Use the <b>show mpls ldp neighbor</b> command to verify LDP configuration in the CSC core.</li> </ul>
Step 7	<pre>show ip cef [vrf vrf-name] [network [mask]] [longer-prefixes] [detail]  Example: Router# show ip cef</pre>	(Optional) Displays entries in the forwarding Information Base (FIB). <ul style="list-style-type: none"> <li>Use the <b>show ip cef</b> command to check the forwarding table (prefixes, next hops, and interfaces).</li> </ul>
Step 8	<pre>show mpls interfaces [[vrf vrf-name] [interface] [detail]   all]  Example: Router# show mpls interfaces</pre>	(Optional) Displays information about one or more or all interfaces that are configured for label switching. <ul style="list-style-type: none"> <li>Use the <b>show mpls interfaces</b> command to verify that the interfaces are configured to use LDP.</li> </ul>
Step 9	<pre>show ip route  Example: Router# show ip route</pre>	(Optional) Displays IP routing table entries. <ul style="list-style-type: none"> <li>Use the <b>show ip route</b> command to display the entire routing table, including host IP address, next hop, and interface.</li> </ul>
Step 10	<pre>disable  Example: Router# disable</pre>	(Optional) Returns to privileged EXEC mode.

## Troubleshooting Tips

You can use the **ping** and **trace** commands to verify complete MPLS connectivity in the core. You also get useful troubleshooting information from the additional **show** commands.

## Configuring VRFs for CSC-PE Routers

Perform this task to configure VPN routing and forwarding (VRF) instances for the backbone carrier edge (CSC-PE) routers.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip vrf vrf-name**
4. **rd route-distinguisher**
5. **route-target {import | export | both} route-target-ext-community**
6. **import map route-map**
7. **exit**
8. **interface type number**
9. **ip vrf forwarding vrf-name**

10. end

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><b>enable</b></p> <p><b>Example:</b> Router&gt; enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
Step 2	<p><b>configure terminal</b></p> <p><b>Example:</b> Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p><b>ip vrf vrf-name</b></p> <p><b>Example:</b> Router(config)# ip vrf vpn1</p>	<p>Defines the VPN routing instance by assigning a VRF name and enters VRF configuration mode.</p> <ul style="list-style-type: none"> <li>The <i>vrf-name</i> argument is the name assigned to a VRF.</li> </ul>
Step 4	<p><b>rd route-distinguisher</b></p> <p><b>Example:</b> Router(config-vrf)# rd 100:1</p>	<p>Creates routing and forwarding tables.</p> <ul style="list-style-type: none"> <li>The <i>route-distinguisher</i> argument adds an 8-byte value to an IPv4 prefix to create a VPN-IPv4 prefix. You can enter an RD in either of these formats: <ul style="list-style-type: none"> <li>16-bit AS number: your 32-bit number, for example, 101:3</li> <li>32-bit IP address: your 16-bit number, for example, 192.168.122.15:1</li> </ul> </li> </ul>
Step 5	<p><b>route-target {import   export   both} route-target-ext-community</b></p> <p><b>Example:</b> Router(config-vrf)# route-target import 100:1</p>	<p>Creates a route-target extended community for a VRF.</p> <ul style="list-style-type: none"> <li>The <b>import</b> keyword imports routing information from the target VPN extended community.</li> <li>The <b>export</b> keyword exports routing information to the target VPN extended community.</li> <li>The <b>both</b> keyword imports routing information from and exports routing information to the target VPN extended community.</li> <li>The <i>route-target-ext-community</i> argument adds the route-target extended community attributes to the VRF's list of import, export, or both (import and export) route-target extended communities.</li> </ul>
Step 6	<p><b>import map route-map</b></p> <p><b>Example:</b> Router(config-vrf)# import map vpn1-route-map</p>	<p>(Optional) Configures an import route map for a VRF.</p> <ul style="list-style-type: none"> <li>The <i>route-map</i> argument specifies the route map to be used as an import route map for the VRF.</li> </ul>

	Command or Action	Purpose
Step 7	<b>exit</b>  <b>Example:</b> Router(config-vrf)# exit	(Optional) Exits to global configuration mode.
Step 8	<b>interface</b> <i>type number</i>  <b>Example:</b> Router(config)# interface Ethernet5/0	Specifies the interface to configure and enters interface configuration mode. <ul style="list-style-type: none"> <li>The <i>type</i> argument specifies the type of interface to be configured.</li> <li>The <i>number</i> argument specifies the port, connector, or interface card number.</li> </ul>
Step 9	<b>ip vrf forwarding</b> <i>vrf-name</i>  <b>Example:</b> Router(config-if)# ip vrf forwarding vpn1	Associates a VRF with the specified interface or subinterface. <ul style="list-style-type: none"> <li>The <i>vrf-name</i> argument is the name assigned to a VRF.</li> </ul>
Step 10	<b>end</b>  <b>Example:</b> Router(config-if)# end	(Optional) Exits to privileged EXEC mode.

### Troubleshooting Tips

Enter a **show ip vrf detail** command and make sure the MPLS VPN is up and associated with the right interfaces.

## Configuring Multiprotocol BGP for VPN Connectivity in the Backbone Carrier

Perform this task to configure multiprotocol BGP (MP-BGP) for VPN connectivity in the backbone carrier.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *as-number*
4. **no bgp default ipv4-unicast**
5. **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *as-number*
6. **neighbor** {*ip-address* | *peer-group-name*} **update-source** *interface-type*
7. **address-family vpnv4** [**unicast**]
8. **neighbor** {*ip-address* | *peer-group-name*} **send-community** **extended**
9. **neighbor** {*ip-address* | *peer-group-name*} **activate**
10. **end**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>router bgp as-number</b>  <b>Example:</b> Router(config)# router bgp 100	Configures a BGP routing process and enters router configuration mode. <ul style="list-style-type: none"> <li>The <i>as-number</i> argument indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along. Valid numbers are from 0 to 65535. Private autonomous system numbers that can be used in internal networks range from 64512 to 65535.</li> </ul>
Step 4	<b>no bgp default ipv4-unicast</b>  <b>Example:</b> Router(config-router)# no bgp default ipv4-unicast	(Optional) Disables the IPv4 unicast address family on all neighbors. <ul style="list-style-type: none"> <li>Use the <b>no</b> form of the <b>bgp default-unicast</b> command if you are using this neighbor for MPLS routes only.</li> </ul>
Step 5	<b>neighbor {ip-address   peer-group-name} remote-as as-number</b>  <b>Example:</b> Router(config-router)# neighbor 10.0.0.1 remote-as 100	Adds an entry to the BGP or multiprotocol BGP neighbor table. <ul style="list-style-type: none"> <li>The <i>ip-address</i> argument specifies the IP address of the neighbor.</li> <li>The <i>peer-group-name</i> argument specifies the name of a BGP peer group.</li> <li>The <i>as-number</i> argument specifies the autonomous system to which the neighbor belongs.</li> </ul>
Step 6	<b>neighbor {ip-address   peer-group-name} update-source interface-type</b>  <b>Example:</b> Router(config-router)# neighbor 10.0.0.1 update-source loopback0	Allows BGP sessions to use a specific operational interface for TCP connections. <ul style="list-style-type: none"> <li>The <i>ip-address</i> argument specifies the IP address of the BGP-speaking neighbor.</li> <li>The <i>peer-group-name</i> argument specifies the name of a BGP peer group.</li> <li>The <i>interface-type</i> argument specifies the interface to be used as the source.</li> </ul>
Step 7	<b>address-family vpnv4 [unicast]</b>  <b>Example:</b> Router(config-router)# address-family vpnv4	Enters address family configuration mode for configuring routing sessions, such as BGP, that use standard VPNv4 address prefixes. <ul style="list-style-type: none"> <li>The optional <b>unicast</b> keyword specifies VPNv4 unicast address prefixes.</li> </ul>

	Command or Action	Purpose
Step 8	<pre>neighbor {ip-address   peer-group-name} send-community extended</pre> <p><b>Example:</b>  Router(config-router-af)# neighbor 10.0.0.1 send-community extended</p>	<p>Specifies that a communities attribute should be sent to a BGP neighbor.</p> <ul style="list-style-type: none"> <li>The <i>ip-address</i> argument specifies the IP address of the BGP-speaking neighbor.</li> <li>The <i>peer-group-name</i> argument specifies the name of a BGP peer group.</li> </ul>
Step 9	<pre>neighbor {ip-address   peer-group-name} activate</pre> <p><b>Example:</b>  Router(config-router-af)# neighbor 10.12.12.12 activate</p>	<p>Enables the exchange of information with a neighboring BGP router.</p> <ul style="list-style-type: none"> <li>The <i>ip-address</i> argument specifies the IP address of the neighbor.</li> <li>The <i>peer-group-name</i> argument specifies the name of a BGP peer group.</li> </ul>
Step 10	<pre>end</pre> <p><b>Example:</b>  Router(config-router-af)# end</p>	<p>(Optional) Exits to privileged EXEC mode.</p>

### Troubleshooting Tips

You can enter a **show ip bgp neighbor** command to verify that the neighbors are up and running. If this command generates an error message, enter a **debug ip bgp x.x.x.x events** command, where *x.x.x.x* is the IP address of the neighbor.

## Configuring the CSC-PE and CSC-CE Routers

To enable the CSC-PE and CSC-CE routers to distribute routes and MPLS labels, perform the following tasks:

- [Configuring LDP on the CSC-PE and CSC-CE Routers, page 15](#) (required)
- [Enabling MPLS Encapsulation on the CSC-PE and CSC-CE Routers, page 16](#) (required)

### Prerequisites

Before you configure the CSC-PE and CSC-CE routers, you must configure an IGP on the CSC-PE and CSC-CE routers. A routing protocol is required between the PE and CE routers that connect the backbone carrier to the customer carrier. The routing protocol enables the customer carrier to exchange IGP routing information with the backbone carrier. Use the same routing protocol that the customer carrier uses. You can choose RIP, OSPF, or static routing as the routing protocol. BGP is not supported. For the configuration steps, see [Configuring MPLS Layer 3 VPNs](#).

### Configuring LDP on the CSC-PE and CSC-CE Routers

MPLS LDP is required between the PE and CE routers that connect the backbone carrier to the customer carrier. You can configure LDP as the default label distribution protocol for the entire router or just for the PE-to-CE interface for VRF.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label protocol ldp**
4. **interface** *type number*
5. **mpls label protocol ldp**
6. **exit**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>mpls label protocol ldp</b>  <b>Example:</b> Router(config)# mpls label protocol ldp	Specifies MPLS LDP as the default label distribution protocol for the router.
Step 4	<b>interface</b> <i>type number</i>  <b>Example:</b> Router(config)# interface Ethernet5/0	(Optional) Specifies the interface to configure and enters interface configuration mode. <ul style="list-style-type: none"> <li>• The <i>type</i> argument specifies the type of interface to be configured.</li> <li>• The <i>number</i> argument specifies the port, connector, or interface card number.</li> </ul>
Step 5	<b>mpls label protocol ldp</b>  <b>Example:</b> Router(config-if)# mpls label protocol ldp	(Optional) Specifies MPLS LDP as the default label distribution protocol for the interface.
Step 6	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	(Optional) Exits to privileged EXEC mode.

## Enabling MPLS Encapsulation on the CSC-PE and CSC-CE Routers

Every packet that crosses the backbone carrier must be encapsulated, so that the packet includes MPLS labels. You can enable MPLS encapsulation for the entire router or just on the interface of the PE or CE router. To enable the encapsulation of packets, perform the following task.



## SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `mpls ip`
4. `interface type number`
5. `mpls ip`
6. `exit`

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<code>enable</code>  <b>Example:</b> Router> <code>enable</code>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<code>configure terminal</code>  <b>Example:</b> Router# <code>configure terminal</code>	Enters global configuration mode.
Step 3	<code>mpls ip</code>  <b>Example:</b> Router(config)# <code>mpls ip</code>	Enables MPLS encapsulation for the router.
Step 4	<code>interface type number</code>  <b>Example:</b> Router(config)# <code>interface Ethernet5/0</code>	(Optional) Specifies the interface to configure and enters interface configuration mode. <ul style="list-style-type: none"> <li>• The <i>type</i> argument specifies the type of interface to be configured.</li> <li>• The <i>number</i> argument specifies the port, connector, or interface card number.</li> </ul>
Step 5	<code>mpls ip</code>  <b>Example:</b> Router(config-if)# <code>mpls ip</code>	(Optional) Enables MPLS encapsulation for the specified interface.
Step 6	<code>exit</code>  <b>Example:</b> Router(config-if)# <code>exit</code>	(Optional) Exits to privileged EXEC mode.

## Verifying the Carrier Supporting Carrier Configuration

The following commands verify the status of LDP sessions that were configured between the backbone carrier and customer carrier. Now the customer carrier ISP sites appear as a VPN customer to the backbone carrier.

**SUMMARY STEPS**

1. `show mpls ldp discovery vrf vrf-name`
2. `show mpls ldp discovery all`

**DETAILED STEPS****Step 1** `show mpls ldp discovery vrf vrf-name`

Use this command to show that the LDP sessions are in VRF VPN1 of the PE router of the backbone carrier, for example:

```
Router# show mpls ldp discovery vrf vpn1

Local LDP Identifier:
 10.0.0.0:0
Discovery Sources:
 Interfaces:
   Ethernet1/0 (ldp): xmit/recv
     LDP Id: 10.0.0.1:0
   POS6/0 (ldp): xmit
```

**Step 2** `show mpls ldp discovery all`

Use this command to list all LDP sessions in a router, for example:

```
Router# show mpls ldp discovery all

Local LDP Identifier:
 10.10.10.10:0
Discovery Sources:
 Interfaces:
   Ethernet1/5 (ldp): xmit/recv
     LDP Id: 10.5.5.5:0
VRF vpn1: Local LDP Identifier:
 10.0.0.1:0
Discovery Sources:
 Interfaces:
   Ethernet1/0 (ldp): xmit/recv
     LDP Id: 10.0.0.1:0
   POS6/0 (ldp): xmit
```

The Local LDP Identifier field shows the LDP identifier for the local label switching router for this session. The Interfaces field displays the interfaces engaging in LDP discovery activity:

- xmit indicates that the interface is transmitting LDP discovery hello packets.
- recv indicates that the interface is receiving LDP discovery hello packets.

**Configuration Examples for MPLS VPN CSC with LDP and IGP**

This section provides the following configuration examples:

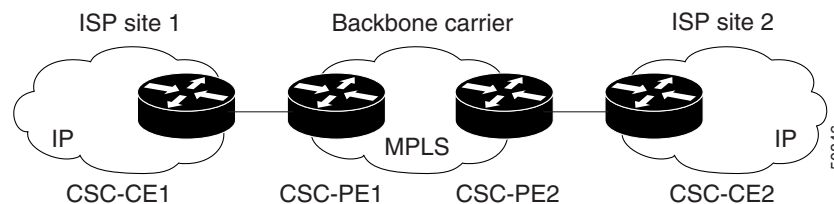
- [MPLS VPN CSC Network with a Customer Who Is an ISP: Example](#)
- [MPLS VPN CSC Network with a Customer Who Is an MPLS VPN Provider: Example](#)
- [MPLS VPN CSC Network That Contains Route Reflectors: Example](#)

- [MPLS VPN CSC Network with a Customer Who Has VPNs at the Network Edge: Example](#)

## MPLS VPN CSC Network with a Customer Who Is an ISP: Example

Figure 6 shows a carrier supporting carrier network configuration where the customer carrier is an ISP. The customer carrier has two sites, each of which is a POP. The customer carrier connects these sites using a VPN service provided by the backbone carrier. The backbone carrier uses MPLS. The ISP sites use IP. To enable packet transfer between the ISP sites and the backbone carrier, the CE routers that connect the ISPs to the backbone carrier run MPLS.

**Figure 6** Carrier Supporting Carrier Network with a Customer Carrier Who Is an ISP



The following examples show the configuration of each router in the carrier supporting carrier network. OSPF is used to connect the customer carrier to the backbone carrier.

### CSC-CE1 Configuration

```
mpls label protocol ldp
!
interface Loopback0
 ip address 10.14.14.14 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface ATM1/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 101 0 51 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
interface ATM2/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
```

```

no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM2/0.1 point-to-point
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
router ospf 200
log-adjacency-changes
redistribute connected subnets
network 10.14.14.14 0.0.0.0 area 200
network 10.15.0.0 0.255.255.255 area 200
network 10.16.0.0 0.255.255.255 area 200

```

## CSC-PE1 Configuration

```

ip cef distributed
!
ip vrf vpn1
rd 100:0
route-target export 100:0
route-target import 100:0
mpls label protocol ldp
no mpls aggregate-statistics
!
interface Loopback0
ip address 10.11.11.11 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface Loopback100
ip vrf forwarding vpn1
ip address 10.19.19.19 255.255.255.255
no ip directed-broadcast
!
interface ATM1/1/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM1/1/0.1
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
interface ATM3/0/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1

```

```

no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/0/0.1 point-to-point
ip vrf forwarding vpn1
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
router ospf 100
log-adjacency-changes
passive-interface ATM3/0/0.1
passive-interface Loopback100
network 10.11.11.11 0.0.0.0 area 100
network 10.0.0.0 0.255.255.255 area 100
!
router ospf 200 vrf vpn1
log-adjacency-changes
redistribute bgp 100 metric-type 1 subnets
network 10.19.19.19 0.0.0.0 area 200
network 10.0.0.0 0.255.255.255 area 200
!
router bgp 100
bgp log-neighbor-changes
timers bgp 10 30
neighbor 10.12.12.12 remote-as 100
neighbor 10.12.12.12 update-source Loopback0
!
address-family ipv4
neighbor 10.12.12.12 activate
neighbor 10.12.12.12 send-community extended
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.12.12.12 activate
neighbor 10.12.12.12 send-community extended
exit-address-family
!
address-family ipv4 vrf vpn1
redistribute ospf 200 match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family

```

## CSC-PE2 Configuration

```

ip cef distributed
!
ip vrf vpn1
rd 100:0
route-target export 100:0
route-target import 100:0
mpls label protocol ldp
no mpls aggregate-statistics
!
interface Loopback0
ip address 10.12.12.12 255.255.255.255
no ip directed-broadcast

```

```

no ip route-cache
no ip mroute-cache
!
interface Loopback100
 ip vrf forwarding vpn1
 ip address 10.20.20.20 255.255.255.255
 no ip directed-broadcast
!
interface ATM0/1/0
 no ip address
 no ip directed-broadcast
 no ip route-cache distributed
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM0/1/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 50 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
interface ATM3/0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache distributed
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM3/0/0.1 point-to-point
 ip vrf forwarding vpn1
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 50 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
router ospf 100
 log-adjacency-changes
 passive-interface ATM3/0/0.1
 passive-interface Loopback100
 network 10.12.12.12 0.0.0.0 area 100
 network 10.0.0.0 0.255.255.255 area 100
!
router ospf 200 vrf vpn1
 log-adjacency-changes
 redistribute bgp 100 metric-type 1 subnets
 network 10.20.20.20 0.0.0.0 area 200
 network 10.0.0.0 0.255.255.255 area 200
!
router bgp 100
 bgp log-neighbor-changes
 timers bgp 10 30
 neighbor 10.11.11.11 remote-as 100
 neighbor 10.11.11.11 update-source Loopback0
!

```

```

address-family ipv4
neighbor 10.11.11.11 activate
neighbor 10.11.11.11 send-community extended
no synchronization
exit-address-family
!
address-family vpv4
neighbor 10.11.11.11 activate
neighbor 10.11.11.11 send-community extended
exit-address-family
!
address-family ipv4 vrf vpn1
redistribute ospf 200 match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family

```

## CSC-CE2 Configuration

```

ip cef
!
mpls label protocol ldp
!
interface Loopback0
ip address 10.16.16.16 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface ATM1/0
no ip address
no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
interface ATM5/0
no ip address
no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip

```

```

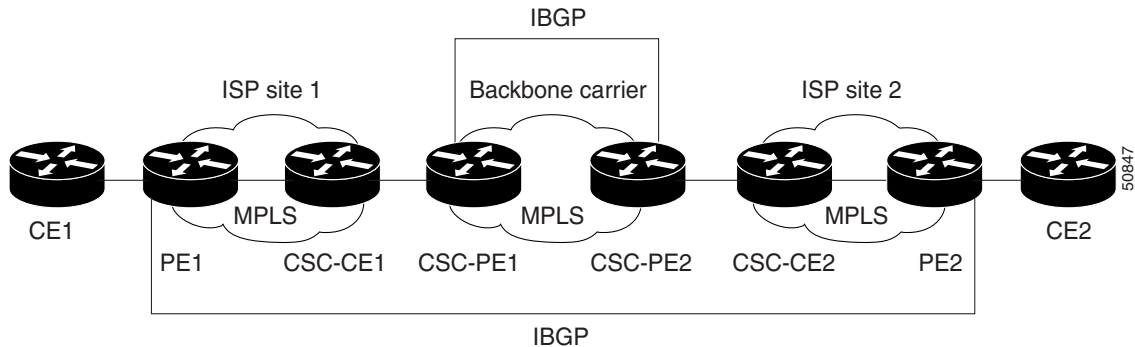
!
router ospf 200
  log-adjacency-changes
  redistribute connected subnets
  network 10.16.16.16 0.0.0.0 area 200
  network 10.0.0.0 0.255.255.255 area 200
  network 10.0.0.0 0.255.255.255 area 200

```

## MPLS VPN CSC Network with a Customer Who Is an MPLS VPN Provider: Example

Figure 7 shows a carrier supporting carrier network configuration where the customer carrier is an MPLS VPN provider. The customer carrier has two sites. The backbone carrier and the customer carrier use MPLS. The IBGP sessions exchange the external routing information of the ISP.

**Figure 7** Carrier Supporting Carrier Network with a Customer Carrier Who Is an MPLS VPN Provider



The following configuration examples show the configuration of each router in the carrier supporting carrier network. OSPF is the protocol used to connect the customer carrier to the backbone carrier.

### CE1 Configuration

```

ip cef
!
interface Loopback0
  ip address 10.17.17.17 255.255.255.255
  no ip directed-broadcast
!
interface Ethernet0/1
  ip address 10.0.0.2 255.0.0.0
  no ip directed-broadcast
!
router ospf 300
  log-adjacency-changes
  redistribute bgp 300 subnets
  passive-interface Ethernet0/1
  network 10.17.17.17 0.0.0.0 area 300
!
router bgp 300
  no synchronization
  bgp log-neighbor-changes
  timers bgp 10 30

```



```

redistribute connected
redistribute ospf 300 match internal external 1 external 2
neighbor 10.0.0.1 remote-as 200
neighbor 10.0.0.1 advertisement-interval 5
no auto-summary

```

## PE1 Configuration

```

ip cef
!
ip vrf vpn2
 rd 200:1
  route-target export 200:1
  route-target import 200:1
mpls label protocol ldp
!
interface Loopback0
 ip address 10.13.13.13 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface ATM1/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 50 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
interface Ethernet3/0
 ip vrf forwarding vpn2
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 no ip mroute-cache
!
router ospf 200
 log-adjacency-changes
 redistribute connected subnets
 passive-interface Ethernet3/0
 network 10.13.13.13 0.0.0.0 area 200
 network 10.0.0.0 0.255.255.255 area 200
!
router bgp 200
 no bgp default ipv4-unicast
 bgp log-neighbor-changes
 timers bgp 10 30
 neighbor 10.15.15.15 remote-as 200
 neighbor 10.15.15.15 update-source Loopback0
!
 address-family ipv4
  neighbor 10.15.15.15 activate
  neighbor 10.15.15.15 send-community extended

```

```

no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.15.15.15 activate
neighbor 10.15.15.15 send-community extended
exit-address-family
!
address-family ipv4 vrf vpn2
neighbor 10.0.0.2 remote-as 300
neighbor 10.0.0.2 activate
neighbor 10.0.0.2 as-override
neighbor 10.0.0.2 advertisement-interval 5
no auto-summary
no synchronization
exit-address-family

```

## CSC-CE1 Configuration

```

mpls label protocol ldp
!
interface Loopback0
 ip address 10.14.14.14 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface ATM1/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 101 0 51 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
interface ATM2/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM2/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 50 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
router ospf 200

```

```

log-adjacency-changes
redistribute connected subnets
network 10.14.14.14 0.0.0.0 area 200
network 10.0.0.0 0.255.255.255 area 200
network 10.0.0.0 0.255.255.255 area 200

```

## CSC-PE1 Configuration

```

ip cef distributed
!
ip vrf vpn1
 rd 100:0
  route-target export 100:0
  route-target import 100:0
mpls label protocol ldp
no mpls aggregate-statistics
!
interface Loopback0
 ip address 11.11.11.11 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface Loopback100
 ip vrf forwarding vpn1
 ip address 10.19.19.19 255.255.255.255
 no ip directed-broadcast
!
interface ATM1/1/0
 no ip address
 no ip directed-broadcast
 no ip route-cache distributed
 atm clock INTERNAL
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM1/1/0.1 point-to-point
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 50 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
interface ATM3/0/0
 no ip address
 no ip directed-broadcast
 no ip route-cache distributed
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM3/0/0.1 point-to-point
 ip vrf forwarding vpn1
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 atm pvc 101 0 51 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!

```

```

router ospf 100
 log-adjacency-changes
 passive-interface ATM3/0/0.1
 passive-interface Loopback100
 network 10.11.11.11 0.0.0.0 area 100
 network 10.0.0.0 0.255.255.255 area 100
!
router ospf 200 vrf vpn1
 log-adjacency-changes
 redistribute bgp 100 metric-type 1 subnets
 network 10.19.19.19 0.0.0.0 area 200
 network 10.0.0.0 0.255.255.255 area 200
!
router bgp 100
 bgp log-neighbor-changes
 timers bgp 10 30
 neighbor 10.12.12.12 remote-as 100
 neighbor 10.12.12.12 update-source Loopback0
!
 address-family ipv4
  neighbor 10.12.12.12 activate
  neighbor 10.12.12.12 send-community extended
 no synchronization
 exit-address-family
!
 address-family vpnv4
  neighbor 10.12.12.12 activate
  neighbor 10.12.12.12 send-community extended
 exit-address-family
!
 address-family ipv4 vrf vpn1
 redistribute ospf 200 match internal external 1 external 2
 no auto-summary
 no synchronization
 exit-address-family

```

## CSC-PE2 Configuration

```

ip cef distributed
!
ip vrf vpn1
 rd 100:0
 route-target export 100:0
 route-target import 100:0
mpls label protocol ldp
no mpls aggregate-statistics
!
interface Loopback0
 ip address 10.12.12.12 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface Loopback100
 ip vrf forwarding vpn1
 ip address 10.20.20.20 255.255.255.255
 no ip directed-broadcast
!
interface ATM0/1/0
 no ip address
 no ip directed-broadcast
 no ip route-cache distributed

```

```

no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM0/1/0.1 point-to-point
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
interface ATM3/0/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/0/0.1 point-to-point
ip vrf forwarding vpn1
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
router ospf 100
log-adjacency-changes
passive-interface ATM3/0/0.1
passive-interface Loopback100
network 10.12.12.12 0.0.0.0 area 100
network 10.0.0.0 0.255.255.255 area 100
!
router ospf 200 vrf vpn1
log-adjacency-changes
redistribute bgp 100 metric-type 1 subnets
network 10.20.20.20 0.0.0.0 area 200
network 10.0.0.0 0.255.255.255 area 200
!
router bgp 100
bgp log-neighbor-changes
timers bgp 10 30
neighbor 10.11.11.11 remote-as 100
neighbor 10.11.11.11 update-source Loopback0
!
address-family ipv4
neighbor 10.11.11.11 activate
neighbor 10.11.11.11 send-community extended
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.11.11.11 activate
neighbor 10.11.11.11 send-community extended
exit-address-family
!
address-family ipv4 vrf vpn1

```

```

redistribute ospf 200 match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family

```

## CSC-CE2 Configuration

```

ip cef
!
mpls label protocol ldp
!
interface Loopback0
 ip address 10.16.16.16 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface ATM1/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 50 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
interface ATM5/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 atm sonet stm-1
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 50 aal5snap
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls ip
!
router ospf 200
 log-adjacency-changes
 redistribute connected subnets
 network 10.16.16.16 0.0.0.0 area 200
 network 10.0.0.0 0.255.255.255 area 200
 network 10.0.0.0 0.255.255.255 area 200

```

## PE2 Configuration

```

ip cef

```

```
ip cef accounting non-recursive
!
ip vrf vpn2
  rd 200:1
  route-target export 200:1
  route-target import 200:1
mpls label protocol ldp
!
interface Loopback0
  ip address 10.15.15.15 255.255.255.255
  no ip directed-broadcast
!
interface Ethernet3/0
  ip vrf forwarding vpn2
  ip address 10.0.0.1 255.0.0.0
  no ip directed-broadcast
!
interface ATM5/0
  no ip address
  no ip directed-broadcast
  atm clock INTERNAL
  atm sonet stm-1
  no atm enable-ilmi-trap
  no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
  ip address 10.0.0.1 255.0.0.0
  no ip directed-broadcast
  atm pvc 100 0 50 aal5snap
  no atm enable-ilmi-trap
  mpls label protocol ldp
  mpls ip
!
router ospf 200
  log-adjacency-changes
  redistribute connected subnets
  passive-interface Ethernet3/0
  network 10.15.15.15 0.0.0.0 area 200
  network 10.0.0.0 0.255.255.255 area 200
!
router bgp 200
  no bgp default ipv4-unicast
  bgp log-neighbor-changes
  timers bgp 10 30
  neighbor 10.13.13.13 remote-as 200
  neighbor 10.13.13.13 update-source Loopback0
  !
  address-family ipv4
    neighbor 10.13.13.13 activate
    neighbor 10.13.13.13 send-community extended
    no synchronization
    exit-address-family
  !
  address-family vpnv4
    neighbor 10.13.13.13 activate
    neighbor 10.13.13.13 send-community extended
    exit-address-family
  !
  address-family ipv4 vrf vpn2
    neighbor 10.0.0.2 remote-as 300
    neighbor 10.0.0.2 activate
    neighbor 10.0.0.2 as-override
    neighbor 10.0.0.2 advertisement-interval 5
  no auto-summary
```

```
no synchronization
exit-address-family
```

## CE2 Configuration

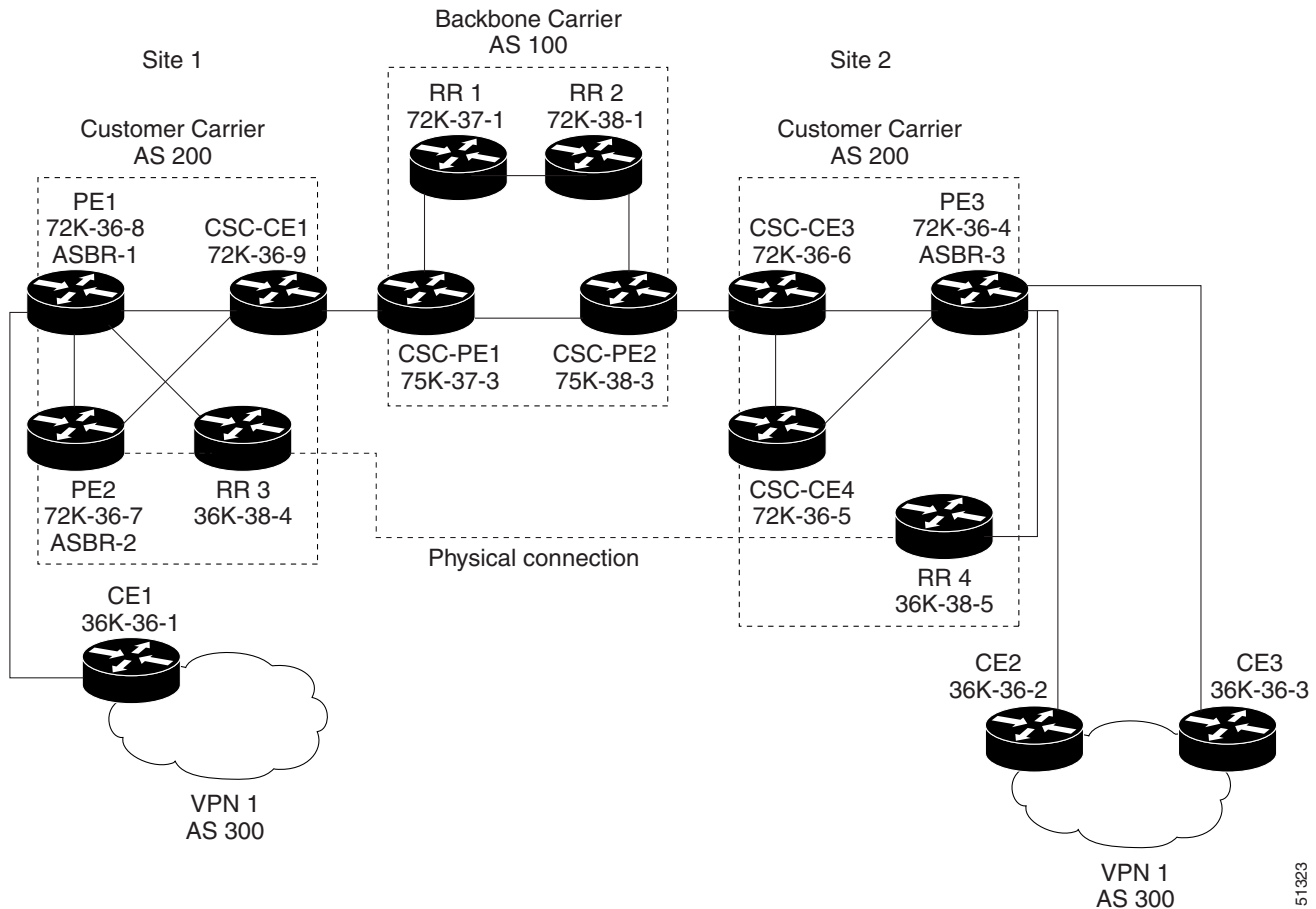
```
ip cef
!
interface Loopback0
 ip address 10.18.18.18 255.255.255.255
 no ip directed-broadcast
!
interface Ethernet0/1
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
!
router ospf 300
 log-adjacency-changes
 redistribute bgp 300 subnets
 passive-interface Ethernet0/1
 network 10.18.18.18 0.0.0.0 area 300
!
router bgp 300
 no synchronization
 bgp log-neighbor-changes
 timers bgp 10 30
 redistribute connected
 redistribute ospf 300 match internal external 1 external 2
 neighbor 10.0.0.1 remote-as 200
 neighbor 10.0.0.1 advertisement-interval 5
 no auto-summary
```

## MPLS VPN CSC Network That Contains Route Reflectors: Example

[Figure 8](#) shows a carrier supporting carrier network configuration that contains route reflectors. The customer carrier has two sites.



**Figure 8** Carrier Supporting Carrier Network that Contains Route Reflectors



**Note**

A connection between route reflectors (RRs) is not necessary.

The following configuration examples show the configuration of each router in the carrier supporting carrier network. Note the following:

- The router IP addresses are abbreviated for ease of reading. For example, the loopback address for PE 1 is 25, which is equivalent to 10.25.25.25.
- The following list shows the loopback addresses for the CSC-PE routers:
  - CSC-PE1 (75K-37-3): loopback 0 = 10.15.15.15, loopback 1 = 10.18.18.18
  - CSC-PE2 (75K-38-3): loopback 0 = 10.16.16.16, loopback 1 = 10.20.20.20

## Backbone Carrier Configuration

### Route Reflector 1 (72K-37-1) Configuration

```
interface Loopback0
 ip address 10.13.13.13 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
```

```

!
interface ATM1/0
  no ip address
  no ip directed-broadcast
  atm clock INTERNAL
  no atm enable-ilmi-trap
  no atm ilmi-keepalive
!
interface ATM1/0.1 mpls
ip address 10.0.0.2 255.0.0.0
  no ip directed-broadcast
  no atm enable-ilmi-trap
  mpls label protocol ldp
  mpls atm vpi 2-5
  mpls ip
!
interface ATM1/1
  no ip address
  no ip directed-broadcast
  atm clock INTERNAL
  no atm enable-ilmi-trap
  no atm ilmi-keepalive
!
interface ATM1/1.1 mpls
ip address 10.0.0.1 255.0.0.0
  no ip directed-broadcast
  no atm enable-ilmi-trap
  mpls label protocol ldp
  mpls atm vpi 2-5
  mpls ip
!
router ospf 100
  auto-cost reference-bandwidth 10000
  network 10.0.0.0 0.255.255.255 area 100
  network 10.1.0.0 0.255.255.255 area 100
  network 10.2.0.0 0.255.255.255 area 100
!
router bgp 100
  no synchronization
  no bgp default ipv4-unicast
  bgp cluster-id 1
  redistribute static
  neighbor 10.15.15.15 remote-as 100
  neighbor 10.15.15.15 update-source Loopback0
  neighbor 10.16.16.16 remote-as 100
  neighbor 10.16.16.16 update-source Loopback0
!
  address-family ipv4 vrf vpn1
  no auto-summary
  no synchronization
  exit-address-family
!
  address-family vpnv4
  neighbor 10.15.15.15 activate
  neighbor 10.15.15.15 route-reflector-client
  neighbor 10.15.15.15 send-community extended
  neighbor 10.16.16.16 activate
  neighbor 10.16.16.16 route-reflector-client
  neighbor 10.16.16.16 send-community extended
  bgp scan-time import 5
  exit-address-family

```

## Route Reflector 2 (72K-38-1) Configuration

```
interface Loopback0
 ip address 10.14.14.14 255.255.255.255
 no ip directed-broadcast
 no ip mroute-cache
!
interface ATM1/0
 no ip address
 no ip directed-broadcast
 atm clock INTERNAL
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM1/0.1 mpls
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls atm vpi 2-5
 mpls ip
!
interface ATM1/1
 no ip address
 no ip directed-broadcast
 atm clock INTERNAL
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM1/1.1 mpls
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 no atm enable-ilmi-trap
 mpls label protocol ldp
 mpls atm vpi 2-5
 mpls ip
!
router ospf 100
 auto-cost reference-bandwidth 10000
 network 10.0.0.0 0.255.255.255 area 100
 network 10.1.0 0.255.255.255 area 100
 network 10.2.0.0 0.255.255.255 area 100
!
router bgp 100
 no synchronization
 no bgp default ipv4-unicast
 bgp cluster-id 1
 redistribute static
 neighbor 10.15.15.15 remote-as 100
 neighbor 10.15.15.15 update-source Loopback0
 neighbor 10.16.16.16 remote-as 100
 neighbor 10.16.16.16 update-source Loopback0
!
```

```

address-family ipv4 vrf vpn1
no auto-summary
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.15.15.15 activate
neighbor 10.15.15.15 route-reflector-client
neighbor 10.15.15.15 send-community extended
neighbor 10.16.16.16 activate
neighbor 10.16.16.16 route-reflector-client
neighbor 10.16.16.16 send-community extended
bgp scan-time import 5
exit-address-family

```

### CSC-PE1 (75K-37-3) Configuration

```

ip cef distributed
!
ip vrf vpn1
rd 100:1
route-target export 100:1
route-target import 100:1
!
interface Loopback0
ip address 10.15.15.15 255.255.255.255
no ip directed-broadcast
!
interface Loopback1
ip vrf forwarding vpn1
ip address 10.18.18.18 255.255.255.255
no ip directed-broadcast
!
interface Ethernet0/0/1
ip vrf forwarding vpn1
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
no ip route-cache distributed
mpls label protocol ldp
mpls ip
!
interface ATM1/1/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM1/1/0.1 mpls
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
no atm enable-ilmi-trap
mpls label protocol ldp
mpls atm vpi 2-5
mpls ip
!
interface ATM3/0/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL

```

```
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/0/0.1 point-to-point
ip vrf forwarding vpn1
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
atm pvc 100 6 32 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
interface ATM3/1/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/1/0.1 mpls
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
no atm enable-ilmi-trap
mpls label protocol ldp
mpls atm vpi 2-5
mpls ip
!
router ospf 100
auto-cost reference-bandwidth 10000
network 10.0.0.0 0.255.255.255 area 100
network 10.1.0.0 0.255.255.255 area 100
network 10.2.0.0 0.255.255.255 area 100
network 10.3.0.0 0.255.255.255 area 100
network 10.4.0.0 0.255.255.255 area 100
!
router ospf 1 vrf vpn1
redistribute bgp 100 metric-type 1 subnets
network 10.0.0.0 0.255.255.255 area 101
network 10.0.0.0 0.255.255.255 area 101
network 10.0.0.0 0.255.255.255 area 101
network 10.0.0.0 0.255.255.255 area 101
!
router bgp 100
no bgp default ipv4-unicast
bgp log-neighbor-changes
neighbor 10.13.13.13 remote-as 100
neighbor 10.13.13.13 update-source Loopback0
neighbor 10.14.14.14 remote-as 100
neighbor 10.14.14.14 update-source Loopback0
!
address-family ipv4
redistribute static
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.13.13.13 activate
neighbor 10.13.13.13 send-community extended
neighbor 10.14.14.14 activate
neighbor 10.14.14.14 send-community extended
exit-address-family
```

```

!
address-family ipv4 vrf vpn1
redistribute ospf 1 match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family

```

### CSC-PE2 (75K-38-3) Configuration

```

ip cef distributed
!
ip vrf vpn1
rd 100:1
route-target export 100:1
route-target import 100:1
!
interface Loopback0
ip address 10.16.16.16 255.255.255.255
no ip directed-broadcast
!
interface Loopback1
ip vrf forwarding vpn1
ip address 10.20.20.20 255.255.255.255
no ip directed-broadcast
!
interface ATM0/1/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM0/1/0.1 mpls
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
no atm enable-ilmi-trap
mpls label protocol ldp
mpls atm vpi 2-5
mpls ip
!
interface ATM2/1/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM2/1/0.1 mpls
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
no atm enable-ilmi-trap
mpls label protocol ldp
mpls atm vpi 2-5
mpls ip
!
interface ATM3/0/0
no ip address
no ip directed-broadcast
no ip route-cache distributed

```

```
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/0/0.1 point-to-point
ip vrf forwarding vpn1
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
atm pvc 100 6 32 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
interface ATM3/1/0
no ip address
no ip directed-broadcast
no ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/1/0.1 point-to-point
ip vrf forwarding vpn1
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
atm pvc 101 6 33 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls ip
!
router ospf 100
auto-cost reference-bandwidth 10000
network 10.0.0.0 0.255.255.255 area 100
network 10.0.0.0 0.255.255.255 area 100
network 10.0.0.0 0.255.255.255 area 100
network 10.0.0.0 0.255.255.255 area 100
network 10.0.0.0 0.255.255.255 area 100
!
router ospf 1 vrf vpn1
redistribute bgp 100 metric-type 1 subnets
network 10.0.0.0 0.255.255.255 area 101
network 10.0.0.0 0.255.255.255 area 101
network 10.0.0.0 0.255.255.255 area 101
network 10.0.0.0 0.255.255.255 area 101
!
router bgp 100
no bgp default ipv4-unicast
bgp log-neighbor-changes
neighbor 10.13.13.13 remote-as 100
neighbor 10.13.13.13 update-source Loopback0
neighbor 10.14.14.14 remote-as 100
neighbor 10.14.14.14 update-source Loopback0
!
address-family ipv4
redistribute static
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.13.13.13 activate
neighbor 10.13.13.13 send-community extended
```

```

neighbor 10.14.14.14 activate
neighbor 10.14.14.14 send-community extended
exit-address-family
!
address-family ipv4 vrf vpn1
redistribute ospf 1 match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family

```

## Customer Carrier Site 1 Configuration

### PE1 (72K-36-8) Configuration

```

ip cef
!
ip vrf vpn2
rd 200:1
route-target export 200:1
route-target import 200:1
no mpls ip propagate-ttl
!
interface Loopback0
ip address 10.25.25.25 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface ATM1/0
no ip address
no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
mpls label protocol ldp
mpls ip
!
interface Ethernet3/0
ip vrf forwarding vpn2
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
no ip mroute-cache
!
interface Ethernet3/1
ip address 10.0.0.1 255.0.0.0
no ip directed-broadcast
no ip mroute-cache
mpls label protocol ldp
mpls ip
!
interface Ethernet3/2
ip address 10.0.0.2 255.0.0.0
no ip directed-broadcast
no ip mroute-cache
mpls label protocol ldp
mpls ip
!

```



```

router ospf 1
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
!
router bgp 200
 neighbor 10.22.22.22 remote-as 200
 neighbor 10.22.22.22 update-source Loopback0
 neighbor 10.23.23.23 remote-as 200
 neighbor 10.23.23.23 update-source Loopback0
!
 address-family ipv4 vrf vpn2
  redistribute connected
  neighbor 10.0.0.2 remote-as 300
  neighbor 10.0.0.2 activate
  neighbor 10.0.0.2 as-override
  no auto-summary
  no synchronization
  exit-address-family
!
 address-family vpnv4
  neighbor 10.22.22.22 activate
  neighbor 10.22.22.22 send-community extended
  neighbor 10.23.23.23 activate
  neighbor 10.23.23.23 send-community extended
  exit-address-family

```

### CSC-CE1 (72K-36-9) Configuration

```

ip cef
no ip domain-lookup
!
interface Loopback0
 ip address 10.11.11.11 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface ATM1/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 6 32 aal5snap
 mpls label protocol ldp
 mpls ip
!
interface ATM2/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM2/0.1 point-to-point
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast

```

```

    atm pvc 100 0 50 aal5snap
mpls label protocol ldp
mpls ip
!
interface Ethernet3/0
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 no ip mroute-cache
mpls label protocol ldp
mpls ip
!
interface Ethernet3/1
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 no ip mroute-cache
mpls label protocol ldp
mpls ip
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101

```

## PE2 (72K-36-7) Configuration

```

ip cef
!
ip vrf vpn2
 rd 200:1
  route-target export 200:1
  route-target import 200:1
no mpls ip propagate-ttl
!
interface Loopback0
 ip address 10.24.24.24 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface Ethernet3/0
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 no ip mroute-cache
mpls label protocol ldp
mpls ip
!
interface Ethernet3/1
 ip vrf forwarding vpn2
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 no ip mroute-cache
!
interface Ethernet3/2
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 no ip mroute-cache
mpls label protocol ldp
mpls ip
!

```

```

interface Ethernet3/3
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 no ip mroute-cache
 mpls label protocol ldp
 mpls ip
 !
router ospf 1
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 network 10.0.0.0 0.255.255.255 area 101
 !
router bgp 200
 neighbor 10.22.22.22 remote-as 200
 neighbor 10.22.22.22 update-source Loopback0
 neighbor 10.23.23.23 remote-as 200
 neighbor 10.23.23.23 update-source Loopback0
 !
 address-family ipv4 vrf vpn2
 neighbor 10.0.0.2 remote-as 300
 neighbor 10.0.0.2 activate
 neighbor 10.0.0.2 as-override
 no auto-summary
 no synchronization
 exit-address-family
 !
 address-family vpnv4
 neighbor 10.22.22.22 activate
 neighbor 10.22.22.22 send-community extended
 neighbor 10.23.23.23 activate
 neighbor 10.23.23.23 send-community extended
 exit-address-family

```

### Route Reflector 3 (36K-38-4) Configuration

```

ip cef
 !
interface Loopback0
 ip address 10.23.23.23 255.255.255.255
 !
interface Ethernet1/1
 ip address 10.0.0.1 255.0.0.0
 mpls label protocol ldp
 mpls ip
 !
interface Ethernet1/2
 ip address 10.0.0.1 255.0.0.0
 mpls label protocol ldp
 mpls ip
 !
interface ATM3/0
 no ip address
 no ip mroute-cache
 atm clock INTERNAL
 no atm scrambling cell-payload
 no atm ilmi-keepalive
 !
interface ATM3/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 atm pvc 100 0 55 aal5snap
 mpls label protocol ldp
 mpls ip

```

```

!
router ospf 1
  log-adjacency-changes
  network 10.0.0.0 0.255.255.255 area 101
  network 10.1.0.0 0.255.255.255 area 101
  network 10.2.0.0 0.255.255.255 area 101
  network 10.3.0.0 0.255.255.255 area 101
!
router bgp 200
  no synchronization
  no bgp default ipv4-unicast
  bgp cluster-id 2
  redistribute static
  neighbor 10.21.21.21 remote-as 200
  neighbor 10.21.21.21 update-source Loopback0
  neighbor 10.24.24.24 remote-as 200
  neighbor 10.24.24.24 update-source Loopback0
  neighbor 10.25.25.25 remote-as 200
  neighbor 10.25.25.25 update-source Loopback0
!
  address-family ipv4 vrf vpn2
  no auto-summary
  no synchronization
  exit-address-family
!
  address-family vpnv4
  neighbor 10.21.21.21 activate
  neighbor 10.21.21.21 route-reflector-client
  neighbor 10.21.21.21 send-community extended
  neighbor 10.24.24.24 activate
  neighbor 10.24.24.24 route-reflector-client
  neighbor 10.24.24.24 send-community extended
  neighbor 10.25.25.25 activate
  neighbor 10.25.25.25 route-reflector-client
  neighbor 10.25.25.25 send-community extended
  exit-address-family

```

## CE1 (36K-36-1) Configuration

```

ip cef
!
interface Loopback0
  ip address 10.28.28.28 255.255.255.255
  no ip directed-broadcast
!
interface Ethernet0/1
  ip address 10.0.0.2 255.0.0.0
  no ip directed-broadcast
!
interface Ethernet0/2
  ip address 10.0.0.2 255.0.0.0
  no ip directed-broadcast
!
router bgp 300
  network 10.0.0.0
  network 10.0.0.0
  network 10.0.0.0
  neighbor 10.0.0.1 remote-as 200
  neighbor 10.0.0.1 remote-as 200

```

## Customer Carrier Site 2 Configuration

### CSC-CE3 (72K-36-6) Configuration

```

ip cef
!
interface Loopback0
 ip address 10.12.12.12 255.255.255.255
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
!
interface ATM1/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 6 32 aal5snap
 mpls label protocol ldp

 mpls ip
!
interface POS2/0
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 encapsulation ppp
 mpls label protocol ldp
 mpls ip
!
interface ATM5/0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 40 aal5snap
 mpls ip
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 101
 network 10.1.0.0 0.255.255.255 area 101
 network 10.2.0.0 0.255.255.255 area 101
 network 10.3.0.0 0.255.255.255 area 101

```

### PE3 (72K-36-4) Configuration

```

ip cef
!
ip vrf vpn2
 rd 200:1
 route-target export 200:1
 route-target import 200:1
!

```

```

!
interface Loopback0
 ip address 10.21.21.21 255.255.255.255
 no ip directed-broadcast
!
interface Ethernet3/0
 ip vrf forwarding vpn2
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
!
interface Ethernet3/1
 ip vrf forwarding vpn2
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
!
interface Ethernet3/2
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 mpls label protocol ldp
 mpls ip
!
interface ATM5/0
 no ip address
 no ip directed-broadcast
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 40 aal5snap
 mpls label protocol ldp
 mpls ip
!
interface ATM6/0
 no ip address
 no ip directed-broadcast
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM6/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 20 aal5snap
 mpls label protocol ldp
 mpls ip
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 101
 network 10.1.0.0 0.255.255.255 area 101
 network 10.2.0.0 0.255.255.255 area 101
 network 10.3.0.0 0.255.255.255 area 101
!
router bgp 200
 neighbor 10.22.22.22 remote-as 200
 neighbor 10.22.22.22 update-source Loopback0
 neighbor 10.23.23.23 remote-as 200
 neighbor 10.23.23.23 update-source Loopback0
!
 address-family ipv4 vrf vpn2
 redistribute connected
 neighbor 10.0.0.2 remote-as 300
 neighbor 10.0.0.2 activate
 neighbor 10.0.0.2 as-override

```

```

neighbor 10.0.0.2 remote-as 300
neighbor 10.0.0.2 activate
no auto-summary
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.22.22.22 activate
neighbor 10.22.22.22 send-community extended
neighbor 10.23.23.23 activate
neighbor 10.23.23.23 send-community extended
exit-address-family

```

### CSC-CE4 (72K-36-5) Configuration

```

ip cef
!
interface Loopback0
 ip address 10.10.10.10 255.255.255.255
 no ip directed-broadcast
!
interface POS4/0
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 encapsulation ppp
 mpls label protocol ldp
 mpls ip
  clock source internal
!
interface ATM5/0
 no ip address
 no ip directed-broadcast
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 0 20 aal5snap
 mpls label protocol ldp
 mpls ip
!
interface ATM6/0
 no ip address
 no ip directed-broadcast
 atm clock INTERNAL
 no atm ilmi-keepalive
!
interface ATM6/0.1 point-to-point
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
 atm pvc 100 6 33 aal5snap
 mpls label protocol ldp
 mpls ip
!
router ospf 1
 network 10.0.0.0 0.255.255.255 area 101
 network 10.1.0.0 0.255.255.255 area 101
 network 10.2.0.0 0.255.255.255 area 101
 network 10.3.0.0 0.255.255.255 area 101

```

**Route Reflector 4 (36K-38-5) Configuration**

```

ip cef
!
interface Loopback0
 ip address 10.22.22.22 255.255.255.255
!
interface Ethernet0/1
 ip address 10.0.0.2 255.0.0.0
 mpls label protocol ldp
 mpls ip
!
interface ATM2/0
 no ip address
 no ip mroute-cache
 atm clock INTERNAL
 no atm scrambling cell-payload
 no atm ilmi-keepalive
!
interface ATM2/0.1 point-to-point
 ip address 10.0.0.1 255.0.0.0
 atm pvc 100 0 55 aal5snap
 mpls label protocol ldp
 mpls ip
!
router ospf 1
 log-adjacency-changes
 network 10.0.0.0 0.255.255.255 area 101
 network 10.1.0.0 0.255.255.255 area 101
 network 10.2.0.0 0.255.255.255 area 101
!
router bgp 200
 no synchronization
 no bgp default ipv4-unicast
 bgp cluster-id 2
 redistribute static
 neighbor 10.21.21.21 remote-as 200
 neighbor 10.21.21.21 update-source Loopback0
 neighbor 10.24.24.24 remote-as 200
 neighbor 10.24.24.24 update-source Loopback0
 neighbor 10.25.25.25 remote-as 200
 neighbor 10.25.25.25 update-source Loopback0
!
 address-family ipv4 vrf vpn2
 no auto-summary
 no synchronization
 exit-address-family
!
 address-family vpnv4
 neighbor 10.21.21.21 activate
 neighbor 10.21.21.21 route-reflector-client
 neighbor 10.21.21.21 send-community extended
 neighbor 10.24.24.24 activate
 neighbor 10.24.24.24 route-reflector-client
 neighbor 10.24.24.24 send-community extended
 neighbor 10.25.25.25 activate
 neighbor 10.25.25.25 route-reflector-client
 neighbor 10.25.25.25 send-community extended
 exit-address-family

```



### CE2 (36K-36-2) Configuration

```
ip cef
!
interface Loopback0
 ip address 10.26.26.26 255.255.255.255
 no ip directed-broadcast
!
interface Ethernet0/1
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
!
interface Ethernet0/2
 ip address 10.0.0.1 255.0.0.0
 no ip directed-broadcast
!
router ospf 300
 redistribute bgp 300
 network 10.0.0.0 0.255.255.255 area 300
 network 10.0.0.0 0.255.255.255 area 300
!
router bgp 300
 network 10.0.0.0
 network 10.1.0.0
 network 10.2.0.0
 neighbor 10.0.0.1 remote-as 200
```

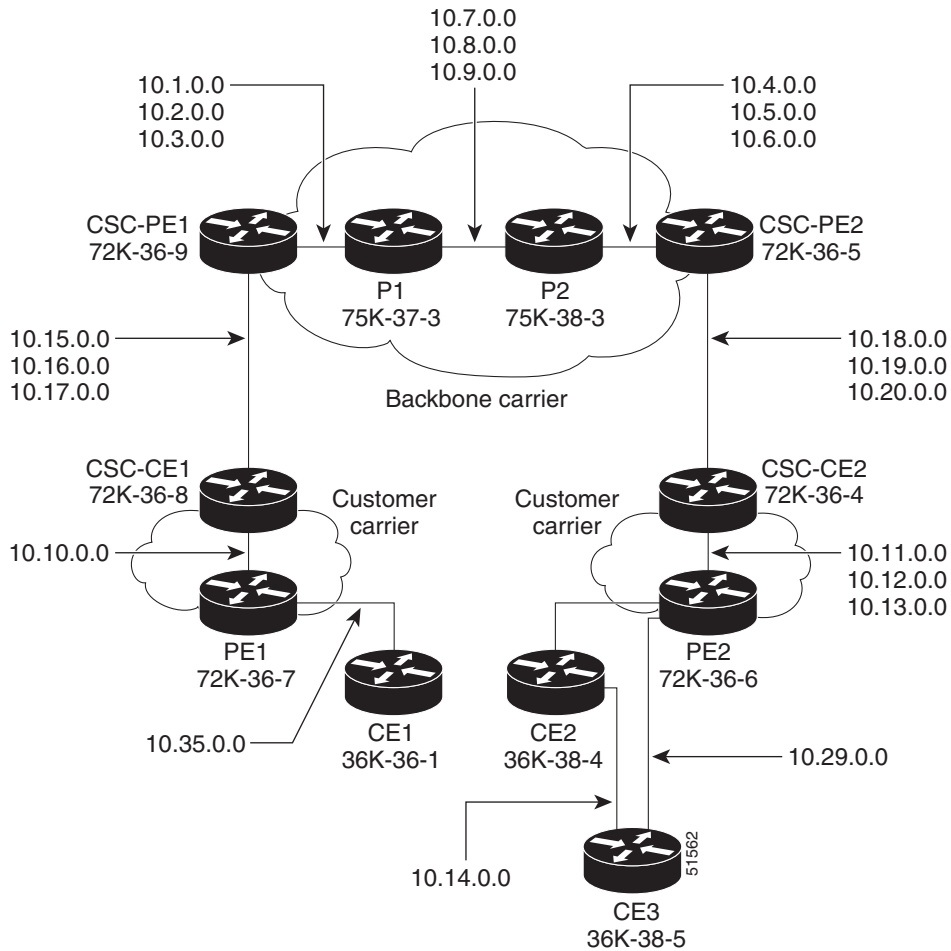
### CE3 (36K-36-3) Configuration

```
ip cef
!
interface Loopback0
 ip address 10.27.27.27 255.255.255.255
 no ip directed-broadcast
!
interface Ethernet1/1
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
!
interface Ethernet1/2
 ip address 10.0.0.2 255.0.0.0
 no ip directed-broadcast
!
router ospf 300
 redistribute bgp 300
 network 10.0.0.0 0.255.255.255 area 300
 network 10.0.0.0 0.255.255.255 area 300
!
router bgp 300
 network 10.0.0.0
 network 10.1.0.0
 network 10.2.0.0
 neighbor 10.0.0.1 remote-as 200
```

## MPLS VPN CSC Network with a Customer Who Has VPNs at the Network Edge: Example

Figure 9 shows a carrier supporting carrier network configuration where the customer carrier has VPNs at the network edge.

Figure 9 Carrier Supporting Carrier Network



## Backbone Carrier Configuration

### CSC-PE1 (72K-36-9) Configuration

```

ip cef
!
ip vrf vpn1
rd 100:0
route-target export 100:0
route-target import 100:0
mpls label protocol ldp
!
!
interface Loopback0
ip address 10.14.14.14 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface Loopback100
ip vrf forwarding vpn1

```

```
ip address 10.22.22.22 255.255.255.255
no ip directed-broadcast
!
interface ATM1/0
no ip address
no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
ip address 10.1.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM1/0.2 point-to-point
ip address 10.2.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM1/0.3 point-to-point
ip address 10.3.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM2/0
no ip address
no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM2/0.1 point-to-point
ip vrf forwarding vpn1
ip address 10.15.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM2/0.2 point-to-point
ip vrf forwarding vpn1
ip address 10.16.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM2/0.3 point-to-point
ip vrf forwarding vpn1
ip address 10.17.0.2 255.255.0.0
```

```

no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
router ospf 100
log-adjacency-changes
redistribute connected subnets
passive-interface ATM2/0.1
passive-interface ATM2/0.2
passive-interface ATM2/0.3
passive-interface Loopback100
network 10.14.14.14 0.0.0.0 area 100
network 10.1.0.0 0.0.255.255 area 100
network 10.2.0.0 0.0.255.255 area 100
network 10.3.0.0 0.0.255.255 area 100
!
router ospf 200 vrf vpn1
log-adjacency-changes
redistribute connected subnets
redistribute bgp 100 metric-type 1 subnets
network 10.22.22.22 0.0.0.0 area 200
network 10.15.0.0 0.0.255.255 area 200
network 10.16.0.0 0.0.255.255 area 200
network 10.17.0.0 0.0.255.255 area 200
!
router bgp 100
bgp log-neighbor-changes
timers bgp 10 30
neighbor 10.11.11.11 remote-as 100
neighbor 10.11.11.11 update-source Loopback0
!
address-family ipv4
neighbor 10.11.11.11 activate
neighbor 10.11.11.11 send-community extended
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.11.11.11 activate
neighbor 10.11.11.11 send-community extended
exit-address-family
!
address-family ipv4 vrf vpn1
redistribute ospf 200 match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family

```

### P1 (75K-37-3) Configuration

```

ip cef distributed
!
mpls label protocol ldp
!
interface Loopback0
ip address 10.12.12.12 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface ATM1/1/0

```

```
no ip address
no ip directed-broadcast
ip route-cache distributed
atm clock INTERNAL
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM1/1/0.1 point-to-point
ip address 10.7.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 103 0 53 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM1/1/0.2 point-to-point
ip address 10.8.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 104 0 54 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM1/1/0.3 point-to-point
ip address 10.9.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 105 0 55 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM3/0/0
no ip address
no ip directed-broadcast
ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/0/0.1 point-to-point
ip address 10.1.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
mpls accounting experimental input
tag-switching ip
!
interface ATM3/0/0.2 point-to-point
ip address 10.2.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM3/0/0.3 point-to-point
ip address 10.3.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
```

```

!
router ospf 100
log-adjacency-changes
redistribute connected subnets
network 10.12.12.12 0.0.0.0 area 100
network 10.1.0.0 0.0.255.255 area 100
network 10.2.0.0 0.0.255.255 area 100
network 10.3.0.0 0.0.255.255 area 100
network 10.7.0.0 0.0.255.255 area 100
network 10.8.0.0 0.0.255.255 area 100
network 10.9.0.0 0.0.255.255 area 100

```

## P2 (75K-38-3) Configuration

```

ip cef distributed
!
mpls label protocol ldp
!
interface Loopback0
ip address 10.13.13.13 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface ATM0/1/0
no ip address
no ip directed-broadcast
ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM0/1/0.1 point-to-point
ip address 10.7.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 103 0 53 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM0/1/0.2 point-to-point
ip address 10.8.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 104 0 54 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM0/1/0.3 point-to-point
ip address 10.9.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 105 0 55 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM3/1/0
no ip address
no ip directed-broadcast
ip route-cache distributed
atm clock INTERNAL
atm sonet stm-1

```

```

no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM3/1/0.1 point-to-point
ip address 10.4.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM3/1/0.2 point-to-point
ip address 10.5.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM3/1/0.3 point-to-point
ip address 10.6.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
router ospf 100
log-adjacency-changes
redistribute connected subnets
network 10.13.13.13 0.0.0.0 area 100
network 10.4.0.0 0.0.255.255 area 100
network 10.5.0.0 0.0.255.255 area 100
network 10.6.0.0 0.0.255.255 area 100
network 10.7.0.0 0.0.255.255 area 100
network 10.8.0.0 0.0.255.255 area 100
network 10.9.0.0 0.0.255.255 area 100
!

```

### CSC-PE2 (72K-36-5) Configuration

```

ip cef
!
ip vrf vpn1
rd 100:0
route-target export 100:0
route-target import 100:0
mpls label protocol ldp
!
interface Loopback0
ip address 10.11.11.11 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface Loopback100
ip vrf forwarding vpn1
ip address 10.23.23.23 255.255.255.255
no ip directed-broadcast
!
interface ATM5/0
no ip address
no ip directed-broadcast

```

```

no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
ip vrf forwarding vpn1
ip address 10.18.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM5/0.2 point-to-point
ip vrf forwarding vpn1
ip address 10.19.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM5/0.3 point-to-point
ip vrf forwarding vpn1
ip address 10.20.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM6/0
no ip address
no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM6/0.1 point-to-point
ip address 10.4.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM6/0.2 point-to-point
ip address 10.5.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM6/0.3 point-to-point
ip address 10.6.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp

```



```

tag-switching ip
!
router ospf 100
log-adjacency-changes
redistribute connected subnets
passive-interface ATM5/0.1
passive-interface ATM5/0.2
passive-interface ATM5/0.3
passive-interface Loopback100
network 10.11.11.11 0.0.0.0 area 100
network 10.4.0.0 0.0.255.255 area 100
network 10.5.0.0 0.0.255.255 area 100
network 10.6.0.0 0.0.255.255 area 100
!
router ospf 200 vrf vpn1
log-adjacency-changes
redistribute connected subnets
redistribute bgp 100 metric-type 1 subnets
network 10.23.23.23 0.0.0.0 area 200
network 10.18.0.0 0.0.255.255 area 200
network 10.19.0.0 0.0.255.255 area 200
network 10.20.0.0 0.0.255.255 area 200
!
router bgp 100
bgp log-neighbor-changes
timers bgp 10 30
neighbor 10.14.14.14 remote-as 100
neighbor 10.14.14.14 update-source Loopback0
!
address-family ipv4
neighbor 10.14.14.14 activate
neighbor 10.14.14.14 send-community extended
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.14.14.14 activate
neighbor 10.14.14.14 send-community extended
exit-address-family
!
address-family ipv4 vrf vpn1
redistribute ospf 200 match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family

```

## Customer Carrier Site 1 Configuration

### CSC-CE1 (72K-36-8) Configuration

```

ip cef
!
mpls label protocol ldp
!
interface Loopback0
ip address 10.15.15.15 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface ATM1/0
no ip address

```

```

no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM1/0.1 point-to-point
ip address 10.15.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM1/0.2 point-to-point
ip address 10.16.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM1/0.3 point-to-point
ip address 10.17.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface Ethernet3/1
ip address 10.10.0.2 255.255.0.0
no ip directed-broadcast
no ip mroute-cache
mpls label protocol ldp
tag-switching ip
!
router ospf 200
log-adjacency-changes
redistribute connected subnets
network 10.15.15.15 0.0.0.0 area 200
network 10.10.0.0 0.0.255.255 area 200
network 10.15.0.0 0.0.255.255 area 200
network 10.16.0.0 0.0.255.255 area 200
network 10.17.0.0 0.0.255.255 area 200

```

### PE1 (72K-36-7) Configuration

```

ip cef
!
ip vrf customersite
rd 200:1
route-target export 200:1
route-target import 200:1
mpls label protocol ldp
!
interface Loopback0
ip address 10.16.16.16 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!

```

```

interface Ethernet3/1
ip vrf forwarding customersite
ip address 10.35.0.2 255.255.0.0
no ip directed-broadcast
no ip mroute-cache
!
interface Ethernet3/2
ip address 30.10.0.1 255.255.0.0
no ip directed-broadcast
no ip mroute-cache
mpls label protocol ldp
tag-switching ip
!
router ospf 200
log-adjacency-changes
redistribute connected subnets
passive-interface Ethernet3/1
network 10.16.16.16 0.0.0.0 area 200
network 10.10.0.0 0.0.255.255 area 200
!
router bgp 200
no bgp default ipv4-unicast
bgp log-neighbor-changes
timers bgp 10 30
neighbor 10.18.18.18 remote-as 200
neighbor 10.18.18.18 update-source Loopback0
!
address-family ipv4
neighbor 10.18.18.18 activate
neighbor 10.18.18.18 send-community extended
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.18.18.18 activate
neighbor 10.18.18.18 send-community extended
exit-address-family
!
address-family ipv4 vrf customersite
neighbor 10.35.0.1 remote-as 300
neighbor 10.35.0.1 activate
neighbor 10.35.0.1 as-override
neighbor 10.35.0.1 advertisement-interval 5
no auto-summary
no synchronization
exit-address-family

```

### CE1 (36K-36-1) Configuration

```

ip cef
!
interface Loopback0
ip address 10.19.19.19 255.255.255.255
no ip directed-broadcast
!
interface Ethernet0/2
ip address 30.35.0.1 255.255.0.0
no ip directed-broadcast
!
router ospf 300
log-adjacency-changes
redistribute connected subnets
redistribute bgp 300 subnets

```

```

passive-interface Ethernet0/2
network 10.19.19.19 0.0.0.0 area 300
!
router bgp 300
no synchronization
bgp log-neighbor-changes
timers bgp 10 30
redistribute connected
redistribute ospf 300 match internal external 1 external 2
neighbor 10.35.0.2 remote-as 200
neighbor 10.35.0.2 advertisement-interval 5
no auto-summary

```

## Customer Carrier Site 2 Configuration

### CSC-CE2 (72K-36-4) Configuration

```

ip cef
!
mpls label protocol ldp
!
interface Loopback0
ip address 10.17.17.17 255.255.255.255
no ip directed-broadcast
!
interface ATM5/0
no ip address
no ip directed-broadcast
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
ip address 10.11.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM5/0.2 point-to-point
ip address 10.12.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM5/0.3 point-to-point
ip address 10.13.0.2 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM6/0
no ip address
no ip directed-broadcast
atm clock INTERNAL
atm sonet stm-1

```

```

no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM6/0.1 point-to-point
ip address 10.18.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM6/0.2 point-to-point
ip address 10.19.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM6/0.3 point-to-point
ip address 10.20.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
router ospf 200
log-adjacency-changes
redistribute connected subnets
network 10.17.17.17 0.0.0.0 area 200
network 10.11.0.0 0.0.255.255 area 200
network 10.12.0.0 0.0.255.255 area 200
network 10.13.0.0 0.0.255.255 area 200
network 10.18.0.0 0.0.255.255 area 200
network 10.19.0.0 0.0.255.255 area 200
network 10.20.0.0 0.0.255.255 area 200

```

## PE2 (72K-36-6) Configuration

```

ip cef
!
ip vrf customersite
rd 200:1
route-target export 200:1
route-target import 200:1
mpls label protocol ldp
!
interface Loopback0
ip address 10.18.18.18 255.255.255.255
no ip directed-broadcast
no ip route-cache
no ip mroute-cache
!
interface Ethernet3/0
ip vrf forwarding customersite
ip address 10.29.0.2 255.255.0.0
no ip directed-broadcast
!
interface Ethernet3/1
ip vrf forwarding customersite
ip address 10.30.0.2 255.255.0.0
no ip directed-broadcast

```

```

!
interface ATM5/0
no ip address
no ip directed-broadcast
no ip mroute-cache
atm clock INTERNAL
atm sonet stm-1
no atm enable-ilmi-trap
no atm ilmi-keepalive
!
interface ATM5/0.1 point-to-point
ip address 10.11.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 100 0 50 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM5/0.2 point-to-point
ip address 10.12.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 101 0 51 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
interface ATM5/0.3 point-to-point
ip address 10.13.0.1 255.255.0.0
no ip directed-broadcast
atm pvc 102 0 52 aal5snap
no atm enable-ilmi-trap
mpls label protocol ldp
tag-switching ip
!
router ospf 200
log-adjacency-changes
redistribute connected subnets
passive-interface Ethernet3/0
passive-interface Ethernet3/1
network 10.18.18.18 0.0.0.0 area 200
network 10.11.0.0 0.0.255.255 area 200
network 10.12.0.0 0.0.255.255 area 200
network 10.13.0.0 0.0.255.255 area 200
!
router bgp 200
no bgp default ipv4-unicast
bgp log-neighbor-changes
timers bgp 10 30
neighbor 10.16.16.16 remote-as 200
neighbor 10.16.16.16 update-source Loopback0
!
address-family ipv4
neighbor 10.16.16.16 activate
neighbor 10.16.16.16 send-community extended
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.16.16.16 activate
neighbor 10.16.16.16 send-community extended
exit-address-family
!
address-family ipv4 vrf customersite
neighbor 10.29.0.1 remote-as 300

```

```

neighbor 10.29.0.1 activate
neighbor 10.29.0.1 as-override
neighbor 10.29.0.1 advertisement-interval 5
neighbor 10.30.0.1 remote-as 300
neighbor 10.30.0.1 activate
neighbor 10.30.0.1 as-override
neighbor 10.30.0.1 advertisement-interval 5
no auto-summary
no synchronization
exit-address-family

```

### CE2 (36K-38-4) Configuration

```

ip cef
!
interface Loopback0
ip address 10.21.21.21 255.255.255.255
!
interface Ethernet1/3
ip address 10.29.0.1 255.255.0.0
!
interface Ethernet5/0
ip address 10.14.0.1 255.255.0.0
!
router ospf 300
log-adjacency-changes
redistribute connected subnets
redistribute bgp 300 subnets
passive-interface Ethernet1/3
network 10.21.21.21 0.0.0.0 area 300
network 10.14.0.0 0.0.255.255 area 300
!
router bgp 300
no synchronization
timers bgp 10 30
redistribute connected
redistribute ospf 300 match internal external 1 external 2
neighbor 10.29.0.2 remote-as 200
neighbor 10.29.0.2 advertisement-interval 5
no auto-summary

```

### CE3 (36K-38-5) Configuration

```

ip cef
!
interface Loopback0
ip address 10.20.20.20 255.255.255.255
no ip directed-broadcast
!
interface Ethernet0/2
ip address 10.30.0.1 255.255.0.0
no ip directed-broadcast
!
interface Ethernet0/3
ip address 10.14.0.2 255.255.0.0
no ip directed-broadcast
!
router ospf 300
log-adjacency-changes
redistribute connected subnets
redistribute bgp 300 subnets
passive-interface Ethernet0/2
network 10.20.20.20 0.0.0.0 area 300

```

```

network 10.14.0.0 0.0.255.255 area 300
!
router bgp 300
no synchronization
bgp log-neighbor-changes
timers bgp 10 30
redistribute connected
redistribute ospf 300 match internal external 1 external 2
neighbor 10.30.0.2 remote-as 200
neighbor 10.30.0.2 advertisement-interval 5
no auto-summary

```

## Additional References

The following sections provide references related to MPLS VPNs.

### Related Documents

Related Topic	Document Title
MPLS	<a href="#">MPLS Product Literature</a>

### Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—



## MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

## RFCs

RFC	Title
RFC 2547	BGP/MPLS VPNs

## Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a>

## Command Reference

This feature uses no new or modified commands.

# Feature Information for MPLS VPN CSC with LDP and IGP

Table 4 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.



## Note

Table 4 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

**Table 4** Feature Information for MPLS VPN CSC with LDP and IGP

Feature Name	Releases	Feature Configuration Information
MPLS VPN Carrier Supporting Carrier	12.0(14)ST 12.0(16)ST 12.2(8)T 12.0(21)ST 12.0(22)S 12.0(23)S	This feature enables you to set up and create an MPLS VPN CSC network that uses LDP to transport MPLS labels and an IGP to transport routes.  In 12.0(14)ST, this feature was introduced. In 12.0(16)ST, this feature was integrated. In 12.2(8)T, this feature was integrated. In 12.0(21)ST, this feature was integrated. In 12.0(22)S, this feature was integrated. In 12.0(23)S, this feature was integrated.

## Glossary

**ASBR**—autonomous system boundary router. A router that connects one autonomous system to another.

**BGP**—Border Gateway Protocol. An interdomain routing protocol designed to provide loop-free routing between separate routing domains that contain independent routing policies (autonomous systems).

**carrier supporting carrier**—A situation where one service provider allows another service provider to use a segment of its backbone network.

**CE router**—customer edge router. A router that is part of a customer network and that interfaces to a provider edge (PE) router. In this document, the CE router sits on the edge of the customer carrier network.

**edge router**—A router that is at the edge of the network. It defines the boundary of the MPLS network. It receives and transmits packets. Also referred to as edge label switch router and label edge router.

**IGP**—Interior Gateway Protocol. Internet protocol used to exchange routing information within an autonomous system.

**LDP**—Label Distribution Protocol. A standard protocol between MPLS-enabled routers to negotiate the labels (addresses) used to forward packets.

**MPLS**—Multiprotocol Label Switching. Switching method that forwards IP traffic using a label. This label instructs the routers and the switches in the network where to forward the packets based on preestablished IP routing information.

**PE router**—provider edge router. A router, at the edge of a service provider's network, that interfaces to CE routers.

**VPN**—Virtual Private Network. A network that enables IP traffic to use tunneling to travel securely over a public TCP/IP network.

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