MPLS VPN—Explicit Null Label Support with BGP IPv4 Label Session

The MPLS VPN—Explicit Null Label Support with Border Gateway Protocol (BGP) IPv4 Label Session feature provides a method to advertise explicit null in a BGP label session for a carrier-supporting-carrier (CSC) customer edge (CE) router.

History for MPLS VPN—Explicit Null Label Support with BGP IPv4 Label Session Feature

Release	Modification
12.0(27)S	This feature was introduced.
12.2(27)SBA	This feature was integrated into Cisco IOS Release 12.2(27)SBA.

Note Software images for Cisco 12000 series Internet routers have been deferred to Cisco IOS Release 12.0(27)S1.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

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Prerequisites for MPLS—VPN Explicit Null Label Support with BGP IPv4 Label Session

- You must configure your network for MPLS VPN.
- You must configure BGP to distribute labels between the CSC-CE and CSC-provider edge (PE) routers.

Restrictions for MPLS—VPN Explicit Null Label Support with BGP IPv4 Label Session

- Configure an explicit null label only in a CSC-CE topology.
- Configure an explicit null label only on a per-neighbor basis.

Information About MPLS—VPN Explicit Null Label Support with BGP IPv4 Label Session

To configure MPLS—VPN Explicit Null Label Support BGP IPv4 Label Session, you need to understand the following concepts:

Feature Design of MPLS—VPN Explicit Null Label Support with BGP IPv4 Label Session

On a CSC-CE with BGP IPv4 label distribution, BGP advertises an implicit null label for directly connected routes. This causes the previous hop (penultimate) router to do penultimate hop popping (PHP).

The MPLS—VPN Explicit Null Label Support BGP IPv4 Label Session feature makes the penultimate router swap the incoming label for (or impose) the explicit null label. This action forces the egress router to process the explicit null label by popping it and inspecting the packet that remains.

Benefits of MPLS—VPN Explicit Null Label Support BGP IPv4 Label Session

Improved Quality of Service (QoS)

The explicit null label helps to preserve quality of service (QoS) bits from one service level agreement (SLA) to another until the packets reach their CSC-CE destination.

How to Configure MPLS—VPN Explicit Null Label Support with BGP IPv4 Label Session

This section contains the following procedures:

Configuring CSC with BGP

Perform this task to configure CSC with BGP.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *autonomous-system-number*
4. **address-family ipv4**
5. **neighbor** *ip-address* **send-label explicit-null**
6. **neighbor** {*ip-address* | *peer-group-name*} **activate**
7. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**router bgp** *automous-system-number* **Example:** `Router(config)# router bgp 100`	Enters router configuration mode and configures the router to run a BGP process.
Step 4	**address-family ipv4** **Example:** `Router(config-router)# address-family ipv4`	Enters address-family configuration mode for the IPv4 address family from which you can configure routing sessions that use standard IPv4 address prefixes.

	Command or Action	Purpose
Step 5	**neighbor** *ip-address* **send-label explicit-null** **Example:** `Router(config-router-af)# neighbor 3.0.0.2 send-label explicit-null`	Send-label advertises the capability of a router to send MPLS labels with BGP routes. • The **explicit-null** keyword allows a CSC-CE router to send labels with a value of 0 to its neighbor.
Step 6	**neighbor** {*ip-address* | *peer-group-name*} **activate** **Example:** `Router(config-router-af)# neighbor 192.168.99.70 activate`	Enables the neighbor to exchange prefixes for the IPv4 address family with the local router.
Step 7	**exit** **Example:** `Router(config-router-af)# exit`	Exits address family configuration mode and returns the router to router configuration mode. • Repeat this step to exit router configuration mode and return the router to global configuration mode.

Verifying Explicit Null Configuration

Perform this task to verify that the explicit null option is configured.

SUMMARY STEPS

1. **enable**
2. **show ip bgp neighbors** [*neighbor-address*] [**received-routes** | **routes** | **advertised-routes** | {**paths** *regexp*} | **dampened-routes** | **received prefix-filter**]]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip bgp neighbors** [*neighbor-address*] [**received-routes** | **routes** | **advertised-routes** | {**paths** *regexp*} | **dampened-routes** | **received prefix-filter**]] **Example:** `Router# show ip bgp neighbors`	Displays information about the TCP and BGP connections to neighbors including explicit null. • The optional *neighbor-address* argument displays the address of the neighbor whose routes you have learned If you omit this argument, all neighbors are displayed. • The optional **received-routes** keyword displays all received routes (both accepted and rejected) from the specified neighbor. • The optional **routes** keyword displays all routes that are received and accepted. This is a subset of the output from the **received-routes** keyword. • The optional **advertised-routes** keyword displays all the routes the router has advertised to the neighbor. • The optional **paths** *regexp* keyword argument combination is a regular expression that is used to match the paths received. • The optional **dampened-routes** keyword displays the dampened routes to the neighbor at the IP address specified. • The optional **received prefix-filter** keyword displays the configured prefix list filter for the specified IP address.

Configuration Examples for MPLS—VPN Explicit Null Label Support with BGP IPv4 Label Session

This section provides the following configuration examples:

Configuring CSC-CE with BGP: Example

In the following CSC-CE example, CSC is configured with BGP to distribute labels and to advertise explicit null for all its connected routes:

```
Router(config-router-af)# neighbor 3.0.0.2 send-label explicit-null

router bgp 100
 bgp log-neighbor-changes
 neighbor 3.0.0.2 remote-as 200
 !
address-family ipv4
 neighbor 3.0.0.2 activate
 neighbor 3.0.0.2 send-label explicit-null
 no auto-summary
 no synchronization
 exit-address-family
```

Verifying Explicit Null Configuration: Example

This section provides sample output for the **show ip bgp neighbors** command.

Sample Output for the show ip bgp neighbors Command

In this example, the **show ip bgp neighbors** command displays information about connected BGP neighbors, including IP addresses, automous number, version numbers, neighbor capabilities, message statistics, and address family statistics that show if explicit null is configured.

```
Router# show ip bgp neighbors

BGP neighbor is 1.0.0.2,  remote AS 300, external link
  BGP version 4, remote router ID 72.72.72.72
  BGP state = Established, up for 00:45:16
  Last read 00:00:16, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
    ipv4 MPLS Label capability: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0
                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                1          2
    Keepalives:            47         47
    Route Refresh:          0          0
```

```
  Total:                 49         50
 Default minimum time between advertisement runs is 30 seconds

For address family: IPv4 Unicast
 BGP table version 9, neighbor version 9/0
 Output queue sizes : 0 self, 0 replicated
 Index 1, Offset 0, Mask 0x2
 Member of update-group 1
 My AS number is allowed for 3 number of times
 AF-dependant capabilities:
   Outbound Route Filter (ORF) type (128) Prefix-list:
 Sending Prefix & Label(advertise explicit-null set)       !Explicit null is configured
                               Sent       Rcvd
 Prefix activity:              ----       ----
   Prefixes Current:              3          3 (Consumes 144 bytes)
   Prefixes Total:                3          6
   Implicit Withdraw:             0          3
   Explicit Withdraw:             0          0
   .........
   .........
```

Additional References

The following sections provide references related to MPLS—VPN Explicit Null Label with BGP IPv4 Label Session.

Related Documents

Related Topic	Document Title
BGP configuration tasks	*Network Protocols Command Reference, Part 1*
IPv4 BGP label distribution	MPLS VPN—InterAS—IPv4 BGP Label Distribution MPLS VPN—Carrier Supporting Carrier—IPv4 BGP Label Distribution

Standards

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

MIBs

MIBs	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: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
RFC 1163	*A Border Gateway Protocol*
RFC 1164	*Application of the Border Gateway Protocol in the Internet*
RFC 2283	*Multiprotocol Extensions for BGP-4*
RFC 2547	*BGP/MPLS VPNs*
RFC 3107	*Carrying Label Information in BGP-4*

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Command Reference

This section documents new or modified commands only.

New Commands

- **neighbor send-label explicit-null**

Modified Commands

- **debug ip bgp**
- **show ip bgp neighborsdebug ip bgp**
- **show ip bgp vpnv4**
- **show mpls forwarding-table**

debug ip bgp

To display information related to processing of the Border Gateway Protocol (BGP), use the **debug ip bgp** command in privileged EXEC mode. To disable debugging output, use the **no** form of this command.

debug ip bgp [*A.B.C.D.* | **dampening** | **events** | **in** | **keepalives** | **out** | **updates** | **vpnv4** | **mpls**]

no debug ip bgp [*A.B.C.D.* | **dampening** | **events** | **in** | **keepalives** | **out** | **updates** | **vpnv4** | **mpls**]

Syntax Description

A.B.C.D.	(Optional) Displays the BGP neighbor IP address.
dampening	(Optional) Displays BGP dampening.
events	(Optional) Displays BGP events.
in	(Optional) Displays BGP inbound information.
keepalives	(Optional) Displays BGP keepalives.
out	(Optional) Displays BGP outbound information.
updates	(Optional) Displays BGP updates.
vpnv4	Optional) Displays Virtual Private Network version 4 (VPNv4) Network Layer Reachability Information (NLRI).
mpls	(Optional) Displays the Multiprotocol Label Switching (MPLS) information.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.0(21)ST	This command was integrated into Cisco IOS Release 12.0(21)ST, and the **mpls** keyword was added.
12.0(22)S	This command was integrated into Cisco IOS Release 12.0(22)S.
12.2(13)T	This command was integrated into Cisco IOS Release 12.2(13)T.
12.0(27)S	The command output was modified to show explicit-null label information.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

Use this command with the **updates** and **mpls** keywords to display explicit-null label information.

Examples

The following example shows sample output, including the explicit-null label, from the **debug ip bgp updates** and the **debug ip bgp mpls** commands:

```
Router# debug ip bgp updates
```

```
BGP updates debugging is on

Router# debug ip bgp mpls

BGP MPLS labels debugging is on


Router#
01:33:53: BGP(0): route 36.36.36.36/32 up
01:33:53: BGP(0): nettable_walker 36.36.36.36/32 route sourced locally
01:33:53: BGP: adding MPLS label to 36.36.36.36/32
01:33:53: BGP: check on 36.36.36.36/32 in LDP - ok
01:33:53: BGP: label imp-null allocated via LDP
01:33:53: BGP-IPv4: send exp-null label for 36.36.36.36/32
01:33:53: BGP-IPv4: Send prefix 36.36.36.36/32, label exp-null    !explicit-null label
being sent
01:33:53: BGP(0): 1.0.0.2 send UPDATE (format) 36.36.36.36/32, next 1.0.0.1, metric 0,
path , mpls label 0 !label value is 0
01:33:53: BGP(0): updgrp 1 - 1.0.0.2 enqueued 1 updates, average/maximum size (bytes)
61/61
```

Related Commands

Command	Description
show debug	Displays active debug output.

neighbor send-label explicit-null

To enable a Border Gateway Protocol (BGP) router to send Multiprotocol Label Switching (MPLS) labels with explicit-null information for a CSC-CE router and BGP routes to a neighboring CSC-PE router, use the **neighbor send-label explicit-null** command in address family configuration mode or router configuration mode. To disable a BGP router from sending MPLS labels with explicit-null information, use the **no** form of this command.

neighbor *ip-address* **send-label explicit-null**

no neighbor *ip-address* **send-label explicit-null**

Syntax Description

ip-address	IP address of the neighboring router.

Defaults

This command is not enabled by default.

Command Modes

Address family configuration

Router configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

This command enables a CSC-CE router to use BGP to distribute MPLS labels with a value of zero for explicit-null instead of implicit-null along with IPv4 routes to a CSC-PE peer router.

You must issue this command only on the local CSC-CE router.

You can use this command only with IPv4 addresses.

Examples

In the following CSC-CE example, CSC is configured with BGP to distribute labels and to advertise explicit null for all its connected routes:

```
Router# configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# router bgp 100

Router(config-router)# neighbor 1.0.0.2 remote-as 300

Router(config-router)# address-family ipv4

Router(config-router-af)# neighbor 1.0.0.2 send-label explicit-null
```

In the following CSC-PE example, CSC is configured with BGP to distribute labels:

```
Router# configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# router bgp 300

Router(config-router)# neighbor 1.0.0.1 remote-as 100

Router(config-router)# address-family ipv4 vrf v1

Router(config-router-af)# neighbor 1.0.0.1 send-label
```

Note Explicit null is not applicable on a CSC-PE router.

Related Commands

Command	Description
neighbor activate	Enables the exchange of information with a neighboring router.
neighbor send-label	Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router.

show ip bgp neighbors

To display information about the Transmission Control Protocol (TCP) and Border Gateway Protocol (BGP) connections to neighbors, use the **show ip bgp neighbors** command in EXEC mode.

show ip bgp neighbors [*neighbor-address*] [**received-routes** | **routes** | **advertised-routes** | {**paths** *regexp*} | **dampened-routes** | **received prefix-filter**]]

Syntax Description

neighbor-address	(Optional) Address of the neighbor from whose routes you have learned. If you omit this argument, all neighbors are displayed.
received-routes	(Optional) Displays all received routes (both accepted and rejected) from the specified neighbor.
routes	(Optional) Displays all routes that are received and accepted. This is a subset of the output from the **received-routes** keyword.
advertised-routes	(Optional) Displays all the routes the router has advertised to the neighbor.
paths *regexp*	(Optional) Regular expression that is used to match the paths received.
dampened-routes	(Optional) Displays the dampened routes to the neighbor at the IP address specified.
received prefix-filter	(Optional) Displays the configured prefix list filter for the specified IP address.

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
10.0	This command was introduced.
11.2	The **received-routes** keyword was added
12.2(4)T	The **received prefix-filter** keyword was added.
12.2(8)T	The no-prepend configuration option was added to the display output.
12.0(21)ST	This command was updated to display MPLS label information.
12.0(22)S	This command was integrated into Cisco IOS Release 12.0(22)S. Support for the Cisco 12000 series routers (Engine 0 and Engine 2) was added. The **received prefix-filter** keyword was added. The command output was modified to show BGP graceful restart capability.
12.2(15)T	The command output was modified to show BGP graceful restart capability.
12.0(27)S	The command output was modified to show BGP advertising explicit-null configuration.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

Use this command to display explicit-null label information.

Examples

The following example shows output, including the explicit-null label, from the **show ip bgp neighbors** command on a CSC-CE router:

```
Router# show ip bgp neighbors

BGP neighbor is 1.0.0.2,  remote AS 300, external link
  BGP version 4, remote router ID 72.72.72.72
  BGP state = Established, up for 01:38:38
  Last read 00:00:37, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
    ipv4 MPLS Label capability: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0
                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                3          2
    Keepalives:           100        100
    Route Refresh:          0          0
    Total:                104        103
  Default minimum time between advertisement runs is 30 seconds

 For address family: IPv4 Unicast
  BGP table version 11, neighbor version 11/0
  Output queue sizes : 0 self, 0 replicated
  Index 1, Offset 0, Mask 0x2
  Member of update-group 1
  My AS number is allowed for 3 number of times
  AF-dependant capabilities:
    Outbound Route Filter (ORF) type (128) Prefix-list:
  Sending Prefix & Label(advertise explicit-null set) !explicit-null configuration set
                                Sent       Rcvd
  Prefix activity:              ----       ----
    Prefixes Current:              3          3 (Consumes 144 bytes)
    Prefixes Total:                4          6
    Implicit Withdraw:             0          3
    Explicit Withdraw:             1          0
    Used as bestpath:            n/a          3
    Used as multipath:           n/a          0

                                  Outbound    Inbound
  Local Policy Denied Prefixes:   --------    -------
    Suppressed duplicate:                0          3
    Bestpath from this peer:             3        n/a
    Total:                               3          3
  Number of NLRIs in the update sent: max 0, min 0

  Connections established 1; dropped 0
  Last reset never
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Local host: 1.0.0.1, Local port: 11000
Foreign host: 1.0.0.2, Foreign port: 179

Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)

Event Timers (current time is 0x5C52FC):
Timer          Starts    Wakeups            Next
Retrans           106          0             0x0
TimeWait            0          0             0x0
AckHold           103         79             0x0
```

```
SendWnd              0          0              0x0
KeepAlive            0          0              0x0
GiveUp               0          0              0x0
PmtuAger             0          0              0x0
DeadWait             0          0              0x0

iss: 1758035101  snduna: 1758037249  sndnxt: 1758037249     sndwnd:  15697
irs:  904214079  rcvnxt:  904216204  rcvwnd:      15738  delrcvwnd:    646

SRTT: 300 ms, RTTO: 607 ms, RTV: 3 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Flags: higher precedence, nagle

Datagrams (max data segment is 1460 bytes):
Rcvd: 136 (out of order: 0), with data: 103, total data bytes: 2124
Sent: 187 (retransmit: 0, fastretransmit: 0), with data: 105, total data bytes: 2147
```

Table 1 describes the significant fields shown in the display.

Table 1 show ip bgp neighbors Field Descriptions

Field	Description
BGP neighbor	IP address of the BGP neighbor and its autonomous system number. If the neighbor is in the same autonomous system as the router, then the link between them is internal; otherwise, it is considered external.
remote AS	Autonomous system of the neighbor.
external link	Indicates that this peer is an External Border Gateway Protocol (EBGP) peer.
BGP version	BGP version being used to communicate with the remote router; the router ID (an IP address) of the neighbor is also specified.
remote router ID	IP address of the neighbor.
BGP state = Established	Internal state of this BGP connection.
up for	Amount of time, in seconds, that the underlying TCP connection has been in existence.
Last read	Time that BGP last read a message from this neighbor.
hold time	Maximum amount of time that can elapse between messages from the peer.
keepalive interval	Time period, in seconds, between sending keepalive packets, which help ensure that the TCP connection is up.
Neighbor capabilities	BGP capabilities advertised and received from this neighbor.
Route refresh	The status of route refresh. Advertised and received is displayed when route refresh has successfully occurred between two routers.
Address family IPv4 Unicast	IP Version 4 unicast-specific properties of this neighbor.
ipv4 MPLS Label capability	Indicates that IPv4 MPLS labels are both sent and received by the EBGP peer.
Message statistics	Number and type of messages.
InQ depth is 0	Size of the inbound queue.

Table 1 show ip bgp neighbors Field Descriptions (continued)

Field	Description
OutQ depth is 0	Size of the outbound queue.
Sent	Total number of BGP messages that have been sent to this peer.
Rcvd	Total number of BGP messages that have been received from this peer.
Opens	Total number of messages sent each time a connection is established.
Notifications	Total number of error messages sent to and received from this peer.
Updates	Total number of update messages sent to and received from this peer.
Keepalives	Total number of keepalive messages sent to and received from this peer.
Route refresh	Total number of route messages sent to and received from this peer.
Total	Total number of all types of messages sent to and received from this peer.
Default minimum time between advertisement runs	Value of minimum advertisement interval.
For address family: IPv4 Unicast	Address family to which the following fields refer.
BGP table version	Indicates that the neighbor has been updated with this version of the primary BGP routing table.
neighbor version	Number used by the software to track the prefixes that have been sent and those that must be sent to this neighbor.
Sending Prefix & Label	Indicates that the EBGP peer sends MPLS labels with the capability of advertising explicit null labels for directly connected routes.
Sent	Total number and type of prefixes that have been sent to this peer.
Rcvd	Total number and type of prefixes that have been received from this peer.
Prefixes Current	Total number of current prefixes sent to and received from this peer.
Prefixes Total	Total number of all prefixes set to and received from this peer.
Used as bestpath	Total number of prefixes used as best path.
Used as multipath	Total number of prefixes used as multipath.
Connections established	Number of times the router has established a TCP connection and the two peers have agreed to speak BGP with each other.
dropped	Number of times that a good connection has failed or been taken down.
Last reset never	Elapsed time since this peering session was last reset.
Connection state	State of BGP peer.

Table 1 show ip bgp neighbors Field Descriptions (continued)

Field	Description
unread input bytes	Number of bytes of packets still to be processed.
Local host, Local port	Peering address of local router, plus port.
Foreign host, Foreign port	Peering address of the neighbor.
Enqueued packets for retransmits	Packets waiting to be retransmitted.
Event Timers	Table displays the name of the timer and the number of starts and wakeups for each one.
Retrans	The number of starts and wakeups for the Retransmission timer.
TimeWait	The number of starts and wakeups for the TimeWait timer.
AckHold	The number of starts and wakeups for the AcknowledgmentHold timer.
SendWnd	The number of starts and wakeups for the SendWnd timer.
KeepAlive	The number of starts and wakeups for the KeepAlive timer.
GiveUp	The number of starts and wakeups for the GiveUp timer.
PmtuAger	The number of starts and wakeups for the PmtuAger timer.
DeadWait	The number of starts and wakeups for the DeadWait timer.
iss	Initial send sequence number.
snduna	Last send sequence number the local host sent but has not received an acknowledgment.
sndnxt	Sequence number the local host will send next.
sndwnd	TCP window size of the remote host.
irs	Initial receive sequence number.
rcvnxt	Last receive sequence number the local host has acknowledged.
rcvwnd	TCP window size of the local host.
delrcvwnd	Delayed receive window—data the local host has read from the connection, but has not yet subtracted from the receive window that the host has advertised to the remote host. The value in this field gradually increases until it is larger than a full-sized packet, at which point it is applied to the rcvwnd field.
SRTT	A calculated smoothed round-trip timeout.
RTTO	Round-trip timeout.
RTV	Variance of the round-trip time.
KRTT	New round-trip timeout (using the Karn algorithm). This field separately tracks the round-trip time of packets that have been re-sent.
minRTT	Smallest recorded round-trip timeout (hard wire value used for calculation).
maxRTT	Largest recorded round-trip timeout.
ACK hold	Time the local host delays an acknowledgment in order to piggyback data on it.

Table 1 show ip bgp neighbors Field Descriptions (continued)

Field	Description
Flags	IP precedence of the BGP packets.
Datagrams: Rcvd	Number of update packets received from a neighbor.
with data	Number of update packets received with data.
total data bytes	Total bytes of data.
Sent	Number of update packets sent.
with data	Number of update packets with data sent.
total data bytes	Total number of data bytes.

Related Commands

Command	Description
neighbor send-label	Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router.
neighbor send-label explicit-null	Enables a BGP router to send MPLS labels with explicit-null information for a CSC-CE router and BGP routes to a neighboring CSC-PE router,

show ip bgp vpnv4

To display Virtual Private Network (VPN) address information from the Border Gateway Protocol (BGP) table, use the **show ip bgp vpnv4** command in EXEC mode.

show ip bgp vpnv4 {**all** | **rd** *route-distinguisher* | **vrf** *vrf-name*} [*ip-prefix/length* [**longer-prefixes**] [*output-modifiers*]] [*network-address* [*mask*] [**longer-prefixes**] [*output-modifiers*]] [**cidr-only**] [**community**] [**community-list**] [**dampened-paths**] [**filter-list**] [**flap-statistics**] [**inconsistent-as**] [**neighbors**] [**paths** [*line*]] [**peer-group**] [**quote-regexp**] [**regexp**] [**summary**] [**labels**]

Syntax Description

all	Displays the complete VPNv4 database.
rd *route-distinguisher*	Displays Network Layer Reachability Information (NLRI) prefixes that have a matching route distinguisher.
vrf *vrf-name*	Displays NLRI prefixes associated with the named VPN routing and forwarding instance (VRF).
ip-prefix/length	(Optional) The IP prefix address (in dotted decimal format) and the length of the mask (0 to 32). The slash mark must be included.
longer-prefixes	(Optional) Displays the entry, if any, that exactly matches the specified prefix parameter and all entries that match the prefix in a longest-match sense. That is, prefixes for which the specified prefix is an initial substring.
output-modifiers	(Optional) For a list of associated keywords and arguments, use context-sensitive help.
network-address	(Optional) The IP address of a network in the BGP routing table.
mask	(Optional) The mask of the network address, in dotted decimal format.
cidr-only	(Optional) Displays only routes that have nonnatural net masks.
community	(Optional) Displays routes matching this community.
community-list	(Optional) Displays routes matching this community list.
dampened-paths	(Optional) Displays paths suppressed on account of dampening (BGP route from peer is up and down).
filter-list	(Optional) Displays routes conforming to the filter list.
flap-statistics	(Optional) Displays flap statistics of routes.
inconsistent-as	(Optional) Displays only routes that have inconsistent autonomous systems of origin.
neighbors	(Optional) Displays details about TCP and BGP neighbor connections.
paths	(Optional) Displays path information.
line	(Optional) A regular expression to match the BGP autonomous system paths.
peer-group	(Optional) Displays information about peer groups.
quote-regexp	(Optional) Displays routes matching the autonomous system path “regular expression.”
regexp	(Optional) Displays routes matching the autonomous system path regular expression.
summary	(Optional) Displays BGP neighbor status.
labels	(Optional) Displays incoming and outgoing BGP labels for each NLRI prefix.

Defaults No default behavior or values

Command Modes EXEC

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.2(2)T	The output of the **show ip bgp vpnv4 all** *ip-prefix/length* command was enhanced to display attributes including multipaths and a best path to the specified network.
12.0(21)ST	The keyword tags was replaced with the keyword labels to conform to the MPLS IETF guidelines. This command was integrated into Cisco IOS Release 12.0(21)ST.
12.0(22)S	This command was integrated into Cisco IOS Release 12.0(22)S.
12.2(13)T	This command was integrated into Cisco IOS Release 12.2(13)T.
12.0(27)S	The command output was modified to include explicit-null label information.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines Use this command with the keywords **all** and **labels** to display explicit-null label information.

Examples The following example shows output, including the explicit-null label, from the **show ip bgp neighbors** command on a CSC-PE router:

```
Router# show ip bgp vpnv4 all labels

   Network          Next Hop      In label/Out label
Route Distinguisher: 100:1 (v1)
   1.0.0.0/24       0.0.0.0         19/aggregate(v1)
   1.0.0.1/32       0.0.0.0         20/nolabel
   1.1.1.1/32       0.0.0.0         21/aggregate(v1)
   36.36.36.36/32   1.0.0.1         25/exp-null !Label value exp-null
   100.100.100.100/32
                    1.0.0.1         23/exp-null
   101.101.101.101/32
                    1.0.0.1         22/exp-null
```

Table 2 describes the significant fields shown in the display.

Table 2 show ip bgp vpnv4 all labels Field Descriptions

Field	Description
Network	Displays the network address from the BGP table.
Next Hop	Displays the address of the BGP next hop.
In label	Displays the label (if any) assigned by this router.

Table 2 show ip bgp vpnv4 all labels Field Descriptions (continued)

Field	Description
Out label	Displays the label assigned by the BGP next hop router.
Route Distinguisher	Displays an 8-byte value added to an IPv4 prefix to create a VPN IPv4 prefix.

Related Commands

Command	Description
neighbor send-label	Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router.
neighbor send-label explicit-null	Enables a BGP router to send MPLS labels with explicit-null information for a CSC-CE router and BGP routes to a neighboring CSC-PE router,

show mpls forwarding-table

To display the contents of the Multiprotocol Label Switching (MPLS) label forwarding information base (LFIB), use the **show mpls forwarding-table** command in EXEC mode.

show mpls forwarding-table [*network* {*mask* | *length*} | **labels** *label* [- *label*] | **interface** *interface* | **next-hop** *address* | **lsp-tunnel** [*tunnel-id*]] [**vrf** *vrf-name*] [**detail**]

Syntax Description

network	(Optional) Destination network number.
mask	(Optional) IP address of the destination mask whose entry is to be shown.
length	(Optional) Number of bits in mask of destination.
labels *label - label*	(Optional) Displays only entries with the specified local labels.
interface *interface*	(Optional) Displays only entries with the specified outgoing interface.
next-hop *address*	(Optional) Displays only entries with the specified neighbor as the next hop.
lsp-tunnel *tunnel-id*	(Optional) Displays only entries with the specified label switched path (LSP) tunnel, or with all LSP tunnel entries.
vrf *vrf-name*	(Optional) Displays only entries with the specified VPN routing/forwarding instance (VRF).
detail	(Optional) Displays information in long form (includes length of encapsulation, length of MAC string, maximum transmission unit (MTU), and all labels).

Defaults

No default behavior or values

Command Modes

EXEC

Command History

Release	Modification
11.1 CT	This command was introduced.
12.1(3)T	This command was modified to reflect new MPLS Internet Engineering Task Force (IETF) terminology and command-line interface (CLI) command syntax.
12.2(8)T	The command was modified to accommodate use of the MPLS experimental (EXP) level as a selection criteria for packet forwarding. The output display was modified to include a bundle adjacency field and exp (vcd) values when the optional **detail** keyword is specified.
12.0(22)S	IPv6 MPLS aggregate label and prefix information was added to the display.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.
12.0(27)S	The command output was modified to include explicit-null label information.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

Use this command to display explicit-null label information.

Examples

The following example shows output, including the explicit-null label = 0, from the **show mpls forwarding-table** command on a CSC-PE router:

```
Router# show mpls forwarding-table

Local  Outgoing    Prefix            Bytes tag  Outgoing   Next Hop
tag    tag or VC   or Tunnel Id      switched   interface
17     Pop tag     34.34.34.34/32    0          Et2/0      3.0.0.2
18     Pop tag     4.0.0.0/24        0          Et2/0      3.0.0.2
19     Aggregate   1.0.0.0/24[V]     0
20     Pop tag     1.0.0.1/32[V]     0          Et2/1      1.0.0.1
21     Aggregate   1.1.1.1/32[V]     0
22     0           101.101.101.101/32[V]   \
                                     0          Et2/1      1.0.0.1
23     0           100.100.100.100/32[V]   \
                                     0          Et2/1      1.0.0.1
25     0           36.36.36.36/32[V] 0          Et2/1      1.0.0.1      !outlabel value 0
```

Table 3 describes the significant fields shown in the display.

Table 3 show mpls forwarding-table Field Descriptions

Field	Description
Local tag	Label assigned by this router.
Outgoing tag or VC	Label assigned by the next hop or virtual path identifier (VPI)/virtual channel identifier (VCI) used to get to next hop. The entries that you can specify in this column include the following: • [T]—Means forwarding through an LSP tunnel. • Untagged—Means that there is no label for the destination from the next hop or that label switching is not enabled on the outgoing interface. • Pop tag—Means that the next hop advertised an implicit NULL label for the destination and that this router popped the top label. • Aggregate—Means there are several prefixes for one local label. Used when IPv6 is configured on edge routers to transport IPv6 traffic over an IPv4 MPLS network. • 0—Means the explicit null label value = 0.
Prefix or Tunnel Id	Address or tunnel to which packets with this label are going. **Note** If IPv6 is configured on edge routers to transport IPv6 traffic over an IPv4 MPLS network, IPv6 is displayed here.
Bytes tag switched	Number of bytes switched with this incoming label.
Outgoing interface	Interface through which packets with this label are sent.
Next Hop	IP address of the neighbor that assigned the outgoing label.

Related Commands

Command	Description
neighbor send-label	Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router.
neighbor send-label explicit-null	Enables a BGP router to send MPLS labels with explicit-null information for a CSC-CE router and BGP routes to a neighboring CSC-PE router.

Glossary

BGP—Border Gateway Protocol. The exterior Border Gateway Protocol used to exchange routing information between routers in separate autonomous systems. BGP uses Transmission Control Protocol (TCP). Because TCP is a reliable protocol, BGP does not experience problems with dropped or fragmented data packets.

CE router—customer edge router. A router on the border between a VPN provider and a VPN customer that belongs to the customer.

EBGP—External Border Gateway Protocol. A BGP session between routers in different autonomous systems (ASs). When a pair of routers in different ASs are more than one IP hop away from each other, an external BGP session between those two routers is called multihop external BGP.

label—A short, fixed-length data identifier that tells switching nodes how to forward data (packets or cells).

label distribution—The techniques and processes used to cause routed traffic to travel through the network on a path other than the one that would have been chosen if standard routing methods had been used.

LDP—Label Distribution Protocol. The protocol that supports MPLS hop-by-hop forwarding by distributing bindings between labels and network prefixes. The Cisco proprietary version of this protocol is the Tag Distribution Protocol (TDP).

LSP—label-switched path. A configured connection between two routers, in which MPLS is used to carry packets. A path created by the concatenation of one or more label switched hops, allowing a packet to be forwarded by swapping labels from an MPLS node to another MPLS node.

MPLS—Multiprotocol Label Switching. A method for directing packets primarily through Layer 2 switching rather than Layer 3 routing. In MPLS, packets are assigned short, fixed-length labels at the ingress to an MPLS cloud by using the concept of forwarding equivalence classes. Within the MPLS domain, the labels are used to make forwarding decisions mostly without recourse to the original packet headers; formerly known as tag switching.

NLRI—Network Layer Reachability Information. BGP sends routing update messages containing NLRI, which describes the route. In this context, an NLRI is a prefix. A BGP update message carries one or more NLRI prefixes and the attributes of a route for the NLRI prefixes. The route attributes include a BGP next hop gateway address, community values, and other information.

PE router—provider edge router. A router on the border between a VPN provider and a VPN customer that belongs to the provider.

QoS—quality of service. A measure of performance for a transmission system that reflects its transmission quality and service availability.

router—A network layer device that uses one or more metrics to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information.

VPN—virtual private network. A secure IP-based network that shares resources on one or more physical networks. A VPN contains geographically dispersed sites that can communicate securely over a shared backbone.

Note Refer to the *Internetworking Terms and Acronyms* for terms not included in this glossary.