



## BGP Best External

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The BGP Best External feature provides the network with a backup external route to avoid loss of connectivity of the primary external route. The BGP Best External feature advertises the most preferred route among those received from external neighbors as a backup route. This feature is beneficial in active-backup topologies, where service providers use routing policies that cause a border router to choose a path received over an Interior Border Gateway Protocol (iBGP) session (of another border router) as the best path for a prefix even if it has an Exterior Border Gateway Protocol (eBGP) learned path. This active-backup topology defines one exit or egress point for the prefix in the autonomous system and uses the other points as backups if the primary link or eBGP peering is unavailable. The policy causes the border router to hide the paths learned over its eBGP sessions from the autonomous system because it does not advertise any path for such prefixes. To cope with this situation, some devices advertise one externally learned path called the best external path.

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## 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 BGP Best External, on page 12](#).

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

## Prerequisites for BGP Best External

- The Bidirectional Forwarding Detection (BFD) protocol must be enabled to quickly detect link failures.
- Ensure that the BGP and the Multiprotocol Label Switching (MPLS) network is up and running with the customer site connected to the provider site by more than one path (multihomed).
- The backup path must have a unique next hop that is not the same as the next hop of the best path.
- BGP must support lossless switchover between operational paths.

## Restrictions for BGP Best External

- The BGP Best External feature will not install a backup path if BGP Multipath is installed and a multipath exists in the BGP table. One of the multipaths automatically acts as a backup for the other paths.
- The BGP Best External feature is not supported with the following features:
  - MPLS VPN Carrier Supporting Carrier
  - MPLS VPN Inter Autonomous Systems, option B
  - MPLS VPN Virtual Routing and Forwarding Label
- The BGP Best External feature cannot be configured with Multicast or Layer 2 VPN (L2VPN) Virtual Routing and Forwarding address families.
- The BGP Best External feature cannot be configured on route reflectors.
- The BGP Best External feature does not support Nonstop Forwarding/Stateful Switchover (NSF/SSO). However, In-Service Software Upgrade (ISSU) is supported if both Route Processors have the BGP Best External feature configured.
- The BGP Best External feature can be configured only on VPNv4, VPNv6, IPv4 VRF, and IPv6 VRF address families.
- When you configure the BGP Best External feature using the **bgp advertise-best-external** command, you need not enable the BGP Prefix-Independent Convergence (PIC) feature with the **bgp additional-paths install** command. The BGP PIC feature is automatically enabled by the BGP Best External feature.
- When you configure the BGP Best External feature, it will override the functionality of the [MPLS VPN--BGP Local Convergence](#) feature. However, you need not remove the **protection local-prefixes** command from the configuration.

# Information About BGP Best External

## BGP Best External Overview

Service providers use routing policies that cause a border router to choose a path received over an internal BGP (iBGP) session (of another border router) as the best path for a prefix even if it has an external BGP (eBGP) learned path. This practice is popularly known as active-backup topology and is done to define one exit or egress point for the prefix in the autonomous system and to use the other points as backups if the primary link or eBGP peering is unavailable.

The policy, though beneficial, causes the border router to hide the paths learned over its eBGP sessions from the autonomous system because the border router does not advertise any path for such prefixes. To cope with this situation, some devices advertise one externally learned path called the best external path. The best external behavior causes the BGP selection process to select two paths to every destination:

- The best path is selected from the complete set of routes known to that destination.
- The best external path is selected from the set of routes received from its external peers.

BGP advertises the best path to external peers. Instead of withdrawing the best path from its internal peers when it selects an iBGP path as the best path, BGP advertises the best external path to the internal peers.

The BGP Best External feature is an essential component of the Prefix-Independent Convergence (PIC) edge for both Internet access and Multiprotocol Label Switching (MPLS) VPN scenarios and makes alternate paths available in the network in the active-backup topology.

## What the Best External Route Means

The BGP Best External feature uses a “best external route” as a backup path, which, according to draft-marques-idr-best-external, is the most preferred route among those received from external neighbors. The most preferred route from external neighbors can be the following:

- Two routers in different clusters that have an Interior Border Gateway Protocol (iBGP) session between them.
- Two routers in different autonomous systems of a confederation that have an External Border Gateway Protocol (eBGP) session between them.

The best external route might be different from the best route installed in the Routing Information Base (RIB). The best route could be an internal route. By allowing the best external route to be advertised and stored, in addition to the best route, networks gain faster restoration of connectivity by providing additional paths that may be used if the primary path fails.

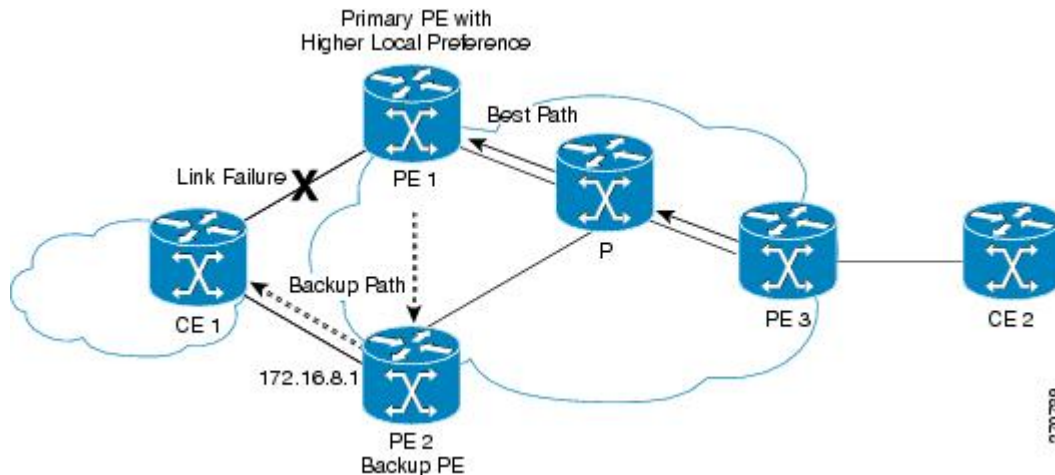
## BGP Best External Feature Operation

The BGP Best External feature is based on Internet Engineering Task Force (IETF) draft-marques-idr-best-external.txt. The BGP Best External feature advertises a best external route to its internal peers as a backup route. The backup route is stored in the RIB and Cisco Express Forwarding. If the

primary path fails, the Border Gateway Protocol (BGP) Prefix-Independent Convergence (PIC) functionality enables the best external path to take over, enabling faster restoration of connectivity.

[BGP Best External Feature Operation](#) shows a Multiprotocol Label Switching (MPLS) VPN using the BGP Best External feature. The network includes the following components:

**Figure 1: MPLS VPN: Best External at the Edge of MPLS VPN**



- Exterior BGP (eBGP) sessions exist between the provider edge (PE) and customer edge (CE) routers.
- PE 1 is the primary router and has a higher local preference setting.
- Traffic from CE 2 uses PE 1 to reach router CE 1.
- PE 1 has two paths to reach CE 1.
- CE 1 is dual-homed with PE 1 and PE 2.
- PE 1 is the primary path and PE 2 is the backup path.

In [BGP Best External Feature Operation](#), traffic in the MPLS cloud flows through PE 1 to reach CE 1. Therefore, PE 2 uses PE 1 as the best path and PE 2 as the backup path.

PE 1 and PE 2 are configured with the BGP Best External feature. BGP computes both the best path (the PE 1-CE 1 link) and a backup path (PE 2) and installs both paths into the Routing Information Base (RIB) and Cisco Express Forwarding. The best external path (PE 2) is advertised to the peer routers, in addition to the best path.

When Cisco Express Forwarding detects a link failure on the PE 1-CE 1 link, Cisco Express Forwarding immediately switches to the backup path PE 2. Traffic is quickly rerouted due to local fast convergence in Cisco Express Forwarding using the backup path. Thus, traffic loss is minimized and fast convergence is achieved.

## Configuration Modes for Enabling BGP Best External

You can enable the BGP Best External feature in different modes, each of which protects Virtual Routing and Forwarding (VRF) in its own way:

- If you issue the **bgp advertise-best-external** command in VPNv4 address family configuration mode, it applies to all IPv4 VRFs. If you issue the command in this mode, you need not issue it for specific VRFs.
- If you issue the **bgp advertise-best-external** command in IPv4 address family configuration mode, it applies only to that VRF.

# How to Configure BGP Best External

## Configuring the BGP Best External Feature

Perform the following task to configure the BGP Best External feature. This task shows how to configure the BGP Best External feature in either an IPv4 or VPNv4 address family. In VPNv4 address family configuration mode, the BGP Best External feature applies to all IPv4 Virtual Routing Forwarding (VRF); you need not configure it for specific VRFs. If you issue the **bgp advertise-best-external** command in IPv4 VRF address family configuration mode, the BGP Best External feature applies only to that VRF.

### Before You Begin

- Configure the MPLS VPN and verify that it is working properly before configuring the BGP Best External feature. See the "Configuring MPLS Layer 3 VPNs" section for more information.
- Configure multiprotocol VRFs to allow you to share route-target policies (import and export) between IPv4 and IPv6 or configure separate route-target policies for IPv4 and IPv6 VPNs. For information about configuring multiprotocol VRFs, see the "MPLS VPN--VRF CLI for IPv4 and IPv6 VPNs section".
- Ensure that the customer edge (CE) router is connected to the network by at least two paths.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *autonomous-system-number*
4. Do one of the following:
  - **address-family ipv4** [**unicast** | **vrf vrf-name**]
  - or
  - **address-family vpnv4** [**unicast**]
  - or
5. **bgp advertise-best-external**
6. **neighbor** *ip-address* **remote-as** *autonomous-system-number*
7. **neighbor** *ip-address* **activate**
8. **neighbor** *ip-address* **fall-over** [**bfd** | **route-map** *map-name*]
9. **end**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<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>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router bgp</b> <i>autonomous-system-number</i>  <b>Example:</b> Router(config)# router bgp 40000	Enters router configuration mode for the specified routing process.
<b>Step 4</b>	Do one of the following: <ul style="list-style-type: none"> <li>• <b>address-family ipv4</b> [<b>unicast</b>   <b>vrf</b> <i>vrf-name</i>]</li> <li>• or</li> <li>• <b>address-family vpnv4</b> [<b>unicast</b>]</li> <li>• or</li> </ul> <b>Example:</b> Router(config-router)# address-family ipv4 unicast  <b>Example:</b> Router(config-router)# address-family vpnv4	Specifies the IPv4 or VPNv4 address family and enters address family configuration mode.  <ul style="list-style-type: none"> <li>• The <b>unicast</b> keyword specifies the IPv4 or VPNv4 unicast address family.</li> <li>• The <b>vrf</b> keyword and <i>vrf-name</i> argument specify the name of the VRF instance to associate with subsequent IPv4 address family configuration mode commands.</li> </ul>
<b>Step 5</b>	<b>bgp advertise-best-external</b>  <b>Example:</b> Router(config-router-af)# bgp advertise-best-external	Calculates and uses an external backup path and installs it into the RIB and Cisco Express Forwarding.

	Command or Action	Purpose
<b>Step 6</b>	<b>neighbor</b> <i>ip-address</i> <b>remote-as</b> <i>autonomous-system-number</i>  <b>Example:</b> <pre>Router(config-router-af)# neighbor 192.168.1.1 remote-as 45000</pre>	<p>Adds the IP address of the neighbor in the specified autonomous system to the IPv4 multiprotocol BGP neighbor table of the local router.</p> <ul style="list-style-type: none"> <li>By default, neighbors that are defined using the <b>neighbor remote-as</b> command in router configuration mode exchange only IPv4 unicast address prefixes. To exchange other address prefix types, neighbors must also be activated using the <b>neighbor activate</b> command in address family configuration mode for the other prefix types.</li> </ul>
<b>Step 7</b>	<b>neighbor</b> <i>ip-address</i> <b>activate</b>  <b>Example:</b> <pre>Router(config-router-af)# neighbor 192.168.1.1 activate</pre>	<p>Enables the neighbor to exchange prefixes for the IPv4 unicast address family with the local router.</p>
<b>Step 8</b>	<b>neighbor</b> <i>ip-address</i> <b>fall-over</b> [ <b>bfd</b>   <b>route-map</b> <i>map-name</i> ]  <b>Example:</b> <pre>Router(config-router-af)# neighbor 192.168.1.1 fall-over bfd</pre>	<p>Configures the BGP peering to use fast session deactivation and enables BFD protocol support for failover.</p> <ul style="list-style-type: none"> <li>BGP will remove all routes learned through this peer if the session is deactivated.</li> </ul>
<b>Step 9</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-router-af)# end</pre>	<p>(Optional) Exits address family configuration mode and returns to privileged EXEC mode.</p>

## Verifying the BGP Best External Feature

Perform the following task to verify that the BGP Best External feature is configured correctly.

## SUMMARY STEPS

1. **enable**
2. **show vrf detail**
3.
  - **show ip bgp ipv4 {mdt {all | rd | vrf} | multicast | tunnel | unicast}**
  - or
  - **show ip bgp vpnv4 {all | rd route-distinguisher | vrf vrf-name} [rib-failure] [ip-prefix/length [longer-prefixes]] [network-address [mask] [longer-prefixes]] [cidr-only] [community] [community-list] [dampened-paths] [filter-list] [flap-statistics] [inconsistent-as] [neighbors] [paths [line]] [peer-group] [quote-regexp] [regexp] [summary] [labels]**
4. **show bgp vpnv4 unicast vrf vrf-name ip-address**
5. **show ip route vrf vrf-name repair-paths ip-address**
6. **show ip cef vrf vrf-name ip-address detail**

## DETAILED STEPS

### Step 1

#### enable

Use this command to enable privileged EXEC mode. Enter your password, if prompted. For example:

#### Example:

```
Router> enable
Router#
```

### Step 2

#### show vrf detail

Use this command to verify that the BGP Best External feature is enabled. The following **show vrf detail** command output shows that the BGP Best External feature is enabled.

#### Example:

```
Router# show vrf detail

VRF test1 (VRF Id = 1); default RD 400:1; default VPNID <not set>
  Interfaces:
    Se4/0
  Address family ipv4 (Table ID = 1 (0x1)):
    Export VPN route-target communities
      RT:100:1          RT:200:1          RT:300:1
      RT:400:1
    Import VPN route-target communities
      RT:100:1          RT:200:1          RT:300:1
      RT:400:1
    No import route-map
    No export route-map
    VRF label distribution protocol: not configured
    VRF label allocation mode: per-prefix

Prefix protection with additional path enabled
Address family ipv6 not active.
```

### Step 3

- **show ip bgp ipv4 {mdt {all | rd | vrf} | multicast | tunnel | unicast}**



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

Use this command to verify that the best external route is advertised. In the command output, the code b indicates a backup path and the code x designates the best external path.

#### Example:

```
Router# show ip bgp vpnv4 all
```

```
BGP table version is 1104964, local router ID is 10.2.2.2
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale, multipath,
b backup-path, x best-external
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop          Metric LocPrf Weight Path
Route Distinguisher: 11:12 (default for vrf blue)
*>i1.0.0.1/32        10.10.3.3                0         200      0 1 ?
* i                  10.10.3.3                0         200      0 1 ?
*                    10.0.0.1                0         200      0 1 ?
*b x                 10.0.0.1                0         200      0 1 ?
*                    10.0.0.1                0         200      0 1 ?
```

#### Step 4 **show bgp vpnv4 unicast vrf** *vrf-name* *ip-address*

Use this command to verify that the best external route is advertised.

#### Example:

```
Router# show bgp vpnv4 unicast vrf vpn1 10.10.10.10
BGP routing table entry for 10:10:10.10.10.10/32, version 10
Paths: (2 available, best #1, table vpn1)
  Advertise-best-external
  Advertised to update-groups:
    1          2
  200
    10.6.6.6 (metric 21) from 10.6.6.6 (10.6.6.6)
    Origin incomplete, metric 0, localpref 200, valid, internal, best
    Extended Community: RT:1:1
    mpls labels in/out 23/23
  200
    10.1.2.1 from 10.1.2.1 (10.1.1.1)
    Origin incomplete, metric 0, localpref 100, valid,
    external, backup/repair, advertise-best-external
    Extended Community: RT:1:1 , recursive-via-connected
    mpls labels in/out 23/nolabel
```

#### Step 5 **show ip route vrf** *vrf-name* **repair-paths** *ip-address*

Use this command to display the repair route.

#### Example:

```
Router# show ip route vrf vpn1 repair-paths
```

```
Routing Table: vpn1
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
```

```

E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP
+ - replicated route, % - next hop override
Gateway of last resort is not set
  10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
B       10.1.1.0/24 [200/0] via 10.6.6.6, 00:38:33
          [RPR][200/0] via 10.1.2.1, 00:38:33
B       10.1.1.1/32 [200/0] via 10.6.6.6, 00:38:33
          [RPR][200/0] via 10.1.2.1, 00:38:33
  10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.1.2.0/24 is directly connected, Ethernet0/0
L       10.1.2.2/32 is directly connected, Ethernet0/0
B       10.1.6.0/24 [200/0] via 10.6.6.6, 00:38:33
          [RPR][200/0] via 10.1.2.1, 00:38:33

```

### Step 6 **show ip cef vrf vrf-name ip-address detail**

Use this command to display the best external route.

#### Example:

```

Router# show ip cef vrf test 10.71.8.164 detail
10.71.8.164/30, epoch 0, flags rib defined all labels
  recursive via 10.249.0.102 label 35
    nexthop 10.249.246.101 Ethernet0/0 label 25
  recursive via 10.249.0.104 label 28,
repair
  nexthop 10.249.246.101 Ethernet0/0 label 24

```

## Configuration Examples for BGP Best External

### Example: Configuring the BGP Best External Feature

The following example shows how to configure the BGP Best External feature in VPNv4 mode:

```

vrf definition test1
  rd 400:1
  route-target export 100:1
  route-target export 200:1
  route-target export 300:1
  route-target export 400:1
  route-target import 100:1
  route-target import 200:1
  route-target import 300:1
  route-target import 400:1
  address-family ipv4
  exit-address-family
exit
!
interface Ethernet1/0
  vrf forwarding test1
  ip address 10.0.0.1 255.0.0.0
exit
!
router bgp 64500
  no synchronization

```

```

bgp log-neighbor-changes
neighbor 10.5.5.5 remote-as 64500
neighbor 10.5.5.5 update-source Loopback0
neighbor 10.6.6.6 remote-as 64500
neighbor 10.6.6.6 update-source Loopback0
no auto-summary
!
address-family vpnv4

bgp advertise-best-external
neighbor 10.5.5.5 activate
neighbor 10.5.5.5 send-community extended
neighbor 10.6.6.6 activate
neighbor 10.6.6.6 send-community extended
exit-address-family
!
address-family ipv4 vrf test1
no synchronization
bgp recursion host
neighbor 192.168.13.2 remote-as 64511
neighbor 192.168.13.2 fall-over bfd
neighbor 192.168.13.2 activate
neighbor 192.168.13.2 as-override
exit-address-family

```

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Command List, All Releases</a>
BGP commands	<a href="#">Cisco IOS IP Routing: BGP Command Reference</a>
Basic MPLS VPNs	“Configuring MPLS Layer 3 VPNs” module in the <i>MPLS: Layer 3 VPNs Configuration Guide</i>
Multiprotocol VRFs	“MPLS VPN VRF CLI for IPv4 and IPv6 VPNs” module in the <i>MPLS: Layer 3 VPNs Configuration Guide</i>
A failover feature that creates a new path after a link or node failure	<a href="#">MPLS VPN--BGP Local Convergence</a>

### Standards

Standard	Title
draft-marques-idr-best-external	<i>BGP Best External, Advertisement of the best external route to iBGP</i>

**MIBs**

MIB	MIBs Link
—	To locate and download MIBs for selected platforms, Cisco software 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 1771	<i>A Border Gateway Protocol 4 (BGP-4)</i>
RFC 2547	<i>BGP/MPLS VPNs</i>

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for BGP Best External

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 1: Feature Information for BGP Best External**

Feature Name	Releases	Feature Information
BGP Best External	12.2(33)SRE 15.2(3)T 15.2(4)S 15.1(1)SY	<p>The BGP Best External feature provides the network with a backup external route to avoid loss of connectivity of the primary external route. This feature advertises the most preferred route among those received from external neighbors as a backup route.</p> <p>The following commands were introduced or modified: <b>bgp advertise-best-external</b>, <b>bgp recursion host</b>, <b>show ip bgp</b>, <b>show ip bgp vpnv4</b>, <b>show ip cef</b>, <b>show ip cef vrf</b>, <b>show ip route</b>, and <b>show ip route vrf</b>.</p>

