BGP NSF Awareness

Nonstop Forwarding (NSF) awareness allows a device to assist NSF-capable neighbors to continue forwarding packets during a Stateful Switchover (SSO) operation. The BGP NSF Awareness feature allows an NSF-aware device that is running BGP to forward packets along routes that are already known for a device that is performing an SSO operation. This capability allows the BGP peers of the failing device to retain the routing information that is advertised by the failing device and continue to use this information until the failed device has returned to normal operating behavior and is able to exchange routing information. The peering session is maintained throughout the entire NSF operation.

- Finding Feature Information, page 1
- Information About BGP NSF Awareness, page 2
- How to Configure BGP NSF Awareness, page 4
- Configuration Examples for BGP NSF Awareness, page 19
- Additional References, page 21
- Feature Information for BGP NSF Awareness, page 22

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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. An account on Cisco.com is not required.
Information About BGP NSF Awareness

Cisco NSF Routing and Forwarding Operation

Cisco NSF is supported by the BGP, EIGRP, OSPF, and IS-IS protocols for routing and by Cisco Express Forwarding (CEF) for forwarding. Of the routing protocols, BGP, EIGRP, OSPF, and IS-IS have been enhanced with NSF capability and awareness, which means that devices running these protocols can detect a switchover and take the necessary actions to continue forwarding network traffic and to recover route information from the peer devices.

In this module, a networking device is said to be NSF-aware if it is running NSF-compatible software. A device is said to be NSF-capable if it has been configured to support NSF; therefore, it rebuilds routing information from NSF-aware or NSF-capable neighbors.

Each protocol depends on CEF to continue forwarding packets during switchover while the routing protocols rebuild the Routing Information Base (RIB) tables. Once the routing protocols have converged, CEF updates the Forwarding Information Base (FIB) table and removes stale route entries. CEF then updates the line cards with the new FIB information.

Cisco Express Forwarding for NSF

A key element of NSF is packet forwarding. In a Cisco networking device, packet forwarding is provided by CEF. CEF maintains the FIB and uses the FIB information that was current at the time of the switchover to continue forwarding packets during a switchover. This feature reduces traffic interruption during the switchover.

During normal NSF operation, CEF on the active RP synchronizes its current FIB and adjacency databases with the FIB and adjacency databases on the standby RP. Upon switchover of the active RP, the standby RP initially has FIB and adjacency databases that are mirror images of those that were current on the active RP. For platforms with intelligent line cards, the line cards will maintain the current forwarding information over a switchover; for platforms with forwarding engines, CEF will keep the forwarding engine on the standby RP current with changes that are sent to it by CEF on the active RP. In this way, the line cards or forwarding engines will be able to continue forwarding after a switchover as soon as the interfaces and a data path are available.

As the routing protocols start to repopulate the RIB on a prefix-by-prefix basis, the updates in turn cause prefix-by-prefix updates for CEF, which it uses to update the FIB and adjacency databases. Existing and new entries will receive the new version (epoch) number, indicating that they have been refreshed. The forwarding information is updated on the line cards or forwarding engine during convergence. The RP signals when the RIB has converged. The software removes all FIB and adjacency entries that have an epoch older than the current switchover epoch. The FIB now represents the newest routing protocol forwarding information.

The routing protocols run only on the active RP, and they receive routing updates from their neighbor routers. Routing protocols do not run on the standby RP. After a switchover, the routing protocols request that the NSF-aware neighbor devices send state information to help rebuild the routing tables.

Note

For NSF operation, the routing protocols depend on CEF to continue forwarding packets while the routing protocols rebuild the routing information.
BGP Graceful Restart for NSF

When an NSF-capable router begins a BGP session with a BGP peer, it sends an OPEN message to the peer. Included in the message is a declaration that the NSF-capable or NSF-aware router has graceful restart capability. Graceful restart is the mechanism by which BGP routing peers avoid a routing flap after a switchover. If the BGP peer has received this capability, it is aware that the device sending the message is NSF-capable. Both the NSF-capable router and its BGP peer(s) (NSF-aware peers) need to exchange the graceful restart capability in their OPEN messages, at the time of session establishment. If both peers do not exchange the graceful restart capability, the session will not be graceful restart capable.

If the BGP session is lost during the RP switchover, the NSF-aware BGP peer marks all the routes associated with the NSF-capable router as stale; however, it continues to use these routes to make forwarding decisions for a set period of time. This functionality means that no packets are lost while the newly active RP is waiting for convergence of the routing information with the BGP peers.

After an RP switchover occurs, the NSF-capable router reestablishes the session with the BGP peer. In establishing the new session, it sends a new graceful restart message that identifies the NSF-capable router as having restarted.

At this point, the routing information is exchanged between the two BGP peers. Once this exchange is complete, the NSF-capable device uses the routing information to update the RIB and the FIB with the new forwarding information. The NSF-aware device uses the network information to remove stale routes from its BGP table. Following that, the BGP protocol is fully converged.

If a BGP peer does not support the graceful restart capability, it will ignore the graceful restart capability in an OPEN message but will establish a BGP session with the NSF-capable device. This functionality will allow interoperability with non-NSF-aware BGP peers (and without NSF functionality), but the BGP session with non-NSF-aware BGP peers will not be graceful restart capable.

BGP NSF Awareness

BGP support for NSF requires that neighbor routers are NSF-aware or NSF-capable. NSF awareness in BGP is also enabled by the graceful restart mechanism. A router that is NSF-aware functions like a router that is NSF-capable with one exception: an NSF-aware router is incapable of performing an SSO operation. However, a router that is NSF-aware is capable of maintaining a peering relationship with an NSF-capable neighbor during an NSF SSO operation, as well as holding routes for this neighbor during the SSO operation.

The BGP Nonstop Forwarding Awareness feature provides an NSF-aware router with the capability to detect a neighbor that is undergoing an SSO operation, maintain the peering session with this neighbor, retain known routes, and continue to forward packets for these routes. The deployment of BGP NSF awareness can minimize the effects of Route Processor (RP) failure conditions and improve the overall network stability by reducing the amount of resources that are normally required for reestablishing peering with a failed router.

NSF awareness for BGP is not enabled by default. The `bgp graceful-restart` command is used to globally enable NSF awareness on a router that is running BGP. NSF-aware operations are also transparent to the network operator and to BGP peers that do not support NSF capabilities.

Note

NSF awareness is enabled automatically in supported software images for Interior Gateway Protocols, such as EIGRP, IS-IS, and OSPF. In BGP, global NSF awareness is not enabled automatically and must be started by issuing the `bgp graceful-restart` command in router configuration mode.
How to Configure BGP NSF Awareness

Configuring BGP Nonstop Forwarding Awareness Using BGP Graceful Restart

The tasks in this section show how to configure BGP Nonstop Forwarding (NSF) awareness using the BGP graceful restart capability.

- The first task enables BGP NSF globally for all BGP neighbors and suggests a few troubleshooting options.
- The second task describes how to adjust the BGP graceful restart timers, although the default settings are optimal for most network deployments.
- The next three tasks demonstrate how to enable or disable BGP graceful restart for individual BGP neighbors, including peer session templates and peer groups.
- The final task verifies the local and peer router configurations of BGP NSF.

Enabling BGP Global NSF Awareness Using BGP Graceful Restart

Perform this task to enable BGP NSF awareness globally for all BGP neighbors. BGP NSF awareness is part of the graceful restart mechanism and BGP NSF awareness is enabled by issuing the `bgp graceful-restart` command in router configuration mode. BGP NSF awareness allows NSF-aware routers to support NSF-capable routers during an SSO operation. NSF-awareness is not enabled by default and should be configured on all neighbors that participate in BGP NSF.

**Note**
The configuration of the restart and stale-path timers is not required to enable the BGP graceful restart capability. The default values are optimal for most network deployments, and these values should be adjusted only by an experienced network operator.

**Note**
Configuring both Bidirectional Forwarding Detection (BFD) and BGP graceful restart for NSF on a device running BGP may result in suboptimal routing.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `router bgp autonomous-system-number`
4. `bgp graceful-restart [restart-time seconds] [stalepath-time seconds]`
5. `end`
DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> router bgp autonomous-system-number</td>
<td>Enters router configuration mode and creates a BGP routing process.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# router bgp 45000</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> bgp graceful-restart [restart-time seconds] [stalepath-time seconds]</td>
<td>Enables the BGP graceful restart capability and BGP NSF awareness.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-router)# bgp graceful-restart</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Exits router configuration mode and enters privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-router)# end</td>
<td></td>
</tr>
</tbody>
</table>

Troubleshooting Tips

To troubleshoot the NSF feature, use the following commands in privileged EXEC mode, as needed:

- **debug ip bgp** —Displays open messages that advertise the graceful restart capability.
- **debug ip bgp event** —Displays graceful restart timer events, such as the restart timer and the stalepath timer.
- **debug ip bgp updates** —Displays sent and received EOR messages. The EOR message is used by the NSF-aware router to start the stalepath timer, if configured.
- **show ip bgp** —Displays entries in the BGP routing table. The output from this command displays routes that are marked as stale by displaying the letter “S” next to each stale route.
• **show ip bgp neighbor** — Displays information about the TCP and BGP connections to neighbor devices. When enabled, the graceful restart capability is displayed in the output of this command.

### What to Do Next

After the peer session template is created, the configuration of the peer session template can be inherited or applied by another peer session template with the `inherit peer-session` or `neighbor inherit peer-session` command.

### Configuring BGP NSF Awareness Timers

Perform this task to adjust the BGP graceful restart timers. There are two BGP graceful restart timers that can be configured. The optional `restart-time` keyword and `seconds` argument determine how long peer routers will wait to delete stale routes before a BGP open message is received. The default value is 120 seconds. The optional `stalepath-time` keyword and `seconds` argument determine how long a router will wait before deleting stale routes after an end of record (EOR) message is received from the restarting router. The default value is 360 seconds.

> **Note**
> The configuration of the restart and stale-path timers is not required to enable the BGP graceful restart capability. The default values are optimal for most network deployments, and these values should be adjusted only by an experienced network operator.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `router bgp autonomous-system-number`
4. `bgp graceful-restart [restart-time seconds]`
5. `bgp graceful-restart [stalepath-time seconds]`
6. `end`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>3</td>
<td><code>router bgp autonomous-system-number</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# router bgp 45000</code></td>
</tr>
<tr>
<td>4</td>
<td><code>bgp graceful-restart [restart-time seconds]</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config-router)# bgp graceful-restart restart-time 130</code></td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong> Only the syntax applicable to this step is used in this example. For more details, see the <em>Cisco IOS IP Routing: BGP Command Reference</em>.</td>
</tr>
<tr>
<td>5</td>
<td><code>bgp graceful-restart [stalepath-time seconds]</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config-router)# bgp graceful-restart stalepath-time 350</code></td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong> Only the syntax applicable to this step is used in this example. For more details, see the <em>Cisco IOS IP Routing: BGP Command Reference</em>.</td>
</tr>
<tr>
<td>6</td>
<td><code>end</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config-router)# end</code></td>
</tr>
</tbody>
</table>

**What to Do Next**

If the `bgp graceful-restart` command has been issued after the BGP session has been established, you must reset by issuing the `clear ip bgp *` command or by reloading the router before graceful restart capabilities will be exchanged. For more information about resetting BGP sessions and using the `clear ip bgp` command, see the “Configuring a Basic BGP Network” module.

**Enabling and Disabling BGP Graceful Restart Using BGP Peer Session Templates**

Perform this task to enable and disable BGP graceful restart for BGP neighbors using peer session templates.

In this task, a BGP peer session template is created, and BGP graceful restart is enabled. A second peer session template is created, and this template is configured to disable BGP graceful restart.
In this example, the configuration is performed at Router B in the figure below, and two external BGP neighbors—Router A and Router E—are identified. The first BGP peer at Router A is configured to inherit the first peer session template, which enables BGP graceful restart, whereas the second BGP peer at Router E inherits the second template, which disables BGP graceful restart. Using the optional `show ip bgp neighbors` command, the status of the BGP graceful restart capability is verified for each BGP neighbor configured in this task.

**Figure 1: Network Topology Showing BGP Neighbors**

The restart and stale-path timers can be modified only using the global `bgp graceful-restart` command. The restart and stale-path timers are set to the default values when BGP graceful restart is enabled for BGP neighbors using peer session templates.

---

**Note**

A BGP peer cannot inherit from a peer policy or session template and be configured as a peer group member at the same. BGP templates and BGP peer groups are mutually exclusive.
SUMMARY STEPS

1. enable
2. configure terminal
3. router bgp autonomous-system-number
4. template peer-session session-template-name
5. ha-mode graceful-restart [disable]
6. exit-peer-session
7. template peer-session session-template-name
8. ha-mode graceful-restart [disable]
9. exit-peer-session
10. bgp log-neighbor-changes
11. neighbor ip-address remote-as autonomous-system-number
12. neighbor ip-address inherit peer-session session-template-number
13. neighbor ip-address remote-as autonomous-system-number
14. neighbor ip-address inherit peer-session session-template-number
15. end
16. show ip bgp template peer-session [session-template-number]
17. show ip bgp neighbors [ip-address [received-routes | routes | advertised-routes | paths [regexp] | dampened-routes | flap-statistics | received prefix-filter | policy [detail]]]

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> router bgp autonomous-system-number</td>
<td>Enters router configuration mode and creates a BGP routing process.</td>
</tr>
<tr>
<td><em>Example:</em> Device(config)# router bgp 45000</td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>4</td>
<td><strong>template peer-session</strong> <em>session-template-name</em></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-router)# template peer-session S1</td>
</tr>
<tr>
<td></td>
<td>• In this example, a peer session template named S1 is created.</td>
</tr>
<tr>
<td>5</td>
<td><strong>ha-mode graceful-restart</strong> [<strong>disable</strong>]</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-router-stmp)# ha-mode graceful-restart disable</td>
</tr>
<tr>
<td></td>
<td>• Use the <strong>disable</strong> keyword to disable BGP graceful restart capability.</td>
</tr>
<tr>
<td></td>
<td>• If you enter this command after the BGP session has been established, you must restart the session in order for the capability to be exchanged with the BGP neighbor.</td>
</tr>
<tr>
<td></td>
<td>• In this example, the BGP graceful restart capability is enabled for the peer session template named S1.</td>
</tr>
<tr>
<td>6</td>
<td><strong>exit-peer-session</strong></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-router-stmp)# exit-peer-session</td>
</tr>
<tr>
<td>7</td>
<td><strong>template peer-session</strong> <em>session-template-name</em></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-router)# template peer-session S2</td>
</tr>
<tr>
<td></td>
<td>• In this example, a peer session template named S2 is created.</td>
</tr>
<tr>
<td>8</td>
<td><strong>ha-mode graceful-restart</strong> [<strong>disable</strong>]</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-router-stmp)# ha-mode graceful-restart disable</td>
</tr>
<tr>
<td></td>
<td>• Use the <strong>disable</strong> keyword to disable BGP graceful restart capability.</td>
</tr>
<tr>
<td></td>
<td>• If you enter this command after the BGP session has been established, you must restart the session in order for the capability to be exchanged with the BGP neighbor.</td>
</tr>
<tr>
<td></td>
<td>• In this example, the BGP graceful restart capability is disabled for the peer session template named S2.</td>
</tr>
<tr>
<td>9</td>
<td><strong>exit-peer-session</strong></td>
</tr>
<tr>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config-router-stmp)# exit-peer-session</td>
</tr>
</tbody>
</table>
**Command or Action** | **Purpose**  
--- | ---  
**Step 10** | bgp log-neighbor-changes  
**Example:**  
Device(config-router)# bgp log-neighbor-changes  
Enables logging of BGP neighbor status changes (up or down) and neighbor resets.  
- Use this command for troubleshooting network connectivity problems and measuring network stability. Unexpected neighbor resets might indicate high error rates or high packet loss in the network and should be investigated.  
**Step 11** | neighbor ip-address remote-as autonomous-system-number  
**Example:**  
Device(config-router)# neighbor 192.168.1.2 remote-as 40000  
Configures peering with a BGP neighbor in the specified autonomous system.  
- In this example, the BGP peer at 192.168.1.2 is an external BGP peer because it has a different autonomous system number from the router where the BGP configuration is being entered (see Step 3).  
**Step 12** | neighbor ip-address inherit peer-session session-template-number  
**Example:**  
Device(config-router)# neighbor 192.168.1.2 inherit peer-session S1  
Inherits a peer session template.  
- In this example, the peer session template named S1 is inherited, and the neighbor inherits the enabling of BGP graceful restart.  
**Step 13** | neighbor ip-address remote-as autonomous-system-number  
**Example:**  
Device(config-router)# neighbor 192.168.3.2 remote-as 50000  
Configures peering with a BGP neighbor in the specified autonomous system.  
- In this example, the BGP peer at 192.168.3.2 is an external BGP peer because it has a different autonomous system number from the router where the BGP configuration is being entered (see Step 3).  
**Step 14** | neighbor ip-address inherit peer-session session-template-number  
**Example:**  
Device(config-router)# neighbor 192.168.3.2 inherit peer-session S2  
Inherits a peer session template.  
- In this example, the peer session template named S2 is inherited, and the neighbor inherits the disabling of BGP graceful restart.  
**Step 15** | end  
**Example:**  
Device(config-router)# end  
Exits router configuration mode and enters privileged EXEC mode.  
**Step 16** | show ip bgp template peer-session [session-template-number]  
(Optional) Displays locally configured peer session templates.  
- The output can be filtered to display a single peer policy template by using the *session-template-name* argument. This command also supports all standard output modifiers.
### Purpose

**Example:**

Device# show ip bgp template peer-session

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 17</strong> show ip bgp neighbors [ip-address [received-routes</td>
<td>routes</td>
</tr>
<tr>
<td>- &quot;Graceful Restart Capability: advertised&quot; will be displayed for each neighbor that has exchanged graceful restart capabilities with this router.</td>
<td></td>
</tr>
<tr>
<td>- In this example, the output is filtered to display information about the BGP peer at 192.168.1.2.</td>
<td></td>
</tr>
</tbody>
</table>

### Examples

The following example shows partial output from the `show ip bgp neighbors` command for the BGP peer at 192.168.1.2 (Router A in the figure above). Graceful restart is shown as enabled. Note the default values for the restart and stale-path timers. These timers can be set only by using the `bgp graceful-restart` command.

**Device# show ip bgp neighbors 192.168.1.2**

BGP neighbor is 192.168.1.2, remote AS 40000, external link  
Inherits from template S1 for session parameters  
BGP version 4, remote router ID 192.168.1.2  
BGP state = Established, up for 00:02:11  
Last read 00:00:23, last write 00:00:27, hold time is 180, keepalive intervals  
Neighbor sessions:  
1 active, is multisession capable  
Neighbor capabilities:  
Route refresh: advertised and received(new)  
Address family IPv4 Unicast: advertised and received  
Graceful Restart Capability: advertised  
Multisession Capability: advertised and received  
Address tracking is enabled, the RIB does have a route to 192.168.1.2  
Connections established 1; dropped 0  
Last reset never  
Transport(tcp) path-mtu-discovery is enabled  
Graceful-Restart is enabled, restart-time 120 seconds, stalepath-time 360 secs  
Connection state is ESTAB, I/O status: 1, unread input bytes: 0  
The following example shows partial output from the `show ip bgp neighbors` command for the BGP peer at 192.168.3.2 (Router E in the figure above). Graceful restart is shown as disabled.

**Device# show ip bgp neighbors 192.168.3.2**

BGP neighbor is 192.168.3.2, remote AS 50000, external link  
Inherits from template S2 for session parameters  
BGP version 4, remote router ID 192.168.3.2  
BGP state = Established, up for 00:01:41  
Last read 00:00:45, last write 00:00:45, hold time is 180, keepalive intervals  
Neighbor sessions:  
1 active, is multisession capable  
Neighbor capabilities:  
Route refresh: advertised and received(new)
Address family IPv4 Unicast: advertised and received
!
Address tracking is enabled, the RIB does have a route to 192.168.3.2
Connections established 1; dropped 0
Last reset never
Transport(tcp) path-mtu-discovery is enabled
Graceful-Restart is disabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0

**Enabling BGP Graceful Restart for an Individual BGP Neighbor**

Perform this task on Router B in the figure above to enable BGP graceful restart on the internal BGP peer at Router C in the figure above. Under the IPv4 address family, the neighbor at Router C is identified, and BGP graceful restart is enabled for the neighbor at Router C with the IP address 172.21.1.2. To verify that BGP graceful restart is enabled, the optional `show ip bgp neighbors` command is used.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `router bgp autonomous-system-number`
4. `address-family ipv4 [unicast | multicast | vrf vrf-name]`
5. `neighbor ip-address remote-as autonomous-system-number`
6. `neighbor ip-address activate`
7. `neighbor ip-address ha-mode graceful-restart [disable]`
8. `end`
9. `show ip bgp neighbors [ip-address [received-routes | routes | advertised-routes | paths [regexp] | dampened-routes | flap-statistics | received prefix-filter | policy [detail]]]`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> router bgp autonomous-system-number</td>
<td>Enters router configuration mode and creates a BGP routing process.</td>
</tr>
<tr>
<td>Example: Device(config)# router bgp 45000</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>Command or Action</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| | address-family ipv4 [unicast | Specifies the IPv4 address family and enters address family configuration mode.  
| | multicast | vrf name] | • The **unicast** keyword specifies the IPv4 unicast address family.  
| | | By default, the router is placed in address family configuration mode for the IPv4 unicast address family if the **unicast** keyword is not specified.  
| | | • The **multicast** keyword specifies IPv4 multicast address prefixes.  
| | | • The **vrf** keyword and **vrf-name** argument specify the name of the VRF instance to associate with subsequent IPv4 address family configuration mode commands.  
| Example: | Device(config-router)# address-family ipv4 unicast |  |

<table>
<thead>
<tr>
<th>Step 5</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| | neighbor ip-address remote-as autonomous-system-number | Configures peering with a BGP neighbor in the specified autonomous system.  
| | | • In this example, the BGP peer at 172.21.1.2 is an internal BGP peer because it has the same autonomous system number as the router where the BGP configuration is being entered (see Step 3).  
| Example: | Device(config-router-af)# neighbor 172.21.1.2 remote-as 45000 |  |

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| | neighbor ip-address activate | Enables the neighbor to exchange prefixes for the IPv4 address family with the local router.  
| | | • In this example, the internal BGP peer at 172.21.1.2 is activated.  
| Example: | Device(config-router-af)# neighbor 172.21.1.2 activate |  |

<table>
<thead>
<tr>
<th>Step 7</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| | neighbor ip-address ha-mode graceful-restart [disable] | Enables the BGP graceful restart capability for a BGP neighbor.  
| | | • Use the **disable** keyword to disable BGP graceful restart capability.  
| | | • If you enter this command after the BGP session has been established, you must restart the session in order for the capability to be exchanged with the BGP neighbor.  
| | | • In this example, the BGP graceful restart capability is enabled for the neighbor at 172.21.1.2.  
| Example: | Device(config-router-af)# neighbor 172.21.1.2 ha-mode graceful-restart |  |

<table>
<thead>
<tr>
<th>Step 8</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| | end | Exits address family configuration mode and returns to privileged EXEC mode.  
| Example: | Device(config-router-af)# end |  |

<table>
<thead>
<tr>
<th>Step 9</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| | show ip bgp neighbors [ip-address | (Optional) Displays information about TCP and BGP connections to neighbors.  
| | [received-routes | • "Graceful Restart Capability: advertised" will be displayed for each neighbor that has exchanged graceful restart capabilities with this router.  
| | routes | advertised-routes | paths [regexp] | dampened-routes | flap-statistics | received prefix-filter | policy [detail]]] |  
| | |  |  |  |  |  |  |  |
Examples

The following example shows partial output from the `show ip bgp neighbors` command for the BGP peer at 172.21.1.2. Graceful restart is shown as enabled. Note the default values for the restart and stale-path timers. These timers can be set using only the global `bgp graceful-restart` command.

```
Device# show ip bgp neighbors 172.21.1.2
BGP neighbor is 172.21.1.2, remote AS 45000, internal link
BGP version 4, remote router ID 172.22.1.1
BGP state = Established, up for 00:01:01
Last read 00:00:02, last write 00:00:07, hold time is 180, keepalive intervals
Neighbor sessions:
1 active, is multisession capable
Neighbor capabilities:
  Route refresh: advertised and received(new)
  Address family IPv4 Unicast: advertised and received
  Graceful Restart Capability: advertised
  Multisession Capability: advertised and received
  !
  Address tracking is enabled, the RIB does have a route to 172.21.1.2
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
  Graceful-Restart is enabled, restart-time 120 seconds, stalepath-time 360 secs
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
```

Disabling BGP Graceful Restart for a BGP Peer Group

Perform this task to disable BGP graceful restart for a BGP peer group. In this task, a BGP peer group is created and graceful restart is disabled for the peer group. A BGP neighbor, Router D at 172.16.1.2 in the figure above, is then identified and added as a peer group member. It inherits the configuration associated with the peer group, which, in this example, disables BGP graceful restart.
### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `router bgp autonomous-system-number`
4. `address-family ipv4 [unicast | multicast | vrf vrf-name]`
5. `neighbor peer-group-name peer-group`
6. `neighbor peer-group-name remote-as autonomous-system-number`
7. `neighbor peer-group-name ha-mode graceful-restart [disable]`
8. `neighbor ip-address peer-group peer-group-name`
9. `end`
10. `show ip bgp neighbors [ip-address [received-routes | routes | advertised-routes | paths [regexp] | dampened-routes | flap-statistics | received prefix-filter | policy [detail]]]`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
  * Enter your password if prompted.  
  **Example:**  
  Device> enable |
| **Step 2** configure terminal | Enters global configuration mode.  
  **Example:**  
  Device# configure terminal |
| **Step 3** router bgp autonomous-system-number | Enters router configuration mode and creates a BGP routing process.  
  **Example:**  
  Device(config)# router bgp 45000 |
| **Step 4** address-family ipv4 [unicast | multicast | vrf vrf-name] | Specifies the IPv4 address family and enters address family configuration mode.  
  * The **unicast** keyword specifies the IPv4 unicast address family.  
    By default, the router is placed in address family configuration mode for the IPv4 unicast address family if the **unicast** keyword is not specified.  
  * The **multicast** keyword specifies IPv4 multicast address prefixes.  
  * The **vrf** keyword and **vrf-name** argument specify the name of the VRF instance to associate with subsequent IPv4 address family configuration mode commands.  
  **Example:**  
  Device(config-router)# address-family ipv4 unicast |
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 5</strong></td>
<td>neighbor peer-group-name peer-group</td>
</tr>
<tr>
<td>Example: Device(config-router-af)# neighbor PG1 peer-group</td>
<td></td>
</tr>
<tr>
<td>Creates a BGP peer group.</td>
<td></td>
</tr>
<tr>
<td>• In this example, the peer group named PG1 is created.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>neighbor peer-group-name remote-as autonomous-system-number</td>
</tr>
<tr>
<td>Example: Device(config-router-af)# neighbor PG1 remote-as 45000</td>
<td></td>
</tr>
<tr>
<td>Configures peering with a BGP peer group in the specified autonomous system.</td>
<td></td>
</tr>
<tr>
<td>• In this example, the BGP peer group named PG1 is added to the IPv4 multiprotocol BGP neighbor table of the local router.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>neighbor peer-group-name ha-mode graceful-restart [disable]</td>
</tr>
<tr>
<td>Example: Device(config-router-af)# neighbor PG1 ha-mode graceful-restart disable</td>
<td></td>
</tr>
<tr>
<td>Enables the BGP graceful restart capability for a BGP neighbor.</td>
<td></td>
</tr>
<tr>
<td>• Use the disable keyword to disable BGP graceful restart capability.</td>
<td></td>
</tr>
<tr>
<td>• If you enter this command after the BGP session has been established, you must restart the session for the capability to be exchanged with the BGP neighbor.</td>
<td></td>
</tr>
<tr>
<td>• In this example, the BGP graceful restart capability is disabled for the BGP peer group named PG1.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td>neighbor ip-address peer-group peer-group-name</td>
</tr>
<tr>
<td>Example: Device(config-router-af)# neighbor 172.16.1.2 peer-group PG1</td>
<td></td>
</tr>
<tr>
<td>Assigns the IP address of a BGP neighbor to a peer group.</td>
<td></td>
</tr>
<tr>
<td>• In this example, the BGP neighbor peer at 172.16.1.2 is configured as a member of the peer group named PG1.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 9</strong></td>
<td>end</td>
</tr>
<tr>
<td>Example: Device(config-router-af)# end</td>
<td></td>
</tr>
<tr>
<td>Exits address family configuration mode and returns to privileged EXEC mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 10</strong></td>
<td>show ip bgp neighbors [ip-address [received-routes</td>
</tr>
<tr>
<td>Example: Device# show ip bgp neighbors 172.16.1.2</td>
<td></td>
</tr>
<tr>
<td>(Optional) Displays information about TCP and BGP connections to neighbors.</td>
<td></td>
</tr>
<tr>
<td>• In this example, the output is filtered to display information about the BGP peer at 172.16.1.2 and the &quot;Graceful-Restart is disabled&quot; line shows that the graceful restart capability is disabled for this neighbor.</td>
<td></td>
</tr>
</tbody>
</table>
Examples

The following example shows partial output from the `show ip bgp neighbors` command for the BGP peer at 172.16.1.2. Graceful restart is shown as disabled. Note the default values for the restart and stale-path timers. These timers can be set using only the global `bgp graceful-restart` command.

```
Device# show ip bgp neighbors 172.16.1.2
BGP neighbor is 172.16.1.2, remote AS 45000, internal link
  Member of peer-group PG1 for session parameters
  BGP version 4, remote router ID 0.0.0.0
  BGP state = Idle
  Neighbor sessions:
    0 active, is multisession capable
  Address tracking is enabled, the RIB does have a route to 172.16.1.2
    Connections established 0; dropped 0
    Last reset never
  Transport(tcp) path-mtu-discovery is enabled
  Graceful-Restart is disabled
```

Verifying the Configuration of BGP Nonstop Forwarding Awareness

Use the following steps to verify the local configuration of BGP NSF awareness on a router and to verify the configuration of NSF awareness on peer routers in a BGP network.

SUMMARY STEPS

1. `enable`
2. `show running-config [options]`
3. `show ip bgp neighbors [ip-address [received-routes | routes | advertised-routes | paths [regexp] | dampened-routes | flap-statistics | received prefix-filter | policy [detail]]]`

DETAILED STEPS

**Step 1**
`enable`
Enables privileged EXEC mode. Enter your password if prompted.

**Example:**
```
Device> enable
```

**Step 2**
`show running-config [options]`
Displays the running configuration on the local router. The output will display the configuration of the `bgp graceful-restart` command in the BGP section. Repeat this command on all BGP neighbor routers to verify that all BGP peers are configured for BGP NSF awareness. In this example, BGP graceful restart is enabled globally and the external neighbor at 192.168.1.2 is configured to be a BGP peer and will have the BGP graceful restart capability enabled.

**Example:**
```
Device# show running-config
```

```
router bgp 45000
```
bgp router-id 172.17.1.99
bgp log-neighbor-changes
bgp graceful-restart restart-time 130
bgp graceful-restart stalepath-time 350
bgp graceful-restart
timers bgp 70 120
neighbor 192.168.1.2 remote-as 40000
neighbor 192.168.1.2 activate
.
.
.
Step 3 show ip bgp neighbors [ip-address [received-routes | routes | advertised-routes | paths [regexp] | dampened-routes | flap-statistics | received prefix-filter | policy [detail]]]

Displays information about TCP and BGP connections to neighbors. "Graceful Restart Capability: advertised" will be displayed for each neighbor that has exchanged graceful restart capabilities with this router.

Configuration Examples for BGP NSF Awareness

Example: Enabling BGP Global NSF Awareness Using Graceful Restart

The following example enables BGP NSF awareness globally on all BGP neighbors. The restart time is set to 130 seconds, and the stale path time is set to 350 seconds. The configuration of these timers is optional, and the preconfigured default values are optimal for most network deployments.

configure terminal
router bgp 45000
bgp graceful-restart
timer bgp 70 120
neighbor 192.168.1.2 remote-as 40000
neighbor 192.168.1.2 activate
.
.
.

Examples: Enabling and Disabling BGP Graceful Restart per Neighbor

The ability to enable or disable the BGP graceful restart capability for an individual BGP neighbor, peer group, or peer session template was introduced. The following example is configured on Router B in the figure below and enables the BGP graceful restart capability for the BGP peer session template named S1 and disables the BGP graceful restart capability for the BGP peer session template named S2. The external BGP neighbor at Router A (192.168.1.2) inherits peer session template S1, and the BGP graceful restart capability is enabled.
for this neighbor. Another external BGP neighbor at Router E (192.168.3.2) is configured with the BGP graceful restart capability disabled after inheriting peer session template S2.

**Figure 2: Network Topology Showing BGP Neighbors for BGP Graceful Restart**

The BGP graceful restart capability is enabled for an individual internal BGP neighbor, Router C at 172.21.1.2, whereas the BGP graceful restart is disabled for the BGP neighbor at Router D, 172.16.1.2, because it is a member of the peer group PG1. The disabling of BGP graceful restart is configured for all members of the peer group, PG1. The restart and stale-path timers are modified, and the BGP sessions are reset.

```plaintext
router bgp 45000
    template peer-session S1
        remote-as 40000
        ha-mode graceful-restart
    exit-peer-session
    template peer-session S2
        remote-as 50000
        ha-mode graceful-restart disable
    exit-peer-session
    bgp log-neighbor-changes
    bgp graceful-restart restart-time 150
    bgp graceful-restart stalepath-time 400
    address-family ipv4 unicast
    neighbor PG1 peer-group
    neighbor PG1 remote-as 45000
    neighbor PG1 ha-mode graceful-restart disable
    neighbor 172.16.1.2 peer-group PG1
    neighbor 172.21.1.2 remote-as 45000
    neighbor 172.21.1.2 activate
    neighbor 172.21.1.2 ha-mode graceful-restart
    neighbor 192.168.1.2 remote-as 40000
    neighbor 192.168.1.2 inherit peer-session S1
    neighbor 192.168.3.2 remote-as 50000
    neighbor 192.168.3.2 inherit peer-session S2
    end
    clear ip bgp *
```

To demonstrate how the last configuration instance of the BGP graceful restart capability is applied, the following example initially enables the BGP graceful restart capability globally for all BGP neighbors. A BGP peer group, PG2, is configured with the BGP graceful restart capability disabled. An individual external
BGP neighbor, Router A at 192.168.1.2 in the figure above, is then configured to be a member of the peer group, PG2. The last graceful restart configuration instance is applied, and, in this case, the neighbor, 192.168.1.2, inherits the configuration instance from the peer group PG2, and the BGP graceful restart capability is disabled for this neighbor.

```
service://192.168.1.2
```

```
router bgp 45000
  bgp log-neighbor-changes
  bgp graceful-restart
  address-family ipv4 unicast
  neighbor PG2 peer-group
  neighbor PG2 remote-as 40000
  neighbor PG2 ha-mode graceful-restart disable
  neighbor 192.168.1.2 peer-group PG2
end
```

clear ip bgp *

---

**Additional References**

**Related Documents**

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Command List, All Releases</td>
</tr>
<tr>
<td>BGP commands</td>
<td>Cisco IOS IP Routing: BGP Command Reference</td>
</tr>
<tr>
<td>Enabling BGP MIB support</td>
<td>“BGP MIB Support” module in the IP Routing: BGP Configuration Guide</td>
</tr>
<tr>
<td>Configuring SNMP Support</td>
<td>SNMP Configuration Guide in the Cisco IOS Network Management Configuration Guide Library</td>
</tr>
<tr>
<td>SNMP Commands</td>
<td>Cisco IOS SNMP Support Command Reference</td>
</tr>
</tbody>
</table>

**Standards**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>—</td>
</tr>
</tbody>
</table>

**MIBs**

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>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></td>
</tr>
</tbody>
</table>
### RFCs

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 1657</td>
<td>BGP-4 MIB</td>
</tr>
<tr>
<td>RFC 1771</td>
<td>A Border Gateway Protocol 4 (BGP-4)</td>
</tr>
<tr>
<td>RFC 2547</td>
<td>BGP/MPLS VPNs</td>
</tr>
<tr>
<td>RFC 2858</td>
<td>Multiprotocol Extensions for BGP-4</td>
</tr>
</tbody>
</table>

### Technical Assistance

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

### Feature Information for BGP NSF Awareness

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 . An account on Cisco.com is not required.
### Table 1: Feature Information for BGP NSF Awareness

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGP NSF Awareness</td>
<td></td>
<td>Nonstop Forwarding (NSF) awareness allows a device to assist NSF-capable neighbors to continue forwarding packets during a Stateful Switchover (SSO) operation. The BGP Nonstop Forwarding Awareness feature allows an NSF-aware device that is running BGP to forward packets along routes that are already known for a device that is performing an SSO operation. This capability allows the BGP peers of the failing device to retain the routing information that is advertised by the failing device and continue to use this information until the failed device has returned to normal operating behavior and is able to exchange routing information. The peering session is maintained throughout the entire NSF operation. The following commands were introduced or modified: <code>bgp graceful-restart</code>, <code>show ip bgp</code>, <code>show ip bgp neighbors</code>.</td>
</tr>
</tbody>
</table>