CHECK POINT
600/700/1100/1200R/1400
APPLIANCE
ADVANCED ROUTING
Guide
Important Information

Latest Software
We recommend that you install the most recent software release to stay up-to-date with the latest functional improvements, stability fixes, security enhancements and protection against new and evolving attacks.

Latest Version of this Document
Download the latest version of this document

To learn more, visit the Check Point Support Center

Feedback
Check Point is engaged in a continuous effort to improve its documentation.
Please help us by sending your comments
mailto:cp_techpub_feedback@checkpoint.com?subject=Feedback on Check Point 600/700/1100/1200R/1400 Appliance Advanced Routing Guide.

Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 October 2017</td>
<td>First release of this document</td>
</tr>
</tbody>
</table>
## Contents

### Important Information

- Introduction to Advanced Routing ......................................................... 6

### BGP

1. Support for BGP-4++ ................................................................. 7
2. BGP Sessions (Internal and External) ............................................. 7
   - Preventing Private AS Numbers from Propagating ...................... 8
3. BGP Path Attributes ................................................................. 8
4. BGP Multi-Exit Discriminator ...................................................... 9
5. BGP Interactions with IGPs ......................................................... 10
6. Inbound BGP Route Filters ......................................................... 10
7. Redistributing Routes to BGP ...................................................... 10
8. BGP Communities ................................................................. 11
9. Route Reflection ........................................................................... 11
10. Confederations ........................................................................... 12
11. EBGP Multihop Support ............................................................ 13
12. BGP Route Dampening ............................................................. 13
13. TCP MD5 Authentication ........................................................... 14
14. Configuring BGP - CLI (bgp) ...................................................... 14
   - BGP ....................................................................................... 18
   - External BGP ........................................................................... 19
   - BGP Peers .............................................................................. 20
   - BGP Confederation Commands .............................................. 23
   - BGP Route Reflection Commands .......................................... 25
   - BGP Route Dampening Commands ........................................ 26
   - Internal BGP ........................................................................... 27
   - BGP Communities Commands .............................................. 31
   - BGP Show Commands ......................................................... 32

### IGMP

- Configuring IGMP - CLI (igmp) .................................................. 33
  - Configuring Interfaces for IGMP .............................................. 34
  - Monitoring IGMP (show igmp) ................................................. 36

### RIP

- RIP .............................................................................................. 37
  - RIP 1 ....................................................................................... 37
  - RIP 2 ....................................................................................... 37
  - Network Mask .......................................................................... 37
  - Authentication ......................................................................... 37
  - RIP Interface Commands ....................................................... 40
  - RIP Global Commands .......................................................... 41
  - RIP Show Commands ............................................................ 42

### OSPF

- Types of Areas ............................................................................. 43
- Area Border Routers ............................................................... 44
Introduction to Advanced Routing

Dynamic Routing is integrated into the embedded version of the Gaia operating system and command-line shell. BGP, OSPF, and RIP are supported.

Dynamic Multicast Routing is supported, using PIM (Sparse Mode (SM), Dense Mode (DM) and Source-Specific Multicast (SSM)) and IGMP.

BGP

In This Section:
- Support for BGP-4++ .......................................................... 7
- BGP Sessions (Internal and External) .................................. 7
- BGP Path Attributes ............................................................. 8
- BGP Multi-Exit Discriminator .............................................. 9
- BGP Interactions with IGPs .................................................. 10
- Inbound BGP Route Filters .................................................. 10
- Redistributing Routes to BGP .............................................. 10
- BGP Communities .............................................................. 11
- Route Reflection ................................................................. 11
- Confederations ................................................................. 12
- EBGP Multihop Support ...................................................... 13
- BGP Route Dampening ...................................................... 13
- TCP MD5 Authentication ................................................... 14
- Configuring BGP - CLI (bgp) ............................................... 14

Border Gateway Protocol (BGP) is an inter-AS protocol, meaning that it can be deployed within and between autonomous systems (AS). An autonomous system is a set of routers under a single technical administration. An AS uses an interior gateway protocol and common metrics to route packets within an AS; it uses an exterior routing protocol to route packets to other ASes.

Note - This implementation supports BGP version 4 and 4++.

BGP sends update messages that consist of network number-AS path pairs. The AS path contains the string of ASes through which the specified network can be reached. An AS path has some structure in order to represent the results of aggregating dissimilar routes. These update messages are sent over TCP transport mechanism to ensure reliable delivery. BGP contrasts with IGPs, which build their own reliability on top of a datagram service.

As a path-vector routing protocol, BGP limits the distribution of router reachability information to its peer or neighbor routers.

You can run BGP over a route-based VPN by enabling BGP on a virtual tunnel interface (VTI).
Support for BGP-4++

Gaia Embedded implements BGP-4++ to support multiprotocol extensions.

You must use an IPv4 address for the router ID (BGP identifier). After the BGP session is completed, you can advertise and withdraw prefixes by sending normal UPDATE messages that include one or both of the new multiprotocol attributes MP_REACH_NLRI (advertises reachability of routes) and MP_UNREACH_NLRI (withdraws routes).

The new attributes are backward compatible. If two routers have a BGP session and only one supports the multiprotocol attributes, they can still exchange unicast IPv4 routes.

On each peer you configure the type of routes (capability) that should be exchanged between peers. Choose this selection:

- IPv4 unicast (the default)

To establish peering, the routers must share a capability.

Note - Do not use the route redistribution and inbound filter pages of the WebUI to configure routing policies for BGP-4++. Use the route map commands in the CLI.

BGP Sessions (Internal and External)

BGP supports these session types between neighbors:

- **Internal** (sometimes referred to as IBGP) - Runs between routers in the same autonomous system.

- **External** (EBGP) - Runs between routers in different autonomous systems.

When you send routes to an external peer, the local AS number is prepended to the AS path. Routes received from an internal neighbor have the same AS path that the route had when it was received from an external peer.

BGP sessions might include a single metric (Multi-Exit Discriminator or MED) in the path attributes. Smaller values are preferred. These values are used to break ties between routes with equal preference from the same neighbor AS.

Internal BGP sessions carry at least one metric in the path attributes that BGP calls the local preference. The size of the metric is identical to the MED. Use of these metrics depends on the type of internal protocol processing.

For BGP implementation, external peers are directly attached to a shared subnet and advertise next hops that are host addresses on the subnet. If you enable the multihop option in the BGP peer template during configuration, this constraint is relaxed.

Internal groups determine the immediate next hops for routes. The next hop received with a route from a peer is used as a forwarding address and to look up an immediate next hop in IGP routes. Internal groups support distant peers, but need to know the IGP whose routes they are using to determine immediate next hops.

Where possible, for internal BGP group types, a single outgoing message is built for all group peers based on the common policy. A copy of the message is sent to every peer in the group, with appropriate adjustments to the next hop field to each peer. This minimizes the computational load needed to run large numbers of peers in these types of groups.
Preventing Private AS Numbers from Propagating

An ISP can assign private AS numbers (64512 to 65535) to a customer to conserve globally unique AS numbers. When an ISP does this, a BGP update from a customer network to the ISP has the private AS number in its AS_PATH attribute. When the ISP propagates its network information to other ISPs, the private AS number is usually included. To avoid this, you can configure Gaia Embedded to remove the private AS number from BGP update messages to external peers.

To configure Gaia Embedded to remove private AS numbers from BGP updates, enable the Remove Private AS option on the configuration page for an external peer.

If you enable this option, private AS numbers are removed from BGP updates based on these rules:

- If the AS_PATH includes both public and private AS numbers, the private AS numbers are not removed.
- If the AS_PATH contains the AS number of the destination peer, private AS numbers are not removed.
- If the AS_PATH includes confederations and all the AS numbers in the AS_PATH are private, all the private AS numbers are removed.

BGP Route Refresh

Gaia Embedded supports the ability to dynamically request BGP route updates from peers and to respond to requests for BGP route updates. For example, if you change the inbound routing policy, you can request that a peer readvertise its previously advertised routes so that the routes can be checked against the new policy. This feature is often referred to as a soft reset because it provides the ability to refresh routes received from a peer without tearing down the established session.

To configure BGP route updates in the:

- CLI - Run these commands:
  ```
  set bgp external remote-as as_number peer ip_address send-route-refresh
  set bgp internal peer ip_address send-route-refresh
  ```
- WebUI - Click the appropriate buttons in the Edit Peer page, in the section Advanced Settings > Route Refresh.

These options work only with peers that support the same capabilities. Gaia Embedded systems can also peer with systems that do not support these options.

BGP Path Attributes

A path attribute is a list of AS numbers that a route has traversed to reach a destination. BGP uses path attributes to provide more information about each route and to help prevent routing loops in an arbitrary topology. You can also use path attributes to determine administrative preferences.

BGP collapses routes with similar path attributes into a single update for advertisement. Routes that are received in a single update are readvertised in a single update. The churn caused by the loss of a neighbor is minimized, and the initial advertisement sent during peer establishment is maximally compressed.

BGP does not read information that the kernel forms message by message. Instead, it fills the input buffer. BGP processes all complete messages in the buffer before reading again. BGP also performs multiple reads to clear all incoming data queued on the socket.
Note - This feature might cause a busy peer connection to block other protocols for prolonged intervals.

Path attributes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS_PATH</td>
<td>Identifies the autonomous systems through which routing information carried in an UPDATE message passed. Components of this list can be AS_SETs or AS_SEQUENCES.</td>
</tr>
<tr>
<td>NEXT_HOP</td>
<td>Defines the IP address of the border router that should be used as the next hop to the destinations listed in the UPDATE message.</td>
</tr>
<tr>
<td>MULTI_EXIT_DISC</td>
<td>Discriminates among multiple exit or entry points to the same neighboring autonomous system. Used only on external links.</td>
</tr>
<tr>
<td>LOCAL_PREF</td>
<td>Determines which external route should be taken and is included in all IBGP UPDATE messages. The assigned BGP speaker sends this message to BGP speakers within its own autonomous system but not to neighboring autonomous systems. Higher values of a LOCAL_PREF are preferred.</td>
</tr>
<tr>
<td>ATOMIC_AGGREGATE</td>
<td>Specifies to a BGP speaker that a less specific route was chosen over a more specific route. The BGP speaker attaches the ATOMIC_AGGREGATE attribute to the route when it reproduces it to other BGP speakers. The BGP speaker that receives this route cannot remove the ATOMIC_AGGREGATE attribute or make any Network Layer Reachability Information (NLRI) of the route more specific. This attribute is used only for debugging purposes.</td>
</tr>
</tbody>
</table>

All unreachable messages are collected into a single message and are sent before reachable routes during a flash update. For these unreachable announcements, the next hop is set to the local address on the connection, no metric is sent, and the path origin is set to incomplete. On external connections, the AS path in unreachable announcements is set to the local AS. On internal connections, the AS path length is set to zero.

Routing information shared between peers in BGP has two formats: announcements and withdrawals. A route announcement indicates that a router either learned of a new network attachment or made a policy decision to prefer another route to a network destination. Route withdrawals are sent when a router makes a new local decision that a network is no longer reachable.

BGP Multi-Exit Discriminator

Multi-exit Discriminator (MED) values are used to help external neighbors decide which of the available entry points into an AS are preferred. A lower MED value is preferred over a higher MED value and breaks the tie between two or more preferred paths.

Note - A BGP session does not accept MEDs from an external peer unless the Accept MED field is set for an external peer.
BGP Interactions with IGPs

All transit ASes must be able to carry traffic that originates from locations outside of that AS, is destined to locations outside of that AS, or both. This requires a certain degree of interaction and coordination between BGP and the Interior Gateway Protocol (IGP) that the particular AS uses. In general, traffic that originates outside of a given AS passes through both interior Gateways (Gateways that support the IGP only) and border Gateways (Gateways that support both the IGP and BGP). All interior Gateways receive information about external routes from one or more of the border Gateways of the AS that uses the IGP.

Depending on the mechanism used to propagate BGP information within a given AS, take special care to ensure consistency between BGP and the IGP, since changes in state are likely to propagate at different rates across the AS. A time window might occur between the moment when some border gateway \((A)\) receives new BGP routing information (which was originated from another border gateway \((B)\) within the same AS) and the moment the IGP within this AS can route transit traffic to the border gateway \((B)\). During that time window, either incorrect routing or black holes can occur.

To minimize such routing problems, border gateway \((A)\) should not advertise to any of its external peers a route to some set of exterior destinations associated with a given address prefix using border gateway \((B)\) until all the interior Gateways within the AS are ready to route traffic destined to these destinations by using the correct exit border gateway \((B)\). Interior routing should converge on the proper exit gateway before advertising routes that use the exit gateway to external peers.

If all routers in an AS are BGP speakers, no interaction is necessary between BGP and an IGP. In such cases, all routers in the AS already have full knowledge of all BGP routes. The IGP is then only used for routing within the AS, and no BGP routes are imported into the IGP. The user can perform a recursive lookup in the routing table. The first lookup uses a BGP route to establish the exit router, while the second lookup determines the IGP path to the exit router.

Inbound BGP Route Filters

BGP routes can be filtered, or redistributed by AS number or AS path regular expression, or both.

BGP stores rejected routes in the routing table with a negative preference. A negative preference prevents a route from becoming active and prevents it from being installed in the forwarding table or being redistributed to other protocols. This behavior eliminates the need to break and re-establish a session upon reconfiguration if importation policy is changed.

The only attribute that can add or modify when you import from BGP is the local preference. The local preference parameter assigns a BGP local preference to the imported route. The local preference is a 32-bit unsigned value, with larger values preferred. This is the preferred way to bias a routing subsystem preference for BGP routes.

Redistributing Routes to BGP

Redistributing to BGP is controlled by an AS. The same policy is applied to all firewalls in the AS. BGP metrics are 16-bit, unsigned quantities; that is, they range from 0 to 65535 inclusive, with zero being the most attractive. While BGP version 4 supports 32-bit unsigned quantities, routed does not.

Note - To define a redistribution policy, use routemaps in the CLI.
BGP Communities

BGP communities allow you to group a set of IP addresses and apply routing decisions based on the identity of the group or community.

To implement this feature, map a set of communities to certain BGP local preference values. Then you can apply a uniform BGP configuration to the community as a whole as opposed to each router within the community. The routers in the community can capture routes that match their community values.

Use community attributes to can configure your BGP speaker to set, append, or modify the community of a route that controls which routing information is accepted, preferred, or distributed to other neighbors. The following table displays some special community attributes that a BGP speaker can apply.

<table>
<thead>
<tr>
<th>Community attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO_EXPORT (0xFFFFFFFF01)</td>
<td>Not advertised outside a BGP confederation boundary. A stand-alone autonomous system that is not part of a confederation should be considered a confederation itself.</td>
</tr>
<tr>
<td>NO_ADVERTISE (0xFFFFFFFF02)</td>
<td>Not advertised to other BGP peers.</td>
</tr>
<tr>
<td>NO_EXPORT_SUBCONFED (0xFFFFFFFF03)</td>
<td>Not advertised to external BGP peers. This includes peers in other members’ autonomous systems inside a BGP confederation.</td>
</tr>
</tbody>
</table>

For more about communities, see RFCs 1997 and 1998.

Route Reflection

Generally, all border routers in a single AS need to be internal peers of each other; all nonborder routers frequently need to be internal peers of all border routers. While this configuration is usually acceptable in small networks, it can lead to unacceptably large internal peer groups in large networks. To help address this problem, BGP supports route reflection for internal and routing peer groups (BGP version 4).

When using route reflection, the rule that specifies that a router can not readvertise routes from internal peers to other internal peers is relaxed for some routers called route reflectors. A typical use of route reflection might involve a core backbone of fully meshed routers. This means that all the routers in the fully meshed group peer directly with all other routers in the group. Some of these routers act as route reflectors for routers that are not part of the core group.

Two types of route reflection are supported. By default, all routes received by the route reflector that originate from a client are sent to all internal peers (including the client group but not the client). If the no-client reflect option is enabled, routes received from a route reflection client are sent only to internal peers that are not members of the client group. In this case, the client group must be fully meshed. In either case, all routes received from a non-client internal peer are sent to all route reflection clients.
Typically, a single router acts as the reflector for a set, or cluster, of clients; for redundancy, two or more routers can also be configured to be reflectors for the same cluster. In this case, a cluster ID should be selected to identify all reflectors serving the cluster, using the cluster ID keyword.

**Best Practice** - Do not use multiple redundant reflectors, as they increase the memory required to store routes on the peers of redundant reflectors.

No special configuration is required on the route reflection clients. From a client perspective, a route reflector is a normal IBGP peer. Any BGP version 4 speaker should be able to be a reflector client.

For further details, refer to the route reflection specification document (RFC 2796 as of this writing).

AS1 has five BGP-speaking routers. With Router B working as a route reflector, there is no need to have all the routers connected in a full mesh.

### Confederations

An alternative to route reflection is BGP confederations. As with route reflectors, you can partition BGP speakers into clusters where each cluster is typically a topologically close set of routers. With confederations, this is accomplished by subdividing the autonomous system into multiple, smaller ASes that communicate among themselves. The internal topology is hidden from the outside world, which perceives the confederation to be one large AS.

Each distinct sub-AS within a confederation is referred to as a routing domain (RD). Routing domains are identified by using a routing domain identifier (RDI). The RDI has the same syntax as an AS number, but as it is not visible outside of the confederation, it does not need to be globally unique, although it does need to be unique within the confederation. Many confederations find it convenient to select their RDIs from the reserved AS space (ASes 64512 through 65535 [see RFC 1930]). RDIs are used as the ASes in BGP sessions between peers within the confederation.

The confederation as a whole, is referred to by a confederation identifier. This identifier is used as the AS in external BGP sessions. As far as the outside world is concerned, the confederation ID is the AS number of the single, large AS. For this reason, the confederation ID must be a globally unique, normally assigned AS number.

**Note** - Do not nest confederations.

For further details, refer to the confederations specification document (RFC 1965 as of this writing).

AS1 has seven BGP-speaking routers grouped under different routing domains: RDI A, RDI B, and RDI C. Instead of having a full-mesh connection among all seven routers, you can have a full-meshed connection within just one routing domain.
EBGP Multihop Support

Connections between BGP speakers of different ASes are referred to as EBGP connections. BGP enforces the rule that peer routers for EBGP connections need to be on a directly attached network. If the peer routers are multiple hops away from each other or if multiple links are between them, you can override this restriction by enabling the EBGP multihop feature. TCP connections between EBGP peers are tied to the addresses of the outgoing interfaces. Therefore, a single interface failure severs the session even if a viable path exists between the peers.

EBGP multihop support can provide redundancy so that an EBGP peer session persists even in the event of an interface failure. Using an address assigned to the loopback interface for the EBGP peering session ensures that the TCP connection stays up even if one of the links between them is down, provided the peer loopback address is reachable. In addition, you can use EBGP multihop support to balance the traffic among all links.

⚠️ Warning - Enabling multihop BGP connections is dangerous because BGP speakers might establish a BGP connection through a third-party AS. This can violate policy considerations and introduce forwarding loops.

Router A and Router B are connected by two parallel serial links. To provide fault tolerance and enable load-balance, enable EBGP multihop and using addresses on the loopback interface for the EBGP peering sessions.

BGP Route Dampening

Route dampening lessens the propagation of flapping routes. A flapping route is a route that repeatedly becomes available then unavailable. Without route dampening, autonomous systems continually send advertisement and withdrawal messages each time the flapping route becomes available or unavailable. As the Internet has grown, the number of announcements per second has grown as well and caused performance problems within the routers.

Route dampening enables routers to keep a history of the routes that are flapping and prevent them from consuming significant network bandwidth. This is achieved by measuring how often a given route becomes available and then unavailable. When a set threshold is reached, that route is no longer considered valid, and is no longer propagated for a given period of time, usually about 30 minutes. If a route continues to flap even after the threshold is reached, the time out period for that route grows in proportion to each additional flap. Once the threshold is reached, the route is dampened or suppressed. Suppressed routes are added back into the routing table once the penalty value is decreased and falls below the reuse threshold.

Route dampening can cause connectivity to appear to be lost to the outside world but maintained on your own network because route dampening is only applied to BGP routes. Because of increasing load on the backbone network routers, most NSPs (MCI, Sprint, UUNet etc.) have set up route suppression.

Note - BGP route dampening is supported only for EBGP. It is not supported for IBGP.
TCP MD5 Authentication

The Internet is vulnerable to attack through its routing protocols and BGP is no exception. External sources can disrupt communications between BGP peers by breaking their TCP connection with spoofed RST packets. Internal sources, such as BGP speakers, can inject bogus routing information from any other legitimate BGP speaker. Bogus information from either external or internal sources can affect routing behavior over a wide area in the Internet.

The TCP MD5 option allows BGP to protect itself against the introduction of spoofed TCP segments into the connection stream. To spoof a connection using MD5 signed sessions, the attacker not only has to guess TCP sequence numbers, but also the password included in the MD5 digest.

Configuring BGP - CLI (bgp)

**Syntax**

**Show Commands:**

```
show bgp
show bgp errors
show bgp groups
show bgp memory
show bgp paths
peer VALUE advertise
peer VALUE detailed
peer VALUE received
peers
detailed peers
detailed peers established
routemap
stats
summary
```
**set bgp internal peer VALUE Commands**

```
set bgp internal peer VALUE
  [ peer-type VALUE ] on
  accept-routes VALUE
  authtype md5 secret VALUE
  authtype none
  capability default
  capability ipv4-unicast VALUE
  graceful-restart-helper off
  graceful-restart-helper on
  graceful-restart-helper-stalepath-time VALUE
  holdtime VALUE
  ignore-first-ashop VALUE
  keepalive VALUE
  local-address VALUE off
  local-address VALUE on
  log-state-transitions VALUE
  log-warnings VALUE
  no-aggregator-id VALUE off
  outgoing-interface VALUE [ peer-type VALUE ] on
  passive-tcp VALUE
  route-refresh off
  route-refresh on
  send-keepalives VALUE
  send-route-refresh request all unicast
  send-route-refresh request ipv4 unicast
  send-route-refresh route-update all unicast
  send-route-refresh route-update ipv4 unicast
  throttle-count VALUE
  trace VALUE off
  trace VALUE on
  weight VALUE
```
Other Set Commands:

set bgp cluster-id VALUE
set bgp communities VALUE

set bgp confederation
  aspath-loops-permitted VALUE
  identifier VALUE

set bgp dampening
  keep-history VALUE
  max-flap VALUE
  off
  on
  reachable-decay VALUE
  reuseBelow VALUE
  suppress-above VALUE
  unreachable-decay VALUE

set bgp default-med VALUE
set bgp default-route-gateway VALUE

set bgp external remote-as VALUE
  description VALUE
  export-routemap VALUE off
  export-routemap VALUE preference VALUE [ family VALUE ] on
  import-routemap VALUE off
  import-routemap VALUE preference VALUE [ family VALUE ] on
  local-address VALUE off
  local-address VALUE on
  off
  on
  outdelay VALUE
  virtual-address VALUE

set bgp internal
  description VALUE
  export-routemap VALUE off
  export-routemap VALUE preference VALUE [ family VALUE ] on
  import-routemap VALUE off
  import-routemap VALUE preference VALUE [ family VALUE ] on
  interface VALUE off
  interface VALUE on
  local-address VALUE off
  local-address VALUE on
  med VALUE
  nexthop-self VALUE
  off
  on
  outdelay VALUE
  protocol VALUE off
  protocol VALUE on
  virtual-address VALUE

set bgp routing-domain
  aspath-loops-permitted VALUE
  identifier VALUE

set bgp synchronization VALUE
set bgp external remote-as VALUE peer VALUE

accept-med VALUE
accept-routes VALUE
aspath-prepend-count VALUE
auth-type md5 secret VALUE
auth-type none
capability default
capability ipv4-unicast VALUE
graceful-restart-helper off
graceful-restart-helper on
graceful-restart-helper-stalepath-time VALUE
holdtime VALUE
ignore-first-ashop VALUE
keepalive VALUE
local-address VALUE off
local-address VALUE on
log-state-transitions VALUE
log-warnings VALUE
med-out VALUE
multihop VALUE
no-aggregator-id VALUE
off
on
outgoing-interface VALUE on
passive-tcp VALUE
removeprivateas VALUE
route-refresh off
route-refresh on
send-keepalives VALUE
send-route-refresh request all unicast
send-route-refresh request ipv4 unicast
send-route-refresh route-update all unicast
send-route-refresh route-update ipv4 unicast
suppress-default-originate VALUE
throttle-count VALUE
trace VALUE off
trace VALUE on
ttl VALUE
BGP

When you do initial configuration, set the router ID. You can also use the following commands to change the router ID.

```
set  router-id default
set  router-id ip_address
```

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>default</td>
<td>Selects the highest interface address when OSPF is enabled.</td>
</tr>
</tbody>
</table>
| ip_address| The Router ID uniquely identifies the router in the autonomous system. The router ID is used by the BGP and OSPF protocols. We recommend setting the router ID rather than relying on the default setting. This prevents the router ID from changing if the interface used for the router ID goes down. Use an address on a loopback interface that is not the loopback address (127.0.0.1).  
  
  Note - In a cluster, you must select a router ID and make sure that it is the same on all cluster members.  
  
  - Range - Dotted-quad. 9[0-255].[0-255].[0-255]. Do not use 0.0.0.0  
  - Default - The interface address of one of the local interfaces. |

Use the following group of commands to set and view parameters for BGP.

```
set as as_number
set as off
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| as as_number| The local autonomous system number of the router. This number is mutually exclusive from the confederation and routing domain identifier. The router can be configured with either the autonomous system number or confederation number, not both.  
  
  Caution: When you change the autonomous system number, all current peer sessions are reset and all BGP routes are deleted. |
| as off      | Disables the configured local autonomous system number. |
External BGP

Use the following commands to configure external sessions of the protocol, that is, between routers in different autonomous systems.

```
set bgp external remote-as as_number
  <on | off>
  aspath-prepend-count <1-25 | default>
  description text
  local-address ip_address <on | off>
  outdelay <0-65535>
  outdelay off
```

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>as_number &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>aspath-prepend-count &lt;1-25</td>
<td>default&gt;</td>
</tr>
<tr>
<td>description text</td>
<td>You can enter a brief text description of the group.</td>
</tr>
<tr>
<td>local-address ip_address &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>outdelay &lt;0-65535&gt;</td>
<td>Specifies the amount of time in seconds that a route must be present in the routing database before it is redistributed to BGP. The configured value applies to all peers configured in this group. This feature dampens route fluctuation. The value zero (0) disables this feature. Default: 0</td>
</tr>
<tr>
<td>outdelay off</td>
<td>Disables outdelay.</td>
</tr>
</tbody>
</table>
BGP Peers

Use the following commands to configure BGP peers. Gaia Embedded supports IPv4 addresses for BGP peers.

```plaintext
set bgp external remote-as as_number peer ip_address
  <on | off>
  med-out <0-4294967294 | default>
  accept-med <on | off>
  multihop <on | off>
  no-aggregator-id <on | off>
  holdtime <6-65535 | default>
  keepalive <2-21845 | default>
  ignore-first-as-hop <on | off>
  send-keepalives <on | off>
  send-route-refresh [request | route-update][ipv4 All] [unicast]
  route-refresh <on | off>
  accept-routes <all | none>
  passive-tcp <on | off>
  removeprivateas <on | off>
  authtype none
  authtype md5 secret secret
  throttle-count <0-65535 | off>
  ttl <1-255 | default>
  suppress-default-originate <on | off>
  log-state-transitions <on | off>
  log-warnings <on | off>
  trace bgp_traceoption <on | off>
  capability <default | ipv4-unicast>
  graceful-restart-helper <on | off>
  graceful-restart-helper-stalepath-time seconds
```

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>med-out &lt;0-4294967294</td>
<td>default&gt;</td>
</tr>
<tr>
<td>accept-med &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>multihop &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>Argument</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>no-aggregator-id &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>holdtime &lt;6-65535</td>
<td>default&gt;</td>
</tr>
<tr>
<td>keepalive &lt;2-21945</td>
<td>default&gt;</td>
</tr>
<tr>
<td>ignore-first-ashop &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>send-keepalives &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>send-route-refresh [request</td>
<td>route-update] [ipv4</td>
</tr>
<tr>
<td>route-refresh &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>accept-routes &lt;all</td>
<td>none&gt;</td>
</tr>
<tr>
<td>Argument</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>passive-tcp &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>removeprivateas &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>authtype none</td>
<td>Specifies not to use an authentication scheme between peers. Using an authentication scheme guarantees that routing information is accepted only from trusted peers. none</td>
</tr>
<tr>
<td>authtype md5 secret secret</td>
<td>Specifies to use md5 authentication between peers. In general, peers must agree on the authentication configuration to and from peer adjacencies. Using an authentication scheme guarantees that routing information is accepted only from trusted peers.</td>
</tr>
<tr>
<td>throttle-count &lt;0-65535</td>
<td>off&gt;</td>
</tr>
<tr>
<td>ttl &lt;1-255</td>
<td>default&gt;</td>
</tr>
<tr>
<td>suppress-default-originate &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>log-state-transitions &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>log-warnings &lt;on</td>
<td>off&gt;</td>
</tr>
</tbody>
</table>
### Argument Description

**trace bgp_traceoption**

<on | off>

Specifies tracing options for your BGP implementation. Log messages are saved in the var/log/isprd directory. Enter the following words to set each trace option.

- packets—Trace all BGP packets to this peer.
- open—Trace all BGP open messages to this peer.
- update—Trace all BGP update messages to this peer.
- keepalive—Trace all keepalive messages to this peer.
- all—Trace all message types.
- general—Trace message related to Route and Normal.
- route—Trace routing table changes for routes installed by this peer.
- normal—Trace normal protocol occurrences. Abnormal protocol occurrences are always traced.
- state—Trace state machine transitions in the protocol.
- policy—Trace application of the protocol and user-specified policy to routes being imported and exported.

**capability <default | ipv4-unicast>**

Specifies capabilities setting. Only IPv4 unicast is supported.

**graceful-restart-helper**

<on | off>

Specifies whether the Check Point system should maintain the forwarding state advertised by peer routers even when they restart to minimize the negative effects caused by peer routers restarting.

**graceful-restart-helper -stalepath-time seconds**

Specifies the maximum amount of time that routes previously received from a restarting router are kept so that they can be revalidated. The timer is started after the peer sends an indication that it has recovered.

### BGP Confederation Commands

Use the following commands to configure BGP confederations. You can configure a BGP confederation in conjunction with external BGP.

```bash
set bgp
    confederation identifier as_number
    confederation identifier off
    confederation aspath-loops-permitted <1-10>
    confederation aspath-loops-permitted default
    routing-domain identifier as_number
    routing-domain identifier off
    routing-domain aspath-loops-permitted <1-10>
    routing-domain aspath-loops-permitted default
    synchronization <on | off>
```
<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>confederation identifier as_number</code></td>
<td>Specifies the identifier for the entire confederation. This identifier is used as the autonomous system number in external BGP sessions. Outside the confederation, the confederation id is the autonomous system number of a single, large autonomous system. Thus the confederation id must be a globally unique, typically assigned autonomous system number.</td>
</tr>
<tr>
<td><code>confederation identifier off</code></td>
<td>Disables the confederation identifier.</td>
</tr>
<tr>
<td><code>confederation aspath-loops permitted &lt;1-10&gt;</code></td>
<td>Specifies the number of times the local autonomous system can appear in an autonomous system path for BGP-learned routes. If this number is higher than the number of times the local autonomous system appears in an autonomous system path, the corresponding routes are discarded or rejected.</td>
</tr>
<tr>
<td><code>confederation aspath-loops-permitted default</code></td>
<td>Specifies a value of 1.</td>
</tr>
<tr>
<td><code>routing-domain identifier as_number</code></td>
<td>Specifies the routing domain identifier (RDI) for this router. You must specify the RDI if you are using BGP confederations. The RDI does not need to be globally unique since it is used only within the domain of the confederation.</td>
</tr>
<tr>
<td><code>routing-domain identifier off</code></td>
<td>Disables the routing-domain identifier</td>
</tr>
<tr>
<td><code>routing-domain aspath-loops-permitted &lt;1-10&gt;</code></td>
<td>Specifies the number of times the local autonomous system can appear in an autonomous system path for BGP-learned routes. If this number is higher than the number of times the local autonomous system appears in an autonomous system path, the corresponding routes are discarded or rejected.</td>
</tr>
<tr>
<td><code>routing-domain aspath-loops-permitted default</code></td>
<td>Specifies a value of 1.</td>
</tr>
<tr>
<td>`synchronization &lt;on</td>
<td>off&gt;`</td>
</tr>
</tbody>
</table>
### BGP Route Reflection Commands

Use these commands to configure BGP route reflection. You can configure route reflection as an alternative to BGP confederations. Route reflection supports both internal and external BGP routing groups.

```bash
set bgp
  internal peer <ip_address> peer-type reflector-client
  internal peer <ip_address> peer-type none
  internal peer <ip_address> peer-type no-client-reflector
  cluster-id ip_address
  cluster-id off
  default-med <0-65535>
  default-med off
  default-route-gateway ip_address
  default-route-gateway off
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>internal peer &lt;peer ip_address&gt; peer-type reflector-client</td>
<td>The peer router &lt;peer ip_address&gt; is a reflector client of the local router.</td>
</tr>
<tr>
<td>internal peer &lt;peer ip_address&gt; peer-type none</td>
<td>The peer router &lt;peer ip_address&gt; is not a reflector client of the local router. This is the default.</td>
</tr>
<tr>
<td>internal peer &lt;peer ip_address&gt; peer-type no-client-reflector</td>
<td>An advanced option.</td>
</tr>
<tr>
<td>cluster-id ip_address</td>
<td>The cluster ID used for route reflection. The cluster ID default is that of the router id. Override the default if the cluster has more than one route reflector</td>
</tr>
<tr>
<td>cluster-id off</td>
<td>Disable the cluster ID.</td>
</tr>
<tr>
<td>default-med &lt;0-65535&gt;</td>
<td>The multi-exit discriminator (MED) metric used to advertise routes through BGP.</td>
</tr>
<tr>
<td>default-med off</td>
<td>Disable the specified MED metric.</td>
</tr>
<tr>
<td>default-route-gateway ip_address</td>
<td>The default route. This route has a higher rank than any configured default static route for this router. If you do not want a BGP peer considered for generating the default route, use the peer &lt;ip_address&gt; suppress-default-originate on command.</td>
</tr>
<tr>
<td>default-route-gateway off</td>
<td>Disables the configured default BGP route.</td>
</tr>
</tbody>
</table>
BGP Route Dampening Commands

Use the following commands to configure BGP route dampening. BGP route dampening maintains a history of flapping routes and prevents advertising these routes. A route is considered to be flapping when it is repeatedly transitioning from available to unavailable or vice versa.

```
set bgp dampening
  <on | off>
  suppress-above <2-32>
  suppress-above default
  reuse below <1-32>
  reuse below default
  max-flat <3-64>
  max-flat default
  reachable-decay <1-900>
  reachable-decay default
  unreachable-decay <1-2700>
  unreachable-decay default
  keep-history <2-5400>
  keep-history default
```

**Note:** BGP route dampening is only supported for External BGP (EBGP).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>suppress-above &lt;2-32&gt;</td>
<td>Specifies the value of the instability metric at which route suppression takes place. A route is not installed in the forwarding table or announced even if it reachable during the period that it is suppressed.</td>
</tr>
<tr>
<td>suppress-above default</td>
<td>Specifies an instability metric value for suppressing routes of 3.</td>
</tr>
<tr>
<td>reuse below &lt;1-32&gt;</td>
<td>Specifies the value of the instability metric at which a suppressed route becomes unsuppressed if it is reachable but currently suppressed. The value assigned to the reuse-below metric must be lower than the suppress-above value.</td>
</tr>
<tr>
<td>reuse below default</td>
<td>Specifies an instability metric value for announcing previously suppressed routes of 2.</td>
</tr>
<tr>
<td>max-flat &lt;3-64&gt;</td>
<td>Specifies the upper limit of the instability metric. The value must be greater than the suppress-above value plus 1. Each time a route becomes unreachable, 1 is added to the current instability metric.</td>
</tr>
<tr>
<td>max-flat default</td>
<td>Specifies the upper limit of the instability metric as 16.</td>
</tr>
<tr>
<td>reachable-decay &lt;1-900&gt;</td>
<td>Specifies the time for the instability metric to reach half of its value when the route is reachable. The smaller the value the sooner a suppressed route becomes reusable.</td>
</tr>
<tr>
<td>reachable-decay default</td>
<td>Specifies a value of 300.</td>
</tr>
</tbody>
</table>
### Internal BGP

Use the following commands to configure internal BGP sessions, that is, between routers within the same autonomous system.

```
set bgp internal
  <on | off>
  description text
  med <0-65535>
  med default
  outdelay <0-65535>
  outdelay off
  nexthop-self <on | off>
  local-address ip_address <on | off>
  interface [all | if_name] <on | off>
  protocol [all | bgp_internal_protocol] <on | off>
  graceful-restart-helper <on | off>
  graceful-restart-helper-stalepath-time seconds
  route-refresh <on | off>

set bgp internal peer ip_address
  peer_type <on | off>
  weight <0-65535>
  weight off
  no-aggregator id <on | off>
  holdtime <6-65535>
  holdtime default
  keepalive <2-21845>
  keepalive default
  ignore-first-as-hop <on | off>
  send-keepalives <on | off>
  send-route-refresh [request | route-update] [unicast]
  accept-routes all
  accept-routes none
  passive-tcp <on | off>
  authtype none
  authtype md5 secret secret
  throttle-count <0-65535>
  throttle count off
  log-state-transitions <on | off>
  log-warnings <on | off>
  trace bgp_traceoption <on | off>
```
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>description text</td>
<td>You can enter a brief text description of the group.</td>
</tr>
<tr>
<td>med &lt;0-65535&gt;</td>
<td></td>
</tr>
<tr>
<td>med default</td>
<td></td>
</tr>
</tbody>
</table>
| outdelay <0-65535> | Specifies the amount of time in seconds that a route must be present in the routing database before it is redistributed to BGP. The configured value applies to all peers configured in this group. This feature dampens route fluctuation. Zero (0), which means that this feature is disabled.  
**Default:** 0 |
| outdelay off      | Disables outdelay. |
| nexthop-self <on | off>        | Specifies for this router to send one of its own IP addresses as the BGP next hop.  
**Default:** off |
| local-address     |             |
| ip_address <on | off>        | The address used on the local end of the TCP connection with the peer. For external peers that do not have multihop enabled, the local address must be on an interface that is shared with the peer or with the peer’s gateway when the gateway parameter is used. A session with an external peer is opened only when an interface with a local address through which the peer or gateway address is directly reachable is operating.  
For other types of peers, a peer session is maintained when any interface with the specified local address is operating. In either case, incoming connections are recognized as matching a configured peer only if they are addressed to the configured local address.  
**Note:** If running BGP in a cluster you must not configure the local address.  
**Default:** Off |
<p>| interface [all | if_name] &lt;on | off&gt;        | Specifies whether to enable the specified internal peer group on all interfaces or a specific interface. |
| protocol [all bgp_internal_protocol] &lt;on | off&gt;        | Specifies whether to enable all internal routing protocols on the specified internal peer group or specific internal protocols. You can enter the following specific internal protocols: direct, rip, static, ospf, and ospfase. |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>peer ip_address</strong></td>
<td>Specifies an internal peer address and peer type. Enter reflector-client to specify that the local router acts as a route reflector for the group of peers named. That is, the local router is the route reflection server, and the named peers are route reflection clients. Normally, the routing daemon readvertises, or reflects, routes it receives from one of its clients to all other IBGP peers, including the other peers in that client’s group. Enter no-client-reflector to specify that a reflection client’s routes are reflected only to internal BGP peers in other groups. Clients in the group are assumed to be direct IBGP peers of each other. Enter none if you do not want to specify route reflection.</td>
</tr>
<tr>
<td>peer_type &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td><strong>peer ip_address</strong></td>
<td>Specifies the weight associated with the specified peer. BGP implicitly stores any rejected routes by not mentioning them in a route filter. BGP explicitly mentions them within the routing table by using a restrict keyword with a negative weight. A negative weight prevents a route from becoming active, which prevents it from being installed in the forwarding table or exported to other protocols. This eliminates the need to break and reestablish a session upon reconfiguration if import route policy is changed.</td>
</tr>
<tr>
<td>weight &lt;0-65535&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>peer ip_address</strong></td>
<td>Specifies the router’s aggregate attribute as zero (rather than the router ID value). This option prevents different routers in an AS from creating aggregate routes with different AS paths.</td>
</tr>
<tr>
<td>aggregator id &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td><strong>peer ip_address</strong></td>
<td>Specifies the BGP holdtime interval, in seconds, when negotiating a connection with the specified peer. If the BGP speaker does not receive a keepalive update or notification message from its peer within the period specified in the holdtime field of the BGP open message, the BGP connection is closed.</td>
</tr>
<tr>
<td>holdtime &lt;6-65535&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>peer ip_address</strong></td>
<td>Specifies a holdtime of 180 seconds.</td>
</tr>
<tr>
<td>holdtime default</td>
<td></td>
</tr>
<tr>
<td><strong>peer ip_address</strong></td>
<td>The keepalive option is an alternative way to specify a holdtime value in seconds when negotiating a connection with the specified peer. You can use the keepalive interval instead of the holdtime interval. You can also use both interval, but the holdtime value must be 3 times the keepalive interval value.</td>
</tr>
<tr>
<td>keepalive &lt;2-21845&gt;</td>
<td></td>
</tr>
<tr>
<td><strong>peer ip_address</strong></td>
<td>Specifies a keepalive interval of 60 seconds.</td>
</tr>
<tr>
<td>ip_address_keepalive</td>
<td></td>
</tr>
<tr>
<td>default</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies to ignore the first autonomous system number in the autonomous system path for routes learned from the corresponding peer. Set this option only if you are peering with a route server in transparent mode, that is, when the route server is configured to redistribute routes from multiple other autonomous systems without prepending its own autonomous system number.</td>
</tr>
<tr>
<td>ignore-first-ashop</td>
<td></td>
</tr>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies for this router always to send keepalive messages even when an update message is sufficient. This option allows interoperability with routers that do not strictly adhere to protocol specifications regarding update.</td>
</tr>
<tr>
<td>send-keepalives</td>
<td></td>
</tr>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>send-route-refresh</td>
<td>Specifies that the router dynamically request BGP route updates from peers or respond to requests for BGP route updates.</td>
</tr>
<tr>
<td>[request</td>
<td>route-update] [unicast]</td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies an inbound BGP policy route if one is not already configured. Enter all to specify accepting routes and installing them with an invalid preference. Depending on the local inbound route policy, these routes are then made active or inactive.</td>
</tr>
<tr>
<td>accept-routes all</td>
<td></td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies an inbound BGP policy route if one is not already configured. Enter none to specify deleting routes learned from a peer. This option saves memory overhead when many routes are rejected because no inbound policy exists.</td>
</tr>
<tr>
<td>accept-routes none</td>
<td></td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies for the router to wait for the specified peer to issue an open message. No tcp connections are initiated by the router.</td>
</tr>
<tr>
<td>passive-tcp &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies not to use an authentication scheme between peers. Using an authentication scheme guarantees that routing information is accepted only from trusted peers.</td>
</tr>
<tr>
<td>authtype none</td>
<td></td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies to use md5 authentication between peers. In general, peers must agree on the authentication configuration to and from peer adjacencies. Using an authentication scheme guarantees that routing information is accepted only from trusted peers.</td>
</tr>
<tr>
<td>authtype md5 secret secret</td>
<td></td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies the number of BGP updates to send at one time. The throttle count option limits the number of BGP updates when there are many BGP peers.</td>
</tr>
<tr>
<td>throttle-count</td>
<td></td>
</tr>
<tr>
<td>&lt;0-65535&gt;</td>
<td></td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Enables the throttle count option.</td>
</tr>
<tr>
<td>throttle count off</td>
<td></td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies for the router to log a message whenever a peer enters or leave the established state.</td>
</tr>
<tr>
<td>log-state-transitions &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>peer ip_address</td>
<td>Specifies for the router to log a message whenever a warning scenario is encountered in the codepath.</td>
</tr>
<tr>
<td>log-warnings &lt;on</td>
<td>off&gt;</td>
</tr>
</tbody>
</table>
### BGP Check Point 600/700/1100/1200R/1400 Appliance Guide Advanced Routing

#### Parameter | Description
--- | ---
peer ip_address trace bgp_traceoption <on | off> | Specifies tracing options for your BGP implementation. Log messages are saved in the *var/log/routed* directory. Enter the following words to set each trace option. Enter packets to trace all BGP packets to this peer. Enter open to trace all the BGP open messages to this peer. Enter update to trace all the BGP update messages to this peer. Enter keepalive to trace all the keepalive messages to this peer. Enter all to trace all the message types. Enter general to trace message related to Route and Normal. Enter route to trace routing table changes for routes installed by this peer. Enter normal to trace normal protocol occurrences. Abnormal protocol occurrences are always traced. Enter state to trace state machine transitions in the protocol. Enter policy to trace application of the protocol and user-specified policy to routes being imported and exported.

graceful-restart-helper <on | off> | Specifies whether the Check Point system should maintain the forwarding state advertised by peer routers even when they restart to minimize the negative effects caused by peer routers restarting.

graceful-restart-helper-stalepath-time seconds | Specifies the maximum amount of time that routes previously received from a restarting router are kept so that they can be revalidated. The timer is started after the peer sends an indication that it has recovered.

route-refresh <on | off> | Re-learns routes previously sent by the BGP peer or refreshes the routing table of the peer. The peer responds to the message with the current routing table. Similarly, if a peer sends a route refresh request the current routing table is re-sent. A user can also trigger a route update without having to wait for a route refresh request from the peer.

### BGP Communities Commands

Use the following command to configure BGP communities. A BGP community is a group of destinations that share the same property. However, a community is not restricted to one network or autonomous system. Use communities to simplify the BGP inbound and route redistribution policies. Use the BGP communities commands together with inbound policy and route redistribution.

```
set bgp communities <on | off>
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
</tbody>
</table>
BGP Show Commands

Use the following commands to monitor and troubleshoot your BGP implementation.

```
show bgp
show bgp
groups
memory
errors
paths
stats
peers
peers detailed
peer ip_address detailed
peers established
peer ip_address advertise
peer ip_address received
summary
```
IGMP

In This Section:

Configuring IGMP - CLI (igmp)........................................................................................................34

Internet Group Management Protocol (IGMP) allows hosts on multiaccess networks to inform locally attached routers of their group membership information. Hosts share their group membership information by multicasting IGMP host membership reports. Multicast routers listen for these host membership reports, and then exchange this information with other multicast routers.

The group membership reporting protocol includes two types of messages: host membership query and host membership report. IGMP messages are encapsulated in IP datagrams, with an IP protocol number of 2. Protocol operation requires that a designated querier router be elected on each subnet and that it periodically multicast a host membership query to the all-hosts group.

Hosts respond to a query by generating host membership reports for each multicast group to which they belong. These reports are sent to the group being reported, which allows other active members on the subnet to cancel their reports. This behavior limits the number of reports generated to one for each active group on the subnet. This exchange allows the multicast routers to maintain a database of all active host groups on each of their attached subnets. A group is declared inactive (expired) when no report is received for several query intervals.

The IGMPv2 protocol adds a leave group message and uses an unused field in the IGMPv.1 host membership query message to specify a maximum response time. The leave group message allows a host to report when its membership in a multicast group terminates. Then, the IGMP querier router can send a group-directed query with a very small maximum response time to probe for any remaining active group members. This accelerated leave extension can reduce the time required to expire a group and prune the multicast distribution tree from minutes, down to several seconds.

The unicast traceroute program allows the tracing of a path from one device to another, using mechanisms that already exist in IP. Unfortunately, you cannot apply such mechanisms to IP multicast packets. The key mechanism for unicast traceroute is the ICMP TTL exceeded message that is specifically precluded as a response to multicast packets. The traceroute facility implemented within routed conforms to the traceroute facility for IP multicast draft specification.


Gaia Embedded supports these IGMP features:

- Multicast traceroute
- Configurability of protocol timers
- Support for interfaces with secondary addresses
Monitoring template using the WebUI, you can configure the following options:

- Version number
- Loss robustness
- Query interval
- Query response interval
- Last-member query interval

Additionally, you can enable and disable router alert.

Check Point supports IGMP in a gateway as part of the support for PIM. The support of IGMP ensures synchronization of IGMP state from master to members when a new member running PIM joins the cluster.

Configuring IGMP - CLI (igmp)

Use the IGMP commands to configure parameters for the internet group management protocol.

Configuring Interfaces for IGMP

Use these commands to configure IGMP for specific interfaces.

```
set igmp interface if_name
version <1 | 2 | 3>
last-member-query-interval <1-25>
last-member=query-interval default
loss-robustness <1-255>
loss-robustness default
query-interval <1-3600>
query-interval default
query-response-interval <1-25>
query-response-interval default
router-alert <on | off>
static-group address <on | off>
local-group address <on | off>
```

**Note** - IGMP version 2 runs by default.

In a gateway cluster, run commands on every cluster member. The configuration of each cluster member must be identical.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface if_name</td>
<td>The interface on which IGMP should be configured.</td>
</tr>
<tr>
<td>last-member-query-interval &lt;1-25&gt;</td>
<td>The maximum response time (in seconds) inserted into IGMP group-specific queries. You can use the last member query interval to tune the “leave latency.” A smaller value results in a reduction in the time to detect the loss of the last member of a multicast group. This value must always be less than the query interval.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>last-member-query-interval default</td>
<td>A value of 1.</td>
</tr>
</tbody>
</table>
| loss-robustness <1-255>           | Lets you tune the expected packet loss on a subnet. If you expect the subnet to be highly lossy, then you can increase the “loss robustness” value. IGMP protocol operation is robust to (lossrobustness – 1) packet loss.  
  - **Default**: 2 |
| loss-robustness default           | A value of 2.                                                                |
| query-interval <1-3600>           | The interval (in seconds) between IGMP general queries which the querier router sends. You can use this parameter to tune the IGMP messaging overhead and has a secondary effect on the timeout of idle IP multicast groups.  
  - **Default**: 125 |
| query-interval default            | A value of 125.                                                             |
| query-response-interval <1-25>    | The maximum response time (in seconds) inserted into the periodic IGMP general queries. You can use the query response interval to tune the burstiness of IGMP messages; a larger value spreads the host IGMP reports over a larger interval, which reduces burstiness. This value must always be less than the query interval.  
  - **Default**: 10. |
| router-alert <on | off>                        | Lets you disable the insertion of IP router alert in all IGMP messages sent on the interface. This can be useful with broken IP implementations that may discard the packet because of the use of this option.  
  - **Default**: off |
| local-group address <on | off>                        | A multicast group address. A local group provides a mechanism to simulate the presence of local receivers for specific groups. When a multicast group is added to an interface, IGMP sends a membership report on the interface. |
### IGMP

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>static-group address</td>
<td>• A multicast group address. A static group provides a mechanism to simulate the presence of local receivers on an interface. When a static group is configured on an interface that also runs a parent multicast protocol (such as PIM), IGMP informs the parent of the presence of a local receiver. In contrast to regular IGMP, no membership reports are sent on the corresponding interface. If the same multicast group is configured as both a local and a static group, local group takes precedence, that is, membership reports are sent out on the interface.</td>
</tr>
<tr>
<td>version &lt;1</td>
<td>2</td>
</tr>
</tbody>
</table>

### Monitoring IGMP (show igmp)

Use these commands to monitor and troubleshoot IGMP.

```bash
show igmp
  stats
  stats receive
  stats transmit
  stats error
  interfaces
  interfaces if_address
  groups [interface logical_interface] [local | static]
  group if_address
  if-stats
  if-stat if_address
  summary
```
CHAPTER 4
RIP

In This Section:

RIP 2 .............................................................................................................................. 37
RIP 1 .............................................................................................................................. 38
Configuring RIP - CLI (rip) ............................................................................................ 39

The Routing Information Protocol (RIP) is one of the oldest, and still widely used, interior gateway
protocols (IGP). RIP uses only the number of hops between nodes to determine the cost of a route
to a destination network and does not consider network congestion or link speed. Other
shortcomings of RIP are that it can create excessive network traffic if there are a large number of
routes and that it has a slow convergence time and is less secure than other IGPs, such as OSPF.

Routers using RIP broadcast their routing tables on a periodic basis to other routers, whether or
not the tables have changed. Each update contains paired values consisting of an IP network
address and a distance to that network. The distance is expressed as an integer, the hop count
metric. Directly connected networks have a metric of 1. Networks reachable through one other
router are two hops, and so on. The maximum number of hops in a RIP network is 15 and the
protocol treats anything equal to or greater than 16 as unreachable.

RIP 2

The RIP version 2 protocol adds capabilities to RIP. Some of the most notable RIP 2 enhancements
follow.

Network Mask

The RIP 1 protocol assumes that all subnetworks of a given network have the same network
mask. It uses this assumption to calculate the network masks for all routes received. This
assumption prevents subnets with different network masks from being included in RIP packets.
RIP 2 adds the ability to explicitly specify the network mask for each network in a packet.

Authentication

RIP 2 packets also can contain one of two types of authentication methods that can be used to
verify the validity of the supplied routing data.

The first method is a simple password in which an authentication key of up to 16 characters is
included in the packet. If this password does not match what is expected, the packet is discarded.
This method provides very little security, as it is possible to learn the authentication key by
watching RIP packets.

The second method uses the MD5 algorithm to create a crypto checksum of a RIP packet and an
authentication key of up to 16 characters. The transmitted packet does not contain the
authentication key itself; instead, it contains a crypto-checksum called the digest. The receiving
router performs a calculation using the correct authentication key and discards the packet if the
digest does not match. In addition, a sequence number is maintained to prevent the replay of older
packets. This method provides stronger assurance that routing data originated from a router with
a valid authentication key.
RIP 1

**Network Mask**

RIP 1 derives the network mask of received networks and hosts from the network mask of the interface from which the packet was received. If a received network or host is on the same natural network as the interface over which it was received, and that network is subnetted (the specified mask is more specific than the natural network mask), then the subnet mask is applied to the destination. If bits outside the mask are set, it is assumed to be a host; otherwise, it is assumed to be a subnet.

**Auto Summarization**

The Check Point implementation of RIP 1 supports auto summarization; this allows the router to aggregate and redistribute nonclassful routes in RIP 1.
Configuring RIP - CLI (rip)

**Description**
Use these commands to configure RIP properties for specific interfaces.

**Syntax**

**Set Commands:**

- `set rip auto-summary VALUE`
- `set rip expire-interval VALUE`
- `set rip export-routemap VALUE
   off
   preference VALUE on`
- `set rip import-routemap VALUE
   off
   preference VALUE on`
- `set rip interface VALUE
  [ version VALUE ] on
  accept-updates VALUE
  metric VALUE
  off
  send-updates VALUE
  transport VALUE
  virtual-address VALUE`
- `set rip interface VALUE authtype
  md5 secret VALUE [ cisco-compatibility VALUE ]
  none
  simple VALUE`
- `set rip update-interval VALUE`

**Show Commands:**

- `show rip`
- `show rip
  errors`
- `show rip
  interface VALUE`
- `show rip
  interfaces`
- `show rip
  neighbors`
- `show rip
  packets`
- `show rip
  routemap`
- `show rip
  summary`

Use this group of commands to set and view parameters for RIP.

**Note** - Gaia Embedded does not have CLI commands for route filtering and redistribution. You must configure inbound routing policies and redistribution of routes through the WebUI. You can configure route maps and route aggregation using CLI commands. Route map configuration done through the CLI takes precedence over route filtering and redistribution configured in the WebUI. For example, if RIP uses route maps for inbound filtering, anything configured on the page for inbound route filters for RIP is ignored. You can still use the WebUI to configure route redistribution into RIP.
RIP Interface Commands

Use these commands to configure RIP properties that apply to a RIP interface.

```
set rip interface if_name
  <off | on>
  version <1 | 2> on
  metric <0-16>
  metric default
  accept-updates <on | off>
  send-updates <on | off>
  transport <multicast | broadcast>
  authtype none
  authtype simple password
  authtype md5 secret secret [cisco-compatibility] <on | off>
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>`interface if_name &lt;off</td>
<td>on&gt;`</td>
</tr>
<tr>
<td><strong>Default</strong>: off</td>
<td></td>
</tr>
<tr>
<td>`&lt;1</td>
<td>2&gt;`</td>
</tr>
<tr>
<td><strong>Default</strong>: 1</td>
<td></td>
</tr>
<tr>
<td><code>metric &lt;0-16&gt;</code></td>
<td>The RIP metric to be added to routes that are sent using the specified interface(s). The default is zero. This is used to make other routers prefer other sources of RIP routes over this router.</td>
</tr>
<tr>
<td><code>metric default</code></td>
<td>A value of 0.</td>
</tr>
<tr>
<td>`accept-updates &lt;on</td>
<td>off&gt;`</td>
</tr>
<tr>
<td><strong>Default</strong>: off</td>
<td></td>
</tr>
<tr>
<td>`send-updates &lt;on</td>
<td>off&gt;`</td>
</tr>
<tr>
<td>`transport &lt;multicast</td>
<td>broadcast&gt;`</td>
</tr>
<tr>
<td><strong>Note</strong>: When you use RIP 2, always select multicast. We recommend that you do not operate RIP 1 and RIP 2 together.</td>
<td></td>
</tr>
<tr>
<td><code>authtype none</code></td>
<td>There is no authentication scheme for the interface to accept routing information from neighboring routers. This option applies to rip version 2 only. In general, routers on a given link must agree on the authentication configuration in order to form neighbor adjacencies. This is used to guarantee that routing information is accepted only from trusted routers.</td>
</tr>
</tbody>
</table>
### Parameter

#### authtype simple password
Implement a simple authentication scheme for the interface to accept routing information from neighboring routers. Enter the Simple Password, from 1 to 16 characters. Must contain alphanumeric characters only. This option applies to RIP version 2 only.

#### authtype md5 secret secret
Implement an authentication scheme that uses an MD5 algorithm for the interface to accept routing information from neighboring routers. Enter the password.

#### cisco-compatibility <on | off>
To ensure interoperability with Cisco routers running RIP MD5 authentication, enable Cisco Compatibility. By default, RIP MD5 is set to conform to the Check Point standard, and not for Cisco compatibility.

**Default**: off

### RIP Global Commands

Use these commands to configure RIP properties that apply to all interfaces configured for RIP.

```
set rip
  auto-summary <on | off>
  update-interval <1-65535>
  update-interval default
  expire-interval <1-65535>
  expire-interval default
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>auto-summary &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong> - Take care when you set this parameter, as RIP has no protocol mechanism to detect misconfiguration.</td>
</tr>
<tr>
<td></td>
<td><strong>Default</strong>: on</td>
</tr>
<tr>
<td>update-interval &lt;1-65535&gt;</td>
<td>The amount of time, in seconds, between regularly scheduled RIP updates. To prevent synchronization of periodic updates, RIP updates are actually sent at a time from the uniform distribution on the interval ([0.5T, 1.5T]) where (T) corresponds to the Update Interval value.</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong> - Take care when you set this parameter, as RIP has no protocol mechanism to detect misconfiguration.</td>
</tr>
<tr>
<td>update-interval default</td>
<td>A value of 30 seconds.</td>
</tr>
</tbody>
</table>

---

Check Point 600/700/1100/1200R/1400 Appliance Guide Advanced Routing | 41
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>expire-interval</td>
<td>The amount of time, in seconds, that must pass without receiving an update for a given route before the route is considered to have timed out. This value should be 6 times the update interval in order to allow for the possibility that packets containing an update could be dropped by the network.</td>
</tr>
<tr>
<td>default</td>
<td>A value of 180 seconds.</td>
</tr>
</tbody>
</table>

**RIP Show Commands**

Use these commands to monitor and troubleshoot RIP.

`show rip`

`show rip interfaces interface <if_name>`

`packets`  

`errors`  

`neighbors`  

`summary`
OSPF

In This Section:

Types of Areas ............................................................................................................... 43
Area Border Routers .................................................................................................... 44
High Availability Support for OSPF .............................................................................. 45
Configuring OSPF - CLI (ospf) ...................................................................................... 45

Open Shortest Path First (OSPF) is an interior gateway protocol (IGP) used to exchange routing
information between routers within a single autonomous system (AS). OSPF calculates the best
path based on true costs using a metric assigned by a network administrator. RIP, the oldest IGP
protocol chooses the least-cost path based on hop count. OSPF is more efficient than RIP, has a
quicker convergence, and provides equal-cost multipath routing where packets to a single
destination can be sent using more than one interface. OSPF is suitable for complex networks
with a large number of routers. It can coexist with RIP on a network.

Gaia Embedded supports OSPFv2, which supports IPv4 addressing.

You can run OSPF over a route-based VPN by enabling OSPF on a virtual tunnel interface (VTI).

Types of Areas

Routers using OSPF send packets called Link State Advertisements (LSA) to all routers in an area.
Areas are smaller groups within the AS that you can design to limit the flooding of an LSA to all
routers. LSAs do not leave the area from which they originated, thus increasing efficiency and
saving network bandwidth.

You must specify at least one area in your OSPF network—the backbone area, which has the
responsibility to propagate information between areas. The backbone area has the identifier
0.0.0.0.

You can designate other areas, depending on your network design, of the following types:

- **Normal Area** — Allows all LSAs to pass through. The backbone is always a normal area.

- **Stub Area** — Stub areas do not allow Type 5 LSAs to be propagated into or throughout the area
  and instead depend on default routing to external destinations. You can configure an area as a
  stub to reduce the number of entries in the routing table [routes external to the OSPF domain
  are not added to the routing table].

- **NSSA (Not So Stubby Area)** — Allows the import of external routes in a limited fashion using
  Type-7 LSAs. NSSA border routers translate selected Type 7 LSAs into Type 5 LSAs which can
  then be flooded to all Type-5 capable areas. Configure an area as an NSSA if you want to
  reduce the size of the routing table, but still want to allow routes that are redistributed to
  OSPF.

**Best Practice** - It is generally recommended that you limit OSPF areas to about 50 routers based
on the limitations of OSPF (traffic overhead, table size, convergence, and so on).

All OSPF areas must be connected to the backbone area. If you have an area that is not connected
to the backbone area, you can connect it by configuring a virtual link, enabling the backbone area
to appear contiguous despite the physical reality.
Note - If you need to connect two networks that both already have backbone areas and you do not want to reconfigure one to something other than 0.0.0.0, you can connect the two backbone areas using a virtual link.

Each router records information about its interfaces when it initializes and builds an LSA packet. The LSA contains a list of all recently seen routers and their costs. The LSA is forwarded only within the area it originated in and is flooded to all other routers in the area. The information is stored in the link-state database, which is identical on all routers in the AS.

Area Border Routers

Routers called Area Border Routers (ABR) have interfaces to multiple areas. ABRs compact the topological information for an area and transmit it to the backbone area. Check Point supports the implementation of ABR behavior as outlined in the Internet draft of the Internet Engineering Task Force (IETF). The definition of an ABR in the OSPF specification as outlined in RFC 2328 does not require a router with multiple attached areas to have a backbone connection. However, under this definition, any traffic destined for areas that are not connected to an ABR or that are outside the OSPF domain is dropped. According to the Internet draft, a router is considered to be an ABR if it has more than one area actively attached and one of them is the backbone area. An area is considered actively attached if the router has at least one interface in that area that is not down.

Rather than redefine an ABR, the Check Point implementation includes in its routing calculation summary LSAs from all actively attached areas if the ABR does not have an active backbone connection, which means that the backbone is actively attached and includes at least one fully adjacent neighbor. You do not need to configure this feature; it functions automatically under certain topographies.

OSPF uses the following types of routes:

- **Intra-area**—Have destinations within the same area.
- **Interarea**—Have destinations in other OSPF areas.
- **Autonomous system external (ASE)**—Have destinations external to the autonomous system (AS). These are the routes calculated from Type 5 LSAs.
- **NSSA ASE Router**—Have destinations external to AS. These are the routes calculated from Type 7 LSAs.

All routers on a link must agree on the configuration parameters of the link. All routers in an area must agree on the configuration parameters of the area. A separate copy of the SPF algorithm is run for each area. Misconfigurations prevent adjacencies from forming between neighbors, and routing black holes or loops can form.
High Availability Support for OSPF

Gaia Embedded supports the OSPF protocol in clusters configured via ClusterXL.

In this configuration, the cluster becomes a Virtual Router, which is seen by neighboring routers as a single router that has an IP address that is the same as the virtual IP address of the cluster. Each member of the cluster runs the OSPF task, but only the member which is designated as primary or master actively participates in the network and exchanges routing information with neighbor routers. When a failover occurs, the standby member of the cluster becomes the master and its OSPF task becomes the active participant in protocol exchanges with neighbor routers.

Gaia Embedded also supports the OSPF protocol over VPN tunnels which terminate in the ClusterXL cluster.

ClusterXL

Gaia Embedded ClusterXL advertises the virtual IP address of the ClusterXL Virtual Router. The OSPF routes database of the master is synchronized across all members of the cluster. The OSPF task of each standby member obtains routing state and information from the master and installs the routes in the kernel as the master does. On a failover, one of the standby members becomes the new master and then continues where the old master failed. During the time that the new master resynchronizes routes database with the neighbor routers, traffic forwarding continues using the old kernel routes until OSPF routes are fully synchronized and pushed into the kernel.

Configuring OSPF - CLI (ospf)

Use the following group of commands to set and view parameters for OSPF. This syntax is shown below for each set of commands.

Note - Gaia Embedded does not have CLI commands for route filtering and redistribution. You must configure inbound routing policies and redistribution of routes through the WebUI. You can configure route maps and route aggregation using CLI commands. Route map configuration done through the CLI takes precedence over route filtering and redistribution configured in the WebUI. For example if OSPF uses route maps for inbound filtering, anything configured on the WebUI page for inbound route filters for OSPF is ignored. You can still use the WebUI to configure route redistribution into OSPF.
When you do initial configuration, set the router ID. You can also use the following commands to change the router ID.

```bash
set router-id
default
ip_address
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>router-id default</td>
<td>Selects the highest interface address when OSPF is enabled.</td>
</tr>
<tr>
<td>router-id ip_address</td>
<td>Specifies a specific IP address to assign as the router ID. Do not use 0.0.0.0 as the router ID address. Check Point recommends setting the router ID rather than relying on the default setting. Setting the router ID prevents the ID from changing if the default interface used for the router ID goes down. The Router ID uniquely identifies the router in the autonomous system. The router ID is used by the BGP and OSPF protocols. We recommend setting the router ID rather than relying on the default setting. This prevents the router ID from changing if the interface used for the router ID goes down. Use an address on a loopback interface that is not the loopback address (127.0.0.1).</td>
</tr>
</tbody>
</table>

Note - In a cluster, you must select a router ID and make sure that it is the same on all cluster members.

- **Range:** Dotted-quad.([0-255].[0-255].[0-255].[0-255]). Do not use 0.0.0.0
- **Default:** The interface address of one of the local interfaces.

**OSPF Global Settings**

Use the following commands to configure setting that apply to all configured OSPF areas, including the backbone and stub areas.

For OSPFv2 use the following commands:

```bash
set ospf
rfc1583-compatibility <on | off>
spf-delay <1-60>
spf-delay default
spf-holdtime <1-60>
spf-holdtime default
default-ase-cost <1-677215>
default-ase-type <1 | 2>
graceful-restart-helper <on | off>
```
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rfc1583-compatibility</td>
<td>The Check Point implementation of OSPF is based on RFC 2178, which fixed some looping problems in an earlier specification of OSPF. If your implementation runs in an environment with OSPF implementations based on RFC 1583 or earlier, enable this option, which is on by default. Setting compatibility with RFC 1583 ensures backward compatibility.</td>
</tr>
<tr>
<td>on</td>
<td></td>
</tr>
<tr>
<td>spf-delay &lt;1-60&gt;</td>
<td>Specifies the time, in seconds, to wait before recalculating the OSPF routing table after a change in the topology.</td>
</tr>
<tr>
<td>spf-delay default</td>
<td>Specifies an spf-delay time of 2 seconds.</td>
</tr>
<tr>
<td>spf-holdtime &lt;1-60&gt;</td>
<td>Specifies the minimum time, in seconds, between recalculations of the OSPF routing table.</td>
</tr>
<tr>
<td>spf-holdtime default</td>
<td>Specifies an spf-holdtime of 5 seconds.</td>
</tr>
<tr>
<td>default-ase-cost &lt;1-6777215&gt;</td>
<td>Specifies the cost assigned to routes from other protocols that are redistributed into OSPF as autonomous systems external. If the route has a cost already specified, that cost takes precedent.</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>default-ase-type &lt;1</td>
<td>2&gt;</td>
</tr>
<tr>
<td>1</td>
<td>Specifies the type assigned to routes from other protocols that are redistributed into OSPF as autonomous systems external. If the route has a type already specified, that type takes precedent.</td>
</tr>
<tr>
<td>graceful-restart-helper</td>
<td>Specifies whether the Check Point system should maintain the forwarding state advertised by peer routers even when they restart to minimize the negative effects caused by peer routers restarting.</td>
</tr>
</tbody>
</table>
**OSPF Interfaces**

Use the following commands to configure a backbone and other areas, such as stub areas, for specified interfaces.

For OSPFv2 use the following commands:

```plaintext
set ospf
   area <backbone | ospf_area> range ip_prefix <on | off>
   area <backbone | ospf_area> range ip_prefix restrict <on | off>
   stub-network ip_prefix <on | off>
   stub-network ip_prefix stub-network-cost <1-677722>

set ospf interface if_name
   area <backbone | ospf_area> <on | off>
   hello-interval <1-65535>
   hello-interval default
   dead-interval <1-65535>
   dead-interval default
   retransmit-interval <1-65535>
   retransmit-interval default
   cost <1-65535>
   priority <0-255>
   passive <on | off>
   authtype none
   simple password
   md5 key authorization key id secret md5 secret
   md5 key authorization key id
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>area &lt;backbone</td>
<td>ospf_area&gt; range ip_prefix &lt;on</td>
</tr>
<tr>
<td>area &lt;backbone</td>
<td>ospf_area&gt; range ip_prefix restrict &lt;on</td>
</tr>
</tbody>
</table>
### OSPF

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>stub-network</td>
<td>Specifies a stub network to which the specified interface range belongs. Configure a stub network to advertise reachability to prefixes that are not running OSPF. The advertised prefix appears as an OSPF internal route and is filtered at area borders with the OSPF area ranges. The prefix must be directly reachable on the router where the stub network is configured, that is, one of the router’s interface addresses must fall within the prefix range to be included in the router-link-state advertisement. Use a mask length of 32 to configure the stub host. The local address of a point-to-point interface can activate the advertised prefix and mask. To advertise reachability to such an address, enter an IP address for the prefix and a non-zero cost for the prefix.</td>
</tr>
<tr>
<td>ip_prefix &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>stub-network</td>
<td>Configure a stub network to advertise reachability to prefixes that are not running OSPF. The advertised prefix appears as an OSPF internal route and is filtered at area borders with the OSPF area ranges. The prefix must be directly reachable on the router where the stub network is configured, that is, one of the router’s interface addresses must fall within the prefix range to be included in the router-link-state advertisement. Use a mask length of 32 to configure the stub host. The local address of a point-to-point interface can activate the advertised prefix and mask. To advertise reachability to such an address, enter an IP address for the prefix and a non-zero cost for the prefix.</td>
</tr>
<tr>
<td>ip_prefix</td>
<td></td>
</tr>
<tr>
<td>stub-network-cost &lt;1-677722&gt;</td>
<td></td>
</tr>
<tr>
<td>interface if_name area</td>
<td>Specifies the OSPF area to which the specified interface belongs.</td>
</tr>
<tr>
<td>&lt;backbone</td>
<td>ospf area&gt; &lt;on</td>
</tr>
<tr>
<td>interface if_name hello-interval</td>
<td>Specifies the interval, in seconds, between hello packets that the router sends on the specified interface. For a given link, this value must be the same on all routers or adjacencies do not form.</td>
</tr>
<tr>
<td>&lt;1-65535&gt;</td>
<td></td>
</tr>
<tr>
<td>interface if_name hello-interval default</td>
<td>Specifies the default value for the hello interval, which is 10 seconds.</td>
</tr>
<tr>
<td>interface if_name dead-interval</td>
<td>Specifies the number of seconds after which a router stops receiving hello packets that it declares the peer down. Generally, you should set this value at 4 times the value of the hello interval. Do not set the value at 0. For a given link, this value must be the same on all routers or adjacencies do not form.</td>
</tr>
<tr>
<td>&lt;1-65535&gt;</td>
<td></td>
</tr>
<tr>
<td>interface if_name dead-interval default</td>
<td>Specifies the default value for the dead interval, which is 40 seconds</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><code>interface if_name</code></td>
<td>Specifies the number of seconds between link state advertisement transmissions for adjacencies belonging to the specified interface. This value also applies to database description and link state request packets. Set this value conservatively, that is, at a significantly higher value than the expected round-trip delay between any two routers on the attached network.</td>
</tr>
<tr>
<td><code>retransmit-interval</code></td>
<td>Specifies the default for the retransmit interval, which is 5 seconds.</td>
</tr>
<tr>
<td><code>default</code></td>
<td>Specifies the weight of the given path in a route. The higher the cost, the less preferred the link. To use one interface over another for routing paths, assign one a higher cost.</td>
</tr>
<tr>
<td><code>interface if_name</code></td>
<td>Specifies the priority for becoming the designated router (DR) on the specified link. When two routers attached to a network attempt to become a designated router, the one with the highest priority wins. This option prevents the DR from changing too often. The DR option applies only to a share-media interface, such as Ethernet or FDDI; a DR is not elected on a point-to-point type interface. A router with a priority of 0 is not eligible to become the DR.</td>
</tr>
<tr>
<td><code>priority</code></td>
<td>Enabling this option puts the specified interface into passive mode; that is, hello packets are not sent from the interface. Putting an interface into passive mode means that no adjacencies are formed on the link. This mode enables the network associated with the specified interface to be included in intra-area route calculation rather than redistributing the network into OSPF and having it function as an autonomous system external. <strong>Default:</strong> off</td>
</tr>
<tr>
<td><code>interface if_name</code></td>
<td>Specifies not to use an authentication scheme for the specified interface.</td>
</tr>
<tr>
<td><code>authtype none</code></td>
<td>Specifies to use simple authentication for the specified interface. Enter an ASCII string that is 8 characters long. Generally, routers on a given link must agree on the authentication configuration to form peer adjacencies. Use an authentication scheme to guarantee that routing information is accepted only from trusted peers.</td>
</tr>
<tr>
<td><code>authtype md5 key authorization key id secret md5 secret</code></td>
<td>Specifies to use MD5 authorization. Enter at least one key ID and its corresponding MD5 secret. If you configure multiple key IDs, the largest key ID is used for authenticating outgoing packets. All keys can be used to authenticate incoming packets. Generally, routers on a given link must agree on the authentication configuration to form peer adjacencies. Use an authentication scheme to guarantee that routing information is accepted only from trusted peers.</td>
</tr>
</tbody>
</table>
**OSPF Virtual Links**

Use the following commands to configure OSPF virtual links. Configure a virtual link if the router is a border router that does not have interfaces in the backbone area. The virtual link is effectively a tunnel across an adjacent non-backbone area whose endpoint must be any of the adjacent area's border routers that has an interface in the backbone area.

For OSPFv2 use the following commands:

```
set ospf area backbone virtual-link ip_address transit-area ospf_area
  <on | off>
  transit-area ospf_area hello-interval <1-65535>
  transit-area ospf_area hello-interval default
  transit-area ospf_area dead interval <1-4294967295>
  transit-area ospf_area dead interval default
  transit-area ospf_area retransmit-interval <1-4294967295>
  transit-area ospf_area retransmit-interval default
  transit-area ospf_area authtype none
  transit-area ospf_area authtype simple password
  transit-area ospf_area authtype md5 key authorization key id secret md5 key
  transit-area ospf_area authtype md5 key authorization key id off
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ip_address transit-area ospf_area</td>
<td>Specifies the IP address of the remote endpoint of the virtual link and transit area, which is a specified ospf area you configure using the set ospf area command. Configure the ospf area you are using as the transit area before you configure the virtual link. The transit area is the area shared by the border router on which you configure the virtual link and the router with an interface in the backbone area. Traffic between the endpoints of the virtual link flow through this area. The virtual link IP address functions as the router ID of the remote endpoint of the virtual link.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area hello-interval</td>
<td>Specifies the interval, in seconds, between hello packets that the router sends on the specified interface. For a given link, this value must be the same on all routers or adjacencies do not form.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area hello-interval default</td>
<td>Specifies an interval of 10 seconds.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area dead-interval</td>
<td>Specifies the number of seconds after which a router stops receiving hello packets that it declares the neighbor down. Generally, you should set this value at 4 times the value of the hello interval. Do not set the value at 0. For a given link, this value must be the same on all routers or adjacencies do not form.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area dead-interval default</td>
<td>Specifies a value of 40 seconds.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area retransmit-interval 1-4294967295</td>
<td>Specifies the number of seconds between link state advertisement transmissions for adjacencies belonging to the specified interface. This value also applies to database description and link state request packets. Set this value conservatively, that is, at a significantly higher value than the expected round-trip delay between any two routers on the attached network.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area retransmit-interval default</td>
<td>Specifies a value of 5 seconds.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area authtype none</td>
<td>Specifies not to use an authentication scheme for the specified interface.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area authtype simple password</td>
<td>Specifies to use simple authentication for the specified interface. Enter an ASCII string that is 8 characters long. Generally, routers on a given link must agree on the authentication configuration to form neighbor adjacencies. Use an authentication scheme to guarantee that routing information is accepted only from trusted peers.</td>
</tr>
<tr>
<td>ip_address transit-area ospf_area authtype md5 key authorization key id secret MD5 secret</td>
<td>Specifies to use MD5 authorization. Enter at least one key ID and its corresponding MD5 secret. If you configure multiple key IDs, the largest key ID is used for authenticating outgoing packets. All keys can be used to authenticate incoming packets. Generally, routers on a given link must agree on the authentication configuration to form neighbor adjacencies. Use an authentication scheme to guarantee that routing information is accepted only from trusted peers.</td>
</tr>
</tbody>
</table>
OSPF Areas

Use the following commands to configure OSPF areas, including the backbone and stub areas.

For OSPFv2, use the following commands.

```
set [instance instance_name] ospf area backbone <on | off>
set ospf area ospf_area
  <on| off>
  stub <on | off>
  stub default-cost <1-677215>
  stub summary <on | off>
  nssa <on | off>
  nssa default-cost <1-677215>
  nssa default-metric-type <1-2>
  nssa import-summary-routes <on | off>
  nssa translator-role <always | candidate>
  nssa translator-stability-interval <1-65535>
  nssa redistribution <on |off>
  nssa range ip_addr [restrict] <on | off>
```

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>backbone &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>stub &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>stub default-cost &lt;1-677215&gt;</td>
<td>Specifies a default route into the stub area with the specified cost.</td>
</tr>
<tr>
<td>stub summary &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>nssa &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>nssa default-cost &lt;1-677215&gt;</td>
<td>Specifies the cost associated with the default route to the NSSA.</td>
</tr>
<tr>
<td>Argument</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>nssa default-metric-type &lt;1-2&gt;</td>
<td>Specifies the type of metric. The default, type 1, is equivalent to the <em>Default ASE Route Type</em> on the OSPF Voyager page. A type 1 route is internal and its metric can be used directly by OSPF for comparison. A type 2 route is external and its metric cannot be used for comparison directly.</td>
</tr>
<tr>
<td>nssa import-summary-routes &lt;on</td>
<td>Specifies if summary routes (summary link advertisements) are imported into the NSSA.</td>
</tr>
<tr>
<td>nssa translator-role &lt;always</td>
<td>Specifies whether this NSSA border router will unconditionally translate Type-7 LSAs into Type-5 LSAs. When role is Always, Type-7 LSAs are translated into Type-5 LSAs regardless of the translator state of other NSSA border routers. When role is Candidate, this router participates in the translator election to determine if it will perform the translations duties.</td>
</tr>
<tr>
<td>nssa translator-stability-interval &lt;1-65535&gt;</td>
<td>Specifies how long in seconds this elected Type-7 translator will continue to perform its translator duties once it has determined that its translator status has been assumed by another NSSA border router. Default: 40 seconds.</td>
</tr>
<tr>
<td>nssa redistribution &lt;on</td>
<td>Specifies if both Type-5 and Type-7 LSAs or only Type-7 LSAs will be originated by this NSSA border router.</td>
</tr>
<tr>
<td>nssa range ip_addr [restrict] &lt;on</td>
<td>Specify the range of addresses to reduce the number of Type-5 LSAs for the NSSA border router. To prevent a specific prefix from being advertised, use the restrict argument.</td>
</tr>
<tr>
<td></td>
<td>off&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OSPF
OSPF Show Commands

Use the following commands to monitor and troubleshoot your OSPF implementation.

To view a summary of your OSPF implementation, including the number of areas configured and the number of interfaces configured within each area, use:

- For OSPFv2: `show ospf`

For OSPFv2 use the following commands:

```
show ospf
neighbors
neighbor ip_address
interfaces
interfaces stats
interfaces detailed
interface ifname
interface ifname stats
interface ifname detailed
packets
errors
errors dd
errors hello
errors ip
errors lsack
errors lsr
errors lsu
errors protocol
events
border-routers
database
database areas
database area ospf_area
database asbr-summary-lsa
database checksum
database database-summary
database detailed
database external-lsa
database network-lsa
database router-lsa
database summary-lsa
database type <1 | 2 | 3 | 4 | 5 | 7> [detailed]
database nssa-external-lsa [detailed]
summary
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>neighbors</td>
<td>Displays the IP addresses of neighboring interfaces, their priority and status, and the number of errors logged for each interface.</td>
</tr>
<tr>
<td>neighbor ip_address</td>
<td>Displays the priority, status, and number of errors logged for the specified IP address.</td>
</tr>
<tr>
<td>interfaces</td>
<td>Displays the names of all configured logical interfaces, their corresponding IP addresses, to area to which each interface is assigned, each interface’s status and the IP addresses of each logical interface’s designated router and backup designated router.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>interfaces stats</td>
<td>Displays the number of each type of error message logged for each OSPF interface as well as the number of link state advertisements sent by each interface.</td>
</tr>
<tr>
<td>interfaces detailed</td>
<td>Displays detailed information about each OSPF interface, including the authentication type configured if any, the router IDs and IP addresses of the designated router and backup designated router, the timer intervals configured for hello wait, dead, and retransmit messages, and the number of neighbors for each interface.</td>
</tr>
<tr>
<td>interface if_name stats</td>
<td>Displays the number of each type of error message logged by the specified interface as well as the number of link-state advertisements sent by the specified interface.</td>
</tr>
<tr>
<td>interface if_name detailed</td>
<td>Displays detailed information about the specified interface, including the authentication type configured if any, the router IDs and IP addresses of the designated router and backup designated router, the timer intervals configured for hello wait, dead, and retransmit messages, and the number of neighbors for each interface.</td>
</tr>
<tr>
<td>packets</td>
<td>Displays the number of each type of packet sent, including hello packets, link-state update packets, and link-state acknowledgment and link-state request packets.</td>
</tr>
<tr>
<td>errors</td>
<td>Displays the number of each type of error message sent, including hello protocol errors, database description errors, protocol errors, link-state acknowledgment errors, link-state request errors, link-state update errors, and IP errors.</td>
</tr>
<tr>
<td>errors dd</td>
<td>Displays the number of each type of database-description error messages only.</td>
</tr>
<tr>
<td>errors hello</td>
<td>Displays the number of each type of hello-error message only.</td>
</tr>
<tr>
<td>errors ip</td>
<td>Displays the number of each type of IP-errors message only.</td>
</tr>
<tr>
<td>errors lsack</td>
<td>Displays the number of each type of link-state acknowledgment error message only.</td>
</tr>
<tr>
<td>errors lsu</td>
<td>Displays the number of each type of link-state update error message only.</td>
</tr>
<tr>
<td>errors lsr</td>
<td>Displays the number of each type of link-state request error messages only.</td>
</tr>
<tr>
<td>errors protocol</td>
<td>Displays the number of each type of protocol error message only.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>border-routers</td>
<td>Displays the IP address of each area border router, the OSPF area of each border router, and the cost associated with each IP address.</td>
</tr>
<tr>
<td>database</td>
<td>Displays router-link state and network-link state statistics for each OSPF area. Also displays the checksum, sequence number, and link count of each OSPF interface.</td>
</tr>
<tr>
<td>database areas</td>
<td>Displays router-link state, network-link state, AS-border-router link state, AS-external link state, and summary-link state statistics for each OSPF area. Also displays the checksum, sequence number, and link count of each OSPF interface.</td>
</tr>
<tr>
<td>database area</td>
<td>Displays router-link state, network-link state, AS-border-router link state, AS-external-link state, and summary-link state statistics for the specified OSPF area. Also displays the checksum, sequence number, and link count of each IP address configured within the specified OSPF area.</td>
</tr>
<tr>
<td>ospf_area</td>
<td>Displays router-link state, network-link state, AS-border-router-link state, AS-external-link state, and summary-link state statistics for the specified OSPF area. Also displays the checksum, sequence number, and link count of each IP address configured within the specified OSPF area.</td>
</tr>
<tr>
<td>database asbr-summary</td>
<td>Displays a summary of AS-border-router link state statistics for each OSPF area. For OSPFv2 only.</td>
</tr>
<tr>
<td>database external</td>
<td>Displays AS-external-link state statistics for each OSPF area.</td>
</tr>
<tr>
<td>database database-summary</td>
<td>Displays a summary of router-link-state, network-link state, summary-link-state, and AS-border-router-link state statistics.</td>
</tr>
<tr>
<td>database network</td>
<td>Displays network-link state statistics, including the advertised router, sequence number, and checksum of each OSPF interface. For OSPFv2 only.</td>
</tr>
<tr>
<td>database nssa-external-lsa [detailed]</td>
<td>Displays type 7 LSAs (NSSA). This argument applies only to OSPF v2.</td>
</tr>
<tr>
<td>database router-lsa</td>
<td>Displays router-link-state statistics, including the advertised router, sequence number, checksum, and link count of each OSPF interface. For OSPFv2 only.</td>
</tr>
<tr>
<td>database summary-lsa</td>
<td>Displays a summary of link-state statistics for each OSPF area. For OSPFv2 only.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| database type <1 | 2 | 3 | 4 | 5 | 7> [detailed] | Displays link-state statistics associated with the specified number:  
  - 1—router-link-state statistics.  
  - 2—network-link-state statistics.  
  - 3—summary-link-state statistics.  
  - 4—AS-border-router-link-state statistics.  
  - 5—AS-external-link-state statistics.  
  - 7—NSSA. This option applies only to OSPF v2. |
| events | Displays the number of interface up/down events; virtual interface up/down events; designated router election events; router ID changes; area border router changes; AS border router changes, and link state advertisement messages. |
Route Aggregation

In This Section:
Configuring Route Aggregation - CLI (aggregate) ...................................................... 60

Route aggregation allows you to take numerous specific routes and aggregate them into one encompassing route. Route aggregation can reduce the number of routes that a given protocol advertises. The aggregates are activated by contributing routes. For example, if a router has many interface routes subnetted from a class C and is running RIP 2 on another interface, the interface routes can be used to create an aggregate route (of the class C) that can then be redistributed into RIP. Creating an aggregate route reduces the number of routes advertised using RIP. You must take care when aggregating if the route that is aggregated contains holes.

Create an aggregate route by first specifying the network address and mask length. Second, a set of contributing routes must be provided. A contributing route is defined when a source (for example, a routing protocol, a static route, an interface route) and a route filter (a prefix) are specified. An aggregate route can have many contributing routes, but at least one of the routes must be present to generate an aggregate.

Aggregate routes are not used for packet forwarding by the originator of the aggregate route, only by the receiver. A router receiving a packet that does not match one of the component routes that led to the generation of an aggregate route responds with an ICMP network unreachable message. This message prevents packets for unknown component routes from following a default route into another network where they would be continually forwarded back to the border router until their TTL expires.
Configuring Route Aggregation - CLI (aggregate)

Create aggregate routes using these commands.

```
set aggregate ip_prefix
  contributing protocol <protocol> contributing-route
    <all | ip_prefix> <on | off>
    <ip_prefix> exact on
    <ip_prefix> refines on
  off
  contributing protocol <protocol> off
  rank default
  rank <0-255>
  weight default
  aspath-truncate <on | off>
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>contributing protocol &lt;protocol&gt; contributing-route &lt;all</td>
<td>ip_prefix&gt; &lt;on</td>
</tr>
<tr>
<td>&lt;ip_prefix&gt; exact on</td>
<td>The contributing route is limited to the specified IP address and mask length only. You cannot enable both exact on and refines on at the same time. If you enable refines on when exact on is enabled, exact on is automatically disabled.</td>
</tr>
<tr>
<td>&lt;ip_prefix&gt; refines on</td>
<td>The contributing route is based on addresses with a greater value than the specified mask length of the specified IP address. You cannot enable both exact on and refines on at the same time. If you enable refines on when exact on is enabled, exact on is automatically disabled.</td>
</tr>
<tr>
<td>rank default</td>
<td>The rank to assign to the aggregate route when routes from different protocols to the same destination are present. For each route, the route from the protocol with the lowest rank is used. Each routing protocol has a different default rank value. Aggregate routes have a default rank of 130.</td>
</tr>
<tr>
<td>rank &lt;0-255&gt;</td>
<td>The rank to assign to the aggregate route when routes from different protocols to the same destination are present. For each route, the route from the protocol with the lowest rank is used. Each routing protocol has a different default rank value. Aggregate routes have a default rank of 130.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>weight default</td>
<td>A value that breaks a tie if select routes going to the same destination have the same rank value. The route with the highest weight is the active route. The active route is installed in the kernel forwarding table and redistributed to the other routing protocols.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Range</strong>: 0-65535.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Default</strong>: 0</td>
</tr>
<tr>
<td>weight &lt;0-65535&gt;</td>
<td>A value that breaks a tie if select routes going to the same destination have the same rank value. The route with the highest weight is the active route. The active route is installed in the kernel forwarding table and redistributed to the other routing protocols.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Default</strong>: 0</td>
</tr>
<tr>
<td>aspath-truncate</td>
<td>Specifies that the autonomous system (AS) path be truncated to the longest common AS path. The default behavior is to build an AS path that consists of sets and sequences of all contributing AS paths.</td>
</tr>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
</tbody>
</table>
Route Maps

In This Section:

Configuring Route Map - CLI (routemap) ...........................................................................62

Route maps are used to control which routes are accepted and announced by dynamic routing protocols. Use route maps to configure inbound route filters, outbound route filters, and to redistribute routes from one protocol to another.

You can define route maps only using the CLI. Routemaps are not available in the WebUI.

Route maps support RIP, BGP, and OSPFv2. You can also use the Route Redistribution and Inbound Route Filters features that you configure using the WebUI. Route map for import policy corresponds to Inbound Route Filters; route map for export policy corresponds to Route Redistribution.

Note - Route maps offer more configuration options than the WebUI configuration for route redistribution and inbound route filters. They are not functionally equivalent.

Protocols can use route maps for redistribution and WebUI settings for inbound route filtering and vice versa. However, if one or more route maps are assigned to a protocol (for import or export), any corresponding WebUI configuration (for route redistribution or inbound route filters) is ignored.

Configuring Route Map - CLI (routemap)

Each route map includes a list of match criteria and set statements. You can apply route maps to inbound, outbound, or redistribution routes. Routes are compared to the match criteria, and all the actions specified in the set criteria are applied to those routes which meet all the match conditions. You can specify the match conditions in any order. If you do not specify any match conditions in a route map, the route map matches all routes.

You define route maps, then assign them to protocols for export or import policy for that protocol. Route maps take precedence over WebUI based configuration.

To create a route map, use CLI commands to specify a set of criteria that must be matched for the command to take effect. If the criteria are matched, then the system executes the actions you specify. A route map is identified by name and an identifying number, an Allow or Restrict clause, and a collection of match and set statements.

There can be more than one instance of a route map (same name, different ID). The lowest numbered instance of a route map is checked first. Route map processing stops when either all the match criteria of some instance of the route map are satisfied, or all the instances of the particular route map are exhausted. If the match criteria are satisfied, the actions in the set section are performed.

Routing protocols can use more than one route map when you specify distinct preference values for each. The appropriate route map with lowest preference value is checked first.
Set Routemap Commands

To set a route map:

```
set routemap rm_name id <1-65535>
    <off|on>
    allow
    inactive
    restrict
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>routemap</td>
<td>The name of the routemap.</td>
</tr>
<tr>
<td>id &lt;1-65535&gt;</td>
<td>The ID of the routemap. You can enter the keyword default or the default value 10.</td>
</tr>
<tr>
<td>&lt;off</td>
<td>on&gt;</td>
</tr>
<tr>
<td></td>
<td>• off to delete a routemap.</td>
</tr>
<tr>
<td>allow</td>
<td>Allow routes that match the routemap.</td>
</tr>
<tr>
<td>inactive</td>
<td>Temporarily disable a routemap. To activate the routemap, use the allow or restrict arguments.</td>
</tr>
<tr>
<td>restrict</td>
<td>Routes that match the routemap are not allowed.</td>
</tr>
</tbody>
</table>

To specify actions for a routemap:

**Note** - Some statements affect only a particular protocol ["Supported Route Map Statements by Protocol" on page 69]. The same parameter cannot appear both as a match and action statement in a routemap. These include Community, Metric, and Nexthop.

```
set routemap rm_name id id_number action
    aspath-prepend-count <1-25>
    community <append | replace | delete> [on|off]
    community <1-65535> as <1-65535> [on|off]
    community no-export [on|off]
    community no-advertise [on|off]
    community no-export-subconfed [on|off]
    community none [on|off]
    localpref <1-65535>
    metric <add|subtract> <1-16>
    metric igp [<add | subtract>] <1-4294967295>
    metric value <1-4294967295>
    nexthop <ip ipv4_address>
    precedence <1-65535>
    preference <1-65535>
    route-type <type-1 | type-2>
    remove action_name
    ospfautomaticTag tag
    ospfmanualtag tag
    riptag tag
```
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>routemap</strong> <em>rm_name</em></td>
<td>Specifies the name of the routemap.</td>
</tr>
<tr>
<td><strong>id</strong> <em>id_number</em></td>
<td>Specifies the ID of the routemap. You can enter the keyword default or the default value 10.</td>
</tr>
<tr>
<td><strong>aspath-prepend-count</strong></td>
<td>Specifies to affix AS numbers at the beginning of the AS path. It indicates the number of times the local AS number should be prepended to the ASPATH before sending out an update. BGP only.</td>
</tr>
<tr>
<td><strong>community</strong> *&lt;append</td>
<td>replace</td>
</tr>
<tr>
<td><strong>community</strong> <em>&lt;1-65535&gt;</em></td>
<td>Specifies a BGP community value.</td>
</tr>
<tr>
<td><strong>as</strong> <em>&lt;1-65535&gt;</em> [on</td>
<td>off]</td>
</tr>
<tr>
<td><strong>community no-export</strong> [on</td>
<td>off]</td>
</tr>
<tr>
<td><strong>community no-advertise</strong> [on</td>
<td>off]</td>
</tr>
<tr>
<td><strong>community no-export-subconfed</strong> [on</td>
<td>off]</td>
</tr>
<tr>
<td><strong>community none</strong> [on</td>
<td>off]</td>
</tr>
<tr>
<td><strong>localpref</strong> <em>&lt;1-65535&gt;</em></td>
<td>Set the local preference for BGP route. BGP only.</td>
</tr>
<tr>
<td><strong>metric</strong> [add</td>
<td>subtract] <em>&lt;1-16&gt;</em></td>
</tr>
<tr>
<td><strong>metric igp</strong> [add</td>
<td>subtract] <em>&lt;1-4294967295&gt;</em></td>
</tr>
<tr>
<td><strong>metric value</strong> <em>&lt;1-4294967295&gt;</em></td>
<td>Set the metric value. For RIP the metric is metric, for OSPF the metric is cost, and for BGP the metric is MED.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>nexthop &lt;ip ipv4_address&gt;</td>
<td>Set IPv4 Nexthop Address. BGP only.</td>
</tr>
<tr>
<td>precedence &lt;1-65535&gt;</td>
<td>Sets the rank of the route. Precedence works across protocols. Use this setting to bias routes of one protocol over the other. The lower value has priority.</td>
</tr>
<tr>
<td>preference &lt;1-65535&gt;</td>
<td>Applies only to BGP. This is equivalent to the bgp weight (in Cisco terms) of the route. However, unlike Cisco, the route with lower value will be preferred. This value is only relevant for the local router.</td>
</tr>
<tr>
<td>route-type &lt;type-1</td>
<td>type-2&gt;</td>
</tr>
<tr>
<td>remove action_name</td>
<td>Remove the specified action from the routemap. For community, it removes all community statements. Allowed values for action_name are: aspath-regex community ifaddress interface metric neighbor network nexthop protocol route-type</td>
</tr>
<tr>
<td>ospfautomaticitag tag</td>
<td>Creates an automatic OSPF route tag.</td>
</tr>
<tr>
<td>ospfmanualtag tag</td>
<td>Creates a manual OSPF route tag.</td>
</tr>
<tr>
<td>riptag tag</td>
<td>Creates a RIP route tag.</td>
</tr>
</tbody>
</table>

To specify the criteria that must be matched for the routemap to take effect:

**Note** - Some statements affect only a particular protocol ("Supported Route Map Statements by Protocol" on page 69). The same parameter cannot appear both as a match and action statement in a routemap. These include Community, Metric, and Nexthop.
set routemap rm_name id <1-65535> match
  as <1-65535> [on | off]
  aspath-regex ["regular_expression" | empty] origin
  <any | igp | incomplete>
  community <1-65535> as <1-65535> [on|off]
  community exact [on|off]
  community no-export [on|off]
  community no-advertise [on|off]
  community no-export-subconfed [on|off]
  community none [on|off]
  ifaddress IPv4_addr [on | off]
  interface interface_name [on | off]
  metric value <1-4294967295>
  neighbor IPv4_addr [on | off]
  network IPv4_network / masklength
  <all | exact | off | refines>
  network<IPv4_network / masklength between masklength and masklength
  nexthop IPv4_addr [on | off]
  protocol <ospf2 | ospf2ase | bgp | rip | static | direct | aggregate>
  route-type <type-1 | type-2 | inter-area | intra-area> [on | off]
  remove match_condition_name

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>as &lt;1-65535&gt; [on</td>
<td>off]</td>
</tr>
<tr>
<td>aspath-regex [&quot;&lt;regular-expression&gt;&quot;</td>
<td>empty] origin &lt;any</td>
</tr>
<tr>
<td>community &lt;1-65535&gt; as &lt;1-65535&gt; [on</td>
<td>off]</td>
</tr>
<tr>
<td>community exact [on</td>
<td>off]</td>
</tr>
<tr>
<td>community no-export [on</td>
<td>off]</td>
</tr>
<tr>
<td>community no-advertise [on</td>
<td>off]</td>
</tr>
<tr>
<td>community no-export-subconfed [on</td>
<td>off]</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>community none</td>
<td>Matches an empty community string, i.e. a route which does not have any communities associated with it. The CLI returns an error if you turn &quot;none&quot; on and other community values already defined, or if &quot;none&quot; is defined and you add some other community value.</td>
</tr>
<tr>
<td>ifaddress IPv4_addr</td>
<td>Match the specified interface address. There can be multiple if address statements.</td>
</tr>
<tr>
<td>interface interface_name</td>
<td>Match the route if the nexthop lies on the specified interface name. There can be multiple interface statements.</td>
</tr>
<tr>
<td>metric value &lt;1-4294967295&gt;</td>
<td>Match the specified metric value.</td>
</tr>
<tr>
<td>neighbor IPv4_addr</td>
<td>Match the neighbors IP address. BGP or RIP. There can be multiple neighbor statements.</td>
</tr>
</tbody>
</table>
| network IPv4_network / masklength | Use with the following keywords:  
  all: Match all networks belonging to this prefix and masklength. This is a combination of exact and refines.                                                                                     
  between masklength and masklength: Specify a range of masklengths to be accepted for the specified prefix.                                                                                           
  exact: Match prefix exactly.                                                                                                                                                                         
  off: Delete the network match statement.                                                                                                                                                             
  refines: Match networks with more specific mask lengths only. Matches only subnets.                                                                                                                  |
<p>| nexthop IPv4_addr  | Match the specified nexthop address.                                                                                                                                                                          |
| protocol &lt;ospf2 | ospf2ase | bgp | rip | static | direct | aggregate&gt; | Match the specified protocol. Use this for route redistribution.                                                                                                                                   |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>route-type &lt;type-1</td>
<td>type-2</td>
</tr>
<tr>
<td>remove match_condition_name</td>
<td>Remove the specified match condition from the routemap. For match conditions which can have multiple match statements (such as network, neighbor), this argument removes all of them.</td>
</tr>
</tbody>
</table>

**Show Routemap Commands**

- `show routemap rm_name {all | <id VALUE>}`
- `show routemaps`

**Routemap Protocol Commands**

**To assign routemaps to protocols:**
The preference value specifies which order the protocol will use each routemap.

```plaintext
set <ospf | rip >
  export-routemap rm_name preference VALUE on
  import-routemap rm_name preference VALUE on
```

**To turn a routemap off:**

```plaintext
set <ospf | rip >
  export-routemap rm_name off
  import-routemap rm_name off
```

**To view routemaps assigned to protocols:**

```plaintext
show <ospf | rip> routemap
```
To set BGP routemaps for export and import policies:

```plaintext
set bgp external remote-as <1-65535> export-routemap rm_name
  off
  preference <1-65535> [family inet] on

set bgp external remote-as <1-65535> import-routemap rm_name
  off
  preference <1-65535> [family inet] on

set bgp internal export-routemap rm_name
  off
  preference <1-65535> [family inet] on

set bgp internal import-routemap rm_name
  off
  preference <1-65535> [family inet] on

show bgp routemap
```

**Note** - You cannot use routemaps in BGP confederations. To configure route filters and redistribution for BGP confederations, use the Inbound Route Filters and Route Redistribution pages in the WebUI.

**Supported Route Map Statements by Protocol**

Some statements affect only a particular protocol, for example, matching the Autonomous System Number is applicable only to BGP. If such a condition is in a routemap used by OSPF, the match condition is ignored. Any non-applicable match conditions or actions are ignored and processing is done as if they do not exist. A log message is generated in /var/log/messages for any such statements.

**Note** - The same parameter cannot appear both as a match and action statement in a routemap. These include Community, Metric, and Nexthop.

**RIP**

- **Import Match conditions:** Neighbor, Network, Interface, Ifaddress, Metric, Neighbor, Nexthop.
- **Import Actions:** Precedence, Metric Add/Subtract
- **Export Match conditions when exporting from RIP:** Interface, Ifaddress, Metric, Network, Nexthop
- **Export Match Conditions when redistributing using Protocol match:** According to the protocol from which route is being redistributed.
- **Export Actions when exporting from RIP:** Metric Add/Subtract
- **Export Actions when redistributing:** Metric Set
**OSPFv2**

- **Import Match conditions**: Network [Route Prefix]
- **Import Actions**: Precedence
- **Export Match conditions when other protocols redistribute OSPF routes**: Network, Interface, Ifaddress, Metric, Route-type, Nexthop
- **Export Match conditions when OSPF redistributes routes from other protocols**: Conditions supported by that protocol
- **Export Actions when redistributing to AS External**: Metric, Route-type

**BGP**

When you do initial configuration, set the router ID. You can also use the following commands to change the router ID.

```
set router-id default
set router-id ip_address
```

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>default</td>
<td>Selects the highest interface address when OSPF is enabled.</td>
</tr>
</tbody>
</table>
| ip_address  | The Router ID uniquely identifies the router in the autonomous system. The router ID is used by the BGP and OSPF protocols. We recommend setting the router ID rather than relying on the default setting. This prevents the router ID from changing if the interface used for the router ID goes down. Use an address on a loopback interface that is not the loopback address (127.0.0.1).

Note - In a cluster, you must select a router ID and make sure that it is the same on all cluster members.

- Range - Dotted-quad. 9[0-255].[0-255].[0-255]. Do not use 0.0.0.0
- Default - The interface address of one of the local interfaces.

Use the following group of commands to set and view parameters for BGP.

```
set as as_number
set as off
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>as as_number</td>
<td>The local autonomous system number of the router. This number is mutually exclusive from the confederation and routing domain identifier. The router can be configured with either the autonomous system number or confederation number, not both. Caution: When you change the autonomous system number, all current peer sessions are reset and all BGP routes are deleted.</td>
</tr>
<tr>
<td>as off</td>
<td>Disables the configured local autonomous system number.</td>
</tr>
</tbody>
</table>
Redistributing Static, Interface, or Aggregate Routes

When redistributing **static** routes into BGP, OSPFv2 or RIP the following match conditions are supported:

- Network Prefix,
- Nexthop
- Interface
- Ifaddress
- Protocol \( \text{proto} = \text{static} \)

When redistributing **interface/direct** routes into BGP, OSPFv2 or RIP the following match conditions are supported:

- Network Prefix
- Interface
- Ifaddress
- Protocol \( \text{proto} = \text{direct} \)

When redistributing **aggregate** routes into BGP, OSPFv2 or RIP the following match conditions are supported:

- Network Prefix
- Protocol \( \text{proto} = \text{aggregate} \)

Route Map Examples

**Example 1**

Redistribute interface route for eth3c0 into ospf, and set the ospf route-type to AS type-2 with cost 20.

```
set routemap direct-to-ospf id 10 on
set routemap direct-to-ospf id 10 match interface eth3c0
set routemap direct-to-ospf id 10 match protocol direct
set routemap direct-to-ospf id 10 action route-type type-2
set routemap direct-to-ospf id 10 action metric value 20

set ospf export-routemap direct-to-ospf preference 1 on
```

**Example 2**

Do not accept routes from RIP neighbor 192.0.2.3, accept routes from neighbor 192.0.2.4 as is, and for all other routes increment the metric by 2.

```
set routemap rip-in id 10 on
set routemap rip-in id 10 restrict
set routemap rip-in id 10 match neighbor 192.0.2.3

set routemap rip-in id 15 on
set routemap rip-in id 15 match neighbor 192.0.2.4

set routemap rip-in id 20 on
set routemap rip-in id 20 action metric add 2

set rip import-routemap rip-in preference 1 on
```
Example 3

Redistribute all static routes into BGP AS group 400. Set the MED value to 100, prepend our AS number to the aspath 4 times. If the route belongs to the prefix 192.0.2.0/8, do not redistribute. Send all BGP routes whose aspath matches the regular expression \((100 \ 200+)\) and set the MED value to 200.

```plaintext
set routemap static-to-bgp id 10 on
set routemap static-to-bgp id 10 restrict
set routemap static-to-bgp id 10 match protocol static
set routemap static-to-bgp id 10 match network 192.0.2.0/8 all

set routemap static-to-bgp id 15 on
set routemap static-to-bgp id 15 match protocol static
set routemap static-to-bgp id 15 action metric 100
set routemap static-to-bgp id 15 action aspath-prepend-count 4

set routemap bgp-out id 10 on
set routemap bgp-out id 10 match aspath-regex "\((100 \ 200+)\)" origin any
set routemap bgp-out id 10 action metric 200

set bgp external remote-as 400 export-routemap bgp-out preference 1 family inet on
set bgp external remote-as 400 export-routemap static-to-bgp preference 2 family inet on
```

Note - There is no need for a match protocol statement for routes belonging to the same protocol.
Protocol-Independent Multicast (PIM) gets its name from the fact that it can work with any existing unicast protocol to perform multicast forwarding. It supports two types of multi-point traffic distribution patterns: dense and sparse.

Dense mode is most useful when:
- Senders and receivers are in close proximity.
- There are few senders and many receivers.
- The volume of multicast traffic is high.
- The stream of multicast traffic is constant.

Dense-mode PIM resembles Distance Vector Multicast Routing Protocol (DVMRP). Like DVMRP, dense-mode PIM uses Reverse Path Forwarding and the flood-and-prune model.

Sparse mode is most useful when:
- A group has few receivers.
- Senders and receivers are separated by WAN links.
- The type of traffic is intermittent.

Sparse-mode PIM is based on the explicit join model; the protocol sets up the forwarding state for traffic by sending join messages. This model represents a substantial departure from flood-and-prune protocols, such as dense-mode PIM, which set up the forwarding state through the arrival of multicast data.

The implementation does not support enabling both dense mode and sparse mode or either mode of PIM and DVMRP on the same appliance. For more information about PIM, read the following Internet Engineering Task Force (IETF) drafts.


You can run PIM over a route-based VPN by enabling PIM on a virtual tunnel interface (VTI). You must use an unnumbered interface for the VTI.
Configuring PIM - CLI (pim)

Syntax

To configure PIM parameters:

```
set pim mode
    dense
    sparse
    ssm

set pim
    assert-interval VALUE
    assert-limit VALUE
    assert-rank protocol VALUE rank VALUE
    bootstrap-candidate local-address VALUE
    bootstrap-candidate off
    bootstrap-candidate on
    bootstrap-candidate priority VALUE
    candidate-rp advertise-interval VALUE
    candidate-rp local-address VALUE
    candidate-rp multicast-group VALUE off
    candidate-rp multicast-group VALUE on
    candidate-rp off
    candidate-rp on
    candidate-rp priority VALUE
    cisco-compatibility VALUE
    data-interval VALUE
    ha-mode off
    ha-mode on
    hello-interval VALUE
    interface VALUE dr-priority VALUE
    interface VALUE local-address VALUE
    interface VALUE off
    interface VALUE on
    interface VALUE virtual-address off
    interface VALUE virtual-address on
    jp-delay-interval VALUE
    jp-interval VALUE
    jp-suppress-interval VALUE
    nat-mode off
    nat-mode on
    network VALUE dr-priority VALUE
    network VALUE off
    network VALUE on
    register-suppress-interval VALUE
    spt-threshold multicast VALUE threshold VALUE off
    spt-threshold multicast VALUE threshold VALUE on
    state-refresh off
    state-refresh on
    state-refresh-interval VALUE
    state-refresh-ttl VALUE
    static-rp off
    static-rp rp-address VALUE multicast-group VALUE off
    static-rp rp-address VALUE multicast-group VALUE on
    static-rp rp-address VALUE off
    static-rp rp-address VALUE on
```
Show Commands

show pim

show pim
  bootstrap
  candidate-rp
  group-rp-mapping VALUE
  interface VALUE
  interfaces
  joins
  memory
  neighbor VALUE
  neighbors
  network VALUE
  networks
  rps
  sparse-mode-stats
  stats
  summary
  timers

PIM Interfaces

After you set PIM to run dense mode, sparse mode or SSM, use the following commands to configure PIM for specific interfaces.

```
set pim interface if_name
  <on | off>
  local-address ip_address
  dr-priority <0-4294967295>
  dr-priority default
```

Sparse Mode PIM

Use the following commands to configure parameters for sparse mode PIM only.

```
set pim
  ha-mode <on | off>
  bootstrap-candidate <on | off>
  bootstrap-candidate local-address ip_address
  bootstrap-candidate priority <0-255>
  bootstrap-candidate priority default
  candidate-rp <on | off>
  candidate-rp local-address ip_address
  candidate-rp priority <0-255>
  candidate-rp priority default
  candidate-rp multicast group mcast_ip_prefix <on | off>
  static-rp off
  static-rp rp-address ip_address < on | off>
  static-rp rp-address ip_address multicast-group mcast_ip_prefix <on | off>
  register-suppress-interval <60-3600>
  register-suppress-interval default
  candidate-rp advertise-interval <1-3600>
  candidate rp-advertise-interval default
  cisco compatibility <on | off>
  spt-threshold multicast mcast_ip_prefix threshold <0-1000000> <on | off>
  spt-threshold multicast mcast_ip_prefix threshold infinity <on | off>
  nat-mode <on | off>
  state-refresh <on | off>
  state-refresh-interval <0 – 255>
  state-refresh-ttl <1 – 255>
```
Timer and Assert Rank Parameters for Dense Mode and Sparse Mode

Use these commands to change or restore default values for timers and assert ranks.

```
set pim
    hello-interval <1-21845>
    hello-interval default
    data-interval <11-3600>
    data-interval default
    assert-interval <1-3600>
    assert-interval default
    assert-limit <10-10000>
    assert-limit default
    assert-limit <0>
    jp-interval <1-3600>
    jp-interval default
    jp-delay-interval <1-3600>
    jp-delay-interval default
    jp-suppress-interval <2-3600>
    jp-suppress-interval default
    assert-rank protocol protocol name rank <0-255>
    assert-rank protocol protocol name rank default
```

Arguments

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;dense</td>
<td>sparse</td>
</tr>
<tr>
<td>interface if_name &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>local-address ip_address</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ha-mode &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>dr-priority &lt;0-4294967295&gt;</td>
<td>Specifies the dr-priority advertised in the PIM hello messages sent on the corresponding interface. This value, which has a default of 1, is used for DR election on a LAN. The router with the highest priority and the highest IP address is elected the designated router. To break a tie, the DR is selected on the basis of the highest IP address. If even one router does not advertise a dr-priority value in its hello messages, the DR election is based on the IP address.</td>
</tr>
<tr>
<td>dr-priority default</td>
<td>Specifies a value of 1.</td>
</tr>
<tr>
<td>bootstrap-candidate &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>bootstrap-candidate local-address ip_address</td>
<td>Specifies the IP address of the bootstrap router used in bootstrap messages. By default, the router picks an address from one of the interfaces on which PIM is enabled.</td>
</tr>
<tr>
<td>bootstrap-candidate priority &lt;0-255&gt;</td>
<td>Specifies the value used to elect the bootstrap router from among the candidate bootstrap routers. The candidate bootstrap router with the highest priority value is elected bootstrap router for the domain. The highest priority value is 0, so the lower the value, the higher the priority.</td>
</tr>
<tr>
<td>bootstrap-candidate priority default</td>
<td>Specifies a value of 0.</td>
</tr>
<tr>
<td>candidate-rp &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td></td>
<td>off</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>candidate-rp</td>
<td>Specifies the IP address of the candidate rendezvous point router used in candidate rendezvous point messages. By default, the router picks an address from one of the interfaces on which PIM is enabled.</td>
</tr>
<tr>
<td>local-address</td>
<td></td>
</tr>
<tr>
<td>ip_address</td>
<td></td>
</tr>
<tr>
<td>candidate-rp priority</td>
<td>Specifies the priority of the candidate rendezvous point included in the corresponding multicast group address. The higher the priority, the lower the value.</td>
</tr>
<tr>
<td>&lt;0-255&gt;</td>
<td></td>
</tr>
<tr>
<td>candidate-rp priority default</td>
<td>Specifies a value of 0.</td>
</tr>
<tr>
<td>candidate-rp multicast-group</td>
<td>Specifies the multicast address advertised in the candidate rendezvous point advertisements. For the multicast IP prefix value, you must enter an IP address and mask length. If you do not specify a group multicast address, the candidate rendezvous point advertises itself as the rendezvous point for all multicast groups.</td>
</tr>
<tr>
<td>mcast_ip_prefix</td>
<td></td>
</tr>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>static-rp off</td>
<td>Disables the static rendezvous point option.</td>
</tr>
<tr>
<td>static-rp rp-address</td>
<td>Specifies to enable or disable a static rendezvous point. If you do not specify an associated multicast group and prefix, the static-rp is considered to be responsible for all multicast groups (224.0.0.0/4).</td>
</tr>
<tr>
<td>ip_address &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>static-rp rp-address</td>
<td>Specifies the IP address associated with the static rendezvous point and the multicast IP address for which the rendezvous point is responsible. For the multicast IP prefix value, you must enter an IP address and mask length.</td>
</tr>
<tr>
<td>ip_address</td>
<td></td>
</tr>
<tr>
<td>multicast-group</td>
<td></td>
</tr>
<tr>
<td>mcast_ip_prefix</td>
<td></td>
</tr>
<tr>
<td>&lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>register-suppress-interval</td>
<td>Specifies the mean interval between receiving a register-stop and allowing registers to be sent again. A lower value means more frequent register bursts at the rendezvous point, while a higher value means a longer join latency for new receivers.</td>
</tr>
<tr>
<td>&lt;60-3600&gt;</td>
<td></td>
</tr>
<tr>
<td>register-suppress-interval default</td>
<td>Specifies a value of 60.</td>
</tr>
<tr>
<td>candidate-rp advertise-interval</td>
<td>Specifies the interval between which candidate-rendezvous point routers send candidate-rendezvous point advertisements.</td>
</tr>
<tr>
<td>&lt;1-3600&gt;</td>
<td></td>
</tr>
<tr>
<td>candidate-rp advertise-interval default</td>
<td>Specifies a value of 60.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>cisco-compatibility</td>
<td>The checksum of the PIM register messages is calculated without including the multicast payload. Earlier releases of Cisco’s IOS calculate the checksum by including the multicast payload. If you experience difficulties having PIM register messages sent by your Check Point appliance being accepted by a Cisco router that is the elected rendezvous point (RP), configure this option. A Check Point appliance that is the elected RP, accepts register messages that calculate the checksum with or without the multicast payload, that is it accepts all register messages.</td>
</tr>
<tr>
<td>spt-threshold</td>
<td>Specifies the multicast group address to apply to the shortest path tree (spt) threshold and the date rate in Kbits/sec to trigger the spt switch over.</td>
</tr>
<tr>
<td>multicast</td>
<td></td>
</tr>
<tr>
<td>mcast_ip_prefix</td>
<td></td>
</tr>
<tr>
<td>threshold &lt;0-1000000&gt;</td>
<td></td>
</tr>
<tr>
<td>spt-threshold</td>
<td>Specifies the data rate in Kbits/sec to trigger the SPT switch over as infinity.</td>
</tr>
<tr>
<td>multicast</td>
<td></td>
</tr>
<tr>
<td>mcast_ip_prefix</td>
<td></td>
</tr>
<tr>
<td>threshold infinity &lt;on</td>
<td>off&gt;</td>
</tr>
<tr>
<td>hello interval</td>
<td>Specifies the interval, in seconds, at which PIM hello messages are sent on the LAN.</td>
</tr>
<tr>
<td>&lt;1-21845&gt;</td>
<td></td>
</tr>
<tr>
<td>hello interval default</td>
<td>Specifies a value of 30.</td>
</tr>
<tr>
<td>data-interval</td>
<td>Specifies the interval, in seconds, after which multicast (S,G) state for a silent source is deleted.</td>
</tr>
<tr>
<td>&lt;11-3600&gt;</td>
<td></td>
</tr>
<tr>
<td>data-interval default</td>
<td>Specifies a value of 210.</td>
</tr>
<tr>
<td>assert-interval</td>
<td>Specifies the interval between the last time an assert is received and the assert is timed out.</td>
</tr>
<tr>
<td>&lt;1-3600&gt;</td>
<td></td>
</tr>
<tr>
<td>assert-interval default</td>
<td>Specifies a value of 180.</td>
</tr>
<tr>
<td>assert-limit</td>
<td>Specifies the number of asserts to send per second.</td>
</tr>
<tr>
<td>&lt;10-10000&gt;</td>
<td></td>
</tr>
<tr>
<td>assert-limit default</td>
<td>Specifies a value of 10.</td>
</tr>
<tr>
<td>assert-limit &lt;0&gt;</td>
<td>Disables the limit placed on the number of asserts that can be sent per second.</td>
</tr>
<tr>
<td>jp-interval</td>
<td>Specifies the interval, in seconds, between which join/prune messages are sent.</td>
</tr>
<tr>
<td>&lt;1-3600&gt;</td>
<td></td>
</tr>
<tr>
<td>jp-interval default</td>
<td>Specifies a value of 60.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>jp-delay-interval</strong>&lt;1-3600&gt;</td>
<td>Specifies maximum interval, in seconds, between the time when the RPF neighbor changes and a triggered Join/Prune message is sent.</td>
</tr>
<tr>
<td><strong>jp-delay-interval default</strong></td>
<td>Specifies a value of 5.</td>
</tr>
<tr>
<td><strong>jp-suppress-interval&lt;2-3600&gt;</strong></td>
<td>Specifies the mean interval between receiving a Join/Prune with a higher “holdtime” and allowing duplicate Join/Prunes to be sent again. Check Point recommends that you set the join/prune suppress interval 1.25 times that of the join/prune interval.</td>
</tr>
<tr>
<td><strong>jp-suppress-interval default</strong></td>
<td>Specifies a value of 75.</td>
</tr>
<tr>
<td><strong>assert-rank protocol protocol name rank&lt;0-255&gt;</strong></td>
<td>Specifies the value assigned to a particular protocol in assert messages. This value is used to compare protocols to determine which router will forward multicast packets on a multi-access LAN. The value is included in assert messages when more than one router on a LAN is capable of forwarding multicast packets and one router detects the other routers’ duplicate packets. Use the following protocol names to set this option: ospf; kernel; igrp; rip; static; bgp; direct and ospfase. The values assigned to each protocol must match for each router on a multi-access LAN.</td>
</tr>
<tr>
<td><strong>assert-rank protocol protocol name rank default</strong></td>
<td>Specifies default assert-rank values for supported protocols that match other implementations. The direct default value is 0. The ospf default value is 10; the kernel default value is 40; the static route default value is 60; the IGRP default value is 80; the rip default value is 100; the bgp default value is 170.</td>
</tr>
<tr>
<td>**nat-mode&lt;on</td>
<td>off&gt;**</td>
</tr>
<tr>
<td>**state-refresh&lt;on</td>
<td>off&gt;**</td>
</tr>
<tr>
<td><strong>state-refresh-interval&lt;0 – 255&gt;</strong></td>
<td>Specifies the interval at which state refresh messages are sent for multicast traffic originated by directly-connected sources.</td>
</tr>
<tr>
<td><strong>state-refresh-ttl&lt;1 – 255&gt;</strong></td>
<td>Specifies the time-to-live (TTL) placed in the state refresh messages originated for multicast traffic from directly-connected sources. This value can be used to limit the forwarding of state refresh messages in the network.</td>
</tr>
</tbody>
</table>
Show PIM Commands

Use these commands to monitor and troubleshoot PIM.

These commands apply to both dense-mode and sparse-mode PIM:

```
show pim
    interfaces
    interfaces if_address
    neighbors
    neighbor ip_address
    memory
    timers
    stats
    summary
```

These commands apply only to sparse-mode PIM:

```
show pim
    bootstrap
    candidate-rp
    joins
    rps
    parse-mode-stats
    group-rp-mapping <mcast_address>
```

Debugging PIM - CLI

Use these commands to debug PIM:

<table>
<thead>
<tr>
<th>Command</th>
<th>Shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>show pim interface</td>
<td>Which interfaces are running PIM, their status, and the mode they are running. This command also displays the interface and its DR priority and the number of PIM neighbors on the interface.</td>
</tr>
<tr>
<td>show pim neighbors</td>
<td>The IP address of each PIM neighbor and the interface on which the neighbor is present. This command also displays the neighbor’s DR priority, generation ID, holdtime and the time the neighbor is set to expire based on the holdtime received in the most recent hello message.</td>
</tr>
<tr>
<td>show pim statistics</td>
<td>The number of different types of PIM packets received and transmitted and any associated errors.</td>
</tr>
<tr>
<td>show mfc cache</td>
<td>Multicast source and group forwarding state by prefix.</td>
</tr>
<tr>
<td>show mfc interfaces</td>
<td>Shows multicast source and group forwarding state by interface.</td>
</tr>
</tbody>
</table>

Use these commands to debug sparse-mode PIM [PIM-SM]:

<table>
<thead>
<tr>
<th>Command</th>
<th>Shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>show pim bootstrap</td>
<td>The IP address and state of the Bootstrap router.</td>
</tr>
<tr>
<td>show pim candidate-rp</td>
<td>The state of the Candidate Rendezvous Point state machine.</td>
</tr>
<tr>
<td>Command</td>
<td>Shows</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td><code>show pim joins</code></td>
<td>PIM’s view of the join-prune ([*, G and S, G]) state, including RP for the group, incoming, and outgoing interface(s), interaction with the multicast forwarding cache and the presence of local members. To view the equivalent information for dense-mode PIM, use the <code>show mfc cache</code> command.</td>
</tr>
<tr>
<td><code>show pim rps</code></td>
<td>The active RP-set, including the RP addresses, their type (or source of information about them) and the groups for which they are configured to act as RP.</td>
</tr>
<tr>
<td><code>show pim group-rp-mapping &lt;group-address&gt;</code></td>
<td>The RP selected for a particular group based on information from the active RP-set.</td>
</tr>
<tr>
<td><code>show pim sparse-mode statistics</code></td>
<td>Error statistics for multicast forwarding cache (MFC); Bootstrap Router (BSR) messages; Candidate Rendezvous Point (CRP) advertisements; and the Internet Group Management Protocol (IGMP).</td>
</tr>
</tbody>
</table>