Configuring High Availability

The Cisco High Availability (HA) technology enable network-wide protection by providing quick recovery from disruptions that may occur in any part of a network. A network's hardware and software work together with Cisco High Availability technology, which besides enabling quick recovery from disruptions, ensures fault transparency to users and network applications.

The following sections describe how to configure Cisco High Availability features on your device:

About Cisco High Availability

The unique hardware and software architecture of your router is designed to maximize router uptime during any network event, and thereby provide maximum uptime and resilience within any network scenario.

This section covers some aspects of Cisco High Availability that may be used on the Cisco Catalyst 8300 Series Edge Platform:

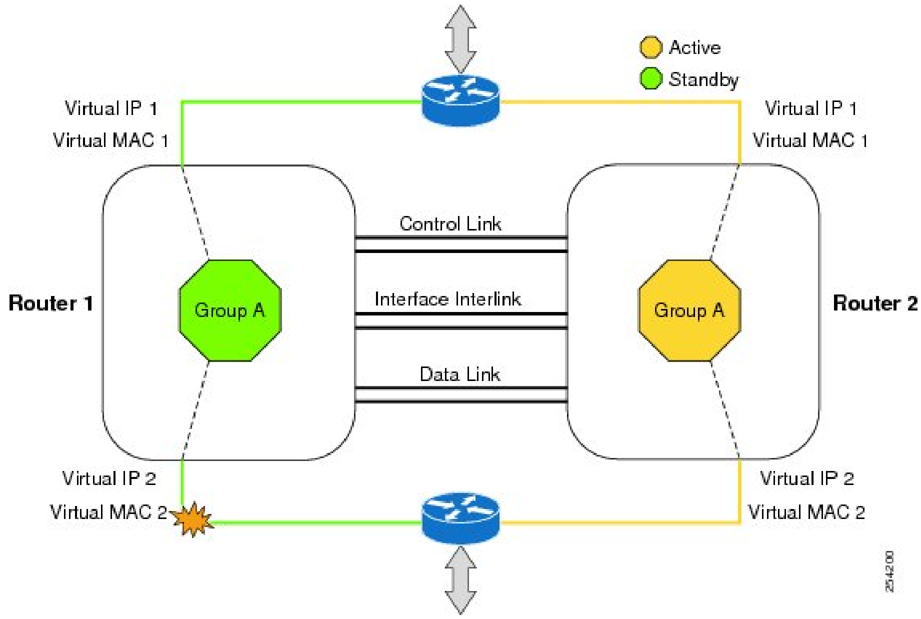
- Interchassis High Availability, on page 1
- Bidirectional Forwarding Detection, on page 2

Interchassis High Availability

The Interchassis High Availability feature is also known as the box-to-box redundancy feature. Interchassis High Availability enables the configuration of pairs of devices to act as backup for each other. This feature can be configured to determine the active device based on several failover conditions. When a failover occurs, the standby device seamlessly takes over and starts processing call signaling and performing media forwarding tasks.

Groups of redundant interfaces are known as redundancy groups. The following figure depicts the active-standby device scenario. It shows how the redundancy group is configured for a pair of devices that have a single outgoing interface.

Figure 1: Redundancy Group Configuration



The device are joined by a configurable control link and data synchronization link. The control link is used to communicate the status of the devices. The data synchronization link is used to transfer stateful information to synchronize the stateful database for the calls and media flows. Each pair of redundant interfaces are configured with the same unique ID number, also known as the RII. For information on configuring Interchassis HA on your device, see Configuring Interchassis High Availability, on page 3.

Bidirectional Forwarding Detection

Bidirectional Forwarding Detection (BFD) is a detection protocol designed to provide fast-forwarding path-failure detection times for all media types, encapsulations, topologies, and routing protocols. In addition to fast-forwarding path-failure detection, BFD provides a consistent failure detection method for network administrators. Because a network administrator can use BFD to detect forwarding path failures at a uniform rate rather than variable rates for different routing protocol hello mechanisms, network profiling and planning is easier, and reconvergence time is consistent and predictable.

For more information on BFD, see the “Bidirectional Forwarding Detection” section in the IP Routing: BFD Configuration Guide .

Bidirectional Forwarding Detection Offload

The Bidirectional Forwarding Detection Offload feature allows the offload of BFD session management to the forwarding engine for improved failure detection times. BFD offload reduces the overall network convergence time by sending rapid failure detection packets (messages) to the routing protocols for recalculating the routing table. See Configuring BFD Offload, on page 4.

Configuring Cisco High Availability

Configuring Interchassis High Availability

Prerequisites

- The active device and the standby device must run on the identical version of the Cisco IOS XE software.
- The active device and the standby device must be connected through an L2 connection for the control path.
- Either the Network Time Protocol (NTP) must be configured or the clock must be set identical on both devices to allow timestamps and call timers to match.
- Virtual Routing and Forwarding (VRF) must be defined in the same order on both active and standby devices for an accurate synchronization of data.
- The latency times must be minimal on all control and data links to prevent timeouts.
- Physically redundant links, such as Gigabit EtherChannel, must be used for the control and data paths.

Restrictions

- The failover time for a box-to-box application is higher for a non-box-to-box application.
- LAN and MESH scenarios are not supported.
- VRFs are not supported and cannot be configured under ZBFW High Availability data and control interfaces.
- The maximum number of virtual MACs supported by the Front Panel Gigabit Ethernet (FPGE) interfaces depends on the platform. For information about the FPGE interfaces, see the Hardware Installation Guide for Cisco Catalyst 8300 Edge Platform.
- When the configuration is replicated to the standby device, it is not committed to the startup configuration; it is in the running configuration. A user must run the **write memory** command to commit the changes that have been synchronized from the active device, on the standby device.

How to Configure Interchassis High Availability

For more information on configuring Interchassis High Availability on the device, see the IP Addressing: NAT Configuration Guide, Cisco IOS XE Release 3S.

Configuring Bidirectional Forwarding

For information on configuring BFD on your device, see the IP Routing BFD Configuration Guide.

For BFD commands, see the Cisco IOS IP Routing: Protocol-Independent Command Reference document.

Configuring BFD Offload

Restrictions

- Only BFD version 1 is supported.
- When configured, only offloaded BFD sessions are supported;, BFD session on RP are not supported.
- Only Asynchronous mode or no echo mode of BFD is supported.
- 511 asynchronous BFD sessions are supported.
- BFD hardware offload is supported for IPv4 sessions with non-echo mode only.
- BFD offload is supported only on port-channel interfaces.
- BFD offload is supported only for the Ethernet interface.
- BFD offload is not supported for IPv6 BFD sessions.
- BFD offload is not supported for BFD with TE/FRR.

How to Configure BFD Offload

BFD offload functionality is enabled by default. You can configure BFD hardware offload on the route processor. For more information, see Configuring BFD and the IP Routing BFD Configuration Guide.

Verifying Interchassis High Availability

Use the following **show** commands to verify the Interchassis High Availability.

Note Prerequisites and links to additional documentation configuring Interchassis High Availability are listed in Configuring Interchassis High Availability, on page 3.

- **show redundancy application group [group-id | all]**
- **show redundancy application transport {client | group [group-id]}**
- **show redundancy application control-interface group [group-id]**
- **show redundancy application faults group [group-id]**
- **show redundancy application protocol {protocol-id | group [group-id]}**
- **show redundancy application if-mgr group [group-id]**
- **show redundancy application data-interface group [group-id]**

The following example shows the redundancy application groups configured on the device:

```
Router# show redundancy application group
Group ID    Group Name                      State
--------    ----------                      -----
1           Generic-Redundancy-1            STANDBY
2           Generic-Redundancy2             ACTIVE
```

The following example shows the details of redundancy application group 1:

```
Router# show redundancy application group 1
Group ID:1
Group Name:Generic-Redundancy-1

Administrative State: No Shutdown
Aggregate operational state : Up
My Role: STANDBY
Peer Role: ACTIVE
Peer Presence: Yes
Peer Comm: Yes
Peer Progression Started: Yes

RF Domain: btob-one
RF state: STANDBY HOT
Peer RF state: ACTIVE
```

The following example shows the details of redundancy application group 2:

```
Router# show redundancy application group 2
Group ID:2
Group Name:Generic-Redundancy2

Administrative State: No Shutdown
Aggregate operational state : Up
My Role: ACTIVE
Peer Role: STANDBY
Peer Presence: Yes
Peer Comm: Yes
Peer Progression Started: Yes

RF Domain: btob-two
RF state: ACTIVE
Peer RF state: STANDBY HOT
```

The following example shows details of the redundancy application transport client:

```
Router# show redundancy application transport client
Client         Conn#  Priority   Interface   L3        L4
( 0)RF           0      1         CTRL       IPV4      SCTP

( 1)MCP_HA       1      1         DATA       IPV4      UDP_REL

( 4)AR           0      1         ASYM       IPV4      UDP

( 5)CF           0      1         DATA       IPV4      SCTP
```

The following example shows configuration details for the redundancy application transport group:

```
Router# show redundancy application transport group
Transport Information for RG (1)
Client = RF
TI   conn_id my_ip          my_port  peer_ip         peer_por intf    L3      L4
0    0       192.0.2.8      59000    192.0.2.4       59000    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip          my_port  peer_ip         peer_por intf    L3      L4
1    1       10.10.2.10     53000    10.10.6.9       53000    DATA    IPV4    UDP_REL
```

```
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
2    0       192.0.2.3       0       192.0.2.3        0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
3    0       10.10.2.10      59001    10.10.6.9       59001    DATA    IPV4    SCTP
Transport Information for RG (2)
Client = RF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
8    0       192.0.2.8       59004    192.0.2.2       59004    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
9    1       10.10.2.10      53002    10.10.6.9       53002    DATA    IPV4    UDP_REL
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
10   0       192.0.2.3       0        192.0.2.3       0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
11   0       10.10.2.10      59005    10.10.6.9       59005    DATA    IPV4    SCTP
```

The following example shows the configuration details of redundancy application transport group 1:

```
Router# show redundancy application transport group 1
Transport Information for RG (1)
Client = RF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
0    0       192.0.2.8       59000    192.0.2.4       59000    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
1    1       10.10.2.10      53000    10.10.2.10      53000    DATA    IPV4    UDP_REL
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
2    0       192.0.2.3       0        192.0.2.3       0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
3    0       10.10.2.10      59001    10.10.2.10      59001    DATA    IPV4    SCTP
```

The following example shows configuration details of redundancy application transport group 2:

```
Router# show redundancy application transport group 2
Transport Information for RG (2)
Client = RF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
8    0       192.0.2.8       59004    192.0.2.4       59004    CTRL    IPV4    SCTP
Client = MCP_HA
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
9    1       10.10.2.10      53002    10.10.2.10      53002    DATA    IPV4    UDP_REL
Client = AR
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
10   0       192.0.2.3       0        192.0.2.3       0        NONE_IN NONE_L3 NONE_L4
Client = CF
TI   conn_id my_ip           my_port  peer_ip         peer_por intf    L3      L4
11   0       10.10.2.10      59005    10.10.2.10      59005    DATA    IPV4    SCTP
```

The following example shows configuration details of the redundancy application control-interface group:

```
Router# show redundancy application control-interface group
The control interface for rg[1] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0

The control interface for rg[2] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
```

```
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0
```

The following example shows configuration details of the redundancy application control-interface group 1:

```
Router# show redundancy application control-interface group 1
The control interface for rg[1] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0
```

The following example shows configuration details of the redundancy application control-interface group 2:

```
Router# show redundancy application control-interface group 2
The control interface for rg[2] is GigabitEthernet0/0/0
Interface is Control interface associated with the following protocols: 2 1
BFD Enabled
Interface Neighbors:
Peer: 192.0.2.4 Active RGs: 1 Standby RGs: 2 BFD handle: 0
```

The following example shows configuration details of the redundancy application faults group:

```
Router# show redundancy application faults group
Faults states Group 1 info:
Runtime priority: [50]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
Faults states Group 2 info:
Runtime priority: [135]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
```

The following example shows configuration details specific to redundancy application faults group 1:

```
Router# show redundancy application faults group 1
Faults states Group 1 info:
Runtime priority: [50]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
```

The following example shows configuration details specific to redundancy application faults group 2:

```
Router# show redundancy application faults group 2
Faults states Group 2 info:
Runtime priority: [135]
RG Faults RG State: Up.
Total # of switchovers due to faults: 0
Total # of down/up state changes due to faults: 2
```

The following example shows configuration details for the redundancy application protocol group:

```
Router# show redundancy application protocol group
RG Protocol RG 1
------------------
Role: Standby
Negotiation: Enabled
Priority: 50
Protocol state: Standby-hot
Ctrl Intf(s) state: Up
Active Peer: address 192.0.4.2, priority 150, intf Gi0/0/0
Standby Peer: Local
Log counters:
```

```
role change to active: 0
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 1
--------------------------
Ctx State: Standby
Protocol ID: 1
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 117, Bytes 7254, HA Seq 0, Seq Number 117, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
Resign: TX 0, RX 0
Active Peer: Present. Hold Timer: 10000
Pkts 115, Bytes 3910, HA Seq 0, Seq Number 1453975, Pkt Loss 0



RG Protocol RG 2
------------------
Role: Active
Negotiation: Enabled
Priority: 135
Protocol state: Active
Ctrl Intf(s) state: Up
Active Peer: Local
Standby Peer: address 192.0.4.2, priority 130, intf Gi0/0/0
Log counters:
role change to active: 1
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 2
--------------------------
Ctx State: Active
Protocol ID: 2
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 118, Bytes 7316, HA Seq 0, Seq Number 118, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
Resign: TX 0, RX 1
Standby Peer: Present. Hold Timer: 10000
Pkts 102, Bytes 3468, HA Seq 0, Seq Number 1453977, Pkt Loss 0
```

The following example shows configuration details for the redundancy application protocol group 1:

```
Router# show redundancy application protocol group 1
RG Protocol RG 1
------------------
```

```
Role: Standby
Negotiation: Enabled
Priority: 50
Protocol state: Standby-hot
Ctrl Intf(s) state: Up
Active Peer: address 192.0.4.2, priority 150, intf Gi0/0/0
Standby Peer: Local
Log counters:
role change to active: 0
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 1
--------------------------
Ctx State: Standby
Protocol ID: 1
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 120, Bytes 7440, HA Seq 0, Seq Number 120, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
Resign: TX 0, RX 0
Active Peer: Present. Hold Timer: 10000
Pkts 118, Bytes 4012, HA Seq 0, Seq Number 1453978, Pkt Loss 0
```

The following example shows configuration details for the redundancy application protocol group 2:

```
Router# show redundancy application protocol group 2
RG Protocol RG 2
------------------
Role: Active
Negotiation: Enabled
Priority: 135
Protocol state: Active
Ctrl Intf(s) state: Up
Active Peer: Local
Standby Peer: address 192.0.4.2, priority 130, intf Gi0/0/0
Log counters:
role change to active: 1
role change to standby: 1
disable events: rg down state 1, rg shut 0
ctrl intf events: up 2, down 1, admin_down 1
reload events: local request 0, peer request 0

RG Media Context for RG 2
--------------------------
Ctx State: Active
Protocol ID: 2
Media type: Default
Control Interface: GigabitEthernet0/0/0
Current Hello timer: 3000
Configured Hello timer: 3000, Hold timer: 10000
Peer Hello timer: 3000, Peer Hold timer: 10000
Stats:
Pkts 123, Bytes 7626, HA Seq 0, Seq Number 123, Pkt Loss 0
Authentication not configured
Authentication Failure: 0
Reload Peer: TX 0, RX 0
```

```
Resign: TX 0, RX 1
Standby Peer: Present. Hold Timer: 10000
Pkts 107, Bytes 3638, HA Seq 0, Seq Number 1453982, Pkt Loss 0
```

The following example shows configuration details for the redundancy application protocol 1:

```
Router# show redundancy application protocol 1
Protocol id: 1, name: rg-protocol-1
BFD: ENABLE
Hello timer in msecs: 3000
Hold timer in msecs: 10000
OVLD-1#show redundancy application protocol 2
Protocol id: 2, name: rg-protocol-2
BFD: ENABLE
Hello timer in msecs: 3000
Hold timer in msecs: 10000
```

The following example shows configuration details for redundancy application interface manager group:

```
Router# show redundancy application if-mgr group
 RG ID: 1
 ==========

 interface      GigabitEthernet0/0/3.152
 ---------------------------------------
 VMAC           0007.b421.4e21
 VIP            203.0.113.1
 Shut           shut
 Decrement      10

 interface      GigabitEthernet0/0/2.152
 ---------------------------------------
 VMAC           0007.b421.5209
 VIP            203.0.113.4
 Shut           shut
 Decrement      10


 RG ID: 2
 ==========

 interface      GigabitEthernet0/0/3.166
 ---------------------------------------
 VMAC           0007.b422.14d6
 VIP            203.0.113.6
 Shut           no shut
 Decrement      10

 interface      GigabitEthernet0/0/2.166
 ---------------------------------------
 VMAC           0007.b422.0d06
 VIP            203.0.113.9
 Shut           no shut
 Decrement      10
```

The following examples shows configuration details for redundancy application interface manager group 1 and group 2:

```
Router# show redundancy application if-mgr group 1

 RG ID: 1
 ==========

 interface      GigabitEthernet0/0/3.152
 ---------------------------------------
```

```
 VMAC           0007.b421.4e21
 VIP            203.0.113.3
 Shut           shut
 Decrement      10

 interface      GigabitEthernet0/0/2.152
 ---------------------------------------
 VMAC           0007.b421.5209
 VIP            203.0.113.2
 Shut           shut
 Decrement      10

Router# show redundancy application if-mgr group 2
 RG ID: 2
 ==========

 interface      GigabitEthernet0/0/3.166
 ---------------------------------------
 VMAC           0007.b422.14d6
 VIP            203.0.113.5
 Shut           no shut
 Decrement      10

 interface      GigabitEthernet0/0/2.166
 ---------------------------------------
 VMAC           0007.b422.0d06
 VIP            203.0.113.7
 Shut           no shut
 Decrement      10
```

The following example shows configuration details for redundancy application data-interface group:

```
Router# show redundancy application data-interface group
The data interface for rg[1] is GigabitEthernet0/0/1
The data interface for rg[2] is GigabitEthernet0/0/1
```

The following examples show configuration details specific to redundancy application data-interface group 1 and group 2:

```
Router# show redundancy application data-interface group 1
The data interface for rg[1] is GigabitEthernet0/0/1

Router # show redundancy application data-interface group 2
The data interface for rg[2] is GigabitEthernet0/0/1
```

Verifying BFD Offload

Use the following commands to verify and monitor BFD offload feature on your device.

Note Configuration of BFD Offload is described in Configuring Bidirectional Forwarding, on page 4.

- **show bfd neighbors [details]**
- **debug bfd [packet | event]**
- **debug bfd event**

The **show bfd neighbors** command displays the BFD adjacency database:

```
Router# show bfd neighbor

IPv4 Sessions
NeighAddr                              LD/RD         RH/RS     State     Int
192.0.2.1                             362/1277       Up        Up        Gi0/0/1.2
192.0.2.5                             445/1278       Up        Up        Gi0/0/1.3
192.0.2.3                            1093/961        Up        Up        Gi0/0/1.4
192.0.2.2                            1244/946        Up        Up        Gi0/0/1.5
192.0.2.6                            1094/937        Up        Up        Gi0/0/1.6
192.0.2.7                            1097/1260       Up        Up        Gi0/0/1.7
192.0.2.4                            1098/929        Up        Up        Gi0/0/1.8
192.0.2.9                            1111/928        Up        Up        Gi0/0/1.9
192.0.2.8                            1100/1254       Up        Up        Gi0/0/1.10
```

The **debug bfd neighbor detail** command displays the debugging information related to BFD packets:

```
Router# show bfd neighbor detail

IPv4 Sessions
NeighAddr                              LD/RD         RH/RS     State     Int
192.0.2.1                             362/1277       Up        Up        Gi0/0/1.2
Session state is UP and not using echo function.
Session Host: Hardware
OurAddr: 192.0.2.2
Handle: 33
Local Diag: 0, Demand mode: 0, Poll bit: 0
MinTxInt: 50000, MinRxInt: 50000, Multiplier: 3
Received MinRxInt: 50000, Received Multiplier: 3
Holddown (hits): 0(0), Hello (hits): 50(0)
Rx Count: 3465, Rx Interval (ms) min/max/avg: 42/51/46
Tx Count: 3466, Tx Interval (ms) min/max/avg: 39/52/46
Elapsed time watermarks: 0 0 (last: 0)
Registered protocols: CEF EIGRP
Uptime: 00:02:50
Last packet: Version: 1                  - Diagnostic: 0
             State bit: Up               - Demand bit: 0
             Poll bit: 0                 - Final bit: 0
             C bit: 1
             Multiplier: 3               - Length: 24
             My Discr.: 1277             - Your Discr.: 362
             Min tx interval: 50000      - Min rx interval: 50000
             Min Echo interval: 0
```

The **show bfd summary** command displays the BFD summary:

```
Router# show bfd summary

                    Session          Up          Down

Total                   400         400             0
```

The **show bfd drops** command displays the number of packets dropped in BFD:

```
Router# show bfd drops
BFD Drop Statistics
                      IPV4     IPV6    IPV4-M    IPV6-M    MPLS_PW   MPLS_TP_LSP
Invalid TTL             0         0       0         0          0       0
BFD Not Configured      0         0       0         0          0       0
No BFD Adjacency        33        0       0         0          0       0
Invalid Header Bits     0         0       0         0          0       0
Invalid Discriminator   1         0       0         0          0       0
Session AdminDown       94        0       0         0          0       0
Authen invalid BFD ver  0         0       0         0          0       0
Authen invalid len      0         0       0         0          0       0
Authen invalid seq      0         0       0         0          0       0
Authen failed           0         0       0         0          0       0
```

The **debug bfd packet** command displays debugging information about BFD control packets.

```
Router# debug bfd packet
*Nov 12 23:08:27.982: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/0 diag:0(No Diagnostic)
 Down C cnt:4 ttl:254 (0)
*Nov 12 23:08:27.982: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:983/1941 diag:3(Neighbor
Signaled Session Down) Init  C cnt:44 (0)
*Nov 12 23:08:28.007: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/983 diag:0(No Diagnostic)
 Up PC cnt:4 ttl:254 (0)
*Nov 12 23:08:28.007: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:983/1941 diag:0(No Diagnostic)
 Up F C cnt:0 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/983 diag:0(No Diagnostic)
 Up FC cnt:0 ttl:254 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:983/1941 diag:0(No Diagnostic)
 Up  C cnt:0 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/0 diag:0(No Diagnostic)
 Down C cnt:3 ttl:254 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Tx IP:192.0.2.3 ld/rd:993/1907 diag:3(Neighbor
Signaled Session Down) Init  C cnt:43 (0)
*Nov 12 23:08:28.311: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1941/983 diag:0(No Diagnostic)
 Up C cnt:0 ttl:254 (0)
*Nov 12 23:08:28.626: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up PC cnt:3 ttl:254 (0)
*Nov 12 23:08:28.626: BFD-DEBUG Packet: Tx IP:192.0.2.3 ld/rd:993/1907 diag:0(No Diagnostic)
 Up F C cnt:0 (0)
*Nov 12 23:08:28.645: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up C cnt:0 ttl:254 (0)
*Nov 12 23:08:28.700: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up FC cnt:0 ttl:254 (0)
*Nov 12 23:08:28.700: BFD-DEBUG Packet: Tx IP:192.0.2.3 ld/rd:993/1907 diag:0(No Diagnostic)
 Up  C cnt:0 (0)
*Nov 12 23:08:28.993: BFD-DEBUG Packet: Rx IP:192.0.2.3 ld/rd:1907/993 diag:0(No Diagnostic)
 Up C cnt:0 ttl:254 (0)
```

The **debug bfd event** displays debugging information about BFD state transitions:

```
Router# deb bfd event

*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.6, ld:1401, handle:77,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.6, ld:1401, handle:77,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.10, ld:1400, handle:39,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.10, ld:1400, handle:39,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.8, ld:1399, handle:25,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.8, ld:1399, handle:25,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.5, ld:1403, handle:173,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.6, ld:1403, handle:173,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.4, ld:1402, handle:95,
 event:DOWN adminDown, (0)
*Nov 12 23:11:29.503: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.4, ld:1402, handle:95,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.639: BFD-HW-API: Handle 1404: Timers: Tx timer 1000000 Detect timer 0
*Nov 12 23:11:30.639: BFD-HW-API: Handle 1404: Flags: Poll 0 Final 0
*Nov 12 23:11:30.639: BFD-HW-API: Handle 1404: Buffer: 0x23480318 0x0000057C 0x00000000
0x000F4240 0x000F4240 0x00000000 size 24
*Nov 12 23:11:30.641: BFD-HW-API: Handle 1405: Timers: Tx timer 1000000 Detect timer 0
*Nov 12 23:11:30.641: BFD-HW-API: Handle 1405: Flags: Poll 0 Final 0
*Nov 12 23:11:30.641: BFD-HW-API: Handle 1405: Buffer: 0x23480318 0x0000057D 0x00000000
```

```
0x000F4240 0x000F4240 0x00000000 size 24
*Nov 12 23:11:30.649: BFD-DEBUG Packet: Rx IP:192.0.2.6 ld/rd:1601/1404
diag:7(Administratively Down) AdminDown C cnt:0 ttl:254 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: V1 FSM ld:1404 handle:207 event:RX ADMINDOWN state:UP
 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: resetting timestamps ld:1404 handle:207 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.1, ld:1404, handle:207,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Packet: Tx IP:192.0.2.1 ld/rd:1404/0 diag:3(Neighbor Signaled
 Session Down) Down C cnt:0 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Packet: Rx IP:192.0.2.1 ld/rd:1620/1405
diag:7(Administratively Down) AdminDown C cnt:0 ttl:254 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: V1 FSM ld:1405 handle:209 event:RX ADMINDOWN state:UP
 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: resetting timestamps ld:1405 handle:209 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.1, ld:1405, handle:209,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Packet: Tx IP:192.0.2.7 ld/rd:1405/0 diag:3(Neighbor Signaled
 Session Down) Down C cnt:0 (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.7, ld:1404, handle:207,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.7, ld:1404, handle:207,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(EIGRP) IP:192.0.2.7, ld:1405, handle:209,
 event:DOWN adminDown, (0)
*Nov 12 23:11:30.650: BFD-DEBUG Event: notify client(CEF) IP:192.0.2.7, ld:1405, handle:209,
 event:DOWN adminDown, (0)
*Nov 12 23:11:31.035: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 192.0.2.8
```