# Configuring Stateful Interchassis Redundancy

The Stateful Interchassis Redundancy feature enables you to configure pairs of devices to act as backups for each other.

This module describes conceptual information about and tasks for configuring stateful interchassis redundancy.


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## Prerequisites for Stateful Interchassis Redundancy

All application redundancy configurations, including Network Address Translation (NAT) rules that have redundancy group associations and mapping IDs, must be identical on both devices, or NAT sessions will not be synchronized between devices and NAT redundancy will not work.

## Restrictions for Stateful Interchassis Redundancy

- By default, Network Address Translation (NAT) high availability (inter and intrabox) does not replicate HTTP sessions to the standby device. To replicate HTTP sessions on the standby device during a switchover, you must configure the **ip nat switchover replication http** command.
- During NAT payload translations with certain applications, there can be IP addresses in the payload that require NAT translation. The application-level gateway (ALG) for that specific application parses the packet for these IP addresses, NAT translates these addresses, and the ALG writes the translated addresses back into the packet.

  Fixup denotes the writing of the translated IP address back into the packet. The write back of data can change the length of a packet, which results in the adjustment of the packet's TCP sequence (SEQ) or acknowledgment (ACK) values by NAT for the life of the TCP connection. NAT writes the new TCP SEQ/ACK values into the packet during SEQ/ACK fixup.

  For example, during a TCP ALG session, SEQ/ACK values may require fixup with mainly ASCII applications such as Domain Name System (DNS), FTP/FTP64, H.323, Real Time Streaming Protocol

(RTSP), and Session Initiation Protocol (SIP). This SEQ/ACK adjustment information gets associated with the NAT session and is synchronized to the standby device periodically.

During a stateful switchover, if the SEQ/ACK information is not completely synchronized to the new active device it is likely that the TCP connection would be reset by endpoints of the application.

- Stateful interchassis redundancy cannot coexist with intrachassis redundancy, including software redundancy.
- In Service Software Upgrade (ISSU) is not supported.
- When changing the paired-address-pooling, bulk port-allocation, or NAT mode settings the following steps must be followed:
  1. Shutdown the redundancy group and NAT interfaces on the standby device using the **shutdown** command. Clear NAT sessions on the standby device after shutting down the redundancy group.
  2. Change the paired-address-pooling, bulk port-allocation, or NAT mode on the standby device first and then on the active device.
  3. Configure the **no shutdown** command for the redundancy group and NAT interfaces on the standby device.
- In a NAT Stateful Interchassis Redundancy configuration, it is mandatory that both peers use the same inside and outside NAT interfaces. If the interfaces are not same, it can lead to duplicate NAT entries.
- The following translations are not synchronized to the standby router :
  - Translations created based on an interface overload rule
  - ICMP requests

**Note** For a standalone NAT router, shut down the NAT interfaces before you make a configuration change.

# Information About Stateful Interchassis Redundancy

## Stateful Interchassis Redundancy Overview

You can configure the Stateful Interchassis Redundancy feature to determine the active device from a group of devices, based on a number of failover conditions. When a failover occurs, the standby device seamlessly takes over, starts performing traffic forwarding services, and maintains a dynamic routing table.

**Note** Manually shutting down the control or data interface link on an active NAT router results in traffic outage as the NAT router never transitions to active state.

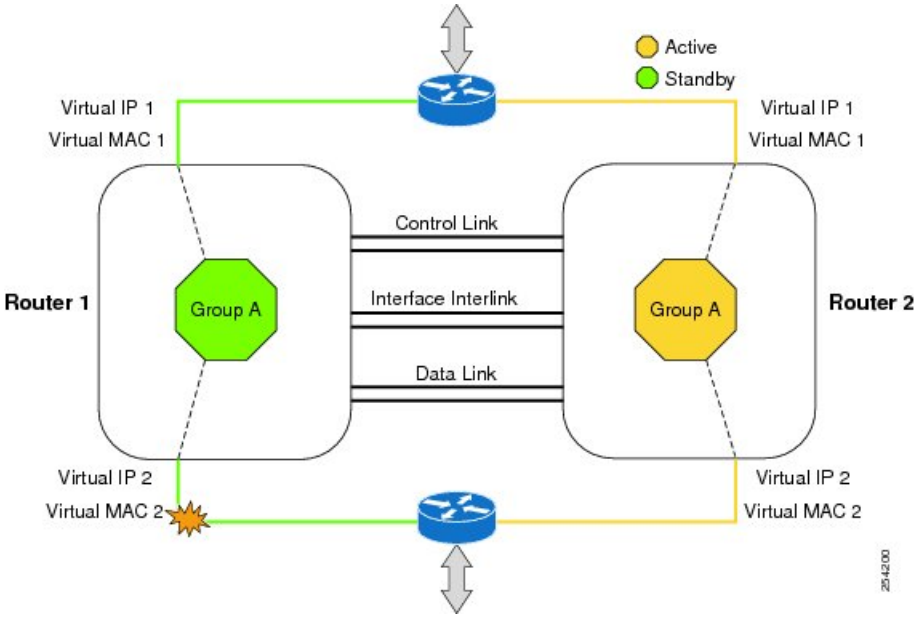
# Stateful Interchassis Redundancy Operation

You can configure pairs of devices to act as hot standbys for each other. Redundancy is configured on an interface basis. Pairs of redundant interfaces are known as redundancy groups (RGs). Redundancy occurs at an application level and does not require a complete physical failure of the interface or device for a switchover of the application to occur. When a switchover occurs, the application activity continues to run seamlessly on the redundant interface.

The figure below depicts an active/standby load-sharing scenario. The figure shows how an RG is configured for a pair of devices that has one outgoing interface. Group A on Router 1 is the active RG and Group A on Router 2 is the standby RG.

Redundant devices are joined by a configurable control link and a data synchronization link. The control link is used to communicate the status of devices. The data synchronization link is used to transfer stateful information from Network Address Translation (NAT) and the firewall and synchronize the stateful database. The pairs of redundant interfaces are configured with the same unique ID number known as the redundant interface identifier (RII).

***Figure 1: Redundancy Group Configuration—One Outgoing Interface***




The status of redundancy group members is determined through the use of hello messages sent over the control link. The software considers either device not responding to a hello message within a configurable amount of time to be a failure and initiates a switchover. For the software to detect a failure in milliseconds, control links run the failover protocol that is integrated with the Bidirectional Forwarding Detection (BFD) protocol. You can configure the following parameters for hello messages:

- Hello time—Interval at which hello messages are sent.
- Hold time—Amount of time before which the active or standby device is declared to be down.

The hello time defaults to 3 seconds to align with the Hot Standby Router Protocol (HSRP), and the hold time defaults to 10 seconds. You can also configure these timers in milliseconds by using the **timers hellotime msec** command.

To determine the pairs of interfaces that are affected by the switchover, you must configure a unique ID for each pair of redundant interfaces. This ID is known as the RII that is associated with the interface.

A switchover to the standby device can occur when the priority setting that is configured on each device changes. The device with the highest priority value acts as the active device. If a fault occurs on either the active or standby device, the priority of the device is decremented by a configurable amount known as the weight. If the priority of the active device falls below the priority of the standby device, a switchover occurs and the standby device becomes the active device. This default behavior can be overridden by disabling the preemption attribute for the RG. You can also configure each interface to decrease the priority when the Layer 1 state of the interface goes down. The priority that is configured overrides the default priority of an RG.

Each failure event that causes a modification of an RG priority generates a syslog entry that contains a time stamp, the RG that was affected, the previous priority, the new priority, and a description of the failure event cause.

A switchover also can occur when the priority of a device or interface falls below a configurable threshold level.

A switchover to the standby device occurs under the following circumstances:

- Power loss or a reload occurs on the active device (including reloads).
- The run-time priority of the active device goes below that of the standby device (with preempt configured).
- The run-time priority of the active device goes below that of the configured threshold.
- The redundancy group on the active device is reloaded manually. Use the **redundancy application reload group** *rg-number* command for a manual reload.

# Associations with Firewalls and NAT

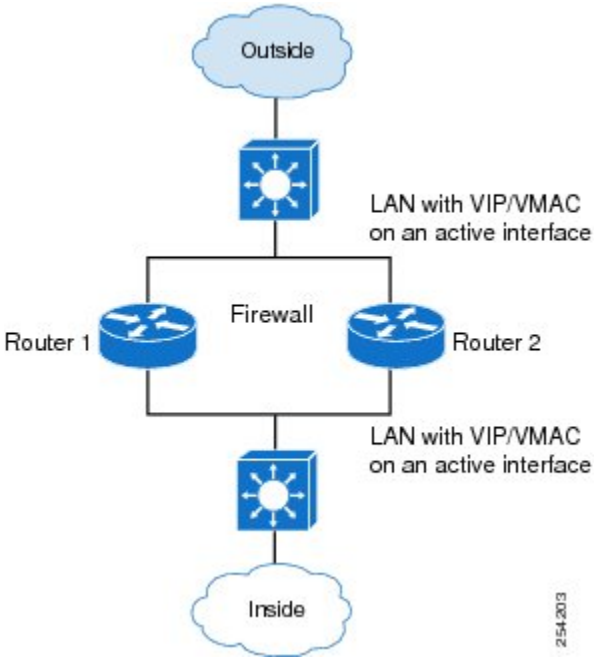
Firewalls use the association of the redundancy group with a traffic interface.

Network Address Translation (NAT) associates the redundancy group with a mapping ID.

# LAN-LAN Topology

The figure below shows the LAN-LAN topology. In a LAN-LAN topology, all participating devices are connected to each other through LAN interfaces on both the inside and the outside. In this scenario, traffic is often directed to the correct firewall if static routing is configured on the upstream or downstream devices to an appropriate virtual IP address. This plaform participate in dynamic routing with upstream or downstream devices. The dynamic routing configuration supported on LAN-facing interfaces must not introduce a dependency on the routing protocol convergence; otherwise, fast failover requirements will not be met.

*Figure 2: LAN-LAN Topology*




# How to Configure Stateful Interchassis Redundancy

## Configuring the Control Interface Protocol

The configuration for the control interface protocol consists of the following elements:

- Authentication information
- Group name
- Hello time
- Hold time
- Protocol instance
- Use of the bidirectional forwarding direction (BFD) protocol

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **redundancy**
4. **mode none**
5. **application redundancy**
6. **protocol** *number*

7. **name** *instance-name*
8. **timers hellotime** [**msec**] *number* **holdtime** [**msec**] *number*
9. **authentication** {**text** *string* | **md5 key-string** [**0** | **7**] *key* | **md5 key-chain** *key-chain-name*}
10. **bfd**
11. **end**

**DETAILED STEPS**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Device> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Device# configure terminal` | Enters global configuration mode. |
| **Step 3** | **redundancy**<br>**Example:**<br>`Device(config)# redundancy` | Enters redundancy configuration mode. |
| **Step 4** | **mode none**<br>**Example:**<br>`Device(config-red)# mode none` | Sets the redundancy mode to none, which is required for this feature. |
| **Step 5** | **application redundancy**<br>**Example:**<br>`Device(config-red)# application redundancy` | Enters redundancy application configuration mode. |
| **Step 6** | **protocol** *number*<br>**Example:**<br>`Device(config-red-app)# protocol 4` | Specifies the protocol instance that will be attached to a control interface, and enters redundancy application protocol configuration mode. |
| **Step 7** | **name** *instance-name*<br>**Example:**<br>`Device(config-red-app-prot)# name rg1` | (Optional) Specifies an optional alias for the protocol instance. |
| **Step 8** | **timers hellotime** [**msec**] *number* **holdtime** [**msec**] *number*<br>**Example:**<br>`Device(config-red-app-prot)# timers hellotime 3 holdtime 10` | Specifies the interval between hello messages sent and the time before a device is declared to be down.<br>• The default time for hello time is 3 seconds and for hold time is 10 seconds. |
| **Step 9** | **authentication** {**text** *string* \| **md5 key-string** [**0** \| **7**] *key* \| **md5 key-chain** *key-chain-name*}<br>**Example:** | Specifies authentication information. |

| | Command or Action | Purpose |
|---|---|---|
| | `Device(config-red-app-prot)# authentication text password` | |
| **Step 10** | **bfd**<br>**Example:**<br>`Device(config-red-app-prot)# bfd` | (Optional) Enables the integration of the failover protocol running on the control interface with the BFD protocol to achieve failure detection in milliseconds.<br>• BFD is enabled by default. |
| **Step 11** | **end**<br>**Example:**<br>`Device(config-red-app-prot)# end` | Exits redundancy application protocol configuration mode and enters privileged EXEC mode. |

# Configuring a Redundancy Group

Redundancy groups consist of the following configuration elements:

- The amount by which the priority will be decremented for each object.
- Faults (objects) that will decrement the priority.
- Failover priority.
- Failover threshold.
- Group instance.
- Group name.
- Initialization delay timer.
- The interface that is associated with the redundancy group (RG).
- The interface that is used as the control interface.
- The interface that is used as the data interface.
- The redundancy interface identifier (RII) number of the RG interface.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **redundancy**
4. **application redundancy**
5. **group** {**1** | **2**}
6. **name** *group-name*
7. **preempt**
8. **priority** *number* **failover-threshold** *number*
9. **track** *object-number* [**decrement** *number* | **shutdown**]
10. **timers delay** *seconds* [**reload** *seconds*]

11. **control** *interface-name* **protocol** *instance*
12. **data** *interface-name*
13. To create another redundancy group, repeat Steps 3 through 12.
14. **end**
15. **configure terminal**
16. **interface** *type number*
17. **redundancy group** *number* **ip** *address* **exclusive** [**decrement** *number*]
18. **redundancy rii** *number*
19. **end**

**DETAILED STEPS**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Device> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Device# configure terminal` | Enters global configuration mode. |
| **Step 3** | **redundancy**<br>**Example:**<br>`Device(config)# redundancy` | Enters redundancy configuration mode. |
| **Step 4** | **application redundancy**<br>**Example:**<br>`Device(config-red)# application redundancy` | Enters redundancy application configuration mode. |
| **Step 5** | **group** {**1** \| **2**}<br>**Example:**<br>`Device(config-red-app)# group 1` | Specifies the redundancy group instance and enters redundancy application group configuration mode. |
| **Step 6** | **name** *group-name*<br>**Example:**<br>`Device(config-red-app-grp)# name rg1` | (Optional) Specifies an optional alias for the protocol instance. |
| **Step 7** | **preempt**<br>**Example:**<br>`Device(config-red-app-grp)# preempt` | Enables preemption on the group and enables the standby device to preempt the active device regardless of which device has higher priority. |
| **Step 8** | **priority** *number* **failover-threshold** *number*<br>**Example:**<br>`Device(config-red-app-grp)# priority 120 failover-threshold 80` | Specifies the initial priority and failover threshold for the redundancy group. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 9** | **track** *object-number* [**decrement** *number* \| **shutdown**]<br>**Example:**<br>`Device(config-red-app-grp)# track 44 decrement 20` | Specifies the amount by which the priority of a redundancy group will be decremented if an event occurs.<br>• You can track multiple objects that influence the priority of the redundancy group. |
| **Step 10** | **timers delay** *seconds* [**reload** *seconds*]<br>**Example:**<br>`Device(config-red-app-grp)# timers delay 10 reload 20` | Specifies the amount of time by which the redundancy group will delay role negotiations that start after a fault occurs or after the system is reloaded. |
| **Step 11** | **control** *interface-name* **protocol** *instance*<br>**Example:**<br>`Device(config-red-app-grp)# control GigabitEthernet0/1/0 protocol 1` | Specifies the control interface that is used by the redundancy group.<br>• This interface is also associated with an instance of the control interface protocol. |
| **Step 12** | **data** *interface-name*<br>**Example:**<br>`Device(config-red-app-grp)# data GigabitEthernet0/1/2` | Specifies the data interface that is used by the redundancy group. |
| **Step 13** | To create another redundancy group, repeat Steps 3 through 12. | — |
| **Step 14** | **end**<br>**Example:**<br>`Device(config-red-app-grp)# end` | Exits redundancy application group configuration mode and enters privileged EXEC mode. |
| **Step 15** | **configure terminal**<br>**Example:**<br>`Device# configure terminal` | Enters global configuration mode. |
| **Step 16** | **interface** *type number*<br>**Example:**<br>`Device(config)# interface gigabitethernet 0/0/1` | Selects an interface to associate with the redundancy group and enters interface configuration mode. |
| **Step 17** | **redundancy group** *number* **ip** *address* **exclusive** [**decrement** *number*]<br>**Example:**<br>`Device(config-if)# redundancy group 1 ip 10.10.1.1 exclusive decrement 20` | Associates the interface with the redundancy group identified by the *number* argument. |
| **Step 18** | **redundancy rii** *number*<br>**Example:**<br>`Device(config-if)# redundancy rii 40` | Specifies a number for the RII associated with this interface.<br>• This number must match the RII of the other interface in the redundancy group. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 19** | **end**<br>**Example:**<br>`Device(config-if)# end` | Exits interface configuration mode and enters privileged EXEC mode. |

# Configuring a Redundant Traffic Interface

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask*
5. **ip nat outside**
6. **ip virtual-reassembly**
7. **negotiation auto**
8. **redundancy rii** *number*
9. **redundancy group** *number* **ip** *address* **exclusive** [**decrement** *number*]
10. **end**

### DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Device> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Device# configure terminal` | Enters global configuration mode. |
| **Step 3** | **interface** *type number*<br>**Example:**<br>`Device(config)# interface gigabitethernet 0/1/5` | Configures an interface and enters interface configuration mode. |
| **Step 4** | **ip address** *ip-address mask*<br>**Example:**<br>`Device(config-if)# ip address 10.1.1.2 255.0.0.0` | Sets a primary or secondary IP address for an interface. |
| **Step 5** | **ip nat outside**<br>**Example:**<br>`Device(config-if)# ip nat outside` | Configures the outside interface for IP address translation. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 6** | **ip virtual-reassembly**<br>**Example:**<br>`Device(config-if)# ip virtual-reassembly` | Enables Virtual Fragmentation Reassembly (VFR) on an interface. |
| **Step 7** | **negotiation auto**<br>**Example:**<br>`Device(config-if)# negotiation auto` | Enables the autonegotiation protocol to configure the speed, duplex, and automatic flow control of the Gigabit Ethernet interface. |
| **Step 8** | **redundancy rii** *number*<br>**Example:**<br>`Device(config-if)# redundancy rii 200` | Specifies a number for the redundancy interface identifier (RII) that is associated with this interface.<br>• This number must match the RII of the other interface in the redundancy group. |
| **Step 9** | **redundancy group** *number* **ip** *address* **exclusive** [**decrement** *number*]<br>**Example:**<br>`Device(config-if)# redundancy group 1 ip 10.1.1.200 exclusive decrement 10` | Associates the interface with the redundancy group identified by the *number* argument. |
| **Step 10** | **end**<br>**Example:**<br>`Device(config-if)# end` | Exits interface configuration mode and enters privileged EXEC mode. |

# Configuring NAT with Stateful Interchassis Redundancy

You must use a mapping ID to associate Network Address Translation (NAT) with a redundancy group.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*}
4. **ip nat inside source list** {{*access-list-number* | *access-list-name*} | **route-map** *name*} **pool** *name* [**redundancy** *redundancy-id* [**mapping-id** *map-id* | **overload** | **reversible** | **vrf** *name*]]
5. **end**

### DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Device> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 2** | **configure terminal**<br>**Example:**<br>`Device# configure terminal` | Enters global configuration mode. |
| **Step 3** | **ip nat pool** *name start-ip end-ip* {**netmask** *netmask* \| **prefix-length** *prefix-length*}<br>**Example:**<br>`Device(config)# ip nat pool VPN-18 10.10.0.0 10.10.255.255 netmask 255.255.0.0` | Defines a pool of IP addresses for NAT. |
| **Step 4** | **ip nat inside source list** {{*access-list-number* \| *access-list-name*} \| **route-map** *name*} **pool** *name* [**redundancy** *redundancy-id* [**mapping-id** *map-id* \| **overload** \| **reversible** \| **vrf** *name*]]<br>**Example:**<br>`Device(config)# ip nat inside source list acl-18 pool VPN-18 redundancy 2 mapping-id 152` | Enables NAT of the inside source address.<br>• You must use a mapping ID to associate NAT with the redundancy group. |
| **Step 5** | **end**<br>**Example:**<br>`Device(config)# end` | Exits interface configuration mode and returns to privileged EXEC mode. |

# Managing and Monitoring Stateful Interchassis Redundancy

All configuration commands in this task are optional. You can use the **show** commands in any order.

### SUMMARY STEPS

1. **enable**
2. **redundancy application reload group** *number* [**peer** | **self**]
3. **show redundancy application group** [*group-id* | **all**]
4. **show redundancy application transport** {**clients** | **group** [*group-id*]}
5. **show redundancy application protocol** {*protocol-id* | **group** [*group-id*]}
6. **show redundancy application faults group** [*group-id*]
7. **show redundancy application if-mgr group** [*group-id*]
8. **show redundancy application control-interface group** [*group-id*]
9. **show redundancy application data-interface group** [*group-id*]
10. **show monitor event-trace rg_infra all**

### DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:** | Enables privileged EXEC mode.<br>• Enter your password if prompted. |

| | Command or Action | Purpose |
|---|---|---|
| | `Device> enable` | |
| **Step 2** | **redundancy application reload group** *number* [**peer** \| **self**]<br>**Example:**<br>`Device# redundancy application reload group 2 self` | Forces the active redundancy group (RG) to reload and the standby RG to become the active RG.<br>• Use the **redundancy application reload** command to verify if the redundancy configuration is working. You must enter this command on the active RG. |
| **Step 3** | **show redundancy application group** [*group-id* \| **all**]<br>**Example:**<br>`Device# show redundancy application group 2` | Displays summary information for the specified group or for all groups. |
| **Step 4** | **show redundancy application transport** {**clients** \| **group** [*group-id*]}<br>**Example:**<br>`Device# show redundancy application transport group 2` | Displays transport information for the specified group or for all groups. |
| **Step 5** | **show redundancy application protocol** {*protocol-id* \| **group** [*group-id*]}<br>**Example:**<br>`Device# show redundancy application protocol 2` | Displays protocol information for the specified group or for all groups. |
| **Step 6** | **show redundancy application faults group** [*group-id*]<br>**Example:**<br>`Device# show redundancy application faults group 2` | Displays information about faults for the specified group or for all groups. |
| **Step 7** | **show redundancy application if-mgr group** [*group-id*]<br>**Example:**<br>`Device# show redundancy application if-mgr group 2` | Displays information about the interface manager (if-mgr) for the specified group or for all groups. |
| **Step 8** | **show redundancy application control-interface group** [*group-id*]<br>**Example:**<br>`Device# show redundancy application control-interface group IF-2` | Displays interface information associated with redundancy groups for the specified control interface. |
| **Step 9** | **show redundancy application data-interface group** [*group-id*]<br>**Example:**<br>`Device# show redundancy application data-interface group IF-2` | Displays interface information associated with redundancy groups for the specified data interface. |
| **Step 10** | **show monitor event-trace rg_infra all**<br>**Example:** | Displays event trace information associated with all redundancy groups. |

| | Command or Action | Purpose |
|---|---|---|
| | Device# show monitor event-trace rg_infra all | |

# Configuration Examples for Stateful Interchassis Redundancy

## Example: Configuring the Control Interface Protocol

```
Device# configure terminal
Device(config)# redundancy
Device(config-red)# mode none
Device(config-red)# application redundancy
Device(config-red-app)# protocol 4
Device(config-red-app-prot)# name rg1
Device(config-red-app-prot)# timers hellotime 3 holdtime 10
Device(config-red-app-prot)# authentication text password
Device(config-red-app-prot)# bfd
```

## Example: Configuring a Redundancy Group

```
Device# configure terminal
Device(config)# redundancy
Device(config-red)# application redundancy
Device(config-red-app)# group 1
Device(config-red-app-grp)# name rg1
Device(config-red-app-grp)# preempt
Device(config-red-app-grp)# priority 120 failover-threshold 80
Device(config-red-app-grp)# track 44 decrement 20
Device(config-red-app-grp)# timers delay 10 reload 20
Device(config-red-app-grp)# control GigabitEthernet0/1/0 protocol 1
Device(config-red-app-grp)# data GigabitEthernet0/1/2
Device(config-red-app-grp)# end
Device# configure terminal
Device(config)# interface GigabitEthernet 0/0/1
Device(config-if)# redundancy group 1 ip 10.10.1.1 exclusive decrement 20
Device(config-if)# redundancy rii 40
```

## Example: Configuring a Redundant Traffic Interface

```
Device# configure terminal
Device(config)# interface GigabitEthernet 0/1/5
Device(config-if)# ip address 10.1.1.2 255.0.0.0
Device(config-if)# ip nat outside
Device(config-if)# ip virtual-reassembly
Device(config-if)# negotiation auto
Device(config-if)# redundancy rii 200
Device(config-if)# redundancy group 1 ip 10.1.1.200 exclusive decrement 10
```

# Example: Configuring NAT with Stateful Interchassis Redundancy

```
Device# configure terminal
Device(config)# ip nat pool VPN-18 10.10.0.0 10.10.255.255 netmask 255.255.0.0
Device(config)# ip nat inside source list acl-18 pool VPN-18 redundancy 2 mapping-id 152
```

# Additional References for Stateful Interchassis Redundancy

### Related Documents

| Related Topic | Document Title |
|---|---|
| Cisco IOS commands | Cisco IOS Master Command List, All Releases |
| IP addressing commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples | Cisco IOS IP Addressing Services Command Reference |
| Fundamental principles of IP addressing and IP routing | *IP Routing Primer* |

### Standards and RFCs

| Standards/RFCs | Title |
|---|---|
| RFC 791 | Internet Protocol |
| RFC 1338 | Classless Inter-Domain Routing (CIDR): an Address Assignment and Aggregation Strategy |
| RFC 1466 | Guidelines for Management of IP Address Space |
| RFC 1716 | Towards Requirements for IP Routers |
| RFC 1918 | Address Allocation for Private Internets |
| RFC 3330 | Special-Use IP Addresses |

### Technical Assistance

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