Stateful Failover for IPsec

Stateful failover for IP Security (IPsec) enables a router to continue processing and forwarding IPsec packets after a planned or unplanned outage occurs. Customers employ a backup (secondary) router that automatically takes over the tasks of the active (primary) router if the active router loses connectivity for any reason. This failover process is transparent to users and does not require adjustment or reconfiguration of any remote peer.

Stateful failover for IPsec is designed to work in conjunction with stateful switchover (SSO) and Hot Standby Routing Protocol (HSRP). HSRP provides network redundancy for IP networks, ensuring that user traffic immediately and transparently recovers from failures in network edge devices or access circuits. That is, HSRP monitors both the inside and outside interfaces so that if either interface goes down, the whole router is deemed to be down and the ownership of Internet Key Exchange (IKE) and IPsec security associations (SAs) is passed to the standby router (which transitions to the HSRP active state). SSO allows the active and standby routers to share IKE and IPsec state information so both routers have enough information to become the active router at any time. To configure stateful failover for IPsec, a network administrator must enable HSRP, assign a virtual IP address (VIP), and enable SSO.

Note Security threats, as well as the cryptographic technologies to help protect against them, are constantly changing. For more information about the latest Cisco cryptographic recommendations, see the Next Generation Encryption (NGE) white paper.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

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

Prerequisites for Stateful Failover for IPsec

Complete, Duplicate IPsec and IKE Configuration on the Active and Standby Devices

This document assumes that you have a complete IKE and IPsec configuration.

The IKE and IPsec configuration that is set up on the active device must be duplicated on the standby device. That is, the crypto configuration must be identical with respect to Internet Security Association and Key Management Protocol (ISAKMP) policy, ISAKMP keys (preshared), IPsec profiles, IPsec transform sets, all crypto map sets that are used for stateful failover, all access control lists (ACLs) that are used in match address statements on crypto map sets, all AAA configurations used for crypto, client configuration groups, IP local pools used for crypto, and ISAKMP profiles.

Note The configuration information between the active and standby devices is not automatically transferred; you are responsible for ensuring that the crypto configurations match on both devices. If the crypto configurations on both devices do not match, failover from the active device to the standby device will not be successful.

Device Requirements

Stateful failover for IPsec requires that your network contains two identical routers that are available to be either the primary or secondary device. Both routers should be the same type of device, have the same CPU and memory, and have either no encryption accelerator or identical encryption accelerators.

Restrictions for Stateful Failover for IPsec

When configuring redundancy for a VPN, the following restrictions apply:

- Both the active and standby devices must run the identical version of the Cisco IOS software, and both the active and standby devices must be connected via a hub or switch.
- The Cisco Integrated Services Routers (ISRs) and the VPN modules that support stateful failover for IPsec are as follows:
  - The AIM-VPN/BPII-PLUS and AIM-VPN/SSL-1 hardware encryption modules are supported on the Cisco 1841 router.
  - The AIM-VPN/EPII-Plus and AIM-VPN/SSL-2 hardware encryption modules are supported on Cisco 2801, 2811, 2821, and 2851 routers.
  - The AIM-VPN/EPII+ and AIM-VPN/SSL-3 hardware encryption modules are supported on the Cisco 3825 router.
  - The AIM-VPN/HPII+ and AIM-VPN/SSL-3 hardware encryption modules are supported on the Cisco 3845 router.

  - The VPN Acceleration Module (VAM) and VAM2 hardware encryption modules are supported on the Cisco 7200 series router.

- Stateful failover for IPsec is supported on the Cisco Integrated Services Routers Generation 2 (ISR G2), with or without the Internal Service Module (ISM). The supported crypto algorithms for ISM in stateful failover are esp-des, esp-3des, esp-aes, esp-md5-hmac, and esp-sha-hmac.
- Stateful Failover for IPsec is not supported on platforms running Cisco IOS-XE software.
- Stateful failover for IPsec is not supported on the Cisco 800 Series Routers.
- Stateful failover for IPsec is not supported on the Cisco ISR 4000 Series Routers.
- Stateful failover for IPsec is not supported on the Cisco ASR 1000 Series Routers.
- IKEv2 does not support stateful IPSec failover. To achieve redundancy for IKEv2, use FlexVPN, DMVPN, redundant VTI Based IPsec VPN tunnels with dynamic routing protocols and backup routes over second tunnel.
- Only “box-to-box” failover is supported; that is, intrachassis failover is not supported.
- WAN interfaces between the active (primary) router and the standby (secondary) router are not supported. (HSRP requires inside interfaces and outside interfaces to be connected via LANs.)
- Load balancing is not supported; that is, no more than one device in a redundancy group can be active at any given time.
- Stateful failover for IPsec with Layer 2 Tunneling Protocol (L2TP) is not supported.
- Stateful Failover for IPsec does not support Internet Key Exchange Version 2 (IKEv2).
- Public key infrastructure (PKI) is not supported when used with stateful failover. (Only preshared keys for IKE are supported.)
- IKE keepalives are not supported. (Enabling this functionality will cause the connection to be torn down after the standby router assumes ownership control.) However, dead peer detection (DPD) and periodic DPD are supported.
- IPsec idle timers are not supported when used with stateful failover.
- A stateful failover crypto map applied to an interface in a virtual routing forwarding (VRF) instance is not supported. However, VRF-aware IPsec features are supported when a stateful failover crypto map is applied to an interface in the global VRF.
- Stateful failover is not compatible or interoperable with the State Synchronization Protocol (SSP) version of stateful failover (which is available in Cisco IOS Release 12.2YX1 and Cisco IOS Release 12.2SU).

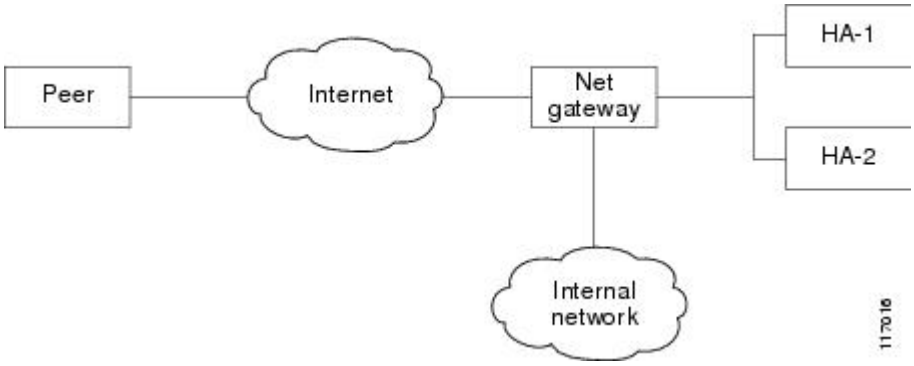
Information About Stateful Failover for IPsec

Supported Deployment Scenarios for Stateful Failover for IPsec

You can implement stateful failover for IPsec in one of the following recommended deployment scenarios: a single interface scenario or a dual interface scenario.

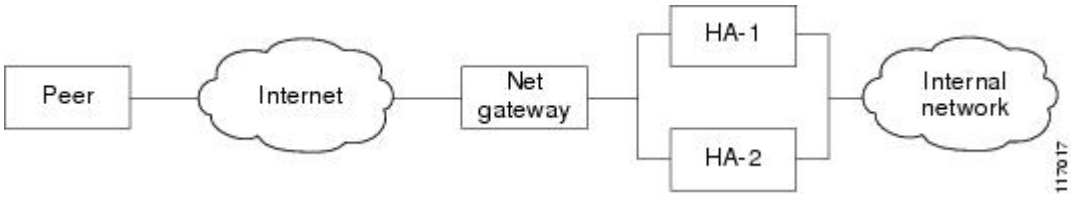
In a single interface scenario, VPN gateways use one LAN connection for both encrypted traffic arriving from remote peers and decrypted traffic flowing to inside hosts (see the figure below). The single interface design allows customers to save money on router ports and subnets. This design is typically used if all traffic flowing in and out of the organization does not traverse the VPN routers.

Figure 1: Single Interface Network Topology



In a dual interface scenario, a VPN gateway has more than one interface, enabling traffic to flow in and out of the router via separate interfaces (see the figure below). This scenario is typically used if traffic flowing in and out of a site must traverse the routers, so the VPN routers will provide the default route out of the network.

Figure 2: Dual Interface Network Topology



The table below lists the functionality available in single-interface and dual-interface scenarios.

Table 1: Single- and Dual-Interface Functionality Overview

Functionality	Single Interface	Dual Interface
Route Injection	Routes must be injected to provide the devices that are behind the VPN gateways with a next hop for traffic that requires encryption. Stateful failover for IPsec typically requires routes to be injected for this network topology.	If the VPN gateways are not the logical next hop for devices inside the network, the routes must be created and injected into the routing process. Thus, traffic that is returning from inside the network can be sent back to the VPN routers for IPsec services before it is sent out. A virtual IP (VIP) address cannot be used as the advertiser of routing updates, so flows must be synchronized via the injected routes. If the VPN gateways are the next hop (default route) for all devices inside the network, the VIP address that is used on the inside interfaces can be used as the next hop. Thus, injection of the VPN routes is not required. However, static routes on inside hosts must be used to direct the routes to the next hop VIP address.
HSRP Configuration	The role of HSRP is simplified in a single interface design because if the only interface is disabled, the entire device is deemed unavailable. This functionality helps to avoid some of the routing considerations to be discussed in the next scenario.	Because each interface pair functions independently, you should configure HSRP so that multiple pairs of interfaces can be tracked. (That is, HSRP should not be configured on only one pair of interfaces or on both pairs of interfaces without each pair mutually tracking each other.) Mutual tracking means that if the outside interface does fail, the inside interface on the same router will also be deemed down, allowing for complete router failover to the secondary router.
Secure State Information	If secure state information is passed between routers, the information is passed over the same interface as all other traffic.	The router has a separate inside and outside interface; thus, the inside interface can be used as a more secure channel for the exchange of state information.

Functionality	Single Interface	Dual Interface
Firewall Configuration	The VPN gateways can sit in front of a firewall or behind a firewall.	VPN gateways may sit behind or in front of a firewall. A firewall can be installed in parallel to the VPN gateways.

IPsec Stateful Failover for Remote Access Connections

The main difference between a remote access and a LAN-to-LAN connection is the use of Xauth and mode-config. IKE Xauth is often used to authenticate a user. IKE mode-config is often used to push security policy from a hub (concentrator) router to a user's IPsec implementation. Mode-config is also typically used to assign an internal company network IP address to a user.

In addition to the differences between a remote access configuration and a LAN-to-LAN configuration, you should note the following remote-access-server-specific functions:

- Assigned IP address—An IP address can be assigned to the client via one of the following options:
  - Local IP pools

    For local IP pools, the administrator must first configure identical local IP address pools on each router in the high availability (HA) pair (via the **ip local pool** *client-address-pool* command). This pool name can be applied in one of two places—in a group policy via the **crypto isakmp client configuration group** *group-name* (and the submode command **pool** *pool-name*) or in a client configuration via the **crypto isakmp client configuration address-pool local** *local-pool* command.

  - RADIUS-assigned address

    If you are using RADIUS authentication and the RADIUS server returns the Framed-IP-Address attribute, the concentrator will always assign the address to the client. It is recommended that you refer to your RADIUS server vendor's documentation, especially for vendors that allow you to configure address pools on the RADIUS server. Typically, those servers require crypto accounting to work properly.

To enable accounting on the HA pair, you should execute the following command on both active and standby devices: **aaa accounting network** and apply radius-accounting either to the crypto ISAKMP profile or the crypto map set.

- RADIUS Network Access Server (NAS)-IP address

  The HA pair should appear as a single device to the RADIUS server. Thus, both HA routers must communicate with the RADIUS server using the same IP address. However, when communicating with the RADIUS server, the router must use a physical IP address, not a virtual IP (VIP) address as the NAS-IP address of the router. To configure the RADIUS NAS-IP address for the HA pair, you must configure the same loopback address in the HA pair via **interface loopback** command; thereafter, you must execute the **ip radius source-interface** command in the HA pair. Finally, add the new loopback IP address to the RADIUS servers configuration so the RADIUS server can process requests from the HA pair.

For additional information on how to configure IPsec stateful failover for a remote access connection, see the section " Example: Configuring Stateful Failover for IPsec for an Easy VPN Server."

Dead Peer Detection with IPsec High Availability

To configure Dead Peer Detection (DPD) with IPsec High Availability (HA), it is recommended that you use a value other than the default (2 seconds). A keepalive time of 10 seconds with 5 retries seems to work well with HA because of the time it takes for the router to get into active mode.

To configure DPD with IPsec HA, use the **crypto isakmp keepalive** command.

How to Enable Stateful Failover for IPsec

Enabling HSRP IP Redundancy and a Virtual IP Address

HSRP provides two services, IP redundancy and a virtual IP (VIP) address. Each HSRP group may provide either or both of these services. IPsec stateful failover uses the IP redundancy services from only one HSRP standby group. It can use the VIP address from one or more HSRP groups. Use this task to configure HSRP on the outside and inside interfaces of the device.

When configuring HSRP, you must ensure the following:

- Both the inside (private) interface and the outside (public) interface must belong to separate HSRP groups, but the HSRP group number can be the same.
- The state of the inside interface and the outside interface must be the same—both interfaces must be in the active state or standby state; otherwise, the packets will not have a route out of the private network.
- Standby priorities should be equal on both active and standby routers. If the priorities are not equal, the higher priority router will unnecessarily take over as the active router, negatively affecting uptime.
- The IP addresses on the HSRP-tracked interfaces of the standby and active routers should both be either lower or higher on one router than the other. In the case of equal priorities (an HA requirement), HSRP will assign the active state on the basis of the IP address. If an addressing scheme exists so that the public IP address of Router A is lower than the public IP address of Router B, but the opposite is true for their private interfaces, an active/standby-standby/active split condition could exist which will break connectivity.

Note Each time an active device relinquishes control to become the standby device, the active device will reload. This functionality ensures that the state of the new standby device synchronizes correctly with the new active device.

Before you begin

Before you perform this task, you must perform one of the following steps to ensure that the correct HSRP settings are configured on the switch that connects the active and standby routers:

- Enable the **spanning-tree portfast** command on every switch port that connects to an HSRP-enabled router interface.
- Disable the Spanning Tree Protocol (STP) on the switch only if your switch does not connect to other switches. Disabling spanning tree in a multiswitch environment may cause network instability.

- Enable the **standby delay minimum** [*min-delay*] **reload** [*reload-delay*] command even if the **spanning-tree portfast** command is configured. This command must be applied to all HSRP interfaces on both routers. During HSRP stateful failover, configure **standby delay minimum** *30* **reload** *60* .

For more information on HSRP instability, see the document *Avoiding HSRP Instability in a Switching Environment with Various Router Platforms*.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **standby** *standby-group-number* **name** *standby-group-name*
5. **standby** *standby-group-number* **ip** *ip-address*
6. **standby** *standby-group-number* **track** *interface-type interface-number*
7. **standby** [*group-number*] **preempt**
8. **standby** [*group-number*] **timers** [**msec**] *hellotime* [**msec**] *holdtime*
9. **standby delay minimum** [*min-delay*] **reload** [*reload-delay*]
10. Repeat this task on both routers (active and standby) and on both interfaces of each router.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface Ethernet 0/0`	Configures an interface type for the router and enters interface configuration mode.
Step 4	**standby** *standby-group-number* **name** *standby-group-name* **Example:** `Router(config-if)# standby 1 name HA-out`	Assigns a user-defined group name to the HSRP redundancy group. **Note** The *standby-group-number* argument should be the same for both routers that are on directly connected interfaces. However, the *standby-group-name* argument should be different between two (or more) groups on the same router. The *standby-group-number* argument can be the same on the other pair of interfaces as well.

	Command or Action	Purpose
Step 5	**standby** *standby-group-number* **ip** *ip-address* **Example:** `Router(config-if)# standby 1 ip 209.165.201.1`	Assigns an IP address that is to be "shared" among the members of the HSRP group and owned by the primary IP address. **Note** The virtual IP address must be configured identically on both routers (active and standby) that are on directly connected interfaces.
Step 6	**standby** *standby-group-number* **track** *interface-type interface-number* **Example:** `Router(config-if)# standby 1 track Ethernet1/0`	(Optional) Configures HSRP to monitor the second interface so that if either of the two interfaces goes down, HSRP causes failover to the standby device. **Note** Although this command is not required, it is recommended for dual interface configurations.
Step 7	**standby** [*group-number*] **preempt** **Example:** `Router(config-if)# standby 1 preempt`	Enables HSRP preemption and preemption delay.
Step 8	**standby** [*group-number*] **timers** [**msec**] *hellotime* [**msec**] *holdtime* **Example:** `Router(config-if)# standby 1 timers 1 5`	(Optional) Configures the time between hello packets and the time before other routers declare the active Hot Standby or standby router to be down. • *holdtime*—Amount of time the routers take to detect types of failure. A larger hold time means that failure detection will take longer. For the best stability, it is recommended that you set the hold time between 5 and 10 times the hello interval time; otherwise, a failover could falsely occur when no actual failure has happened.
Step 9	**standby delay minimum** [*min-delay*] **reload** [*reload-delay*] **Example:** `Router(config-if)# standby delay minimum reload 120`	Configures the delay period before the initialization of HSRP groups. **Note** It is suggested that you enter 120 as the value for the *reload-delay* argument and leave the *min-delay* argument at the preconfigured default value.
Step 10	Repeat this task on both routers (active and standby) and on both interfaces of each router.	—

Troubleshooting Tips

To help troubleshoot possible HSRP-related configuration problems, issue any of the following HSRP-related debug commands—**debug standby errors**, **debug standby events**, and **debug standby packets** [**terse**].

Examples

The following example shows how to configure HSRP on a router:

```
interface Ethernet0/0
 ip address 209.165.201.1 255.255.255.224
 standby 1 ip 209.165.201.3
 standby 1 preempt
 standby 1 name HA-out
 standby 1 track Ethernet1/0
 standby delay reload 120
```

What to Do Next

After you have successfully configured HSRP on the inside and outside interfaces, you should enable SSO as described in the section "Enabling SSO."

Enabling SSO

Enabling SSO Interaction with IPsec and IKE

SSO is a method of providing redundancy and synchronization for many Cisco IOS applications and features. SSO is necessary for IPsec and IKE to learn about the redundancy state of the network and to synchronize their internal application state with their redundant peers.

Before you begin

Before you perform this task, you must:

- Configure HSRP before enabling SSO.
- Include the following commands in the local address section of the Stream Control Transmission Protocol (SCTP) section when configuring Inter-Process Communication (IPC):
  - **retransmit-timeout** *retran-min* [*msec*] *retra-max* [*msec*]
  - **path-retransmit** *max-path-retries*
  - **assoc-retransmit** *retries*

Note The above commands are included to avoid losing SCTP communication between peers.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **redundancy inter-device**
4. **scheme standby** *standby-group-name*
5. **exit**
6. **ipc zone default**
7. **association** *association-ID*

8. **protocol sctp**
9. **local-port** *local-port-number*
10. **local-ip** *device-real-ip-address* [*device-real-ip-address2*]
11. **retransmit-timeout** *retran-min* [*msec*] *retra-max* [*msec*]
12. **path-retransmit** *max-path-retries*
13. **assoc-retransmit** *max-association-retries*
14. **exit**
15. **remote-port** *remote-port-number*
16. **remote-ip** *peer-real-ip-address* [*peer-real-ip-address2*]
17. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**redundancy inter-device** **Example:** `Router(config)# redundancy inter-device`	Configures redundancy and enters inter-device configuration mode. • To exit inter-device configuration mode, use the **exit** command. To remove all inter-device configuration, use the **no** form of the command.
Step 4	**scheme standby** *standby-group-name* **Example:** `Router(config-red-interdevice)# scheme standby HA-out`	Defines the redundancy scheme. Currently, "standby" is the only supported scheme. • *standby-group-name*—Must match the standby name specified in the **standby name** interface configuration command. Also, the standby name should be the same on both routers. **Note** Only the active or standby state of the standby group is used for SSO. The VIP address of the standby group is not required or used by SSO. Also, the standby group does not have to be part of any crypto map configuration.
Step 5	**exit** **Example:** `Router(config-red-interdevice)# exit`	Exits inter-device configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 6	**ipc zone default** **Example:** `Router(config)# ipc zone default`	Configures the inter-device communication protocol, Inter-Process Communication (IPC), and enters IPC zone configuration mode. • Use this command to initiate the communication link between the active router and standby router.
Step 7	**association** *association-ID* **Example:** `Router(config-ipczone)# association 1`	Configures an association between the two devices and enters IPC association configuration mode. • *association-ID*—Association ID assignment. The value range is from 1 through 255. The association ID must be unique within a specific zone.
Step 8	**protocol sctp** **Example:** `Router(config-ipczone-assoc)# protocol sctp`	Configures Stream Control Transmission Protocol (SCTP) as the transport protocol and enters SCTP protocol configuration mode.
Step 9	**local-port** *local-port-number* **Example:** `Router(config-ipc-protocol-sctp)# local-port 5000`	Defines the local SCTP port number that is used to communicate with the redundant peer and enters IPC transport-SCTP local configuration mode. • *local-port-number*—There is no default value. This argument must be configured for the local port to enable inter-device redundancy. Valid port values: 1 to 65535. The local port number should be the same as the remote port number on the peer router.
Step 10	**local-ip** *device-real-ip-address* [*device-real-ip-address2*] **Example:** `Router(config-ipc-local-sctp)# local-ip 10.0.0.1`	Defines at least one local IP address that is used to communicate with the redundant peer. • The local IP addresses must match the remote IP addresses on the peer router. There can be either one or two IP addresses, which must be in the global VRF. A virtual IP address cannot be used.
Step 11	**retransmit-timeout** *retran-min* [*msec*] *retra-max* [*msec*] **Example:** `Router(config-ipc-local-sctp)# retransmit-timeout 300 10000`	Configures the maximum amount of time, in milliseconds, that SCTP will wait before retransmitting data. • *retran-min*—Range is 300 to 60000. Default value is 300. • *retran-max*—Range is 300 to 60000. Default value is 600.
Step 12	**path-retransmit** *max-path-retries* **Example:** `Router(config-ipc-local-sctp)# path-retransmit 10`	Configures the number of consecutive retransmissions SCTP will perform before failing a path within an association. • *max-path-retries*—Range is 2 to 10. Default value is 4 retries.

	Command or Action	Purpose
Step 13	**assoc-retransmit** *max-association-retries* **Example:** `Router(config-ipc-local-sctp)# assoc-retransmit 10`	Configures the number of consecutive retransmissions SCTP will perform before failing an association. • *max-association-retries*—Range is 2 to 10. Default value is 4 retries.
Step 14	**exit** **Example:** `Router(config-ipc-local-sctp)# exit`	Exits IPC transport-SCTP local configuration mode and enters SCTP protocol configuration mode.
Step 15	**remote-port** *remote-port-number* **Example:** `Router(config-ipc-protocol-sctp)# remote-port 5000`	Defines the remote SCTP port number that is used to communicate with the redundant peer and enters IPC transport-SCTP remote configuration mode. • *remote-port-number*—There is no default value. This argument must be configured for the remote port to enable inter-device redundancy. Valid port values: 1 to 65535. The remote port number should be the same as the local port number on the peer router.
Step 16	**remote-ip** *peer-real-ip-address* [*peer-real-ip-address2*] **Example:** `Router(config-ipc-remote-sctp)# remote-ip 10.0.0.2`	Defines at least one remote IP address of the redundant peer that is used to communicate with the local device. • All remote IP addresses must refer to the same device. • A virtual IP address cannot be used.
Step 17	**end** **Example:** `Router(config-ipc-remote-sctp)# end`	Exits IPC transport-SCTP remote configuration mode and returns to privileged EXEC mode.

Troubleshooting Tips

To help troubleshoot possible SSO-related configuration problems, use the **debug redundancy** command.

Examples

The following example shows how to enable SSO:

```
!
redundancy inter-device
 scheme standby HA-out
!
!
ipc zone default
 association 1
  no shutdown
  protocol sctp
   local-port 5000
    local-ip 10.0.0.1
    retransmit-timeout 300 10000
```

```
    path-retransmit 10
    assoc-retransmit 10
   remote-port 5000
    remote-ip 10.0.0.2
!
```

What to Do Next

After you have enabled SSO, you should configure reverse route injection (RRI) on a crypto map as described in the section "Configuring Reverse Route Injection on a Crypto Map."

Configuring Reverse Route Injection on a Crypto Map

You should configure Reverse Route Injection (RRI) on all existing crypto maps that you want to use with stateful failover. RRI is used with stateful failover so that the routers on the inside network can learn about the correct path to the current active device. When failover occurs, the new active device injects the RRI routes into its IP routing table and sends out routing updates to its routing peers.

Configuring Reverse Route Injection on Dynamic Crypto Map

Dynamic crypto map entries, like regular static crypto map entries, are grouped into sets. A set is a group of dynamic crypto map entries all with the same dynamic map name, but each with a different dynamic sequence number. Each member of the set may be configured for RRI.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto dynamic-map** *map-name seq-num*
4. **reverse-route**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**crypto dynamic-map** *map-name seq-num* **Example:** `Router(config)# crypto dynamic-map mymap 10`	Creates a dynamic crypto map entry and enters crypto map configuration mode.
Step 4	**reverse-route** **Example:**	Enables RRI for a dynamic crypto map.

	Command or Action	Purpose
	`Router(config-crypto-map)# reverse-route`	
Step 5	**end** **Example:** `Router(config-crypto-map)# end`	Exits crypto map configuration mode and returns to privileged EXEC mode.

Configuring Reverse Route Injection on a Static Crypto Map

Static crypto map entries are grouped into sets. A set is a group of static crypto map entries all with the same static map name, but each with a different sequence number. Each static crypto map in the map set can be configured for RRI. Use this task to configure RRI on a static crypto map.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto map** *map-name seq-num* **ipsec-isakmp**
4. **reverse-route**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**crypto map** *map-name seq-num* **ipsec-isakmp** **Example:** `Router(config)# crypto map to-peer-outside 10 ipsec-isakmp`	Creates or modifies a crypto map entry and enters crypto map configuration mode.
Step 4	**reverse-route** **Example:** `Router(config-crypto-map)# reverse-route`	Dynamically creates static routes based on crypto ACLs.
Step 5	**end** **Example:** `Router(config-crypto-map)# end`	Exits crypto map configuration mode and returns to privileged EXEC mode.

Examples

The following example shows how to configure RRI on the static crypto map “to-peer-outside”:

```
crypto map to-peer-outside redundancy replay-interval inbound 1000 outbound 10000
crypto map to-peer-outside 10 ipsec-isakmp
 set peer 209.165.200.225
 set transform-set trans1
 match address peer-outside
 reverse-route
```

What to Do Next

After you have configured RRI, you can enable stateful failover for IPsec and IKE.

Enabling Stateful Failover for IKE and IPsec

Enabling Stateful Failover for IKE

There is no specific CLI necessary to enable stateful failover for IKE. It is enabled for a particular virtual IP address when a stateful failover crypto map is applied to an interface.

Enabling Stateful Failover for IPsec

Use this task to enable stateful failover for IPsec. All IPsec state information is transferred from the active router to the standby router via the SSO redundancy channel that was specified in the task “Enabling SSO.”

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **crypto map** *map-name* [**redundancy** *standby-group-name* [**stateful**]]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:**	Defines an interface that has already been configured for redundancy and enters interface configuration mode.

	Command or Action	Purpose
	`Router(config)# interface Ethernet 0/0`	
Step 4	**crypto map** *map-name* [**redundancy** *standby-group-name* [**stateful**]] **Example:** `Router(config-if)# crypto map to-peer-outside redundancy HA-out stateful`	Binds the crypto map on the specified interface to the redundancy group. **Note** Although the standby group does not have to be the same group that was used when enabling SSO, it must be the same group that was used with the **standby ip** command on this interface. This crypto map will use the same virtual IP address for both IKE and IPsec to communicate with peers.
Step 5	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Troubleshooting Tips

To help troubleshoot possible IPsec-HA-related problems, use the **debug crypto ipsec ha** [**detail**] [**update**] command.

Examples

The following example shows how to configure IPsec stateful failover on the crypto map “to-peer-outside”:

```
interface Ethernet0/0
 ip address 209.165.201.1 255.255.255.224
 standby 1 ip 209.165.201.3
 standby 1 preempt
 standby 1 name HA-out
 standby 1 track Ethernet1/0
 crypto map to-peer-outside redundancy HA-out stateful
```

Enabling Stateful Failover for Tunnel Protection

Use an existing IPsec profile to configure stateful failover for tunnels using IPsec. (You do not configure the tunnel interface as you would with a crypto map configuration.)

Note The tunnel source address must be a virtual IP address, and it must not be an interface name.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto ipsec profile** *name*
4. **redundancy** *standby-group-name* **stateful**
5. **exit**

6. **interface tunnel** *number*
7. **tunnel protection ipsec profile** *name*
8. **tunnel source** *virtual-ip-address*
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**crypto ipsec profile** *name* **Example:** `Router(config)# crypto ipsec profile peer-profile`	Defines the IPsec parameters that are to be used for IPsec encryption between two routers and enters crypto map configuration mode.
Step 4	**redundancy** *standby-group-name* **stateful** **Example:** `Router(config-crypto-map)# redundancy HA-out stateful`	Configures stateful failover for tunnels using IPsec.
Step 5	**exit** **Example:** `Router(config-crypto-map)# exit`	Exits crypto map configuration mode and returns to global configuration mode.
Step 6	**interface tunnel** *number* **Example:** `Router(config)# interface tunnel 5`	Configures a tunnel interface and enters interface configuration mode • *number*—Specifies the number of the interface that you want to create or configure. There is no limit on the number of tunnel interfaces you can create.
Step 7	**tunnel protection ipsec profile** *name* **Example:** `Router(config-if)# tunnel protection ipsec profile catprofile`	Associates a tunnel interface with an IPsec profile. • *name*—Specifies the name of the IPsec profile; this value must match the name specified in the **crypto ipsec profile name** command.
Step 8	**tunnel source** *virtual-ip-address* **Example:** `Router(config-if)# tunnel source 10.1.1.1`	Sets the source address for a tunnel interface. • *virtual-ip-address*—Must be a VIP address. **Note** Do not use the interface name as the tunnel source.

	Command or Action	Purpose
Step 9	**end** **Example:** `Router(config-if)# end`	Exits interface confiiguration mode and returns to privileged EXEC mode.

Examples

The following example shows how to configure stateful failover for tunnel protection:

```
crypto ipsec profile peer-profile
 redundancy HA-out stateful

interface Tunnel1
 ip unnumbered Loopback 0
 tunnel source 209.165.201.3
 tunnel destination 10.0.0.5
 tunnel protection ipsec profile peer-profile
!
interface Ethernet0/0
 ip address 209.165.201.1 255.255.255.224
 standby 1 ip 209.165.201.3
 standby 1 name HA-out
```

What to Do Next

After you have configured stateful failover, you can use the CLI to protect, verify, and manage your configurations. For more information on completing these tasks, see the sections "Protecting SSO Traffic" and "Managing and Verifying HA Information."

Protecting SSO Traffic

Use this task to secure a redundancy group via an IPsec profile. To configure SSO traffic protection, the active and standby devices must be directly connected to each other via Ethernet networks.

The crypto maps that are automatically generated when protecting SSO traffic are applied to each interface, which corresponds to an IP address that was specified via the **local-ip** command. Traffic destined for an IP address that was specified via the **remote-ip** command is forced out of the crypto-map-configured interface via an automatically created static host route.

Note If you are certain that the SSO traffic between the redundancy group runs on a physically secure interface, you do not have to configure SSO traffic protection.

Note Security threats, as well as the cryptographic technologies to help protect against them, are constantly changing. For more information about the latest Cisco cryptographic recommendations, see the Next Generation Encryption (NGE) white paper.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto isakmp key** *keystring* **address** *peer-address*
4. **crypto ipsec transform-set** *transform-set-name transform-set-list*
5. **crypto ipsec profile** *profile-name*
6. **set transform-set** *transform-set-name*
7. **exit**
8. **redundancy inter-device**
9. **security ipsec** *profile-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**crypto isakmp key** *keystring* **address** *peer-address* **Example:** `Router(config)# crypto isakmp key abc123 address 0.0.0.0 0.0.0.0`	Configures a preshared authentication key. • *peer-address*—Specified the SCTP remote IP address.
Step 4	**crypto ipsec transform-set** *transform-set-name transform-set-list* **Example:** `Router(config)# crypto ipsec transform-set trans2 ah-sha-hmac esp-aes`	Configures a transform set that defines the packet format and cryptographic algorithms used for IPsec.
Step 5	**crypto ipsec profile** *profile-name* **Example:** `Router(config)# crypto ipsec profile sso-secure`	Defines an IPsec profile that describes how the traffic will be protected and enters crypto map configuration mode.
Step 6	**set transform-set** *transform-set-name* **Example:** `Router(config-crypto-map)# set transform-set trans2`	Specifies which transform sets can be used with the IPsec profile.
Step 7	**exit** **Example:** `Router(config-crypto-map)# exit`	Exits crypto map configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 8	**redundancy inter-device** **Example:** `Router(config)# redundancy inter-device`	Configures redundancy and enters inter-device configuration mode.
Step 9	**security ipsec** *profile-name* **Example:** `Router(config-red-interdevice)# security ipsec sso-secure`	Applies the IPsec profile to the redundancy group communications, protecting all SSO traffic that is passed between the active and standby devices.

Examples

The following example shows how to configure SSO traffic protection:

```
crypto isakmp key abc123 address 0.0.0.0 0.0.0.0 no-xauth
!
crypto ipsec transform-set trans2 ah-sha-hmac esp-aes
!
crypto ipsec profile sso-secure
 set transform-set trans2
!
redundancy inter-device
 scheme standby HA-out
 security ipsec sso-secure
```

Managing and Verifying HA Information

Managing Anti-Replay Intervals

Use this optional task to modify the interval in which an IP redundancy-enabled crypto map forwards anti-replay updates from the active router to the standby router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto map** *map-name* **redundancy replay-interval inbound** *in-value* **outbound** *out-value*
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**crypto map** *map-name* **redundancy replay-interval inbound** *in-value* **outbound** *out-value* **Example:** `Router(config)# crypto map to-peer-outside redundancy replay-interval inbound 1000 outbound 10000`	Modifies the interval at which inbound and outbound replay counters are passed from an active device to a standby device. • **inbound** *in-value*—Number of inbound packets that are processed before an antireplay update is sent from the active router to the standby router. Default value: one update every 1,000 packets. • **outbound** *out-value*—Number of outbound packets that are processed before an antireplay update is sent from the active router to the standby router. Default value: one update every 100,000 packets.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.

Examples

The following example shows how to modify replay counter intervals between the active and standby devices on the crypto map "to-peer-outside":

```
crypto map to-peer-outside redundancy replay-interval inbound 1000 outbound 10000
crypto map to-peer-outside 10 ipsec-isakmp
 set peer 209.165.200.225
 set transform-set trans1
 match address peer-outside
```

Managing and Verifying HA Configurations

Use any of the steps within this optional task to display and verify the high availability configurations.

SUMMARY STEPS

1. **enable**
2. **show redundancy** [**states** | **inter-device**]
3. **show crypto isakmp sa** [**active** | **standby**]
4. **show crypto ipsec sa** [**active** | **standby**]
5. **show crypto session** [**active** | **standby**]
6. **show crypto ha**
7. **clear crypto isakmp** [**active** | **standby**]
8. **clear crypto sa** [**active** | **standby**]

9. **clear crypto session** [**active** | **standby**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show redundancy** [**states**	**inter-device**] **Example:** `Router# show redundancy states`	Displays the current state of SSO on the configured device. • After the two devices have negotiated with each other, one device should show an "ACTIVE" state and the other device should show a "STANDBY HOT" state.
Step 3	**show crypto isakmp sa** [**active**	**standby**] **Example:** `Router# show crypto isakmp sa active`	Displays IKE SAs present on the device. • An "ACTIVE" or "STDBY" state is shown for each SA. • The **active** keyword displays only ACTIVE, HA-enabled SAs; the **standby** keyword displays only STDBY, HA-enabled SAs.
Step 4	**show crypto ipsec sa** [**active**	**standby**] **Example:** `Router# show crypto ipsec sa active`	Displays IPsec SAs present on the device. • An "ACTIVE" or "STDBY" state is shown for each SA. • The **active** keyword displays only ACTIVE, HA-enabled SAs; the **standby** keyword displays only STDBY, HA-enabled SAs.
Step 5	**show crypto session** [**active**	**standby**] **Example:** `Router# show crypto session active`	Displays crypto sessions that are currently present on the device. • An "ACTIVE" or "STANDBY" state is shown as part of the state of each session, such as "UP-STANDBY." Only HA-enabled SAs are shown.
Step 6	**show crypto ha** **Example:** `Router# show crypto ha`	Displays all virtual IP addresses that are currently in use by IPsec and IKE.
Step 7	**clear crypto isakmp** [**active**	**standby**] **Example:** `Router# clear crypto isakmp active`	Clears IKE SAs. • When this command is issued on the standby device, all standby IKE SAs are resynchronized from the active device.

	Command or Action	Purpose
		• The **active** keyword clears only IKE-HA-enabled SAs in the active state; the **standby** keyword clears only IKE-HA-enabled SAs in the standby state.
Step 8	**clear crypto sa** [**active** | **standby**] **Example:** `Router# clear crypto sa active`	Clears IPsec SAs. • When this command is issued on the standby device, all standby IPsec SAs are resynchronized from the active device. • The **active** keyword clears only IPsec-HA-enabled SAs in the active state; the **standby** keyword clears only IPsec-HA-enabled SAs in the standby state.
Step 9	**clear crypto session** [**active** | **standby**] **Example:** `Router# clear crypto session active`	Clears both IKE and IPsec SAs. • Any standby SAs will resynchronize from the active device after they are cleared on the standby. Only HA-enabled SAs are cleared from the device.

Examples

Verifying the Active Device

```
Router# show redundancy states

       my state = 13 -ACTIVE
     peer state = 8  -STANDBY HOT
           Mode = Duplex
        Unit ID = 0
     Split Mode = Disabled
   Manual Swact = Enabled
 Communications = Up
   client count = 7
 client_notification_TMR = 30000 milliseconds
          keep_alive TMR = 4000 milliseconds
        keep_alive count = 0
    keep_alive threshold = 7
           RF debug mask = 0x0

Router# show crypto isakmp sa active

dst             src             state          conn-id slot status
209.165.201.3   209.165.200.225 QM_IDLE              5    0 ACTIVE

Router# show crypto ipsec sa active

interface:Ethernet0/0
    Crypto map tag:to-peer-outside, local addr 209.165.201.3
   protected vrf:(none)
   local  ident (addr/mask/prot/port):(192.168.0.1/255.255.255.255/0/0)
   remote ident (addr/mask/prot/port):(172.16.0.1/255.255.255.255/0/0)
   current_peer 209.165.200.225 port 500
     PERMIT, flags={origin_is_acl,}
    #pkts encaps:3, #pkts encrypt:3, #pkts digest:3
```

```
    #pkts decaps:4, #pkts decrypt:4, #pkts verify:4
    #pkts compressed:0, #pkts decompressed:0
    #pkts not compressed:0, #pkts compr. failed:0
    #pkts not decompressed:0, #pkts decompress failed:0
    #send errors 0, #recv errors 0
     local crypto endpt.:209.165.201.3, remote crypto endpt.:209.165.200.225
     path mtu 1500, media mtu 1500
     current outbound spi:0xD42904F0(3559458032)
     inbound esp sas:
      spi:0xD3E9ABD0(3555306448)
        transform:esp-aes ,
        in use settings ={Tunnel, }
        conn id:2006, flow_id:6, crypto map:to-peer-outside
        sa timing:remaining key lifetime (k/sec):(4586265/3542)
             HA last key lifetime sent(k):(4586267)
        ike_cookies:9263635C CA4B4E99 C14E908E 8EE2D79C
        IV size:16 bytes
        replay detection support:Y
        Status:ACTIVE
inbound ah sas:
      spi: 0xF3EE3620(4092474912)
        transform: ah-sha-hmac ,
        in use settings ={Tunnel, }
        conn id: 2006, flow_id: 6, crypto map: to-peer-outside
        sa timing: remaining key lifetime (k/sec): (4586265/3542)
             HA last key lifetime sent(k): (4586267)
        ike_cookies: 9263635C CA4B4E99 C14E908E 8EE2D79C
        replay detection support: Y
        Status: ACTIVE
     inbound pcp sas:
     outbound esp sas:
      spi: 0xD42904F0(3559458032)
        transform: esp-aes ,
        in use settings ={Tunnel, }
        conn id: 2009, flow_id: 9, crypto map: to-peer-outside
        sa timing: remaining key lifetime (k/sec): (4586266/3542)
             HA last key lifetime sent(k): (4586267)
        ike_cookies: 9263635C CA4B4E99 C14E908E 8EE2D79C
        IV size: 16 bytes
        replay detection support: Y
        Status: ACTIVE
     outbound ah sas:
      spi: 0x75251086(1965363334)
        transform: ah-sha-hmac ,
        in use settings ={Tunnel, }
        conn id: 2009, flow_id: 9, crypto map: to-peer-outside
        sa timing: remaining key lifetime (k/sec): (4586266/3542)
             HA last key lifetime sent(k): (4586267)
        ike_cookies: 9263635C CA4B4E99 C14E908E 8EE2D79C
        replay detection support: Y
        Status: ACTIVE
     outbound pcp sas:

Router# show crypto session active

Crypto session current status
Interface: Ethernet0/0
Session status: UP-ACTIVE
Peer: 209.165.200.225 port 500
  IKE SA: local 209.165.201.3/500 remote 209.165.200.225/500 Active
  IKE SA: local 209.165.201.3/500 remote 209.165.200.225/500 Active
  IPSEC FLOW: permit ip host 192.168.0.1 host 172.16.0.1
        Active SAs: 4, origin: crypto map
```

```
Router# show crypto ha

IKE VIP: 209.165.201.3
  stamp: 74 BA 70 27 9C 4F 7F 81 3A 70 13 C9 65 22 E7 76
IPSec VIP: 209.165.201.3
IPSec VIP: 255.255.255.253
IPSec VIP: 255.255.255.254
```

Verifying the Standby Device

```
Router# show redundancy states

       my state = 8  -STANDBY HOT
     peer state = 13 -ACTIVE
           Mode = Duplex
        Unit ID = 0
     Split Mode = Disabled
   Manual Swact = Enabled
 Communications = Up
   client count = 7
 client_notification_TMR = 30000 milliseconds
          keep_alive TMR = 4000 milliseconds
        keep_alive count = 1
    keep_alive threshold = 7
           RF debug mask = 0x0

Router# show crypto isakmp sa standby

dst             src             state          conn-id slot status
209.165.201.3   209.165.200.225 QM_IDLE              5    0 STDBY

Router# show crypto ipsec sa standby

interface:Ethernet0/0
    Crypto map tag:to-peer-outside, local addr 209.165.201.3
   protected vrf:(none)
   local  ident (addr/mask/prot/port):(192.168.0.1/255.255.255.255/0/0)
   remote ident (addr/mask/prot/port):(172.16.0.1/255.255.255.255/0/0)
   current_peer 209.165.200.225 port 500
     PERMIT, flags={origin_is_acl,}
    #pkts encaps:0, #pkts encrypt:0, #pkts digest:0
    #pkts decaps:0, #pkts decrypt:0, #pkts verify:0
    #pkts compressed:0, #pkts decompressed:0
    #pkts not compressed:0, #pkts compr. failed:0
    #pkts not decompressed:0, #pkts decompress failed:0
    #send errors 0, #recv errors 0
     local crypto endpt.:209.165.201.3, remote crypto endpt.:209.165.200.225
     path mtu 1500, media mtu 1500
     current outbound spi:0xD42904F0(3559458032)
     inbound esp sas:
      spi:0xD3E9ABD0(3555306448)
        transform:esp-aes ,
        in use settings ={Tunnel, }
        conn id:2012, flow_id:12, crypto map:to-peer-outside
        sa timing:remaining key lifetime (k/sec):(4441561/3486)
             HA last key lifetime sent(k):(4441561)
        ike_cookies:00000000 00000000 00000000 00000000
        IV size:16 bytes
        replay detection support:Y
        Status:STANDBY
     inbound ah sas:
      spi:0xF3EE3620(4092474912)
```

```
        transform:ah-sha-hmac ,
        in use settings ={Tunnel, }
        conn id:2012, flow_id:12, crypto map:to-peer-outside
        sa timing:remaining key lifetime (k/sec):(4441561/3486)
             HA last key lifetime sent(k):(4441561)
        ike_cookies:00000000 00000000 00000000 00000000
        replay detection support:Y
        Status:STANDBY
     inbound pcp sas:
     outbound esp sas:
      spi:0xD42904F0(3559458032)
        transform:esp-aes ,
        in use settings ={Tunnel, }
        conn id:2011, flow_id:11, crypto map:to-peer-outside
        sa timing:remaining key lifetime (k/sec):(4441561/3485)
             HA last key lifetime sent(k):(4441561)
        ike_cookies:00000000 00000000 00000000 00000000
        IV size:16 bytes
        replay detection support:Y
        Status:STANDBY
     outbound ah sas:
      spi:0x75251086(1965363334)
        transform:ah-sha-hmac ,
        in use settings ={Tunnel, }
        conn id:2011, flow_id:11, crypto map:to-peer-outside
        sa timing:remaining key lifetime (k/sec):(4441561/3485)
             HA last key lifetime sent(k):(4441561)
        ike_cookies:00000000 00000000 00000000 00000000
        replay detection support:Y
        Status:STANDBY
     outbound pcp sas:

Router# show crypto session standby

Crypto session current status
Interface:Ethernet0/0
Session status:UP-STANDBY
Peer:209.165.200.225 port 500
  IKE SA:local 209.165.201.3/500 remote 209.165.200.225/500 Active
  IPSEC FLOW:permit ip host 192.168.0.1 host 172.16.0.1
        Active SAs:4, origin:crypto map

Router# show crypto ha

IKE VIP:209.165.201.3
  stamp:74 BA 70 27 9C 4F 7F 81 3A 70 13 C9 65 22 E7 76
IPSec VIP:209.165.201.3
IPSec VIP:255.255.255.253
IPSec VIP:255.255.255.254
ha-R2#
```

Verifying the Active and Standby SAs

The following sample output shows SAs of both the active and standby devices:

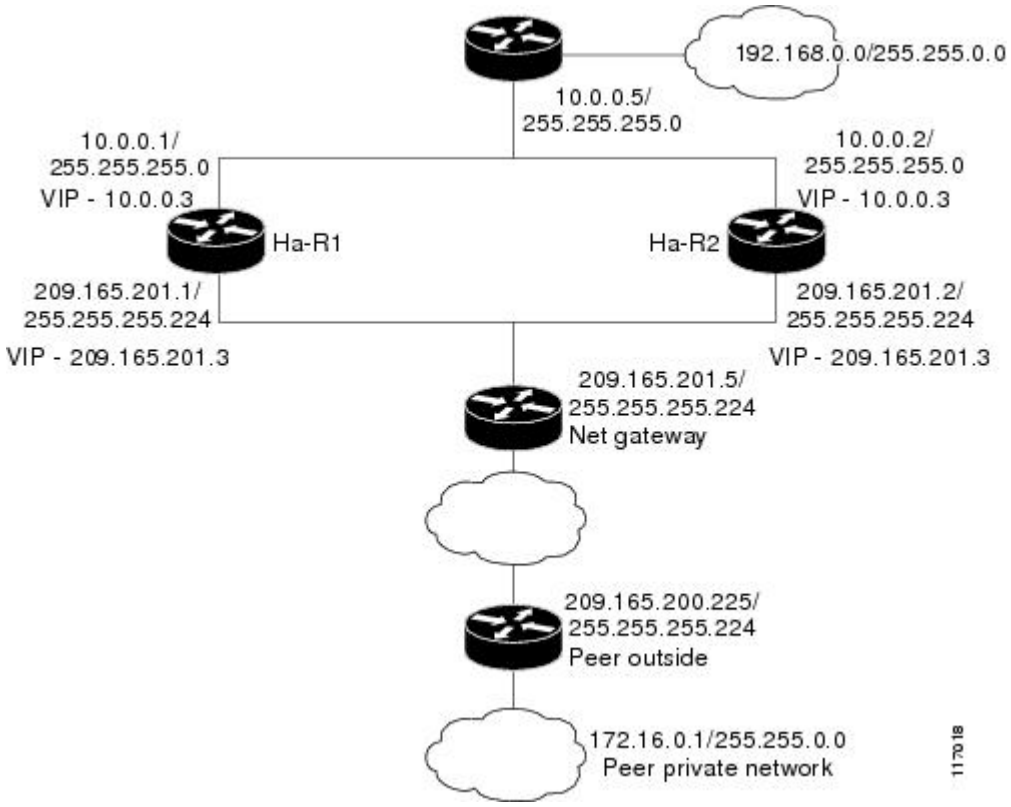
```
Router# show crypto isakmp sa

dst             src             state          conn-id slot status
209.165.201.3   209.165.200.225 QM_IDLE              2    0 STDBY
10.0.0.1        10.0.0.2        QM_IDLE              1    0 ACTIVE
```

Configuration Examples for Stateful Failover for IPsec

Example: Configuring Stateful Failover for IPsec

The figure below and the following sample outputs from the **show running-config** command illustrate how to configure stateful failover on two devices—Ha-R1 and Ha-R2.

Figure 3: IPsec Stateful Failover Sample Topology



Stateful Failover Configuration on Ha-R1

```
Ha-R1# show running-config

Building configuration...
Current configuration :2086 bytes
!
version 12.3
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Ha-R1
!
boot-start-marker
boot-end-marker
!
```

```
!
redundancy inter-device
 scheme standby HA-out
 security ipsec sso-secure
!
logging buffered 10000000 debugging
logging rate-limit console 10000
!
!
ipc zone default
 association 1
  no shutdown
  protocol sctp
   local-port 5000
    local-ip 10.0.0.1
   remote-port 5000
    remote-ip 10.0.0.2
!
clock timezone PST 0
no aaa new-model
ip subnet-zero
!
crypto isakmp policy 1
 encr aes
 authentication pre-share
 group 14
crypto isakmp key cisco123 address 0.0.0.0 0.0.0.0 no-xauth
!
!
crypto ipsec transform-set trans1 ah-sha-hmac esp-aes
crypto ipsec transform-set trans2 ah-sha-hmac esp-aes 256
!
crypto ipsec profile sso-secure
 set transform-set trans2
!
!
crypto map to-peer-outside redundancy replay-interval inbound 1000 outbound 10000
crypto map to-peer-outside 10 ipsec-isakmp
 set peer 209.165.200.225
 set transform-set trans1
 match address peer-outside
!
!
!
interface Ethernet0/0
 ip address 209.165.201.1 255.255.255.224
 standby 1 ip 209.165.201.3
 standby 1 preempt
 standby 1 name HA-out
 standby 1 track Ethernet1/0
 standby delay reload 120
 crypto map to-peer-outside redundancy HA-out stateful
!
interface Ethernet1/0
 ip address 10.0.0.1 255.255.255.0
 standby 2 ip 10.0.0.3
 standby 2 preempt
 standby 2 name HA-in
 standby delay reload 120
 standby 2 track Ethernet0/0
!
interface Serial2/0
 no ip address
 shutdown
```

```
 serial restart-delay 0
!
interface Serial3/0
 no ip address
 shutdown
 serial restart-delay 0
!
ip classless
ip route 0.0.0.0 0.0.0.0 209.165.201.5
ip route 192.168.0.0 255.255.0.0
no ip http server
no ip http secure-server
!
!
!
ip access-list extended peer-outside
 permit ip host 192.168.0.1 host 172.16.0.1
!
!
control-plane
!
!
line con 0
 exec-timeout 0 0
 transport preferred all
 transport output all
line aux 0
 transport preferred all
 transport output all
line vty 0 4
 login
 transport preferred all
 transport input all
 transport output all
!
end
```

Stateful Failover Configuration on Ha-R2

```
Ha-R2# show running-config

Building configuration...
Current configuration :2100 bytes
!
version 12.3
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Ha-R2
!
boot-start-marker
boot-end-marker
!
!
redundancy inter-device
 scheme standby HA-out
 security ipsec sso-secure
!
logging buffered 10000000 debugging
logging rate-limit console 10000
!
!
```

```
ipc zone default
 association 1
  no shutdown
  protocol sctp
   local-port 5000
    local-ip 10.0.0.2
   remote-port 5000
    remote-ip 10.0.0.1
!
clock timezone PST 0
no aaa new-model
ip subnet-zero
!
!
crypto isakmp policy 1
 encr aes
 authentication pre-share
 group 14
 lifetime 120
crypto isakmp key cisco123 address 0.0.0.0 0.0.0.0 no-xauth
!
!
crypto ipsec transform-set trans1 ah-sha-hmac esp-aes
crypto ipsec transform-set trans2 ah-sha-hmac esp-aes 256
!
crypto ipsec profile sso-secure
 set transform-set trans2
!
!
crypto map to-peer-outside redundancy replay-interval inbound 1000 outbound 10000
crypto map to-peer-outside 10 ipsec-isakmp
 set peer 209.165.200.225
 set transform-set trans1
 match address peer-outside
!
!
!
interface Ethernet0/0
 ip address 209.165.201.2 255.255.255.224
 standby 1 ip 209.165.201.3
 standby 1 preempt
 standby 1 name HA-out
 standby 1 track Ethernet1/0
 standby delay reload 120
 crypto map to-peer-outside redundancy HA-out stateful
!
interface Ethernet1/0
 ip address 10.0.0.2 255.255.255.0
 standby 2 ip 10.0.0.3
 standby 2 preempt
 standby 2 name HA-in
 standby delay reload 120
 standby 2 track Ethernet0/0
!
interface Serial2/0
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial3/0
 no ip address
 shutdown
 serial restart-delay 0
!
```

```
ip classless
ip route 0.0.0.0 0.0.0.0 209.165.201.5
ip route 192.168.0.0 255.255.0.0
no ip http server
no ip http secure-server
!
!
!
ip access-list extended peer-outside
 permit ip host 192.168.0.1 host 172.16.0.1
!
!
control-plane
!
!
line con 0
 exec-timeout 0 0
 transport preferred all
 transport output all
line aux 0
 transport preferred all
 transport output all
line vty 0 4
 login
 transport preferred all
 transport input all
 transport output all
!
end
```

Example: Configuring Stateful Failover for IPsec for an Easy VPN Server

The following sample outputs from the **show running-config** command show how to configure stateful failover for a remote access connection via an Easy VPN server:

Stateful Failover for an Easy VPN Server Configuration on RAHA-R1

```
RAHA-R1# show running-config

Building configuration...
Current configuration :3829 bytes
!
version 12.3
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname RAHA-R1
!
boot-start-marker
boot-end-marker
!
redundancy inter-device
 scheme standby HA-out
!
username remote_user password 0 letmein
!
ipc zone default
 association 1
  no shutdown
  protocol sctp
```

```
   local-port 5000
    local-ip 10.0.0.1
   remote-port 5000
    remote-ip 10.0.0.2
!
aaa new-model
!
!
! Enter the following command if you are doing Xauth locally.
aaa authentication login local_xauth local
!
! Enter the following command if you are doing Xauth remotely via RADIUS.
!aaa authentication login radius_xauth group radius
!
! Enter the following command if you are not doing Xauth
!aaa authentication login no_xauth none
!
! Enter the following command if you are doing local group authentication.
aaa authorization network local_auth local
!
! Enter the following command if you are doing group authentication remotely via RADIUS.
!aaa authorization network radius_auth group radius
!
!
! Enter the following command if you are doing Xauth remotely via RADIUS.
!
aaa accounting network radius_accounting start-stop group radius
aaa session-id common
ip subnet-zero
!
crypto isakmp policy 1
 encr aes
 hash sha
 authentication pre-share
 group 14
!
!
! Enter the following command if you are doing group authentication locally.
crypto isakmp client configuration group unity
 key abc123
 domain abc.com
 pool client-address-pool
!
!
crypto ipsec transform-set trans1 esp-aes esp-sha-hmac
!
crypto dynamic-map to-remote-client 10
 set transform-set trans1
 reverse-route remote-peer
!
! Use this map if you want to do local group authentication and Xauth.
crypto map to_peer_outside_local_xauth client authentication list local_xauth
crypto map to_peer_outside_local_xauth isakmp authorization list local_auth
crypto map to_peer_outside_local_xauth client configuration address respond
crypto map to_peer_outside_local_xauth 10 ipsec-isakmp dynamic to-remote-client
!
! Use this map if you want to use Radius for group authentication and Xauth.
!crypto map to_peer_outside_radius_xauth isakmp client authentication list radius_xauth
!crypto map to_peer_outside_radius_xauth client accounting list radius_accounting
!crypto map to_peer_outside_radius_xauth isakmp authorization list radius_auth
!crypto map to_peer_outside_radius_xauth isakmp client configuration address respond
!crypto map to_peer_outside_radius_xauth isakmp 10 ipsec-isakmp dynamic to-remote-client
!
! Use this map if you want to do local group authentication and no Xauth
```

```
!crypto map to_peer_outside_no_xauth isakmp authorization list local_auth
!crypto map to_peer_outside_no_xauth configuration address respond
!crypto map to_peer_outside_no_xauth 10 ipsec-isakmp dynamic to-remote-client
!
interface Ethernet0/0
 ip address 209.165.201.1 255.255.255.224
 standby 1 ip 209.165.201.3
 standby 1 preempt
 standby 1 name HA-out
 standby 1 track Ethernet1/0
 standby delay reload 120
 crypto map to_peer_outside_local_xauth redundancy HA-out stateful
!
interface Ethernet1/0
 ip address 10.0.0.1 255.255.255.0
 standby 2 ip 10.0.0.3
 standby 2 preempt
 standby 2 name HA-in
 standby 2 track Ethernet0/0
 standby delay reload 120
!
! Enable loopback0 if you are using radius for Xauth, group auth, or accounting with !
crypto HA
!interface loopback0
! ip address 192.168.100.1 255.255.255.255
!
! Enable this command if you are using radius for Xauth, group auth, or accounting with !
crypto HA
!ip radius source-interface loopback0
!
ip local pool client-address-pool 50.0.0.1 50.0.0.254
ip classless
ip route 0.0.0.0 0.0.0.0 209.165.201.5
ip route 192.168.0.0 255.255.255.0 10.0.0.5
!
radius-server host 192.168.0.0 255.255.0.0 auth-port 1845 acct-port 1846
radius-server key radius123
!
control-plane
!
!
line con 0
 exec-timeout 0 0
line aux 0
line vty 0 4
!
end
```

Stateful Failover for an Easy VPN Server Configuration on RAHA-R2

```
RAHA-R2# show running-config

Building configuration...
Current configuration :3829 bytes
!
version 12.3
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname RAHA-R2
!
boot-start-marker
```

```
boot-end-marker
!
redundancy inter-device
 scheme standby HA-out
!
username remote_user password 0 letmein
!
ipc zone default
 association 1
  no shutdown
  protocol sctp
   local-port 5000
    local-ip 10.0.0.2
   remote-port 5000
    remote-ip 10.0.0.1
!
aaa new-model
!
!
! Enter the following command if you are doing Xauth locally.
aaa authentication login local_xauth local
!
! Enter the following command if you are doing Xauth remotely via RADIUS.
!aaa authentication login radius_xauth group radius
!
! Enter the following command if you are not doing Xauth.
!aaa authentication login no_xauth none
!
! Enter the following command if you are doing local group authentication.
aaa authorization network local_auth local
!
! Enter the following command if you are doing group authentication remotely via RADIUS.
!aaa authorization network radius_auth group radius
!
!
! Enter the following command if you are doing Xauth remotely via RADIUS.
!aaa accounting network radius_accounting start-stop group radius
aaa session-id common
ip subnet-zero
!
crypto isakmp policy 1
 encr aes
 hash sha
 authentication pre-share
 group 14
!
!
! Enter the following commands if you are doing group authentication locally.
crypto isakmp client configuration group unity
 key abc123
 domain abc.com
 pool client-address-pool
!
!
crypto ipsec transform-set trans1 esp-aes esp-sha-hmac
!
crypto dynamic-map to-remote-client 10
 set transform-set trans1
 reverse-route remote-peer
!
!
! Use this map if you want to dolocal group authentication and Xauth.
crypto map to_peer_outside_local_xauth client authentication list local_xauth
crypto map to_peer_outside_local_xauth isakmp authorization list local_auth
```

```
crypto map to_peer_outside_local_xauth client configuration address respond
crypto map to_peer_outside_local_xauth 10 ipsec-isakmp dynamic to-remote-client
!
! Use this map if you want to use Radius for group authentication and Xauth.
!crypto map to_peer_outside_radius_xauth isakmp client authentication list radius_xauth
!crypto map to_peer_outside_radius_xauth client accounting list radius_accounting
!crypto map to_peer_outside_radius_xauth isakmp authorization list radius_auth
!crypto map to_peer_outside_radius_xauth isakmp client configuration address respond
!crypto map to_peer_outside_radius_xauth isakmp 10 ipsec-isakmp dynamic to-remote-client
!
!
! Use this map if you want to do local authentication and no Xauth.
!crypto map to_peer_outside_no_xauth isakmp authorization list local_auth
!crypto map to_peer_outside_no_xauth configuration address respond
!crypto map to_peer_outside_no_xauth 10 ipsec-isakmp dynamic to-remote-client
!
interface Ethernet0/0
 ip address 209.165.201.2 255.255.255.224
 standby 1 ip 209.165.201.3
 standby 1 preempt
 standby 1 name HA-out
 standby 1 track Ethernet1/0
 standby delay reload
 crypto map to_peer_outside_local_xauth redundancy HA-out stateful
!
interface Ethernet1/0
 ip address 10.0.0.2 255.255.255.0
 standby 2 ip 10.0.0.3
 standby 2 preempt
 standby 2 name HA-in
 standby 2 track Ethernet0/0
 standby delay reload
!
! Enable loopback0 if you are using radius for Xauth, group auth, or accounting with !
crypto HA
!interface loopback0
! ip address 192.168.100.1 255.255.255.255
!
! Enable this command if you are using radius for Xauth, group auth, or accounting with !
crypto HA
!ip radius source-interface loopback0
!
ip local pool client-address-pool 50.0.0.1 50.0.0.254
ip classless
ip route 0.0.0.0 0.0.0.0 209.165.201.5
ip route 192.168.0.0 255.255.0.0
!
radius-server host 192.168.0.200 auth-port 1845 acct-port 1846
radius-server key radius123
!
control-plane
!
!
!
line con 0
 exec-timeout 0 0
line aux 0
line vty 0 4
!
end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Commands List, All Releases*
Security commands	• *Cisco IOS Security Command Reference: Commands A to C* • *Cisco IOS Security Command Reference: Commands D to L* • *Cisco IOS Security Command Reference: Commands M to R* • *Cisco IOS Security Command Reference: Commands S to Z*
RRI	"IPSec VPN High Availability Enhancements" in the *VPN Availability Configuration Guide*
HSRP	"Configuring HSRP" in the *First Hop Redundancy Protocols Configuration Guide*
Easy VPN Server	"Cisco Easy VPN Remote" in the *Easy VPN Configuration Guide*
IKE configuration	"Configuring Internet Key Exchange for IPsec VPNs" in the *Internet Key Exchange for IPsec VPNs Configuration Guide*
IPsec configuration	"Configuring Security for VPNs with IPsec" in the *Security for VPNs with IPsec Configuration Guide*
Recommended cryptographic algorithms	Next Generation Encryption

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

Feature Information for Stateful Failover for IPsec

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

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

Table 2: Feature Information for Stateful Failover for IPsec

Feature Name	Releases	Feature Information
Stateful Failover for IPsec	12.3(11)T	The Stateful Failover for IP Sec feature enables a router to continue processing and forwarding IPsec packets after a planned or unplanned outage occurs. Customers employ a backup (secondary) router that automatically takes over the tasks of the active (primary) router if the active router loses connectivity for any reason. The following commands were introduced or modified: **clear crypto isakmp, clear crypto sa, clear crypto session, crypto map (interface IPsec), crypto map redundancy replay-interval, debug crypto ha, debug crypto ipsec ha, debug crypto isakmp ha, local-ip (IPC transport-SCTP local), local-port, redundancy inter-device, redundancy stateful, remote-ip (IPC transport-SCTP remote), remote-port, scheme, security ipsec, show crypto ha, show crypto ipsec sa, show crypto isakmp sa, show crypto session, show redundancy.**