

High Availability for Devices

The following topics describe how to configure Active/Standby failover to accomplish high availability of the Firewall Threat Defense.

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Secure Firewall Threat Defense high availability

Secure Firewall Threat Defense high availability is a failover configuration that

- requires two identical Firewall Threat Defense devices connected through a dedicated failover link and optionally a state link
- supports Active/Standby failover where one unit passes traffic while the standby unit does not actively pass traffic synchronizes configuration and state information, and
- monitors the health of the active unit (hardware, interfaces, software, and environmental status) to determine if failover conditions are met.

Failover process details

When a failover occurs, the active unit fails over to the standby unit, which then becomes active. The health of the active unit (hardware, interfaces, software, and environmental status) is monitored to determine if specific failover conditions are met. If those conditions are met, failover occurs.

Note High availability is not supported on Firewall Threat Defense Virtual running in the public cloud. See the Secure Firewall Threat Defense Virtual getting started guides for more information about configuring the Firewall Threat Defense Virtual device for high availability.

High availability system requirements

High availability system requirements are specifications that define the hardware, software, and license prerequisites for Firewall Threat Defense devices to function in a High availability configuration.

Hardware requirements

Hardware requirements are specifications that ensure two units in a High availability configuration can

- maintain identical hardware configurations including model, interfaces, modules, and RAM
- support proper synchronization and failover functionality, and
- ensure reliable high availability operation.

Hardware requirement specifications

The two units in a High availability configuration must meet these requirements:

- Be the same model. In addition, for container instances, they must use the same resource profile attributes.

  For the Firepower 9300, High Availability is only supported between same-type modules. However, the two chassis can include mixed modules. For example, each chassis has an SM-56, SM-48, and SM-40. You can create High Availability pairs between the SM-56 modules, between the SM-48 modules, and between the SM-40 modules.

  If you change the resource profile after you add the High Availability pair to the Firewall Management Center, update the inventory for each unit on the **Devices** > **Device Management** > **Device** > **System** > **Inventory** dialog box.

  If you assign a different profile to instances in an established high-availability pair, which requires the profile to be the same on both units, you must:

  1. Break high availability.
  2. Assign the new profile to both units.
  3. Re-establish high availability.

- Have the same number and types of interfaces.

  For the Firepower 4100/9300 chassis, all interfaces must be preconfigured in FXOS identically before you enable High availability. If you change the interfaces after you enable High availability, make the interface changes in FXOS on the Standby unit, and then make the same changes on the Active unit.

If you are using units with different flash memory sizes in your High availability configuration, make sure the unit with the smaller flash memory has enough space to accommodate the software image files and the

configuration files. If it does not, configuration synchronization from the unit with the larger flash memory to the unit with the smaller flash memory will fail.

Software requirements

Software requirements are configuration specifications that High availability units must meet to function properly in a failover configuration.

Required software specifications

The two units in a High availability configuration must meet these requirements:

- Be in the same firewall mode (routed or transparent).
- Have the same software version.
- Be in the same domain or group on the Firewall Management Center.
- Have the same NTP configuration. See Synchronize time on FTD devices.
- Configuration changes must be fully deployed to the devices.
- Not have DHCP or PPPoE configured in any of their interfaces.
- (Firepower 4100/9300) Have the same flow offload mode, either both enabled or both disabled.

License requirements for Firewall Threat Defense devices in a high availability pair

Both Firewall Threat Defense units in a high availability configuration must have the same licenses.

High availability configurations require two license entitlements: one for each device in the pair.

Before high availability is established, it does not matter which licenses are assigned to the secondary/standby device. During high availability configuration, the Firewall Management Center releases any unnecessary licenses assigned to the standby unit and replaces them with identical licenses assigned to the primary/active unit.

For example, if the active unit has a Essentials license and a IPS license, and the standby unit has only a Essentials license, the Firewall Management Center communicates with the Smart Software Manager to obtain an available IPS license from your account for the standby unit. If your license account does not include enough purchased entitlements, your account becomes Out-of-Compliance until you purchase the correct number of licenses.

Failover and stateful failover links

A failover link and stateful failover link are dedicated connections that

- establish communication between the two units in a failover configuration
- require the same interface to be used between corresponding devices for consistency, and
- transmit critical failover and state information between the paired units.

Configuration recommendations

Cisco recommends to use the same interface between two devices in a failover link or a stateful failover link. For example, in a failover link, if you have used eth0 in device 1, use the same interface (eth0) in device 2 as well.

Failover link

A failover link is a communication mechanism that enables two units in a failover pair to constantly communicate to determine the operating status of each unit.

Failover link data

This below information is communicated over the failover link:

- The unit state (active or standby)
- Hello messages (keep-alives)
- Network link status
- MAC address exchange
- Configuration replication and synchronization

Interface for the failover link

A failover link interface is a dedicated communication channel that

- exists solely for failover communication between high availability units
- uses an unused data interface (physical, or EtherChannel)
- cannot be shared with normal networking interfaces or user data traffic, and
- requires specific interface sizing based on the device model.

Interface restrictions and requirements

You can use an unused data interface (physical, or EtherChannel) as the failover link; however, you cannot specify an interface that is currently configured with a name. You also cannot use a subinterface with the exception of a subinterface defined on the chassis for multi-instance mode. The failover link interface is not configured as a normal networking interface; it exists for failover communication only. This interface can only be used for the failover link (and also for the state link).

The Firewall Threat Defense does not support sharing interfaces between user data and the failover link. You also cannot use separate subinterfaces on the same parent for the failover link and for data (multi-instance chassis subinterfaces only). If you use a chassis subinterface for the failover link, then all subinterfaces on that parent, and the parent itself, are restricted for use as failover links.



Note When using an EtherChannel as the failover or state link, you must confirm that the same EtherChannel with the same member interfaces exists on both devices before establishing high availability.

See these guidelines for the failover link:

- Firepower 4100/9300—You cannot use the management-type interface for the failover link.
- See these guidelines for sizing the link.

Table 1: Failover link size

Model	Interface Size for Combined Failover and State Link
Firepower 1010	1 Gbps
Firepower 1100	1 Gbps
Secure Firewall 1200	1 Gbps
Secure Firewall 3100	Secure Firewall 3105—1 Gbps Secure Firewall 3110—1 Gbps Secure Firewall 3120—1 Gbps Secure Firewall 3130—10 Gbps Secure Firewall 3140—10 Gbps
Firepower 4100	10 Gbps
Secure Firewall 4200	10 Gbps
Firepower 9300	10 Gbps

The alternation frequency is equal to the unit hold time.

Note If you have a large configuration and a low unit hold time, alternating between the member interfaces can prevent the secondary unit from joining/re-joining. In this case, disable one of the member interfaces until after the secondary unit joins.

For an EtherChannel used as the failover link, to prevent out-of-order packets, only one interface in the EtherChannel is used. If that interface fails, then the next interface in the EtherChannel is used. You cannot alter the EtherChannel configuration while it is in use as a failover link.

Connect the failover link

The failover link enables communication and coordination between units in a failover configuration.

You need to establish a physical connection between the failover units to enable proper failover functionality.

Procedure

Connect the failover link using one of the following methods:

- Using a switch, with no other device on the same network segment (broadcast domain or VLAN) as the failover interfaces of the Firewall Threat Defense device.

- Using an Ethernet cable to connect the units directly, without the need for an external switch.

If you do not use a switch between the units and the interface fails, the link is brought down on both peers. This condition may hamper troubleshooting efforts because you cannot easily determine which unit has the failed interface and caused the link to come down.

The failover link is physically connected and ready for failover configuration.

Stateful failover links

A stateful failover link is a network connection that

- passes connection state information between failover units, and
- must be configured to enable stateful failover functionality.

State link configuration requirements

To use Stateful Failover, you must configure a Stateful Failover link (also known as the state link) to pass connection state information.

Shared failover links

A shared failover link is an interface conservation method that enables multiple network functions to use the same failover connection, though dedicated interfaces for state and failover links should be considered for large configurations and high traffic networks.

Dedicated interface for the stateful failover link

A dedicated interface for the stateful failover link is a data interface configuration that uses a dedicated physical or EtherChannel interface specifically for the state link in failover deployments.

Performance considerations

You can use a dedicated data interface—such as a physical or EtherChannel interface—for the state link. For requirements about a dedicated state link, refer to Interface for the failover link, on page 4. See the section on connecting the state link for additional information Connect the failover link, on page 5.

For optimum performance with long-distance failover, the state link latency should be less than 10 milliseconds but no more than 250 milliseconds. If latency exceeds 10 milliseconds, performance might degrade due to retransmission of failover messages.

Failover and data link interruption avoidance

Failover and data link interruption avoidance is a network design practice that

- ensures failover links and data interfaces travel through different paths to decrease the chance that all interfaces fail at the same time
- prevents failover operation suspension when the failover link is down, and
- maintains network resilience by using proper connection scenarios.

Connection scenarios

We recommend that failover links and data interfaces travel through different paths to decrease the chance that all interfaces fail at the same time. If the failover link is down, the failover operation is suspended until the health of the failover link is restored.

These connection scenarios help design a resilient failover network.

Scenario 1—Not recommended

If a single switch or a set of switches are used to connect both failover and data interfaces between two Firewall Threat Defense devices, then when a switch or inter-switch-link is down, both Firewall Threat Defense devices become active. Therefore, the two connection methods shown in these figures are **not** recommended.

Figure 1: Connecting with a single switch—not recommended

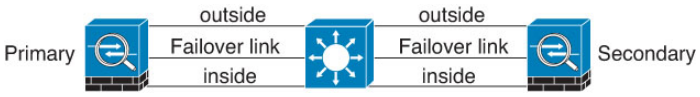
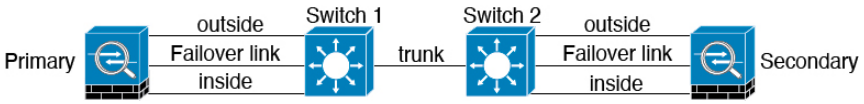


Figure 2: Connecting with a double-switch—not recommended



Scenario 2—Recommended

We recommend that failover links not use the same switch as the data interfaces. Instead, use a different switch or use a direct cable to connect the failover link, as shown in these figures.

Figure 3: Connecting with a different switch

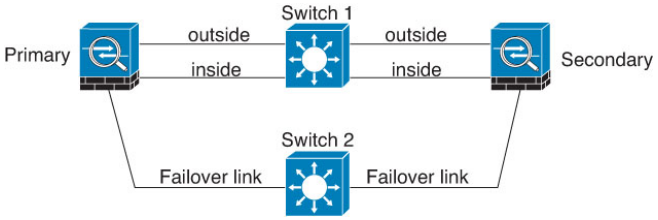
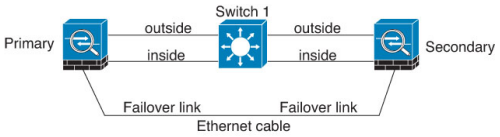


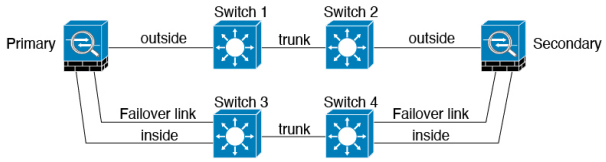
Figure 4: Connecting with a cable



Scenario 3—Recommended

If the Firewall Threat Defense data interfaces are connected to more than one set of switches, then a failover link can be connected to one of the switches, preferably the switch on the secure (inside) side of network, as shown in this figure.

Figure 5: Connecting with a secure switch



MAC addresses and IP addresses in High availability

MAC addresses and IP addresses in High availability are network addressing mechanisms that

- provide unique identification for network interfaces during failover scenarios
- maintain network connectivity when primary devices become unavailable, and
- ensure seamless traffic flow between active and standby configurations.

Address configuration types

When you configure your interfaces, you can specify an active IP address and a standby IP address on the same network. Generally, when a failover occurs, the new active unit takes over the active IP addresses and MAC addresses. Because network devices see no change in the MAC to IP address pairing, no ARP entries change or time out anywhere on the network.

Note Although recommended, the standby address is not required. Without a standby IP address, the active unit cannot perform network tests to check the standby interface health; it can only track the link state. You also cannot connect to the standby unit on that interface for management purposes.

The IP address and MAC address for the state link do not change at failover.

Active/standby configurations use specific address handling methods:

For Active/Standby High availability, see the following for IP address and MAC address usage during a failover event:

1. The active unit always uses the primary unit's IP addresses and MAC addresses.
2. When the active unit fails over, the standby unit assumes the IP addresses and MAC addresses of the failed unit and begins passing traffic.
3. When the failed unit comes back online, it is now in a standby state and takes over the standby IP addresses and MAC addresses.

However, if the secondary unit boots without detecting the primary unit, then the secondary unit becomes the active unit and uses its own MAC addresses, because it does not know the primary unit MAC addresses. When the primary unit becomes available, the secondary (active) unit changes the MAC addresses to those of the primary unit, which can cause an interruption in your network traffic. Similarly, if you swap out the primary unit with new hardware, a new MAC address is used.

If you disable high availability and set the failover configurations to a disabled state, you will need to manually resume high availability, or reboot the device. It is recommended to use the command **configure**

high-availability resume and resume the high availability instead of rebooting the device. If you reload the standby unit with the failover configuration disabled, the standby unit boots up as the active unit and uses the primary unit's IP addresses and MAC addresses. This leads to duplicate IP addresses and causes network traffic disruptions. Use the command **configure high-availability resume** to enable failover and restore the traffic flow.



Note If you enable failover on a standalone device, the data interfaces go down at negotiation state of failover, interrupting traffic.

Virtual MAC addresses guard against this disruption, because the active MAC addresses are known to the secondary unit at startup, and remain the same in the case of new primary unit hardware. We recommend that you configure the virtual MAC address on both the primary and secondary units to ensure that the secondary unit uses the correct MAC addresses when it is the active unit, even if it comes online before the primary unit. If you do not configure virtual MAC addresses, you might need to clear the ARP tables on connected routers to restore traffic flow. The Firewall Threat Defense does not send gratuitous ARPs for static NAT addresses when the MAC address changes, so connected routers do not learn of the MAC address change for these addresses.

For Active/Active failover, see the following for IP address and MAC address usage during a failover event:

1. The primary unit autogenerates active and standby MAC addresses for all interfaces in failover group 1 and 2 contexts. You can also manually configure the MAC addresses if necessary, for example, if there are MAC address conflicts.
2. Each unit uses the active IP addresses and MAC addresses for its active failover group, and the standby addresses for its standby failover group. For example, the primary unit is active for failover group 1, so it uses the active addresses for contexts in failover group 1. It is standby for the contexts in failover group 2, where it uses the standby addresses.
3. When a unit fails over, the other unit assumes the active IP addresses and MAC addresses of the failed failover group and begins passing traffic.
4. When the failed unit comes back online, and you enabled the preempt option, it resumes the failover group.

Virtual MAC addresses provide specialized functionality:

The Firewall Threat Defense has multiple methods to configure virtual MAC addresses. We recommend using only one method. If you set the MAC address using multiple methods, the MAC address used depends on many variables, and might not be predictable.

For multi-instance capability, the FXOS chassis autogenerates only primary MAC addresses for all interfaces. You can overwrite the generated MAC address with a virtual MAC address with both the primary and secondary MAC addresses, but predefining the secondary MAC address is not essential; setting the secondary MAC address does ensure that to-the-box management traffic is not interrupted in the case of new secondary unit hardware.

MAC address table updates occur during failover events:

During failover, the device that is designated as the new active device generates multicast packets for each MAC address entry in the MAC table and sends them to all the bridge group interfaces. This action prompts the upstream switches in the bridge group to update their routing tables with the new active device's interface to ensure accurate traffic forwarding.

The time taken to generate multicast packets and update the routing tables of the upstream switches depends on the number of entries in the MAC address table and the number of bridge group interfaces. Use the **show failover statistics state-switch-delay** command to display statistics related to the delays encountered during failover events.

Stateful failover

A stateful failover is a high availability mechanism that

- continuously passes per-connection state information from the active unit to the standby unit
- maintains connection information after a failover occurs, and
- allows supported end-user applications to continue communication sessions without reconnecting.

Stateful failover operation

During Stateful Failover, the active unit continually passes per-connection state information to the standby unit. After a failover occurs, the same connection information is available at the new active unit. Supported end-user applications are not required to reconnect to keep the same communication session.

Supported features

Supported features are high availability capabilities that

- enable state information to be passed to the standby Firewall Threat Defense device during Stateful Failover
- maintain connection states and critical information for seamless traffic flow, and
- ensure minimal disruption during failover events.

State information types

For Stateful Failover, these state information types are passed to the standby device:

- NAT translation table.
- TCP and UDP connections and states, including HTTP connection states. Other types of IP protocols, and ICMP, are not parsed by the active unit, because they get established on the new active unit when a new packet arrives.
- Snort connection states, inspection results, and pin hole information, including strict TCP enforcement.
- The ARP table
- The Layer 2 bridge table (for bridge groups)
- The ISAKMP and IPsec SA table
- GTP PDP connection database
- SIP signaling sessions and pin holes.
- Static and dynamic routing tables—Stateful Failover participates in dynamic routing protocols, like OSPF and EIGRP, so routes that are learned through dynamic routing protocols on the active unit are maintained

in a Routing Information Base (RIB) table on the standby unit. Upon a failover event, packets travel normally with minimal disruption to traffic because the active secondary unit initially has rules that mirror the primary unit. Immediately after failover, the re-convergence timer starts on the newly active unit. Then the epoch number for the RIB table increments. During re-convergence, OSPF and EIGRP routes become updated with a new epoch number. Once the timer is expired, stale route entries (determined by the epoch number) are removed from the table. The RIB then contains the newest routing protocol forwarding information on the newly active unit.



Note Routes are synchronized only for link-up or link-down events on an active unit. If the link goes up or down on the standby unit, dynamic routes sent from the active unit may be lost. This is normal, expected behavior.

- DHCP Server—DHCP address leases are not replicated. However, a DHCP server configured on an interface will send a ping to make sure an address is not being used before granting the address to a DHCP client, so there is no impact to the service. State information is not relevant for DHCP relay or DDNS.
- Access control policy decisions—Decisions related to traffic matching (including URL, URL category, geolocation, and so forth), intrusion detection, malware, and file type are preserved during failover. However, for connections being evaluated at the moment of failover, there are the following caveats:
  - AVC—App-ID verdicts are replicated, but not detection states. Proper synchronization occurs as long as the App-ID verdicts are complete and synchronized before failover occurs.
  - Intrusion detection state—Upon failover, once mid-flow pickup occurs, new inspections are completed, but old states are lost.
  - File malware blocking—The file disposition must become available before failover.
  - File type detection and blocking—The file type must be identified before failover. If failover occurs while the original active device is identifying the file, the file type is not synchronized. Even if your file policy blocks that file type, the new active device downloads the file.
- User identity decisions from the identity policy, including the user-to-IP address mappings gathered passively through ISE Session Directory, and active authentication through captive portal. Users who are actively authenticating at the moment of failover might be prompted to authenticate again.
- Network AMP—Cloud lookups are independent from each device, so failover does not affect this feature in general. Specifically:
  - Signature Lookup—If failover occurs in the middle of a file transmission, no file event is generated and no detection occurs.
  - File Storage—If failover occurs when the file is being stored, it is stored on the original active device. If the original active device went down while the file was being stored, the file does not get stored.
  - File Pre-classification (Local Analysis)—If failover occurs in the middle of pre-classification, detection fails.
  - File Dynamic Analysis (Connectivity to the cloud)—If failover occurs, the system might submit the file to the cloud.

  - Archive File Support—If failover occurs in the middle of an analysis, the system loses visibility into the file/archive.
  - Custom Blocking—If failover occurs, no events are generated.
- Security Intelligence decisions. However, DNS-based decisions that are in process at the moment of failover are not completed.
- RA VPN—Remote access VPN end users do not have to reauthenticate or reconnect the VPN session after a failover. However, applications operating over the VPN connection could lose packets during the failover process and not recover from the packet loss.
- From all the connections, only established ones will be replicated on the Standby device.

Unsupported features

Unsupported features are device capabilities that

- are not passed to the standby Firewall Threat Defense in Stateful Failover
- do not maintain state information during failover events, and
- may require re-establishment after a failover occurs.

State information limitations

For Stateful Failover, the following state information is not passed to the standby Firewall Threat Defense:

- Sessions in plaintext tunnels other than GREv0 and IPv4-in-IP. Sessions inside tunnels are not replicated and the new active node will not be able to reuse existing inspection verdicts to match the correct policy rules.
- Decrypted TLS/SSL connections—The decryption states are not synchronized, and if the active unit fails, then decrypted connections will be reset. New connections will need to be established to the new active unit. Connections that are not decrypted (in other words, those that match a TLS/SSL Do Not Decrypt rule action) are not affected and are replicated correctly.
- Multicast routing.

Bridge group requirements for high availability

Bridge group requirements for high availability are special considerations that

- address traffic loss on bridge group member interfaces during failover
- prevent switch ports from entering blocking state for 30 to 50 seconds, and
- provide workarounds to maintain connectivity during topology changes.

High availability workarounds

There are special considerations for high availability when using bridge groups.

When the active unit fails over to the standby unit, the switch port running Spanning Tree Protocol (STP) can go into a blocking state for 30 to 50 seconds when it senses the topology change. To avoid traffic loss on the

bridge group member interfaces while the port is in a blocking state, you can configure one of the following workarounds:

- Switch port is in Access mode—Enable the STP PortFast feature on the switch:

```
interface interface_id
  spanning-tree portfast
```

  The PortFast feature immediately transitions the port into STP forwarding mode upon linkup. The port still participates in STP. So if the port is to be a part of the loop, it eventually transitions into STP blocking mode.

- If the switch port is in Trunk mode, or you cannot enable STP PortFast, then you can use one of the following less desirable workarounds that impacts failover functionality or STP stability:
  - Disable interface monitoring on the bridge group and member interfaces.
  - Increase the interface hold time in the failover criteria to a high value that will allow STP to converge before the unit fails over.
  - Decrease the STP timers on the switch to allow STP to converge faster than the interface hold time.

Failover health monitoring

Failover health monitoring is a system capability that monitors each unit for overall health and interface health.

Health monitoring tests

The Firewall Threat Defense device performs tests to determine the state of each unit. This section includes information about how the Firewall Threat Defense device performs tests to determine the state of each unit.

Unit health monitoring

Unit health monitoring is a failover mechanism that

- determines the health of peer units by monitoring the failover link with hello messages
- sends LANTEST messages on each data interface when three consecutive hello messages are missed, and
- initiates appropriate failover actions based on peer unit responsiveness.

Unit health monitoring behavior

The Firewall Threat Defense device determines the health of the other unit by monitoring the failover link with hello messages. If a unit does not receive three consecutive hello messages on the failover link, the sends LANTEST messages on each data interface, including the failover link, to validate whether the peer is responsive. The action that the Firewall Threat Defense device takes depends on the response from the other unit. These are the possible actions:

- If the Firewall Threat Defense device receives a response on the failover link, then it does not fail over.
- If the Firewall Threat Defense device does not receive a response on the failover link, but it does receive a response on a data interface, then the unit does not failover. The failover link is marked as failed. You

should restore the failover link as soon as possible because the unit cannot fail over to the standby while the failover link is down.

- If the Firewall Threat Defense device does not receive a response on any interface, then the standby unit switches to active mode and classifies the other unit as failed.

Note During a high-availability failover event, the Firewall Threat Defense device device may briefly appear as **Offline** in the device's health monitoring dashboard. This happens because health alerts are cleared during the process and are only updated after the process is complete. Wait for the failover operation to finish.

Heartbeat module redundancy

Heartbeat module redundancy is a high availability feature that

- sends heartbeat messages using the data plane transport infrastructure to supplement control plane heartbeat packets
- increments a counter when the peer receives heartbeat packets in the data plane
- prevents false failover or split-brain scenarios when the control plane is congested with traffic.

Heartbeat module redundancy behavior

Each unit in the HA periodically sends a broadcast keepalive heartbeat packet over the failover link. If the control plane is too busy handling traffic, sometimes the heartbeat packets do not reach the peers, or the peers do not process the heartbeat packets due to CPU overloading. When peers cannot communicate the keepalive status within the configurable timeout period, a false failover or split-brain scenario occurs.

The heartbeat module in the data plane helps to avoid the occurrence of false failover or split-brain due to traffic congestion in the control plane.

- The additional heartbeat module works similarly to the control plane module but sends and receives heartbeat messages using the data plane transport infrastructure.
- When the peer receives heartbeat packets in the data plane, a counter gets incremented.
- If the heartbeat transfer in the control plane fails, the node checks the heartbeat counter in the data plane. If the counter is incrementing, then the peer is alive, and the cluster does not perform a failover in this situation.

Note

- The additional heartbeat module is enabled by default whenever HA is enabled. You do not have to set a poll interval for the additional heartbeat module in the data plane. This module uses the same heartbeat interval that you set for the control plane.

Interface monitoring

Interface monitoring is a failover capability that

- tracks the health of up to 1025 interfaces to detect interface failures

- performs interface tests when hello messages are not received within 15 seconds, and
- triggers failover when the number of failed interfaces meets the defined threshold.

Interface monitoring operation

When a unit does not receive hello messages on a monitored interface for 15 seconds, it runs interface tests. If one of the interface tests fails for an interface, but this same interface on the other unit continues to successfully pass traffic, then the interface is considered to be failed, and the device stops running tests.

If the threshold you define for the number of failed interfaces is met (see **Devices** > **Device Management**, and then **High Availability** > **Failover Trigger Criteria**), and the active unit has more failed interfaces than the standby unit, then a failover occurs. If an interface fails on both units, then both interfaces go into the "Unknown" state and do not count towards the failover limit defined by failover interface policy.

An interface becomes operational again if it receives any traffic. A failed device returns to standby mode if the interface failure threshold is no longer met.

If an interface has IPv4 and IPv6 addresses configured on it, the device uses the IPv4 addresses to perform the health monitoring. If an interface has only IPv6 addresses configured on it, then the device uses IPv6 neighbor discovery instead of ARP to perform the health monitoring tests. For the broadcast ping test, the device uses the IPv6 all nodes address (FE02::1).

Interface tests

Interface tests are monitoring mechanisms that:

- evaluate interface operational status during failover scenarios
- run sequentially with approximately 1.5 second duration per test, and
- determine interface failure status on Firewall Threat Defense device units.

Interface test sequence

The Firewall Threat Defense device uses these interface tests in sequence:

1. Link Up/Down test—A test of the interface status. If the Link Up/Down test indicates that the interface is down, then the device considers it failed, and testing stops. If the status is Up, then the device performs the Network Activity test.
2. Network Activity test—A received network activity test. At the start of the test, each unit clears its received packet count for its interfaces. As soon as a unit receives any eligible packets during the test, then the interface is considered operational. If both units receive traffic, then testing stops. If one unit receives traffic and the other unit does not, then the interface on the unit that does not receive traffic is considered failed, and testing stops. If neither unit receives traffic, then the device starts the ARP test.
3. ARP test—A test for successful ARP replies. Each unit sends a single ARP request for the IP address in the most recent entry in its ARP table. If the unit receives an ARP reply or other network traffic during the test, then the interface is considered operational. If the unit does not receive an ARP reply, then the device sends a single ARP request for the IP address in the *next* entry in the ARP table. If the unit receives an ARP reply or other network traffic during the test, then the interface is considered operational. If both units receive traffic, then testing stops. If one unit receives traffic, and the other unit does not, then the interface on the unit that does not receive traffic is considered failed, and testing stops. If neither unit receives traffic, then the device starts the Broadcast Ping test.

4. Broadcast Ping test—A test for successful ping replies. Each unit sends a broadcast ping, and then counts all received packets. If the unit receives any packets during the test, then the interface is considered operational. If both units receive traffic, then testing stops. If one unit receives traffic, and the other unit does not, then the interface on the unit that does not receive traffic is considered failed, and testing stops. If neither unit receives traffic, then testing starts over again with the ARP test. If both units continue to receive no traffic from the ARP and Broadcast Ping tests, then these tests will continue running in perpetuity.

Interface status

Interface status is a monitoring indicator that

- shows the current operational state of monitored interfaces in a failover configuration
- tracks traffic reception and hello packet communication between peer units, and
- determines whether an interface is actively monitored by the failover process.

Interface status types

Monitored interfaces can have these status types:

- **Unknown**: Initial status. This status can also mean the status cannot be determined.
- **Normal**: The interface is receiving traffic.
- **Normal (Waiting)**: The interface is up, but has not yet received a hello packet from the corresponding interface on the peer unit.
- **Normal (Not-Monitored)**: The interface is up, but is not monitored by the failover process.
- **Testing**: Hello messages are not heard on the interface for five poll times.
- **Link Down**: The interface or VLAN is administratively down.
- **Link Down (Waiting)**: The interface or VLAN is administratively down and has not yet received a hello packet from the corresponding interface on the peer unit.
- **Link Down (Not-Monitored)**: The interface or VLAN is administratively down, but is not monitored by the failover process.
- **No Link**: The physical link for the interface is down.
- **No Link (Waiting)**: The physical link for the interface is down and has not yet received a hello packet from the corresponding interface on the peer unit.
- **No Link (Not-Monitored)**: The physical link for the interface is down, but is not monitored by the failover process.
- **Failed**: No traffic is received on the interface, yet traffic is heard on the peer interface.

Failover triggers and detection timing

Failover triggers and detection timing are high availability mechanisms that:

- initiate automatic switchover when specific failure conditions occur on the active unit,

- monitor system health through configurable detection thresholds and timing parameters, and
- ensure service continuity by transferring control to the standby unit when failures exceed defined limits.

Failover triggering events and timing parameters

These events trigger failover in a Firepower high availability pair:

- More than 50% of the Snort instances on the active unit are down.
- Disk space on the active unit is more than 90% full.
- The **no failover active** command is run on the active unit or the **failover active** command is run on the standby unit.
- The active unit has more failed interfaces than the standby unit.
- Interface failure on the active device exceeds the threshold configured.

  By default, failure of a single interface causes failover. You can change the default value by configuring a threshold for the number of interfaces or a percentage of monitored interfaces that must fail for the failover to occur. If the threshold is exceeded on the active device, failover occurs. If the threshold is exceeded on the standby device, the unit moves to **Fail** state.

  To change the default failover criteria, enter this command in global configuration mode:

Table 2: Interface policy command

Command	Purpose
failover interface-policy num [%] `hostname (config)# failover interface-policy 20%`	Changes the default failover criteria. When specifying a specific number of interfaces, the *num* argument can be from 1 to 250. When specifying a percentage of interfaces, the *num* argument can be from 1 to 100.

This table shows the failover triggering events and associated failure detection timing. If failover occurs, you can view the reason for the failover in the Message Center, along with various operations pertaining to the high availability pair. You can configure these thresholds to a value within the specified minimum-maximum range.

Table 3: Firewall Threat Defense failover times

Failover triggering event	Minimum	Default	Maximum
Active unit loses power, hardware goes down, or the software reloads or crashes. When any of these occur, the monitored interfaces or failover link do not receives any hello message.	800 milliseconds	15 seconds	45 seconds
Active unit interface physical link down.	500 milliseconds	5 seconds	15 seconds
Active unit interface up, but connection problem causes interface testing.	5 seconds	25 seconds	75 seconds

Active/standby failover

Active/standby failover is a high availability configuration that

- lets you use a standby Firewall Threat Defense device to take over the functionality of a failed unit,
- enables the standby unit to become the active unit when the active unit fails, and
- allows the failed unit to come back online as the standby unit if the problem is temporary.

The failed unit must be replaced if the problem is not temporary. Set the standby unit to primary before replacing the failed unit to retain the configuration of the secondary unit.

For multiple context mode, the ASA can fail over the entire unit (including all contexts) but cannot fail over individual contexts separately.

Primary/secondary roles and active/standby status

Primary/secondary roles and active/standby status are failover configuration concepts that

- define unit hierarchy, with primary units taking precedence during simultaneous startup
- determine IP address and MAC address usage patterns during failover operations, and
- establish traffic flow responsibilities between paired units in Active/Standby failover configurations.

Primary and secondary unit differences

When setting up Active/Standby failover, you configure one unit to be primary and the other to be secondary. During configuration, the primary unit's policies are synchronized to the secondary unit. At this point, the two units act as a single device for device and policy configuration. However, for events, dashboards, reports and health monitoring, they continue to display as separate devices.

The main differences between the two units in a failover pair are related to which unit is active and which unit is standby, namely which IP addresses to use and which unit actively passes traffic.

However, a few differences exist between the units depending on which unit is primary (as specified in the configuration) and which unit is secondary:

- The primary unit always becomes the active unit if both units start up at the same time (and are of equal operational health).
- The primary unit MAC addresses are always coupled with the active IP addresses. The exception to this rule occurs when the secondary unit becomes active and cannot obtain the primary unit MAC addresses over the failover link. In this case, the secondary unit MAC addresses are used.

Active unit determination at startup

Active unit determination at startup is a high availability process that

- sets a unit to standby if it boots and detects a peer already running as active,
- sets a unit to active if it boots and does not detect a peer, and
- sets the primary unit as active and secondary unit as standby if both units boot simultaneously.

Failover events

A failover event is a system condition that

- triggers an active unit to transfer control to a standby unit in Active/Standby failover configurations
- occurs on a unit basis, and
- follows specific failover policies that determine whether failover occurs and what actions each unit takes.

Failover event policies and actions

This table shows the failover action for each failure event. For each failure event, the table shows the failover policy (failover or no failover), the action taken by the active unit, the action taken by the standby unit, and any special notes about the failover condition and actions.

Table 4: Failover events

Failure Event	Policy	Active Unit Action	Standby Unit Action	Notes
Active unit failed (power or hardware)	Failover	n/a	Become active Mark active as failed	No hello messages are received on any monitored interface or the failover link.
Formerly active unit recovers	No failover	Become standby	No action	None.
Standby unit failed (power or hardware)	No failover	Mark standby as failed	n/a	When the standby unit is marked as failed, then the active unit does not attempt to fail over, even if the interface failure threshold is surpassed.
Failover link failed during operation	No failover	Mark failover link as failed	Mark failover link as failed	You should restore the failover link as soon as possible because the unit cannot fail over to the standby unit while the failover link is down.
Failover link failed at startup	No failover	Become active Mark failover link as failed	Become active Mark failover link as failed	If the failover link is down at startup, both units become active.
State link failed	No failover	No action	No action	State information becomes out of date, and sessions are terminated if a failover occurs.
Interface failure on active unit above threshold	Failover	Mark active as failed	Become active	None.
Interface failure on standby unit above threshold	No failover	No action	Mark standby as failed	When the standby unit is marked as failed, then the active unit does not attempt to fail over even if the interface failure threshold is surpassed.

Config-sync optimization

Config-sync optimization is a configuration synchronization enhancement that

- compares configuration hash values between active and joining devices to determine if full synchronization is necessary
- enables faster device rejoining by skipping full configuration synchronization when hash values match, and
- reduces maintenance window and upgrade time during high availability operations.

Guidelines and limitations of configuration sync optimization

When a device reboots or rejoins after a suspend or resume high availability, the joining device clears its running configuration. The active device then sends its entire configuration to the joining device for a full configuration synchronization. If the active device has a large configuration, this process can take several minutes.

The configuration sync optimization functionality enables comparing the configuration of the joining device and the active device by exchanging configuration hash values. If the hash computed on both active and joining devices match, the joining device skips full configuration synchronization and rejoin the high availability configuration. This functionality ensures faster peering and reduces maintenance window and upgrade time.

Guidelines and limitations:

- The configuration sync optimization functionality is enabled by default.
- Firewall Threat Defense multiple context mode supports configuration sync optimization by sharing the context order during full configuration synchronization, allowing comparison of context order during subsequent node-rejoin.
- If you configure passphrase and failover IPsec key, then configuration sync optimization is not effective as the hash value computed in the active and standby devices differs.
- If you configure the device with dynamic ACL or SNMPv3, configuration sync optimization is not effective.
- Active device synchronizes full configuration with flapping LAN links as default behavior. During failover flaps between active and standby devices, configuration sync optimization is not triggered and devices perform a full configuration synchronization.
- Configuration sync optimization gets triggered when the high availability configuration recovers from an interruption or loss of network communication between the active and standby devices.

Monitoring config-sync optimization:

- Syslog messages are generated displaying whether the hash values computed on the active and joining unit match, does not match, or if the operation timeout expires.
- The syslog message also displays the time elapsed, from the time of sending the hash request to the time of getting and comparing the hash response.

Note The Configuration State in **show failover state** command displays the config sync state status during HA joining. This state does not reflect the later config deployments or changes, and replication on device until a resync has been initiated.

Requirements and prerequisites for high availability

This reference provides the requirements and prerequisites needed to implement high availability functionality.

Model support

Secure Firewall Threat Defense

Supported domains

Any

User roles

Admin

Network Admin

Guidelines for High availability

Model Support

- 1010/1210/ 1220:
  - You should not use the switch port functionality when using High availability. Because the switch ports operate in hardware, they continue to pass traffic on both the active *and* the standby units. High availability is designed to prevent traffic from passing through the standby unit, but this feature does not extend to switch ports. In a normal High availability network setup, active switch ports on both units will lead to network loops. We suggest that you use external switches for any switching capability. Note that VLAN interfaces can be monitored by failover, while switch ports cannot. Though Firewall Management Center allows you to configure switch ports / VLAN interfaces in HA, it may lead to misconfiguration due to network loops when connecting to external switches.
  - You can only use a firewall interface as the failover link.
- Firepower 9300—Intra-chassis High Availability is not supported.
- The Firewall Threat Defense Virtual on public cloud networks such as Microsoft Azure and Amazon Web Services are not supported with High availability because Layer 2 connectivity is required.

Additional Guidelines

- When a device that is part of a Threat Defense HA pair with site-to-site VPN configuration is reverted to a previous version, re-establishing the HA pair or deployment may fail. In this scenarion, you must follow these steps:

  1. After the revert, choose **Devices** > **VPN** > **Site to Site**.
  2. Select the VPN topology associated with the HA device.
  3. Re-select the correct VPN interface for the affected device.
  4. Save the VPN topology.
  5. Deploy configuration on the device.
  6. Re-establish the HA pair.

- When the active unit fails over to the standby unit, the connected switch port running Spanning Tree Protocol (STP) can go into a blocking state for 30 to 50 seconds when it senses the topology change. To avoid traffic loss while the port is in a blocking state, you can enable the STP PortFast feature on the switch:

  interface *interface_id* **spanning-tree portfast**

  This workaround applies to switches connected to both routed mode and bridge group interfaces. The PortFast feature immediately transitions the port into STP forwarding mode upon linkup. The port still participates in STP. So if the port is to be a part of the loop, the port eventually transitions into STP blocking mode.

- Configuring port security on the switches connected to the Firewall Threat Defense device failover pair can cause communication problems when a failover event occurs. This problem occurs when a secure MAC address configured or learned on one secure port moves to another secure port, a violation is flagged by the switch port security feature.
- For Active/Standby High availability and a VPN IPsec tunnel, you cannot monitor both the active and standby units using SNMP over the VPN tunnel. The standby unit does not have an active VPN tunnel, and will drop traffic destined for the NMS. You can instead use SNMPv3 with encryption so the IPsec tunnel is not required.
- Both the peer devices go into unknown state and high-availability configuration fails if you run clish in any of the peer devices while creating a High Availability pair.
- Immediately after failover, the source address of syslog messages will be the failover interface address for a few seconds.
- For better convergence (during a failover), you must shut down the interfaces on a HA pair that are not associated with any configuration or instance.
- In high availability deployments with a shared failover and state interfaces, if the connectivity over failover interface fails while the standby unit is in sync config state, and eventually when the standby unit switches to active state, it results in a split brain. This is observed even when there is a monitored interface.

  The connectivity over failover interface can fail in the following situations:

  - After the standby unit reboots, the connectivity over failover interface fails while the standby unit is in sync config state.

- After enabling previously disabled failover on the standby unit, the connectivity over failover interface fails while the standby unit is in sync config state.

To avoid split brain, use failover and state interfaces. If the connectivity failures over the failover interfaces persist, isolate the new active (previously standby) unit from the network.

- If you configure failover encryption in evaluation mode, the systems use DES for the encryption. If you then register the devices using an export-compliant account, the devices will use AES after a reboot. Thus, if a system reboots for any reason, including after installing an upgrade, the peers will be unable to communicate and both units will become the active unit. We recommend that you do not configure encryption until after you register the devices. If you do configure this in evaluation mode, we recommend you remove the encryption before registering the devices.
- When using SNMPv3 with failover, if you replace a failover unit, then SNMPv3 users are not replicated to the new unit. You must remove the users, re-add them, and then redeploy your configuration to force the users to replicate to the new unit.
- The device does not share SNMP client engine data with its peer.
- If you have a very large number of access control and NAT rules, the size of the configuration can prevent efficient configuration replication, resulting in the standby unit taking an excessively long time to reach standby ready state. This can also impact your ability to connect to the standby unit during replication through the console or SSH session. To enhance configuration replication performance, enable transactional commit for both access rules and NAT, using the **asp rule-engine transactional-commit access-group** and **asp rule-engine transactional-commit nat** commands.
- A unit in a High availability pair transitioning to the standby role synchronizes its clock with the active unit.

  Example:

```
firepower#show clock
01:00:52 UTC Mar 1 2022

...
01:01:18 UTC Mar 1 2022 <======= Incorrect (previous) clock
Cold Standby              Sync Config               Detected an Active mate

19:38:21 UTC Apr 9 2022 <======= Updated clock
Sync Config               Sync File System          Detected an Active mate
...
firepower/sec/stby#show clock
19:38:40 UTC Apr 9 2022
```

- The units in High availability do not dynamically synchronize the clock. Here are some examples of events when synchronization takes place:
  - A new High availability pair is created.
  - High availability is broken and re-created.
  - Communication over the failover link was disrupted and reestablished.
  - Failover status was manually changed at the CLI using the **no failover/failover** or **configure high-availability suspend/resume** (Firewall Threat Defense) commands.
- Enabling High availability forces all routes to be deleted and are re-added after the High availability progression changes to the Active state. You could experience connection loss during this phase.

- If you replace the primary unit, then when you re-create high-availability, you should set the replacement unit as the *secondary* unit so that the configurations are replicated from the former secondary unit to the replacement unit. If you set the replacement unit as primary, you will accidentally overwrite the configuration that is present on the operational unit.
- Configure identical strong encryption on both Threat Defense devices before forming the High availability. If they are non-identical, the HA peers may enter a split-brain state.
- Deploying Firepower 1100 devices in high availability with hundreds of interfaces configured on them can result in increased delay in the failover time (seconds).
- In the High availability configuration, short-lived connections, usually using port 53, are closed quickly and never transferred or synchronized from Active to Standby, so there might be a difference in the number of connections on both High availability devices. This is expected behavior for short-lived connections. You can try to compare the connections that are long-lived (for example, more than 30-60 seconds).
- In the High availability configuration, embryonic connections—connection requests that have not yet completed the three-way handshake process—are closed quickly and not synchronized between the active and standby devices. This design ensures HA system efficiency and security. For this reason, there might be a difference in the number of connections on both High availability devices, which is to be expected.
- If the failover LAN link is not connected back-to-back and instead connected through one or more switches, a failure within the intermediate path can cause the active unit to lose connectivity with the standby unit, resulting in inconsistent active/standby states. Although this does not impact High availability functionality, it is recommended to check and recover the failover-link path between the active and standby units.

  When the failover LAN link is down, it is not recommended to deploy any configuration, as it may not be replicated to the peer unit.
- See the Secure Firewall Threat Defense Virtual getting started guides and review your Firewall Threat Defense Virtual device configurations for high availability.
- In OSPF, after a failover, the OSPF connection with the peer device becomes invalid. Terminate the invalid connection, and then establish a new OSPF connection.
- In transparent mode, if you have problems with the active unit losing the MAC address of the hot-standby router (HSRP), create a static mapping for the MAC address.
- UCAPL or CC compliance mode cannot be changed if the threat defense device is in high availability. Modify the compliance mode before forming the high availability pair.

Add a high availability pair

Establish an Active/Standby high-availability pair to ensure network protection continuity in case of device failure.

When establishing an Active/Standby high-availability pair, you designate one of the devices as primary and the other as secondary. The Firewall Management Center deploys a merged configuration to the paired devices. If there is a conflict, the primary device setting is used. In a multidomain deployment, devices in a high-availability pair must belong to the same domain.

Note The failover link and the stateful failover link are in a private IP space and are only used for communication between peers in a high-availability pair. After high availability is established, selected interface links and encryption settings cannot be modified without breaking the high-availability pair and reconfiguring it.

Caution Creating or breaking a high-availability pair immediately restarts the Snort process on the primary and secondary devices, temporarily interrupting traffic inspection on both devices. Whether traffic drops during this interruption or passes without further inspection depends on how the assigned device handles traffic. Refer to Snort restart traffic behavior. The system warns you that continuing to create a high-availability pair restarts the Snort process on the primary and secondary devices and allows you to cancel.

Before you begin

Confirm that both devices:

- Are the same model.
- Have the same number and type of interfaces.
- Are in the same domain and group.
- Have normal health status and are running the same software.
- Are either in routed or transparent mode.

Note Only routed mode is supported for manager access on a data interface.

- Have the same NTP configuration. See Synchronize time on FTD devices.
- Are fully deployed with no uncommitted changes.
- Do not have DHCP or PPPoE configured on any interfaces.
- For manager access on a data interface:
  - Use the same data interface on both devices for manager access.
  - You cannot use DHCP; only a static IP address is supported. Features that rely on DHCP cannot be used, including DDNS and zero-touch provisioning.

Note If you use zero-touch provisioning to register the device, when you use the outside interface for manager access, it uses DHCP by default. Before you can enable high availability, you need to change the IP address to a static address. See Change the device IP address. Alternatively, you can use the Management interface instead; DHCP is supported on Management with high availability.

- Have different static IP addresses in the same subnet.

- Use the same manager configuration (**configure manager add** command) to ensure that the connectivity is the same.
- You cannot use the data interface as the failover or state link.

Note The high availability formation is possible between the two Firewall Threat Defense devices when the certificate available on the primary device is not present on the secondary device. When high availability is formed, the certificate will be synched on the secondary device.

Procedure

Step 1 Add both devices to the Firewall Management Center according to Registration with the management center.

Step 2 Choose **Devices** > **Device Management**.

Step 3 From the **Add** drop-down menu, choose **High Availability**.

Step 4 Enter a display **Name** for the high-availability pair.

Step 5 Choose the **Primary Peer** device for the high-availability pair.

Step 6 Choose the **Secondary Peer** device for the high-availability pair.

Step 7 Click **Continue**.

Step 8 Under **LAN Failover Link**, choose an **Interface** with enough bandwidth to reserve for failover communications.

Note Only interfaces that do not have a logical name and do not belong to a security zone, will be listed in the **Interface** drop-down in the **Add High Availability Pair** dialog.

Step 9 Type any identifying **Logical Name**.

Step 10 Type a **Primary IP** address for the failover link on the active unit.

This address should be on an unused subnet.

Note 169.254.1.0/24 and fd00:0:0:*::/64 are internally used subnets and cannot be used for the failover or state links.

Step 11 Optionally, choose **Use IPv6 Address**.

Step 12 Type a **Secondary IP** address for the failover link on the standby unit. This IP address must be in the same subnet as the primary IP address.

Step 13 If IPv4 addresses are used, type a **Subnet Mask** that applies to both the primary and secondary IP addresses.

Step 14 Optionally, under **Stateful Failover Link**, choose the same **Interface**, or choose a different interface and enter the high availability configuration information.

Note 169.254.1.0/24 and fd00:0:0:*::/64 are internally used subnets and cannot be used for the failover or state links.

Step 15 (Optional) Choose **Enabled** and choose the **Key Generation** method for IPsec Encryption between the failover links.

Step 16 Click **OK**. This process takes a few minutes as the process synchronizes system data.

After a successful configuration, the high availability pair is established with one device as active and the other as standby. .

Note We recommend to back up the devices. You can use the backup to quickly replace the devices when they fail and to restore the high availability service without being delinked from the Firewall Management Center. For more information, see *Cisco Secure Firewall Management Center Administration Guide*.

Configure optional high availability parameters

You can view the initial High Availability Configuration on the Firewall Management Center. You cannot edit these settings without breaking the high availability pair and then re-establishing it. To edit these settings, you must first break the high availability pair and re-establish it. You can modify the Failover Trigger Criteria to improve failover results. Interface Monitoring helps you determine which interfaces are best suited for failover.

Configure standby IP addresses and interface monitoring

Configure standby IP addresses for high availability interfaces to enable the active unit to perform network tests and check standby interface health beyond just tracking link state.

For each interface, set a standby IP address. Although recommended, the standby address is not required. Without a standby IP address, the active unit cannot perform network tests to check the standby interface health; it can only track the link state.

By default, monitoring is enabled on all named physical interfaces and, for the 10101210/1220, all VLAN interfaces,. You might want to exclude interfaces attached to less critical networks from affecting your failover policy. Switch ports are not eligible for interface monitoring.

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the device high-availability pair you want to edit, click the **Edit** ( ).

Step 3 Click the **High Availability** tab.

Step 4 In the **Monitored Interfaces** area, click the **Edit** ( ) next to the interface you want to edit.

Step 5 Check the **Monitor this interface for failures** check box.

Step 6 On the **IPv4** tab, enter the **Standby IP Address**.

This address must be a free address on the same network as the active IP address.

Step 7 If you configured the IPv6 address manually, on the **IPv6** tab, click the **Edit** (✎) next to the active IP address, enter the **Standby IP Address**, and click **OK**.

This address must be a free address on the same network as the active IP address. For autogenerated and **Enforce EUI 64** addresses, the standby address is automatically generated.

Step 8 Click **OK**.

Edit high availability failover criteria

This task allows you to customize failover criteria for high availability device pairs to match your specific network deployment requirements.

You can customize failover criteria based on your network deployment.

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the device high-availability pair you want to edit, click the **Edit** (✎).

Step 3 Choose **High Availability**.

Step 4 Next to **Failover Trigger Criteria**, click the **Edit** (✎).

Step 5 Under **Interface Failure Threshold**, choose the number or percentage of interfaces that must fail before the device fails over.

Step 6 Under **Hello packet Intervals**, choose how often hello packets are sent over the failover link.

Step 7 Click **OK**.

Configure virtual MAC addresses

Configure active and standby MAC addresses to minimize loss of traffic during failover and provide redundancy against IP address mapping for failover.

You can configure active and standby MAC addresses for failover using the following methods in the Secure Firewall Management Center:

- From the **Advanced tab** on the **Edit Interface** page during interface configuration; see Configure the MAC address.
- From the **Add Interface MAC Address** dialog-box which is accessed from the **High Availability** page; see this procedure.

Note To configure the MAC address in both primary and secondary units (so that the MAC address is transferred to all sub-interfaces to both the high-availability units), the recommended approach is to use the **Interfaces** tab to replicate the MAC addresses on sub-interfaces over both active and standby high-availability units.

If you configure active and standby MAC addresses in both locations, the addresses defined during interface configuration take precedence for failover.

You can minimize loss of traffic during failover by designating active and standby MAC addresses to the physical interface. This feature offers redundancy against IP address mapping for failover.

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the device high-availability pair you want to edit, click **Edit** ( ).

Step 3 Click **High Availability**.

Step 4 Click the **Add** ( ) icon next to Interface MAC Addresses.

Step 5 Choose a **Physical Interface**.

Step 6 Enter the **Active Interface MAC Address**.

Step 7 Enter the **Standby Interface MAC Address**.

Step 8 Click **OK**.

Note For detailed information, see Task 2, steps from 10 to 14 in Configure FTD High Availability on Firepower Appliances.

Manage High availability

This section describes how to manage High availability units after you enable High availability, including how to change the High availability setup and how to force failover from one unit to another.

Switch the Active Peer in the Firewall Threat Defense High Availability Pair

This task allows you to manually switch the active and standby units in a high availability pair, effectively forcing failover for reasons such as persistent fault or health events on the current active unit.

After you establish the Firewall Threat Defense high availability pair, you can manually switch the active and standby units, effectively forcing failover for reasons such as persistent fault or health events on the current active unit. Both units should be fully deployed before you complete this procedure.

Before you begin

Refresh node status for a single Firewall Threat Defense high availability pair, on page 30. This ensures that the status on the Firewall Threat Defense high availability device pair is in sync with the status on the Firewall Management Center.

Follow these steps to switch the active peer in the high availability pair:

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the high availability pair where you want to change the active peer, click the **Switch Active Peer**.

Step 3 Choose an option:

- Click **Yes** to immediately make the standby device the active device in the high availability pair.
- Click **No** to cancel and return to the Device Management page.

Refresh node status for a single Firewall Threat Defense high availability pair

Refresh the high availability node status to obtain accurate information about the active and standby device in a high availability pair when communication issues result in out of sync data.

Whenever active or standby devices in the Firewall Threat Defense high availability pair are rebooted, the Firewall Management Center may not display accurate high availability status for either device. This is because when the device reboots, the high availability status is immediately updated on the device and its corresponding event is sent to the Firewall Management Center. However, the status may not be updated on the Firewall Management Center because the communication between the device and the Firewall Management Center is yet to be established.

Communication failures or weak communication channels between the Firewall Management Center and devices may result in out of sync data. When you switch the active and standby devices in a high availability pair, the change may not be reflected in the Firewall Management Center even after a significant time duration.

In these scenarios, you can refresh the high availability node status to obtain accurate information about the active and standby device in a high availability pair.

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the high availability pair where you want to refresh the node status, click the **Refresh HA Node Status**.

Step 3 Click **Yes** to refresh the node status.

Suspend and resume high availability

You can suspend a unit in a high-availability pair, which is useful when:

- Both units are in an active-active situation, and fixing the communication on the failover link does not correct the problem.
- You want to troubleshoot an active or standby unit and do not want the units to fail over during that time.

When you suspend high availability, the currently active device remains active and continues handling all user connections. However, failover criteria are no longer monitored, and the system will never fail over to the now pseudo-standby device.

When using a data interface for manager access, the management connection will be broken until after you resume.

The primary difference between suspending high availability and breaking high availability is that on a suspended high-availability device, the high-availability configuration is retained. When you break high availability, the configuration is erased. Thus, you have the option to resume high availability on a suspended system, which enables the existing configuration and makes the two devices function as a failover pair again.

To suspend high availability, use the **configure high-availability suspend** command.

```
> configure high-availability suspend
Please ensure that no deployment operation is in progress before suspending
high-availability.
Please enter 'YES' to continue if there is no deployment operation in
progress and 'NO' if you wish to abort: YES
Successfully suspended high-availability.
```

If you suspend high availability from the active unit, the configuration is suspended on both the active and standby units. The standby unit interface configuration is also erased. If you suspend it from the standby unit, it is suspended on the standby unit only, but the active unit will not attempt to fail over to a suspended unit.

To resume failover, use the **configure high-availability resume** command.

```
> configure high-availability resume
Successfully resumed high-availablity.
```

You can resume a unit only if it is in Suspended state. The unit will negotiate active/standby status with the peer unit.

Note Suspending high availability is a temporary state. If you reload a unit, it resumes the high-availability configuration automatically and negotiates the active/standby state with the peer.

Replace a unit in Firewall Threat Defense high availability pair

This reference explains the process for replacing a failed unit in a Firewall Threat Defense high availability pair, including both backup restore and manual replacement procedures.

To replace a failed unit in the Firewall Threat Defense high availability pair using a backup file, see *Restoring Firewall Management Centers and Managed Devices* in the *Cisco Secure Firewall Management Center Administration Guide*.

If you do not have a backup of the failed device, you must break high availability. Then, register the replacement device to the Secure Firewall Management Center and reestablish high availability. The process varies depending on whether the device is primary or secondary:

- Replace a Primary Firewall Threat Defense HA Unit with no Backup, on page 32
- Replace a Secondary Firewall Threat Defense HA Unit with no Backup, on page 33

Replace a Primary Firewall Threat Defense HA Unit with no Backup

This task replaces a failed primary unit in a Firewall Threat Defense high availability pair to restore redundancy and maintain network protection.

Follow these steps below to replace a failed primary unit in the Firewall Threat Defense high availability pair. Failing to follow these steps can overwrite the existing high availability configuration.



Caution Creating or breaking the Firewall Threat Defense high availability pair immediately restarts the Snort process on the primary and secondary devices, temporarily interrupting traffic inspection on both devices. Whether traffic drops during this interruption or passes without further inspection depends on how the assigned device handles traffic. Refer to Snort restart traffic behavior. The system warns you that continuing to create a high availability pair restarts the Snort process on the primary and secondary devices and allows you to cancel.



Caution Never move a disk from sensor or Firewall Management Center to another device without reimaging the disk. This is an unsupported configuration and can cause breakage in functionality.

Procedure

Step 1 Choose **Force Break** to separate the high availability pair; see Break a high availability pair, on page 34.



Note The break operation removes all the configuration related to HA from Firewall Threat Defense and Firewall Management Center, and you need to recreate it manually later. To successfully configure the same HA pair, ensure that you save the IPs, MAC addresses, and monitoring configuration of all the interfaces/subinterfaces prior to executing the HA break operation.

Step 2 Unregister the failed primary Firewall Threat Defense device from the Firewall Management Center; see Unregister a Device from the Firewall Management Center.

Step 3 Register the replacement Firewall Threat Defense to the Firewall Management Center; see Registration with the management center.

Step 4 Configure high availability, using the existing secondary/active unit as the primary device and the replacement device as the secondary/standby device during registration; see Add a high availability pair, on page 24.

Replace a Secondary Firewall Threat Defense HA Unit with no Backup

This task allows you to restore high availability functionality by replacing a failed secondary unit in an Firewall Threat Defense high availability pair.

When a secondary unit fails in a high availability configuration, you need to replace it and recreate the HA pair to maintain network redundancy and protection.

Caution Creating or breaking the Firewall Threat Defense high availability pair immediately restarts the Snort process on the primary and secondary devices, temporarily interrupting traffic inspection on both devices. Whether traffic drops during this interruption or passes without further inspection depends on how the assigned device handles traffic. Refer to Snort restart traffic behavior. The system warns you that continuing to create a high availability pair restarts the Snort process on the primary and secondary devices and allows you to cancel.

Procedure

Step 1 Choose **Force Break** to separate the high availability pair.

See Break a high availability pair, on page 34.

Note The break operation removes all the configuration related to HA from Firewall Threat Defense and Firewall Management Center, and you need to recreate it manually later. To successfully configure the same HA pair, ensure that you save the IPs, MAC addresses, and monitoring configuration of all the interfaces/subinterfaces prior to executing the HA break operation.

Step 2 Unregister the secondary Firewall Threat Defense device from the Firewall Management Center.

See Unregister a Device from the Firewall Management Center.

Step 3 Register the replacement Firewall Threat Defense to the Firewall Management Center.

See Registration with the management center.

Step 4 Configure high availability, using the existing primary/active unit as the primary device and the replacement device as the secondary/standby device during registration.

See Add a high availability pair, on page 24.

Break a high availability pair

Break a high availability pair to remove the high-availability configuration from both units while maintaining traffic flow on the active unit.

When you break a high-availability pair, the high-availability configuration is removed from both units.

When using the Management interface for manager access: The active unit remains up and passing traffic. The standby unit interface configuration is erased.

When using a data interface for manager access: See the following details.

- The active unit remains up and passing traffic.
- The standby unit data interfaces are shut down except for the manager access interface, which remains up using the standby IP address so it can maintain the management connection.
- In a remote branch deployment setup, all standby unit data interfaces that are assigned with a logical name are shut down except for the manager access interface, which remains up to maintain the management connection.
- If the primary unit is in the standby state:
  - The IP addresses for manager access are swapped permanently in the Firewall Management Center configuration: the primary unit uses the standby IP address, and the secondary unit uses the active IP address.
  - If the Firewall Management Center initiated the management connection, and you specified a hostname for the device, then you need to update the DNS server so the swapped IP addresses are associated with the correct hostnames.
  - Breaking high availability causes a deployment to the standby unit. If the management connection is not yet reestablished because of the swapped IP addresses, the deployment may fail. In this case, you will need to manually trigger the deployment later (after the management connection is established). Be sure to complete the standby deployment before deploying changes to the active unit.

Policies that were not deployed to the active unit prior to the break operation continue to remain un-deployed after the break operation is complete. Deploy the policies on the standalone device after the break operation is complete.

Note

- When IPsec is enabled on high availability interfaces on the Firewall Threat Defense device, the device cannot prioritize the encrypted packets into the high-priority receive queue. As a result, during high-volume data traffic scenarios, attempts to break high availability may fail as the device cannot efficiently manage and prioritize the large number of encrypted connections. To view the device's resource usage and the maximum throughput, use the `show resource usage` command.
- If you cannot reach the high-availability pair using the Firewall Management Center, connect to the CLI on each device and enter **configure high-availability disable** to manually break high availability. See also Unregister a High Availability Pair and Register to a New Firewall Management Center, on page 35.

Caution Breaking the Firewall Threat Defense high-availability pair immediately restarts the Snort process on the primary and secondary units, temporarily interrupting traffic inspection on both devices. Whether traffic drops during this interruption or passes without further inspection depends on how the assigned device handles traffic. Refer to Snort restart traffic behavior.

Before you begin

- Refresh node status for a single Firewall Threat Defense high availability pair, on page 30. This ensures that the status on the high-availability pair is in sync with the status on the Firewall Management Center.

Follow these steps to break a high availability pair:

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the high-availability pair you want to break, click **More** (⋮) and choose **Break**.

Step 3 If the standby peer does not respond, check **Force Break**.

Step 4 Click **Yes**.

The Break operation removes the high-availability configuration from the active and standby units.

A FlexConfig policy deployed on the active unit may show a deployment failure after the break high-availability operation. You must alter and re-deploy the FlexConfig policy on the active unit.

What to do next

If you are using a FlexConfig policy on the active unit, alter and re-deploy the FlexConfig policy to eliminate deployment errors.

Note After you break high availability, the Firewall Threat Defense device that was operating as the active unit will still have the standby unit's IP address listed in its configuration. To resolve this, do an additional deployment on the formerly active Firewall Threat Defense device to remove the standby unit's IP address from its configuration.

Unregister a High Availability Pair and Register to a New Firewall Management Center

This task allows you to unregister a High Availability pair from the Firewall Management Center, which keeps the High Availability pair intact. You might want to unregister the pair if you want to register it to a new Firewall Management Center or if the Firewall Management Center can no longer reach the pair.

Unregistering a High Availability pair:

- Severs all communication between the Firewall Management Center and the pair.
- Removes the pair from the **Device Management** page.
- Returns the pair to local time management if the pair's platform settings policy is configured to receive time from the Firewall Management Center using NTP.
- Leaves the configuration intact, so the pair continues to process traffic.

  Policies, such as NAT and VPN, ACLs, and the interface configurations remain intact.

Registering the pair again to the same or a different Firewall Management Center causes the configuration to be removed, so the pair will stop processing traffic at that point; the High Availability configuration remains intact so you can add the pair as a whole. You can choose an access control policy at registration, but you will have to re-apply other policies after registration and then deploy the configuration before it will process traffic again.

Before you begin

- This procedure requires CLI access to the primary unit.

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the High Availability pair you want to unregister, click **More** (⋮) and choose **Unregister**.

Step 3 Click **Yes**. The device High Availability pair is unregistered.

Step 4 You can register the pair to a new (or the same) Firewall Management Center by adding the primary unit as a new device.

a) Determine the primary unit by connecting to the CLI on one unit, and entering the **show failover** command.

The first line of the output shows whether this unit is Primary or Secondary.

```
> show failover
Failover unit Primary
Failover LAN Interface: failover GigabitEthernet0/2 (up)
Reconnect timeout 0:00:00
Unit Poll frequency 1 seconds, holdtime 15 seconds
Failover On

[...]
```

b) At the primary unit's CLI, identify the new Firewall Management Center using the **configure manager add** command. See Modify Firewall Threat Defense management interface settings at the CLI.

c) Choose **Devices** > **Device Management**, and then click **Add** > **Device**.

You only need to add the primary unit as a device, and the Firewall Management Center will discover the secondary unit.

Monitoring High availability

Monitoring High availability is a system capability that enables you to view the High availability status.

View failover history

View the failover history of both high availability devices in a single view to understand the chronological order of failover events and their reasons.

You can view the failover history of both high availability devices in a single view. The history displays in chronological order and includes the reason for any failover.

Before you begin

Follow these steps to view failover history:

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the device high-availability pair you want to edit, click **Edit** ( ).

Step 3 Choose **Summary**.

Step 4 Under General, click **View** ( ).

View stateful failover statistics

This task allows you to monitor the stateful failover link statistics to assess the performance and health of your high availability configuration.

You can view the stateful failover link statistics of both the primary and secondary devices in the high availability pair.

Procedure

Step 1 Choose **Devices** > **Device Management**.

Step 2 Next to the device high-availability pair you want to edit, click **Edit** ( ).

Step 3 Choose **High Availability**.

Step 4 Under Stateful Failover Link, click **View** ( ).

Step 5 Choose a device to view statistics.

Troubleshoot configuration sync failure

When forming a failover pair, the joining unit clears its running configuration and replicates the entire configuration from the active unit. Upon completing full configuration sync, the joining unit assumes the standby ready role and establishes the failover pair. After the unit joins the failover pair, any configuration change on the active unit are also replicated on the standby unit to keep both the units synchronized.

If the standby unit fails to replicate any configuration change commands, it reports configuration sync failure and exit the high availability by disabling failover. This section describes steps for identifying and troubleshooting configuration sync failure error reported by the standby unit.

To view the configuration sync errors or stats, you can use these CLI commands through an SSH session or the Threat Defense CLI:

- **show failover config-sync errors all** to display all configuration synchronization errors related to failover.
- **show failover config-sync stats all** to view statistics regarding failover configuration synchronization.

To re-enable high availability:

- Re-enable failover by executing the **failover reset** command on the active unit.
- If re-enabling the failover is not successful, delete or update the configuration change that the standby unit failed to replicate, and then re-enable the failover.



Note If the maximum interface limit is reached, the number of VPN tunnels on the active and standby units may be inconsistent. In this situation run the**write standby**command on the active unit to sync the configuration.

History for high availability

This reference provides a chronological history of high availability features, enhancements, and improvements implemented across various software versions. The information helps you track the evolution of high availability capabilities and understand when specific features were introduced.

Feature	Minimum Firewall Management Center	Minimum Firewall Threat Defense	Details
Improved role switch time during failover	7.7	7.7	When a failover occurs, the new active device generates multicast packets for each MAC address entry and sends them to all bridge group interfaces, prompting the upstream switches to update their routing tables. This task of generating and sending multicast packets to the bridge interfaces now runs asynchronously in the data plane, allowing critical failover tasks in the control plane to proceed without delays. This enhancement improves role switch time during a failover and reduces downtime.

Feature	Minimum Firewall Management Center	Minimum Firewall Threat Defense	Details
High availability support for the manager access data interface	7.4	7.4	You can now use a data interface for manager access with Firewall Threat Defense high availability.
Unregistering a high-availability pair now allows you to re-register without breaking the pair	7.3	Any	When you DELETE (unregister) a high-availability pair, you no longer have to manually break the pair at the CLI and re-register standalone devices. You can now add the primary unit to a new Firewall Management Center, and the standby unit will be discovered automatically. Re-registering the pair will still erase the configuration, and your policies will need to be re-applied.
Policy rollback support for high availability	7.2	Any	The **configure policy rollback** command is supported for high availability.
Config-Sync Optimization feature for faster HA peering	7.2	Any	The Config-Sync Optimization feature enables comparing the configuration of the joining unit and the active unit by exchanging config-hash values. If the hash computed on both active and joining units match, the joining unit skips full config-sync and rejoin the HA. This feature enables faster HA peering and reduces maintenance window and upgrade time.
Improvements to the upgrade workflow for clustered and high-availability devices	7.1	Any	We made improvements to the upgrade workflow for clustered and high-availability devices: • The upgrade wizard now correctly displays clustered and high-availability units as groups, rather than as individual devices. The system can identify, report, and preemptively require fixes for group-related issues you might have. For example, you cannot upgrade a cluster on the Firepower 4100/9300 if you have made unsynced changes on Firepower Chassis Manager. • We improved the speed and efficiency of copying upgrade packages to clusters and high-availability pairs. Previously, the FMC copied the package to each group member sequentially. Now, group members can GET the package from each other as part of their normal sync process. • You can now specify the upgrade order of data units in a cluster. The control unit always upgrades last.
Clearing routes in a high-availability group or cluster.	7.1	Any	In previous releases, the **clear route** command cleared the routing table on the unit only. Now, when operating in a high-availability group or cluster, the command is available on the active or control unit only, and clears the routing table on all units in the group or cluster.

Feature	Minimum Firewall Management Center	Minimum Firewall Threat Defense	Details

FTD High Availability Hardening	6.2.3	Any	Version 6.2.3 introduces features for FTD devices in high availability:
			• Whenever active or standby FTD devices in a high-availability pair restart, the FMC may not display accurate high-availability status for either managed device. However, the status may not upgrade on the FMC because the communication between the device and the FMC is not established yet. The **Refresh Node Status** option on the **Devices** > **Device Management** page allows you to refresh the high-availability unit status to obtain accurate information about the active and standby device in a high-availability pair.
			• The **Devices** > **Device Management** page of the FMC UI has a new **Switch Active Peer** icon.
			• Version 6.2.3 includes a new REST API object, **Device High Availability Pair Services**, that contains four functions:
			  • **DELETE ftddevicehapairs**
			  • **PUT ftddevicehapairs**
			  • **POST ftddevicehapairs**
			  • **GET ftddevicehapairs**