



Configuring IKEv2 Load Balancer

The IKEv2 Load Balancer feature provides support for enabling clusters of FlexVPN gateways and distributes incoming Internet Key Exchange Version 2 (IKEv2) connection requests among FlexVPN gateways. This feature redirects the incoming FlexVPN or AnyConnect client requests to the least loaded FlexVPN gateway based on the system and crypto load factors.

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Finding Feature Information

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

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

Prerequisites for IKEv2 Load Balancer

- For the server-side configuration, the Hot Standby Router Protocol (HSRP) and FlexVPN server (IKEv2 profile) must be configured.
- For the client-side configuration, the FlexVPN client must be configured.

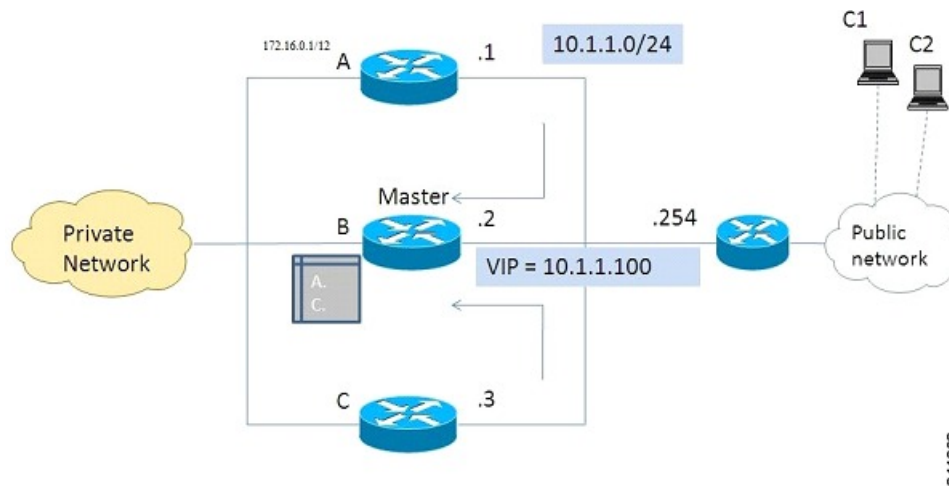
Information About IKEv2 Load Balancer

Overview of IKEv2 Load Balancer

The IKEv2 Load Balancer Support feature provides a Cluster Load Balancing (CLB) solution by redirecting requests from remote access clients to the Least Loaded Gateway (LLG) in the Hot Standby Router Protocol (HSRP) group or cluster. An HSRP cluster is a group of gateways or FlexVPN servers in a LAN or in an enterprise network. The CLB solution works with the Internet Key Exchange Version 2 (IKEv2) redirect mechanism defined in RFC 5685 by redirecting requests to the LLG in the HSRP cluster.

The figure below shows the working of the IKEv2 cluster load balancing solution.

Figure 1: IKEv2 Cluster Load Balancing Solution



- 1 An active HSRP gateway is elected as a “master” in the HSRP group and takes ownership of the Virtual IP address (VIP) for the group. The master maintains a list of gateways in the cluster, keeps track of the load on each gateway, and redirects the FlexVPN client requests to the LLG.
- 2 The remaining gateways, termed as “slaves,” send load updates to the master at periodic intervals.
- 3 When an IKEv2 client connects to the HSRP VIP, the request first reaches the master, which in turn, redirects the request to the LLG in the cluster.

The components of the CLB solution are as follows:

- HSRP
- CLB master
- CLB slave
- CLB communication
- IKEv2 redirects mechanism

Hot Standby Router Protocol

Hot Standby Router Protocol (HSRP) is used to elect the HSRP master or Active Router (AR). For HSRP to elect a designated device, you must configure the VIP for one device in the group. This address is learned by other devices in the group. The IP address that is assigned to the master is used as the VIP for the group. The HSRP active router (also called CLB master) receives the IKEv2 requests and redirects these requests to the LLG in the cluster. The redirection is performed at the IKEv2 protocol level thereby achieving the following:

- All requests from the FlexVPN client reach the HSRP master as the VIP is configured on the FlexVPN clients. The configuration of FlexVPN clients is minimized because the FlexVPN clients must only know the VIP of the HSRP cluster.
- The CLB master is run on the same gateway as the HSRP master, thereby maintaining the load information of all CLB slaves. The CLB master enables effective redirection of requests and avoids multiple redirects and loops.

CLB Master

A CLB master runs on the HSRP master or Active Router (AR). The master receives updates from CLB slaves and sorts them based on their load condition to calculate the least loaded gateway (LLG). The master sends the IP address of the LLG to IKEv2 (on the FlexVPN server). The IP address is sent to the initiator (FlexVPN client), which initiates an IKEv2 session with the LLG. The master redirects incoming IKEv2 client connections towards the LLG. For more information, see section [“IKEv2 Redirect Mechanism, on page 4.”](#)

**Note**

“CLB nodes” are used where both a CLB master and CLB slave must be specified.

CLB Slave

A CLB slave runs on all devices in an HSRP group except on the Active Router (AR). The slaves are responsible for sending periodic load updates to the server. A CLB slave is a fully functional IKEv2 gateway which supplies information to the CLB master. Apart from updates, CLB slaves send messages for aliveness assurance to the CLB master.

CLB Load Management Mechanism

The CLB Load Management Mechanism is a TCP-based protocol that runs between the CLB master and the CLB slaves. The CLB load management mechanism informs the CLB master about the load on the CLB slaves. Based on this information, the CLB master selects the LLG to handle the session on each new incoming IKEv2 connection.

Benefits of IKEv2 Load Balancer

- The IKEv2 Load Balancer Support feature is easy to configure and cost-effective.
- A FlexVPN client need not know the IP addresses of all gateways in the cluster. The client need only know the virtual IP address of the cluster.
- The entire crypto session is redirected to a node in the cluster.

IKEv2 Redirect Mechanism

The IKEv2 redirect mechanism enables a VPN gateway to redirect a FlexVPN client request to another VPN gateway based on load conditions and maintenance requirements.

The IKEv2 redirect mechanism is performed on security association (SA) initialization (IKE_SA_INIT) and on SA authentication (IKE_AUTH).

Redirect During IKEv2 Initial Exchange (SA Initialization)

A FlexVPN client, or an AnyConnect client indicates support for Internet Key Exchange Version 2 (IKEv2) redirect mechanism by including a REDIRECT_SUPPORTED notification message in the initial IKE_SA_INIT request. Use the **crypto ikev2 redirect client** command to enable the redirect mechanism on a client. Use the **crypto ikev2 redirect gateway init** command to enable redirect at IKE_SA_INIT on the gateway.

To redirect an IKEv2 request to another new gateway, the gateway that receives the IKE_SA_INIT request selects the IP address or the fully qualified domain name (FQDN) of the new gateway (in this case, the LLG) with help of the crypto load balancer (CLB) module. The gateway replies with an IKE_SA_INIT response that contains a REDIRECT notification message. The notification includes information such as the new gateway and the nonce value from the payload in the IKE_SA_INIT request. When a client receives the IKE_SA_INIT response, it verifies the nonce value sent in the IKE_SA_INIT request and the gateway information provided in the redirect notification, and confirms whether the redirect notification is as per the configuration.



Note

If the nonce value does not match, the client discards the response and waits for another response, thereby preventing denial of service (DoS) attacks on the initiator. DoS attacks could be caused by an attacker injecting incorrect redirect payloads in IKE_SA_INIT responses.

In the IKE_SA_INIT exchange with the new gateway, the client message contains the REDIRECTED_FROM notification payload. The REDIRECTED_FROM notification payload consists of the IP address of the original VPN gateway that redirected the client. The IKEv2 exchange then proceeds as it would have proceeded with the original gateway.



Note

The client may be redirected again by the new gateway if the new gateway also cannot serve the client. The client does not include the REDIRECT_SUPPORTED payload again in the IKE_SA_INIT exchange with the new gateway after the redirect. The presence of the REDIRECTED_FROM notification payload in the IKE_SA_INIT exchange with the new gateway indicates to the new gateway that the client supports the IKEv2 redirects mechanism.

Redirect During IKE_AUTH Exchange (SA Authentication)

A thorough security analysis shows that redirect during IKE_AUTH is neither more nor less secure than redirect during IKE_INIT. However, for performance and scalability reasons, we recommend redirect during IKE_INIT. Use the **crypto ikev2 redirect gateway auth** command to enable the redirect mechanism on the gateway. Use the **redirect gateway auth** command to enable redirect on authentication for selected IKEv2 profiles.

In this method, the client authorization payload is verified before sending the redirect notification payload. A client also verifies the gateway authorization payload before acting on the redirect notification. As the authorization payload is exchanged and successfully verified, the IKEv2 security association (SA) is validated successfully and the INITIAL_CONTACT is processed to decide on redirecting the request. If there is a redirect, the gateway creates the IKE SA and sends the IKE_AUTH response with the redirect notification.

A child SA is not created in this method. The IKE_AUTH does not contain a payload pertaining to a child SA. When the client receives the IKE_AUTH response, the client verifies the gateway authentication payload and deletes the IKEv2 SA with the gateway by sending a delete notification. The client acts on the redirect notification payload to establish connection with the new gateway. The client does not wait for an acknowledgment for the delete notification before establishing a connection with the new gateway. If the IKE_AUTH exchange involves the Extensible Authentication Protocol (EAP) authentication, the gateway has the choice of sending the redirect payload in the first or last IKE_AUTH response. The EAP authentication is included in the first IKE_AUTH response because it is not necessary to provide credentials for each redirect.

Compatibility and Interoperability

The IKEv2 redirect mechanism is based on RFC 5685. The gateway (IKEv2 responder) is compatible with clients (IKEv2 initiator) that implement the standard. Similarly, the client (initiator) implementation must be compatible with third party servers (responder) implementing the standard. The load management mechanism is Cisco proprietary and is only supported on Cisco IOS devices.

Handling Redirect Loops

A client request could be redirected multiple times in a sequence because of either an incorrect configuration or a denial of service (DoS) attack. In some cases, a client could enter a loop with two or more gateways redirecting the client to the other gateway thereby denying service to the client. To prevent this, a client can be configured, using the **crypto ikev2 redirect client** command with the **max-redirects number** keyword argument pair, to not accept more than a specific number of redirects for a particular IKEv2 security association (SA) setup.

IKEv2 Cluster Reconnect

The IKEv2 cluster reconnect allows Cisco AnyConnect client to reconnect to any server in the cluster. The **crypto ikev2 reconnect key** is introduced on the server to encrypt the opaque data pushed to the client. During failure detection, the client does reconnect with new or existing server without having to prompt for authentication credentials again.

There are only two key index values, 1 and 2 and at any point in time, any one of the keys configured using this will be active. The Cisco IOS server will be able to decrypt the reconnect data as long as the reconnect key is configured using the reconnect key CLI on the IOS server. This is true even if the key is only the back-up key.



Note

This feature is available on Cisco IOS devices configured to work as Cisco AnyConnect server. The AnyConnect client software version that supports this feature are 4.2 and future releases. This feature is applicable for new deployments only. Once this feature is enabled on the Cisco IOS server, older releases of Cisco AnyConnect clients will not be supported.

How to Configure IKEv2 Load Balancer

Configuring the Server Cluster

Configuring an HSRP Group for Load Balancing

Perform this task to configure a single Hot Standby Router Protocol (HSRP) group for a cluster.

Hot Standby Router Protocol (HSRP) is used to elect the HSRP master or Active Router (AR). For HSRP to elect a designated device, you must configure the VIP for one device in the group. This address is learned by other devices in the group. The IP address that is assigned to the master is used as the VIP for the group. The HSRP active router (also called CLB master) receives the IKEv2 requests and redirects these requests to the LLG in the cluster. The redirection is performed at the IKEv2 protocol level thereby achieving the following:

- All requests from the FlexVPN client reach the HSRP master as the VIP is configured on the FlexVPN clients. The configuration of FlexVPN clients is minimized because the FlexVPN clients must only know the VIP of the HSRP cluster.
- The CLB master is run on the same gateway as the HSRP master, thereby maintaining the load information of all CLB slaves. The CLB master enables effective redirection of requests and avoids multiple redirects and loops.



Note

This task describes the minimum commands required to configure an HSRP group for load balancing.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask* [**secondary**]
5. **standby** [*group-number*] **priority** *priority*
6. **standby** *group-name*
7. **exit**
8. Repeat Steps 3 to 7 to configure an HSRP group for another cluster.

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.

	Command or Action	Purpose
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	interface <i>type number</i> Example: Device(config)# interface GigabitEthernet 0/0/0	Configures an interface type and enters interface configuration mode.
Step 4	ip address <i>ip-address mask</i> [secondary] Example: Device(config-if)# ip address 10.0.0.1 255.255.255.0	Specifies a primary or secondary IP address for an interface.
Step 5	standby [<i>group-number</i>] priority <i>priority</i> Example: Device(config-if)# standby 1 priority 110	Configures the HSRP priority.
Step 6	standby <i>group-name</i> Example: Device(config-if)# standby group1	Specifies the name of the HSRP standby group.
Step 7	exit Example: Device(config-if)# exit	Exits to global configuration mode.
Step 8	Repeat Steps 3 to 7 to configure an HSRP group for another cluster.	—

Configuring the Load Management Mechanism

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto ikev2 cluster**
4. **holdtime *milliseconds***
5. **master {*overload-limit percent* | **weight** {**crypto-load** *weight-number* | **system-load** *weight-number*}}**
6. **port *port-number***
7. **slave {*hello milliseconds* | **max-session** *number* | **priority** *number* | **update** *milliseconds*}**
8. **standby-group *group-name***
9. **shutdown**
10. **exit**
11. **crypto ikev2 reconnect key *key index active name***
12. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	crypto ikev2 cluster Example: Device(config)# crypto ikev2 cluster	Defines an IKEv2 cluster policy and enters IKEv2 cluster configuration mode.
Step 4	holdtime <i>milliseconds</i> Example: Device(config-ikev2-cluster)# holdtime 10000	(Optional) Specifies the time, in milliseconds, to receive messages from a peer. • If no messages are received within the configured time, the peer is declared “dead.”
Step 5	master {<i>overload-limit percent</i> weight {crypto-load <i>weight-number</i> system-load <i>weight-number</i>}}	Specifies settings for the master in the HSRP cluster. • overload-limit <i>percent</i> —The threshold load of the cluster. The load limit to decide when a device is busy and to ignore it when redirecting it for requests.

	Command or Action	Purpose
	<p>Example: <pre>Device(config-ikev2-cluster)# master weight crypto-load 10</pre></p>	<ul style="list-style-type: none"> • weight—Specifies the weight of a load attribute. Range: 0 to 100. Default: 100. • crypto-load <i>weight-number</i>—The IKE and IPsec security association (SA) load. • system-load <i>weight-number</i>—The system and memory load.
Step 6	<p>port <i>port-number</i></p> <p>Example: <pre>Device(config-ikev2-cluster)# port 2000</pre></p>	(Optional) Specifies the cluster master listen port.
Step 7	<p>slave {<i>hello milliseconds</i> <i>max-session number</i> <i>priority number</i> <i>update milliseconds</i>}</p> <p>Example: <pre>Device(config-ikev2-cluster)# slave max-session 90</pre></p>	<p>Specifies settings for slave gateways in the HSRP group.</p> <ul style="list-style-type: none"> • hello <i>milliseconds</i>—The hello interval, in milliseconds, for a slave gateway. • max-session <i>number</i>—The maximum number of SAs allowed on a slave. This keyword is mandatory and cannot be skipped. • priority <i>number</i>—The slave priority. • update <i>milliseconds</i>—The interval, in milliseconds, between two update messages for a slave gateway.
Step 8	<p>standby-group <i>group-name</i></p> <p>Example: <pre>Device(config-ikev2-cluster)# standby-group group1</pre></p>	<p>Defines the HSRP group containing the slaves.</p> <ul style="list-style-type: none"> • <i>group-name</i>—The group name is derived from the <i>group-name</i> argument specified in the standby name command.
Step 9	<p>shutdown</p> <p>Example: <pre>Device(config-ikev2-cluster)# shutdown</pre></p>	(Optional) Disables the IKEv2 cluster policy.
Step 10	<p>exit</p> <p>Example: <pre>Device(config-ikev2-cluster)# exit</pre></p>	Exits IKEv2 cluster configuration mode and returns to global configuration mode.
Step 11	<p>crypto ikev2 reconnect key <i>key index active name</i></p> <p>Example: <pre>Device(config)# crypto ikev2 reconnect key 1 active test123</pre></p>	<p>Enables the IKEv2 opaque data support for session reconnect.</p> <p>Note The ikev2 cluster reconnect feature is enabled for encryption only when the active keyword is present in the ikev2 reconnect key active <i>key-name key-string</i>. The active keyword is mandatory to enable the cluster reconnect feature. If you use the ikev2 reconnect key <i>key-name key-string</i> command without the active keyword in the command, the headend will only be able to decrypt.</p>

	Command or Action	Purpose
Step 12	end Example: Device(config-ikev2-cluster)# end	Exits IKEv2 cluster configuration mode and returns to privileged EXEC mode.

Activating the IKEv2 Redirect Mechanism on the Server

SUMMARY STEPS

1. enable
2. configure terminal
3. crypto ikev2 redirect gateway init
4. end

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	crypto ikev2 redirect gateway init Example: Device(config)# crypto ikev2 redirect gateway init	Enables the IKEv2 redirect mechanism on the gateway during SA initiation.
Step 4	end Example: Device(config)# end	Exits global configuration mode and returns to privileged EXEC mode.

Activating the IKEv2 Redirect Mechanism on the Client

SUMMARY STEPS

1. enable
2. configure terminal
3. crypto ikev2 redirect client [max-redirects *number*]
4. end

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	crypto ikev2 redirect client [max-redirects <i>number</i>] Example: Device(config)# crypto ikev2 redirect client max-redirects 15	Enables the IKEv2 redirect mechanism on the FlexVPN client. <ul style="list-style-type: none"> • max-redirects <i>number</i>—(Optional) Specifies the maximum number of redirects that can be configured on the FlexVPN client for redirect loop detection.
Step 4	end Example: Device(config)# end	Exits global configuration mode and returns to privileged EXEC mode.

Configuration Examples for IKEv2 Load Balancer

Example: Configuring an HSRP Group for Load Balancing

The following example shows RouterA configured as the active router for an Hot Standby Router Protocol (HSRP) group with a priority of 110. The default priority level is 100. This HSRP group is assigned the group name of group1. The group name is referred in the cluster policy.

```
Device(config)# hostname RouterA
Device(config)# interface GigabitEthernet 0/0/0
```

Example: Configuring the Load Management Mechanism

```

Device(config-if)# ip address 10.0.0.1 255.255.255.0
Device(config-if)# standby 1 priority 110
Device(config-if)# standby group1
Device(config-if)# end

```

Example: Configuring the Load Management Mechanism

The following example shows how to configure the load management mechanism in IKEv2:

```

Device> enable
Device# configure terminal
Device(config)# crypto ikev2 cluster
Device(config-ikev2-cluster)# holdtime 10000
Device(config-ikev2-cluster)# master crypto-load 10
Device(config-ikev2-cluster)# port 2000
Device(config-ikev2-cluster)# slave priority 90
Device(config-ikev2-cluster)# standby-group group1
Device(config-ikev2-cluster)# shutdown
Device(config-ikev2-cluster)# end

```

Example: Configuring the Redirect Mechanism

The following example shows how to enable the redirect mechanism on a client and during initiation on a gateway:

```

Device> enable
Device# configure terminal
Device(config)# crypto ikev2 redirect client
Device(config)# crypto ikev2 redirect gateway init
Device(config)# end

```

Example: Configuring the Cluster Reconnect Key

The following example shows how to enable the reconnect key on a server:

```

Device> enable
Device# configure terminal
Device(config)# crypto ikev2 reconnect key 1 active key
Device(config)# crypto ikev2 reconnect key 2 test
Device(config)# end

```

Additional References**Related Documents**

Related Topic	Document Title
Cisco IOS commands	Master Command List, All Releases

Related Topic	Document Title
Security commands	<ul style="list-style-type: none"> • Cisco IOS Security Command Reference Commands A to C • Cisco IOS Security Command Reference Commands D to L • Cisco IOS Security Command Reference Commands M to R • Cisco IOS Security Command Reference Commands S to Z
HSRP configuration	Configuring HSRP
HSRP commands	Cisco IOS First Hop Redundancy Protocols Command Reference

Standards and RFCs

Standard/RFC	Title
RFC 5685	<i>Redirect Mechanism for the Internet Key Exchange Protocol Version 2 (IKEv2)</i>

Technical Assistance

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

Feature Information for IKEv2 Load Balancer

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

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

Table 1: Feature Information for IKEv2 Load Balancer

Feature Name	Releases	Feature Information
IKEv2 fast convergence with cluster reconnect for Anyconnect	Cisco IOS XE Release 3.17S	The IKEv2 fast convergence with cluster reconnect for Anyconnect feature enables the Cisco AnyConnect client to reconnect to any server in the cluster. The following command was introduced or modified: crypto ikev2 reconnect key
IKEv2 Load Balancer Support	Cisco IOS XE Release 3.8S	The IKEv2 Load Balancer Support feature distributes incoming IKEv2 requests from FlexVPN clients among IKEv2 FlexVPN servers or gateways by redirecting requests to the least loaded gateway. The following commands were introduced or modified: crypto ikev2 cluster, crypto ikev2 redirect, holdtime, master (IKEv2), port (IKEv2), redirect gateway, slave (IKEv2), standby-group, show crypto ikev2 cluster, show crypto ikev2 sa.