IPsec Virtual Tunnel Interfaces

IPsec virtual tunnel interfaces (VTIs) provide a routable interface type for terminating IPsec tunnels and an easy way to define protection between sites to form an overlay network. IPsec VTIs simplify the configuration of IPsec for protection of remote links, support multicast, and simplify network management and load balancing.

Note

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

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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.
Restrictions for IPsec Virtual Tunnel Interfaces

**IPsec Transform Set**
The IPsec transform set must be configured in tunnel mode only.

**IKE Security Association**
The Internet Key Exchange (IKE) security association (SA) is bound to the VTI.

**IPsec SA Traffic Selectors**
Static VTIs (SVTIs) support only a single IPsec SA that is attached to the VTI interface. The traffic selector for the IPsec SA is always "IP any any."

**IPv4**
This feature supports SVTIs that are configured to encapsulate IPv4 packets.

**Tunnel Protection**
Do not configure the `shared` keyword when using the `tunnel mode ipsec ipv4` command for IPsec IPv4 mode.

**Traceroute**
The traceroute function with crypto offload on VTIs is not supported.

Information About IPsec Virtual Tunnel Interfaces

The use of IPsec VTIs can simplify the configuration process when you need to provide protection for remote access and it provides an alternative to using generic routing encapsulation (GRE) or Layer 2 Tunneling Protocol (L2TP) tunnels for encapsulation. A benefit of using IPsec VTIs is that the configuration does not require static mapping of IPsec sessions to a physical interface. The IPsec tunnel endpoint is associated with an actual (virtual) interface. Because there is a routable interface at the tunnel endpoint, many common interface capabilities can be applied to the IPsec tunnel.

The IPsec VTI allows for the flexibility of sending and receiving both IP unicast and multicast encrypted traffic on any physical interface, such as in the case of multiple paths. Traffic is encrypted or decrypted when it is forwarded from or to the tunnel interface and is managed by the IP routing table. Using IP routing to forward the traffic to the tunnel interface simplifies the IPsec VPN configuration. Because DVTIs function like any other real interface you can apply quality of service (QoS), firewall, and other security services as soon as the tunnel is active.

The following sections provide details about the IPsec VTI:

Benefits of Using IPsec Virtual Tunnel Interfaces

IPsec VTIs allow you to configure a virtual interface to which you can apply features. Features for clear-text packets are configured on the VTI. Features for encrypted packets are applied on the physical outside interface.
When IPsec VTIs are used, you can separate the application of features such as Network Address Translation (NAT), ACLs, and QoS and apply them to clear-text, or encrypted text, or both.

There are two types of VTI interfaces: static VTIs (SVTIs) and dynamic VTIs (DVTIs).

**Static Virtual Tunnel Interfaces**

SVTI configurations can be used for site-to-site connectivity in which a tunnel provides always-on access between two sites.

Additionally, multiple Cisco IOS software features can be configured directly on the tunnel interface and on the physical egress interface of the tunnel interface. This direct configuration allows users to have solid control on the application of the features in the pre- or post-encryption path.

The figure below illustrates how a SVTI is used.

![Figure 1: IPsec SVTI](image)

The IPsec VTI supports native IPsec tunneling and exhibits most of the properties of a physical interface.

**Dynamic Virtual Tunnel Interfaces**

DVTIs can provide highly secure and scalable connectivity for remote-access VPNs. The DVTI technology replaces dynamic crypto maps and the dynamic hub-and-spoke method for establishing tunnels.

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### Note

You can configure DVTIs with IKEv1 or IKEv2. The legacy crypto map based configuration supports DVTIs with IKEv1 only. A DVTI configuration with IKEv2 is supported only in FlexVPN.

DVTIs can be used for both the server and the remote configuration. The tunnels provide an on-demand separate virtual access interface for each VPN session. The configuration of the virtual access interfaces is cloned from a virtual template configuration, which includes the IPsec configuration and any Cisco IOS software feature configured on the virtual template interface, such as QoS, NetFlow, or ACLs.

DVTIs function like any other real interface, so you can apply QoS, firewall, or other security services as soon as the tunnel is active. QoS features can be used to improve the performance of various applications across the network. Any combination of QoS features offered in Cisco IOS software can be used to support voice, video, or data applications.
DVTIs provide efficiency in the use of IP addresses and provide secure connectivity. DVTIs allow dynamically downloadable per-group and per-user policies to be configured on a RADIUS server. The per-group or per-user definition can be created using an extended authentication (Xauth) User or Unity group, or can be derived from a certificate. DVTIs are standards based, so interoperability in a multiple-vendor environment is supported. IPsec DVTIs allow you to create highly secure connectivity for remote access VPNs and can be combined with Cisco Architecture for Voice, Video, and Integrated Data (AVVID) to deliver converged voice, video, and data over IP networks. The DVTI simplifies VPN routing and forwarding-(VRF-) aware IPsec deployment. The VRF is configured on the interface.

A DVTI requires minimal configuration on the router. A single virtual template can be configured and cloned. The DVTI creates an interface for IPsec sessions and uses the virtual template infrastructure for dynamic instantiation and management of dynamic IPsec VTIs. The virtual template infrastructure is extended to create dynamic virtual-access tunnel interfaces. DVTIs are used in hub-and-spoke configurations. A single DVTI can support several static VTIs.

The figure below illustrates the DVTI authentication path.

**Figure 2: Dynamic IPsec VTI**

The authentication shown in the figure above follows this path:

1. User 1 calls the router.
2. Router 1 authenticates User 1.
3. IPsec clones the virtual access interface from the virtual template interface.

**Traffic Encryption with the IPsec Virtual Tunnel Interface**

When an IPsec VTI is configured, encryption occurs in the tunnel. Traffic is encrypted when it is forwarded to the tunnel interface. Traffic forwarding is handled by the IP routing table, and dynamic or static routing can be used to route traffic to the SVTI. DVTI uses reverse route injection to further simplify the routing configurations. Using IP routing to forward the traffic to encryption simplifies the IPsec VPN configuration. The IPsec virtual tunnel also allows you to encrypt multicast traffic with IPsec.
IPsec packet flow into the IPSec tunnel is illustrated in the figure below.

*Figure 3: Packet Flow into the IPsec Tunnel*

After packets arrive on the inside interface, the forwarding engine switches the packets to the VTI, where they are encrypted. The encrypted packets are handed back to the forwarding engine, where they are switched through the outside interface.

The figure below shows the packet flow out of the IPsec tunnel.

*Figure 4: Packet Flow out of the IPsec Tunnel*
Multi-SA Support for Dynamic Virtual Interfaces

DVTI supports multiple IPsec SAs. The DVTI can accept multiple IPsec selectors that are proposed by the initiator.

The DVTIs allow per-peer features to be applied on a dedicated interface. You can order features in such way that all features that are applied on the virtual access interfaces are applied before applying crypto. Additionally, all the features that are applied on the physical interfaces are applied after applying crypto. Clean routing is available across all VRFs so that there are no traffic leaks from one VRF to another before encrypting.

Multi-SA VTIs ensure interoperation with third-party devices and provide a flexible, clean, and modular feature-set.

Multi-SA VTIs enable a clean Cisco IOS XE infrastructure, even when the Cisco IOS XE software interoperates with the third-party devices that only implement crypto maps.

VRF and Scalability of Baseline Configuration:

Virtual access instances inherit the Inside-VRF (IVRF) from the template configuration. Users must configure several templates to enforce an appropriate IVRF for each customer. The number of templates must be equal to the number of customers connecting to the headend. Such a configuration is cumbersome and undesirable and also affects performance because each template declaration consumes one Interface Descriptor Block (IDB).

This complication can be avoided by allowing the IKE profile to override the virtual access VRF with the VRF configured on the IKE profile. A better solution is to allow the IKE profile to override the virtual access VRF using AAA, but this method is supported only for IKEv2.

The VRF configured in the ISAKMP profile is applied to the virtual access first. Then the configuration from virtual template is applied to the virtual access. If your virtual template contains `ip vrf forwarding` command configuration, the VRF from the template overrides the VRF from the ISAKMP profile.

Rules for Initial Configuration of a VRF:

The following rules must be applied during the initial configuration of VRF:

- If you configure IVRF in the IKE profile without configuring it in the virtual template, then you must apply the VRF from the IKE profile on each virtual access derived from this IKE profile.
- If you configure VRF in an IKE profile and virtual template, then the virtual template IVRF gets precedence.

Rules for Changing the VRF:

If you change the VRF configured in an IKE profile, all the IKE SAs, IPsec SAs, and the virtual access identifier derived from this profile will get deleted. The same rule applies when the VRF is configured on the IKE profile for the first time.

Dynamic Virtual Tunnel Interface Life Cycle

IPsec profiles define the policy for DVTIs. The dynamic interface is created at the end of IKE Phase 1 and IKE Phase 1.5. The interface is deleted when the IPsec session to the peer is closed. The IPsec session is closed when both IKE and IPsec SAs to the peer are deleted.
Routing with IPsec Virtual Tunnel Interfaces

Because VTIs are routable interfaces, routing plays an important role in the encryption process. Traffic is encrypted only if it is forwarded out of the VTI, and traffic arriving on the VTI is decrypted and routed accordingly. VTIs allow you to establish an encryption tunnel using a real interface as the tunnel endpoint. You can route to the interface or apply services such as QoS, firewalls, network address translation (NAT), and NetFlow statistics as you would to any other interface. You can monitor the interface and route to it, and the interface provides benefits similar to other Cisco IOS interface.

FlexVPN Mixed Mode Support

The FlexVPN Mixed Mode feature provides support for carrying IPv4 traffic over IPsec IPv6 transport. This is the first phase towards providing dual stack support on the IPsec stack. This implementation does not support using a single IPsec security association (SA) pair for both IPv4 and IPv6 traffic.

This feature is only supported for Remote Access VPN with IKEv2 and Dynamic VTI.

The FlexVPN Mixed Mode feature provides support for carrying IPv6 traffic over IPsec IPv4 transport from Cisco IOS XE Everest 16.4.1.

IKE Profile Based Tunnel Selection

The IKE Profile Based Tunnel Selection feature uses the Internet Key Exchange (IKE) or Internet Key Exchange version 2 (IKEv2) profile to select a tunnel interface for an IPsec session. Use keywords isakmp-profile or ikev2-profile keyword in the tunnel protection command to specify an IKE profile or IKEv2 profile respectively.

The IKE Profile Based Tunnel Selection feature allows tunnel interfaces to share the tunnel source IP address and IPsec transform set without sharing the IPsec security association databases (SADBs) among tunnel interfaces thereby providing the following benefits:

- Tunnels are secure and there is no traffic leak.
- All tunnel types are supported.
- Seamless migration from IKEv1 to IKEv2 by accommodating configurations from legacy VPN technologies to coexist and share the local address with newer VPN technologies.
- Ability to set up multiple IKE and IPsec tunnels between peers sharing the same local or remote addresses.

IKEv2 profile must be manually applied in the IPsec profile to initiate an ikev2 session. On the responder, a dynamic virtual tunnel interface (DVTI) IKEv2 profile must be manually applied under the IPsec profile for IPsec to accept the incoming connection. For a DVTI responder, IPsec uses the parent IKE profile which is configured under the virtual template for validating the proposal request. By default, IPsec initiates and accepts IKE sessions if no IKE profile is configured on an IPsec profile. You cannot simultaneously configure an IKE profile and an IKEv2 profile on an IPsec profile. If you configure an IKE profile and an IKEv2 profile on an IPsec profile, the IKE profile is overridden by the IKEv2 profile.
Auto Tunnel Mode Support in IPsec

When configuring a VPN headend in a multiple vendor scenario, you must be aware of the technical details of the peer or responder. For example, some devices may use IPsec tunnels while others may use generic routing encapsulation (GRE) or IPsec tunnel, and sometimes, a tunnel may be IPv4 or IPv6. In the last case, you must configure an Internet Key Exchange (IKE) profile and a virtual template.

The Tunnel Mode Auto Selection feature eases the configuration and spares you about knowing the responder’s details. This feature automatically applies the tunneling protocol (GRE or IPsec) and transport protocol (IPv4 or IPv6) on the virtual template as soon as the IKE profile creates the virtual access interface. This feature is useful on dual stack hubs aggregating multivendor remote access, such as Cisco AnyConnect VPN Client, Microsoft Windows7 Client, and so on.

**Note**
The Tunnel Mode Auto Selection feature eases the configuration for a responder only. The tunnel must be statically configured for an initiator.

IPSec Mixed Mode Support for VTI

The IPSec Mixed Mode feature provides support for carrying IPv4 traffic over IPsec IPv6 transport. This is the first phase towards providing dual stack support on the IPsec stack. This implementation does not support using a single IPsec security association (SA) pair for both IPv4 and IPv6 traffic.

This feature is supported for SVTI as well as DVTI and IKEv1 as well as IKEv2.

How to Configure IPsec Virtual Tunnel Interfaces

Configuring Static IPsec Virtual Tunnel Interfaces

**SUMMARY STEPS**

1. enable
2. configure terminal
3. crypto IPsec profile profile-name
4. set transform-set transform-set-name [transform-set-name2...transform-set-name6]
5. exit
6. interface type number
7. ip address address mask
8. tunnel mode ipsec ipv4
9. tunnel source interface-type interface-number
10. tunnel destination ip-address
11. tunnel protection IPsec profile profile-name
12. end
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 1 | enable | Enables privileged EXEC mode.  
- Enter your password if prompted. |
| Example: | Device> enable |
| Step 2 | configure terminal | Enters global configuration mode. |
| Example: | Device# configure terminal |
| Step 3 | crypto IPsec profile *profile-name* | Defines the IPsec parameters that are to be used for IPsec encryption between two IPsec devices, and enters IPsec profile configuration mode. |
| Example: | Device(config)# crypto IPsec profile PROF |
| Step 4 | set transform-set *transform-set-name*  
[transform-set-name2...transform-set-name6] | Specifies which transform sets can be used. |
<p>| Example: | Device(ipsec-profile)# set transform-set tset |
| Step 5 | exit | Exits IPsec profile configuration mode, and enters global configuration mode. |
| Example: | Device(ipsec-profile)# exit |
| Step 6 | interface <em>type number</em> | Specifies the interface on which the tunnel will be configured and enters interface configuration mode. |
| Example: | Device(config)# interface tunnel 0 |
| Step 7 | ip address <em>address mask</em> | Specifies the IP address and mask. |
| Example: | Device(config-if)# ip address 10.1.1.1 255.255.255.0 |
| Step 8 | tunnel mode ipsec ipv4 | Defines the mode for the tunnel. |
| Example: | Device(config-if)# tunnel mode ipsec ipv4 |</p>
<table>
<thead>
<tr>
<th>Step 9</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><code>tunnel source</code></td>
<td>Specifies the tunnel source as a loopback interface.</td>
</tr>
<tr>
<td></td>
<td><code>interface-type</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>interface-number</code></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device(config-if)# tunnel source loopback 0</code></td>
<td></td>
</tr>
<tr>
<td>Step 10</td>
<td><code>tunnel destination</code></td>
<td>Identifies the IP address of the tunnel destination.</td>
</tr>
<tr>
<td></td>
<td><code>ip-address</code></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device(config-if)# tunnel destination 172.16.1.1</code></td>
<td></td>
</tr>
<tr>
<td>Step 11</td>
<td><code>tunnel protection IPsec profile</code></td>
<td>Associates a tunnel interface with an IPsec profile.</td>
</tr>
<tr>
<td></td>
<td><code>profile-name</code></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device(config-if)# tunnel protection IPsec profile PROF</code></td>
<td></td>
</tr>
<tr>
<td>Step 12</td>
<td><code>end</code></td>
<td>Exits interface configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device(config-if)# end</code></td>
<td></td>
</tr>
</tbody>
</table>

### Configuring BGP over IPsec Virtual Tunnel Interfaces

Perform this task to optionally configure BGP over the virtual tunnel interfaces of two routers.

**Before You Begin**
Perform steps in Configuring Static IPsec Virtual Tunnel Interfaces, on page 8.

**SUMMARY STEPS**

1. `router bgp autonomous-system-number`
2. `neighbor ip-address remote-as autonomous-system-number`
3. `network network-ip-address mask subnet-mask`
4. `exit`
5. Enter the following commands on the second router.
6. `router bgp autonomous-system-number`
7. `neighbor ip-address remote-as autonomous-system-number`
8. `network network-ip-address mask subnet-mask`
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** router bgp autonomous-system-number | Enters router configuration mode and creates a BGP routing process.  
autonomous-system-number — Number of an autonomous system that identifies the router to other BGP routers and tags the routing information that is passed along. Number in the range from 1 to 65535.  
In the example, the first router in this procedure is identified as "65510". |
| Example: Device(config)# router bgp 65510 |
| **Step 2** neighbor ip-address remote-as autonomous-system-number | ip-address — IP address of the adjacent router's tunnel interface.  
autonomous-system-number — Number of an autonomous system that identifies the router of the second router. Number in the range from 1 to 65535. |
| Example: Device(config-router)# neighbor 10.1.1.2 remote-as 65511 |
| **Step 3** network network-ip-address mask subnet-mask | network-ip-address — IP address of the network advertised in BGP. For example, the IP address of a loopback interface.  
subnet-mask — Subnet mask of the network advertised in BGP.  
**Note** The BGP network command network and mask must exactly match a route that is already in the routing table for it to be brought into BGP and advertised to BGP neighbors. This is different from EIGRP, OSPF where the network statement just has to "cover" an interface network and it will pick up the network with mask from the interface. |
| Example: Device(config-router)# network 2.2.2.0 mask 255.255.255.0 |
| **Step 4** exit | Exits router configuration mode. |
| Example: Device(config-router)# exit |
| **Step 5** Enter the following commands on the second router. |
| **Step 6** router bgp autonomous-system-number | Enters router configuration mode and creates a BGP routing process.  
autonomous-system-number — Number of an autonomous system that identifies the router to other BGP routers and tags the routing information that is passed along. Number in the range from 1 to 65535.  
In the example, the second router in this procedure is identified as "65511". |
| Example: Device(config)# router bgp 65511 |
| **Step 7** neighbor ip-address remote-as autonomous-system-number | ip-address — IP address of the adjacent router's tunnel interface. |
| Example: Device(config-router)# neighbor 10.1.1.1 remote-as 65510 |
### Configuring Dynamic IPsec Virtual Tunnel Interfaces

#### SUMMARY STEPS

1. enable
2. configure terminal
3. crypto ipsec profile profile-name
4. set transform-set transform-set-name [transform-set-name2...transform-set-name6]
5. exit
6. interface virtual-template number type tunnel
7. tunnel mode ipsec ipv4
8. tunnel protection IPsec profile profile-name
9. exit
10. crypto isakmp profile profile-name
11. match identity address ip-address mask
12. virtual template template-number
13. end

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>Enabling EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

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**Step 8**

**network** network-ip-address **mask** subnet-mask

**Example:**

Device(config-router)# network 1.1.1.0 mask 255.255.255.0

**network-ip-address**—IP address of the network advertised in BGP. For example, the IP address of a loopback interface.

**subnet-mask**—subnet mask of the network advertised in BGP.

**Note** Use the exact network IP address and subnet mask.
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 3</strong></td>
<td>crypto ipsec profile <em>profile-name</em></td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# crypto ipsec profile PROF</td>
<td>Defines the IPsec parameters that are to be used for IPsec encryption between two IPsec devices and enters IPsec profile configuration mode.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>set transform-set <em>transform-set-name</em> [transform-set-name2...transform-set-name6]</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(ipsec-profile)# set transform-set tset</td>
<td>Specifies which transform sets can be used with the crypto map entry.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>exit</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(ipsec-profile)# exit</td>
<td>Exits ipsec profile configuration mode and enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>interface virtual-template <em>number</em> type tunnel</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# interface virtual-template 2 type tunnel</td>
<td>Defines a virtual-template tunnel interface and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>tunnel mode ipsec ipv4</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# tunnel mode ipsec ipv4</td>
<td>Defines the mode for the tunnel.</td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td>tunnel protection IPsec profile <em>profile-name</em></td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# tunnel protection ipsec profile PROF</td>
<td>Associates a tunnel interface with an IPsec profile.</td>
</tr>
<tr>
<td><strong>Step 9</strong></td>
<td>exit</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# exit</td>
<td>Exits interface configuration mode.</td>
</tr>
<tr>
<td><strong>Step 10</strong></td>
<td>crypto isakamp profile <em>profile-name</em></td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# crypto isakamp profile profile1</td>
<td>Defines the ISAKMP profile to be used for the virtual template.</td>
</tr>
<tr>
<td><strong>Step 11</strong></td>
<td>match identity address <em>ip-address</em> mask</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(conf-isa-prof)# match identity address 10.1.1.0 255.255.255.0</td>
<td>Matches an identity from the ISAKMP profile and enters isakmp-profile configuration mode.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
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</tr>
<tr>
<td><strong>Step 12</strong> virtual template template-number</td>
<td>Specifies the virtual template attached to the ISAKMP profile.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# virtual-template 1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 13</strong> end</td>
<td>Exits global configuration mode and enters privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# end</td>
<td></td>
</tr>
</tbody>
</table>

**Configuring Multi-SA Support for Dynamic Virtual Tunnel Interfaces Using IKEv1**

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

1. `enable`
2. `configure terminal`
3. `ip vrf vrf-name`
4. `rd route-distinguisher`
5. `exit`
6. `crypto keyring keyring-name`
7. `pre-shared-key address key key`
8. `exit`
9. `crypto isakmp profile profile-name`
10. `keyring keyring-name`
11. `match identity address mask`
12. `virtual-template template-number`
13. `exit`
14. `crypto ipsec transform-set transform-set-name transform1 [transform2] [transform3]`
15. `exit`
16. `crypto ipsec profile name`
17. `set security-policy limit maximum-limit`
18. `set transform-set transform-set-name [transform-set-name2 .... transform-set-name6]`
19. `exit`
20. `interface virtual-template number type tunnel`
21. `ip vrf forwarding vrf-name`
22. `ip unnumbered type number`
23. `tunnel mode ipsec ipv4`
24. `tunnel protection profile ipsec profile-name`
25. `end`

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device$ configure terminal</code></td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>3</td>
<td><code>ip vrf vrf-name</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>4</td>
<td><code>rd route-distinguisher</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>5</td>
<td><code>exit</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>6</td>
<td><code>crypto keyring keyring-name</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>7</td>
<td><code>pre-shared-key address key key</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>8</td>
<td><code>exit</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>9</td>
<td><code>crypto isakmp profile profile-name</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>10</td>
<td><code>keyring keyring-name</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>11</td>
<td><code>match identity address mask</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>12</td>
<td><code>virtual-template template-number</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>13</td>
<td><code>exit</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(conf-isa-prof)# exit</code></td>
</tr>
<tr>
<td>14</td>
<td><code>crypto ipsec transform-set transform-set-name</code></td>
</tr>
<tr>
<td></td>
<td><code>transform1 [transform2] [transform3]</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# crypto ipsec transform-set cisco esp-aes esp-sha-hmac</code></td>
</tr>
<tr>
<td>15</td>
<td><code>exit</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(conf-crypto-trans)# exit</code></td>
</tr>
<tr>
<td>16</td>
<td><code>crypto ipsec profile name</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# crypto ipsec profile cisco-ipsec-profile-101</code></td>
</tr>
<tr>
<td>17</td>
<td><code>set security-policy limit maximum-limit</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(ipsec-profile)# set security-policy limit 3</code></td>
</tr>
<tr>
<td>18</td>
<td><code>set transform-set transform-set-name</code></td>
</tr>
<tr>
<td></td>
<td><code>[transform-set-name2 .... transform-set-name6]</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(ipsec-profile)# set transform-set cisco</code></td>
</tr>
<tr>
<td>19</td>
<td><code>exit</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(ipsec-profile)# exit</code></td>
</tr>
<tr>
<td>20</td>
<td><code>interface virtual-template number type tunnel</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# interface virtual-template 101 type tunnel</code></td>
</tr>
<tr>
<td>21</td>
<td><code>ip vrf forwarding vrf-name</code></td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td><code>Device(config-if)# ip vrf forwarding VRF-100-1</code></td>
</tr>
</tbody>
</table>
### Configuring IPsec Mixed Mode Support for SVTIs

#### SUMMARY STEPS

1. enable
2. configure terminal
3. crypto IPsec profile profile-name
4. set transform-set transform-set-name [transform-set-name2...transform-set-name6]
5. exit
6. interface type number
7. ip address address mask
8. Do one of the following:
   - tunnel mode ipsec ipv4 v6-overlay
   - tunnel mode ipsec ipv6 v4-overlay
9. tunnel source interface-type interface-type
10. tunnel destination ip-address
11. tunnel protection IPsec profile profile-name
12. end

---

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 22</td>
<td>ip unnumbered type number</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# ip unnumbered GigabitEthernet 0.0</td>
</tr>
<tr>
<td>Step 23</td>
<td>tunnel mode ipsec ipv4</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# tunnel mode ipsec ipv4</td>
</tr>
<tr>
<td>Step 24</td>
<td>tunnel protection profile ipsec profile-name</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# tunnel protection ipsec profile PROF</td>
</tr>
<tr>
<td>Step 25</td>
<td>end</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# end</td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Step 1</td>
<td><strong>enable</strong></td>
</tr>
<tr>
<td></td>
<td><em>Example:</em></td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2</td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td></td>
<td><em>Example:</em></td>
</tr>
<tr>
<td></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td>Step 3</td>
<td><strong>crypto IPsec profile</strong> profile-name</td>
</tr>
<tr>
<td></td>
<td><em>Example:</em></td>
</tr>
<tr>
<td></td>
<td>Device(config)# crypto IPsec profile PROF</td>
</tr>
<tr>
<td>Step 4</td>
<td><strong>set transform-set</strong> transform-set-name</td>
</tr>
<tr>
<td></td>
<td>[transform-set-name2...transform-set-name6]</td>
</tr>
<tr>
<td></td>
<td><em>Example:</em></td>
</tr>
<tr>
<td></td>
<td>Device(ipsec-profile)# set transform-set tset</td>
</tr>
<tr>
<td>Step 5</td>
<td><strong>exit</strong></td>
</tr>
<tr>
<td></td>
<td><em>Example:</em></td>
</tr>
<tr>
<td></td>
<td>Device(ipsec-profile)# exit</td>
</tr>
<tr>
<td>Step 6</td>
<td><strong>interface</strong> type number</td>
</tr>
<tr>
<td></td>
<td><em>Example:</em></td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface tunnel 0</td>
</tr>
<tr>
<td>Step 7</td>
<td><strong>ip address</strong> address mask</td>
</tr>
<tr>
<td></td>
<td><em>Example:</em></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip address 10.1.1.1 255.255.255.0</td>
</tr>
<tr>
<td>Step 8</td>
<td>Do one of the following:</td>
</tr>
<tr>
<td></td>
<td>• tunnel mode ipsec ipv4 v6-overlay</td>
</tr>
<tr>
<td></td>
<td>• tunnel mode ipsec ipv6 v4-overlay</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Example: Device(config-if)# tunnel mode ipsec ipv4 v6-overlay</td>
<td><strong>Step 9</strong> <strong>tunnel source</strong> <code>interface-type interface-type</code> Specifies the tunnel source as a loopback interface.</td>
</tr>
<tr>
<td>Example: Device(config-if)# tunnel source loopback 0</td>
<td><strong>Step 10</strong> <strong>tunnel destination</strong> <code>ip-address</code> Identifies the IP address of the tunnel destination.</td>
</tr>
<tr>
<td>Example: Device(config-if)# tunnel destination 172.16.1.1</td>
<td><strong>Step 11</strong> <strong>tunnel protection IPsec profile</strong> <code>profile-name</code> Associates a tunnel interface with an IPsec profile.</td>
</tr>
<tr>
<td>Example: Device(config-if)# tunnel protection IPsec profile PROF</td>
<td><strong>Step 12</strong> <strong>end</strong> Exits interface configuration mode and returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>
Configuring IPsec Mixed Mode Support for Dynamic VTIs

SUMMARY STEPS

1. enable
2. configure terminal
3. crypto ipsec profile profile-name
4. set mixed mode
5. set transform-set transform-set-name [transform-set-name2...transform-set-name6]
6. exit
7. interface virtual-template number type tunnel
8. tunnel mode ipsec ipv4
9. tunnel protection IPsec profile profile-name
10. exit
11. crypto isakamp profile profile-name
12. match identity address ip-address mask
13. virtual template template-number
14. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> crypto ipsec profile profile-name</td>
<td>Defines the IPsec parameters that are to be used for IPsec encryption</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# crypto ipsec profile PROF</td>
<td>between two IPsec devices and enters IPsec profile configuration mode.</td>
</tr>
<tr>
<td><strong>Step 4</strong> set mixed mode</td>
<td>Defines the IPsec parameters that are to be used for IPsec encryption</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# set mixed mode</td>
<td>between two IPsec devices and enters IPsec profile configuration mode.</td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>5</td>
<td>set transform-set transform-set-name [transform-set-name2...transform-set-name6]</td>
</tr>
<tr>
<td></td>
<td>Example: Device(ipsec-profile)# set transform-set tset</td>
</tr>
<tr>
<td>6</td>
<td>exit</td>
</tr>
<tr>
<td></td>
<td>Example: Device(ipsec-profile)# exit</td>
</tr>
<tr>
<td>7</td>
<td>interface virtual-template number type tunnel</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config)# interface virtual-template 2 type tunnel</td>
</tr>
<tr>
<td>8</td>
<td>tunnel mode ipsec ipv4</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config-if)# tunnel mode ipsec ipv4</td>
</tr>
<tr>
<td>9</td>
<td>tunnel protection IPsec profile profile-name</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config-if)# tunnel protection ipsec profile PROF</td>
</tr>
<tr>
<td>10</td>
<td>exit</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config-if)# exit</td>
</tr>
<tr>
<td>11</td>
<td>crypto isakamp profile profile-name</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config)# crypto isakamp profile profile1</td>
</tr>
<tr>
<td>12</td>
<td>match identity address ip-address mask</td>
</tr>
<tr>
<td></td>
<td>Example: Device(conf-isa-prof)# match identity address 10.1.1.0 255.255.255.0</td>
</tr>
<tr>
<td>13</td>
<td>virtual template template-number</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config)# virtual-template 1</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 14</strong></td>
<td><strong>end</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# end</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Exits global configuration mode and enters privileged EXEC mode.</td>
</tr>
</tbody>
</table>

### Configuration Examples for IPsec Virtual Tunnel Interfaces

#### Example: Static Virtual Tunnel Interface with IPsec

The following example configuration uses a preshared key for authentication between peers. VPN traffic is forwarded to the IPsec VTI for encryption and then sent out the physical interface. The tunnel on subnet 10 checks packets for the IPsec policy and passes them to the Crypto Engine (CE) for IPsec encapsulation. The figure below illustrates the IPsec VTI configuration.

**Figure 5: VTI with IPsec**

**Router Configuration**

```plaintext
version 12.3
service timestamps debug datetime
service timestamps log datetime
hostname 7200-3
no aaa new-model
ip subnet-zero
ip cef
controller ISA 6/1

! crypto isakmp policy 1
  encr aes
  authentication pre-share
group 14
crypto isakmp key Cisco12345 address 0.0.0.0 0.0.0.0
crypto ipsec transform-set T1 esp-aes esp-sha-hmac
crypto ipsec profile P1
  set transform-set T1
  !
interface Tunnel0
  ip address 10.0.51.203 255.255.255.0
  load-interval 30
  tunnel source 10.0.149.203
tunnel destination 10.0.149.217
tunnel mode IPsec ipv4
tunnel protection IPsec profile P1
  !
  ip address 10.0.149.203 255.255.255.0
duplex full
  !
  ip address 10.0.35.203 255.255.255.0
duplex full
```
Example: Static Virtual Tunnel Interface with IPsec

Router Configuration

version 12.3
hostname c1750-17
no aaa new-model
ip subnet-zero
ip cef
crypto isakmp policy 1
encri aes
authentication pre-share
group 14
crypto isakmp key Cisco12345 address 0.0.0.0 0.0.0.0
crypto ipsec transform-set T1 esp-aes esp-sha-hmac
crypto ipsec profile P1
set transform-set T1

interface Tunnel0
ip address 10.0.51.217 255.255.255.0

tunnel source 10.0.149.217
tunnel destination 10.0.149.203
tunnel mode ipsec ipv4
tunnel protection ipsec profile P1

interface
ip address 10.0.149.217 255.255.255.0
speed 100
full-duplex

interface
ip address 10.0.36.217 255.255.255.0
load-interval 30
full-duplex

ip classless
ip route 10.0.36.0 255.255.255.0 Tunnel0
line con 0
line aux 0
line vty 0 4

Example: Verifying the Results for the IPsec Static Virtual Tunnel Interface

This section provides information that you can use to confirm that your configuration is working properly. In this display, Tunnel 0 is “up,” and the line protocol is “up.” If the line protocol is “down,” the session is not active.

Verifying the IPsec Static Virtual Tunnel Interface

Router# show interface tunnel 0
Tunnel0 is up, line protocol is up
Hardware is Tunnel
Internet address is 10.0.51.203/24
MTU 1514 bytes, BW 9 Mbit, DLY 500000 usec,
reliability 255/255, txload 103/255, rxload 110/255
Encapsulation TUNNEL, loopback not set
Keepalive not set
Tunnel source 10.0.149.203, destination 10.0.149.217
Tunnel protocol/transport ipsec/ip, key disabled, sequencing disabled
Tunnel TTL 255
Checksumming of packets disabled, fast tunneling enabled
Tunnel transmit bandwidth 8000 (kbps)
Tunnel receive bandwidth 8000 (kbps)
Tunnel protection via IPsec (profile "P1")
Last input never, output never, output hang never
Last clearing of "show interface" counters never
Input queue: 1/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/0 (size/max)
30 second input rate 13000 bits/sec, 34 packets/sec
30 second output rate 36000 bits/sec, 34 packets/sec
Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
59968 packets output, 15369696 bytes, 0 underruns
0 output errors, 0 collisions, 0 interface resets
0 output buffer failures, 0 output buffers swapped out

Router# show crypto session

Crypto session current status
Interface: Tunnel0
Session status: UP-ACTIVE
Peer: 10.0.149.217 port 500
IKE SA: local 10.0.149.203/500 remote 10.0.149.217/500 Active
IPsec FLOW: permit ip 0.0.0.0/0.0.0.0 0.0.0.0/0.0.0.0
Active SAs: 4,

Router# show ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
Gateway of last resort is not set
10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C 10.0.35.0/24 is directly connected, Ethernet3/3
S 10.0.36.0/24 is directly connected, Tunnel0
C 10.0.51.0/24 is directly connected, Ethernet3/0
C 10.0.149.0/24 is directly connected, Tunnel0

Example: VRF-Aware Static Virtual Tunnel Interface

To add the VRF to the static VTI example, include the `ipvrf` and `ip vrf forwarding` commands to the configuration as shown in the following example.

**Cisco 7206 Router Configuration**

```bash
cisco 7206
.
ip vrf sample-vti1
 rd 1:1
 route-target export 1:1
 route-target import 1:1
!
!
interface Tunnel0
 ip vrf forwarding sample-vti1
 ip address 10.0.51.217 255.255.255.0
 tunnel source 10.0.149.217
```
Example: Static Virtual Tunnel Interface with QoS

You can apply any QoS policy to the tunnel endpoint by including the `service-policy` statement under the tunnel interface. The following example shows how to police traffic out the tunnel interface.

**Cisco 7206 Router Configuration**

```
hostname cisco 7206
.
class-map match-all VTI
  match any
!
policy-map VTI
  class VTI
    police cir 2000000
    conform-action transmit
    exceed-action drop
!
!
interface Tunnel0
  ip address 10.0.51.217 255.255.255.0
  tunnel source 10.0.149.217
  tunnel destination 10.0.149.203
  tunnel mode ipsec ipv4
  tunnel protection ipsec profile P1
  service-policy output VTI
!
!
end
```
Example: Static Virtual Tunnel Interface with Virtual Firewall

Applying the virtual firewall to the SVTI tunnel allows traffic from the spoke to pass through the hub to reach the Internet. The figure below illustrates an SVTI with the spoke protected inherently by the corporate firewall.

Figure 6: Static VTI with Virtual Firewall

The basic SVTI configuration has been modified to include the virtual firewall definition:

Cisco 7206 Router Configuration

```
hostname cisco 7206
.
.
ip inspect max-incomplete high 1000000
ip inspect max-incomplete low 800000
ip inspect one-minute high 1000000
ip inspect one-minute low 800000
ip inspect tcp synwait-time 60
ip inspect tcp max-incomplete host 100000 block-time 2
ip inspect name IOSFW1 tcp timeout 300
ip inspect name IOSFW1 udp
!
interface GigabitEthernet0/1
description Internet Connection
ip address 172.18.143.246 255.255.255.0
ip access-group 100 in
ip nat outside
!
interface Tunnel0
ip address 10.0.51.217 255.255.255.0
ip nat inside
ip inspect IOSFW1 in
tunnel source 10.0.149.217
tunnel destination 10.0.149.203
tunnel mode ipsec ipv4
tunnel protection ipsec profile P1
!
ip classless
ip route 0.0.0.0 0.0.0.0 172.18.143.1
!
ip nat translation timeout 120
ip nat translation finrst-timeout 2
```
ip nat translation max-entries 300000  
ip nat pool test1 10.2.100.1 10.2.100.50 netmask 255.255.255.0  
ip nat inside source list 110 pool test1 vrf test-vti1 overload  

access-list 100 permit esp any any  
access-list 100 permit udp any eq isakmp any  
access-list 100 permit udp any eq non500-isakmp any  
access-list 100 permit icmp any any  
access-list 110 deny esp any any  
access-list 110 deny udp any eq isakmp any  
access-list 110 permit ip any any  
access-list 110 deny udp any eq non500-isakmp any  
end

Example: Dynamic Virtual Tunnel Interface Easy VPN Server

The following example illustrates the use of the DVTI Easy VPN server, which serves as an IPsec remote access aggregator. The client can be a home user running a Cisco VPN client or a Cisco IOS router configured as an Easy VPN client.

Cisco 7206 Router Configuration

hostname cisco 7206  
! 
aaa new-model  
aaa authentication login local_list local  
aaa authorization network local_list local  
aaa session-id common  
! 
ip subnet-zero  
ip cef  
! 
username cisco password 0 cisco123  
! 
controller ISA 1/1  
! 
crypto isakmp policy 1  
enck aes  
authentication pre-share  
group 14  
! 
crypto isakmp client configuration group group1  
key cisco123  
pool group1pool  
save-password  
! 
crypto isakmp profile vpn1-ra  
match identity group group1  
 client authentication list local_list  
isakmp authorization list local_list  
client configuration address respond  
virtual-template 1  
! 
crypto ipsec transform-set VTI-TS esp-aes esp-sha-hmac  
! 
crypto ipsec profile test-vti1  
set transform-set VTI-TS  
! 
interface GigabitEthernet0/1  
description Internet Connection  
ip address 172.18.143.246 255.255.255.0  
! 
interface GigabitEthernet0/2  
description Internal Network  
ip address 10.2.1.1 255.255.255.0  
!
interface Virtual-Template1 type tunnel
    ip unnumbered GigabitEthernet0/1
    ip virtual-reassembly
    tunnel mode ipsec ipv4
    tunnel protection ipsec profile test-vti1
end

ip local pool group1pool 192.168.1.1 192.168.1.4
ip classless
ip route 0.0.0.0 0.0.0.0 172.18.143.1

Example: Verifying the Results for the Dynamic Virtual Tunnel Interface Easy VPN Server

The following examples show that a DVTI has been configured for an Easy VPN server.

Router# show running-config interface Virtual-Access2
Building configuration...
Current configuration : 250 bytes
interface Virtual-Access2
    ip unnumbered GigabitEthernet0/1
    ip virtual-reassembly
    tunnel source 172.18.143.246
    tunnel destination 172.18.143.208
    tunnel mode ipsec ipv4
    tunnel protection ipsec profile test-vti1
    no tunnel protection ipsec initiate
end
Router# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route
Gateway of last resort is 10.2.1.10 to network 0.0.0.0
172.18.0.0/24 is subnetted, 1 subnets
C 172.18.143.0 is directly connected, GigabitEthernet0/1
192.168.1.0/32 is subnetted, 1 subnets
S 192.168.1.1 [1/0] via 0.0.0.0, Virtual-Access2
10.0.0.0/24 is subnetted, 1 subnets
C 10.2.1.0 is directly connected, GigabitEthernet0/2
S* 0.0.0.0/0 [1/0] via 172.18.143.1

Example: VRF-Aware IPsec with a Dynamic VTI When VRF Is Configured Under a Virtual Template

The following example shows how to configure VRF-aware IPsec under a virtual template to take advantage of the DVTI:

hostname cisco 7206
!
ip vrf VRF-100-1
    rd 1:1
!
ip vrf VRF-100-2
    rd 1:1
!
crypto keyring cisco-100-1
  pre-shared-key address 10.1.1.1 key cisco-100-1
crypto keyring cisco-100-2
  pre-shared-key address 10.1.2.1 key cisco-100-2
crypto isakmp profile cisco-isakmp-profile-100-1
  keyring cisco-100-1
  match identity address 10.1.1.0 255.255.255.0
  virtual-template 101
crypto isakmp profile cisco-isakmp-profile-100-2
  keyring cisco-100-2
  match identity address 10.1.2.0 255.255.255.0
  virtual-template 102
!
crypto ipsec transform-set cisco esp-aes esp-sha-hmac
crypto ipsec profile cisco-ipsec-profile-101
  set security-policy limit 3
  set transform-set cisco
!
crypto ipsec profile cisco-ipsec-profile-102
  set security-policy limit 5
  set transform-set Cisco
!
interface Virtual-Template101 type tunnel
  ip vrf forwarding VRF-100-1
  ip unnumbered Ethernet 0/0
  tunnel mode ipsec ipv4
  tunnel protection ipsec profile cisco-ipsec-profile-101
!
interface Virtual-Template102 type tunnel
  ip vrf forwarding VRF-100-2
  ip unnumbered Ethernet 0/0
  tunnel mode ipsec ipv4
  tunnel protection ipsec profile cisco-ipsec-profile-102
!

Example: VRF-Aware IPsec with Dynamic VTI When VRF Is Configured Under a Virtual Template with the Gateway Option in an IPsec Profile

The following example shows how to configure VRF-aware IPsec to take advantage of the DVTI, when the VRF is configured under a virtual template with the gateway option in an IPsec profile.

hostname ASR 1000

ip vrf VRF-100-1
  rd 1:1
!
ip vrf VRF-100-2
  rd 1:1
!
crypto keyring cisco-100-1
  pre-shared-key address 10.1.1.1 key cisco-100-1
crypto keyring cisco-100-2
  pre-shared-key address 10.1.2.1 key cisco-100-2
crypto isakmp profile cisco-isakmp-profile-100-1
  keyring cisco-100-1
  match identity address 10.1.1.0 255.255.255.0
  virtual-template 101
crypto isakmp profile cisco-isakmp-profile-100-2
  keyring cisco-100-2
  match identity address 10.1.2.0 255.255.255.0
  virtual-template 102
!
crypto ipsec transform-set cisco esp-3des esp-sha-hmac
crypto ipsec profile cisco-ipsec-profile-101
set security-policy limit 3
set transform-set cisco
set reverse-route gateway 172.16.0.1
!
crypto ipsec profile cisco-ipsec-profile-102
set security-policy limit 5
set transform-set cisco
set reverse-route gateway 172.16.0.1
!
interface Virtual-Template101 type tunnel
ip vrf forwarding VRF-100-1
ip unnumbered Ethernet 0/0
tunnel mode ipsec ipv4
tunnel protection ipsec profile cisco-ipsec-profile-101
!
interface Virtual-Template102 type tunnel
ip vrf forwarding VRF-100-2
ip unnumbered Ethernet 0/0
tunnel mode ipsec ipv4
tunnel protection ipsec profile cisco-ipsec-profile-102
!

Example: VRF-Aware IPsec with a Dynamic VTI When VRF Is Configured Under an ISAKMP Profile

hostname cisco 7206
!
ip vrf VRF-100-1
 rd 1:1
!
ip vrf VRF-100-2
 rd 1:1
!
crypto keyring cisco-100-1
 pre-shared-key address 10.1.1.1 key cisco-100-1
crypto keyring cisco-100-2
 pre-shared-key address 10.1.2.1 key cisco-100-2
crypto isakmp profile cisco-isakmp-profile-100-1
 vrf VRF-100-1
 keyring cisco-100-1
 match identity address 10.1.1.0 255.255.255.0
 virtual-template 1
crypto isakmp profile cisco-isakmp-profile-100-2
 vrf VRF-100-2
 keyring cisco-100-2
 match identity address 10.1.2.0 255.255.255.0
 virtual-template 1
!
!
crypto ipsec transform-set cisco esp-aes esp-sha-hmac
crypto ipsec profile cisco-ipsec-profile
 set security-policy limit 3
 set transform-set cisco
!
!
interface Virtual-Template 1 type tunnel
 ip unnumbered ethernet 0/0
tunnel mode ipsec ipv4
tunnel protection ipsec profile cisco-ipsec-profile
!
Example: VRF-Aware IPsec with a Dynamic VTI When VRF Is Configured Under an ISAKMP Profile and a Gateway Option in an IPsec Profile

The following example shows how to configure VRF-aware IPsec to take advantage of the DVTI, when the VRF is configured under an ISAKMP profile and a gateway option in an IPsec profile:

```
hostname ASR 1000
ip vrf VRF-100-1
  rd 1:1
ip vrf VRF-100-2
  rd 1:1
crypto keyring cisco-100-1
  pre-shared-key address 10.1.1.1 key cisco-100-1
crypto keyring cisco-100-2
  pre-shared-key address 10.1.2.1 key cisco-100-2
crypto isakmp profile cisco-isakmp-profile-100-1
  vrf VRF-100-1
  keyring cisco-100-1
  match identity address 10.1.1.0 255.255.255.0
  virtual-template 1
crypto isakmp profile cisco-isakmp-profile-100-2
  vrf VRF-100-2
  keyring cisco-100-2
  match identity address 10.1.2.0 255.255.255.0
  virtual-template 1
crypto ipsec transform-set cisco esp-3des esp-sha-hmac
crypto ipsec profile cisco-ipsec-profile
  set security-policy limit 3
  set transform-set cisco
  set reverse-route gateway 172.16.0.1
interface Virtual-Template1 type tunnel
  ip unnumbered Ethernet 0/0
  tunnel mode ipsec ipv4
  tunnel protection ipsec profile cisco-ipsec-profile
```

Example: VRF-Aware IPsec with a Dynamic VTI When VRF Is Configured Under Both a Virtual Template and an ISAKMP Profile

When separate VRFs are configured under an ISAKMP profile and a virtual template, the VRF configured under the virtual template takes precedence. This configuration is not recommended.

The following example shows how to configure VRF-aware IPsec to take advantage of the DVTI when the VRF is configured under both a virtual template and an ISAKMP profile:

```
hostname ASR 1000
```
Example: Dynamic Virtual Tunnel Interface with Virtual Firewall

The DVTI Easy VPN server can be configured behind a virtual firewall. Behind-the-firewall configuration allows users to enter the network, while the network firewall is protected from unauthorized access. The virtual firewall uses Context-Based Access Control (CBAC) and NAT applied to the Internet interface as well as to the virtual template.

hostname cisco 7206
.
.
ip inspect max-incomplete high 1000000
ip inspect max-incomplete low 800000
ip inspect one-minute high 1000000
ip inspect one-minute low 800000
ip inspect tcp synwait-time 60
ip inspect tcp max-incomplete host 100000 block-time 2
ip inspect name IOSFW1 tcp timeout 300
ip inspect name IOSFW1 udp
.
.
interface GigabitEthernet0/1
description Internet Connection
ip address 172.18.143.246 255.255.255.0
ip access-group 100 in
ip nat outside
!
interface GigabitEthernet0/2
description Internal Network
ip address 10.2.1.1 255.255.255.0
!
interface Virtual-Template1 type tunnel
Example: Dynamic Virtual Tunnel Interface with QoS

You can add QoS to the DVTI tunnel by applying the service policy to the virtual template. When the template is cloned to make the virtual access interface, the service policy will also be applied to the virtual access interface. The following example shows the basic DVTI configuration with QoS added.

```
hostname cisco 7206
.

class-map match-all VTI
  match any
!
policy-map VTI
  class VTI
    police cir 2000000
      conform-action transmit
      exceed-action drop
!
.
interface Virtual-Template1 type tunnel
  ip vrf forwarding test-vti1
  ip unnumbered Loopback0
  ip virtual-reassembly
  tunnel mode ipsec ipv4
  tunnel protection ipsec profile test-vti1
  service-policy output VTI
!
.
!
end
```
Additional References for IPsec Virtual Tunnel Interface

Related Documents

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<th>Document Title</th>
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Standards and RFCs

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<td>RFC 2408</td>
<td>Internet Security Association and Key Management Protocol</td>
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<td>RFC 2409</td>
<td>The Internet Key Exchange (IKE)</td>
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Technical Assistance

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<th>Description</th>
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<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>

Feature Information for IPsec Virtual Tunnel Interfaces

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 IPsec Virtual Tunnel Interfaces

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<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Configuration Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic IPsec VTIs</td>
<td>Cisco IOS XE Release 2.1</td>
<td>Dynamic VTIs enable efficient use of IP addresses and provide secure connectivity. Dynamic VTIs allow dynamically downloadable per-group and per-user policies to be configured on a RADIUS server. IPsec dynamic VTIs allow you to create highly secure connectivity for remote access VPNs. The dynamic VTI simplifies VRF-aware IPsec deployment. The following commands were introduced or modified: crypto isakmp profile, interface virtual-template, show vtemplate, tunnel mode, virtual-template.</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Configuration Information</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>FlexVPN Mixed Mode Support</td>
<td>Cisco IOS XE Release 3.10S</td>
<td>The FlexVPN Mixed Mode feature provides support for carrying IPv4 traffic over IPsec IPv6 transport. This is the first phase towards providing dual stack support on the IPsec stack. This implementation does not support using a single IPsec security association (SA) pair for both IPv4 and IPv6 traffic. This feature is only supported for Remote Access VPN with IKEv2 and Dynamic VTI.</td>
</tr>
<tr>
<td>IKE Profile Based Tunnel Selection</td>
<td>Cisco IOS XE Release 3.10S</td>
<td>The Profile Based Tunnel Selection feature uses the Internet Key Exchange (IKE) or Internet Key Exchange version 2 (IKEv2) profile to select a tunnel interface for an IPsec session thereby allowing tunnel interfaces to share the tunnel source IP address and IPsec transform set without sharing the IPsec security association databases (SADBs) among tunnel interfaces. The following commands were introduced or modified: <code>tunnel protection ipsec profile</code>.</td>
</tr>
<tr>
<td>Multi-SA for Dynamic VTIs</td>
<td>Cisco IOS XE Release 3.2S</td>
<td>The DVTI can accept multiple IPsec selectors that are proposed by the initiator. The following commands were introduced or modified: <code>set security-policy limit</code>, <code>set reverse-route</code>.</td>
</tr>
<tr>
<td>Static IPsec VTIs</td>
<td>Cisco IOS XE Release 2.1</td>
<td>IPsec VTIs provide a routable interface type for terminating IPsec tunnels and an easy way to define protection between sites to form an overlay network. IPsec VTIs simplify configuration of IPsec for protection of remote links, support multicast, and simplify network management and load balancing.</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Configuration Information</td>
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<tr>
<td>Tunnel Mode Auto Selection</td>
<td>Cisco IOS XE Release 3.12S</td>
<td>The Tunnel Mode Auto Selection feature eases the configuration and spares you about knowing the responder's details. This feature automatically applies the tunneling protocol (GRE or IPsec) and transport protocol (IPv4 or IPv6) on the virtual template as soon as the IKE profile creates the virtual access interface. The following command was introduced or modified: <code>virtual-template</code></td>
</tr>
<tr>
<td>FlexVPN Mixed Mode v6 over v4 Transport</td>
<td>Cisco IOS XE Everest 16.4.1</td>
<td>The FlexVPN Mixed Mode v6 over v4 Transport feature provides support for carrying IPv6 traffic over IPsec IPv4 transport. This implementation does not support using a single IPsec security association (SA) pair for both IPv4 and IPv6 traffic.</td>
</tr>
</tbody>
</table>