



IPsec Virtual Tunnel Interface

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IP security (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 configuration of IPsec for protection of remote links, support multicast, and simplify network management and load balancing.

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see 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 at the end of this document.

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 Interface

IPsec Transform Set

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



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IKE Security Association

The Internet Key Exchange (IKE) security association (SA) is bound to the VTI. Because IKE SA is bound to the VTI, the same IKE SA cannot be used for a crypto map.

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 and IPv6 Packets

This feature supports SVTIs that are configured to encapsulate IPv4 packets or IPv6 packets, but IPv4 packets cannot carry IPv6 packets, and IPv6 packets cannot carry IPv4 packets.

Proxy

SVTIs support only the “IP any any” proxy.

QoS Traffic Shaping

The shaped traffic is process switched.

Stateful Failover

IPsec stateful failover is not supported with IPsec VTIs.

Tunnel Protection

The **shared** keyword is not required and must not be configured when using the **tunnel mode ipsec ipv4** command for IPsec IPv4 mode.

Static VTIs Versus GRE Tunnels

The IPsec VTI is limited to IP unicast and multicast traffic only, as opposed to generic routing encapsulation (GRE) tunnels, which have a wider application for IPsec implementation.

VRF-Aware IPsec Configuration

In VRF-aware IPsec configurations with either SVTIs or Dynamic VTIs (DVTIs), the VRF must not be configured in the Internet Security Association and Key Management Protocol (ISAKMP) profile. Instead, the VRF must be configured on the tunnel interface for SVTIs. For DVTIs, you must apply VRF to the virtual template using the **ip vrf forwarding** command.

Information About IPsec Virtual Tunnel Interface

The use of IPsec VTIs both greatly simplifies the configuration process when you need to provide protection for remote access and provides a simpler alternative to using a generic routing encapsulation (GRE) tunnel for encapsulation and crypto maps with IPsec. A major benefit associated with IPsec VTIs is that the configuration does not require a 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 compared to the more complex process of using access control lists (ACLs) with the crypto map in native IPsec configurations. DVTIs function like any other real interface so that you can apply quality of service (QoS), firewall, and other security services as soon as the tunnel is active.

Without Virtual Private Network (VPN) Acceleration Module2+ (VAM2+) accelerating virtual interfaces, the packet traversing an IPsec virtual interface is directed to the router processor (RP) for encapsulation. This method tends to be slow and has limited scalability. In hardware crypto mode, all the IPsec VTIs are accelerated by the VAM2+ crypto engine, and all traffic going through the tunnel is encrypted and decrypted by the VAM2+.

The following sections provide details about the IPsec VTI:

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- [Static Virtual Tunnel Interfaces, page 3](#)
- [Dynamic Virtual Tunnel Interfaces, page 4](#)
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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 NAT, ACLs, and QoS and apply them to clear-text or encrypted text, or both. When crypto maps are used, there is no simple way to apply encryption features to the IPsec tunnel.

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

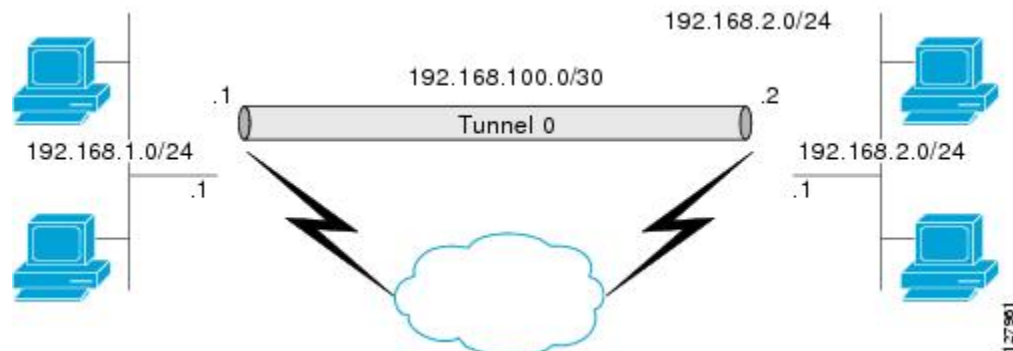
Static Virtual Tunnel Interfaces

SVTI configurations can be used for site-to-site connectivity in which a tunnel provides always-on access between two sites. The advantage of using SVTIs as opposed to crypto map configurations is that users can enable dynamic routing protocols on the tunnel interface without the extra 24 bytes required for GRE headers, thus reducing the bandwidth for sending encrypted data.

Additionally, multiple Cisco IOS XE 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



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

DVTIs can be used for both the server and 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 XE software feature configured on the virtual template interface, such as QoS, NetFlow, or ACLs.

DVTIs function like any other real interface so that you can apply QoS, firewall, 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 XE 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 extended authentication (Xauth) User or Unity group, or it 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 Virtual Private Network (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.

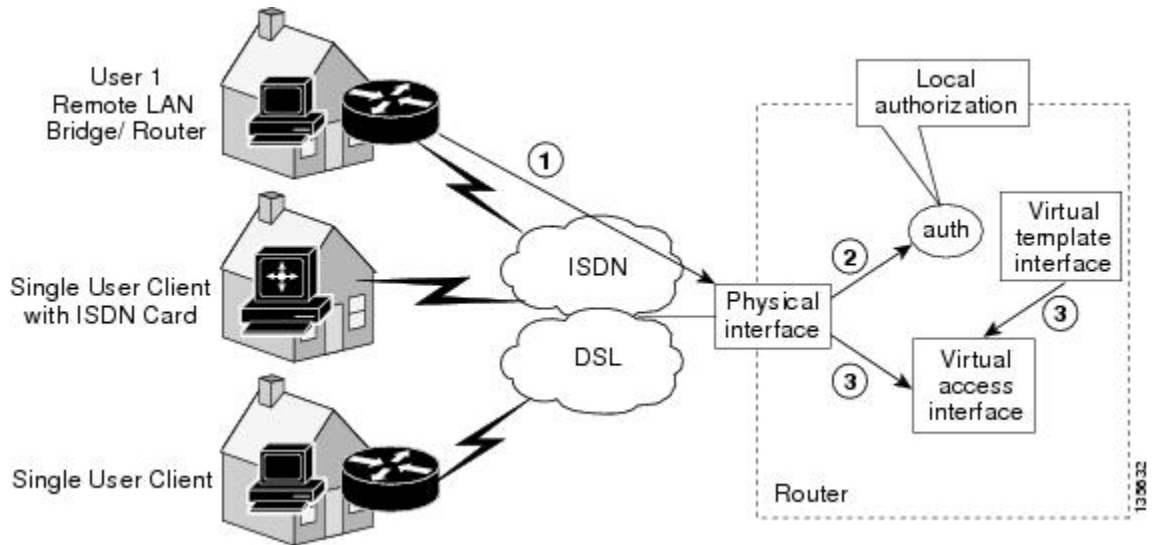


Note

DVTI is supported in Easy VPNs. That is, the DVTI end must be configured as an Easy VPN server. DVTI can also be used in site-to-site scenarios.

The figure below illustrates the DVTI authentication path.

Figure 2 *Dynamic IPsec VTI*

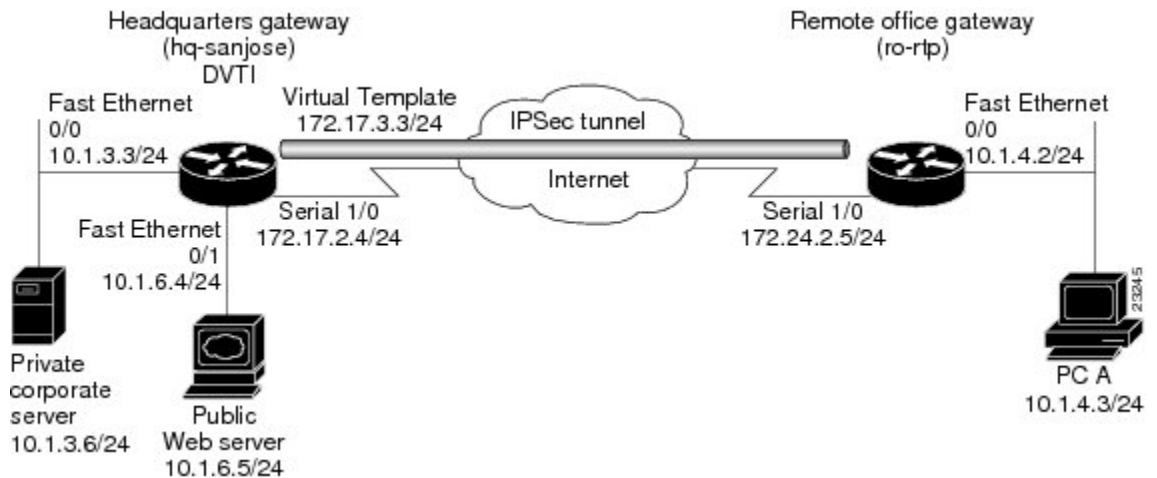


The authentication shown in the figure above follows this path:

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

The figure below illustrates the DVTI authentication path in a site-to-site scenario.

Figure 3 *Dynamic IPsec VTI in a Site-to-Site Scenario*



Dynamic Virtual Tunnel Interface Life Cycle

IPsec profiles define 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

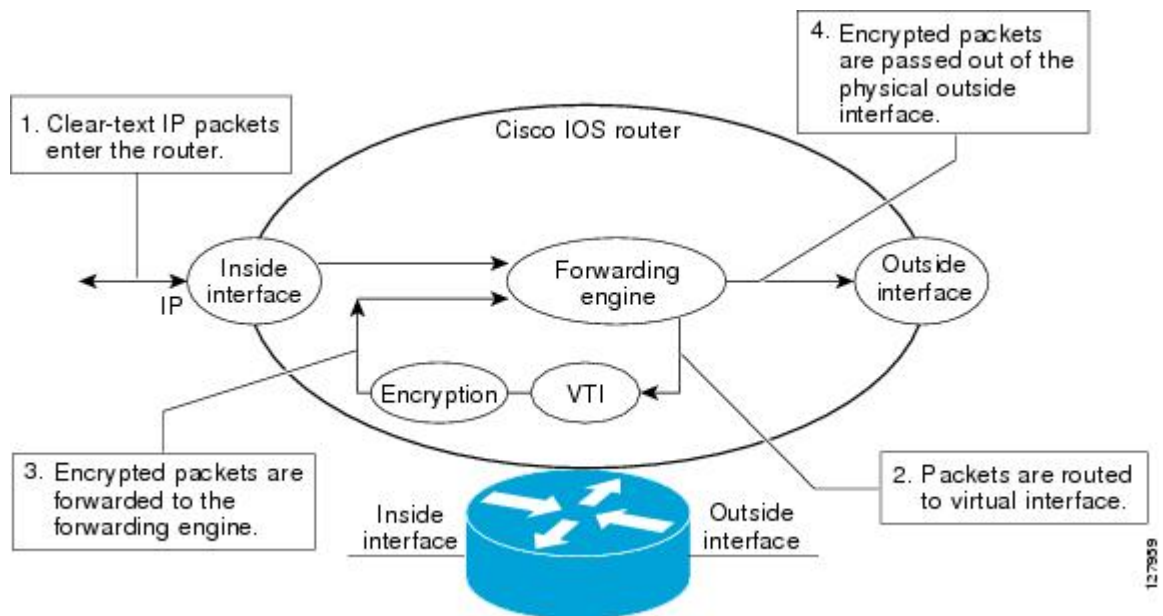
Because VTIs are routable interfaces, routing plays an important role in the encryption process. Traffic is encrypted only if it is forwarded out of the VTI, and traffic arriving on the VTI is decrypted and routed accordingly. VTIs allow you to establish an encryption tunnel using a real interface as the tunnel endpoint. You can route to the interface or apply services such as QoS, firewalls, network address translation, and NetFlow statistics as you would to any other interface. You can monitor the interface and route to it, and it has an advantage over crypto maps because it is a real interface and provides the benefits of any other Cisco IOS 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 because the use of ACLs with a crypto map in native IPsec configurations is not required. 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.

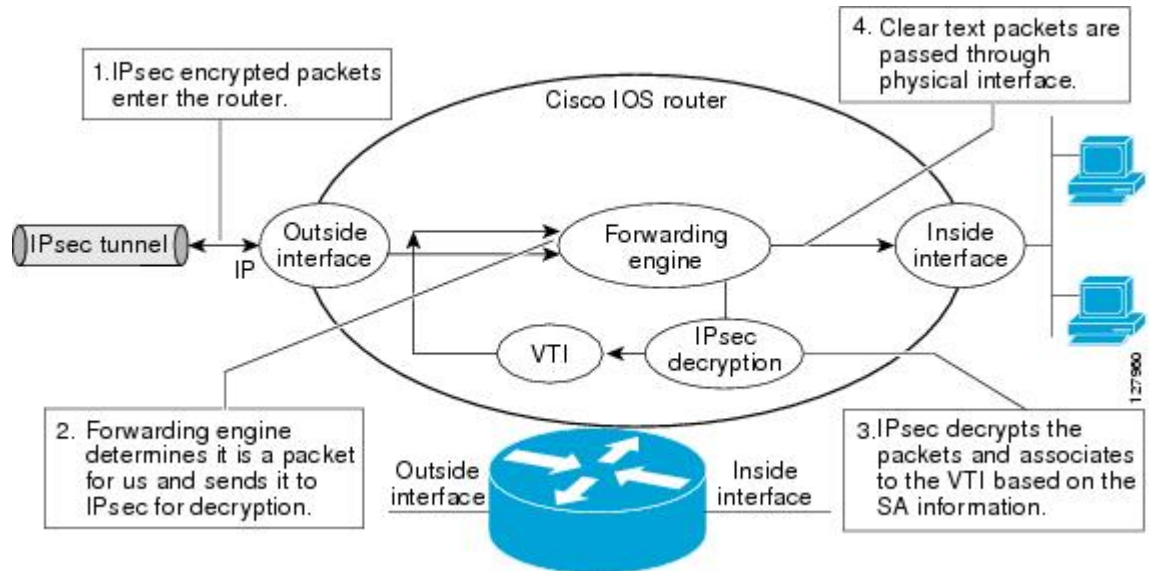
Figure 4 Packet Flow into the IPsec Tunnel



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 5 Packet Flow out of the IPsec Tunnel



How to Configure IPsec Virtual Tunnel Interface

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Configuring Static IPsec Virtual Tunnel Interfaces

Perform this task to configure a static IPsec VTI.

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. **interface** *type number*
6. **ip address** *address mask*
7. **tunnel mode ipsec ipv4**
8. **tunnel source** *interface*
9. **tunnel destination** *ip-address*
10. **tunnel protection ipsec profile** *profile-name* [*shared*]

DETAILED STEPS

| | Command or Action | Purpose |
|---------------|--|---|
| Step 1 | <p>enable</p> <p>Example:</p> <pre>Router> enable</pre> | <p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> • Enter your password if prompted. |
| Step 2 | <p>configure terminal</p> <p>Example:</p> <pre>Router# configure terminal</pre> | <p>Enters global configuration mode.</p> |
| Step 3 | <p>crypto ipsec profile <i>profile-name</i></p> <p>Example:</p> <pre>Router(config)# crypto ipsec profile PROF</pre> | <p>Defines the IPsec parameters that are to be used for IPsec encryption between two IPsec routers.</p> |
| Step 4 | <p>set transform-set <i>transform-set-name</i> [<i>transform-set-name2</i>...<i>transform-set-name6</i>]</p> <p>Example:</p> <pre>Router(config)# set transform-set tset</pre> | <p>Specifies which transform sets can be used with the crypto map entry.</p> |
| Step 5 | <p>interface <i>type number</i></p> <p>Example:</p> <pre>Router(config)# interface tunnel0</pre> | <p>Specifies the interface on which the tunnel is configured and enters interface configuration mode.</p> |
| Step 6 | <p>ip address <i>address mask</i></p> <p>Example:</p> <pre>Router(config-if)# ip address 10.1.1.1 255.255.255.0</pre> | <p>Specifies the IP address and mask.</p> |
| Step 7 | <p>tunnel mode ipsec ipv4</p> <p>Example:</p> <pre>Router(config-if)# tunnel mode ipsec ipv4</pre> | <p>Defines the mode for the tunnel.</p> |

| | Command or Action | Purpose |
|----------------|--|--|
| Step 8 | tunnel source <i>interface</i> Example: Router(config-if)# tunnel source loopback0 | Specifies the tunnel source as a loopback interface. |
| Step 9 | tunnel destination <i>ip-address</i> Example: Router(config-if)# tunnel destination 172.16.1.1 | Identifies the IP address of the tunnel destination. |
| Step 10 | tunnel protection ipsec profile <i>profile-name</i> [shared] Example: Router(config-if)# tunnel protection ipsec profile PROF | Associates a tunnel interface with an IPsec profile. |

Configuring Dynamic IPsec Virtual Tunnel Interfaces

Perform this task to configure a dynamic IPsec VTI.

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. **interface virtual-template** *number*
6. **tunnel mode ipsec ipv4**
7. **tunnel protection ipsec profile** *profile-name* [**shared**]
8. **exit**
9. **crypto isakamp profile** *profile-name*
10. **virtua l- template** *template-number*

DETAILED STEPS

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

| Command or Action | Purpose |
|---|--|
| <p>Step 2 configure terminal</p> <p>Example:</p> <pre>Router# configure terminal</pre> | Enters global configuration mode. |
| <p>Step 3 crypto ipsec profile <i>profile-name</i></p> <p>Example:</p> <pre>Router(config)# crypto ipsec profile PROF</pre> | Defines the IPsec parameters that are to be used for IPsec encryption between two IPsec routers. |
| <p>Step 4 set transform-set <i>transform-set-name</i> [<i>transform-set-name2...transform-set-name6</i>]</p> <p>Example:</p> <pre>Router(config)# set transform-set tset</pre> | Specifies which transform sets can be used with the crypto map entry. |
| <p>Step 5 interface virtual-template <i>number</i></p> <p>Example:</p> <pre>Router(config)# interface virtual-template 2</pre> | Defines a virtual-template tunnel interface and enters interface configuration mode. |
| <p>Step 6 tunnel mode ipsec ipv4</p> <p>Example:</p> <pre>Router(config-if)# tunnel mode ipsec ipv4</pre> | Defines the mode for the tunnel. |
| <p>Step 7 tunnel protection ipsec profile <i>profile-name</i> [shared]</p> <p>Example:</p> <pre>Router(config-if)# tunnel protection ipsec profile PROF</pre> | Associates a tunnel interface with an IPsec profile. |
| <p>Step 8 exit</p> <p>Example:</p> <pre>Router(config-if)# exit</pre> | Exits interface configuration mode. |

| | Command or Action | Purpose |
|---------|--|--|
| Step 9 | <code>crypto isakamp profile <i>profile-name</i></code> | Defines the ISAKAMP profile to be used for the virtual template. |
| | Example: Router(config)# <code>crypto isakamp profile red</code> | |
| Step 10 | <code>virtual-template <i>template-number</i></code> | Specifies the virtual template attached to the ISAKAMP profile. |
| | Example: Router(config)# <code>virtual-template 1</code> | |

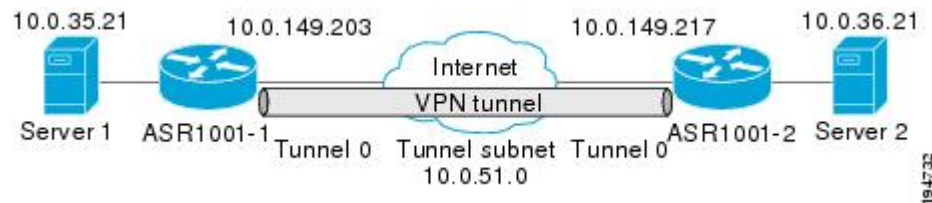
Configuration Examples for IPsec Virtual Tunnel Interface

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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 IPsec policy and passes them to the Crypto Engine (CE) for IPsec encapsulation. The figure below illustrates the IPsec VTI configuration.

Figure 6 VTI with IPsec



Router ASR 1000-1 Configuration

```

version 2.1
service timestamps debug datetime
service timestamps log datetime
hostname ASR 1000-1
no aaa new-model
ip subnet-zero
ip cef
controller ISA 6/1
!
crypto isakmp policy 1
encr 3des
authentication pre-share
group 2
crypto isakmp key Cisco12345 address 0.0.0.0 0.0.0.0
crypto IPsec transform-set T1 esp-3des esp-sha-hmac
crypto IPsec profile P1
set transform-set T1
!
interface Tunnel0
ip address 10.0.51.203 255.255.255.0
ip ospf mtu-ignore
load-interval 30
tunnel source 10.0.149.203
tunnel destination 10.0.149.217
tunnel mode IPsec ipv4
tunnel protection IPsec profile P1
!
interface FastEthernet3/0
ip address 10.0.149.203 255.255.255.0
duplex full
!
interface FastEthernet3/3
ip address 10.0.35.203 255.255.255.0
duplex full
!
ip classless
ip route 10.0.36.0 255.255.255.0 Tunnel0
line con 0
line aux 0
line vty 0 4
end

```

Router ASR 1000-2 Configuration

```

version 2.1
hostname ASR 1000-2
no aaa new-model
ip subnet-zero
ip cef
crypto isakmp policy 1
encr 3des
authentication pre-share
group 2
crypto isakmp key Cisco12345 address 0.0.0.0 0.0.0.0
crypto IPsec transform-set T1 esp-3des esp-sha-hmac
crypto IPsec profile P1
set transform-set T1
!
interface Tunnel0
ip address 10.0.51.217 255.255.255.0
ip ospf mtu-ignore
tunnel source 10.0.149.217
tunnel destination 10.0.149.203
tunnel mode ipsec ipv4
tunnel protection ipsec profile P1
!
interface FastEthernet0/0
ip address 10.0.149.217 255.255.255.0
speed 100

```

```

full-duplex
!
interface FastEthernet1/0
 ip address 10.0.36.217 255.255.255.0
 load-interval 30
 full-duplex
!
ip classless
ip route 10.0.35.0 255.255.255.0 Tunnel0
line con 0
line aux 0
line vty 0 4
end

```

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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 Router Status

```

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 Kbit, 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
191320 packets input, 30129126 bytes, 0 no buffer
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, origin: crypto map
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 not set
10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C 10.0.35.0/24 is directly connected, FastEthernet3/3
S 10.0.36.0/24 is directly connected, Tunnel0
C 10.0.51.0/24 is directly connected, Tunnel0
C 10.0.149.0/24 is directly connected, FastEthernet3/0

```

Example VRF-Aware Static Virtual Tunnel Interface

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

Router Configuration

```

hostname ASR 1000-1
.
.
.
ip vrf sample-vt1
  rd 1:1
  route-target export 1:1
  route-target import 1:1
!
.
.
.
interface Tunnel0
  ip vrf forwarding sample-vt1
  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
.
.
.
!
end

```

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 is policing traffic out the tunnel interface:

Router Configuration

```

hostname router1
.
.
.
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

```

```

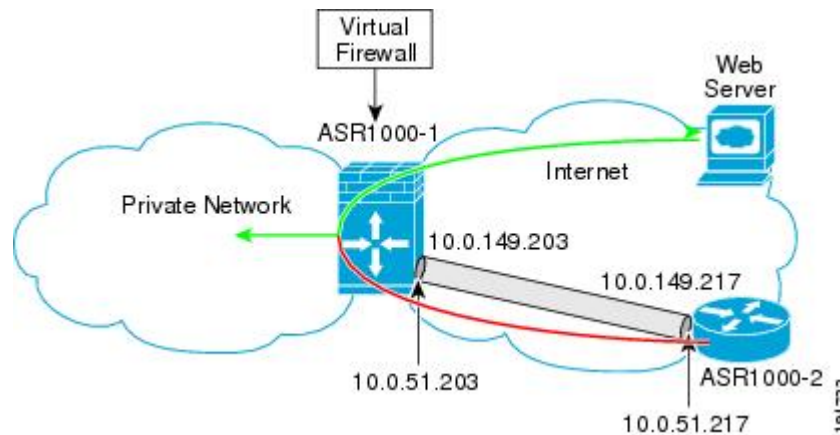
tunnel destination 10.0.149.203
tunnel mode ipsec ipv4
tunnel protection ipsec profile P1
service-policy output VTI
!
.
.
!
end

```

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 a SVTI with the spoke protected inherently by the corporate firewall.

Figure 7 Static VTI with Virtual Firewall



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

Router 1 Configuration

```

hostname ASR 1000-1
.
.
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-vtil 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 it can be a Cisco IOS XE router configured as an Easy VPN client.

Router Configuration

```

hostname ASR 1000-1
!
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
  encr 3des
  authentication pre-share
  group 2
!
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-3des esp-sha-hmac
!
crypto ipsec profile test-vtil
  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-Templatel type tunnel
  ip unnumbered GigabitEthernet0/1
  ip virtual-reassembly
  tunnel mode ipsec ipv4
  tunnel protection ipsec profile test-vtil
!
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
!
end

```

- [Example Verifying the Results for the Dynamic Virtual Tunnel Interface Easy VPN Server, page 17](#)

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-vtil
  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 Dynamic Virtual Tunnel Interface Easy VPN Client

The following example shows how you can set up a router as the Easy VPN client. This example uses basically the same idea as the Easy VPN client that you can run from a PC to connect. In fact, the configuration of the Easy VPN server works for the software client or the Cisco IOS XE client.

```

hostname ASR 1000
!
no aaa new-model

```

```

!
ip cef
!
username cisco password 0 cisco123
!
crypto ipsec client ezvpn CLIENT
  connect manual
  group group1 key cisco123
  mode client
  peer 172.18.143.246
  virtual-interface 1
  username cisco password cisco123
  xauth userid mode local
!
interface Loopback0
  ip address 10.1.1.1 255.255.255.255
!
interface FastEthernet0/0
  description Internet Connection
  ip address 172.18.143.208 255.255.255.0
  crypto ipsec client ezvpn CLIENT
!
interface FastEthernet0/1
  ip address 10.1.1.252 255.255.255.0
  crypto ipsec client ezvpn CLIENT inside
!
interface Virtual-Template1 type tunnel
  ip unnumbered Loopback0
!
ip route 0.0.0.0 0.0.0.0 172.18.143.1 254
!
end

```

The client definition can be set up in many different ways. The mode specified with the **connect** command can be automatic or manual. If the connect mode is set to manual, then the IPsec tunnel has to be initiated manually by a user.

Also note use of the **mode** command. The mode can be client, network-extension, or network-extension-plus. This example indicates client mode, which means that the client is given a private address from the server. Network-extension mode is different from client mode in that the client specifies for the server its attached private subnet. Depending on the mode, the routing table on either end is slightly different. The basic operation of the IPSec tunnel remains the same, regardless of the specified mode.

- [Example Verifying the Results for the Dynamic Virtual Tunnel Interface Easy VPN Client, page 18](#)

Example Verifying the Results for the Dynamic Virtual Tunnel Interface Easy VPN Client

The following examples illustrate different ways to display the status of the DVTI:

```

Router# show running-config interface Virtual-Access2
Building configuration...
Current configuration : 148 bytes
!
interface Virtual-Access2
  ip unnumbered Loopback1
  tunnel source FastEthernet0/0
  tunnel destination 172.18.143.246
  tunnel mode ipsec ipv4
end
Router# show running-config interface Loopback1
Building configuration...
Current configuration : 65 bytes
!
interface Loopback1
  ip address 192.168.1.1 255.255.255.255
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 172.18.143.1 to network 0.0.0.0
 10.0.0.0/32 is subnetted, 1 subnets
C    10.1.1.1 is directly connected, Loopback0
 172.18.0.0/24 is subnetted, 1 subnets
C    172.18.143.0 is directly connected, FastEthernet0/0
 192.168.1.0/32 is subnetted, 1 subnets
C    192.168.1.1 is directly connected, Loopback1
S*  0.0.0.0/0 [1/0] via 0.0.0.0, Virtual-Access2
Router# show crypto ipsec client ezvpn
Easy VPN Remote Phase: 6
Tunnel name : CLIENT
Inside interface list: FastEthernet0/1
Outside interface: Virtual-Access2 (bound to FastEthernet0/0)
Current State: IPSEC_ACTIVE
Last Event: SOCKET_UP
Address: 192.168.1.1
Mask: 255.255.255.255
Save Password: Allowed
Current EzVPN Peer: 172.18.143.246

```

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

The following example shows how to configure VRF-Aware IPsec to take advantage of the DVTI:

```

hostname ASR 1000
.
.
.
ip vrf test-vt1
 rd 1:1
  route-target export 1:1
  route-target import 1:1
!
.
.
.
interface Virtual-Templat1 type tunnel
 ip vrf forwarding test-vt1
 ip unnumbered Loopback0
 ip virtual-reassembly
 tunnel mode ipsec ipv4
 tunnel protection ipsec profile test-vt1
!
.
.
.
end

```

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

The following example shows how to configure VRF-Aware IPsec to take advantage of the DVTI when VRF is configured under an ISAKMP profile:

```

hostname ASR 1000
.
.
.

```

```

ip vrf test-vtil
rd 1:1
route-target export 1:1
route-target import 1:1
!
.
.
.
crypto isakmp profile cisco-isakmp-profile
  vrf test-vtil
  keyring key
  match identity address 4.0.0.22 255.255.255.255
!
.
.
.
interface Virtual-Template1 type tunnel
ip unnumbered Loopback0
ip virtual-reassembly
tunnel mode ipsec ipv4
tunnel protection ipsec profile test-vtil
!
.
.
end

```

Example Dynamic VTI When VRF Is Configured Under a Virtual Template and an ISAKMP Profile



Note

When separate VRFs are configured under isakmp profile and virtual-template, the VRF configured under virtual template takes precedence.

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

```

hostname ASR 1000
.
.
.
ip vrf test-vti2
rd 1:2
route-target export 1:1
route-target import 1:1
!
.
.
.
ip vrf test-vtil
rd 1:1
route-target export 1:1
route-target import 1:1
!
.
.
.
crypto isakmp profile cisco-isakmp-profile
  vrf test-vti2
  keyring key
  match identity address 4.0.0.22 255.255.255.255
!
.
.
.
interface Virtual-Template1 type tunnel
ip vrf forwarding test-vtil

```

```

ip unnumbered Loopback0
ip virtual-reassembly
tunnel mode ipsec ipv4
tunnel protection ipsec profile test-vti1
!
.
.
end

```

Example Dynamic Virtual Tunnel Interface with a 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 ASR 1000
.
.
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-Templatel type tunnel
ip unnumbered Loopback0
ip nat inside
ip inspect IOSFW1 in
tunnel mode ipsec ipv4
tunnel protection ipsec profile test-vti1
!
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 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 is applied there. The following example shows the basic DVTI configuration with QoS added:

```
hostname ASR 1000
.
.
.
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-vt1
  ip unnumbered Loopback0
  ip virtual-reassembly
  tunnel mode ipsec ipv4
  tunnel protection ipsec profile test-vt1
  service-policy output VTI
!
.
.
.
!
end
```

Additional References

Related Documents

| Related Topic | Document Title |
|---|--|
| IPsec security issues | “Configuring Security for VPNs with IPsec” module in the <i>Cisco IOS XE Security Configuration Guide: Secure Connectivity</i> |
| QoS configuration tasks | <i>Cisco IOS XE Quality of Service Solutions Configuration Guide</i> |
| Security commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples | <i>Cisco IOS Security Command Reference</i> |
| VPN configuration tasks | “Easy VPN Server” module in the <i>Cisco IOS XE Security Configuration Guide: Secure Connectivity</i> |
| Cisco IOS commands | Cisco IOS Master Commands List, All Releases |

Standards

| Standard | Title |
|---|-------|
| No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature. | |

MIBs

| MIB | MIBs Link |
|---|---|
| No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature. | To locate and download MIBs for selected platforms, Cisco IOS software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs |

RFCs

| RFC | Title |
|----------|--|
| RFC 2401 | <i>Security Architecture for the Internet Protocol</i> |
| RFC 2408 | <i>Internet Security Association and Key Management Protocol</i> |
| RFC 2409 | <i>The Internet Key Exchange (IKE)</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 IPsec Virtual Tunnel Interface

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 Interface*

| Feature Name | Releases | Feature Configuration Information |
|-------------------|--------------------------|---|
| Static IPsec VTIs | Cisco IOS XE Release 2.1 | <p>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.</p> <ul style="list-style-type: none"> • Static Virtual Tunnel Interfaces, page 3 • Configuring Static IPsec Virtual Tunnel Interfaces, page 7 <p>The following commands were introduced or modified: crypto isakmp profile, interface virtual-template, show vtemplate, tunnel mode.</p> |

| Feature Name | Releases | Feature Configuration Information |
|--------------------|--------------------------|--|
| Dynamic IPsec VTIs | Cisco IOS XE Release 2.1 | <p>Dynamic VTIs provide efficiency in the 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. The per-group or per-user definition can be created using Xauth User or Unity group, or it can be derived from a certificate. Dynamic VTIs are standards based, so interoperability in a multiple-vendor environment is supported. IPsec dynamic VTIs allow you to create highly secure connectivity for remote access VPNs and can be combined with Cisco AVVID to deliver converged voice, video, and data over IP networks. The dynamic VTI simplifies VRF-aware IPsec deployment. The VRF is configured on the interface.</p> <p>The following sections provide information about this feature:</p> <ul style="list-style-type: none"> • Dynamic Virtual Tunnel Interfaces, page 4 • Configuring Dynamic IPsec Virtual Tunnel Interfaces, page 9 <p>The following command was introduced or modified: virtual-template.</p> <p>Cisco IOS XE Release 3.2S -- DVTI supports multiple IPsec SAs.</p> <p>The DVTI can accept multiple IPsec selectors that are proposed by the initiator.</p> <p>The following commands were introduced or modified: set security-policy limit, set reverse-route.</p> |

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