

# Configuring GRE over IPSec Between a Cisco IOS Router and a VPN 5000 Concentrator Using Static Routing

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Cisco has announced the end of sales for the Cisco VPN 5000 Series Concentrators. For more information, please see the [End-of-Sales Announcement](#).

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## Introduction

This document describes how to configure generic routing encapsulation (GRE) over IPSec between a Cisco VPN 5000 Series Concentrator and a Cisco router running Cisco IOS® software. The GRE-over-IPSec feature is introduced in the VPN 5000 Concentrator 6.0(19) software release.

In this example, static routing is used to route packets across the tunnel.

## Prerequisites

### Requirements

There are no specific requirements for this document.

### Components Used

The information in this document is based on these software and hardware versions:

- Cisco IOS Software Release 12.2(3)
- Cisco VPN 5000 Concentrator software version 6.0(19)

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

## Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

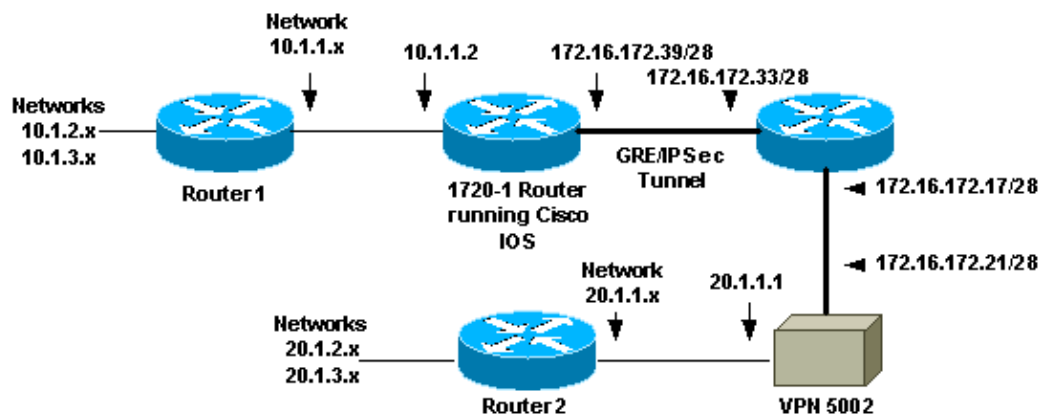
## Configure

In this section, you are presented with the information to configure the features described in this document.

**Note:** To find additional information on the commands used in this document, use the Command Lookup Tool (registered customers only).

## Network Diagram

This document uses the network setup shown in this diagram.



GRE over IPSec is configured between the 1720–1 router running Cisco IOS software and the VPN 5002 Concentrator. Behind the router and the VPN Concentrator, there are multiple networks that are advertised through Open Shortest Path First (OSPF). OSPF runs within the GRE tunnel between the router and the VPN Concentrator.

- These networks are behind the 1720–1 router.
  - ◆ 10.1.1.0/24
  - ◆ 10.1.2.0/24
  - ◆ 10.1.3.0/24
- These networks are behind the VPN 5002 Concentrator.
  - ◆ 20.1.1.0/24
  - ◆ 20.1.2.0/24
  - ◆ 20.1.3.0/24

## Configurations

This document uses these configurations.

- 1720–1 Router

- VPN 5002 Concentrator

**Note:** With Cisco IOS Software Releases 12.2(13)T and later (higher numbered T–train codes, 12.3 and later codes), you must apply the configured IPsec crypto map to the physical interface only. You no longer have to apply the crypto map on the GRE tunnel interface. Having the crypto map on the physical and the tunnel interfaces when you use Cisco IOS Software Releases 12.2.(13)T and later should still work, but Cisco Systems recommends that you apply the crypto map on the physical interface only.

1720-1 Router
<pre>Current configuration : 1305 bytes ! version 12.2 service timestamps debug uptime service timestamps log uptime no service password-encryption ! hostname 1720-1 ! no logging buffered no logging monitor enable secret 5 \$1\$vIzI\$RqD0Lq1qbSFCCjVELFLfH/ ! memory-size iomem 15 ip subnet-zero no ip domain-lookup ! ip audit notify log ip audit po max-events 100 ip ssh time-out 120 ip ssh authentication-retries 3 ! crypto isakmp policy 1   hash md5   authentication pre-share crypto isakmp key cisco123 address 172.16.172.21 ! ! crypto ipsec transform-set myset esp-des esp-md5-hmac   mode transport ! crypto map vpn 10 ipsec-isakmp   set peer 172.16.172.21   set transform-set myset   match address 102 ! cns event-service server ! ! ! interface Tunnel0   ip address 50.1.1.1 255.255.255.252   tunnel source FastEthernet0   tunnel destination 172.16.172.21   crypto map vpn ! interface FastEthernet0   ip address 172.16.172.39 255.255.255.240   speed auto   crypto map vpn ! interface Serial0   ip address 10.1.1.2 255.255.255.0   encapsulation ppp</pre>

```

!
ip classless
ip route 0.0.0.0 0.0.0.0 172.16.172.33
ip route 10.1.0.0 255.255.0.0 10.1.1.1
ip route 20.1.0.0 255.255.0.0 Tunnel0
no ip http server
!
access-list 102 permit gre host 172.16.172.39 host 172.16.172.21
!
line con 0
line aux 0
line vty 0 4
    password cisco
    login
!
no scheduler allocate
end

```

### VPN 5002 Concentrator

```

[ General ]
VPNGateway           = 172.16.172.17
EthernetAddress      = 00:05:32:3e:90:40
DeviceType           = VPN 5002/8 Concentrator
ConfiguredOn         = Timeserver not configured
ConfiguredFrom       = Command Line, from Console

[ IKE Policy ]
Protection            = SHA_DES_G1
Protection            = MD5_DES_G2
Protection            = MD5_DES_G1

[ Tunnel Partner VPN 1 ]
KeyLifeSecs          = 3500
KeepaliveInterval    = 120
TunnelType            = GREinIPSec
InactivityTimeout    = 120
Transform             = ESP(MD5,DES)
BindTo                = "Ethernet 1:0"
SharedKey             = "cisco123"
Certificates          = Off
Mode                  = Main
KeyManage             = Reliable
Partner              = 172.16.172.39

[ IP VPN 1 ]
HelloInterval        = 10
SubnetMask            = 255.255.255.252
IPAddress           = 50.1.1.2
DirectedBroadcast    = Off
Numbered              = On
Mode                  = Routed

[ IP Ethernet 1:0 ]
Mode                  = Routed
SubnetMask            = 255.255.255.240
IPBroadcast           = 172.16.172.32
IPAddress           = 172.16.172.21

[ IP Ethernet 0:0 ]
Mode                  = Routed
IPBroadcast           = 20.1.1.255
SubnetMask            = 255.255.255.0
IPAddress             = 20.1.1.1

```

```
[ Logging ]
Level                = Debug
LogToAuxPort        = On
Enabled              = On

[ Ethernet Interface Ethernet 0:0 ]
DUPLEX               = half
SPEED                = 10meg

[ IP Static ]
0.0.0.0 0.0.0.0 20.1.1.5 1
10.1.1.0 255.255.255.0 VPN 1 1
10.1.2.0 255.255.255.0 VPN 1 1
10.1.3.0 255.255.255.0 VPN 1 1

Configuration size is 1696 out of 65500 bytes.
```

## Verify

This section provides information you can use to confirm your configuration is working properly.

Certain **show** commands are supported by the Output Interpreter Tool (registered customers only) , which allows you to view an analysis of **show** command output.

- These commands can be run on the Cisco IOS router.
  - ◆ **show crypto isakmp sa** Shows all current Internet Security Association and Key Management Protocol (ISAKMP) security associations (SAs).
  - ◆ **show crypto ipsec sa** Shows all current IPsec SAs.
  - ◆ **show crypto engine connection active** Shows packet encryption/decryption counter for each IPsec SAs.
- You can run these commands on the VPN 5002 Concentrator.
  - ◆ **show system log buffer** Shows basic syslog information.
  - ◆ **vpn trace dump** Shows detailed information about VPN processes.

## Troubleshoot

This section provides information you can use to troubleshoot your configuration.

### Troubleshooting Commands

**Note:** Before issuing **debug** commands, please see Important Information on Debug Commands.

You can run these commands on the Cisco IOS router.

- **debug crypto isakmp** Shows detailed information about Internet Key Exchange (IKE) phase I (Main Mode) negotiation.
- **debug crypto ipsec** Shows detailed information about IKE phase II (Quick Mode) negotiation.
- **debug crypto engine** Debugs packet encryption/decryption and Diffie–Hellman (DH) process.

## Sample debug Output

Sample debug output for the router and VPN Concentrator is shown here.

- Cisco IOS Router
- VPN 5002 Concentrator

### Debugs on the Cisco IOS Router

Output of **debug crypto isakmp** and **debug crypto ipsec** commands on the router is shown here.

```
5d20h: ISAKMP (0:0): received packet from 172.16.172.21 (N) NEW SA
5d20h: ISAKMP: local port 500, remote port 500
5d20h: ISAKMP (0:81): processing SA payload. message ID = 0
5d20h: ISAKMP (0:81): found peer pre-shared key matching 172.16.172.21
5d20h: ISAKMP (0:81): Checking ISAKMP transform 1 against priority 1 policy
5d20h: ISAKMP: encryption DES-CBC
5d20h: ISAKMP: hash SHA
5d20h: ISAKMP: auth pre-share
5d20h: ISAKMP: default group 1
5d20h: ISAKMP (0:81): atts are not acceptable. Next payload is 3
5d20h: ISAKMP (0:81): Checking ISAKMP transform 2 against priority 1 policy
5d20h: ISAKMP: encryption DES-CBC
5d20h: ISAKMP: hash MD5
5d20h: ISAKMP: auth pre-share
5d20h: ISAKMP: default group 2
5d20h: ISAKMP (0:81): atts are not acceptable. Next payload is 3
5d20h: ISAKMP (0:81): Checking ISAKMP transform 3 against priority 1 policy
5d20h: ISAKMP: encryption DES-CBC
5d20h: ISAKMP: hash MD5
5d20h: ISAKMP: auth pre-share
5d20h: ISAKMP: default group 1
5d20h: ISAKMP (0:81): atts are acceptable. Next payload is 0
5d20h: ISAKMP (0:81): processing vendor id payload
5d20h: ISAKMP (0:81): SA is doing pre-shared key authentication
using id type ID_IPV4_ADDR
5d20h: ISAKMP (0:81): sending packet to 172.16.172.21 (R) MM_SA_SETUP
5d20h: ISAKMP (0:81): received packet from 172.16.172.21 (R) MM_SA_SETUP
5d20h: ISAKMP (0:81): processing KE payload. message ID = 0
5d20h: ISAKMP (0:81): processing NONCE payload. message ID = 0
5d20h: ISAKMP (0:81): found peer pre-shared key matching 172.16.172.21
5d20h: ISAKMP (0:81): SKEYID state generated
5d20h: ISAKMP (0:81): sending packet to 172.16.172.21 (R) MM_KEY_EXCH
5d20h: ISAKMP (0:81): received packet from 172.16.172.21 (R) MM_KEY_EXCH
5d20h: ISAKMP (0:81): processing ID payload. message ID = 0
5d20h: ISAKMP (0:81): processing HASH payload. message ID = 0
5d20h: ISAKMP (0:81): SA has been authenticated with 172.16.172.21
5d20h: ISAKMP (81): ID payload
    next-payload : 8
    type          : 1
    protocol      : 17
    port          : 500
    length        : 8
5d20h: ISAKMP (81): Total payload length: 12
5d20h: ISAKMP (0:81): sending packet to 172.16.172.21 (R) QM_IDLE
5d20h: ISAKMP (0:81): received packet from 172.16.172.21 (R) QM_IDLE
5d20h: ISAKMP (0:81): processing HASH payload. message ID = 241
5d20h: ISAKMP (0:81): processing SA payload. message ID = 241
5d20h: ISAKMP (0:81): Checking IPSec proposal 1
5d20h: ISAKMP: transform 1, ESP_DES
5d20h: ISAKMP: attributes in transform:
5d20h: ISAKMP: SA life type in seconds
5d20h: ISAKMP: SA life duration (VPI) of 0x0 0x0 0xD 0xAC
5d20h: ISAKMP: SA life type in kilobytes
```

```
5d20h: ISAKMP: SA life duration (VPI) of 0x0 0x10 0x0 0x0
5d20h: ISAKMP: encaps is 2
5d20h: ISAKMP: authenticator is HMAC-MD5
5d20h: ISAKMP (0:81): atts are acceptable.
5d20h: IPSEC(validate_proposal_request): proposal part #1,
(key eng. msg.) dest= 172.16.172.39, src= 172.16.172.21,
dest_proxy= 172.16.172.39/255.255.255.255/47/0 (type=1),
src_proxy= 172.16.172.21/255.255.255.255/47/0 (type=1),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 0s and 0kb,
spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x0
5d20h: ISAKMP (0:81): processing NONCE payload. message ID = 241
5d20h: ISAKMP (0:81): processing ID payload. message ID = 241
5d20h: ISAKMP (81): ID_IPV4_ADDR src 172.16.172.21 prot 47 port 0
5d20h: ISAKMP (0:81): processing ID payload. message ID = 241
5d20h: ISAKMP (81): ID_IPV4_ADDR dst 172.16.172.39 prot 47 port 0
5d20h: ISAKMP (0:81): asking for 1 spis from ipsec
5d20h: IPSEC(key_engine): got a queue event...
5d20h: IPSEC(spi_response): getting spi 895566248 for SA
from 172.16.172.21 to 172.16.172.39 for prot 3
5d20h: ISAKMP: received ke message (2/1)
5d20h: ISAKMP (0:81): sending packet to 172.16.172.21 (R) QM_IDLE
5d20h: ISAKMP (0:81): received packet from 172.16.172.21 (R) QM_IDLE
5d20h: ISAKMP (0:81): Creating IPsec SAs
5d20h: inbound SA from 172.16.172.21 to 172.16.172.39
(proxy 172.16.172.21 to 172.16.172.39)
5d20h: has spi 0x356141A8 and conn_id 362 and flags 0
5d20h: lifetime of 3500 seconds
5d20h: lifetime of 1048576 kilobytes
5d20h: outbound SA from 172.16.172.39 to 172.16.172.21
(proxy 172.16.172.39 to 172.16.172.21 )
5d20h: has spi 337 and conn_id 363 and flags 0
5d20h: lifetime of 3500 seconds
5d20h: lifetime of 1048576 kilobytes
5d20h: ISAKMP (0:81): deleting node 241 error FALSE reason
"quick mode done (await())"
5d20h: IPSEC(key_engine): got a queue event...
5d20h: IPSEC(initialize_sas): ,
(key eng. msg.) dest= 172.16.172.39, src= 172.16.172.21,
dest_proxy= 172.16.172.39/0.0.0.0/47/0 (type=1),
src_proxy= 172.16.172.21/0.0.0.0/47/0 (type=1),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3500s and 1048576kb,
spi= 0x356141A8(895566248), conn_id= 362, keysize= 0, flags= 0x0
5d20h: IPSEC(initialize_sas): ,
(key eng. msg.) src= 172.16.172.39, dest= 172.16.172.21,
src_proxy= 172.16.172.39/0.0.0.0/47/0 (type=1),
dest_proxy= 172.16.172.21/0.0.0.0/47/0 (type=1),
protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3500s and 1048576kb,
spi= 0x151(337), conn_id= 363, keysize= 0, flags= 0x0
5d20h: IPSEC(create_sa): sa created,
(sa) sa_dest= 172.16.172.39, sa_prot= 50,
sa_spi= 0x356141A8(895566248),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 362
5d20h: IPSEC(create_sa): sa created,
(sa) sa_dest= 172.16.172.21, sa_prot= 50,
sa_spi= 0x151(337),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 363
5d20h: IPSEC(add_sa): peer asks for new SAs -- expire current in 120 sec.,
(sa) sa_dest= 172.16.172.21, sa_prot= 50,
sa_spi= 0x150(336),
sa_trans= esp-des esp-md5-hmac , sa_conn_id= 361,
(identity) local= 172.16.172.39, remote= 172.16.172.21,
local_proxy= 172.16.172.39/255.255.255.255/47/0 (type=1),
remote_proxy= 172.16.172.21/255.255.255.255/47/0 (type=1)
```

1720-1#

1720-1#show crypto isakmp sa

dst	src	state	conn-id	slot
172.16.172.39	172.16.172.21	QM_IDLE	81	0

1720-1#show crypto ipsec sa

interface: FastEthernet0

Crypto map tag: vpn, local addr. 172.16.172.39

local ident (addr/mask/prot/port): (172.16.172.39/255.255.255.255/0/0)

remote ident (addr/mask/prot/port): (172.16.172.21/255.255.255.255/0/0)

current\_peer: 172.16.172.21

PERMIT, flags={transport\_parent,}

#pkts encaps: 0, #pkts encrypt: 0, #pkts digest 0

#pkts decaps: 0, #pkts decrypt: 0, #pkts verify 0

#pkts compressed: 0, #pkts decompressed: 0

#pkts not compressed: 0, #pkts compr. failed: 0,

#pkts decompress failed: 0, #send errors 0, #recv errors 0

local crypto endpt.: 172.16.172.39, remote crypto endpt.: 172.16.172.21

path mtu 1514, media mtu 1514

current outbound spi: 0

inbound esp sas:

inbound ah sas:

inbound pcp sas:

outbound esp sas:

outbound ah sas:

outbound pcp sas:

local ident (addr/mask/prot/port): (172.16.172.39/255.255.255.255/47/0)

remote ident (addr/mask/prot/port): (172.16.172.21/255.255.255.255/47/0)

current\_peer: 172.16.172.21

PERMIT, flags={origin\_is\_acl,transport\_parent,parent\_is\_transport,}

#pkts encaps: 34901, #pkts encrypt: 34901, #pkts digest 34901

#pkts decaps: 34900, #pkts decrypt: 34900, #pkts verify 34900

#pkts compressed: 0, #pkts decompressed: 0

#pkts not compressed: 0, #pkts compr. failed: 0,

#pkts decompress failed: 0, #send errors 0, #recv errors 0

local crypto endpt.: 172.16.172.39, remote crypto endpt.: 172.16.172.21

path mtu 1500, media mtu 1500

current outbound spi: 151

inbound esp sas:

spi: 0x356141A8(895566248)

transform: esp-des esp-md5-hmac ,

in use settings = {Transport, }

slot: 0, conn id: 362, flow\_id: 163, crypto map: vpn

sa timing: remaining key lifetime (k/sec): (1046258/3306)

IV size: 8 bytes

replay detection support: Y

inbound ah sas:

inbound pcp sas:

outbound esp sas:

spi: 0x151(337)



```
transform: esp-des esp-md5-hmac ,
in use settings ={Transport, }
slot: 0, conn id: 363, flow_id: 164, crypto map: vpn
sa timing: remaining key lifetime (k/sec): (1046258/3306)
IV size: 8 bytes
replay detection support: Y
```

outbound ah sas:

outbound pcp sas:

interface: Tunnel0

Crypto map tag: vpn, local addr. 172.16.172.39

local ident (addr/mask/prot/port): (172.16.172.39/255.255.255.255/0/0)

remote ident (addr/mask/prot/port): (172.16.172.21/255.255.255.255/0/0)

current\_peer: 172.16.172.21

```
PERMIT, flags={transport_parent,}
#pkts encaps: 0, #pkts encrypt: 0, #pkts digest 0
#pkts decaps: 0, #pkts decrypt: 0, #pkts verify 0
#pkts compressed: 0, #pkts decompressed: 0
#pkts not compressed: 0, #pkts compr. failed: 0,
#pkts decompress failed: 0, #send errors 0, #recv errors 0
```

local crypto endpt.: 172.16.172.39, remote crypto endpt.: 172.16.172.21

path mtu 1514, media mtu 1514

current outbound spi: 0

inbound esp sas:

inbound ah sas:

inbound pcp sas:

outbound esp sas:

outbound ah sas:

outbound pcp sas:

local ident (addr/mask/prot/port): (172.16.172.39/255.255.255.255/47/0)

remote ident (addr/mask/prot/port): (172.16.172.21/255.255.255.255/47/0)

current\_peer: 172.16.172.21

```
PERMIT, flags={origin_is_acl,transport_parent,parent_is_transport,}
#pkts encaps: 35657, #pkts encrypt: 35657, #pkts digest 35657
#pkts decaps: 35656, #pkts decrypt: 35656, #pkts verify 35656
#pkts compressed: 0, #pkts decompressed: 0
#pkts not compressed: 0, #pkts compr. failed: 0,
#pkts decompress failed: 0, #send errors 0, #recv errors 0
```

local crypto endpt.: 172.16.172.39, remote crypto endpt.: 172.16.172.21

path mtu 1500, media mtu 1500

current outbound spi: 151

inbound esp sas:

spi: 0x356141A8(895566248)

```
transform: esp-des esp-md5-hmac ,
in use settings ={Transport, }
slot: 0, conn id: 362, flow_id: 163, crypto map: vpn
sa timing: remaining key lifetime (k/sec): (1046154/3302)
IV size: 8 bytes
replay detection support: Y
```

```

inbound ah sas:

inbound pcg sas:

outbound esp sas:
  spi: 0x151(337)
  transform: esp-des esp-md5-hmac ,
  in use settings ={Transport, }
  slot: 0, conn id: 363, flow_id: 164, crypto map: vpn
  sa timing: remaining key lifetime (k/sec): (1046154/3302)
  IV size: 8 bytes
  replay detection support: Y

outbound ah sas:

outbound pcg sas:

```

1720-1#**show crypto engine connections active**

ID	Interface	IP-Address	State	Algorithm	Encrypt	Decrypt
81	FastEthernet0	172.16.172.39	set	HMAC_MD5+DES_56_CB	0	0
362	FastEthernet0	172.16.172.39	set	HMAC_MD5+DES_56_CB	0	23194
363	FastEthernet0	172.16.172.39	set	HMAC_MD5+DES_56_CB	23195	0

## Debugs on the VPN 5002 Concentrator

Syslog output on the VPN Concentrator is shown here.

```

VPN5002_8_323E9040: Main# VPN 0:1 opened for 172.16.172.39 from 172.16.172.39.
User assigned IP address 50.1.1.2

```

VPN5002\_8\_323E9040: Main#**show vpn partner verbose**

Port Number	Partner Address	Partner Port	Default Partner	Bindto Address	Connect Time
VPN 0:1	172.16.172.39	500	No	172.16.172.21	00:00:13:26

```

Auth/Encrypt: MD5e/DES User Auth: Shared Key
Access: Static Peer: 172.16.172.39 Local: 172.16.172.21
Start:14518 seconds Managed:15299 seconds State:imnt_maintenance

```

```

IOP slot 1:
No active connections found.

```

VPN5002\_8\_323E9040: Main#**show vpn statistics verbose**

	Current Active	In Negot	High Water	Running Total	Script Starts	Script OK	Script Error
Users	0	0	0	0	0	0	0
Partners	1	0	1	81	81	1	158
Total	1	0	1	81	81	1	158

```

Stats VPN0:1
Wrapped 79733
Unwrapped 79734
BadEncap 0
BadAuth 0
BadEncrypt 0
rx IP 79749
rx IPX 0

```

```

rx Other          0
tx IP             79761
tx IPX            0
tx Other          0
IKE rekey         0

```

Input VPN pkts dropped due to no SA: 0

Input VPN pkts dropped due to no free queue entries: 0

IOP slot 1:

	Current Active	In Negot	High Water	Running Total	Script Starts	Script OK	Script Error
Users	0	0	0	0	0	0	0
Partners	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0

```

Stats
  Wrapped
  Unwrapped
  BadEncap
  BadAuth
  BadEncrypt
  rx IP
  rx IPX
  rx Other
  tx IP
  tx IPX
  tx Other
  IKE rekey

```

Input VPN pkts dropped due to no SA: 0

Input VPN pkts dropped due to no free queue entries: 0

## Misconfiguration of Tunnel Mode

The VPN 5000 Concentrator proposes transport mode by default when GRE over IPSec is used. When the Cisco IOS router is misconfigured for tunnel mode, then this errors occur.

Debug output on the Cisco IOS router is shown here.

```

2d21h: ISAKMP (0:23): Checking IPSec proposal 1
2d21h: ISAKMP: transform 1, ESP_DES
2d21h: ISAKMP: attributes in transform:
2d21h: ISAKMP: SA life type in seconds
2d21h: ISAKMP: SA life duration (VPI) of 0x0 0x1 0x51 0x80
2d21h: ISAKMP: SA life type in kilobytes
2d21h: ISAKMP: SA life duration (VPI) of 0x0 0x10 0x0 0x0
2d21h: ISAKMP: encaps is 2
2d21h: ISAKMP: authenticator is HMAC-MD5
2d21h: IPSEC(validate_proposal): invalid transform proposal flags -- 0x0

```

The log on the VPN 5002 Concentrator shows an entry similar to this output.

```

lan-lan-VPN0:1:[172.16.172.39]: received notify from partner --
notify: NO PROPOSAL CHOSEN

```

## Related Information

- [Cisco VPN 5000 Series Concentrators End-of-Sales Announcement](#)
  - [Cisco VPN 5000 Concentrator Support Page](#)
  - [Cisco VPN 5000 Client Support Page](#)
  - [IPSec Support Page](#)
  - [Technical Support – Cisco Systems](#)
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