AlliedWare$^{\text{TM}}$ OS

How To | Troubleshoot a Virtual Private Network (VPN)

This How To Note describes how to test and troubleshoot an IPsec configuration, using the CLI and the GUI.

What information will you find in this document?

This How To Note contains the following information:

Related How To Notes

Allied Telesis offers How To Notes with a wide range of VPN solutions, from quick and simple solutions for connecting home and remote offices, to advanced multi-feature setups. Notes also describe how to create a VPN between an Allied Telesis router and equipment from a number of other vendors.

For a complete list of VPN How To Notes, see the *Overview of VPN Solutions in How To Notes* in the How To Library at www.alliedtelesis.com/resources/literature/howto.aspx.

Which products and software versions does it apply to?

IPsec is available on the following routers and switches:

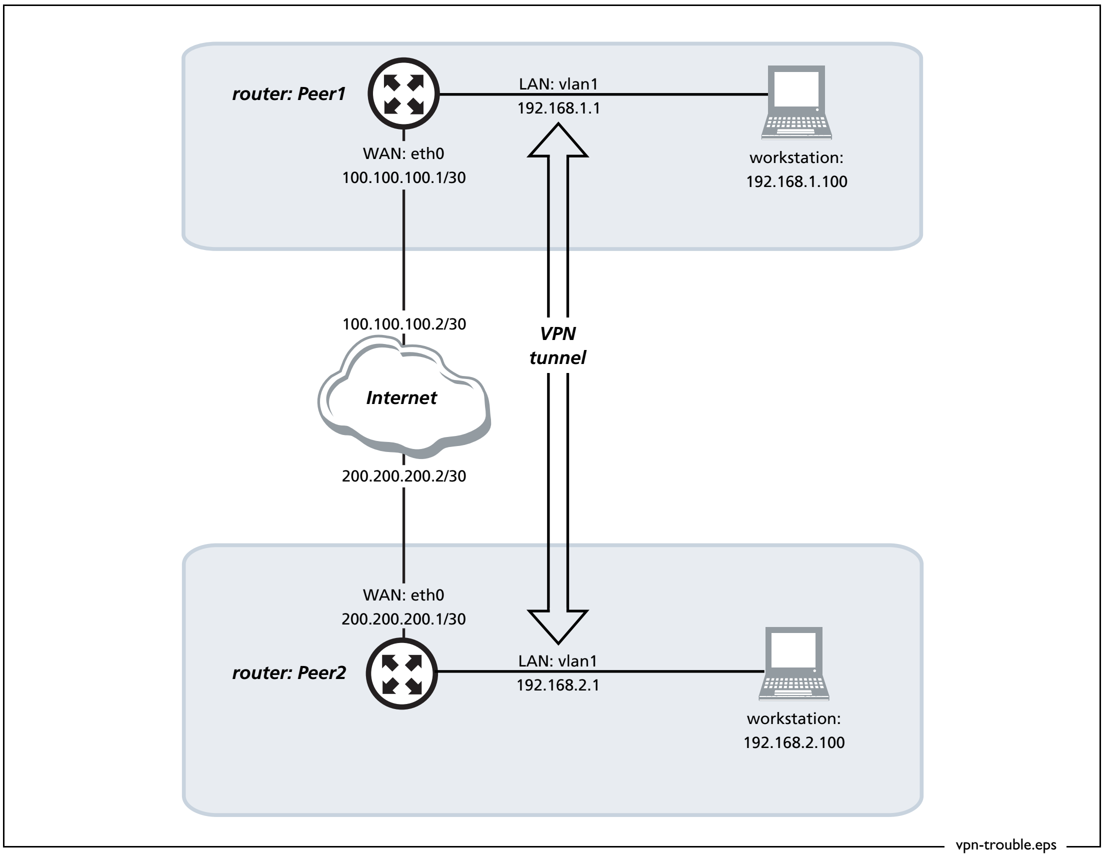
- AR400 Series routers
- AR700 Series routers
- Rapier i Series switches
- AT-8800 Series switches

Most of the troubleshooting tips apply to all Software Versions that support the above products, except for the following features that are available on Software Version 2.9.1 or later:

- VPN Wizards within the GUI, which simplify VPN configuration. These are available on AR415S and AR44xS routers.
- the command **show debug ipsec**

An example network

In this How To Note, we illustrate some (though not all) of the troubleshooting steps with examples from the network shown in the following diagram. While this network is simple, the troubleshooting tips apply to more complex configurations too.



How to test a tunnel

Check the LANs are reachable

The simplest way to test a tunnel is to ping from one LAN to the other.

From a PC attached to one peer, ping a PC attached to the other peer.

For example, consider the network shown in the figure on " An example network" on page 3. If the PC attached to Peer2 has an address of 192.168.2.100, you can test the tunnel by using the following command at the command prompt on the PC attached to Peer1:

```
ping 192.168.2.100
```

If a Microsoft Windows PC's IP address was assigned dynamically, you can find out what it is by using the following command at the command prompt:

```
ipconfig
```

Check traffic goes through the VPN

To tell if traffic passes through the tunnel, perform a traceroute from one LAN to the other—so from a PC attached to one peer, perform a traceroute to a PC attached to the other peer.

For example, if the PC attached to Peer2 has an address of 192.168.2.100, that means using the following command at the command prompt on the (Windows) PC attached to Peer1:

```
tracert 192.168.2.100
```

If traffic goes through the tunnel, the traceroute may display IP addresses from one or both peers' private networks and public interfaces. If it shows other public IP addresses, then traffic is not passing through the tunnel.

Check counters

Another way to be certain that the router is encrypting traffic and sending it over the tunnel is to use the IPsec counter command, as follows:

1. Log into the router's CLI as described in your Installation and Safety Guide, or if you are using the GUI, select Diagnostics, then Command Line.
2. Enter the command:

   ```
   show ipsec policy=<name> counters
   ```

   where <*name*> is the name of an encrypting policy (a policy with **action=ipsec**).

   Note the current values of the outProcessDone counter (in the Outbound Packet Processing Counters section) and the inProcessDone counter (in the Inbound Packet Processing Counters section).
3. From a PC attached to one peer, ping a PC attached to the other peer. Note that you have to ping from a PC, not from the GUI—the GUI Command Line page does not display the ping response.
4. Enter the command **show ipsec policy counters** again. The outProcessDone counter should have incremented once for each ping packet sent, and the inProcessDone counter should have incremented once for each echo reply.
5. Take note if any error counters increment. They may indicate the cause of any problems.

How to troubleshoot a tunnel

This section gives some troubleshooting tasks that you can use to work out why a tunnel is not working. The tips are divided into the following categories:

- "1. Check the WAN to WAN connectivity" on page 6
- "2. Confirm VPN establishment" on page 7
- "3. Check debugging information" on page 11
- "4. Check the router configuration" on page 13
- "5. Fix and prevent SA out-of-step problems" on page 17
- "6. Check Microsoft Windows XP SP2 client configuration" on page 17
- "7. Reset ISAKMP and IPsec" on page 18

Note: If you created the VPN through a VPN wizard on the GUI, edit it by re-running the wizard. The wizards give you the option of editing an existing tunnel instead of creating a new one.

You need to log in as a security officer to use most security commands. If you set up the VPN by following the instructions in a How To Note, the security officer is probably called "secoff".

Security timeout

By default, the router requires security officers to re-enter their password after 60 seconds of idle time on the CLI. You may find that this is too short. If so, you can increase it by logging into the CLI and entering the command:

```
set user securedelay=seconds
```

1. Check the WAN to WAN connectivity

Before your VPN can work, you obviously need connectivity between the WANs on each peer router. This step describes how to test this.

To check that the IPsec peers can connect through the intermediary network or Internet, perform a ping or traceroute from one peer router to the other peer's public interface. Note that this is not a payload (LAN to LAN) check.

Note that both ping and traceroute may not work if you have a firewall enabled on either peer. Firewalls are more likely to allow pings, so start with ping. If you suspect that the firewall is blocking pings, move to "2. Confirm VPN establishment" on page 7—those tests are not affected by the firewall.

To perform a ping or traceroute on an Allied Telesis router peer, log into the router's command line interface (CLI), as described in your Installation and Safety Guide. Then enter the commands:

```
ping destination-ipadd

trace destination-ipadd
```

For the example in the figure on page 3, to ping from Peer1 to the public interface of Peer2, enter the following command on Peer1:

```
ping 200.200.200.1
```

To send a traceroute from Peer1 to the public interface of Peer2, enter the following command on Peer1:

```
trace 200.200.200.1
```

Note that:

- this step does not attempt to send the ping or traceroute packets through the (non-working) VPN tunnel. It sends them directly through the Internet to check whether the error is in the underlying IP connection instead of the tunnel configuration.
- you cannot use the GUI to perform a ping or traceroute (even on the Diagnostics > Command Line page).

2. Confirm VPN establishment

VPNs are made up of ISAKMP and IPsec SAs. This step checks how far the ISAKMP and IPsec processing has progressed, and whether the SAs have established. This may tell you the cause of a failing VPN. This section describes how to check whether:

- the two phases of ISAKMP negotiation were successful, and if not, at what stage the process failed
- ISAKMP SAs were created
- IPsec SAs were created
- IPsec SAs are staying up

▶ Check ISAKMP log entries

To check ISAKMP log entries, either:

- log into the CLI and enter the following command:

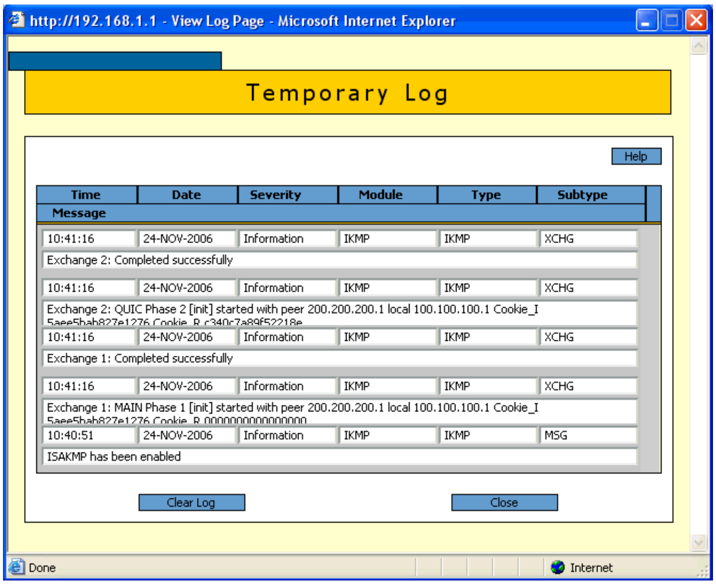
```
show log module=isakmp
```

- log into the GUI and from the left-hand menu, select Monitoring, then Log, then View. Select Filters and Module: ISAKMP, then click the View Log button.

A successfully-established tunnel will have entries for successful Phase 1 and Phase 2 negotiations. If the phases are not completing, look for log messages that indicate the cause of failure, and that indicate the step at which the process fails.

Successful tunnel

The following screenshot gives an example of the log messages produced when the router initiated a VPN.


http://192.168.1.1 - View Log Page - Microsoft Internet Explorer
Temporary Log
Help
Clear Log
Close
Done
Internet

Time	Date	Severity	Module	Type	Subtype
Message					
10:41:16	24-NOV-2006	Information	IKMP	IKMP	XCHG
Exchange 2: Completed successfully					
10:41:16	24-NOV-2006	Information	IKMP	IKMP	XCHG
Exchange 2: QUIC Phase 2 [init] started with peer 200.200.200.1 local 100.100.100.1 Cookie_I 5aee5bab827e1276 Cookie_R c340c7a89f52218e					
10:41:16	24-NOV-2006	Information	IKMP	IKMP	XCHG
Exchange 1: Completed successfully					
10:41:16	24-NOV-2006	Information	IKMP	IKMP	XCHG
Exchange 1: MAIN Phase 1 [init] started with peer 200.200.200.1 local 100.100.100.1 Cookie_I 5aee5bab827e1276 Cookie_R 0000000000000000					
10:40:51	24-NOV-2006	Information	IKMP	IKMP	MSG
ISAKMP has been enabled					

▶ Check IPsec log entries

To check IPsec log entries, either:

- log into the CLI and enter the following command:

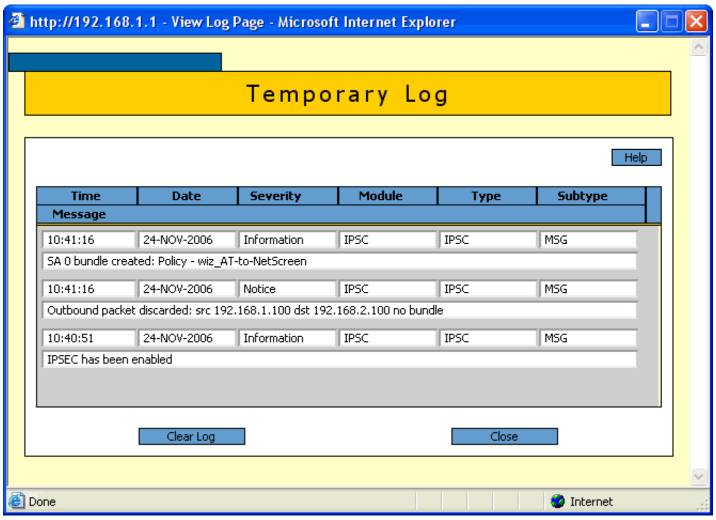
```
show log module=ipsec
```

- log into the GUI and from the left-hand menu, select Monitoring, then Log, then View. Select Filters and Module: IPSEC, then click the View Log button.

Successful tunnel

With successfully-established tunnels, an entry says that the IPsec SA bundle has been created.

The following screenshot shows the log messages produced when the router initiated a VPN.


http://192.168.1.1 - View Log Page - Microsoft Internet Explorer
Temporary Log
Help
Clear Log
Close
Done
Internet

Time	Date	Severity	Module	Type	Subtype
Message					
10:41:16	24-NOV-2006	Information	IPSC	IPSC	MSG
SA 0 bundle created: Policy - wiz_AT-to-NetScreen					
10:41:16	24-NOV-2006	Notice	IPSC	IPSC	MSG
Outbound packet discarded: src 192.168.1.100 dst 192.168.2.100 no bundle					
10:40:51	24-NOV-2006	Information	IPSC	IPSC	MSG
IPSEC has been enabled					

▶ Check for ISAKMP SAs and the ISAKMP exchange

Check whether each router successfully opens ISAKMP SAs. If they do, this indicates that ISAKMP negotiation has succeeded. On each router, log into its CLI and enter the following command:

```
show isakmp sa
```

Successful tunnel

The following figure shows an established ISAKMP SA.

```
SecOff Peer1> show isakmp sa

                                    Expiry Limits - hard/soft/used
SA Id PeerAddress     EncA.  HashA. Bytes                 Seconds
------------------------------------------------------------------------
1     200.200.200.1   3DES   SHA    -/-/-                 86400/82080/970
```

Unsuccessful tunnel

The following figure shows an ISAKMP SA that has not properly established—it is only in the preparation stage. The encryption and hash algorithms are not set, and the expiry limits are all 0.

```
SecOff Peer1> show isakmp sa

                                    Expiry Limits - hard/soft/used
SA Id PeerAddress     EncA.  HashA. Bytes                 Seconds
------------------------------------------------------------------------
1     200.200.200.1    -      -     0/0/0                 0/0/0
```

If the SA is not establishing, you can get more information by checking the ISAKMP exchange process, to see how far through the process the peers get before failing. Enter the following command:

```
show isakmp exchange
```

In this example, **show isakmp exchange** shows that negotiation stalled at the Phase 1 SASENT stage.

```
SecOff Peer1> show isakmp exch
ISAKMP Exchanges

   Id  Phase  State       PeerAddress                                 Type
  ----------------------------------------------------------------------
  348      1  SASENT      200.200.200.1                               MAIN
```

If ISAKMP negotiation is stalled, check that your ISAKMP policy configuration settings match those on the peer.

If the output of **show isakmp exchange** shows nothing, this either means that negotiation has not started, or that it has started and has successfully set up the ISAKMP SA. Use **show isakmp sa** to check whether it has set up the SA.

If an SA is open, you can see details about it by using the command:

```
show isakmp sa=sa-id
```

▶ Check for IPsec SAs

Check whether each router successfully opens IPsec SAs. On each router, log into its CLI and enter the following command:

```
show ipsec sa
```

If ISAKMP Phase 2 negotiations occurred successfully, then the IPsec SAs will have been established. If you saw an ISAKMP SA in the previous debugging step, but do not see an IPsec SA, this could mean that:

- ISAKMP was unable to successfully negotiate an IPsec SA (Phase 2 negotiations failed). If this happens, check that your IPsec policy configuration settings match those on the peer. The issue could also indicate some other incompatibility between the peers.
- the IPsec SA was established but was removed quickly. This could be because of a mismatch in heartbeat or dead peer detection settings.

Successful tunnel

The following figure shows an example of the IPsec SA for a successfully-established VPN.

```
SecOff Peer1> show ipsec sa

SA Id  Policy              Bundle  State    Protocol    OutSPI      InSPI
-------------------------------------------------------------------------
    0 wiz_Peer1 to Peer2        0 Valid     ESP    1612248718   992095719
```

The following figure shows the matching SA on the remote peer.

```
SecOff Peer2> show ipsec sa

SA Id  Policy              Bundle  State    Protocol    OutSPI      InSPI
-------------------------------------------------------------------------
    3 wiz_Peer1 to Peer2        0 Valid     ESP     992095719  1612248718
```

If an SA is open, you can see details about it by using the command:

```
show ipsec sa=sa-id
```

3. Check debugging information

This section describes how to collect:

- debugging messages, which the router outputs at each step of ISAKMP processing
- output of all commands that are relevant for VPNs.

▶ Use ISAKMP debugging

ISAKMP debuggings lets you examine the ISAKMP processes for information about the point of failure.

On each router, log into its CLI and enter the following command:

```
enable isakmp debug
```

As ISAKMP processes occur, information about them is displayed onscreen. Look for messages that indicate:

- which peer fails to respond, and why it did not respond
- phase 1 completion and phase 2 completion. If the phases are not completing, note the step at which a router fails to get a response from the peer, and why.

For even more detailed output, use the command:

```
enable isakmp debug=all
```

If the debugging output indicates a problem but you cannot clearly determine the order of events, it may be helpful to reset ISAKMP and IPsec on each router before debugging. This makes sure that you see the debugging from a clean start. See "7. Reset ISAKMP and IPsec" on page 18 for instructions.

For examples of ISAKMP debugging output from functional VPNs, see the How To Note *How To Create Concurrent VPNs with Remote Routers, Microsoft Windows Vista Clients and XP Clients, over NAT-T.*

If necessary, contact your Allied Telesis representative for help with interpreting this information. If sending debugging output to your representative, please use **enable isakmp debug=all**.

To stop the debug display, enter one of the following commands:

```
disable isakmp debug
disable isakmp debug=all
```

▶ Check IPsec and all related settings

With software version 2.9.1 and later, you can run a single command (**show debug ipsec**) that captures the output of all the **show** commands that are relevant when debugging VPN tunnels. The output from this command may show you the source of the problem, especially if you are a more experienced user. However, it is most likely to be useful if you need to send debugging information to your Allied Telesis representative. The following table shows the list of commands that this command runs.

	Commands that run when you enter the command show debug ipsec
‡	show system (with current config file)
	show file
	show install
‡	show feature
	show release
‡	show config dynamic
	show buffer scan
	show cpu
	show log
	show exception
	show ipsec policy sabundle
§	show ipsec sa=*sa*
	show ipsec sa counters
	show ipsec counters
¶	show ipsec policy=*policy* counters
	show enco
	show enco channel
†	show enco channel=*channel*
†	show enco channel=*channel* counters
	show enco counters
	show isakmp sa
	show isakmp exchange
	show isakmp exchange detail
	show isakmp sa detail
	show isakmp counters
	show ffile check

‡ When the router is in security mode, this command produces output only when the user has security officer privilege.

§ Selects all current IPsec SAs.

¶ Selects all IPsec policies configured with **action=ipsec**.

† Selects all ENCO channels in use.

This command produces a lot of output, so you need to save the output for analysis. To do this, log into each router's CLI and do one of the following:

- set the router to run the command and save the output on your PC, by turning on logging in your terminal emulator and then entering the command:

  ```
  show debug ipsec
  ```

- set the router to run the command and save the output in a text file on the router, by entering the command:

  ```
  create file=ipsec.txt command="show debug ipsec"
  ```

4. Check the router configuration

Once the previous steps have indicated where the VPN is failing, you should check your configuration. This section lists a number of common configuration issues that may cause VPNs to fail.

▶ Check the address settings

Check that you have used the correct IP addresses and masks in the IPsec policy settings on each peer.

In particular, check that you have not swapped local and remote settings. For example, the local address at one end should be the remote address at the other end. To check this, log into the CLI and use the command:

```
show config dynam=ipsec
```

▶ Check that the remote and local LAN IP addresses are different

You can only create VPNs between LANs that have different subnet addresses. This can be an issue for roaming clients, who may try to connect from a remote network that (by coincidence) has the same subnet address as the local LAN. This is especially likely if you are using a very common private subnet such as 192.168.1.0.

Therefore, if a roaming VPN client cannot access your local LAN, check that the remote LAN uses a different IP subnet to the local LAN.

You can reduce the probability of this issue by choosing a relatively unusual addressing scheme for your local LAN.

Make sure the local address is the default

Check the router's "local" IP address—the address set by using the command **set ip local**. If this has been changed from the default of "Not set", this may invalidate ISAKMP negotiation. To check what the local address is set to, log into the CLI and use the command:

```
show ip interface
```

The IP Address and Mask entries for the interface LOCAL should say "Not set", as shown in bold in the following figure.

```
Interface      Type      IP Address        Bc Fr  PArp   Filt RIP Met.   SAMode   IPSc
Pri. Filt      Pol.Filt  Network Mask      MTU    VJC    GRE  OSPF Met.  DBcast   Mul.
GArp VLAN Tag  VLAN Pri  InvArp
--------------------------------------------------------------------------------
LOCAL          ---       Not set           -  -   -      ---  --         Pass     --
---            ---       Not set           1500   -      ---  --         ---      ---
On   none      none      -
.
.
.
--------------------------------------------------------------------------------
```

To reset the local address to the default of "Not set", use the command:

```
set ip local ip=0.0.0.0
```

Check the encryption settings

Check that both routers use the same encryption settings, including the encryption type, key type (such as preshared key) and key value. If you used a VPN wizard, check that the routers use compatible settings on the Advanced page of the wizard. If you used the CLI, use the commands:

```
show config dynam=ipsec
```

```
show config dynam=isakmp
```

Check that the encryption key has the expected value. To check the key, list the current keys by logging into the CLI and entering the following command:

```
show enco key
```

For pre-shared keys, use the output of **show enco key** to work out the key ID of the key that you are interested in. Then display that key's value by entering the following command:

```
show enco key=key-id
```

Pre-shared keys must have the same value on each peer.

▶ Check details of the configuration

Check the configuration in detail, by logging into the CLI and entering the following command:

```
show config dynamic
```

In particular, check the ISAKMP, IPsec and firewall sections. You can display these sections one at a time by using the commands:

```
show config dynamic=ipsec
show config dynamic=isakmp
show config dynamic=firewall
```

If you followed an example from a How To Note, that Note may list the commands for the full router configuration. If so, compare your configuration with the example's configuration.

▶ Check that NAT-T is enabled

If you are using NAT-T, it needs to be enabled. To check this, log into the CLI and enter the following command:

```
show config dynamic=isakmp
```

and check that the ISAKMP policy includes the parameter **natt=true**.

▶ Check the firewall rules

Make sure that the firewall is allowing the traffic it needs to allow.

To check the firewall configuration, log into the CLI and enter one or both of the following commands:

```
show firewall policy=name
show config dynamic=firewall
```

In particular:

- check that all interfaces are attached to the firewall and have been appropriately set as private or public interfaces
- check that a rule exists to allow traffic to UDP port 500 on the public interface
- if NAT-T is used, check that a rule exists to allow traffic to UDP port 4500 on the public interface

- for site-to-site VPNs, check that a pair of rules exist to allow the VPN traffic to pass. These rules must achieve the following effect:
  - on the public interface, allow decrypted VPN traffic to pass through the firewall. This rule uses the parameters **action=nonat** or **allow**, and **encapsulation=ipsec**
  - on the private interface, allow packets to pass through the firewall if they are from the private LAN and should go through the VPN to the remote private LAN. This rule uses the parameters **action=nonat** or **allow**, and selects traffic using **ip=*local-lan-address-range*** and **remoteip=*remote-lan-address-range***

  Use **action=nonat** if the firewall has a NAT relationship defined between the interfaces that the VPN will traverse. Use **action=allow** if the firewall does not use NAT between these interfaces.
- for roaming clients, check that a rule exists on the public interface to allow the L2TP/VPN traffic to pass through the firewall. This rule for L2TP needs to use the parameters **action=nonat** or **allow**, and to select traffic using **gblport=1701** and **encapsulation=ipsec**
- check that the rule order achieves the effect you want. The firewall performs the action of the first rule that matches a packet.

▶ Check the IPsec policies

If you want users on the LAN to use the Internet without going through the VPN tunnel, check that an IPsec policy for this exists on the public interface. For example, the policy could use the following command if eth0 is the public interface:

```
create ipsec pol=internet int=eth0 ac=permit
```

The policy needs to allow all traffic and must come last in the list of IPsec policies.

5. Fix and prevent SA out-of-step problems

SA out-of-step occurs when one IPsec peer believes an IPsec SA is still up and sends data down it, while the other IPsec peer has removed the same SA. This can occur after a power cut, or after a dial-up modem has dropped off.

Fix If the SAs are out of step, you can recover by disabling and re-enabling ISAKMP and IPsec on each peer, as described in "7. Reset ISAKMP and IPsec" on page 18.

You should also look at the following suggestions to prevent the problem from recurring.

Prevent You can prevent SAs from getting out of step by using one of the following options, depending on the type of peer:

- ISAKMP heartbeats—use these whenever both peers are Allied Telesis routers or managed layer 3 switches
- PPP over L2TP echo request monitoring—use this with Windows VPN clients

The following options may also help prevent SA out-of-step problems and apply to a wider range of peers:

- **senddeletes=true** in the ISAKMP policy. When the router deletes SAs, this ensures that it sends Delete notifications to the peer. When the peer receives a Delete notification, it deletes the applicable SA.

  You can use this option for all VPN types. However, peers cannot send Delete notifications if a power cut occurs.
- **respondbadspi=true** in the IPsec policy and **sendnotify=true** in the ISAKMP policy. When the SAs are out of step, the router may receive ESP packets with unknown Security Parameter Index (SPI) values. When the router detects an unknown SPI, these settings force the router and the peer to renegotiate the tunnel.

  You can use this option with site-to-site VPNs that use main mode, when both peers have fixed IP addresses. This option does not work in aggressive mode.

For more information about SA issues, see " What to do if the remote VPN peer sets up multiple ISAKMP SAs when responding to your router" on page 22.

6. Check Microsoft Windows XP SP2 client configuration

If your router is behind a NAT gateway and accepts incoming connections (is a VPN responder) then you may need to modify VPN clients that run Windows XP Service Pack 2. Service Pack 2 introduced a change that restricts NAT gateways at the responder end.

For more information, see the Microsoft Knowledge Base article *The default behavior of IPsec NAT traversal (NAT-T) is changed in Windows XP Service Pack 2* at: support.microsoft.com/default.aspx?kbid=885407.

7. Reset ISAKMP and IPsec

Unless it will interrupt other functioning VPNs, you can reset ISAKMP and IPsec by disabling and re-enabling them on each router. You may want to leave this step until after you have used the previous steps to try and find the cause of the problem, so you can fix it and prevent a recurrence.

Resetting IPsec fixes some problems by forcing the peers to renegotiate the VPN. It also means you can start checking log messages and debug output (see earlier steps) from the beginning of negotiations.

To disable IPsec and ISAKMP, log into the router's CLI and use the following commands (in this order):

```
disable ipsec
disable isakmp
```

To re-enable ISAKMP and IPsec, use the following commands (in this order):

```
enable isakmp
enable ipsec
```

If possible, re-enable IPsec at the same time on each router.

How to make the router select the right ISAKMP policy during incoming Phase 1 ISAKMP proposals

VPN users sometimes experience policy selection issues when using more complicated IPsec configurations. Typically these occur for configurations that use multiple ISAKMP policies with “any” or “dynamic” peer address. For example, this situation occurs in *How To Configure VPNs In A Corporate Network, With Optional Prioritisation of VoIP*, and this section describes the solution used in that How To Note.

Here is a configuration example where the wrong policy could be selected:

```
create isakmp policy=isakmp peer=any key=1 mode=main natt=true
  encalg=3desouter

set isakmp policy=isakmp localid=example1 remoteid=ARRouter

set isakmp policy=isakmp sendn=true sendd=true

set isakmp policy=isakmp heart=both


create isakmp policy=isakmp2 peer=any key=2 mode=main natt=true
  encalg=3desouter

set isakmp policy=isakmp2 localid=example2 remoteid=WindowsVPN

set isakmp policy=isakmp2 sendn=true sendd=true

set isakmp policy=isakmp2 heart=none

ena isakmp
```

This section looks at the background, outlines the selection process, looks at the example in detail, and then describes the solution to the problem.

Background comments

There may be situations where you need to have multiple ISAKMP policies that are all configured with **peer=any** or **peer=dynamic**.

For example, you can define two ISAKMP policies with **peer=any** in order to meet different feature requirements for two different types of peers. Two such peers could be:

- an AR router peer that is dynamically assigned an IP address by its ISP, and
- a Windows VPN client peer which also receives a dynamically assigned IP address

In this situation, we recommend using ISAKMP heartbeats for the AR router peer so that you can have good recovery of SAs after a power cycle. However, you would need a separate policy not using heartbeats for the Windows VPN Client peers, because these do not support ISAKMP heartbeats. Instead, they use another mechanism for recovery.

For another example, you could need two ISAKMP policies for two different dynamic peers, if you wanted each peer to use a unique pre-shared key value.

Understanding selection

In these situations, it is important to appreciate which ISAKMP policy will be selected during an incoming ISAKMP phase 1 proposal.

The router works out which policy to select by checking the following items, in order:

1. peer address
2. remote ID (in aggressive mode only)
3. SA proposal values (encryption algorithm, hashing algorithm, etc).

It selects the policy on the basis of the first item that gives a unique match. For example, in aggressive mode, if two policies have the same peer address (or both have **peer=any**), then the router next inspects their remote IDs.

The selection steps for ISAKMP main mode are the same as for aggressive mode, except that the remote ID field cannot be used as part of ISAKMP policy selection. This means that if you have multiple ISAKMP policies configured to the same peer address (or with **peer=any**) and the only difference between the policies is the remote ID, then ISAKMP main mode cannot select a policy on this difference alone. It selects the first matching ISAKMP policy by policy name order instead.

Example problem

Let's look again at the configuration example that suffered a selection problem:

```
create isakmp pol=isakmp peer=any key=1 mode=main natt=true
  encalg=3desouter

set isakmp pol=isakmp localid=example1 remoteid=ARRouter

set isakmp pol=isakmp sendn=true sendd=true

set isakmp pol=isakmp heart=both


create isakmp pol=isakmp2 peer=any key=2 mode=main natt=true
  encalg=3desouter

set isakmp pol=isakmp2 localid=example2 remoteid=WindowsVPN

set isakmp pol=isakmp2 sendn=true sendd=true

set isakmp pol=isakmp2 heart=none

ena isakmp
```

There are a number of points of difference between these two policies. However, the following fields cannot not be used as selection points, because this information is not received in the phase 1 exchange:

- These policies have different keys, but the pre-shared key is obviously not sent during exchanges, so this cannot be used as a selection point.
- These policies have different heartbeat modes, but the incoming proposal does not indicate preference for heartbeat.
- These policies have different ID fields, but when using ISAKMP main mode, the incoming phase 1 proposal does not define IDs.

- These policies at present use the same hash algorithm and encryption algorithm: **hashalg=sha** and **encalg=3desouter**. These details are proposed in the incoming phase 1 proposal and could be used for selection, but in this example they are the same.

The end result of this problem is that all incoming proposals are being matched against the first policy only. This policy uses heartbeat mode. This might be good for some peers, but those that don't support heartbeat mode (Windows VPN) will find themselves being disconnected (VPN dropped) after a short period.

Solution

The solution is to configure the policies so that they have a point of difference for phase 1 selection. There are two approaches for this.

Differentiation by encryption algorithm

One approach would be to make the encryption algorithms unique. For example, you could make the AR router peer propose **encalg=3des2key** and adjust the local configuration to suit. 3des2key is a unique encryption algorithm that Windows will not propose. Windows does support the more standard **3desouter**, so this becomes a convenient point of distinction, as shown in the following commands:

```
set isakmp pol=isakmp encalg=3des2key

set isakmp pol=isakmp2 encalg=3desouter
```

Differentiation by ISAKMP mode

The other approach would be to set ISAKMP aggressive mode. This way the ID fields will be listed as part of the incoming phase 1 proposal and we can select on a unique Remote ID field.

However, note that Windows VPN clients do not support ISAKMP aggressive mode, but only main mode. This does not have to matter—making one ISAKMP policy use aggressive mode and the other use main mode serves as a point of distinction in itself.

Because Windows clients use main mode, the ID fields are proposed during phase 2 exchange. Phase 2 exchange is too late to serve for policy selection, but because the ID fields are quoted in Phase 2 exchange, the remote ID in your selected policy must match the local ID of the Windows client (or your policy can use **remoteid=any**). The local ID of a Windows client is the Windows “Full computer name”, which you can see on the Computer Name tab of the Properties dialog box for My Computer.

To use the mode to differentiate, use the following command for the policy for the AR router peer:

```
set isakmp pol=isakmp mode=aggressive
```

and the following command for the policy for the Windows peer, configured second:

```
set isakmp pol=isakmp2 mode=main
```

What to do if the remote VPN peer sets up multiple ISAKMP SAs when responding to your router

This section describes how to troubleshoot configurations if they result in many ISAKMP SAs on the peer. If the peer router has a large number of ISAKMP SAs, it is probably because of one of the following causes:

- power failure, which stops the router from sending ISAKMP Delete messages
- misconfiguration or non-support of heartbeat messages

This section first describes these causes, then the solutions. Then it lists other less-common possible causes.

Cause 1: Power failure

If the power fails on your router, or it restarts, the router and its peer negotiate for new VPN SAs when they next need to exchange traffic. If your router initiates the negotiation and is using ISAKMP aggressive mode, the previous SAs will not be deleted on the peer. This is because:

- aggressive mode does not reset the peer's SAs by sending Initial Contact messages, and
- a power failure prevents your router from sending Delete messages to the peer

If a succession of power cycles occurs, the peer may end up with many ISAKMP SAs.

See " Preventing multiple SAs on the peer" on page 23 for solutions in this situation.

Cause 2: Mismatched heartbeat configuration

A large number of SAs may be created when one peer sends and expects to receive ISAKMP heartbeat messages while the other peer does not send ISAKMP heartbeat messages (either through misconfiguration or because it does not support ISAKMP heartbeats). In this situation, the router that expects to receive heartbeats deletes the associated SAs, but the peer does not.

Example configuration with misconfigured heartbeats

Let's look in more detail at two routers with misconfigured ISAKMP heartbeats. The configuration of Router 1 is:

```
create isakmp pol=isakmp peer=ipadd key=1 mode=aggressive
  natt=true

set isakmp pol=isakmp localid=ARRouter1 remoteid=ARRouter2

set isakmp pol=isakmp sendnotify=true senddeletes=false

set isakmp pol=isakmp heart=both
```

The configuration of Router 2 is:

```
create isakmp pol=isakmp peer=any key=1 mode=aggressive natt=true

set isakmp pol=isakmp localid=ARRouter2 remoteid=ARRouter1
set isakmp pol=isakmp sendnotify=true senddeletes=false
set isakmp pol=isakmp heart=none
```

In this configuration one peer believes ISAKMP heartbeats are to be sent and received, and the other peer does not. Neither peer is configured to send Delete messages, and note that aggressive mode is being used.

The ISAKMP heartbeat feature is a good feature to use to detect the health of your peer—as long as both peers support heartbeats. If only one peer supports heartbeats, the following sequence could happen:

1. Router 1 initiates a VPN towards Router 2. Router 1 has ISAKMP heartbeats enabled, so it sends and expects to receive these heartbeat messages. When heartbeats are not received, Router 1 disconnects its peer (Router 2).
2. Router 1 deletes both the associated IPsec and ISAKMP SAs, but does not send a Delete message to the peer because **senddeletes=false**. Therefore, Router 2 still has both the IPsec and ISAKMP SAs up, and these will remain until expiry.
3. So now if Router 1 still wants to send VPN payload traffic, it quickly re-starts ISAKMP negotiations. This configuration uses aggressive mode, therefore the Initial Contact message that main mode uses is not sent. Without this Initial Contact message, the new ISAKMP SA establishes but any existing SAs on the peer remain. This means that the peer now has redundant ISAKMP SAs for this VPN connection.
4. Because of the mismatch with the heartbeat configuration, this process continues. The newly established ISAKMP SA and IPsec SA soon get deleted on Router 1, but again they remain on Router 2 because no Delete message is sent to it. The cycle continues for as long as Router 1 continues to need to send VPN payload traffic, and very soon Router 2 has many ISAKMP SAs up.

Preventing multiple SAs on the peer

There are several items that you can change to give a robust solution. These items apply to both problem causes:

- Use main mode instead of aggressive mode, if possible. Using main mode means that an Initial Contact message is sent for new negotiations, which triggers the peer to remove old ISAKMP SAs. You can use main mode in conjunction with the send Delete messages feature, for increased robustness. Note that ISAKMP main mode depends on the **sendnotify** parameter being enabled, to ensure that the Initial Contact message is sent.
- Set **senddeletes=true**, which ensures that the router sends Delete messages for previous SAs.
- Ensure that both peers use the same heartbeats configuration—**heart=both** if both peers support heartbeats.

In some situations you need to use aggressive mode (for an example see " How to make the router select the right ISAKMP policy during incoming Phase 1 ISAKMP proposals" on page 19). In this case, we recommend you set **senddeletes=true**. This is a sufficient solution in most situations. However, the router cannot send a Delete message if the power fails or the router restarts. In that case, the ISAKMP SAs time out after 24 hours by default. If you have frequent power cycles, you can reduce the ISAKMP SA expiry time (**set isakmp policy=*name* expiryseconds=*seconds***).

Example configuration that avoids excess SAs

The following configuration is a robust example that avoids excess SAs from both causes.

Router 1 (with changes in bold):

```
create isakmp pol=isakmp peer=ipadd key=1 mode=main natt=true
set isakmp pol=isakmp localid=ARRouter1 remoteid=ARRouter2
set isakmp pol=isakmp sendnotify=true senddeletes=true
set isakmp pol=isakmp heart=both
```

Router 2:

```
create isakmp pol=isakmp peer=any key=1 mode=main natt=true
set isakmp pol=isakmp localid=ARRouter2 remoteid=ARRouter1
set isakmp pol=isakmp sendnotify=true senddeletes=true
set isakmp pol=isakmp heart=both
```

Other reasons for accumulation of SAs

ISAKMP SAs might also accumulate in the following situations (although probably only if sending of Delete messages is also disabled):

- if the **expirykbytes** parameter is set for the ISAKMP policy, and the **expirykbytes** soft-expiry threshold is reached much more quickly than the **expiryseconds** limit. When the **expirykbytes** limit is reached, the router negotiates a new ISAKMP SA, but the old SA remains until the **expiryseconds** limit is reached.
- if the **phase2xchglimit** parameter is configured and phase 2 re-negotiations occur frequently. However, this is not a commonly used configuration option.
- if the peer uses a different heartbeat mechanism. Other vendors' equipment may be configured to use proprietary heartbeats, or Dead Peer Detection (RFC 3706), which is not available on Allied Telesis Labs routers. This may cause the peer to detect the VPN connection as failing, in which case the peer would delete the ISAKMP SAs.
- if the lower-layer link is dynamic and the link is reset. For example, Allied Telesis Labs routers will remove the IPsec SAs if the link has a dynamic IP address that is reset. Similar behaviour might happen for Windows L2TP/VPN if the L2TP or PPP connection is reset.

Also, in the following situations, the peer may not receive ISAKMP Delete messages:

- if the Delete message was lost or dropped. Informational Delete messages are not reliably transported, so if the message is dropped enroute, then a retransmission will not be sent.
- if you disable the ISAKMP module (by using the command **disable isakmp**). In this case, the peer may be left with one ISAKMP SA remaining. This is because the Delete message cannot be sent if no suitable SA exists.

When you have multiple policies to the same peer, you also need to consider the following points:

- As described above, ISAKMP main mode uses Initial Contact messages when a connection is first established with a peer. The Initial Contact message means that any existing SAs on the peer are removed when the first SA for the peer is established. So, if only one policy existed for the peer and heartbeats failed, the redundant ISAKMP SAs would be removed on the peer by the Initial Contact message. With multiple policies, this might not happen because another SA might exist for the peer for another policy.

- The **respondbadspi** IPsec policy parameter may not work in all cases with multiple policies to the same peer. It only works if no other ISAKMP SAs exist for the peer. So it works correctly if the router restarts (which is what it is primarily designed for). However, it does not work if multiple SAs to the same peer exist, then one policy's ISAKMP/IPsec SAs are removed, and then IPsec messages with bad SPIs are received.

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