Network Configuration Example

Configuring Policy-Based VPNs Using J Series Routers and SRX Series Devices

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CHAPTER 1

Configuring Policy-Based VPNs Using J Series Routers and SRX Series Devices

About This Network Configuration Example

This network configuration example describes policy-based VPN tunnels and provides a step-by-step example for configuring policy-based VPNs on Juniper Networks SRX Series Services Gateways.

Configuring Policy-Based VPN Using an SRX Series or a J Series Device and an SSG Device Overview

The Juniper Networks Junos operating system (Junos OS), which runs on J Series and SRX Series devices, provides not only a powerful operating system, but also a rich IP services toolkit. Junos OS ensures an efficient and predictable IP infrastructure through IP dependability and security. Junos OS has been greatly enhanced with security and virtual private network (VPN) capabilities from the Juniper Networks Firewall/IPsec VPN platforms, which include the Secure Services Gateway (SSG) product family. This document provides detailed information about IP Security (IPsec) interoperability configuration between a J Series router or SRX Series device and an SSG device. This document also provides troubleshooting information for J Series router and SRX Series devices.

The configuration of a Junos OS routing/security device for VPN support is very flexible. You can create route-based and policy-based VPN tunnels. This document focuses on policy-based VPN tunnels.

This document is intended for network design and security engineers, as well as anyone who requires secure connectivity over public networks.

Related Documentation

- Comparing Policy-Based and Route-Based VPNs on page 6
- Example: Configuring Policy-Based VPN Using an SRX Series or a J Series Device and an SSG Device on page 8

Comparing Policy-Based and Route-Based VPNs

It is important to understand the differences between policy-based and route-based VPNs and why one might be preferable to the other.

Table 1 on page 6 lists the differences between route-based VPNs and policy-based VPNs.

Table 1: Differences Between Route-Based VPNs and Policy-Based VPNs

Route-Based VPNs	Policy-Based VPNs
With route-based VPNs, a policy does not specifically reference a VPN tunnel.	With policy-based VPN tunnels, a tunnel is treated as an object that, together with source, destination, application, and action, constitutes a tunnel policy that permits VPN traffic.
The policy references a destination address.	In a policy-based VPN configuration, a tunnel policy specifically references a VPN tunnel by name.
The number of route-based VPN tunnels that you create is limited by the number of route entries or the number of st0 interfaces that the device supports, whichever number is lower.	The number of policy-based VPN tunnels that you can create is limited by the number of policies that the device supports.
Route-based VPN tunnel configuration is a good choice when you want to conserve tunnel resources while setting granular restrictions on VPN traffic.	With a policy-based VPN, although you can create numerous tunnel policies referencing the same VPN tunnel, each tunnel policy pair creates an individual IPsec security association (SA) with the remote peer. Each SA counts as an individual VPN tunnel.
With a route-based approach to VPNs, the regulation of traffic is not coupled to the means of its delivery. You can configure dozens of policies to regulate traffic flowing through a single VPN tunnel between two sites, and only one IPsec SA is at work. Also, a route-based VPN configuration allows you to create policies referencing a destination reached through a VPN tunnel in which the action is deny.	In a policy-based VPN configuration, the action must be permit and must include a tunnel.
Route-based VPNs support the exchange of dynamic routing information through VPN tunnels. You can enable an instance of a dynamic routing protocol, such as OSPF, on an st0 interface that is bound to a VPN tunnel.	The exchange of dynamic routing information is not supported in policy-based VPNs.

Table 1: Differences Between Route-Based VPNs and Policy-Based VPNs *(continued)*

Route-Based VPNs	Policy-Based VPNs
Route-based configurations are used for hub-and-spoke topologies.	Policy-based VPNs cannot be used for hub-and-spoke topologies.
With route-based VPNs, a policy does not specifically reference a VPN tunnel.	When a tunnel does not connect large networks running dynamic routing protocols and you do not need to conserve tunnels or define various policies to filter traffic through the tunnel, a policy-based tunnel is the best choice.
Route-based VPNs do not support remote-access (dial-up) VPN configurations.	Policy-based VPN tunnels are required for remote-access (dial-up) VPN configurations.
Route-based VPNs might not work correctly with some third-party vendors.	Policy-based VPNs might be required if the third party requires separate SAs for each remote subnet.
When the security device does a route lookup to find the interface through which it must send traffic to reach an address, it finds a route via a secure tunnel interface (**st0**) , which is bound to a specific VPN tunnel. With a route-based VPN tunnel, you can consider a tunnel as a means for delivering traffic, and can consider the policy as a method for either permitting or denying the delivery of that traffic.	With a policy-based VPN tunnel, you can consider a tunnel as an element in the construction of a policy.
Route-based VPNs support NAT for st0 interfaces.	Policy-based VPNs cannot be used if NAT is required for tunneled traffic.

For the purposes of this network configuration example, the focus is on policy-based VPN configuration and troubleshooting. Additional Junos OS-specific VPN configuration and troubleshooting network configuration examples can be found at http://www.juniper.net/techpubs/en_US/junos/information-products/pathway-pages/nce/index.html .

Related Documentation

- Configuring Policy-Based VPN Using an SRX Series or a J Series Device and an SSG Device Overview on page 5
- Example: Configuring Policy-Based VPN Using an SRX Series or a J Series Device and an SSG Device on page 8

Example: Configuring Policy-Based VPN Using an SRX Series or a J Series Device and an SSG Device

This topic includes the following sections:

Requirements

This example uses the following hardware and software components:

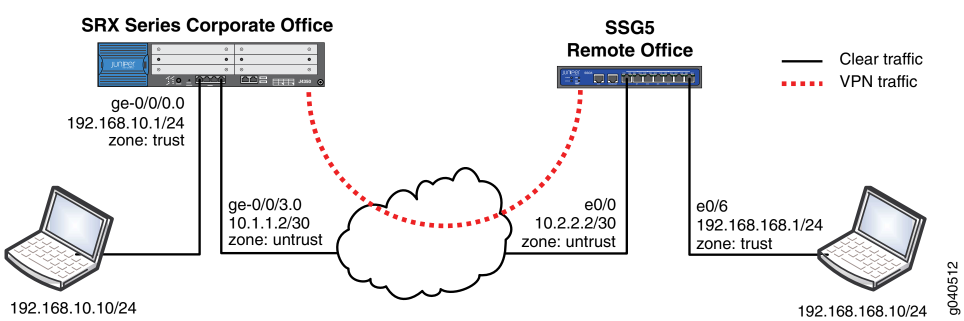
- Junos OS Release 9.5 or later
- Juniper Networks SRX Series Services Gateways or J Series Services Routers

NOTE: This configuration example has been tested using the software release listed and is assumed to work on all later releases.

Overview and Topology

Figure 1 on page 8 shows the network topology used in this configuration example.

Figure 1: Network Topology



This example assumes the following:

- The internal LAN interface is **ge-0/0/0** in zone **trust** and has a private IP subnetwork address.
- The Internet interface is **ge-0/0/3** in zone **untrust** and has a public IP subnetwork address.
- All traffic between the local and remote LANs is permitted, and traffic can be initiated from either side.
- The Juniper Networks SSG5 Secure Services Gateway has already been configured with the correct information for this example.

The basic steps for configuring Junos OS devices for policy-based VPNs are:

1. Configure the IP addresses for Gigabit Ethernet interfaces **ge-0/0/0.0** and **ge-0/0/3.0.**
2. Configure the default route to the Internet next hop.

   Optionally, you can use a dynamic routing protocol such as OSPF instead. Configuring OSPF is beyond the scope of this document.
3. Configure security zones, and bind the interfaces to the appropriate zones.

   Also ensure that you have enabled the necessary host-inbound services on the interfaces or the zone. For this example, enable the Internet Key Exchange (IKE) service on either the **ge-0/0/3** interface or the **untrust** zone.
4. Configure address book entries for each zone.

   This is necessary for the security policies.
5. Configure phase 1 (IKE) gateway settings.

   NOTE: For this example, the **standard** proposal set is used. However, you can create a different proposal if necessary.
6. Configure phase 2 (IP Security [IPsec]) VPN settings.

   Optionally, you can also configure VPN monitor settings if you want.

   NOTE: For this example, the **standard** proposal set and Perfect Forward Secrecy (PFS) **group 2** are used. However, you can create a different proposal if necessary.
7. Configure tunnel policies to permit remote office traffic into the corporate LAN and vice versa.

   Also configure an outgoing **trust** to **untrust** permit-all policy with source NAT for Internet traffic. Ensure that the tunnel policy is above the permit-all policy. Otherwise, the policy lookup never reaches the tunnel policy.
8. Configure the TCP-maximum segment size (**tcp-mss**) for IPsec traffic to eliminate the possibility of fragmented TCP traffic.

   This will lessen the resource usage on the device.

Configuration

To configure a policy-based VPN, perform the following tasks:

- Configuring Junos OS on page 10
- Verifying Policy-Based VPN Connections on page 14
- Troubleshooting on page 18
- Results on page 28

Configuring Junos OS

Step-by-Step Procedure

To configure the Junos OS device for a policy-based VPN:

1. Configure interface IP addresses.

   Junos OS uses the concept of units for the logical component of an interface. In this example, **unit 0** and **family inet (IPv4)** are used.

   ```
   [edit]
   user@CORPORATE# set interfaces ge-0/0/0 unit 0 family inet address 10.10.10.1/24
   user@CORPORATE# set interfaces ge-0/0/3 unit 0 family inet address 1.1.1.2/30
   ```

2. Configure a default route.

   When processing the first packet of a new session, the Junos OS device first performs a route lookup. The static route, which happens to be the default route, determines the zone that the VPN traffic needs to egress. In this example, the VPN traffic ingresses on interface **ge-0/0/0.0** with the next hop of **1.1.1.1**. Thus, the traffic egresses out interface **ge-0/0/3.0**. Any tunnel policy needs to take into account the ingress and egress interfaces.

   ```
   [edit]
   user@CORPORATE# set routing-options static route 0.0.0.0/0 next-hop 1.1.1.1
   ```

3. Configure security zones, and assign interfaces to the zones.

   The ingress and egress zones are determined by the ingress and egress interfaces involved in the route lookup. From step 1 and step 2, you can see that packets ingress on **ge-0/0/0** and that the ingress zone is the **trust** zone. Following the route lookup, the egress interface is **ge-0/0/3**, which signifies that the egress zone is the **untrust** zone. Thus, the tunnel policy needs to be from **from-zone trust to-zone untrust** and vice versa.

   ```
   [edit]
   user@CORPORATE# set security zones security-zone trust interfaces ge-0/0/0.0
   user@CORPORATE# set security zones security-zone untrust interfaces ge-0/0/3.0
   ```

4. Configure host-inbound services for each zone.

   Host-inbound services are for traffic destined for the Junos OS device itself. This includes but is not limited to FTP, HTTP, HTTPS, IKE, ping, rlogin, RSH, SNMP, SSH, Telnet, TFTP, and traceroute. For this example, assume that you want to allow all such services from zone **trust**. For security reasons, allow only IKE on the Internet facing zone **untrust**, which is required for IKE negotiations to occur. However, other services such as management and troubleshooting can also be individually enabled if required.

   ```
   [edit]
   user@CORPORATE# set security zones security-zone trust host-inbound-traffic
     system-services all
   user@CORPORATE# set security zones security-zone untrust host-inbound-traffic
     system-services ike
   ```

5. Configure address book entries for each zone.

This example uses the address book object names **local-net** and **remote-net**. There are some limitations with regard to the characters that are supported for address book names.

```
[edit]
user@CORPORATE# set security zones security-zone trust address-book address
  local-net 10.10.10.0/24
user@CORPORATE# set security zones security-zone untrust address-book address
  remote-net 192.168.168.0/24
```

6. Configure the IKE policy for main mode, standard proposal set, and preshared key.

   This example uses proposal set **standard**, which includes **preshared-group2-3des-sha1** and **preshared-group2-aes128-sha1** proposals. However, a unique proposal can be created and specified in the IKE policy in accordance with your corporate security policy.

   ```
   [edit]
   user@CORPORATE# set security ike policy ike-policy1 mode main
   user@CORPORATE# set security ike policy ike-policy1 proposal-set standard
   user@CORPORATE# set security ike policy ike-policy1 pre-shared-key ascii-text
     "secretkey"
   ```

7. Configure the IKE gateway (phase 1) with a peer IP address, IKE policy, and outgoing interface.

   A remote IKE peer can be identified by **IP address**, fully qualified domain name/user-fully qualified domain name (**FQDN/u-FQDN**), or **ASN1-DN** (PKI certificates). For this example, identify the peer by IP address. The gateway address should be the remote peer's public IP address. It is important to specify the correct external interface. If either the peer address or external interface specified is incorrect, then the IKE gateway will not be properly identified during phase 1 negotiations.

   ```
   [edit]
   user@CORPORATE# set security ike gateway ike-gate ike-policy ike-policy1
   user@CORPORATE# set security ike gateway ike-gate address 2.2.2.2
   user@CORPORATE# set security ike gateway ike-gate external-interface ge-0/0/3.0
   ```

8. Configure an IPsec policy for the standard proposal set.

   As mentioned for phase 1, for the purposes of this example, the **standard** proposal set is used, which includes the **esp-group2- 3des-sha1** and **esp-group2-aes128-sha1** proposals. However, a unique proposal can be created and then specified in the IPsec policy if needed.

   ```
   [edit]
   user@CORPORATE# set security ipsec policy vpn-policy1 proposal-set standard
   ```

9. Configure an IPsec VPN with an IKE gateway and an IPsec policy.

   For this example, the VPN name **ike-vpn** needs to be referenced in the security policy to create a security association.

   ```
   [edit]
   user@CORPORATE# set security ipsec vpn ike-vpn ike gateway ike-gate
   user@CORPORATE# set security ipsec vpn ike-vpn ike ipsec-policy vpn-policy1
   ```

10. Configure VPN bidirectional security policies for tunnel traffic.

For this example, traffic from the corporate LAN to the remote office LAN requires a **from-zone trust to-zone untrust** tunnel policy. However, if a session needs to originate from the remote LAN to the corporate LAN, then a tunnel policy in the opposite direction **from-zone untrust to-zone trust** is also needed. By including the **pair-policy** statement, the VPN becomes bidirectional. Enter the zone **trust** to zone **untrust** hierarchy.

NOTE:

- In addition to the permit action, you need to specify the IPsec profile to be used. Source NAT can be enabled on the policy if desired, but that is beyond the scope of this document.
- For tunnel policies, the action is always permit. If you are configuring a policy with the deny action, you will not see an option for specifying the tunnel.

```
[edit security policies from-zone trust to-zone untrust]
user@CORPORATE# set policy vpnpolicy-tr-unt match source-address local-net
user@CORPORATE# set policy vpnpolicy-tr-unt match destination-address
  remote-net
user@CORPORATE# set policy vpnpolicy-tr-unt match application any
user@CORPORATE# set policy vpnpolicy-tr-unt then permit tunnel ipsec-vpn ike-vpn
user@CORPORATE# set policy vpnpolicy-tr-unt then permit tunnel pair-policy
  vpnpolicy-unt-tr
```

```
[edit security policies from-zone untrust to-zone trust]
user@CORPORATE# set policy vpnpolicy-unt-tr match source-address remote-net
user@CORPORATE# set policy vpnpolicy-unt-tr match destination-address local-net
user@CORPORATE# set policy vpnpolicy-unt-tr match application any
user@CORPORATE# set policy vpnpolicy-unt-tr then permit tunnel ipsec-vpn ike-vpn
user@CORPORATE# set policy vpnpolicy-unt-tr then permit tunnel pair-policy
  vpnpolicy-tr-unt
```

11. Configure a source NAT rule and a security policy for Internet traffic.

```
[edit security nat source rule-set nat-out]
user@CORPORATE# set from zone trust
user@CORPORATE# set to zone untrust
user@CORPORATE# set rule interface-nat match source-address 10.10.10.0/24
user@CORPORATE# set rule interface-nat match destination-address 0.0.0.0/0
user@CORPORATE# set rule interface-nat then source-nat interface
```

```
[edit security policies from-zone trust to-zone untrust]
user@CORPORATE# set policy any-permit match source-address any
user@CORPORATE# set policy any-permit match destination-address any
user@CORPORATE# set policy any-permit match application any
user@CORPORATE# set policy any-permit then permit
```

This policy permits all traffic from zone **trust** to zone **untrust**. With **source-nat interface** specified, the device translates the source IP and port for outgoing traffic, using the IP address of the egress interface as the source IP address and a random higher port for the source port. If required, more granular policies can be created to permit or deny certain traffic.

TIP: The security policy Internet traffic must be below the VPN bidirectional security policy because the policy list is read from top to bottom. If this policy is above the VPN policy, then the traffic always matches this policy and does not continue to the next policy. Thus, no user traffic is encrypted.

12. If it is necessary to move the VPN policy, use the **insert** command.

    ```
    [edit security policies from-zone trust to-zone untrust]
    user@CORPORATE# insert policy vpnpolicy-tr-unt before policy any-permit
    ```

13. Configure the TCP-maximum segment size (**tcp-mss**) to eliminate fragmentation of TCP traffic across the tunnel.

    The **tcp-mss** is negotiated as part of the TCP three-way handshake. It limits the maximum size of a TCP segment to better fit the maximum transmission unit (MTU) limits of a network. This is especially important for VPN traffic because the IPsec encapsulation overhead, along with the IP and frame overhead, can cause the resulting Encapsulating Security Payload (ESP) packet to exceed the MTU of the physical interface, thereby causing fragmentation. Fragmentation increases bandwidth and device resource usage and is always best avoided.

    ```
    [edit]
    user@CORPORATE# set security flow tcp-mss ipsec-vpn mss 1350
    ```

    NOTE: The value of 1350 is a recommended starting point for most Ethernet-based networks with an MTU of 1500 or greater. This value might need to be altered if any device in the path has a lower MTU or if there is any added overhead such as PPP or Frame Relay. As a general rule, you might need to experiment with different **tcp-mss** values to obtain optimal performance.

14. This is the SSG5 portion of the configuration and is provided for your reference.

    The focus of this example is the configuration and troubleshooting of the Junos OS device. For the purpose of completing the network topology shown inFigure 1 on page 8, a sample of the relevant configurations is provided for an SSG5 device. However, the concepts for configuration of policy-based VPNs for Juniper Networks Firewall/VPN products are well documented in the Concepts and Examples (C&E) guides. For more information, see the *Concepts & Examples ScreenOS Reference Guide* at: http://www.juniper.net/techpubs/software/screenos/.

    ```
    set interface ethernet0/6 zone "Trust"
    set interface ethernet0/0 zone "Untrust"
    set interface ethernet0/6 ip 192.168.168.1/24
    set interface ethernet0/6 route
    set interface ethernet0/0 ip 2.2.2.2/30
    set interface ethernet0/0 route
    set flow tcp-mss 1350
    ```

set address "Trust" "local-net" 192.168.168.0 255.255.255.0
set address "Untrust" "corp-net" 10.10.10.0 255.255.255.0
set ike gateway "corp-ike" address 1.1.1.2 Main outgoing-interface ethernet0/0 preshare "secretkey" sec-level standard
set vpn "corp-vpn" gateway "corp-ike" replay tunnel idletime 0 sec-level standard
set policy id 11 from "Trust" to "Untrust" "local-net" "corp-net" "ANY" tunnel vpn "corp-vpn" pair-policy 10
set policy id 10 from "Untrust" to "Trust" "corp-net" "local-net" "ANY" tunnel vpn "corp-vpn" pair-policy 11
set policy id 1 from "Trust" to "Untrust" "ANY" "ANY" "ANY" nat src permit
set route 0.0.0.0/0 interface ethernet0/0 gateway 2.2.2.1

Verifying Policy-Based VPN Connections

Step-by-Step Procedure

To verify VPN Connections for Policy-Based VPNs, perform the following steps:

1. Confirm IKE (phase 1) status. The remote peer is **2.2.2.2**. The state shows **UP**. If the state shows **DOWN** or if there are no IKE security associations present, then there is a problem with phase 1 establishment. Confirm that the remote IP address, IKE policy, and external interfaces are all correct. Common errors include incorrect IKE policy parameters such as incorrect mode type (aggressive or main), preshared keys or phase 1 proposals (all must match on the peers). An incorrect external interface is another common misconfiguration. This interface must be the correct interface to receive the IKE packets. If configurations have been checked, then check the kmd log for any errors, or run traceoptions (see “Troubleshooting” on page 18).

   ```
   user@CORPORATE> show security ike security-associations
   Index Remote Address State Initiator cookie Responder cookie Mode
   4 2.2.2.2 UP 5e1db3f9d50b0de6 e50865d9ebf134f8 Main
   ```

2. In the following show command output, note that the Index number is 4. This value is unique for each IKE security association and allows you to get more details from that particular security association. The detail option gives more information that includes the role (initiator or responder). This is useful to know because troubleshooting is usually best done on the peer that has the responder role. Also shown are details regarding the authentication and encryption algorithms used, the phase 1 lifetime, and the traffic statistics. Traffic statistics can be used to verify that traffic is flowing properly in both directions. Also note the number of IPsec security associations created or in progress. This helps to determine the existence of any completed phase 2 negotiations.

   ```
   user@CORPORATE> show security ike security-associations index 4 detail
   IKE peer 2.2.2.2, Index 4,
   Role: Responder, State: UP
   Initiator cookie: 5e1db3f9d50b0de6, Responder cookie: e50865d9ebf134f8
   Exchange type: Main, Authentication method: Pre-shared-keys
   Local: 1.1.1.2:500, Remote: 2.2.2.2:500
   Lifetime: Expires in 28770 seconds
   Algorithms:
   Authentication : sha1
   Encryption : 3des-cbc
   Pseudo random function: hmac-sha1
   Traffic statistics:
   Input bytes : 852
   Output bytes : 856
   ```



```
Input packets: 5
Output packets: 4
Flags: Caller notification sent
IPsec security associations: 1 created, 0 deleted
Phase 2 negotiations in progress: 0
```

3. Confirm IPsec (phase 2) status. From steps 1 and 2, you can see that there is one IPsec security association (SA) pair and that the port used is **500**, which means there is no NAT traversal (nat-traversal would show port 4500 or a random high port). Also, you can see the security parameter index (SPI) used for both directions, as well as the lifetime (in seconds) and usage limits or lifesize (in kilobytes). In the following output, you can see **3565/ unlim**, which means that phase 2 lifetime is set to expire in 3565 seconds. There is no lifesize specified; thus, it shows unlimited (unlim). Phase 2 lifetime can differ from phase 1 lifetime because phase 2 is not dependent on phase 1 after the VPN is up. The **Mon** column refers to VPN monitoring status. If VPN monitoring is enabled, then this shows U (up) or D (down). A hyphen (-) means that VPN monitoring is not enabled for this SA. For more details on VPN monitoring, refer to the complete Junos OS documentation. Note that Vsys always shows 0. Note also the ID number 2. This is the Index value and is unique for each IPsec security association.

```
user@CORPORATE> show security ipsec security-associations
total configured sa: 2
ID Gateway Port Algorithm SPI Life:sec/kb Mon vsys
<2 2.2.2.2 500 ESP:3des/sha1 a63eb26f 3565/ unlim - 0
>2 2.2.2.2 500 ESP:3des/sha1 a1024ed9 3565/ unlim - 0
```

4. In the following show command output, you can view more details for a particular security association. The following output shows the **Local Identity** and **Remote Identity**. These elements compose the proxy ID for this SA. Proxy ID mismatch is a very common reason for phase 2 failing to complete. For policy-based VPNs, the proxy ID is derived from the security policy. From the security policy, the local address and remote address are derived from the address book entries, and the service is derived from the application configured for the policy. If phase 2 fails due to a proxy ID mismatch, confirm from the policy which address book entries are configured, and verify the addresses to confirm that they match what is being sent. Also, verify the service to ensure that the ports match what is being sent.

   Note that if multiple objects are configured in a policy for source address, destination address, or application, then the resulting proxy ID for that parameter changes to zeroes. For example, assume the tunnel policy has multiple local addresses of **10.10.10.0/24** and **10.10.20.0/24**, remote address **192.168.168.0/24**, and application junos-http. The resulting proxy ID would be local **0.0.0.0/0**, remote **192.168.168.0/24**, service **80**. This can affect interoperability if the remote peer is not configured for the second subnet.

   For certain third-party vendors, you may need to manually enter the proxy ID to match. If IPsec cannot complete, then check the kmd log or set traceoptions as detailed in “Troubleshooting” on page 18.

```
user@CORPORATE> show security ipsec security-associations index 2 detail
Virtual-system: Root
Local Gateway: 1.1.1.2, Remote Gateway: 2.2.2.2
Local Identity: ipv4_subnet(any:0,[0..7]=10.10.10.0/24)
Remote Identity: ipv4_subnet(any:0,[0..7]=192.168.168.0/24)
```

```
DF-bit: clear
Policy-name: vpnpolicy-unt-tr
Direction: inbound, SPI: 2789126767, AUX-SPI: 0
Hard lifetime: Expires in 3558 seconds
Lifesize Remaining: Unlimited
Soft lifetime: Expires in 2986 seconds
Mode: tunnel, Type: dynamic, State: installed, VPN Monitoring: -
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Anti-replay service: enabled, Replay window size: 32
Direction: outbound, SPI: 2701283033, AUX-SPI: 0
Hard lifetime: Expires in 3558 seconds
Lifesize Remaining: Unlimited
Soft lifetime: Expires in 2986 seconds
Mode: tunnel, Type: dynamic, State: installed, VPN Monitoring: -
Protocol: ESP, Authentication: hmac-sha1-96, Encryption: 3des-cbc
Anti-replay service: enabled, Replay window size: 32
```

5. In the following show command output, check the statistics and errors for an IPsec SA. This command is used to check Encapsulating Security Payload (ESP) and Authentication Header (AH) counters and to check for any errors with a particular IPsec security association. You normally do not want to see error values other than zero. However if you experience packet loss issues across a VPN, one approach is to use the show command multiple times and confirm that the encrypted and decrypted packet counters are incrementing. Also, verify whether any error counter increments while you are experiencing the issue. It may also be necessary to enable security flow traceoptions (see “Troubleshooting” on page 18) to view which ESP packets are experiencing errors and why.

```
user@CORPORATE> show security ipsec statistics index 2
ESP Statistics:
Encrypted bytes: 920
Decrypted bytes: 6208
Encrypted packets: 5
Decrypted packets: 87
AH Statistics:
Input bytes: 0
Output bytes: 0
Input packets: 0
Output packets: 0
Errors:
AH authentication failures: 0, Replay errors: 0
ESP authentication failures: 0, ESP decryption failures: 0
Bad headers: 0, Bad trailers: 0
```

6. Test the traffic flow across the VPN. After you have confirmed the status of phase 1 and phase 2, the next step is to test the traffic flow across the VPN. One way to test the traffic flow is through the **ping** command. You can ping from a local host PC to a remote host PC. You can also initiate the **ping** command from the Junos OS device itself. The following is an example of testing using the **ping** command from the Junos OS device to the remote PC host. Note that when initiating ping packets from the Junos OS device, the source interface needs to be specified in order to be sure that route lookup is correct and that the appropriate zones can be referenced in policy lookup. In this case, because **ge-0/0/0.0** resides in the same security zone as the local host PC, **ge-0/0/0** needs to be specified in the **ping** commands so that the policy lookup can be from zone **trust** to zone **untrust**. Similarly, you can initiate a **ping** command from the remote host to the local host.

```
user@CORPORATE> ping 192.168.168.10 interface ge-0/0/0 count 5

PING 192.168.168.10 (192.168.168.10): 56 data bytes
64 bytes from 192.168.168.10: icmp_seq=0 ttl=127 time=8.287 ms
64 bytes from 192.168.168.10: icmp_seq=1 ttl=127 time=4.119 ms
64 bytes from 192.168.168.10: icmp_seq=2 ttl=127 time=5.399 ms
64 bytes from 192.168.168.10: icmp_seq=3 ttl=127 time=4.361 ms
64 bytes from 192.168.168.10: icmp_seq=4 ttl=127 time=5.137 ms
--- 192.168.168.10 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 4.119/5.461/8.287/1.490 ms
```

7. You can also initiate a **ping** command from the SSG5 device itself, as shown in the following output. If pings fail from either direction, this could indicate an issue with routing, policy, end host, or perhaps an issue with the encryption/decryption of the ESP packets. One way to check is to view the IPsec statistics to see whether any errors are reported. Also, you can confirm end host connectivity by pinging from a host on the same subnet as the end host. Assuming that the end host is reachable by other hosts, the issue probably is not with the end host. For routing and policy issues, you can enable security flow traceoptions.

```
ssg5-> ping 10.10.10.10 from ethernet0/6
Type escape sequence to abort
Sending 5, 100-byte ICMP Echos to 10.10.10.10, timeout is 1 seconds from
ethernet0/6
!!!!!
Success Rate is 100 percent (5/5), round-trip time min/avg/max=4/4/5 ms
```

Troubleshooting

Step-by-Step Procedure

Basic troubleshooting begins by first isolating the issue and then focusing the debugging efforts on the area where the problem is occurring. One common approach is to start with the lowest layer of the Open System Interconnection (OSI) model and work up the OSI stack to confirm at which layer the failure occurs.

Following this methodology, the first step to troubleshooting is to confirm the physical connectivity of the Internet link at the physical and data link level. Next, by using the **ping** command, confirm that the Junos OS device has connectivity to the Internet next hop, followed by confirming connectivity to the remote IKE peer. If this is confirmed, then confirm that IKE phase 1 can complete by running the verification commands. After phase 1 is confirmed, confirm phase 2. Finally, confirm that traffic is flowing across the VPN. If the VPN is not in the **UP** state, then there is little reason to test any transit traffic across the VPN. Likewise, if phase 1 is not successful, then it is unnecessary to look at phase 2 issues.

To troubleshoot issues further at the different levels, configure traceoptions. Traceoptions are enabled in configuration mode and are a part of the Junos OS operating configuration. This means that a configuration commit is necessary before a traceoption will take effect. Likewise, removing traceoptions requires deleting or deactivating the configuration, followed by committing the configuration. With a traceoption flag enabled, the data from the traceoption will be written to a log file, which may be predetermined or manually configured and stored in flash memory. This means that any trace logs are retained even after a system reboot. Ensure there is sufficient storage available in the flash memory before implementing traceoptions.

To troubleshoot, perform the following steps:

1. You can check the available storage in the following show command output, in which **/dev/ad0s1a** represents the onboard flash memory and is currently at 65% capacity. You can also view available storage on the J-Web homepage under System Storage. The output of all traceoptions is written to logs stored in the **/var/log** directory. To view a list of all the logs in**/var/log**, use the **show log** operational mode command.

```
user@CORPORATE> show system storage
Filesystem Size Used Avail Capacity Mounted on
/dev/ad0s1a 213M 136M 75M 65% /
devfs 1.0K 1.0K 0B 100% /dev
devfs 1.0K 1.0K 0B 100% /dev/
/dev/md0 144M 144M 0B 100% /junos
/cf 213M 136M 75M 65% /junos/cf
devfs 1.0K 1.0K 0B 100% /junos/dev/
procfs 4.0K 4.0K 0B 100% /proc
/dev/bo0s1e 24M 13K 24M 0% /config
/dev/md1 168M 7.3M 147M 5% /mfs
/dev/md2 58M 38K 53M 0% /jail/tmp
/dev/md3 7.7M 108K 7.0M 1% /jail/var
devfs 1.0K 1.0K 0B 100% /jail/dev
/dev/md4 1.9M 6.0K 1.7M 0% /jail/html/oem
```

2. Check the traceoption logs. Enabling traceoptions begins the logging of the output to the filenames specified or to the default log file for the traceoption. View the

appropriate log to see the trace output. The following are the show commands for viewing the appropriate logs.

user@CORPORATE> **show log kmd**
user@CORPORATE> **show log security-trace**

```
user@CORPORATE> show log messages
Logs can also be uploaded to an FTP server with the 'file copy' command. The syntax is as follows:
file copy <filename> <destination> as below.
```

```
user@CORPORATE> file copy /var/log/kmd ftp://10.10.10.10/kmd.log
ftp://10.10.10.10/kmd.log 100% of 35 kB 12 MBps
```

NOTE: For the Juniper Networks SRX3000 line, SRX5000 line, and SRX1400 devices, the logs are located in the /var/tmp directory and the SPU ID values are included in the log filename. For example /var/tmp/kmd14.

3. To view success or failure messages in IKE or IPsec, view the kmd log, using the **show log kmd** command. Although the kmd log displays a general reason for any failure, it may be necessary to obtain additional details by enabling IKE traceoptions. As a general rule, it is always best to troubleshoot on the peer that has the role of responder. Enable IKE traceoptions for phase 1 and phase 2 negotiation issues. The following example shows all of the IKE traceoptions.

```
user@CORPORATE# set security ike traceoptions file ?

Possible completions:
<filename> Name of file in which to write trace information
files Maximum number of trace files (2..1000)
match Regular expression for lines to be logged
no-world-readable Don't allow any user to read the log file
size Maximum trace file size (10240..1073741824)
world-readable Allow any user to read the log file
```

```
user@CORPORATE# set security ike traceoptions flag ?

Possible completions:
all Trace everything
certificates Trace certificate events
database Trace security associations database events
general Trace general events
ike Trace IKE module processing
parse Trace configuration processing
policy-manager Trace policy manager processing
routing-socket Trace routing socket messages
timer Trace internal timer events
```

4. By default, if no filename is specified, then all IKE traceoptions are written to the kmd log. However, you can specify a different filename if you wish. If a different filename is specified, then all IKE and IPsec related logs are no longer written to the kmd log.

   To write trace data to the log, you must specify at least one flag option. The **file size** option determines the maximum size of a log file in bytes. For example, 1m or 1000000 generates a maximum file size of 1 MB. The **file files** option determines the maximum number of log files that are generated and stored in the flash memory. Remember to commit the configuration changes to start the trace. The following example shows recommended traceoptions for troubleshooting most IKE-related issues.

[edit security ike traceoptions]
user@CORPORATE# **set file size 1m**
user@CORPORATE# **set flag policy-manager**
user@CORPORATE# **set flag ike**
user@CORPORATE# **set flag routing-socket**
user@CORPORATE# **commit**

5. Review the kmd log for success/failure messages. In the following show command output are some excerpts of successful phase 1 and phase 2 completion as well as some instances of failure. Phase 1 and phase 2 successful. The following output shows that the local address is **1.1.1.2** and the remote peer is **2.2.2.2.** The output **udp:500** indicates that no NAT traversal was negotiated. You should see a phase 1 done message, along with the role (initiator or responder). Next you should see a phase 2 done message with proxy ID information. At this point, you can confirm that the IPsec SA is up, using the verification commands in Steps 1 through 4.

```
user@CORPORATE> show log kmd
Oct 8 10:41:40 Phase-1 [responder] done for local=ipv4(udp:500,[0..3]=1.1.1.2)
remote=ipv4(udp:500,[0..3]=2.2.2.2)
Oct 8 10:41:51 Phase-2 [responder] done for p1_local=ipv4(udp:500,[0..3]=1.1.1.2)
p1_remote=ipv4(udp:500,[0..3]=2.2.2.2) p2_local=ipv4_subnet(any:0,[0..7]=10.10.10.0/24)
p2_remote=ipv4_subnet(any:0,[0..7]=192.168.168.0/24)
```

6. Phase 1 failing to complete, example 1. In the following show command output, the local address is **1.1.1.2** and the remote peer is **2.2.2.2**. The role is responder. The reason for failing is **No proposal chosen**. This is likely caused by mismatched phase 1 proposals. To resolve this issue, configure the phase 1 proposals to match on the peers. Also confirm that a tunnel policy exists for the VPN.

```
user@CORPORATE> show log kmd
Oct 8 10:31:10 Phase-1 [responder] failed with error(No proposal chosen) for
local=unknown(any:0,[0..0]=) remote=ipv4(any:0,[0..3]=2.2.2.2)
Oct 8 10:31:10 1.1.1.2:500 (Responder) <-> 2.2.2.2:500 { 011359c9 ddef501d - 2216ed2a bfc50f5f [-
1] / 0x00000000 } IP; Error = No proposal chosen (14)
```

7. Phase 1 failing to complete, example 2. In the following show command output, the local address is **1.1.1.2** and the remote peer is **2.2.2.2**. The role is responder. The reason for failing may seem to indicate that no proposal was chosen. However, you also see **peer:2.2.2.2** is not recognized. This message could be caused by an incorrect peer address, a mismatched peer ID type, or an incorrect peer ID, depending on whether this is a dynamic or static VPN. The peer address must be checked first before the phase 1 proposal is checked. To resolve this issue, confirm that the local peer has the correct peer IP address. Also confirm that the peer is configured with IKE ID type as the IP address.

```
user@CORPORATE> show log kmd
Oct 8 10:39:40 Unable to find phase-1 policy as remote peer:2.2.2.2 is not recognized.
Oct 8 10:39:40 KMD_PM_P1_POLICY_LOOKUP_FAILURE: Policy lookup for Phase-1 [responder] failed for
p1_local=ipv4(any:0,[0..3]=1.1.1.2) p1_remote=ipv4(any:0,[0..3]=2.2.2.2)
Oct 8 10:39:40 1.1.1.2:500 (Responder) <-> 2.2.2.2:500 { 18983055 dbe1d0af - a4d6d829 f9ed3bba [-
1] / 0x00000000 } IP; Error = No proposal chosen (14)
```


8. Phase 1 failing to complete, example 3. In the following show command output, the remote peer is **2.2.2.2**. Invalid payload type usually indicates a problem with the decryption of the IKE packet due to a mismatched preshared key. To resolve this issue, configure the preshared keys to match on the peers.

```
user@CORPORATE> show log kmd
Oct 8 10:36:20 1.1.1.2:500 (Responder) <-> 2.2.2.2:500 { e9211eb9 b59d543c - 766a826d bd1d5ca1 [-
1] / 0x00000000 } IP; Invalid next payload type = 17
Oct 8 10:36:20 Phase-1 [responder] failed with error(Invalid payload type) for
local=unknown(any:0,[0..0]=) remote=ipv4(any:0,[0..3]=2.2.2.2)
```

9. Phase 1 successful, phase 2 failing to complete, example 1. In the following show command output, the local address is **1.1.1.2** and the remote peer is **2.2.2.2**. Phase 1 was successful, based on the **Phase-1 [responder] done** message. The reason for the failure is due to **No proposal chosen** during phase 2 negotiation. The issue is likely phase 2 proposal mismatch between the two peers. To resolve this issue, configure the phase 2 proposals to match on the peers.

```
user@CORPORATE> show log kmd
Oct 8 10:53:34 Phase-1 [responder] done for local=ipv4(udp:500,[0..3]=1.1.1.2)
remote=ipv4(udp:500,[0..3]=2.2.2.2)
Oct 8 10:53:34 1.1.1.2:500 (Responder) <-> 2.2.2.2:500 { cd9dff36 4888d398 - 6b0d3933 f0bc8e26 [0]
/ 0x1747248b } QM; Error = No proposal chosen (14)
```

10. Phase 1 successful, phase 2 failing to complete, example 2. In the following show command output, phase 1 was successful. The reason for failure in phase 2 may seem to be that no proposal was chosen. However, there is also the message **Failed to match the peer proxy ids**, which means that the proxy ID did not match what was expected. Phase 2 proxy ID of remote=192.168.168.0/24, local=10.10.20.0/24, service=any was received. It is clear that this does not match the configurations on the local peer; thus, proxy ID match fails. This results in the error: **No proposal chosen**. To resolve this, configure one peer proxy ID so that it matches the other peer. Note that for a route-based VPN, the proxy ID, by default, is all zeroes (local=0.0.0.0/0, remote=0.0.0.0/0, service=any). If the remote peer specifies a proxy ID other than all zeroes, then you must manually configure the proxy ID within the IPsec profile of the peer.

```
user@CORPORATE> show log kmd
Oct 8 10:56:00 Phase-1 [responder] done for local=ipv4(udp:500,[0..3]=1.1.1.2)
remote=ipv4(udp:500,[0..3]=2.2.2.2)
Oct 8 10:56:00 Failed to match the peer proxy ids
p2_remote=ipv4_subnet(any:0,[0..7]=192.168.168.0/24)
p2_local=ipv4_subnet(any:0,[0..7]=10.10.20.0/24) for the remote peer:ipv4(udp:500,[0..3]=2.2.2.2)
Oct 8 10:56:00 KMD_PM_P2_POLICY_LOOKUP_FAILURE: Policy lookup for Phase-2 [responder] failed for
p1_local=ipv4(udp:500,[0..3]=1.1.1.2) p1_remote=ipv4(udp:500,[0..3]=2.2.2.2)
p2_local=ipv4_subnet(any:0,[0..7]=10.10.20.0/24)
p2_remote=ipv4_subnet(any:0,[0..7]=192.168.168.0/24)
Oct 8 10:56:00 1.1.1.2:500 (Responder) <-> 2.2.2.2:500 { 41f638eb cc22bbfe - 43fd0e85 b4f619d5 [0]
/ 0xc77fafcf } QM; Error = No proposal chosen (14)
```

11. The following is a problem scenario using the network diagram. See Figure 1 on page 8.

    a. Remote PC **192.168.168.10** can ping local PC **10.10.10.10**.

    b. Local PC **10.10.10.10** cannot ping **192.168.168.10**.

c. Based on the output from show commands, IPsec SA is up, and the statistics show no errors.

Considering that the IPsec tunnel is up, then it is likely that there is a problem with the route lookup, security policy, or some other flow issue. Enable security flow traceoptions to determine why the traffic is successful in one direction but not the other.

NOTE: Enabling flow traceoptions can increase system CPU and memory usage. Therefore, we do not recommend enabling flow traceoptions during peak traffic load times or when CPU utilization is very high. We recommend enabling packet filters to lower resource usage and to facilitate pinpointing the packets of interest. Be sure to delete or deactivate all flow traceoptions and remove any unnecessary log files from the flash memory after you complete troubleshooting.

12. Enable security flow traceoptions for routing or policy issues. See the following example of output for security flow traceoptions. By default, if no filename is specified, then all flow traceoptions output is written to the security-trace log file. However, you can specify a different filename if you wish. To write trace data to the log, you must specify at least one flag option. The **file size** option determines the maximum size of a log file in bytes. For example, 1m or 1000000 generates a maximum file size of 1 MB. The **file files** option determines the maximum number of log files that are generated and stored in flash memory. Remember to commit the configuration changes to start the trace.

```
user@CORPORATE# set security flow traceoptions file ?
Possible completions:
<filename> Name of file in which to write trace information
files Maximum number of trace files (2..1000)
match Regular expression for lines to be logged
no-world-readable Don't allow any user to read the log file
size Maximum trace file size (10240..1073741824)
world-readable Allow any user to read the log file
```

```
user@CORPORATE# set security flow traceoptions flag ?

Possible completions:
ager Ager events
all All events
basic-datapath Basic packet flow
cli CLI configuration and commands changes
errors Flow errors
fragmentation Ip fragmentation and reassembly events
high-availability Flow high-availability information
host-traffic Flow host-traffic information
lookup Flow lookup events
multicast Multicast flow information
packet-drops Packet drops
route Route information
session Session creation and deletion events
session-scan Session scan information
tcp-advanced Advanced TCP packet flow
```



```
tcp-basic TCP packet flow
tunnel Tunnel information
```

13. Junos OS can configure packet filters to limit the scope of the traffic to be captured. You can filter the output based on source/destination IP address, source/destination port, interface, and IP protocol. Up to 64 filters can be configured. A packet filter also matches the reverse direction to capture the reply traffic, assuming that the source of the original packet matches the filter. The following example shows the packet flow filter options.

    user@CORPORATE# **set security flow traceoptions packet-filter *filter-name* ?**

```
Possible completions:
+ apply-groups Groups from which to inherit configuration data
+ apply-groups-except Don't inherit configuration data from these groups
destination-port Match TCP/UDP destination port
destination-prefix Destination IPv4 address prefix
interface Logical interface
protocol Match IP protocol type
source-port Match TCP/UDP source port
source-prefix Source IPv4 address prefix
```

14. Terms listed within the same packet filter act as a Boolean logical **AND** statement. This means that all statements within the packet filter need to match in order to write the output to the log. A listing of multiple filter names acts as a logical **OR**. Using packet filters, the following example lists the recommended traceoptions for security flow for the problem scenario given in Step 11.

    [edit security flow traceoptions]
    user@REMOTE# **set file size 1m files 3**
    user@REMOTE# **set flag basic-datapath**
    user@REMOTE# **set packet-filter remote-to-local source-prefix 192.168.168.10/32**
    user@REMOTE# **set packet-filter remote-to-local destination-prefix 10.10.10.10/32**
    user@REMOTE# **set packet-filter local-to-remote source-prefix 10.10.10.0/32**
    user@REMOTE# **set packet-filter local-to-remote destination-prefix 192.168.168.0/32**
    user@REMOTE# **set packet-filter remote-esp protocol 50**
    user@REMOTE# **set packet-filter remote-esp source-prefix 2.2.2.2/32**

15. The following output details the reasoning behind each flow traceoption setting.

    [edit security flow traceoptions]

    user@CORPORATE# **show**

```
file flow-trace-log size 1m files 3;
flag basic-datapath;
```

16. In the following example the **security-trace** log file is set to 1 MB and up to 3 files can be created. The reason for this is that because of the nature of flow traceoptions, a single file could become full very quickly, depending on how much traffic is captured. The **basic-datapath** flag shows details for most flow-related problems.

```
packet-filter remote-to-local {
  source-prefix 192.168.168.10/32;
  destination-prefix 10.10.10.10/32;
}
```

17. The filter used in Step 16 is for capturing the decapsulated or unencrypted traffic from the remote PC to the local PC. Because there are multiple terms, policy execution acts as a Boolean logical **AND**, which means that the source IP address and destination IP address must both match the filter. If the source IP address matches but the destination IP address does not, then the packet is not captured. Because packet filters are bidirectional, it is not necessary to configure a filter for the reply traffic.

    ```
    packet-filter local-to-remote {
      source-prefix 10.10.10.0/32;
      destination-prefix 192.168.168.0/32;
    }
    ```

18. As mentioned in Step 17, no filter is required for capturing the reply traffic. However, a filter captures only the packets which are originally sourced from the specified side. Thus, the **local-to-remote** filter in Step 17 is still required to capture traffic which sources from the local side to the remote side. The filter in the example is optional and depends on whether or not the previous filter captured any packets. This filter captures all ESP (IP protocol 50) or encrypted packets from remote peer **2.2.2.2**. Note that this filter captures **ALL** encrypted traffic from **2.2.2.2**, including packets that perhaps you are not interested in. If the unencrypted traffic is captured, then this last filter may not be necessary.

    With the three problem statements mentioned in the problem scenario in Step 11, you can now begin to look at the flow traceoptions log to isolate the issue. Assume that the third statement is correct, based on IKE and IPsec troubleshooting. Therefore, the next step is to validate the first problem statement to confirm that the remote PC can ping the local PC. Then you can troubleshoot the second problem statement to find out why the traffic fails in the reverse direction.

    ```
    packet-filter remote-esp {
      protocol 50;
      source-prefix 2.2.2.2/32;
    }
    ```

19. Validate the first problem statement. Send a ping packet from **192.168.168.10** to **10.10.10.10** and then view the security-trace log. Because no filename is specified, view the flow traceoptions output using the **show log security-trace** command. The following flow traceoptions output shows successful traffic flow from remote PC to the local PC. The first packet captured is the ESP, or encrypted packet.

```
user@CORPORATE> show log security-trace
******<2.2.2.2/42558->1.1.1.2/45679;50> matched filter remote-esp: <untrust/ge-0/0/3.0> ******
Oct 6 19:20:33 19:20:33.863580:CID-0:RT: packet [184] ipid = 12384, @497afcee ******
Oct 6 19:20:33 19:20:33.863590:CID-0:RT: ge-0/0/3.0:2.2.2.2->1.1.1.2, 50
Oct 6 19:20:33 19:20:33.863597:CID-0:RT: find flow: table 0x4b5265e0, hash 192852(0x3ffff), sa
2.2.2.2, da 1.1.1.2, sp 42558, dp 45679, proto 50, tok 12
Oct 6 19:20:33 19:20:33.863614:CID-0:RT: find flow: table 0x4b59eb00, hash 340(0xfff), sa 2.2.2.2,
da 1.1.1.2, sp 42558, dp 45679, proto 50, tok 12
Oct 6 19:20:33 19:20:33.863630:CID-0:RT: flow session id 257024
Oct 6 19:20:33 19:20:33.863635:CID-0:RT: flow_decrypt: tun 51761360(flag b), iif 68
Oct 6 19:20:33 19:20:33.863682:CID-0:RT:inject tunnel pkt mbuf 0x497afb40
Oct 6 19:20:33 19:20:33.863689:CID-0:RT:injected tunnel pkt mbuf 0x497afb40
```

Based on the top header in the output in Step 19, the packet is from **2.2.2.2** to **1.1.1.2**; the IP protocol is **50**. The ingress interface is **ge-0/0/3.0** in zone **untrust** and matching packet filter **remote-esp**. This is the ESP packet from the remote peer. The port values for IP protocol 50 are not the same as with TCP/UDP. The values are an amalgamation of the SPI value for the tunnel. The **flow session id** is the tunnel session created for the ESP traffic. You can view details about this session using the **show security flow session session-identifier <session id>** command. The **flow_decrypt** message indicates that the decryption process is to take place. The **tun** value is an internal pointer, and **iif** refers to the incoming logical interface index. You can view all the logical interface index numbers using the **show interface extensive** command.

20. The following is the decrypted packet output. Based on the top header in the output for the show log security-trace command, the packet is from **192.168.168.10** to **10.10.10.10**; the IP protocol is **1**. The ingress interface is **ge-0/0/3.0** because the source is from across the VPN. Therefore, the ingress zone is zone **untrust** and matching packet filter **remote-to-local**. This is an ICMP packet. In particular, **icmp, (8/0)** indicates that this is an ICMP type 8, code 0, which is an echo request. The source port is the ICMP sequence value, and the destination port is the ICMP identifier.

```
user@CORPORATE> show log security-trace
******<192.168.168.10/2048->10.10.10.10/1098;1> matched filter remote-to-local: <untrust/
ge-0/0/3.0> ******
Oct 6 19:20:33 19:20:33.863714:CID-0:RT: packet [128] ipid = 41035, @497afd12 ******
Oct 6 19:20:33 19:20:33.863724:CID-0:RT: ge-0/0/3.0:192.168.168.10->10.10.10.10, icmp, (8/0)
Oct 6 19:20:33 19:20:33.863730:CID-0:RT: find flow: table 0x4b5265e0, hash 223505(0x3ffff), sa
192.168.168.10, da 10.10.10.10, sp 21480, dp 1024, proto 1, tok 12
Oct 6 19:20:33 19:20:33.863746:CID-0:RT: flow_first_sanity_check: in <ge-0/0/3.0>, out <N/A>
Oct 6 19:20:33 19:20:33.863754:CID-0:RT: flow_first_in_dst_nat: in <ge-0/0/3.0>, out <N/A
Oct 6 19:20:33 19:20:33.863757:CID-0:RT: flow_first_in_dst_nat: dst_adr 10.10.10.10, sp 21480, dp
1024
Oct 6 19:20:33 19:20:33.863765:CID-0:RT: chose interface N/A as incoming nat if.
Oct 6 19:20:33 19:20:33.863769:CID-0:RT: flow_first_routing: Before route-lookup ifp: in <ge-
0/0/3.0>, out <N/A>
Oct 6 19:20:33 19:20:33.863772:CID-0:RT:flow_first_routing: call flow_route_lookup(): src_ip
192.168.168.10, x_dst_ip 10.10.10.10, ifp ge-0/0/3.0, sp 21480, dp 1024, ip_proto 1, tos 0
Oct 6 19:20:33 19:20:33.863782:CID-0:RT:Doing DESTINATION addr route-lookup
Oct 6 19:20:33 19:20:33.863790:CID-0:RT:Doing SOURCE addr route-lookup
Oct 6 19:20:33 19:20:33.863802:CID-0:RT: routed (x_dst_ip 10.10.10.10) from ge-0/0/3.0 (ge-
0/0/3.0 in 0) to ge-0/0/0.0, Next-hop: 10.10.10.10
Oct 6 19:20:33 19:20:33.863810:CID-0:RT: policy search from zone (untrust) 7-> zone
(trust) 6
Oct 6 19:20:33 19:20:33.863826:CID-0:RT: policy found 6
Oct 6 19:20:33 19:20:33.863833:CID-0:RT:No src xlate
Oct 6 19:20:33 19:20:33.863836:CID-0:RT: choose interface ge-0/0/0.0 as outgoing phy if
Oct 6 19:20:33 19:20:33.863840:CID-0:RT:is_loop_pak: No loop: on ifp: ge-0/0/0.0, addr:
10.10.10.10, rtt_idx:0
Oct 6 19:20:33 19:20:33.863846:CID-0:RT: Using app_id from service lookup 0
Oct 6 19:20:33 19:20:33.863849:CID-0:RT: session application type 0, name (null), timeout 60sec,
alg 0
Oct 6 19:20:33 19:20:33.863854:CID-0:RT: service lookup identified service 0.
Oct 6 19:20:33 19:20:33.863858:CID-0:RT: flow_first_final_check: in <ge-0/0/3.0>, out <ge-
0/0/0.0>
Oct 6 19:20:33 19:20:33.863866:CID-0:RT: existing vector list 2-59b5c308.
Oct 6 19:20:33 19:20:33.863872:CID-0:RT: existing vector list 2-59b5c308.
Oct 6 19:20:33 19:20:33.863879:CID-0:RT: Session (id:45) created for first pak 2
Oct 6 19:20:33 19:20:33.863883:CID-0:RT: flow_first_install_session======> 0x4c6fecb0
Oct 6 19:20:33 19:20:33.863889:CID-0:RT: nsp 0x4c6fecb0, nsp2 0x4c6fed08
```



```
Oct 6 19:20:33 19:20:33.863900:CID-0:RT: 5 tuple sa 192.168.168.10, da 10.10.10.10, sp 21480, dp
1024, proto 1
Oct 6 19:20:33 19:20:33.863909:CID-0:RT: set route old fto 0x59b5c180, new fto 0x59b5c180
Oct 6 19:20:33 19:20:33.863918:CID-0:RT: 5 tuple sa 10.10.10.10, da 192.168.168.10, sp 1024, dp
21480, proto 1
Oct 6 19:20:33 19:20:33.863926:CID-0:RT: set route old fto 0x59b5c1f8, new fto 0x59b5c1f8
Oct 6 19:20:33 19:20:33.863937:CID-0:RT: flow session id 45
Oct 6 19:20:33 19:20:33.863943:CID-0:RT: post addr xlation: 192.168.168.10->10.10.10.10.
Oct 6 19:20:33 19:20:33.863949:CID-0:RT: encap vector
Oct 6 19:20:33 19:20:33.863952:CID-0:RT: no more encapping needed
```

There is no existing session for this flow, so first-packet processing occurs. Next route lookup occurs. Route lookup must occur to determine the ingress and egress zones for security policy lookup. Route lookup determines that the packet needs to egress out **ge-0/0/0.0**. Because interface **ge-0/0/0.0** is associated with zone **trust**, and **ge-0/0/3.0** is associated with zone **untrust**, the policy lookup is from-zone **untrust** to-zone **trust**. Policy 6 was found, which permits the traffic.

21. The details for policy 6 can be viewed with the **show security policies** command.

    user@CORPORATE> **show security policies | find "Index: 6"**

```
Policy: vpnpolicy-unt-tr, action-type: permit, State: enabled, Index: 6
Sequence number: 1
From zone: untrust, To zone: trust
Source addresses:
remote-net: 192.168.168.0/24
Destination addresses:
local-net: 10.10.10.0/24
Application: any
IP protocol: 0, ALG: 0, Inactivity timeout: 0
Source port range: [0-0]
Destination port range: [0-0]
Tunnel: ike-vpn, Type: IPsec, Index: 2
Pair policy: vpnpolicy-tr-unt
```

22. At this point, the session is created; in this case, the session ID is **45**. The reply packet is also captured and shows existing session 45 is found as shown in the following output. Note that **icmp, (0/0)** indicates that this is an ICMP packet type 0, code 0, which is an ICMP echo reply. The packet is shown going into tunnel 4000002. This means that the tunnel is 0x2, which converts to SA index 2 in decimal notation. This confirms that the traffic initiating from remote PC **192.168.168.10** to local PC **10.10.10.10** is successful.

user@CORPORATE> **show log security-trace**

```
******<10.10.10.10/0->192.168.168.10/3146;1> matched filter local-to-remote: <trust/
ge-0/0/0.0> ******
Oct 6 19:20:33 19:20:33.865626:CID-0:RT: packet [128] ipid = 42775, @498333ce ******
Oct 6 19:20:33 19:20:33.865637:CID-0:RT: ge-0/0/0.0:10.10.10.10->192.168.168.10, icmp, (0/0)
Oct 6 19:20:33 19:20:33.865643:CID-0:RT: find flow: table 0x4b5265e0, hash 221617(0x3ffff), sa
10.10.10.10, da 192.168.168.10, sp 1024, dp 21480, proto 1, tok 10
Oct 6 19:20:33 19:20:33.865660:CID-0:RT: flow session id 45
Oct 6 19:20:33 19:20:33.865668:CID-0:RT:xlate_icmp_pak: set nat invalid 45, timeout 1, reason 3
Oct 6 19:20:33 19:20:33.865673:CID-0:RT: post addr xlation: 10.10.10.10->192.168.168.10.
Oct 6 19:20:33 19:20:33.865681:CID-0:RT: encap vector
Oct 6 19:20:33 19:20:33.865683:CID-0:RT: going into tunnel 40000002.
Oct 6 19:20:33 19:20:33.865689:CID-0:RT: flow_encrypt: 0x51761360
Oct 6 19:20:33 19:20:33.865734:CID-0:RT:inject tunnel pkt mbuf 0x49833220
Oct 6 19:20:33 19:20:33.865741:CID-0:RT:injected tunnel pkt mbuf 0x49833220
```


23. Troubleshoot the second problem statement. In the the second problem statement, the local PC cannot ping the remote PC. You can determine the problem by reviewing the security-trace log while attempting to ping from **10.10.10.10** to **192.168.168.10**. The following is a sample output showing a failure.

```
user@CORPORATE> show log security-trace
******<10.10.10.10/2048->192.168.168.10/18763;1> matched filter local-to-remote: <trust/
ge-0/0/0.0> ******
Oct 6 19:21:30 19:21:30.416831:CID-0:RT: packet [128] ipid = 42795, @49f59b4e ******
Oct 6 19:21:30 19:21:30.416843:CID-0:RT: ge-0/0/0.0:10.10.10.10->192.168.168.10, icmp, (8/0)
Oct 6 19:21:30 19:21:30.416850:CID-0:RT: find flow: table 0x4b5265e0, hash 41820(0x3ffff), sa
10.10.10.10, da 192.168.168.10, sp 43700, dp 1024, proto 1, tok 10
Oct 6 19:21:30 19:21:30.416867:CID-0:RT: flow_first_sanity_check: in <ge-0/0/0.0>,out <N/A>
Oct 6 19:21:30 19:21:30.416877:CID-0:RT: flow_first_in_dst_nat: in <ge-0/0/0.0>, out <N/A>
Oct 6 19:21:30 19:21:30.416880:CID-0:RT: flow_first_in_dst_nat: dst_adr 192.168.168.10, sp 43700,
dp 1024
Oct 6 19:21:30 19:21:30.416887:CID-0:RT: chose interface ge-0/0/0.0 as incoming nat if.
Oct 6 19:21:30 19:21:30.416891:CID-0:RT: flow_first_routing: Before route-lookup ifp: in <ge-
0/0/0.0>, out <N/A>
Oct 6 19:21:30 19:21:30.416895:CID-0:RT:flow_first_routing: call flow_route_lookup(): src_ip
10.10.10.10, x_dst_ip 192.168.168.10, ifp ge-0/0/0.0, sp 43700, dp 1024, ip_proto 1, tos 0
Oct 6 19:21:30 19:21:30.416904:CID-0:RT:Doing DESTINATION addr route-lookup
Oct 6 19:21:30 19:21:30.416914:CID-0:RT:Doing SOURCE addr route-lookup
Oct 6 19:21:30 19:21:30.416918:CID-0:RT: routed (x_dst_ip 192.168.168.10) from ge-0/0/0.0 (ge-
0/0/0.0 in 0) to ge-0/0/3.0, Next-hop: 1.1.1.1
Oct 6 19:21:30 19:21:30.416926:CID-0:RT: policy search from zone (trust) 6->zone (untrust) 7
Oct 6 19:21:30 19:21:30.416943:CID-0:RT: policy found 4
Oct 6 19:21:30 19:21:30.416954:CID-0:RT: dip id = 2/0, 10.10.10.10/43700->1.1.1.2/1039
Oct 6 19:21:30 19:21:30.416964:CID-0:RT: choose interface ge-0/0/3.0 as outgoing phy if
Oct 6 19:21:30 19:21:30.416967:CID-0:RT:is_loop_pak: No loop: on ifp: ge-0/0/3.0, addr:
192.168.168.10, rtt_idx:0
Oct 6 19:21:30 19:21:30.416973:CID-0:RT: Using app_id from service lookup 0
Oct 6 19:21:30 19:21:30.416976:CID-0:RT: session application type 0, name (null), timeout 60sec,
alg 0
Oct 6 19:21:30 19:21:30.416982:CID-0:RT: service lookup identified service 0.
Oct 6 19:21:30 19:21:30.416986:CID-0:RT: flow_first_final_check: in <ge-0/0/0.0>, out <ge-
0/0/3.0>
Oct 6 19:21:30 19:21:30.416994:CID-0:RT: existing vector list 0-59b5c220.
Oct 6 19:21:30 19:21:30.417000:CID-0:RT: existing vector list 0-59b5c220.
Oct 6 19:21:30 19:21:30.417006:CID-0:RT: Session (id:50) created for first pak 0
Oct 6 19:21:30 19:21:30.417010:CID-0:RT: flow_first_install_session======> 0x4c6ff318
Oct 6 19:21:30 19:21:30.417016:CID-0:RT: nsp 0x4c6ff318, nsp2 0x4c6ff370
Oct 6 19:21:30 19:21:30.417027:CID-0:RT: 5 tuple sa 10.10.10.10, da 192.168.168.10, sp 43700, dp
1024, proto 1
Oct 6 19:21:30 19:21:30.417036:CID-0:RT: set route old fto 0x59b5c1f8, new fto 0x59b5c1f8
Oct 6 19:21:30 19:21:30.417045:CID-0:RT: 5 tuple sa 192.168.168.10, da 1.1.1.2, sp 1024, dp 1039,
proto 1
Oct 6 19:21:30 19:21:30.417070:CID-0:RT: set route old fto 0x59b5c180, new fto 0x59b5c180
Oct 6 19:21:30 19:21:30.417081:CID-0:RT: flow session id 50
Oct 6 19:21:30 19:21:30.417088:CID-0:RT: post addr xlation: 1.1.1.2->192.168.168.10.
```

Based on the top header in the output in Step 23, the packet is from **10.10.10.10** to **192.168.168.10**; the IP protocol is 1. No session is found, so first packet processing occurs. Next, route-lookup occurs. The route lookup correctly shows that the egress interface is **ge-0/0/3.0**. Therefore, policy lookup is from zone **trust** to zone **untrust**. The packet matches policy index 4.

24. To confirm if policy index 4 is the correct policy, use the **show security policies** command.


```
user@CORPORATE> show security policies

Default policy: deny-all
From zone: trust, To zone: untrust
Policy: any-permit, State: enabled, Index: 4, Sequence number: 1
Source addresses: any
Destination addresses: any
Applications: any
Action: permit
Policy: vpnpolicy-tr-unt, State: enabled, Index: 7, Sequence number: 2
Source addresses: local-net
Destination addresses: remote-net
Applications: any
Action: permit, tunnel
From zone: trust, To zone: trust
Policy: intrazone-permit, State: enabled, Index: 5, Sequence number: 1
Source addresses: any
Destination addresses: any
Applications: any
Action: permit
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From zone: untrust, To zone: trust
Policy: vpnpolicy-unt-tr, State: enabled, Index: 6, Sequence number: 1
Source addresses: remote-net
Destination addresses: local-net
Applications: any
Action: permit, tunnel
```

From the output in Step 24, you can see that policy index 4 is the **any-permit** policy. However, in order to be sent across the VPN, the traffic must match tunnel policy **vpnpolicy-tr-unt**, which is policy index 7. But policy index 7 is below policy index 4; thus, the traffic always matches the **any-permit** policy first. Recall that policy lookup is always from top to bottom.

25. To resolve the order of policy issue, place the tunnel policy above the **any-permit** policy using the insert command as follows.

```
[edit security policies from-zone trust to-zone untrust]
user@CORPORATE# insert policy vpnpolicy-tr-unt before policy any-permit
```

Why did the remote PC to local PC traffic succeed despite that there is no route or policy configured for the reply traffic? The order of packet processing is important to answering this question. Junos OS first inspects the packet to see whether there is already an existing session. If no session exists, then a route lookup is performed. Next, policy lookup is performed. When the first packet reaches the device from the remote PC to the local PC, the session is built for the reply packet. When the reply packet is received, it matches the existing session and is then forwarded. If a session match is found, then no further route or policy lookup occurs.

Results

For reference, the configuration of the Corporate Office Router is shown.

Corporate Office Router

```
system {
  host-name CORPORATE;
  root-authentication {
    encrypted-password "$1$heGUvm8Y$t4wI4Oc0NR8dZlDNz0No2."; ## SECRET-DATA
```



```
    syslog {
        user * {
            any emergency;
        }
        file messages {
            any any;
            authorization info;
        }
        file interactive-commands {
            interactive-commands any;
        }
    }
}
interfaces {
    ge-0/0/0 {
        unit 0 {
            family inet {
                address 10.10.10.1/24;
            }
        }
    }
    ge-0/0/3 {
        unit 0 {
            family inet {
                address 1.1.1.2/30;
            }
        }
    }
}
routing-options {
    static {
        route 0.0.0.0/0 next-hop 1.1.1.1;
    }
}
security {
    ike {
        traceoptions {
            flag ike;
            flag policy-manager;
            flag routing-socket;
        }
        policy ike-policy1 {
            mode main;
            proposal-set standard;
            pre-shared-key ascii-text "$9$dhwoGF39A0IGDPQFnpu8X7"; ## SECRET-DATA
        }
        gateway ike-gate {
            ike-policy ike-policy1;
            address 2.2.2.2;
            external-interface ge-0/0/3.0;
        }
    }
    ipsec {
        policy vpn-policy1 {
            proposal-set standard;
        }
```



```
    vpn ike-vpn {
      ike {
        gateway ike-gate;
        ipsec-policy vpn-policy1;
      }
    }
  }
  zones {
    security-zone untrust {
      address-book {
        address remote-net 192.168.168.0/24;
      }
      host-inbound-traffic {
        system-services {
          ike;
        }
      }
      interfaces {
        ge-0/0/3.0;
      }
    }
    security-zone trust {
      address-book {
        address local-net 10.10.10.0/24;
      }
      host-inbound-traffic {
        system-services {
          all;
        }
      }
      interfaces {
        ge-0/0/0.0;
      }
    }
    policies {
      from-zone trust to-zone untrust {
        policy vpnpolicy-tr-unt {
          match {
            source-address local-net;
            destination-address remote-net;
            application any;
          }
          then {
            permit {
              tunnel {
                ipsec-vpn ike-vpn;
                pair-policy vpnpolicy-unt-tr;
              }
            }
          }
        }
        policy any-permit {
          match {
            source-address any;
            destination-address any;
            application any;
```

```
                }
                then {
                    permit ;
                }
            }
        }
        from-zone untrust to-zone trust {
            policy vpnpolicy-unt-tr {
                match {
                    source-address remote-net;
                    destination-address local-net;
                    application any;
                }
                then {
                    permit {
                        tunnel {
                            ipsec-vpn ike-vpn;
                            pair-policy vpnpolicy-tr-unt;
                        }
                    }
                }
            }
        }
    }
    flow {
        traceoptions {
            file size 1m files 3;
            flag basic-datapath;
            packet-filter remote-to-local {
                source-prefix 192.168.168.10/32;
                destination-prefix 10.10.10.10/32;
            }
            packet-filter local-to-remote {
                source-prefix 10.10.10.0/32;
                destination-prefix 192.168.168.0/32;
            }
            packet-filter remote-esp {
                protocol 50;
                source-prefix 2.2.2.2/32;
            }
        }
        tcp-mss {
            ipsec-vpn {
                mss 1350;
            }
        }
    }
  }
 }
}
```

Related Documentation

- Configuring Policy-Based VPN Using an SRX Series or a J Series Device and an SSG Device Overview on page 5
- Comparing Policy-Based and Route-Based VPNs on page 6