Packet Tracer - Configure and Verify a Site-to-Site IPsec VPN Using CLI

Topology

Addressing Table

<table>
<thead>
<tr>
<th>Device</th>
<th>Interface</th>
<th>IP Address</th>
<th>Subnet Mask</th>
<th>Default Gateway</th>
<th>Switch Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>G0/0</td>
<td>192.168.1.1</td>
<td>255.255.255.0</td>
<td>N/A</td>
<td>S1 F0/0</td>
</tr>
<tr>
<td></td>
<td>S0/0/0 (DCE)</td>
<td>10.1.1.2</td>
<td>255.255.255.252</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>R2</td>
<td>G0/0</td>
<td>192.168.2.1</td>
<td>255.255.255.0</td>
<td>N/A</td>
<td>S2 F0/0</td>
</tr>
<tr>
<td></td>
<td>S0/0/0</td>
<td>10.1.1.1</td>
<td>255.255.255.252</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>S0/0/1 (DCE)</td>
<td>10.2.2.1</td>
<td>255.255.255.252</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>R3</td>
<td>G0/0</td>
<td>192.168.3.1</td>
<td>255.255.255.0</td>
<td>N/A</td>
<td>S3 F0/0</td>
</tr>
<tr>
<td></td>
<td>S0/0/1</td>
<td>10.2.2.2</td>
<td>255.255.255.252</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>PC-A</td>
<td>NIC</td>
<td>192.168.1.3</td>
<td>255.255.255.0</td>
<td>192.168.1.1</td>
<td>S1 F0/0</td>
</tr>
<tr>
<td>PC-B</td>
<td>NIC</td>
<td>192.168.2.3</td>
<td>255.255.255.0</td>
<td>192.168.2.1</td>
<td>S2 F0/0</td>
</tr>
<tr>
<td>PC-C</td>
<td>NIC</td>
<td>192.168.3.3</td>
<td>255.255.255.0</td>
<td>192.168.3.1</td>
<td>S3 F0/18</td>
</tr>
</tbody>
</table>

Objectives
- Verify connectivity throughout the network.
- Configure R1 to support a site-to-site IPsec VPN with R3.

Background / Scenario
The network topology shows three routers. Your task is to configure R1 and R3 to support a site-to-site IPsec VPN when traffic flows between their respective LANs. The IPsec VPN tunnel is from R1 to R3 via R2. R2 acts as a pass-through and has no knowledge of the VPN. IPsec provides secure transmission of sensitive
information over unprotected networks, such as the Internet. IPsec operates at the network layer and protects and authenticates IP packets between participating IPsec devices (peers), such as Cisco routers.

ISAKMP Phase 1 Policy Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>R1</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Distribution Method</td>
<td>Manual or ISAKMP</td>
<td>ISAKMP</td>
</tr>
<tr>
<td>Encryption Algorithm</td>
<td>DES, 3DES, or AES</td>
<td>AES 256</td>
</tr>
<tr>
<td>Hash Algorithm</td>
<td>MD5 or SHA-1</td>
<td>SHA-1</td>
</tr>
<tr>
<td>Authentication Method</td>
<td>Pre-shared keys or RSA</td>
<td>pre-share</td>
</tr>
<tr>
<td>Key Exchange</td>
<td>DH Group 1, 2, or 5</td>
<td>DH 5</td>
</tr>
<tr>
<td>IKE SA Lifetime</td>
<td>86400 seconds or less</td>
<td>86400</td>
</tr>
<tr>
<td>ISAKMP Key</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Bolded parameters are defaults. Only unbolded parameters have to be explicitly configured.

IPsec Phase 2 Policy Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>R1</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transform Set Name</td>
<td>VPN-SET</td>
<td>VPN-SET</td>
</tr>
<tr>
<td>ESP Transform Encryption</td>
<td>esp-aes</td>
<td>esp-aes</td>
</tr>
<tr>
<td>ESP Transform Authentication</td>
<td>esp-sha-hmac</td>
<td>esp-sha-hmac</td>
</tr>
<tr>
<td>Peer IP Address</td>
<td>10.2.2.2</td>
<td>10.1.1.2</td>
</tr>
<tr>
<td>Traffic to be Encrypted</td>
<td>access-list 110 (source 192.168.1.0 dest 192.168.3.0)</td>
<td>access-list 110 (source 192.168.3.0 dest 192.168.1.0)</td>
</tr>
<tr>
<td>Crypto Map Name</td>
<td>VPN-MAP</td>
<td>VPN-MAP</td>
</tr>
<tr>
<td>SA Establishment</td>
<td>ipsec-isakmp</td>
<td>ipsec-isakmp</td>
</tr>
</tbody>
</table>

The routers have been pre-configured with the following:

- Password for console line: ciscoconpa55
- Password for vty lines: ciscovtypa55
- Enable password: ciscoenpa55
- SSH username and password: SSHadmin / ciscossheapa55
- OSPF 101

**Part 1: Configure IPsec Parameters on R1**

**Step 1: Test connectivity.**

Ping from PC-A to PC-C.
Step 2: Enable the Security Technology package.
   a. On R1, issue the `show version` command to view the Security Technology package license information.
   b. If the Security Technology package has not been enabled, use the following command to enable the package.
      ```
      R1(config)# license boot module c1900 technology-package securityk9
      ```
   c. Accept the end-user license agreement.
   d. Save the running-configuration and reload the router to enable the security license.
   e. Verify that the Security Technology package has been enabled by using the `show version` command.

Step 3: Identify interesting traffic on R1.
Configure ACL 110 to identify the traffic from the LAN on R1 to the LAN on R3 as interesting. This interesting traffic will trigger the IPsec VPN to be implemented when there is traffic between the R1 to R3 LANs. All other traffic sourced from the LANs will not be encrypted. Because of the implicit `deny all`, there is no need to configure a `deny ip any any` statement.

   ```
   R1(config)# access-list 110 permit ip 192.168.1.0 0.0.0.255 192.168.3.0 0.0.0.255
   ```

Step 4: Configure the IKE Phase 1 ISAKMP policy on R1.
Configure the `crypto ISAKMP policy 10` properties on R1 along with the shared crypto key `vpnPa55`. Refer to the ISAKMP Phase 1 table for the specific parameters to configure. Default values do not have to be configured. Therefore, only the encryption method, key exchange method, and DH method must be configured.

   ```
   Note: The highest DH group currently supported by Packet Tracer is group 5. In a production network, you would configure at least DH 14.
   ```

   ```
   R1(config)# crypto isakmp policy 10
   R1(config-isakmp)# encryption aes 256
   R1(config-isakmp)# authentication pre-share
   R1(config-isakmp)# group 5
   R1(config-isakmp)# exit
   ```

   ```
   R1(config)# crypto isakmp key vpnpa55 address 10.2.2.2
   ```

Step 5: Configure the IKE Phase 2 IPsec policy on R1.
   a. Create the transform-set VPN-SET to use `esp-aes` and `esp-sha-hmac`.
      ```
      R1(config)# crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac
      ```
   b. Create the crypto map VPN-MAP that binds all of the Phase 2 parameters together. Use sequence number 10 and identify it as an ipsec-isakmp map.
      ```
      R1(config)# crypto map VPN-MAP 10 ipsec-isakmp
      R1(config-crypto-map)# description VPN connection to R3
      R1(config-crypto-map)# set peer 10.2.2.2
      R1(config-crypto-map)# set transform-set VPN-SET
      R1(config-crypto-map)# match address 110
      R1(config-crypto-map)# exit
      ```
Step 6: Configure the crypto map on the outgoing interface.

Bind the VPN-MAP crypto map to the outgoing Serial 0/0/0 interface.

R1(config)# interface s0/0/0
R1(config-if)# crypto map VPN-MAP

Part 2: Configure IPsec Parameters on R3

Step 1: Enable the Security Technology package.

a. On R3, issue the `show version` command to verify that the Security Technology package license information has been enabled.

b. If the Security Technology package has not been enabled, enable the package and reload R3.

Step 2: Configure router R3 to support a site-to-site VPN with R1.

Configure reciprocating parameters on R3. Configure ACL 110 identifying the traffic from the LAN on R3 to the LAN on R1 as interesting.

R3(config)# access-list 110 permit ip 192.168.3.0 0.0.0.255 192.168.1.0 0.0.0.255

Step 3: Configure the IKE Phase 1 ISAKMP properties on R3.

Configure the crypto ISAKMP policy 10 properties on R3 along with the shared crypto key vpnpa55.

R3(config)# crypto isakmp policy 10
R3(config-isakmp)# encryption aes 256
R3(config-isakmp)# authentication pre-share
R3(config-isakmp)# group 5
R3(config-isakmp)# exit
R3(config)# crypto isakmp key vpnpa55 address 10.1.1.2

Step 4: Configure the IKE Phase 2 IPsec policy on R3.

a. Create the transform-set VPN-SET to use esp-aes and esp-sha-hmac.

R3(config)# crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac

b. Create the crypto map VPN-MAP that binds all of the Phase 2 parameters together. Use sequence number 10 and identify it as an ipsec-isakmp map.

R3(config)# crypto map VPN-MAP 10 ipsec-isakmp
R3(config-crypto-map)# description VPN connection to R1
R3(config-crypto-map)# set peer 10.1.1.2
R3(config-crypto-map)# set transform-set VPN-SET
R3(config-crypto-map)# match address 110
R3(config-crypto-map)# exit

Step 5: Configure the crypto map on the outgoing interface.

Bind the VPN-MAP crypto map to the outgoing Serial 0/0/1 interface. **Note:** This is not graded.

R3(config)# interface s0/0/1
R3(config-if)# crypto map VPN-MAP
Part 3: Verify the IPsec VPN

Step 1: Verify the tunnel prior to interesting traffic.
   Issue the `show crypto ipsec sa` command on R1. Notice that the number of packets encapsulated, encrypted, decapsulated, and decrypted are all set to 0.

Step 2: Create interesting traffic.
   Ping PC-C from PC-A.

Step 3: Verify the tunnel after interesting traffic.
   On R1, re-issue the `show crypto ipsec sa` command. Notice that the number of packets is more than 0, which indicates that the IPsec VPN tunnel is working.

Step 4: Create uninteresting traffic.
   Ping PC-B from PC-A. **Note**: Issuing a ping from router R1 to PC-C or R3 to PC-A is not interesting traffic.

Step 5: Verify the tunnel.
   On R1, re-issue the `show crypto ipsec sa` command. Notice that the number of packets has not changed, which verifies that uninteresting traffic is not encrypted.

Step 6: Check results.
   Your completion percentage should be 100%. Click **Check Results** to see feedback and verification of which required components have been completed.