CONFIGURING SITE TO SITE IPSEC VPN TUNNEL BETWEEN CISCO ROUTERS

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Site-to-Site IPSec VPN Tunnels are used to allow the secure transmission of data, voice and video between two sites (e.g offices or branches). The VPN tunnel is created over the Internet public network and encrypted using a number of advanced encryption algorithms to provide confidentiality of the data transmitted between the two sites.

This article will show how to setup and configure two Cisco routers to create a permanent secure site-to-site VPN tunnel over the Internet, using the IP Security (IPSec) protocol. In this article we assume both Cisco routers have a **static public IP address**. Readers interested in configuring support for **dynamic public IP address endpoint routers** can refer to our Configuring Site to Site IPSec VPN with Dynamic IP Endpoint Cisco Routers article.

IPSec VPN tunnels can also be configured using GRE (Generic Routing Encapsulation) Tunnels with IPsec. GRE tunnels greatly simply the configuration and administration of VPN tunnels and are covered in our Configuring Point-to-Point GRE VPN Tunnels article. Lastly, DMVPNs – a new VPN trend that provide major flexibility and almost no administration overhead can also be examined by reading our Understanding Cisco Dynamic Multipoint VPN (DMVPN), Dynamic Multipoint VPN (DMVPN) Deployment Models & Architectures and Configuring Cisco Dynamic Multipoint VPN (DMVPN) - Hub, Spokes , mGRE Protection and Routing - DMVPN Configuration articles.

ISAKMP (Internet Security Association and Key Management Protocol) and IPSec are essential to building and encrypting the VPN tunnel. ISAKMP, also called IKE (Internet Key Exchange), is the negotiation protocol that allows two hosts to agree on how to build an IPsec security association. ISAKMP negotiation consists of two phases: Phase 1 and Phase 2.

Phase 1 creates the first tunnel, which protects later ISAKMP negotiation messages. Phase 2 creates the tunnel that protects data. IPSec then comes into play to encrypt the data using encryption algorithms and provides authentication, encryption and anti-replay services.

IPSEC VPN REQUIREMENTS

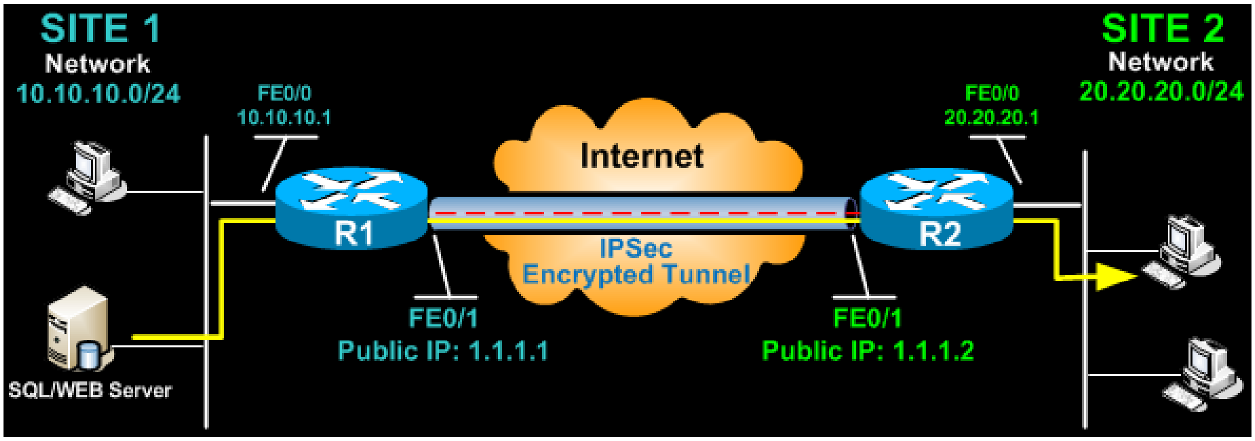
To help make this an easy-to-follow exercise, we have split it into two steps that are required to get the Site-to-Site IPSec VPN Tunnel to work.

These steps are:

(1) Configure **ISAKMP** (ISAKMP Phase 1)

(2) Configure **IPSec** (ISAKMP Phase 2, ACLs, Crypto MAP)

Our example setup is between two branches of a small company, these are **Site 1** and **Site 2**. Both the branch routers connect to the Internet and have a static IP Address assigned by their ISP as shown on the diagram:



Site 1 is configured with an internal network of **10.10.10.0/24**, while **Site 2** is configured with network **20.20.20.0/24**. The goal is to securely connect both LAN networks and allow full communication between them, without any restrictions.

CONFIGURE ISAKMP (IKE) - (ISAKMP PHASE 1)

IKE exists only to establish SAs (Security Association) for IPsec. Before it can do this, IKE must negotiate an SA (an ISAKMP SA) relationship with the peer.

To begin, we'll start working on the Site 1 router (R1).

First step is to configure an ISAKMP Phase 1 policy:

```
R1(config)#  crypto isakmp policy 1
R1(config-isakmp)# encr 3des
R1(config-isakmp)# hash md5
R1(config-isakmp)# authentication pre-share
R1(config-isakmp)# group 2
R1(config-isakmp)# lifetime 86400
```

The above commands define the following (in listed order):

3DES - The encryption method to be used for Phase 1.
MD5 - The hashing algorithm
Pre-share - Use Pre-shared key as the authentication method
Group 2 - Diffie-Hellman group to be used

86400 – Session key lifetime. Expressed in either kilobytes (after x-amount of traffic, change the key) or seconds. Value set is the default value.

We should note that **ISAKMP Phase 1** policy is defined globally. This means that if we have five different remote sites and configured five different ISAKMP Phase 1 policies (one for each remote router), when our router tries to negotiate a VPN tunnel with each site it will send all five policies and use the first match that is accepted by both ends.

Next we are going to define a pre shared key for authentication with our peer (R2 router) by using the following command:

```
R1(config)# crypto isakmp key firewallcx address 1.1.1.2
```

The peer's pre shared key is set to **firewallcx** and its public IP Address is 1.1.1.2. Every time R1 tries to establish a VPN tunnel with R2 (1.1.1.2), this pre shared key will be used.

CONFIGURE IPSEC - 4 SIMPLE STEPS

To configure IPSec we need to setup the following in order:

- **Create extended ACL**
- **Create IPSec Transform**
- **Create Crypto Map**
- **Apply crypto map to the public interface**

Let us examine each of the above steps.

STEP 1: CREATING EXTENDED ACL

Next step is to create an access-list and define the traffic we would like the router to pass through the VPN tunnel. In this example, it would be traffic from one network to the other, 10.10.10.0/24 to 20.20.20.0/24. Access-lists that define VPN traffic are sometimes called **crypto access-list** or **interesting traffic access-list**.

```
R1(config)# ip access-list extended VPN-TRAFFIC
R1(config-ext-nacl)# permit ip 10.10.10.0 0.0.0.255 20.20.20.0 0.0.0.255
```

STEP 2: CREATE IPSEC TRANSFORM (ISAKMP PHASE 2 POLICY)

Next step is to create the transform set used to protect our data. We've named this **TS**:

```
R1(config)# crypto ipsec transform-set TS esp-3des esp-md5-hmac
```

The above command defines the following:

- **ESP-3DES** - Encryption method
- **MD5** - Hashing algorithm

STEP 3: CREATE CRYPTO MAP

The Crypto map is the last step of our setup and connects the previously defined ISAKMP and IPSec configuration together:

```
R1(config)# crypto map CMAP 10 ipsec-isakmp
R1(config-crypto-map)# set peer 1.1.1.2
R1(config-crypto-map)# set transform-set TS
R1(config-crypto-map)# match address VPN-TRAFFIC
```

We’ve named our crypto map CMAP. The **ipsec-isakmp** tag tells the router that this crypto map is an IPsec crypto map. Although there is only one peer declared in this crypto map (1.1.1.2), it is possible to have multiple peers within a given crypto map.

STEP 4: APPLY CRYPTO MAP TO THE PUBLIC INTERFACE

The final step is to apply the crypto map to the outgoing interface of the router. Here, the outgoing interface is FastEthernet 0/1.

```
R1(config)# interface FastEthernet0/1
R1(config- if)# crypto map CMAP
```

Note that you can assign only one crypto map to an interface.

As soon as we apply crypto map on the interface, we receive a message from the router that confirms isakmp is on: “ISAKMP is ON”.

At this point, we have completed the IPSec VPN configuration on the Site 1 router.

We now move to the Site 2 router to complete the VPN configuration. The settings for Router 2 are identical, with the only difference being the peer IP Addresses and access lists:

```
R2(config)# crypto isakmp policy 1
R2(config-isakmp)# encr 3des
R2(config-isakmp)# hash md5
R2(config-isakmp)# authentication pre-share
R2(config-isakmp)# group 2
R2(config-isakmp)# lifetime 86400

R2(config)# crypto isakmp key firewallcx address 1.1.1.1
R2(config)# ip access-list extended VPN-TRAFFIC
R2(config-ext-nacl)# permit ip 20.20.20.0 0.0.0.255 10.10.10.0 0.0.0.255

R2(config)# crypto ipsec transform-set TS esp-3des esp-md5-hmac
```

```
R2(config)# crypto map CMAP 10 ipsec-isakmp
R2(config-crypto-map)# set peer 1.1.1.1
R2(config-crypto-map)# set transform-set TS
R2(config-crypto-map)# match address VPN-TRAFFIC

R2(config)# interface FastEthernet0/1
R2(config- if)# crypto map CMAP
```

NETWORK ADDRESS TRANSLATION (NAT) AND IPSEC VPN TUNNELS

Network Address Translation (NAT) is most likely to be configured to provide Internet access to internal hosts. When configuring a Site-to-Site VPN tunnel, it is imperative to instruct the router **not to perform NAT** (deny NAT) on packets destined to the remote VPN network(s).

This is easily done by inserting a deny statement at the beginning of the NAT access lists as shown below:

For Site 1’s router:

```
R1(config)# ip nat inside source list 100 interface fastethernet0/1 overload
R1(config)# access-list 100 remark -=[Define NAT Service]=-
R1(config)# access-list 100 deny ip 10.10.10.0 0.0.0.255 20.20.20.0 0.0.0.255
R1(config)# access-list 100 permit ip 10.10.10.0 0.0.0.255 any
R1(config)# access-list 100 remark
```

And Site 2’s router:

```
R2(config)# ip nat inside source list 100 interface fastethernet0/1 overload
R2(config)# access-list 100 remark -=[Define NAT Service]=-
R2(config)# access-list 100 deny ip 20.20.20.0 0.0.0.255 10.10.10.0  0.0.0.255
R2(config)# access-list 100 permit ip 20.20.20.0 0.0.0.255 any
R2(config)# access-list 100 remark
```

ESTABLISHING AND VERIFYING THE IPSEC VPN TUNNEL

At this point, we’ve completed our configuration and the VPN Tunnel is ready to be brought up. To initiate the VPN Tunnel, we need to force one packet to traverse the VPN and this can be achieved by pinging from one router to another:

```
R1# ping 20.20.20.1 source fastethernet0/0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.20.20.1, timeout is 2 seconds:
Packet sent with a source address of 10.10.10.1
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 44/47/48 ms
```

The first icmp echo (ping) received a timeout, but the rest received a reply, as expected. The time required to bring up the VPN Tunnel is sometimes slightly more than 2 seconds, causing the first ping to timeout.

To verify the VPN Tunnel, use the show crypto session command:

```
R1# show crypto session
Crypto session current status
Interface: FastEthernet0/1
Session status: UP-ACTIVE
Peer: 1.1.1.2 port 500
  IKE SA: local 1.1.1.1/500 remote 1.1.1.2/500 Active
  IPSEC FLOW: permit ip 10.10.10.0/255.255.255.0 20.20.20.0/255.255.255.0
```