LAN-to-LAN IPsec VPNs

A LAN-to-LAN VPN connects networks in different geographic locations. The ASA supports LAN-to-LAN VPN connections to Cisco or third-party peers when the two peers have IPv4 inside and outside networks (IPv4 addresses on the inside and outside interfaces).

For LAN-to-LAN connections using mixed IPv4 and IPv6 addressing, or all IPv6 addressing, the ASA supports VPN tunnels if both peers are ASAs and if both inside networks have matching addressing schemes (both IPv4 or both IPv6).

Specifically, the following topologies are supported when both peers are ASAs:

- The ASAs have IPv4 inside networks and the outside network is IPv6 (IPv4 addresses on the inside interfaces and IPv6 addresses on the outside interfaces).
- The ASAs have IPv6 inside networks and the outside network is IPv4 (IPv6 addresses on the inside interface and IPv4 addresses on the outside interfaces).
- The ASAs have IPv6 inside networks and the outside network is IPv6 (IPv6 addresses on the inside and outside interfaces).

Note
The ASA supports LAN-to-LAN IPsec connections with Cisco peers and with third-party peers that comply with all relevant standards.

This chapter describes how to build a LAN-to-LAN VPN connection. It includes the following sections:

- **Summary of the Configuration, page 9-2**
- **Configuring Site-to-Site VPN in Multi-Context Mode, page 9-2**
- **Configuring Interfaces, page 9-3**
- **Configuring ISAKMP Policy and Enabling ISAKMP on the Outside Interface, page 9-4**
- **Creating an IKEv1 Transform Set, page 9-6**
- **Creating an IKEv2 Proposal, page 9-7**
- **Configuring an ACL, page 9-7**
- **Defining a Tunnel Group, page 9-8**
- **Creating a Crypto Map and Applying It To an Interface, page 9-9**
Summary of the Configuration

This section provides a summary of the example LAN-to-LAN configuration this chapter describes. Later sections provide step-by-step instructions.

hostname(config)# interface ethernet0/0
hostname(config-if)# ip address 10.10.4.100 255.255.0.0
hostname(config-if)# nameif outside
hostname(config-if)# no shutdown
hostname(config)# crypto ikev1 policy 1
hostname(config-ikev1-policy)# authentication pre-share
hostname(config-ikev1-policy)# encryption 3des
hostname(config-ikev1-policy)# hash sha
hostname(config-ikev1-policy)# group 2
hostname(config-ikev1-policy)# lifetime 43200
hostname(config)# crypto ikev1 enable outside
hostname(config)# crypto ikev2 policy 1
hostname(config-ikev2-policy)# encryption 3des
hostname(config-ikev2-policy)# group 2
hostname(config-ikev2-policy)# prf sha
hostname(config-ikev2-policy)# lifetime 43200
hostname(config)# crypto ikev2 enable outside
hostname(config)# crypto ipsec ikev1 transform-set FirstSet esp-3des esp-md5-hmac
hostname(config)# crypto ipsec ikev2 ipsec-proposal secure
hostname(config)# crypto ipsec-proposal)# protocol esp encryption 3des aes des
hostname(config)# crypto ipsec-proposal)# protocol esp integrity sha-1
hostname(config)# access-list l2l_list extended permit ip 192.168.0.0 255.255.0.0
150.150.0.0 255.255.0.0
hostname(config)# tunnel-group 10.10.4.108 type ipsec-l2l
hostname(config)# tunnel-group 10.10.4.108 ipsec-attributes
hostname(config)# ikev1 pre-shared-key 44kkaol59636jnfx
hostname(config)# crypto map abcmap 1 match address l2l_list
hostname(config)# crypto map abcmap 1 set peer 10.10.4.108
hostname(config)# crypto map abcmap 1 set ikev1 transform-set FirstSet
hostname(config)# crypto map abcmap 1 set ikev2 ipsec-proposal secure
hostname(config)# crypto map abcmap interface outside
hostname(config)# write memory

Configuring Site-to-Site VPN in Multi-Context Mode

Follow these steps to allow site-to-site support in multi-mode. By performing these steps, you can see how resource allocation breaks down.

Step 1 To configure the VPN in multi-mode, configure a resource class and choose VPN licenses as part of the allowed resource. The "Configuring a Class for Resource Management" provides these configuration steps. The following is an example configuration:

class cxtx1
    limit-resource VPN Burst Other 100
    limit-resource VPN Other 1000

Step 2 Configure a context and make it a member of the configured class that allows VPN licenses. The "Configuring a Security Context" provides these configuration steps. The following is an example configuration:

context context1
    member cxtx1
    allocate-interface GigabitEthernet3/0.2
    allocate-interface GigabitEthernet3/1.2
    allocate-interface Management0/0
Step 3 Configure connection profiles, policies, crypto maps, and so on, just as would with single context VPN configuration of site-to-site VPN.

Configuring Interfaces

An ASA has at least two interfaces, referred to here as outside and inside. Typically, the outside interface is connected to the public Internet, while the inside interface is connected to a private network and is protected from public access.

To begin, configure and enable two interfaces on the ASA. Then, assign a name, IP address and subnet mask. Optionally, configure its security level, speed, and duplex operation on the security appliance.

Note The ASA's outside interface address (for both IPv4/IPv6) cannot overlap with the private side address space.

To configure interfaces, perform the following steps, using the command syntax in the examples:

Step 1 To enter Interface configuration mode, in global configuration mode enter the interface command with the default name of the interface to configure. In the following example the interface is ethernet0.

```
hostname(config)# interface ethernet0/0
hostname(config-if)#
```

Step 2 To set the IP address and subnet mask for the interface, enter the ip address command. In the following example the IP address is 10.10.4.100 and the subnet mask is 255.255.0.0.

```
hostname(config-if)# ip address 10.10.4.100 255.255.0.0
hostname(config-if)#
```

Step 3 To name the interface, enter the nameif command, maximum of 48 characters. You cannot change this name after you set it. In the following example the name of the ethernet0 interface is outside.

```
hostname(config-if)# nameif outside
hostname(config-if)##
```

Step 4 To enable the interface, enter the no version of the shutdown command. By default, interfaces are disabled.

```
hostname(config-if)# no shutdown
hostname(config-if)#
```

Step 5 To save your changes, enter the write memory command:

```
hostname(config-if)# write memory
hostname(config-if)#
```

Step 6 To configure a second interface, use the same procedure.
ISAKMP is the negotiation protocol that lets two hosts agree on how to build an IPsec security association (SA). It provides a common framework for agreeing on the format of SA attributes. This includes negotiating with the peer about the SA, and modifying or deleting the SA. ISAKMP separates negotiation into 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.

IKE uses ISAKMP to setup the SA for IPsec to use. IKE creates the cryptographic keys used to authenticate peers.

The ASA supports IKEv1 for connections from the legacy Cisco VPN client, and IKEv2 for the AnyConnect VPN client.

To set the terms of the ISAKMP negotiations, you create an IKE policy, which includes the following:

- The authentication type required of the IKEv1 peer, either RSA signature using certificates or preshared key (PSK).
- An encryption method, to protect the data and ensure privacy.
- A Hashed Message Authentication Codes (HMAC) method to ensure the identity of the sender, and to ensure that the message has not been modified in transit.
- A Diffie-Hellman group to determine the strength of the encryption-key-determination algorithm. The ASA uses this algorithm to derive the encryption and hash keys.
- For IKEv2, a separate pseudo-random function (PRF) used as the algorithm to derive keying material and hashing operations required for the IKEv2 tunnel encryption.
- A limit to the time the ASA uses an encryption key before replacing it.

With IKEv1 policies, for each parameter, you set one value. For IKEv2, you can configure multiple encryption and authentication types, and multiple integrity algorithms for a single policy. The ASA orders the settings from the most secure to the least secure and negotiates with the peer using that order. This allows you to potentially send a single proposal to convey all the allowed transforms instead of the need to send each allowed combination as with IKEv1.

The following sections provide procedures for creating IKEv1 and IKEv2 policies and enabling them on an interface:

- Configuring ISAKMP Policies for IKEv1 Connections, page 9-4
- Configuring ISAKMP Policies for IKEv2 Connections, page 9-5

### Configuring ISAKMP Policies for IKEv1 Connections

To configure ISAKMP policies for IKEv1 connections, use the `crypto ikev1 policy` command to enter IKEv1 policy configuration mode where you can configure the IKEv1 parameters.

Perform the following steps and use the command syntax in the following examples as a guide.

**Step 1** Enter IPsec IKEv1 policy configuration mode. For example:

```
hostname(config)# crypto ikev1 policy 1
hostname(config-ikev1-policy)#
```

**Step 2** Set the authentication method. The following example configures a preshared key:
Configuring ISAKMP Policy and Enabling ISAKMP on the Outside Interface

**Step 3** Set the encryption method. The following example configures 3DES:
```
hostname(config-ikev1-policy) # encryption 3des
```

**Step 4** Set the HMAC method. The following example configures SHA-1:
```
hostname(config-ikev1-policy) # hash sha
```

**Step 5** Set the Diffie-Hellman group. The following example configures Group 2:
```
hostname(config-ikev1-policy) # group 2
```

**Step 6** Set the encryption key lifetime. The following example configures 43,200 seconds (12 hours):
```
hostname(config-ikev1-policy) # lifetime 43200
```

**Step 7** Enable IKEv1 on the interface named outside in either single or multiple context mode:
```
hostname(config) # crypto ikev1 enable outside
```

**Step 8** To save your changes, enter the `write memory` command:
```
hostname(config) # write memory
```

---

**Configuring ISAKMP Policies for IKEv2 Connections**

To configure ISAKMP policies for IKEv2 connections, use the `crypto ikev2 policy priority` command to enter IKEv2 policy configuration mode where you can configure the IKEv2 parameters.

Perform the following steps:

**Step 1** Enter IPsec IKEv2 policy configuration mode. For example:
```
hostname(config)# crypto ikev2 policy 1
```

**Step 2** Set the encryption method. The following example configures 3DES:
```
hostname(config-ikev2-policy)# encryption 3des
```

**Step 3** Set the Diffie-Hellman group. The following example configures Group 2:
```
hostname(config-ikev2-policy)# group 2
```

**Step 4** Set the pseudo-random function (PRF) used as the algorithm to derive keying material and hashing operations required for the IKEv2 tunnel encryption. The following example configures SHA-1 (an HMAC variant):
```
hostname(config-ikev2-policy)# prf sha
```
Step 5 Set the encryption key lifetime. The following example configures 43,200 seconds (12 hours):

```
hostname(config-ikev2-policy)# lifetime seconds 43200
hostname(config-ikev2-policy)#
```

Step 6 Enable IKEv2 on the interface named outside:

```
hostname(config)# crypto ikev2 enable outside
hostname(config)#
```

Step 7 To save your changes, enter the `write memory` command:

```
hostname(config)# write memory
hostname(config)#
```

Creating an IKEv1 Transform Set

An IKEv1 transform set combines an encryption method and an authentication method. During the IPsec security association negotiation with ISAKMP, the peers agree to use a particular transform set to protect a particular data flow. The transform set must be the same for both peers.

A transform set protects the data flows for the ACL specified in the associated crypto map entry. You can create transform sets in the ASA configuration, and then specify a maximum of 11 of them in a crypto map or dynamic crypto map entry.

Table 9-1 lists valid encryption and authentication methods.

<table>
<thead>
<tr>
<th>Valid Encryption Methods</th>
<th>Valid Authentication Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>esp-des</td>
<td>esp-md5-hmac</td>
</tr>
<tr>
<td>esp-3des (default)</td>
<td>esp-sha-hmac (default)</td>
</tr>
<tr>
<td>esp-aes (128-bit encryption)</td>
<td></td>
</tr>
<tr>
<td>esp-aes-192</td>
<td></td>
</tr>
<tr>
<td>esp-aes-256</td>
<td></td>
</tr>
<tr>
<td>esp-null</td>
<td></td>
</tr>
</tbody>
</table>

Tunnel Mode is the usual way to implement IPsec between two ASAs that are connected over an untrusted network, such as the public Internet. Tunnel mode is the default and requires no configuration.

To configure a transform set, perform the following site-to-site tasks in either single or multiple context mode:

Step 1 In global configuration mode enter the `crypto ipsec ikev1 transform-set` command. The following example configures a transform set with the name FirstSet, esp-3des encryption, and esp-md5-hmac authentication. The syntax is as follows:

```
crypto ipsec ikev1 transform-set transform-set-name encryption-method authentication-method
```

```
hostname(config)# crypto ipsec transform-set FirstSet esp-3des esp-md5-hmac
hostname(config)#
```
Creating an IKEv2 Proposal

For IKEv2, you can configure multiple encryption and authentication types, and multiple integrity algorithms for a single policy. The ASA orders the settings from the most secure to the least secure and negotiates with the peer using that order. This allows you to potentially send a single proposal to convey all the allowed transforms instead of the need to send each allowed combination as with IKEv1.

Table 9-1 lists valid IKEv2 encryption and authentication methods.

<table>
<thead>
<tr>
<th>Valid Encryption Methods</th>
<th>Valid Integrity Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>des</td>
<td>sha (default)</td>
</tr>
<tr>
<td>3des (default)</td>
<td>md5</td>
</tr>
<tr>
<td>aes</td>
<td></td>
</tr>
<tr>
<td>aes-192</td>
<td></td>
</tr>
<tr>
<td>aes-256</td>
<td></td>
</tr>
</tbody>
</table>

To configure an IKEv2 proposal, perform the following tasks in either single or multiple context mode:

**Step 1** In global configuration mode, use the `crypto ipsec ikev2 ipsec-proposal` command to enter ipsec proposal configuration mode where you can specify multiple encryption and integrity types for the proposal. In this example, `secure` is the name of the proposal:

```
hostname(config)# crypto ipsec ikev2 ipsec-proposal secure
```

**Step 2** Then enter a protocol and encryption types. ESP is the only supported protocol. For example:

```
hostname(config-ipsec-proposal)# protocol esp encryption 3des aes des
```

**Step 3** Enter an integrity type. For example:

```
hostname(config-ipsec-proposal)# protocol esp integrity sha-1
```

**Step 4** Save your changes.

Configuring an ACL

The ASA uses access control lists to control network access. By default, the adaptive security appliance denies all traffic. You need to configure an ACL that permits traffic. For more information, see "Information About Access Control Lists" in the general operations configuration guide.
The ACLs that you configure for this LAN-to-LAN VPN control connections are based on the source and translated destination IP addresses. Configure ACLs that mirror each other on both sides of the connection.

An ACL for VPN traffic uses the translated address.

To configure an ACL, perform the following steps:

---

**Step 1** Enter the `access-list extended` command. The following example configures an ACL named `l2l_list` that lets traffic from IP addresses in the 192.168.0.0 network travel to the 150.150.0.0 network. The syntax is `access-list listname extended permit ip source-ipaddress source-netmask destination-ipaddress destination-netmask`.

```
hostname(config)# access-list l2l_list extended permit ip 192.168.0.0 255.255.0.0 150.150.0.0 255.255.0.0
```

**Step 2** Configure an ACL for the ASA on the other side of the connection that mirrors the ACL. Subnets that are defined in two different crypto ACLs and are attached to the same crypto map should not overlap. In the following example, the prompt for the peer is `hostname2`.

```
hostname2(config)# access-list l2l_list extended permit ip 150.150.0.0 255.255.0.0 192.168.0.0 255.255.0.0
```

---

**Note** For more information on configuring an ACL with a VPN filter, see the *Specifying a VLAN for Remote Access or Applying a Unified Access Control Rule to the Group Policy*, page 4-48.

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**Defining a Tunnel Group**

A tunnel group is a set of records that contain tunnel connection policies. You configure a tunnel group to identify AAA servers, specify connection parameters, and define a default group policy. The ASA stores tunnel groups internally.

There are two default tunnel groups in the ASA: DefaultRAGroup, which is the default IPsec remote-access tunnel group, and DefaultL2Lgroup, which is the default IPsec LAN-to-LAN tunnel group. You can modify them, but not delete them.

The main difference between IKE versions 1 and 2 lies in terms of the authentication method they allow. IKEv1 allows only one type of authentication at both VPN ends (that is, either preshared key or certificate). However, IKEv2 allows asymmetric authentication methods to be configured (that is, preshared key authentication for the originator but certificate authentication for the responder) using separate local and remote authentication CLIs. Therefore, with IKEv2 you have asymmetric authentication, in which one side authenticates with one credential and the other side uses another credential (either a preshared key or certificate).

You can also create one or more new tunnel groups to suit your environment. The ASA uses these groups to configure default tunnel parameters for remote access and LAN-to-LAN tunnel groups when there is no specific tunnel group identified during tunnel negotiation.

To establish a basic LAN-to-LAN connection, you must set two attributes for a tunnel group:

- Set the connection type to IPsec LAN-to-LAN.
- Configure an authentication method for the IP address (that is, a preshared key for IKEv1 and IKEv2).
Creating a Crypto Map and Applying It To an Interface

Crypto map entries pull together the various elements of IPsec security associations, including the following:

- Which traffic IPsec should protect, which you define in an ACL.
- Where to send IPsec-protected traffic, by identifying the peer.
- What IPsec security applies to this traffic, which a transform set specifies.
- The local address for IPsec traffic, which you identify by applying the crypto map to an interface.

For IPsec to succeed, both peers must have crypto map entries with compatible configurations. For two crypto map entries to be compatible, they must, at a minimum, meet the following criteria:

- The crypto map entries must contain compatible crypto ACLs (for example, mirror image ACLs). If the responding peer uses dynamic crypto maps, the entries in the ASA crypto ACL must be “permitted” by the peer’s crypto ACL.
Creating a Crypto Map and Applying It To an Interface

- The crypto map entries each must identify the other peer (unless the responding peer is using a dynamic crypto map).
- The crypto map entries must have at least one transform set in common.

If you create more than one crypto map entry for a given interface, use the sequence number (seq-num) of each entry to rank it: the lower the seq-num, the higher the priority. At the interface that has the crypto map set, the ASA evaluates traffic against the entries of higher priority maps first.

Create multiple crypto map entries for a given interface if either of the following conditions exist:

- Different peers handle different data flows.
- You want to apply different IPsec security to different types of traffic (to the same or separate peers), for example, if you want traffic between one set of subnets to be authenticated, and traffic between another set of subnets to be both authenticated and encrypted. In this case, define the different types of traffic in two separate ACLs, and create a separate crypto map entry for each crypto ACL.

To create a crypto map and apply it to the outside interface in global configuration mode, perform the following steps in either single or multiple context mode:

**Step 1** To assign an ACL to a crypto map entry, enter the `crypto map match address` command.

The syntax is `crypto map map-name seq-num match address aclname`. In the following example the map name is abcmap, the sequence number is 1, and the ACL name is 121_list.

```
hostname(config)# crypto map abcmap 1 match address 121_list
```

**Step 2** To identify the peer(s) for the IPsec connection, enter the `crypto map set peer` command.

The syntax is `crypto map map-name seq-num set peer {ip_address1 | hostname1} [... ip_address10 | hostname10]`. In the following example the peer name is 10.10.4.108.

```
hostname(config)# crypto map abcmap 1 set peer 10.10.4.108
```

**Step 3** To specify an IKEv1 transform set for a crypto map entry, enter the `crypto map ikev1 set transform-set` command.

The syntax is `crypto map map-name seq-num ikev1 set transform-set transform-set-name`. In the following example, the transform set name is FirstSet.

```
hostname(config)# crypto map abcmap 1 set transform-set FirstSet
```

**Step 4** To specify an IKEv2 proposal for a crypto map entry, enter the `crypto map ikev2 set ipsec-proposal` command:

The syntax is `crypto map map-name seq-num set ikev2 ipsec-proposal proposal-name`. In the following example, the proposal name is secure.

With the `crypto map` command, you can specify multiple IPsec proposals for a single map index. In that case, multiple proposals are transmitted to the IKEv2 peer as part of the negotiation, and the order of the proposals is determined by the administrator upon the ordering of the crypto map entry.

**Note** If combined mode (AES-GCM/GMAC) and normal mode (all others) algorithms exist in the IPsec proposal, then you cannot send a single proposal to the peer. You must have at least two proposals in this case, one for combined mode and one for normal mode algorithms.

```
hostname(config)# crypto map abcmap 1 set ikev2 ipsec-proposal secure
```
Applying Crypto Maps to Interfaces

You must apply a crypto map set to each interface through which IPsec traffic travels. The ASA supports IPsec on all interfaces. Applying the crypto map set to an interface instructs the ASA to evaluate all interface traffic against the crypto map set and to use the specified policy during connection or security association negotiations.

Binding a crypto map to an interface also initializes the runtime data structures, such as the security association database and the security policy database. When you later modify a crypto map in any way, the ASA automatically applies the changes to the running configuration. It drops any existing connections and reestablishes them after applying the new crypto map.

To apply the configured crypto map to the outside interface, perform the following steps:

**Step 1**  Enter the `crypto map interface` command. The syntax is `crypto map map-name interface interface-name`.

```
hostname(config)# crypto map abcmap interface outside
hostname(config)#
```

**Step 2**  Save your changes.

```
hostname(config)# write memory
hostname(config)#
```