



# Configuring Internet Key Exchange for IPsec VPNs

This module describes how to configure the Internet Key Exchange (IKE) protocol for basic IP Security (IPsec) Virtual Private Networks (VPNs). IKE is a key management protocol standard that is used in conjunction with the IPsec standard. IPsec is an IP security feature that provides robust authentication and encryption of IP packets.

IPsec can be configured without IKE, but IKE enhances IPsec by providing additional features, flexibility, and ease of configuration for the IPsec standard.

IKE is a hybrid protocol, that implements the Oakley key exchange and Skeme key exchange inside the Internet Security Association Key Management Protocol (ISAKMP) framework. (ISAKMP, Oakley, and Skeme are security protocols implemented by IKE.)



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**Note** Security threats, as well as the cryptographic technologies to help protect against them, are constantly changing. For more information about the latest Cisco cryptographic recommendations, see the [Next Generation Encryption](#) (NGE) white paper.

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## Creating IKE Policies

Restrictions for configuring AES IKE policy

- IPsec and long keys (the “k9” subsystem) must be supported.
- AES cannot encrypt IPsec and IKE traffic if an acceleration card is present.

```
enable
configure terminal
crypto isakmp policy 10
```

```

encryption aes 256
hash sha
authentication pre-share
group 14
end

```

## Troubleshooting Tips

- Clear (and reinitialize) IPsec SAs by using the **clear crypto sa EXEC** command.

Using the **clear crypto sa** command without parameters will clear out the full SA database, which will clear out active security sessions. You may also specify the **peer**, **map**, or **entry** keywords to clear out only a subset of the SA database. For more information, see the **clear crypto sa** command in the Cisco IOS Security Command Reference.

- The default policy and default values for configured policies do not show up in the configuration when you issue the **show running-config** command. To display the default policy and any default values within configured policies, use the **show crypto isakmp policy** command.
- Any IPsec transforms or IKE encryption methods that the current hardware does not support should be disabled; they are ignored whenever an attempt to negotiate with the peer is made.

If a user enters an IPsec transform or an IKE encryption method that the hardware does not support, a warning message will be generated. These warning messages are also generated at boot time. When an encrypted card is inserted, the current configuration is scanned. If any IPsec transforms or IKE encryption methods are found that are not supported by the hardware, a warning message will be generated.

## Configuring IKE Authentication

After you have created at least one IKE policy in which you specified an authentication method (or accepted the default method), you need to configure an authentication method. IKE policies cannot be used by IPsec until the authentication method is successfully configured.




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**Note** Before configuring IKE authentication, you must have configured at least one IKE policy, which is where the authentication method was specified (or RSA signatures was accepted by default).

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To configure IKE authentication, you should perform one of the following tasks, as appropriate:

## Configuring RSA Keys Manually for RSA Encrypted Nonces




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**Note** This task can be performed only if a CA is not in use.

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```

enable
configure terminal
crypto key generate rsa general-keys modulus 360
crypto key generate ec keysizes 256 label Router_1_Key
end

```

### Optional Configuration using Named Key

```
enable
configure terminal
crypto key pubkey-chain rsa
named-key otherpeer.example.com
address 10.5.5.1
key-string
00302017 4A7D385B 1234EF29 335FC973
2DD50A37 C4F4B0FD 9DADE748 429618D5
18242BA3 2EDFBDD3 4296142A DDF7D3D8
08407685 2F2190A0 0B43F1BD 9A8A26DB
07953829 791FCDE9 A98420F0 6A82045B
90288A26 DBC64468 7789F76E EE21
quit
```

### Optional Configuration using Addresses Key

```
enable
configure terminal
crypto key pubkey-chain rsa
addressed-key 10.1.1.2 encryption
address 10.5.5.1
key-string
00302017 4A7D385B 1234EF29 335FC973
2DD50A37 C4F4B0FD 9DADE748 429618D5
18242BA3 2EDFBDD3 4296142A DDF7D3D8
08407685 2F2190A0 0B43F1BD 9A8A26DB
07953829 791FCDE9 A98420F0 6A82045B
90288A26 DBC64468 7789F76E EE21
quit
```

## Configuring Preshared Keys



**Note** Preshared keys do not scale well with a growing network.

#### Restrictions for Mask Preshared Keys

- The SA cannot be established between the IPsec peers until all IPsec peers are configured for the same preshared key.
- The mask preshared key must be distinctly different for remote users requiring varying levels of authorization. A new preshared key should be configured for each level of trust and correct keys must be assigned to the correct parties. Otherwise, an untrusted party may obtain access to protected data.

```
enable
configure terminal
crypto isakmp identity address
crypto isakmp key sharedkeystring address 192.168.1.33 no-xauth
crypto isakmp key sharedkeystring address 10.0.0.1
end
```

## Configuring IKE Mode Configuration

```
enable
configure terminal
```

```
ip local pool pool1 172.16.23.0 172.16.23.255
crypto isakmp client configuration address-pool local pool1
end
```

## Configuration Examples for an IKE Configuration

### Example: Creating IKE Policies

This section contains the following examples, which show how to configure an AES IKE policy and a 3DES IKE policy.




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**Note** Cisco no longer recommends using 3DES; instead, you should use AES. For more information about the latest Cisco cryptographic recommendations, see the [Next Generation Encryption](#) (NGE) white paper.

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### Example: Creating an AES IKE Policy

The following example is sample output from the **show running-config** command. In this example, the AES 256-bit key is enabled.

```
Current configuration : 1665 bytes
!
version 12.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname "Router1"
!
!
ip subnet-zero
!
!
no ip domain lookup
!
ip audit notify log
ip audit po max-events 100
!
crypto isakmp policy 10
  encryption aes 256
  authentication pre-share
  lifetime 180
crypto isakmp key cisco123 address 10.0.110.1
!
!
crypto ipsec transform-set aasset esp-aes 256 esp-sha-hmac
  mode transport
.
.
.
```

## Example: Creating 3DES IKE Policies

This example creates two IKE policies, with policy 15 as the highest priority, policy 20 as the next priority, and the existing default priority as the lowest priority. It also creates a preshared key to be used with policy 20 with the remote peer whose IP address is 192.168.224.33.

```
crypto isakmp policy 15
  encryption 3des
  hash md5
  authentication rsa-sig
  group 2
  lifetime 5000
!
crypto isakmp policy 20
  authentication pre-share
  lifetime 10000
!
crypto isakmp key 1234567890 address 192.168.224.33
```

In the example, the encryption DES of policy default would not appear in the written configuration because this is the default value for the encryption algorithm parameter.

If the **show crypto isakmp policy** command is issued with this configuration, the output is as follows:

```
Protection suite priority 15
encryption algorithm:3DES - Triple Data Encryption Standard (168 bit keys)
hash algorithm:Message Digest 5
authentication method:Rivest-Shamir-Adleman Signature
Diffie-Hellman group:#2 (1024 bit)
lifetime:5000 seconds, no volume limit
Protection suite priority 20
encryption algorithm:DES - Data Encryption Standard (56 bit keys)
hash algorithm:Secure Hash Standard
authentication method:preshared Key
Diffie-Hellman group:#1 (768 bit)
lifetime:10000 seconds, no volume limit
Default protection suite
encryption algorithm:DES - Data Encryption Standard (56 bit keys)
hash algorithm:Secure Hash Standard
authentication method:Rivest-Shamir-Adleman Signature
Diffie-Hellman group:#1 (768 bit)
lifetime:86400 seconds, no volume limit
```

Note that although the output shows “no volume limit” for the lifetimes, you can configure only a time lifetime (such as 86,400 seconds); volume-limit lifetimes are not configurable.

## Example: Configuring IKE Authentication

The following example shows how to manually specify the RSA public keys of two IPsec peer-- the peer at 10.5.5.1 uses general-purpose keys, and the other peer uses special-usage keys:

```
crypto key pubkey-chain rsa
  named-key otherpeer.example.com
  address 10.5.5.1
  key-string
  005C300D 06092A86 4886F70D 01010105
  00034B00 30480241 00C5E23B 55D6AB22
  04AEF1BA A54028A6 9ACC01C5 129D99E4
  64CAB820 847EDAD9 DF0B4E4C 73A05DD2
```

```

BD62A8A9 FA603DD2 E2A8A6F8 98F76E28
D58AD221 B583D7A4 71020301 0001
quit
exit
addressed-key 10.1.1.2 encryption
key-string
00302017 4A7D385B 1234EF29 335FC973
2DD50A37 C4F4B0FD 9DADE748 429618D5
18242BA3 2EDFBDD3 4296142A DDF7D3D8
08407685 2F2190A0 0B43F1BD 9A8A26DB
07953829 791FCDE9 A98420F0 6A82045B
90288A26 DBC64468 7789F76E EE21
quit
exit
addressed-key 10.1.1.2 signature
key-string
0738BC7A 2BC3E9F0 679B00FE 53987BCC
01030201 42DD06AF E228D24C 458AD228
58BB5DDD F4836401 2A2D7163 219F882E
64CE69D4 B583748A 241BED0F 6E7F2F16
0DE0986E DF02031F 4B0B0912 F68200C4
C625C389 0BFF3321 A2598935 C1B1
quit
exit
exit

```

## Verifying IKE Policies

```
Router# show crypto isakmp policy
```

```

Global IKE policy
Protection suite of priority 1
  encryption algorithm: Three key triple DES
  hash algorithm:      Secure Hash Standard
  authentication method: Pre-Shared Key
  Diffie-Hellman group: #5 (1536 bit)
  lifetime:            86400 seconds, no volume limit

```

## Verifying RSA Keys

```
Router# show crypto key pubkey-chain rsa
```

```
Codes: M - Manually configured, C - Extracted from certificate
```

Code	Usage	IP-Address/VRF	Keyring	Name
C	Signing		default	cn=Cisco Licensing Root CA,o=Cisco
C	Signing		default	cn=CA
C	Signing		default	cn=Cisco Root CA M1,o=Cisco
C	Signing		default	cn=Cisco Root CA 2048,o=Cisco
Systems				
C	Signing		default	cn=Cisco Manufacturing CA,o=Cisco
Systems				
C	Signing		default	ou=Class 3 Public Primary
Certification Authority,o=VeriSign, Inc.,c=US				
C	Signing		default	cn=Cisco Root CA M2,o=Cisco
C	Signing		default	cn=Cisco Manufacturing CA
SHA2,o=Cisco				
C	Signing		default	cn=Licensing Root - DEV,o=Cisco

# Additional References

## Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
Security commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	<ul style="list-style-type: none"> <li>• <a href="#">Cisco IOS Security Command Reference Commands A to C</a></li> <li>• <a href="#">Cisco IOS Security Command Reference Commands D to L</a></li> <li>• <a href="#">Cisco IOS Security Command Reference Commands M to R</a></li> <li>• <a href="#">Cisco IOS Security Command Reference Commands S to Z</a></li> </ul>
IPsec configuration	<a href="#">Configuring Security for VPNs with IPsec</a>
IKE Version 2	<a href="#">Configuring Internet Key Exchange Version 2</a>
Configuring RSA keys to obtain certificates from a CA	<a href="#">Deploying RSA Keys Within a PKI</a>
Suite-B ESP transforms	<a href="#">Configuring Security for VPNs with IPsec</a>
Suite-B support for certificate enrollment for a PKI	<a href="#">Configuring Certificate Enrollment for a PKI</a>

## Standards

Standards	Title
None	--

## MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**RFCs**

RFCs	Title
RFC 2408	<a href="#">Internet Security Association and Key Management Protocol (ISAKMP)</a>
RFC 2409	The Internet Key Exchange (IKE)
RFC 2412	<a href="#">The OAKLEY Key Determination Protocol</a>

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>