Chapter 48

IP Security (IPsec)

Introduction

This chapter describes:

- Internet Protocol Security Facility (IPsec)
  A set of security protocols that provides encryption and authentication to IPv4 and IPv6 packets
- Internet Security Association Key Management Protocol (ISAKMP)
  A common framework for a key management implementation – the framework that IKE uses
- Internet Key Exchange (IKE) protocol
  A mechanism for negotiating IPsec protection and keys.
- NAT-Traversal
  An enhancement to IPsec and ISAKMP protocols that lets Virtual Private Network (VPN) clients communicate through NAT gateways over the Internet.
- Configuration examples of VPN client support for Microsoft Windows 2000 and XP®

Additionally, this chapter describes an implementation of Pre-IPsec Security Associations (based on 1998 Internet Drafts), and how to upgrade a Virtual Private Network (VPN) based on this IPsec implementation.

Some interface and port types mentioned in this chapter may not be supported on your router. The interface and port types that are available vary depending on your product's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the Hardware Reference.

You may need special feature licences to use some encryption algorithms, or to increase the number of VPN tunnels that can be active concurrently. Contact your authorised distributor or reseller for details.

IP Security (IPsec)

IPsec provides the following security services for traffic at the IP layer:

- Data origin authentication—identifying who sent the data.
- Confidentiality (encryption)—ensuring that the data has not been read en route.
- Connectionless integrity—ensuring the data has not been changed en route.
- Replay protection—detecting packets received more than once to help protect against denial of service attacks.

IPsec protects one or more paths between a pair of hosts, a pair of security gateways, or a security gateway and a host. A *security gateway* is an intermediate device, such as a router or firewall, that implements IPsec. Two devices that use IPsec to protect a path between them are called *peers*.

IPsec requires a PCI Accelerator Card (PAC) to provide hardware data compression and encryption. A PAC is a hardware processing unit the router's CPU controls.

Security Protocols and Modes

The following protocols provide security services:

- Encapsulating Security Payload (ESP)
- Authentication Header (AH)

The Encapsulating Security Payload protocol (protocol 50) provides encryption (confidentiality) and authentication (connectionless integrity and data origin authentication). ESP protects an IP packet but not additional headers that ESP adds.

The Authentication Header protocol provides everything that ESP does – connectionless integrity and data origin authentication – but it does not encrypt to ensure confidentiality. AH protects an IP packet and also additional headers that AH adds.

ESP and AH may be applied alone or together to provide the desired security services. The security they provide depends on the cryptographic algorithms they apply. Both are algorithm-independent, which lets new algorithms be added without affecting other parts of the implementation. The RFCs specify a set of default algorithms to ensure interoperability between IPsec implementations.

Both protocols support the two IPsec modes: transport and tunnel. Transport mode protects an IP load in upper layer protocols such as UDP and TCP protocols. AH and ESP intercept packets from the transport layer that are intended for the network layer, protect the transport header, and provide the configured security. Transport mode provides end-to-end security where the communications endpoint is also the cryptographic endpoint.

Tunnel mode protects data by encapsulating entire packets that are decapsulated by a security gateway. Tunnel mode may be used with security gateways where the destination of the packet differs from the security endpoint. IPsec also supports nested tunnels.

Compression Protocol

IP Payload Compression (IPComp) provides compression services for traffic at the IP layer. The following RFCs specify IPComp:

- RFC 2393, *IP Payload Compression Protocol (IPComp)*
- RFC 2395, *IP Payload Compression Using LZS*

IPComp provides *stateless compression* to compressible IP packets. Stateless compression means that each packet is compressed (and decompressed) with no dependence on any other packet. Stateless compression is not as efficient as *stateful compression* that uses information gained in compressing previous packets to better compress the current packet. However, stateless compression is required for IP packets as they may be re-ordered or lost while traversing the Internet, thus depriving the decompressing device of the information used by the compressing device to achieve the more efficient compression.

The compression algorithms that IPComp uses can expand uncompressible data so IPComp tries to compress packets when they are larger than a certain size. This increases the chance of achieving a useable compression. IPComp sends packets uncompressed if they expand during compression. When too many uncompressible packets are seen, IPComp stops trying to compress them for a set number of packets.

IPComp must try to compress packets before IPsec because encrypted data is not compressible.

Security Associations (SA)

A Security Association (SA) is a one-way connection that provides security services between IPsec peers. For example, SAs determine the security protocols and the keys. An IPsec database (SADB) maintains the SAs that the IPsec protocols use.

Typically, two SAs are created on each end for a traffic stream. That is, Host A would have one SA to process inbound traffic and one to process outbound traffic. Individual SAs are protocol-specific; each uses Authentication Header (AH) or Encapsulating Security Payload (ESP) protocols but not both. When multiple SAs are necessary for a traffic stream between two hosts, the collection of SAs is grouped into an *SA bundle*.

An SA is uniquely identified by a combination of the following:

- a random number called the Security Parameter Index (SPI)
- an IP destination address
- a security protocol header, either AH or ESP

A transport mode SA is a security association between two hosts. Tunnel mode protects the whole IP packet by applying AH or ESP to tunnelled packets.

A tunnel mode SA is one applied to an IP tunnel. Whenever either end of a security association is a security gateway, the SA **must** be in tunnel mode. This avoids problems with fragmentation and reassembly of IPsec packets, and avoids problems where multiple paths exist between security gateways. An exception is where the security gateway is acting as a host and the traffic (e.g. a Telnet session) is destined for a security gateway.

A tunnel mode SA has an outer IP header that specifies the IPsec peer, and an inner IP header that specifies the destination for the packet. The security protocol header appears after the outer IP header and before the inner IP header. If AH is employed in tunnel mode, the tunnelled packet and portions of the outer IP header are protected. If ESP is employed, only the tunnelled packet is protected.

ISAKMP/IKE

The Internet Security Association and Key Management Protocol (ISAKMP) provides a framework for negotiating SAs and their attributes, including secret keys. The Internet Key Exchange (IKE) protocol is based on the ISAKMP framework and provides an authenticated key exchange method using the Diffie-Hellman algorithm.

ISAKMP

The Internet Security Association and Key Management Protocol (ISAKMP) is defined in RFC 2408. It prescribes procedures and packet formats to securely establish, negotiate, modify, and delete Security Associations (SAs) and their attributes, including secret keys. It provides a common framework for a key management implementation and is independent of key generation, authentication, encryption algorithms, and SA definitions. A key management protocol based on the ISAKMP framework must define its own key generation techniques, encryption algorithms, and authentication types. ISAKMP can be implemented over any transport layer although UDP port 500 is required in order to comply with the RFC.

ISAKMP uses random values called *cookies* to identify separate negotiations and to stop denial of service attacks. Although total protection against denial of service attacks is impossible, it is possible to protect computing resources such as slow Diffie-Hellman calculations. ISAKMP requires that the authentication, key exchange, and SA negotiation be linked together. *Connection hijacking*, where a third party switches places with one of the original parties during the negotiation, is therefore not possible. Man-in-the-middle attacks such as interception, insertion, deletion, modification, and replay are prevented by message authentication. If anything out of the ordinary happens during an ISAKMP exchange, the ISAKMP state machine returns to idle state and does not create unauthenticated SAs.

ISAKMP Messages

Each ISAKMP message is constructed from a generic ISAKMP header followed by one or more payloads. The ISAKMP RFC defines the following payloads:

Name	Description
Security Association (SA)	Used to negotiate security attributes and indicates the DOI and situation under which the negotiation is taking place.
Proposal (P)	Part of the SA payload containing security protocols such as AH and ESP.
Transform (T)	Part of the proposal payload containing security attributes for the specified security mechanism.
Key Exchange (KE)	Key exchange specific data.

Name	Description
Identification (ID)	DOI-specific information for identifying communicating peers.
Certificate (CERT)	Used to transport certificates.
Certificate Request (CR)	Used to request a certificate from the other peer.
Hash (HASH)	Data the hash function generates for the purpose of verifying the integrity of the message or entity authentication.
Signature (SIG)	Data generated by the digital signature function used to authenticate some part of the message.
Nonce (NONCE)	Random data used to guarantee liveness and protect against replay attacks.
Notification (N)	ISAKMP and DOI-specific informational data.
Delete (D)	Used to notify the other peer that a SA has been deleted.
Vendor ID (VID)	Used to enable devices to recognise remote instances of their implementations and use proprietary extensions.
Attribute (ATTR)	Used to exchange configuration information.

ISAKMP requires that an authenticated key exchange be supported and that strong peer authentication be used. However it does not define what algorithms must be used.

Key Management

Encryption algorithms are used with encryption keys. Encryption algorithms such as DES have undergone hundreds of hours of cryptanalysis and the mathematics behind the algorithm are well published. It is unlikely that an attack on DES encrypted data would come in the form of an attack on the DES encryption algorithm. It is more likely that an attacker would try to discover the value of the encryption key used to encrypt the data. This means that the security of encrypted data depends on the security of the encryption key. If a key has been created and securely stored, an intruder would have to try every possible key, which is unlikely.

The term *key management* refers to the creation, distribution, storage, and deletion of keys. If an attacker were to obtain an encryption key, they could decrypt sessions they recorded any length of time ago. Therefore a key management protocol must ensure keys are never compromised.

The concept of a *session key* is used to increase the security of encryption keys. If a key is changed frequently, an attacker could not try every possible key often enough on the encrypted data. Also, if a key is compromised in the future, only the data encrypted with that particular session key can be decrypted.

Session keys must be changed on a regular basis, so manually keyed IPsec soon becomes unmanageable. Keys to other sites must be changed regularly for every site in the VPN. This can be a long and tedious job in large VPNs. Therefore, session keys must be changed automatically, and more importantly, securely.

Two devices that engage in ISAKMP negotiations are described as being ISAKMP *peers*. Communication between two ISAKMP peers takes the form of an ISAKMP exchange, which consists of a finite number of messages and is dynamically created and destroyed as required. ISAKMP defines the following negotiation phases for key management:

Phase	Description
1	When the ISAKMP SA is established that provides a secure, authenticated channel for traffic between two ISAKMP peers.
1.5	Exchanges occur after the ISAKMP SA has been created in phase 1, but before phase 2 SAs can be created. These are commonly used for extended authentication and remote configuration.
2	When all traffic is under the protection of the ISAKMP SA. The negotiation of SAs and keys on behalf of services such as IPsec, as defined in a particular DOI, makes it possible to negotiate more than one phase 2 SA over the same ISAKMP SA without having to re-establish communications with the ISAKMP peers.

Key Exchange

The most important property of a key management protocol is how session keys are exchanged. Key exchange has two parts:

- Key generation
- Key transport

A key exchange protocol must ensure that only the two negotiating parties know the value of the exchanged session key. SKIP, Photuris, SKEME, and Oakley are examples of key exchange protocols. If one key is compromised, it must not cause other keys to be compromised. This property is called Perfect Forward Secrecy (PFS). Identity protection ensures that the identity of the two parties exchanging keys cannot be discovered. If either party can initiate the key exchange, then the key exchange protocol is said to display *symmetry*. Other properties such as replay protection ensure that the key management protocol is not susceptible to denial of service and man-in-the-middle attacks.

The principal behind public key cryptography is that a user can encrypt a message with a public key and be sure that only the person who holds the private part of the public key pair can decrypt it. This makes public key cryptography ideal for transporting session keys between IPsec peers.

RSA is a public key algorithm that is commonly used in key exchanges. A session key can be created at one end of a connection, encrypted with the peer's RSA public key, and transmitted over the connection to the peer. Because only the peer who has the private part of the RSA key can decrypt the session key, the key can be securely transferred. The Secure Shell protocol is an example of using RSA to exchange session keys.

The Diffie-Hellman key exchange method also uses public key cryptography. It is not an encryption algorithm and is designed specifically for key exchange. The public and private values in Diffie-Hellman do not need to be kept secret and commonly used values are well documented and published. The mathematics behind Diffie-Hellman enables two parties to generate a shared secret key with the knowledge that no other party can calculate that same value.

Using RSA for key exchange is faster than Diffie-Hellman but has the disadvantage that the public part of the RSA keys must first be exchanged. That the other party in the negotiation is the true owner of the key must also be verified. Diffie-Hellman does not require that information be previously exchanged but is slightly slower than RSA.

See Chapter 42, Compression and Encryption Services for more information on public key cryptography, RSA, and Diffie-Hellman.

Key Exchange Authentication

Key exchange authentication guarantees that each party knows they are talking to the correct party. It must also ensure that all messages before and after the authentication procedure could not have been substituted by a third party. This means that all messages must be authenticated.

Key exchange without authentication is susceptible to an attack known as the "man-in-the-middle attack" where a third party intercepts the key negotiation and pretends to be the opposite end to both parties. The result is that both parties negotiate keys with the third party thinking they have negotiated with each other.

Authentication of each entity can take place after the session key has been generated or during the key exchange process itself. It is common for the session key to include a piece of information that could be known only by the actual negotiating parties. Then each party can be authenticated by proving they know the session key.

Authentication techniques usually fall into two categories—weak and strong. Weak authentication includes sending keys in clear-text or using easily guessed keys. Strong authentication includes public key encryption and digital signatures. Strong authentication techniques generally require more overhead.

Password (or shared key) authentication works on the principal that the remote party is the only one who knows the value of the shared secret. Both parties are authenticated when they prove they know the secret. For this kind of authentication to work, the shared secret must be securely entered at both ends of the link.

Public key cryptography is an example of strong authentication. If a remote party decrypts a message encrypted with a particular public key, then they must be the true owner of the public/private key pair. Before authentication can take place, public keys must first be exchanged and verified as the correct key for the other party. This can be done manually by the administrator (by comparing the key at each peer), or automatically by using certificates that link a public key to an entity and are signed by a trusted third party. Because public key values are not secret, the key exchange (or certificate exchange) does not need to be done over a secure channel.

ISAKMP Exchange Types

The ISAKMP exchange and ISAKMP messages are the building blocks for a key management protocol using the ISAKMP framework. An ISAKMP exchange consists of a finite number of messages that are constructed from a defined set of payloads. The following exchange types are defined in the ISAKMP RFC:

- Base
- Identity protection
- Authentication
- Aggressive
- Informational

A key management protocol that uses ISAKMP such as IKE defines additional exchange types as necessary.

IKE

The Internet Key Exchange (IKE) protocol is defined in RFC 2409 and provides key management for IPsec by combining parts of the Oakley and SKEME protocols with the ISAKMP framework.

The Oakley key determination protocol is defined in RFC 2412 and describes a method of authenticated key exchange with PFS and identity protection. The SKEME protocol is defined in Krawcyzk's document "*SKEME: A Versatile Secure Key Exchange Mechanism for Internet*". It also provides an authenticated key exchange and describes a method of public key authentication with fast re-keying using nonces.

IKE Exchanges

IKE defines two phase 1 exchanges to create the ISAKMP SA:

- *Main mode* is an implementation of the ISAKMP identity protection exchange and must be implemented.
- *Aggressive mode* is an implementation of the ISAKMP aggressive exchange and may optionally be implemented.

IKE also defines a *New Group mode* that must be used after phase 1, and allows new Diffie-Hellman public key values to be negotiated.

IKE defines a new ISAKMP exchange called *Quick mode* for phase 2 only. This exchange negotiates SAs on behalf of other services such as IPsec.

ISAKMP informational exchanges can take place in phase 1 or phase 2 and notify the other end of errors and SA deletions.

To allow the exchange of configuration information, a *transaction exchange* has been defined. This exchange can take place in either phase 1, phase 1.5, or phase 2. It is commonly used in phase 1.5 to transport extended authentication information.

All IKE exchanges conform to standard ISAKMP payload syntax and attribute encoding. The SA payload is always first in phase 1 messages. The hash payload must always be first in all phase 2 messages. Other ISAKMP payloads can be received in any order.

IKE Security Association Negotiation

The SA payload used by Main, Aggressive, and Quick Modes takes the form of *Transform* payloads encapsulated in *Proposal* payloads encapsulated in an SA payload. In phase 1 there can be only one SA payload and one Proposal payload. Different options for the ISAKMP SA are described in separate Transform payloads. In phase 2 it is possible to negotiate more than one SA at once. Hence there can be more than one SA payload. Each SA payload can have more than one Proposal payload (i.e. AH and ESP). Each Proposal payload can have more than one Transform payload (i.e. SHA or MD5).

IKE Key Exchange

IKE takes its key exchange method from RFC 2412, *The OAKLEY Key Determination Protocol*. It uses the Diffie-Hellman public key algorithm and can be completed in three or more messages. It provides the authenticated key exchange required by ISAKMP and can optionally provide PFS for phase 2. The Oakley protocol defines a set of Diffie-Hellman public key values known as the Oakley groups. IKE requires that the Oakley MODP Group 1 be supported in a compliant implementation.

IKE Authentication

IKE implementations must support authentication via pre-shared keys and may optionally support authentication with public key encryption, signatures, or a revised method of using public key encryption.

Authentication using a pre-shared key has the least computational overhead of the different authentication methods. However, the shared key must be securely transported to each device before ISAKMP negotiations take place. The key exchange is authenticated by adding the shared key to the key generation process. Each party then proves they know the value of the session key by encrypting and decrypting the last message in the phase 1 exchange.

Authentication using public key encryption is slower than pre-shared key but is a stronger method. The nonce payloads are encrypted using the peer's public key. The ability to decrypt the nonce authenticates the exchange. Public key encryption also provides phase 1 identity protection by encrypting the ID payload with the peer's public key.

Authentication using signatures is slower than pre-shared key but is a stronger method. Signed hashes are exchanged at the end of the exchange and authentication is achieved by verifying the signature with the peer's public key. Because only the owner of the private part of the public key pair can sign the hash, as long as the signature decrypts correctly the peer is the true owner of the public key.

Both public key encryption and signatures require that public keys for each party be exchanged and verified. In the simple case the public key can be exchanged manually and verified by the administrator. Alternatively the public keys can be extracted from a certificate that links the key to the peer and is signed by a trusted third party. IKE provides mechanisms for exchanging certificates by allowing messages to have an optional certificate payload or certificate request payload. This requires each IKE peer to have a separate method for obtaining certificates signed by a Certification Authority (CA).

Extended Authentication (XAUTH) allows legacy authentication mechanisms such as RADIUS to be used to extend phase 1 authentication. It does not replace phase 1 authentication and is completed in phase 1.5 before phase 2 SAs can be created.

IPsec on the Router

The router provides an RFC-compliant implementation of IPsec. The IPsec implementation supports AH and ESP, and integrates IPComp into IPsec for ease of management. The following RFCs specify IPsec:

- RFC 2104, *HMAC: Keyed-Hashing for Message Authentication*.
- RFC 2401, *Security Architecture for the Internet Protocol*.
- RFC 2402, *IP Authentication Header*.
- RFC 2403, *The Use of HMAC-MD5-96 within ESP and AH*.
- RFC 2404, *The Use of HMAC-SHA-1-96 within ESP and AH*.
- RFC 2405, *The ESP DES-CBC Cipher Algorithm With Explicit IV*.
- RFC 2406, *IP Encapsulating Security Payload (ESP)*.
- RFC 2407, *The Internet IP Security Domain of Interpretation for ISAKMP*.
- RFC 2408, *Internet Security Association and Key Management Protocol (ISAKMP)*.
- RFC 2409, *The Internet Key Exchange (IKE)*.
- RFC 2410, *The NULL Encryption Algorithm and Its Use With IPsec*.
- RFC 2411, *IP Security Document Roadmap*.
- RFC 2412, *The OAKLEY Key Determination Protocol*.

IPsec is also compatible with the following Internet Drafts:

- *The ISAKMP Configuration Method*, Revision 5, 17 August 1999
- *Extended Authentication within ISAKMP/Oakley (XAUTH)*, Revision 6, 1 December 1999
- *A Hybrid Authentication Mode for IKE*, Revision 2, 21 June 1999

For backwards compatibility, the router also supports an older Security Association protocol based on 1998 Internet drafts.

Modification of the IPsec configuration requires Security Officer privilege. See "User Authentication Database" on page 41-10 of Chapter 41, User Authentication for more information about creating users and login names with Security Officer privilege.

IPsec uses ENCO services for various encryption, authentication, and compression algorithms. If the ENCO module is not configured to provide the resources required by IPsec, the IPsec configuration does not work as intended.

See Chapter 42, Compression and Encryption Services for more information about configuring ENCO resources.

The router implements IPsec with the following components:

- The IPsec configuration, which is stored in the IPsec Security Policy Database (SPD). Three entities are used to define the IPsec configuration—SA specifications, bundle specifications, and policies. See "Security Policy Database (SPD)" on page 48-13 for a description of these entities.
- The currently active Security Associations and SA bundles. These are created from the IPsec configuration, either manually or by the ISAKMP/IKE key management protocol. See "SA Bundles" on page 48-16 for a description of SAs and SA bundles. Manual and ISAKMP/IKE key management is described in "Security through Key Management" on page 48-16.

The IPsec implementation also provides backwards compatibility with the older Security Association implementation and a mechanism for converting old SA configurations to the equivalent IPsec configuration. "Pre-IPsec Security Associations" on page 48-20 describes this functionality.

Security Policy Database (SPD)

The protection IPsec offers is based on requirements defined by IPsec policies stored in a Security Policy Database (SPD) established and maintained by a Security Officer. When the router is in security mode, only users with Security Officer privilege can change the IPsec configuration. The three entities that define the IPsec configuration in the SPD are:

- **SA specifications**
- **Bundle specifications**
- **IPsec policies**

SA specifications

SA specifications are templates for SAs. They specify attributes an SA has when it is created. The router creates Security Associations (SA) in pairs: one for outbound packets and one for inbound packets. When an SA pair is created, a specification determines SA attributes. Attributes of an SA specification are the key management mechanism to create SAs, encryption and/or authentication algorithms that SAs use, and how the SAs provide an anti-replay service, if any. When the specification requires a manual key management mechanism to create SAs, the specification identifies SPIs and encryption and/or authentication keys that the SAs need.

Bundle specifications

Bundle specifications are templates for SA bundles. They specify the number and order of SAs an SA bundle has when it is created. A bundle specification used by ISAKMP/IKE to negotiate an SA bundle can specify more than one bundle of SAs, in order, with the most desired bundle first. ISAKMP/IKE negotiates with the IPsec peer to determine the bundle to use.

The router creates an SA pair as part of an SA bundle. However, there is often only one pair in a bundle. When a bundle is created, a specification determines its attributes. Attributes of a specification is the key management mechanism to create the bundle, the SA pairs created for the bundle, and the lifetime expiry limits of the SA pairs created for the bundle. SA pairs are represented by SA specification identification numbers in a *bundle string*, which can also contain the connectors *and*, *or*, and a comma.

Bundle specifications that specify manual key management to create a bundle can specify that it consist of one, two, or three SA pairs. Each pair must use a different IPsec protocol (ESP, AH, or IPComp.) The SA specification identification numbers in the bundle string that create the pairs are separated by *ands*. SAs are applied to outbound packets in the order of the respective SA specifications in the bundle string. They are applied in the reverse order to inbound packets.

Bundle specifications that specify ISAKMP/IKE to create the bundle can specify one or more proposals, each consisting of one, two, or three SA pairs. Each of these proposals is separated by a comma in the bundle string. Pairs proposed in the bundle string can have more than one SA specification proposed for it. If different SA specifications offer a choice of algorithm(s) for the same IPsec protocol, they are separated by *or* in the bundle string.

For example, assume the following three SA specifications have been created:

- SA specification 1: ESP providing triple DES encryption.
- SA specification 2: ESP providing DES encryption.
- SA specification 3: AH providing MD5 authentication.

A valid bundle string would be:

```
"1 OR 2 AND 3, 1 OR 2"
```

This bundle string specifies two proposals. The preferred proposal, which is listed first, ("`1 OR 2 AND 3`") proposes a bundle of two SA pairs; an ESP SA pair ("`1 OR 2`") and an AH SA pair ("`3`"). There is a choice for the ESP SA pair between triple DES ("`1`") and DES ("`2`") with triple DES being the preferred choice as it is listed first. The AH SA pair must use MD5.

The second proposal ("`1 OR 2`") proposes a bundle of one SA pair; an ESP SA pair with a choice between triple DES ("`1`") and DES ("`2`") with triple DES being the preferred choice as it is listed first.

Other possible bundle strings using these SA specifications include:

```
"1 AND 3, 1, 2 AND 3, 2"
"1, 2 AND 3"
"1, 2"
```

IPsec policies

In general, the mode that processes each IP packet is determined by matching information from the IP and transport layer headers of the IP packet with IPsec policies in the SPD.

Policies link together a rule for selecting a set of IP packets and an action. The actions are to permit, deny, or apply IPsec processing. A policy can be attached to only one IP logical interface, but multiple IPsec policies can be attached to the same IP logical interface. When multiple policies are attached to one IP logical interface, the policies are ordered and packets traversing the interface are matched against the policies' selection rules in order. Policies with more specific selection rules must be placed ahead of those with general rules. The commands **create ipsec policy** command on page 48-51 and **set ipsec policy** command on page 48-94 allow the order of policies on an interface to be managed. IPsec polices are attached to IP logical interfaces and receive packets for processing when the IPsec module is enabled.

Information used to select packets are called *selectors*. The packet selection rule is defined in a policy by assigning a value to one of the following selectors:

- Remote IP address – a single address, a range of addresses or a masked subnet
- Local IP address – a single address, a range of addresses or a masked subnet
- Remote port
- Local port
- Transport protocol such as UDP, TCP, and ICMP
- Local system name or user name
- Remote system name or user name

If a value is not assigned to a selector, the default is to match any value. An IP packet must have fields that match all the selectors of a policy to be selected by a policy. Each SA pair in each SA bundle associated with a policy also has selectors and selection values assigned to them.

A policy can have one SA bundle that processes all packets for a policy (in this case the pairs in the bundle have the same selection values as the policy). Or a policy can have more than one bundle, each of which processes a sub-set of the packets that match the policy. In this case, the pairs in each bundle have selection values that are more specific than those on the policy – their selection values for one or more selectors are the actual values seen in IP packets matching the policy. The configuration of the policy determines which of these two cases will exist. Each policy has a parameter (**saselectorfrompkt**) that specifies the SA selectors that take their selection value from the associated field of the IP packet rather than from the policy selection.

An IPsec policy can define these actions:

- **permit**—matching packets are allowed to bypass IPsec and are processed normally by the router
- **deny**—discard matching packets
- **ipsec**—IPsec processing is applied to matching packets

If the action is **ipsec**, the policy must also specify:

- The IP address of the IPsec peer, or **any** or **dynamic**. See "Dynamic IP Addresses" on page 48-17.
- The key management method to be used for creating an SA bundle to process the selected packets (either **isakmp** or **manual**).
- The bundle specification to be used when creating an SA bundle to process the selected packets.

If the key management is ISAKMP, the policy may also specify:

- That ISAKMP/IKE must use Perfect Forward Secrecy (PFS) when creating keys for the bundle.
- An Oakley group to be used by ISAKMP/IKE when negotiating the bundle.
- That Extended Authentication (XAUTH) is to be used. If the router is to be used as an XAUTH client, then an XAUTH username and password must also be supplied. Hybrid XAUTH allows phase 1 client authentication to be skipped but can only be used with an authentication type of **rsasignatures**.

SA Bundles

Each SA pair created on the router is stored in the Security Association Database (SAD) on the router. Each pair belongs to one SA bundle. Each bundle the router creates is attached to one IPsec policy and more than one bundle can be attached to the same policy. When multiple bundles are attached to a policy, the first one with pairs whose selectors match the packet is used to process the packet. Each policy is allowed a maximum of 100 concurrent IPsec SA bundles.

Multiple bundles may be assigned to one policy because:

- A second bundle may be created to replace a bundle that is nearing its lifetime expiry limit. In this case, there are two bundles that differ only in the keys and SPIs of their SA pairs. The new bundle is always placed before the old one and is therefore chosen to process all packets.
- A policy may be configured so that one or more of its selectors creates a new bundle for each new packet value seen of that selector. In this case, multiple bundles are active at any one time, and the bundle used to process a packet is the one with selectors that match the packet.

Create an SA bundle in one of the following ways:

- Manually, in which case the SA specifications used to create the SA pairs in the bundle specify the keys and SPIs to use.
- Using ISAKMP/IKE, in which case ISAKMP/IKE negotiates the keys and SPIs to use for the SA pairs.

Each SA bundle providing encryption, compression or authentication services requires between one and three ENCO channels, as each active SA pair requires one encryption channel. IPsec tunnels using all three services require three ENCO channels. This means the number of concurrent IPsec tunnels is limited by the number of available ENCO channels. To display the maximum number of ENCO channels on the router, use the **show enco** command.

Security through Key Management

IPsec security services use cryptographic keys for authentication and encryption. IPsec relies on a separate set of mechanisms to put these keys in place. IPsec requires support for both manual and automatic distribution of keys. ISAKMP/IKE is the default automatic key management mechanism. Other automated key distribution techniques may be used. For more information, see "ISAKMP/IKE" on page 48-6.

Manual key management

When an IPsec policy is configured to use manual key management to create its SA bundles, all bundle specifications and SA specifications that the policy uses must have their key management attribute set to **manual**.

When using manual key management, SA bundles are created when:

- Policies are created using the **create ipsec policy** command on page 48-51, and IPsec has previously been enabled with the **enable ipsec** command on page 48-80.
- IPsec is enabled with the **enable ipsec** command on page 48-80, and policies have previously been created using the **create ipsec policy** command on page 48-51.
- Parameters of the policy that affect the IPsec processing configuration are changed with the **set ipsec policy** command on page 48-94, and IPsec has previously been enabled with the **enable ipsec** command on page 48-80. In this case, the current SA bundles are destroyed first.

When using manual key management, SA bundles are destroyed when:

- An SA bundle or a policy is explicitly destroyed using the **destroy ipsec policy** command on page 48-72, and IPsec has previously been enabled with the **enable ipsec** command on page 48-80.
- IPsec is disabled using the **disable ipsec** command on page 48-74.
- Parameters of the policy affecting the IPsec processing configuration are changed with the **set ipsec policy** command on page 48-94, and IPsec has previously been enabled with the **enable ipsec** command on page 48-80. In this case, new SA bundles are created after the current ones are destroyed.

ISAKMP/IKE key management

When an IPsec policy is configured to use ISAKMP/IKE to create its SA bundles, all bundle specifications and SA specifications that the policy uses must have their key management attribute set to **isakmp**.

When using ISAKMP/IKE key management, IPsec requests that a new bundle be negotiated when the IP module passes it a packet for a policy that does not have a bundle or does not have a bundle with selectors that match the packet. Outbound packets are queued while IPsec is waiting for ISAKMP/IKE to negotiate a bundle. SA bundles are also created when an IPsec peer requests that ISAKMP/IKE negotiates a bundle.

SA pairs negotiated by ISAKMP/IKE have lifetime expiry limits, specified in seconds and/or kilobytes of data processed. When a pair in a bundle nears its lifetime limit, IPsec requests that ISAKMP/IKE negotiate a replacement bundle. The replacement is used as soon as it is negotiated.

Dynamic IP Addresses

In the simplest case two IPsec peers have fixed IP addresses. The IPsec and ISAKMP policies they use to communicate can be configured with these addresses. However, it is possible for a router with a dynamically assigned IP address to protect IP traffic using IPsec, provided that it uses ISAKMP key management and only communicates with IPsec peers that have fixed IP addresses.

Whenever an IPsec peer with a fixed IP address (Router A) is communicating with an IPsec peer with a dynamically assigned IP address (Router B) it needs to know the system name or user name of Router B so that it can select the correct IPsec and ISAKMP policies to use for communications with Router B. If it can also verify a password associated with Router B's name the name can be used to verify that the IPsec peer is indeed Router B.

Router A and Router B can use one of the following methods for their IPsec communications:

- Router A has an ISAKMP policy specifying **any** peer. Router B has an ISAKMP policy specifying the IP address of Router A.

  Router A has an IPsec policy configured with **peeraddress**=**dynamic** and **rname** set to the name of Router B. Router B has an IPsec policy with **peeraddress** set to the IP address of Router A and **lname** set to its own name.

- Router A has an ISAKMP policy specifying **any** peer and XAUTH configured. Router B has an ISAKMP policy specifying the IP address of Router A and with XAUTH configured with its own user name and password.

  Router A has an IPsec policy configured with **peeraddress**=**any**. Router B has an IPsec policy with **peeraddress** set to the IP address of Router A.

  In this case, the same IPsec policy is used for any peer. Authentication of the peer is provided by ISAKMP XAUTH.

In both of the above cases it may be necessary for Router A to add an IP route for the network(s) represented by Router B when it discovers the actual IP address that Router B is using. This is accomplished by specifying an IP route template on Router A's IPsec policy. When the policy is used to establish communications with a peer, an IP route is added using the information in the specified route template. [For information on setting up IP route templates see "Route Templates" on page 22-28 of Chapter 22, Internet Protocol (IP).]

IPsec Support for IPv6

IPsec is mandatory in IPv6. With encryption key handling, it provides authentication and encryption to all IPv6 traffic.

See Chapter 42, Compression and Encryption Services for more information about encryption key handling.

To create IPsec policies for IPv6 traffic, use the command:

```
create ipsec policy=name interface=interface action={deny|
    ipsec|permit} ipversion=6
    [bundlespecification=bundlespecification-id] [group={0|1|
    2}] [icmptype={list|ndall}] [isakmppolicy=isakmp-policy-
    name] [keymanagement={isakmp|manual}] [laddress={any|
    ipv6add[/prefix-length]|ipv6add-ipv6add}] [lname={any|
    system-name}] [lport={any|opaque|port}]
    [peeraddress={ipv6add|any|dynamic}] [position=pos]
    [raddress={any|ipv6add[/prefix-length]|ipv6add-ipv6add}]
    [rname={any|system-name}] [rport={any|port|opaque}]
    [saselectorfrompkt={all|laddress|lport|none|raddress|
    rport|transportprotocol}] [transportprotocol={any|egp|
    esp|gre|icmp|opaque|ospf|rsvp|tcp|udp|protocol}]
    [usepfskey={true|false}]
```

Setting the **ipversion** parameter to **6** indicates that this policy applies to IPv6 traffic and that only IPv6 addresses and network connections are valid.

The **icmptype** parameter includes an **ndall** option, which is equivalent to specifying types 133,134,135 and 136 (the types that are required for IPv6 neighbour discovery). IPv6 routing functions correctly when these packet types are accepted and processed by the router.

To modify existing IPsec policies, use the command:

```
set ipsec policy=name [other options]
```

To create ISAKMP policies for key management for IPv6 traffic, use the command:

```
create isakmp policy=name peer={ipv6add|any} ipversion=6
    [authtype={preshared|rsaencr|rsasig}]
    [dhexponentlength=160..1023] [encalg={3des2key|3desinner|
    3desouter|des}] [expirykbytes=1..1000]
    [expiryseconds=600..31449600] [group={0|1|2}]
    [hashalg={SHA|MD5}] [key=0..65535] [localid={ipv6add|
    domainname|user-domainname|dist-name}]
    [localrsakey=0..65535] [mode={main|aggressive}]
    [msgbackoff={incremental|none}] [msgretrylimit=0..1024]
    [msgtimeout=1..86400] [phase2xchglimit={none|1..1024}]
    [policyfilename=filename] [prenegotiate={on|off|true|
    false}] [senddeletes={on|off|true|false}] [sendnotify={on|
    off|true|false}] [sendidalways={on|off|true|false}]
    [setcommitbit={on|off|true|false}] [remoteid={ipv6add|
    domainname|user-domainname|dist-name}]
    [retryikeattempts={0..16|continuous}]
```

Connections can be accepted from any IPv6 address by setting the **peer** parameter to **any**.

To modify existing ISAKMP policies, use the command:

```
set isakmp policy=name [other options]
```

IPsec over UDP

Intermediate devices that modify the IP header often prevent IPsec from operating correctly. In general, devices fail to operate correctly or block the packet when they require more information about the packet than is in the IP header. These types of devices function effectively with UDP and TCP, but do not understand the data streams created by IPsec (AH, ESP, and IPComp), and typically can only handle one IPsec flow from one source to one destination.

To solve this problem, IPsec over UDP encapsulates IPsec inside UDP packets. Packets are encrypted and authenticated with ESP, which authenticates the packet payload only. AH cannot be made to function with devices that modify the IP header. The AH protocol is unable to authenticate this changed header.

To enable UDP tunnelling for IPsec packets on a per policy basis, use the command:

```
set ipsec policy=name udptunnel=true
```

When tunnelling is enabled for the router policy, the router encapsulates traffic processed by IPsec inside UDP packets. The remote device decapsulates the packets and processes them normally. Therefore, intermediate devices are needed only to process UDP packets.

Many gateway devices keep a state for UDP data streams that expires unless refreshed frequently. To prevent this expiry, UDP heartbeats can be enabled on a per-policy basis. Heartbeat packets are sent that periodically refresh the state entries of intermediate devices. To enable UDP heartbeats, use the command:

```
set ipsec policy=name udpheartbeats=true
```

By default, the router listens on and sends all IPsec packets over UDP port 2746. The listen port is created when the first IPsec policy with UDP tunnelling enabled is created, and is closed when the last policy with UDP tunnelling enabled is destroyed.

Both the local listen and the remote destination ports can be changed from the default. To change the remote port to which the UDP tunnelled packets are sent, use the command:

```
set ipsec policy=name edpport=port
```

To change the local listen port, use the command:

```
set ipsec udpport=port
```

IPsec over UDP packets, being a generic UDP data stream, are blocked by the router unless a permit policy is created that allows them to pass through. To create this permit policy, use the command:

```
create ipsec policy=name action=permit lport=2746
```

In this example, the local listen port is the default (2746). This policy must come before other policies on an IPsec enabled interface.

Pre-IPsec Security Associations

The router supports, for backward compatibility, the Pre-IPsec Security Association implementation, based on 1998 Internet Drafts, as implemented in Software Version 7.4.

The software allows mixed networks of old Security Association implementations and IPsec. An IP logical interface may have both IPsec policies and old SAs attached to it. This allows a router to communicate using old SAs with one set of routers and to communicate using IPsec with another set of routers. To enable backward compatibility, use the command:

```
enable ipsec oldsa interface=interface
```

To upgrade a router from the old SA implementation to IPsec, use the command:

```
activate ipsec convertoldsa [sa=sa-id]
```

to convert the old SA configuration in memory into a functionally equivalent IPsec configuration in memory. The old SA configuration is removed from memory. After the conversion process, the IPsec policies created do not have valid IPsec peer addresses. These need to be entered manually before the new IPsec configuration can be used. This conversion process does not change the router configuration file in any way. To retain the new IPsec configuration over a router restart, update the configuration file with the command:

```
create config=filename
```

Alternatively, edit the current boot configuration script with the command:

```
edit filename
```

ISAKMP/IKE on the Router

ISAKMP/IKE is implemented with ISAKMP commands. Changing the ISAKMP configuration requires Security Officer privilege.

ISAKMP negotiates Security Associations on behalf of IPsec. When an IPsec policy specifies ISAKMP for key management, ISAKMP must be enabled and an ISAKMP policy must exist for the ISAKMP peer.

To enable or disable ISAKMP, use the commands:

```
enable isakmp [localrsakey=key-id] [policyserverenabled={on|
   off|true|false}] [policyfilename=filename] [udpport=port]

disable isakmp
```

To display the status of ISAKMP, use the command:

```
show isakmp
```

The router uses ENCO services for encryption, authentication, and key storage services. ISAKMP requires DES encryption and the Diffie-Hellman key exchange algorithm.

See Chapter 42, Compression and Encryption Services for more information about configuring ENCO resources.

Because ISAKMP uses UDP port 500 as its transport protocol, care must be taken to ensure this traffic is not blocked by IP or IPsec. Typically, an IPsec **permit** policy must be added to the interface over which ISAKMP traffic is sent and received. An example of a command to add a **permit** policy for ISAKMP traffic is:

```
create ipsec policy=isakmp interface=ppp0 action=permit
   lport=500 rport=500
```

ISAKMP Policies

An ISAKMP policy specifies how to communicate with an ISAKMP peer and how to authenticate one. The information in the ISAKMP policy is used during ISAKMP exchanges and when an ISAKMP SA is created.

An ISAKMP policy specifies an encryption algorithm and a hash algorithm. The encryption algorithm encrypts ISAKMP messages to protect them against eavesdropping. The hash algorithm authenticates ISAKMP messages to prevent man-in-the-middle attacks.

An ISAKMP policy must also specify the address of the remote ISAKMP peer. This is used to match an ISAKMP policy to an IPsec peer. When IPsec requests the negotiation of an IPsec SA, it supplies both the IPsec SA details and the IP address of the ISAKMP peer. The IP address is used to find the ISAKMP policy with the matching peer address, and this policy is used for the negotiation. If the policy peer address is set to **any,** the policy is used to match a remote ISAKMP peer with an unknown IP address.

An ISAKMP policy must specify one of the following methods to authenticate an ISAKMP peer:

- Pre-shared key
- RSA encryption
- RSA signatures

A pre-shared key requires that a secret key be transported to both ISAKMP peers securely before the ISAKMP negotiation takes place.

RSA encryption and RSA signatures both require that RSA public keys be exchanged before ISAKMP negotiations take place. However, this can be done using methods that are not secure because RSA public keys are not secret.

See Chapter 42, Compression and Encryption Services for more information about transferring ENCO keys between routers.

An ISAKMP policy may also specify a different Diffie-Hellman group from the Oakley MODP Group 1 default. The more secure Oakley MODP Group 2 group may be used at the expense of negotiation speed. A less secure MODP Group 0 is also available.

On AR440S, AR441S, and AR450S routers only, you can specify the *Advanced Encryption Standard* (AES) algorithm for ISAKMP policies and SA specifications. AES is a FIPS approved symmetric block cipher that is documented in FIPS PUB 197. AES supports variable key lengths that can be longer than DES (and Triple DES) keys. With AES you specify a 128, 192 or 256 bit key that is used to generate sub-keys. These sub-keys and 128 bit blocks of data are then subjected to the encryption and decryption routines.

A feature licence is required to use AES encryption. Contact your authorised distributor or reseller for details.

To create, modify, or destroy an ISAKMP policy, use the commands:

```
create isakmp policy=name peer={ipadd|any}
    [authtype={preshared|rsaencr|rsasig}]
    [dhexponentlength=160..1023] [encalg={3des2key|
    3desinner|3desouter|des|aes128|aes192|aes256]
    [expirykbytes=1..1000] [expiryseconds=600..31449600]
    [group={0|1|2}] [hashalg={sha|md5}] [hybridxauth={on|off|
    true|false}] [key=0..65535] [localid={ipadd|domainname|
    user-domainname|dist-name}] [localrsakey=0..65535]
    [mode={main|aggressive}] [msgbackoff={incremental|none}]
    [msgretrylimit=0..1024] [msgtimeout=1..86400]
    [phase2xchglimit=none|1..1024] [policyfilename=filename]
    [prenegotiate={on|off|true|false}] [remoteid={ipadd|
    domainname|user-domainname|dist-name}]
    [retryikeattempts={0.16|continuous}] [senddeletes={on|
    off|true|false}] [sendnotify={on|off|true|false}]
    [sendidalways={on|off|true|false}] [setcommitbit={on|off|
    true|false}] [srcinterface=interface] [xauth={client|
    server|none}] [xauthname=username] [xauthpasswd=password]
    [xauthtype={generic|radius}]

set isakmp policy=name [other-options]

destroy isakmp policy=name
```

To display the currently defined ISAKMP policies or details of a particular policy, use the command:

```
show isakmp policy[=name]
```

Retransmitting ISAKMP Messages

The **msgbackoff**, **msgretrylimit** and **msgtimeout** parameters determine whether ISAKMP messages are retransmitted, and how often retransmitted messages are sent. These parameters are set using the commands:

```
create isakmp policy=name peer={ipadd|any}
    [msgbackoff={incremental|none}] [msgretrylimit=0..1024]
    [msgtimeout=1..86400] [other parameters]

set isakmp policy=name [msgbackoff={incremental|none}]
    [msgretrylimit=0..1024] [msgtimeout=1..86400]
    [other parameters]
```

When the router transmits an ISAKMP message, it starts a timer for the **msgtimeout** interval. If the router expects a response, but does not receive one before the timer expires, it retransmits the original message. If the number of retransmissions sent reaches the **msgretrylimit**, then the exchange times out and fails.

Informational and Heartbeat messages are not retransmitted, as no response is expected back from the peer for these message types. The ISAKMP exchange **mode** has no impact on whether messages are retransmitted.

The **msgretrylimit** parameter sets the maximum number of times the router retransmits a message. The default is **8**.

- When **0** is specified, messages are not retransmitted.
- When a number between 1 and 1024 is specified, the message is retransmitted until either that limit is reached, or the retransmission is successful.

The **msgtimeout** parameter sets the delay, in seconds, between the initial ISAKMP message transmission and the subsequent retransmission. The default is **4**.

The **msgbackoff** parameter provides a choice of back-off patterns for ISAKMP policies which are configured to retransmit messages. The default is **incremental**.

- When **incremental** is specified, the delay between retransmissions increases in a linear manner, by twice the value set by the **msgtimeout** parameter. That is, every retransmitted message is delayed by the last delay time plus twice the **msgtimeout** value.
- When **none** is specified, the delay between retransmissions is static. All retransmissions are sent after the delay specified by the **msgtimeout** parameter.

ISAKMP policies created without changing the defaults for these three parameters will have this message retransmission pattern:

1. The router sends the initial message.
2. The router retransmits the message 4 seconds later.
3. If a second retransmission is needed, this occurs 8 seconds (twice the value set by the **msgtimeout** parameter) after the first retransmission.
4. Further retransmission have a progressively larger delay. The gap between the second and third retransmissions is 16 seconds, the gap between the third and fourth retransmissions is 24 seconds, the next gap is 32 seconds, then 40, 48 and 56 seconds after each retransmission attempt.
5. After the eighth retransmission, the exchange times out.

ISAKMP Exchanges

An ISAKMP SA must exist between two IPsec peers before IPsec SA negotiations can take place. If the ISAKMP policy specifies that the ISAKMP SA is to be pre-negotiated, then the ISAKMP SA is created on router startup. When no ISAKMP SA exists when IPsec requests that an SA be negotiated, the phase 2 exchange is queued and a phase 1 exchange starts. After the phase 1 exchange successfully creates the ISAKMP SA, phase 1.5 exchanges start. When phase 1.5 exchanges finish or none are required, phase 2 exchanges start.

To display details of currently active ISAKMP exchanges, use the command:

```
show isakmp exchange[=exchange-id]
```

Reattempting ISAKMP Exchanges

By default, ISAKMP only attempts each negotiation once. However, in case the first attempt fails, the **retryikeattempts** parameter can be set to retry the exchange until either the connection is established, or the retry limit is reached.

ISAKMP **retryikeattempts** is intended to help re-establish ISAKMP exchanges when network problems or key exchange errors occur. Specifically, ISAKMP reattempts exchanges when:

- the router rejects SA proposals sent by the peer
- authentication fails during phase 1 or phase 2
- the exchange times out during phase 1 or phase 2
- the peer sends a Delete SA notification message for the most recent SA

ISAKMP will not reattempt XAUTH authentication failures (phase 1.5). XAUTH failures indicate that either the router and its peer have different authentication details, or a third party is attempting to connect to the router. This needs to be investigated manually.

To specify the retry limit for a policy, use the **retryikeattempts** parameter in the commands:

```
create isakmp policy=name peer={ipv4add|ipv6add|any}
    [retryikeattempts={0..16|continuous}] [other parameters]

set isakmp policy=name peer={ipv4add|ipv6add|any}
    [retryikeattempts={0..16|continuous}] [other parameters]
```

ISAKMP **retryikeattempts** is intended for permanent VPN connections only. For the **retryikeattempts** parameter to be valid, a specific peer IP address must be configured in both the ISAKMP and IPsec policies.

ISAKMP Security Associations (SA)

ISAKMP SAs protect phase 2 ISAKMP traffic between the local router and remote ISAKMP peers. ISAKMP SAs ensure that information negotiated for other security services, such as IPsec, is kept secret and authenticated. For instance, ISAKMP SAs are used to protect IPsec SAs and keys. It also provides identity protection for the security service SAs created. A single ISAKMP SA is dynamically created for each ISAKMP peer.

ISAKMP SAs are created during phase 1 exchanges, using information stored in the ISAKMP policy. Unlike IPsec SAs, you cannot manually create ISAKMP SAs. To create an ISAKMP policy, or alter an existing policy, use the commands:

```
create isakmp policy=name peer={ipv4add|ipv6add|any}
    [other parameters]

set isakmp policy=name [peer={ipv4add|ipv6add|any}]
    [other parameters]
```

Algorithms that encrypt and authenticate messages from the remote ISAKMP peer are stored in the ISAKMP SA along with keys for the algorithms. The ENCO Diffie-Hellman key exchange algorithm creates keys for ISAKMP SAs.

An ISAKMP SA is identified by cookies in the ISAKMP message header and is stored locally in the ISAKMP Security Association Database (SAD). To view the ISAKMP SAs held in the SAD, use the command:

```
show isakmp sa
```

To view details about the ISAKMP SAs useful for troubleshooting connections, use the command:

```
show isakmp counters=sad
```

To display details about a specific existing ISAKMP SA, use the command:

```
show isakmp sa=sa-id
```

IPsec tunnels are limited by the number of available ENCO channels on the router, as each active IPsec SA requires an ENCO channel. As only one ISAKMP SA is needed per IPsec tunnel, the maximum number of ISAKMP SAs that the router can store is set to the same value as the maximum number of ENCO channels. To see the maximum number of ENCO channels, use the **show enco** command.

ISAKMP Heartbeats

ISAKMP heartbeat exchanges provide additional security by enabling the central router to detect when it loses the connection between it and the remote router. The dial-up router sends a heartbeat message to the central router every 20 seconds. If three messages in a row are not received, the central router concludes that the line has been lost and deletes the ISAKMP SAs for the remote router.

To enable or disable ISAKMP heartbeat exchange for an existing policy, use the command:

```
set isakmp policy=name heartbeatmode={both|none|receive|send}
    [other parameters]
```

To enable ISAKMP heartbeat exchange for a new policy, use the command:

```
create isakmp policy=name heartbeatmode={both|none|receive|
    send} [other parameters]
```

The remote router should be set to **heartbeatmode=send** and the central router to **heartbeatmode=receive**.

To display the current heartbeat mode, use the commands:

```
show isakmp policy=name
show isakmp sa=sa-id
```

To display the number of heartbeat packets received, use the command:

```
show isakmp counters
```

When heartbeat exchanges are incompatible with third party equipment, the router can instead send a notification message to its peer if it receives packets containing an unknown Security Parameter Index (SPI). However, heartbeat exchanges are more robust under denial of service attacks, and may be able to detect the problem before any network traffic is lost. See the section "Responding to IPsec Packets from an Unknown Tunnel" on page 48-26 for details on implementing notification messages.

Responding to IPsec Packets from an Unknown Tunnel

The router recognises traffic for current IPsec tunnels by checking the Security Parameter Index (SPI) value of the IPsec packets. If the router receives an IPsec packet with an unknown SPI value from a known peer, this indicates that there is a discrepancy with the IPsec tunnel between the router and its peer. When configured to, the router can then send a message to the peer, notifying it to delete the SAs for the router, which closes the tunnel.

Unknown SPI values can occur if the router restarts while there is a current IPsec tunnel. Because the IPsec SAs are lost, the router no longer recognises traffic sent through the IPsec tunnel. However, the peer will keep sending traffic via the tunnel unless it is notified that the SAs are invalid.

The router can send a notification message to its peer, informing it to delete the SAs for the selected tunnel. This stops the peer from sending IPsec traffic until new SAs have been established. This feature is only valid for connections where:

- The peer IP address is a static IPv4 address.
- IPsec tunnel mode is used. This is specified by setting the **mode** parameter to **tunnel** in the **create ipsec saspecification** command.
- The ISAKMP policy for the peer has the **mode** parameter set to **main**, and the **sendnotify** parameter set to **true**.
- The IPsec policy for the peer has the **action** parameter set to **ipsec**, the **keymanagement** parameter set to **isakmp**, and the **peeraddress** parameter set to a valid IPv4 address.

To enable the router to send this type of notification message to its peer, set the **respondbadspi** parameter to **true** in the command:

```
create ipsec policy=name interface=interface action=ipsec
   keymanagement=isakmp peeraddress=ipv4add
   respondbadspi=true [other parameters]
```

When a configured IPsec policy receives a packet with an unknown SPI value, a new ISAKMP exchange is established and an initial contact notification message is sent. This message tells the peer to remove all SAs for the router. This destroys the IPsec tunnel, and a new tunnel needs to be established before any further IPsec traffic can be sent.

This feature provides an alternative to using heartbeat exchanges. Heartbeat exchanges are more robust under denial of service attacks, and may be able to detect the problem before any network traffic is lost; however heartbeat exchanges may be incompatible with some third party equipment. See the section "ISAKMP Heartbeats" on page 48-25 for details on implementing heartbeat exchanges.

IPsec NAT-Traversal

IPsec NAT-Traversal is an enhancement to IPsec and ISAKMP protocols that lets Virtual Private Network (VPN) clients communicate through NAT gateways over the Internet. For example, business travellers commonly use IPsec on their laptops to gain remote VPN access to the central office. When working off-site, these users sometimes need to connect to the Internet through a NAT gateway such as from a hotel. Network Address Translation (NAT) gateways are often part of a company's firewall and let its Local Area Network (LAN) appear as one IP address to the world. For more information about NAT devices, refer to RFC 1631 and to "Network Address Translation (NAT)" on page 22-48 of Chapter 22, Internet Protocol (IP).

Problems arise with NAT devices for a number of reasons. A key one is that when they handle IPsec packets, they cannot access encrypted UDP or TCP headers. Therefore, NAT devices cannot identify traffic for different private devices and cannot properly track individual sessions.

NAT-T and IPsec UDP tunnelling are two solutions that are not compatible; only one should be enabled. We recommend NAT-T where practicable.

NAT-T is not on the NAT gateway and is not an "IPsec pass-through". NAT-T lets IPsec/ISAKMP peers send traffic through NAT gateways by putting packets inside UDP packets. This solution enables remote VPN users to communicate successfully when NAT gateways are part of the connection.

Basic NAT-T Operations

Using NAT-D (discovery) messages, NAT-T negotiates with a peer to determine if NAT gateways are present and at which end of the network. Each peer sends at least two NAT-D messages as part of the ISAKMP phase 1 negotiation. The first message contains a hash of a destination IP address; subsequent messages contain source addresses. A NAT device is detected when address messages from the peer have incorrect hash values, which indicates that a NAT device changed IP addresses.

Also during phase 1, NAT-T determines whether a peer has NAT-T capabilities by detecting a vendor ID. Vendor IDs tell what version of NAT-T the peer supports. When a NAT device is not detected or a peer does not support NAT-T, normal IPsec negotiations and protection occur.

When an ISAKMP initiator detects a NAT device during an exchange, communication changes from UDP port 500 to port 4500. Log messages inform users that the UDP port has changed. Main or Aggressive mode packets received on the old port are discarded and a separate log is created.

Because IPsec traffic can also be received on port 4500, ISAKMP adds and removes the non-ESP marker at the start of the ISAKMP message so that messages can be detected and passed to the ISAKMP module. ISAKMP drops packets when it receives them on port 4500 without a non-ESP marker.

NAT-T inserts a UDP header between the outer IP and ESP headers thereby encapsulating the ESP data (figure below). NAT-T encapsulates IPsec traffic only when a NAT device is detected.

Figure 48-1: UDP Encapsulation for NAT-T

IPsec intercepts UDP-encapsulated ESP packets before they are passed to UDP.

A peer behind a NAT device sends keepalive messages to ensure that port mappings in the device remain active between peers. Keepalive intervals are not configurable. The purpose of keepalive messages is different from heartbeat messages controlled by the **heartbeatmode** parameter in ISAKMP policy commands, which detect an IKE peer. IKE heartbeat messages and NAT-T keepalive messages do not affect each other.

NAT-T on the Router

This NAT-T implementation supports interoperability with the following VPN clients:

- Microsoft Windows 2000®
- Microsoft Windows XP®
- SafeNet SoftRemote®

NAT-T can also be implemented router-to-router for offices with their own IPsec router behind a NAT device.

NAT-T is compliant with the following RFC:

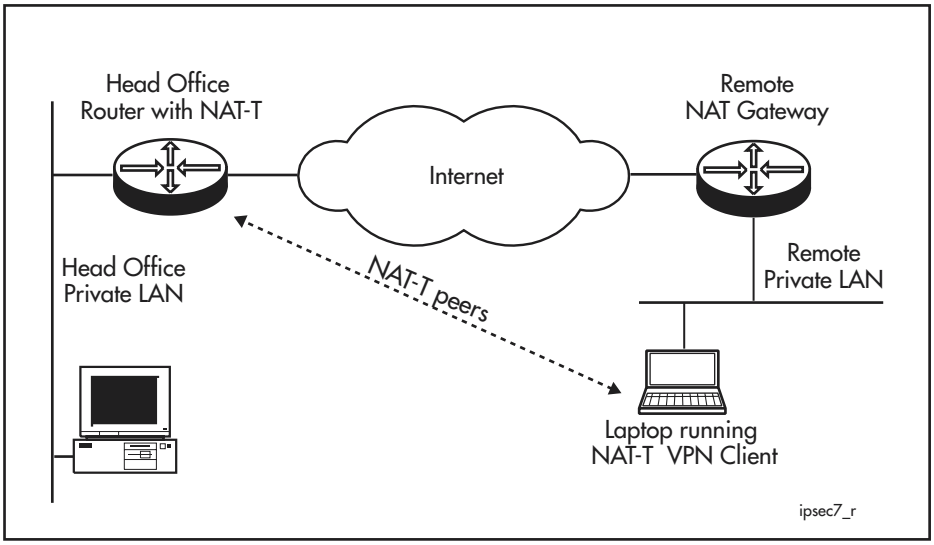
- RFC 3947 *Negotiation of NAT-Traversal in the IKE*.

NAT-T is also compatible with the following IETF Internet-Drafts:

- draft-ietf-ipsec-nat-t-ike-02, *Negotiation of NAT-Traversal in the IKE*, which describes the modifications to IKE to support NAT detection and UDP tunnel negotiation
- draft-ietf-ipsec-udp-encaps-02, *UDP Encapsulation of IPsec Packets*, which defines the method of UDP encapsulation of IPSec packets
- draft-ietf-ipsec-nat-t-ike-03, *Negotiation of NAT-Traversal in the IKE*, which describes the modifications to IKE to support NAT detection and UDP tunnel negotiation
- draft-ietf-ipsec-udp-encaps-03, *UDP Encapsulation of IPsec Packets*, which defines the method of UDP encapsulation of IPSec packets

- draft-ietf-ipsec-nat-t-ike-08, *Negotiation of NAT-Traversal in the IKE*, which describes the modifications to IKE to support NAT detection and UDP tunnel negotiation
- draft-ietf-ipsec-udp-encaps-08, *UDP Encapsulation of IPsec Packets*, which defines the method of UDP encapsulation of IPSec packets

Figure 48-2: NAT-T peers negotiate traffic through a NAT gateway device



NAT-T is disabled by default, and is enabled or disabled in the ISAKMP policy. We recommend that users carefully read security considerations in the IETF drafts to fully understand the implications of using NAT-T. When users create an ISAKMP policy with the **create isakmp policy** command, they define how peers respond during an ISAKMP exchange, and can use the **nattraversal** parameter to enable NAT-T if they prefer. They can later use the same parameter with the **set isakmp policy** command to disable NAT-T again.

Users should configure an IPsec policy to allow ISAKMP traffic on UDP port 4500 so that it flows through the IPsec layer to ISAKMP. Refer to the ISAKMP policy commands in this chapter to change or add a policy.

Peers send their original, untranslated addresses to each other, which they store in the ISAKMP SA. Recipients use original addresses (OAs) to correct the checksums in the UDP or TCP headers in the IPsec payload.

NAT-T is implemented for IPv4 for both transport and tunnel modes. We recommend transport mode for MS clients. For SafeNet and router-to-router connections, we recommend tunnel mode and specifying unique IP addresses for remote peers. Refer to the **set ipsec saspecification** command to set modes.

Pre-IPsec Security Associations

An older implementation of Security Associations (based on RFCs 1825, 1827, and 1829 and subsequently updated by Internet Drafts) provided IP payload encryption using a method for encapsulating DES-encrypted IP payloads in IP packets.

IPsec outdates the functionality of the old Security Association (SA) implementation, but we still support this SA implementation for backward compatibility. There are easy upgrade options to convert an old SA configuration to IPsec. For more information on updating an old SA configuration to IPsec, see "Pre-IPsec Security Associations" on page 48-20.

The old SA implementation uses ENCO services to provide its own set of services to IP. IP uses SAs to implement IP payload encryption. AT-VPNet uses security associations and IP payload encryption to create secure virtual private networks across the Internet.

An SA defines a security transform to be applied to all traffic between any of its members. A Security Association exists on one or more routers and defines a Virtual Private Network (VPN).

A security association is identified by its Security Parameters Index (SPI). The SPI must be same on all instances of the security association throughout the VPN.

The members of an IP security association are IP addresses or contiguous groups of addresses. A member is defined by a base IP address and a network mask. A member is local to a given router if it is separated from the Internet by the router, otherwise it is remote. Thus all members of a security association are local to one router and remote to the other routers in the VPN.

An IP interface may have zero or more security associations. If an IP interface does not have an assigned security association, all IP packets transiting the interface are processed normally by the IP routing software. If an IP interface uses one or more security associations it passes all packets transiting the interface to the SA. The SA examines the source and destination addresses of a packet to determine if the packet is in any of the security associations used by the interface. If a match is found the packet is forwarded to the ENCO module on the channel to which the security association is attached. In this way the configured transform is applied to the packet. If a packet is not in one of the security associations it is discarded or passed through the interface, depending on the setting of the **samode** parameter for the IP interface.

Currently the security transforms available are DES CBC, 2-key Triple DES, and 3-key Triple DES Inner mode.

The SA module attaches to ENCO channels. The ENCO channels are configured not to retain process histories between data packets as the IP module does not require that packets be decrypted in the same order they were encrypted. Re-ordered or lost IP packets do not cause subsequent packets to be discarded due to decryption check errors and therefore the SA module never needs to reset its ENCO channels.

The SA module uses statically defined, manually managed keys. A network key has to be created on one router and then entered into all the other routers in the VPN.

For more information about creating and entering keys into the router, see Chapter 42, Compression and Encryption Services.

Configuration Examples

The following examples in this section illustrate how to configure IPsec and ISAKMP/IKE on a router.

- **VPN-only with details about ISAKMP/IKE key management**
- **VPN with NAT-Traversal**

A 3DES algorithm is used in the VPN-only example but may also be used in a configuration for VPN with NAT-Traversal. This means that a 3DES feature licence key must be on the router. Licence information can be obtained from your authorised distributor or reseller.

The following documents describe more solutions, and are available from the Resource Center on your Documentation and Tools CD-ROM or from www.alliedtelesis.co.uk/en-gb/solutions/techdocs.asp?area=howto:

- *How To Configure Microsoft Windows XP Virtual Private Network (VPN) client interoperability with NAT-T support*
- *How To Configure Microsoft Windows 2000 Virtual Private Network (VPN) client interoperability with NAT-T support*
- *How To Configure Microsoft Windows 2000 Virtual Private Network (VPN) client interoperability without NAT-T support*
- *How To Configure Microsoft Windows XP Virtual Private Network (VPN) client interoperability without NAT-T support*

Some interface types, port types, or command options in these examples may not be supported on your router. Interfaces and port types vary depending on the router model, and whether an expansion option (PIC, NSM) is installed. For more information, see the Hardware Reference.

Setting Security

Before you begin, security keys must be created by entering a series of commands on a terminal connected directly to port 0 (or to the console port) on the router. The values for the keys must be the same on both routers.

It is important that your router be in security mode to avoid keys being destroyed when you restart it.

1. **Define a security officer.**

   Complete this step on both the head office and remote site routers.

   The following terminal output shows prompts along with commands you must enter (bold text) to define a security officer. You must define these on each router that uses the keys.

```
Manager> add user=secoff password=your-password
priv=securityofficer
User Authentication  Database
----------------------------------------------------------------
Username: secoff ()
Status: Enabled Privelige: Sec Off Telnet: No
Logins: 0 Fails: 0 Sent: 0 Rcvd: 0
----------------------------------------------------------------
Manager> enable system security
Info (134003): Operation successful.
Manager> login secoff
Password:
----------------------------------------------------------------
```

2. **Generate a pre-shared key at the head office router.**

   For a router-to-router solution, generate a random key with the command:

   ```
   create enco key=1 type=general random
   ```

   Or to also allow incoming Microsoft VPN clients, enter the pre-shared key as alphanumeric with the command:

   ```
   create enco key=1 type=general value=alphanumeric-key
   ```

   To display the key value, use the command:

   ```
   show enco key=1
   ```

   Note the value so that you can load it on the remote router. This pre-shared key is used to encrypt ISAKMP negotiation. See "ISAKMP/IKE" on page 48-6 for more information.

   See Chapter 42, Compression and Encryption Services for more information about generating and entering keys.

3. **Create the same pre-shared key at the remote site.**

   To enter the random or alphanumeric key from the previous step, use the command:

   ```
   create enco key=1 type=general value=secret-key
   ```

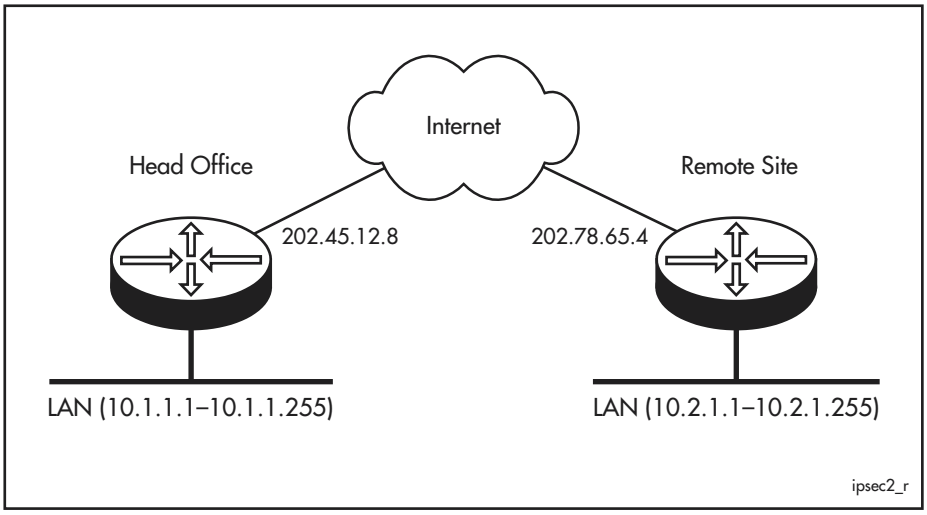
VPN-only with details about ISAKMP/IKE key management

This example shows how to configure and use IPsec with ISAKMP key management for a VPN-only Internet connection. ISAKMP/IKE negotiates the required IPsec SAs between two routers and sets up the secret keys required by the encryption and authentication algorithms. The configuration sets up an encrypted VPN over the Internet that is for VPN only, and does not permit Internet browsing.

When ISAKMP/IKE starts negotiating IPsec protocols and secret keys between the two routers, the ISAKMP traffic is protected by an ISAKMP SA. The encryption algorithm and hash algorithm that protect ISAKMP traffic must be specified in the relevant ISAKMP policy. DES and SHA are used in the examples in this section.

In this example, the head office router has the resources to perform 3DES encryption, and is configured to use 3DES2KEY as the preferred encryption algorithm. However, the remote router does not have the resources or a licence to use 3DES encryption so is configured to perform DES encryption. Therefore, DES is chosen when ISAKMP/IKE negotiates the encryption algorithm between the two routers. But if the remote router can perform 3DES encryption later, the configuration on the head office router still works. Both routers prefer the SHA hash algorithm to MD5 or DESMAC.

Figure 48-3: Network for VPN-only with ISAKMP/IKE key management.



To configure the head office router

1. **Create an ISAKMP policy.**

   The ISAKMP policy specifies the authentication method that identifies the remote router. It can be RSA encryption or a pre-shared key. This example uses a pre-shared key. First ensure you have defined a pre-shared key (see "Setting Security" on page 48-32).

   To create an ISAKMP policy that uses the shared key, use the commands:

   ```
   create isakmp policy=office_isakmp_policy peer=202.78.65.4
      authtype=preshared key=1 encalg=des hashalg=sha

   set isakmp policy=office_isakmp_policy senddeletes=on
      setcommitbit=on
   ```

2. **Create an SA specification.**

   ISAKMP can be configured to negotiate different algorithms by creating different SA specifications. For example, the IPsec ESP protocol supports various encryption algorithms. Depending on your configuration, ISAKMP makes a series of proposals to the peer about the encryption algorithms that ISAKMP, ESP, and AH use.

   In this example, the head office router is configured to choose 3DES2KEY in preference over DES. While AH supports MD5, DESMAC, and SHA as the hash algorithm, the router uses SHA.

   When creating IPsec SA specifications for ISAKMP key management, the **keymanagement** parameter must be set to ISAKMP. You need not specify SPI values and encryption key identities because ISAKMP/IKE negotiates them when creating actual SAs.

   To create an SA specification for the IPsec ESP protocol with DES encryption, use the command:

   ```
   create ipsec saspecification=1 keymanagement=isakmp
      protocol=esp encalg=des hashalg=null
   ```

   To create an SA specification for the IPsec ESP protocol with 3DES2KEY encryption, use the command:

   ```
   create ipsec saspecification=2 keymanagement=isakmp
      protocol=esp encalg=3des2key hashalg=null
   ```

   To create an SA specification for the IPsec AH protocol with the SHA hash algorithm, use the command:

   ```
   create ipsec saspecification=3 keymanagement=isakmp
      protocol=ah hashalg=sha
   ```

3. **Create a bundle specification.**

   Bundle specifications group together a set of SA specifications to create SA bundles. If you use a comma, you can specify several SA bundle proposals. Each bundle is proposed to the peer for consideration.

   To create a bundle specification, use the command:

   ```
   create ipsec bundlespecification=1 keymanagement=isakmp
      string="2 and 3,1 and 3"
   ```

4. **Create an IPsec policy.**

   Each IPsec policy has selector fields that define filtering rules for IP packets. IP packets are matched against these fields to determine the action to take. Possible actions are **ipsec**, **permit**, or **deny.** See "IPsec policies" on page 48-14 for more information about actions.

   ISAKMP traffic must be permitted through the IPsec module so that the ISAKMP module can process it. To create an IPsec policy to permit ISAKMP traffic on the ppp0 interface, use the command:

   ```
   create ipsec policy=office_vpn_isakmp int=ppp0
      action=permit lport=500 rport=500
   ```

   By default ISAKMP traffic is received and transmitted over UDP port 500.

   To create a policy with an **ipsec** action, which encrypts your chosen payload traffic, use the command:

   ```
   create ipsec policy=office_vpn_ipsec int=ppp0 action=ipsec
      keymanagement=isakmp bundlespecification=1
      peer=202.78.65.4
   ```

Set the filter fields of the policy to protect data from the head office IP subnet 10.1.1.0 255.255.255.0 and destined for the remote site IP subnet 10.2.1.0 255.255.255.0 (Figure 48-3 on page 48-33):

```
set ipsec policy=office_vpn_ipsec laddress=10.1.1.0
   lmask=255.255.255.0 raddress=10.2.1.0
   rmask=255.255.255.0
```

5. **Enable IPsec and ISAKMP processing.**

   To enable IPsec and ISAKMP and activate the configuration, use the commands:

```
enable ipsec

enable isakmp
```

Reminder

It is important to create and set a boot-up configuration file that specifies a security officer. Use the commands:

```
create config=ipsec.cfg

set config=ipsec.cfg
```

Without this configuration file, no one can log in as security officer after a reboot. This means you would need to use the **disable system security** command to regain control of the router, but it automatically destroys keys.

To configure the remote router

1. **Create an ISAKMP policy.**

   A matching ISAKMP policy must be created on the remote router for the head office router. First ensure you have defined a pre-shared key (see "Setting Security" on page 48-32).

   To create an ISAKMP policy on the remote router, use the command:

```
create isakmp policy=office_isakmp_policy peer=202.45.12.8
   authtype=preshared key=1 encalg=des hashalg=sha

set isakmp policy=office_isakmp_policy senddeletes=on
   setcommitbit=on
```

2. **Create an SA specification.**

   The SA specifications needed for the remote router are similar to the ones on the head office router. In this example, the remote router has no valid licence or resources to run 3DES encryption, so only DES encryption can be used. The identification numbers for the SA specifications can be different on both routers.

   To create an SA specification for the IPsec ESP protocol, use the command:

```
create ipsec sas=1 keymanagement=isakmp protocol=esp
   keym=des hashalg=null
```

   To create an SA specification for the IPsec AH protocol, use the command:

```
create ipsec sas=2 keymanagement=isakmp protocol=ah
   hashalg=sha
```

3. **Create bundle specifications.**

   To create a bundle specification on the remote router and group together the two SA specifications, use the command:

```
create ipsec bundlespecification=1 keymanagement=isakmp
   string="1 and 2"
```

4. Create an IPsec policy.

The remote router needs IPsec policies that match requirements of the head office IPsec policies.

ISAKMP traffic must be permitted through the IPsec module so that the ISAKMP module can process it. To create an IPsec policy to permit ISAKMP traffic on the ppp0 interface, use the command:

```
create ipsec policy=office_vpn_isakmp int=ppp0
   action=permit lport=500 rport=500
```

By default ISAKMP traffic is received and transmitted over UDP port 500.

To create a policy with an **ipsec** action, which encrypts your chosen payload traffic, use the command:

```
create ipsec policy=office_vpn_ipsec int=ppp0 action=ipsec
   keymanagement=isakmp bundlespecification=1
   peer=202.45.12.8
```

The **laddress** and **raddress** parameters determine the traffic to which the policy applies. They must be opposite to the ones set in the policy at the head office router:

```
set ipsec policy=office_vpn_ipsec laddress=10.2.1.0
   lmask=255.255.255.0 raddress=10.1.1.0
   rmask=255.255.255.0
```

5. Enable IPsec and ISAKMP processing.

To enable IPsec and ISAKMP and to activate the configuration, use the commands:

```
enable ipsec

enable isakmp
```

Reminder

It is important to create and set a boot-up configuration file that specifies a security officer. Use the commands:

```
create config=ipsec.cfg

set config=ipsec.cfg
```

Without this configuration file, no one can log in as security officer after a reboot. This means you would need to use the **disable system security** command to regain control of the router, but it automatically destroys keys.

VPN with NAT-Traversal

This example is a basic router-to-router solution with NAT-Traversal for a Virtual Private Network (VPN) that shows:

- NAT gateways at both ends of the VPN link
- a firewall configuration at both ends
- how to allow Internet access such as browsing

General Considerations

- This example also works with a NAT gateway at the initiator end, responder end, or neither end.
- IPsec and ISAKMP policies must refer to valid Internet peer addresses. When a peer router is directly connected to the Internet, this address is on its local WAN interface. When a peer accesses the Internet through a NAT gateway, this address is on the NAT gateway.
- If you have a NAT gateway at the responder end, it must be configured to allow traffic (*pinholes*) for UDP ports 500 and 4500.
- One end of the link must have a fixed Internet address. To enable both peers to initiate an IPsec link, both ends must have fixed addresses and both NAT gateways must have pinholes for UDP ports 500 and 4500.

  Many ISPs assign dynamic addresses that may change periodically, and you may need to ask for a fixed address.
- ISAKMP peers behind NAT gateways must identify themselves using a name string.
- If your office VPN router is behind an external gateway that does not use NAT, for example a firewall or IP filtering device, then the external gateway needs an ESP (protocol 50) permit rule in addition to UDP 500 and UDP 4500 permit rules. This allows NAT-T to work in most situations.
- If you configure your router remotely, we strongly recommend using Secure Shell. Telnet should not be used to access a secure gateway.

Other Interfaces

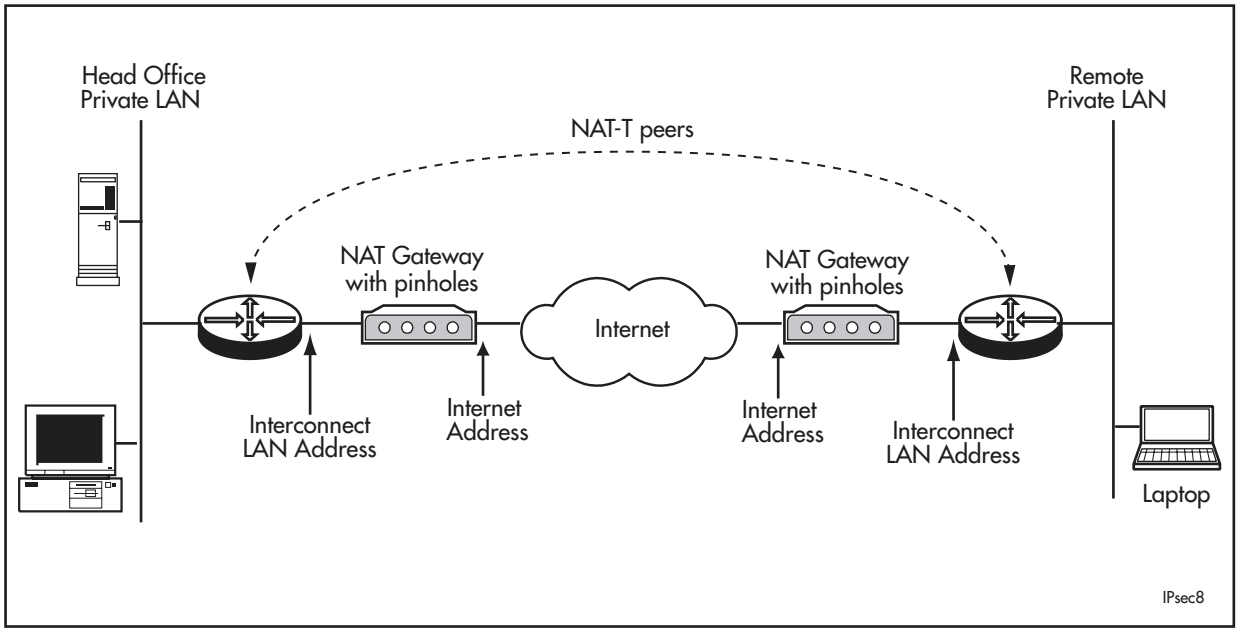
This example uses VLANs, but this configuration can run over other interfaces such as eth0. To customise this example to use eth0, do the following:

- Replace the relevant **create vlan** command with

  ```
  set eth0 mtu=1300
  ```

- Replace **int=**vlan2 with **int=**eth0 in all relevant commands.

Figure 48-4: NAT-T router-to-router solution in IPsec tunnel mode



To configure the head office

1. **Set the router name.**

   First ensure you have defined a pre-shared key (see "Setting Security" on page 48-32), then use the commands:

   ```
   set system name="Head Office"
   ```

2. **Set security and authentication.**

   To add a security officer, use the commands:

   ```
   add user=secoff pass=secoff priv=sec login=yes telnet=yes
   delete user=manager
   ```

   During initial configuration when you are attending the router, we recommend that you set the security timeout period to 10 minutes. This avoids the inconvenience of logging in every time you pause. Use the command:

   ```
   set user securedelay=600
   ```

   After configuration, return the timeout to 60 seconds to maximise security. Use the command:

   ```
   set user securedelay=60
   ```

   ISAKMP Extended Authentication (XAUTH) is used in this example. To set the name and password by which to authenticate the IPsec peer, use the command:

   ```
   add user=remote password=friend
   ```

   Or for RADIUS server support for authentication, use the command:

   ```
   add radius server=radius-server-address secret=your-key
   ```

3. **Create a public VLAN.**

   To create a public VLAN, use the commands:

   ```
   create vlan=public vid=2
   add vlan=2 port=1
   ```

4. Assign IP addresses to the interfaces.

Smaller MRU/MTU settings are needed for IPsec tunnel mode so that larger payload packets successfully pass through the IPsec tunnel.

To enable IP, use the commands:

```
add ip int=vlan2 ip=interconnect-LAN-address frag=yes

add ip int=vlan1 ip=head-office-LAN-address

add ip rou=0.0.0.0 mask=0.0.0.0 int=vlan2
   next=NAT-gateway-address
```

5. Enable a firewall.

To create a firewall policy and add to it, use the commands:

```
create fire policy=main

add fire policy=main int=vlan1 type=private

add fire policy=main int=vlan2 type=public

add fire policy=main nat=enhanced int=vlan1 gblint=vlan2
```

To allow ISAKMP and NAT-T traffic on appropriate UDP ports, use the commands:

```
add fire policy=main rule=1 int=vlan2 action=allow
   ip=interconnect-LAN-address protocol=udp port=500
   gblip=interconnect-LAN-address gblpo=500

add fire policy=main rule=2 int=vlan2 action=allow
   ip=interconnect-LAN-address protocol=udp port=4500
   gblip=interconnect-LAN-address gblpo=4500
```

To allow VPN traffic to bypass this firewall NAT, use the command:

```
add fire policy=main rule=3 int=vlan2 action=nonat
   prot=all ip=head-office-LAN-ip-range x.x.x.x - x.x.x.x
   encap=ipsec
```

To add a NAT bypass rule for internally initiated VPN traffic to the remote site, use the command:

```
add firewall policy=main ru=4 action=nonat int=vlan1
   prot=all ip=head-office-LAN-ip-range x.x.x.x - x.x.x.x
   policy=main ru=4 remoteip=remote-LAN-ip-range
   x.x.x.x - x.x.x.x
```

6. Configure an SA specification.

The IPsec AH protocol is not used in this example but SHA is used as an alternative integrity check on the ESP protocol. DES encryption is used to encrypt the VPN payload.

To create an SA specification, use the commands:

```
create ipsec sas=1 key=isakmp protocol=esp encalg=des
   hasha=sha

create ipsec bundlespecification=1 key=isakmp string="1"
```

7. Create an IPsec policy.

To allow ISAKMP key negotiation and NAT-T processing to bypass IPsec, use the commands:

```
create ipsec policy=isakmp int=vlan2 action=permit

set ipsec policy=isakmp lp=500

create ipsec policy=natt_udp int=vlan2 action=permit

set ipsec policy=natt_udp lp=4500
```

To create a policy where the internet address of the peer is fixed, use the command:

```
create ipsec policy=remote_site int=vlan2 action=ipsec
   key=isakmp bundlespecification=1
   peer=remote-internet-address isa=to_remote
```

Or when the remote router has a dynamically assigned IP address, use the command:

```
create ipsec policy=remote_site int=vlan2 action=ipsec
   key=isakmp bundlespecification=1 peer=dynamic
   isa=to_remote
```

8. Set the IPsec policy and enable IPsec.

To set the IPsec policy to the remote router, use the command:

```
set ipsec policy=remote_site
   lad=head-office-LAN-ip-subnet-address
   lmask=head-office-LAN-ip-subnet-mask
   rad=remote-LAN-ip-subnet-address
   rmask=remote-LAN-ip-subnet-mask
```

For both VPN and internet-browsing access, use an **internet** policy. Do not use this for VPN-only access.

```
create ipsec policy=internet int=vlan2 action=permit
```

To enable IPsec, use the command:

```
enable ipsec
```

9. Create an ISAKMP policy.

To create a policy when the internet address of the peer is fixed, use the command:

```
create isakmp policy=to_remote
   peer=remote-internet-address key=1
```

Or when the peer has a dynamically assigned IP address, use the command:

```
create isakmp policy=to_remote peer=any key=1
```

10. Set the ISAKMP policy.

To set the ISAKMP policy to the remote router, use the command:

```
set isakmp policy=to_remote localid=head_office
   heartbeat=receive

set isakmp policy=to_remote sendd=true setc=true

set isakmp policy=to_remote NATT=on
```

The **heartbeat** parameter is optional and lets the office delete inactive SAs if the Internet connection for the remote site drops. Heartbeats can be set to **send**, **receive**, or **both**. The receiver expects to receive heartbeats; when three are missing, it deletes the associated SA to avoid SA "out of step" fault conditions.

When heartbeat exchanges are incompatible with third party equipment, the router can instead send a notification message to its peer if it receives packets with an unknown SPI. See the section "Responding to IPsec Packets from an Unknown Tunnel" on page 48-26 for details on implementing notification messages.

11. Authenticate the IPsec peer.

To use Extended Authentication, use the command:

```
set isakmp policy=to_remote xauth=server xauthtype=generic
```

12. Enable ISAKMP key negotiation.

Use the command:

```
enable isakmp
```

Reminder

It is important to create and set a boot-up configuration file that specifies a security officer. Use the commands:

```
create config=ipsec.cfg
set config=ipsec.cfg
```

Without this configuration file, no one can log in as security officer after a reboot. This means you would need to use the **disable system security** command to regain control of the router, but it automatically destroys keys.

To configure the remote router

1. Set the router name.

First ensure you have defined a pre-shared key (see "Setting Security" on page 48-32), then use the commands:

```
set system name="Remote Site"
```

2. Set security and authentication.

To add a security officer, use the commands:

```
add user=secoff pass=secoff priv=sec login=yes telnet=yes
delete user=manager
```

During initial configuration when you are attending the router, we recommend that you set the security timeout period to 10 minutes. This avoids the inconvenience of logging in every time you pause. Use the command:

```
set user securedelay=600
```

After configuration, return the timeout to 60 seconds to maximise security. Use the command:

```
set user securedelay=60
```

3. Create a public VLAN.

To create a public VLAN, use the commands:

```
create vlan=public vid=2
add vlan=2 port=1
```

4. Assign IP addresses to the interfaces.

Smaller MRU/MTU settings are needed for IPsec tunnel mode so that larger payload packets successfully pass through the IPsec tunnel.

To enable IP, use the commands:

```
add ip int=vlan2 ip=interconnect-LAN-address frag=yes
add ip int=vlan1 ip=remote-LAN-address
add ip rou=0.0.0.0 mask=0.0.0.0 int=vlan2
   next=NAT-gateway-address
```

5. Enable a firewall.

To create a firewall policy and add rules to it, use the commands:

```
create fire poli=main
add fire policy=main int=vlan1 type=private
add fire policy=main int=vlan2 type=public
add fire policy=main nat=enhanced int=vlan1 gblint=vlan2
```

To allow ISAKMP and NAT-T traffic on appropriate UDP ports, use the commands:

```
add fire policy=main rule=1 int=vlan2 action=allow
   ip=interconnect-LAN-address prot=udp port=500
   gblip=interconnect-LAN-address gblpo=500
add fire poli=main rule=2 int=vlan2 action=allow
   ip=interconnect-LAN-address prot=udp port=4500
   gblip=interconnect-LAN-address gblpo=4500
```

To allow VPN traffic to bypass this firewall NAT, use the command:

```
add fire poli=main rule=3 int=vlan2 action=nonat
   protocol=all ip=remote-LAN-ip-range x.x.x.x - x.x.x.x
   encap=ipsec
```

To add a rule for internally initiated VPN traffic to the head office, use the command:

```
add firewall policy=main rule=4 action=nonat int=vlan1
   protocol=all ip=remote-LAN-ip-range x.x.x.x - x.x.x.x
   policy=main rule=4 remoteip=head-office-LAN-ip-range
   x.x.x.x - x.x.x.x
```

6. Configure an SA specification.

To create an SA specification, use the commands:

```
create ipsec sas=1 key=isakmp protocol=esp encalg=des
   hasha=sha
create ipsec bundlespecification=1 key=isakmp string="1"
```

7. Create an IPsec policy.

To allow ISAKMP key negotiation and NAT-T processing to bypass IPsec, use the commands:

```
create ipsec policy=isakmp int=vlan2 action=permit
set ipsec policy=isakmp lp=500 rp=500
create ipsec policy=natt_udp int=vlan2 action=permit
set ipsec policy=natt_udp lp=4500 rp=4500
```

To create a policy when the internet address of the peer is fixed, use the command:

```
create ipsec policy=head_office int=vlan2 action=ipsec
   key=isakmp bundlespecification=1
   peer=head-office-internet-address isa=to_office
```

Or when the peer has a dynamically assigned IP address, use the command:

```
create ipsec policy=head_office int=vlan2 action=ipsec
   key=isakmp bundlespecification=1
   peer=dynamic isa=to_office
```

8. Set the IPsec policy and enable IPsec.

To set the IPsec policy to the head office, use the command:

```
set ipsec policy=head_office
    lad=remote-LAN-ip-subnet-address
    lmask=remote-LAN-ip-subnet-mask
    rad=head-office-LAN-ip-subnet-address
    rmask=head-office-LAN-ip-subnet-mask
```

For both VPN and internet-browsing access, use an **internet** policy. Do not use this for VPN-only access.

```
create ipsec policy=internet int=vlan2 action=permit
```

To enable IPsec, use the command:

```
enable ipsec
```

9. Create an ISAKMP policy.

To create a policy where the internet address of the peer is on the peer's NAT gateway or its router, use the command:

```
create isakmp policy=to_office
   peer=head-office-internet-address key=1

set isakmp policy=to_office localid=remote_site
   heartbeat=send

set isakmp policy=to_office sendd=true setc=true

set isakmp policy=to_office NATT=on
```

The **heartbeat** parameter is optional and lets the office delete inactive SAs if the Internet connection for the remote site drops. Heartbeats can be set to **send**, **receive**, or **both**. The receiver expects to receive heartbeats; when three are missing, it deletes the associated SA to avoid SA "out of step" fault conditions.

When heartbeat exchanges are incompatible with third party equipment, the router can instead send a notification message to its peer if it receives packets with an unknown SPI. See the section "Responding to IPsec Packets from an Unknown Tunnel" on page 48-26 for details on implementing notification messages.

10. Authenticate the IPsec peer.

To use Extended Authentication, use the command:

```
set isakmp policy=to_office xauth=client xauthname=remote
   xauthpass=friend
```

11. Enable ISAKMP key negotiation.

Use the command:

```
enable isakmp
```

Reminder

It is important to create and set a boot-up configuration file that specifies a security officer. Use the commands:

```
create config=ipsec.cfg

set config=ipsec.cfg
```

Without this configuration file, no one can log in as security officer after a reboot. This means you would need to use the **disable system security** command to regain control of the router, but it automatically destroys keys.

Troubleshooting IPsec

Both IPsec and ISAKMP require the services of the ENCO module. Depending on the configuration of IPsec policies, IPsec may require the following resources:

- DES encryption
- 3DES encryption
- HMAC authentication
- STAC compression

ISAKMP may require:

- DES encryption
- 3DES encryption
- the Diffie-Hellman key exchange algorithm

To display the resources that the ENCO module can provide, use the **show enco** command.

See Chapter 42, Compression and Encryption Services for more information about configuring ENCO resources.

If you need to contact your authorised distributor or reseller regarding an ISAKMP or IPsec problem, please include the output from the **show debug ipsec** command, as well as any output you have captured from ISAKMP or IPsec debugging. For further details about the **show debug ipsec** command, see Chapter 4, Configuring and Monitoring the System.

IPsec

If IPsec has not been enabled, it does not process IP packets. To display the status of IPsec, use the command:

```
show ipsec
```

IPsec events are logged in the router log. If IPsec is not working correctly, check the router log by using with the command:

```
show log
```

If the router log does not indicate why IPsec is failing to operate correctly, check the IPsec counters by using the command:

```
show ipsec counter
```

Before traffic can be processed by an IPsec policy, IPsec SAs and an SA bundle must have been created for that policy. To check whether an SA bundle has been created for a particular policy, use the command:

```
show ipsec policy=policy_name
```

To display the contents of the SA database and counters for an entry in the database, use the command:

```
show ipsec sa=sa-id [counter]
```

If an IPsec SA and bundle has not been created and key management is set to ISAKMP, then check the ISAKMP counters by using the command:

```
show isakmp counter
```

ISAKMP may not be able to negotiate an IPsec SA when IPsec configurations at each end of the link are incompatible.

If **keymanagement** is set to **manual** or **isakmp**, and counters suggest that ISAKMP was not able to negotiate an SA due to incompatible transforms, check the IPsec configuration at each end of the link by using the commands:

```
show ipsec saspecification
show ipsec bundlespecification
show ipsec policy
```

To enable or disable IPsec debugging, use the commands:

```
enable ipsec policy[=name] debug={all|filter|packet}
disable ipsec policy={all|name} debug={all|trace}
```

Debugging for **filter** explains why packets are not being matched to a particular policy. Debugging for **trace** shows where a packet has failed in the IPsec process. Debugging for **packet** displays the contents of a packet at different stages of the IPsec process.

ISAKMP

If ISAKMP is not enabled, it does not listen on port 500 for ISAKMP messages. To display the status of ISAKMP, use the command:

```
show isakmp
```

ISAKMP events are logged in the router log. If ISAKMP is not working correctly, check the router log by using with the command:

```
show log
```

When the ISAKMP SA between two ISAKMP peers has been created, there are messages in the log indicating that a phase 1 ISAKMP exchange has started and completed successfully. The successful creation of an ISAKMP SA can be confirmed by viewing the SA in the ISAKMP SA database by using the command:

```
show isakmp sa
```

If the router log indicates that an ISAKMP phase 1 exchange has started but not finished, then the exchange may be waiting for the remote peer to reply. Until it times out and stops re-transmitting the last message, the exchange can still be displayed by using the command:

```
show isakmp exchange
```

If the router log does not indicate why an ISAKMP negotiation has failed, check the ISAKMP counters by using the command:

```
show isakmp counter
```

If the ISAKMP SA has not been created successfully, then check the counters for **main** mode. If the ISAKMP SA has been successfully created but IPsec SAs are not being negotiated, then check the counters for **quick** mode. In both cases the **general** counters may explain why ISAKMP messages are not being processed.

To enable or disable ISAKMP debugging, use the commands:

```
enable isakmp debug={all|default|packet|pkt|pktraw|state|
   trace|tracemore}
```

```
disable isakmp debug={all|default|packet|pkt|pktraw|state|
   trace|tracemore}
```

The **state** and **trace** options help determine the part of the ISAKMP negotiation that is failing. If these modes fail to reveal the problem, your support centre may ask that you capture text by using the **all** option.

The most common reason for the failure of a phase 1 ISAKMP exchange is that the pre-shared key or RSA public keys have not been configured correctly. Make sure that the pre-shared key is identical on each end of the link, and that the public key of each router is loaded onto the other router correctly.

The most common reason for the failure of a phase 2 ISAKMP exchange is that IPsec configurations at each end of the link are incompatible. Check that both of these are correct.

Command Reference

This section describes the commands available on the router to enable, configure, control, and monitor IPsec. IPsec requires IP routing and IP interfaces to be enabled and configured. See Chapter 22, Internet Protocol (IP) for the commands required to enable and configure IP routing and IP interfaces.

The shortest valid command is denoted by capital letters in the Syntax section. See "Conventions" on page lxv of About this Software Reference in the front of this manual for details of the conventions used to describe command syntax. See Appendix A, Messages for a complete list of error messages and their meanings.

Some interface and port types mentioned in this chapter may not be supported on your router. The interface and port types that are available vary depending on your product's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the Hardware Reference.

activate ipsec convertoldsa

Syntax

```
ACTivate IPSec CONVERToldsa [SA=sa-id]
```

Description

This command converts an old SA configuration in router memory to a functionality equivalent IPsec configuration in memory. IPsec must be enabled before this command can be used. This command requires a user with Security Officer privilege when the router is in security mode.

The **sa** parameter specifies the SA configuration to convert. If an SA is not specified, all old SAs are converted. If an SA is specified, only that SA is converted. The *sa-id* is an SA identification number from 0 to 255.

This command destroys the old SA configuration, and a warning message is displayed to let the user confirm the conversion.

When the conversion is complete, a message reminds the user to update the peer IP address of their policies and to save the configuration to a new boot configuration script.

Examples

To convert an old SA with the identification number 2 to the equivalent IPsec configuration, use the command:

```
act ips convert sa=2
```

To convert all old SA configurations to equivalent IPsec configurations, use the command:

```
act ips convert
```

Related Commands

disable ipsec oldsa
enable ipsec oldsa

add sa member

Syntax

```
ADD SA=sa-id MEMber={LOCal|REMote} IPaddress=ipadd
   MASK=ipadd
```

Description

This command adds a member to a security association, and configures the router's pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration. This command requires a user with security officer privilege when the router is in security mode.

Parameter	Description
SA	The security association that the member is added to. The *sa-id* is an identification number from 0 to 255. Default: no default
MEMber	Whether the member is a local or remote member. Default: no default
IPaddress	The base IP address of the member, in dotted decimal notation. Default: no default
MASK	The range of IP addresses that belong to the member, in dotted decimal notation. Default: no default

Examples

To add a local member consisting of the IP addresses 192.168.1.1 to 192.168.1.15 to SA 1, use the command:

```
add sa=1 mem=local ip=192.168.1.1 mask=255.255.255.240
```

Related Commands

delete sa member
show sa

create ipsec bundlespecification

Syntax

```
CREate IPSec BUNDlespecification=bundlespecification-id
   KEYmanagement={ISakmp|MAnual} STRING="bundle-string"
   [EXPIRYKbytes=1..4193280] [EXPIRYSeconds=300..31449600]
```

Description

This command creates a bundle specification with the specified identification number in the IPsec Security Policy Database (SPD). It requires a user with security officer privilege when the router is in security mode. Bundle specifications are templates to create SA bundles, and specify the number and order of SAs in a bundle. All SA bundles are created from a bundle specification.

Parameter	Description
BUNDlespecification	The identification number of the bundle. A bundle specification with the same identification number must not already exist. The *bundlespecification-id* is a number from 0 to 255. Default: no default
KEYmanagement	Whether the bundle specification is to be used manually to create an SA bundle or if it is to be used by ISAKMP/IKE to negotiate an SA bundle. Default: no default
STRING	The SA specifications to use to create SAs in a bundle. The *bundle-string* is a string 1 to 100 characters long, containing numbers from 0 to 255, and the separators *and*, *or*, and a comma. Bundle specifications used for manual key management can specify that the bundle consist of one, two, or three SAs. Each SA must use a different IPsec protocol (ESP, AH, or IPComp). The SA specification identification numbers in the bundle string that are used to create the SAs are separated by *ands*. The SAs are applied to outbound packets in the order of their respective SA specifications in the bundle string. They are applied in the reverse order on inbound packets. Bundle specifications that ISAKMP/IKE uses can specify one or more "proposals" separated by commas. Each proposal can contain one, two, or three SAs. If different SA specifications offer a choice of algorithm(s) for the same IPsec protocol, they are separated by *or* in the bundle string. The order of SA specifications separated by *ors* determines the order of preference when used to negotiate an SA. SAs created from the negotiated proposal are applied to outbound packets in the order of their respective SA specifications in the bundle string. They are applied in the reverse order on inbound packets. Default: no default
EXPIRYKBytes	The number of kilobytes of data that the SAs in the bundle can process before the bundle expires and must be renegotiated. This parameter is valid when the **keymanagement** parameter is set to **isakmp**. Default: **4193280**
EXPIRYSeconds	The maximum lifetime in seconds of the SAs in a bundle before the bundle expires and must be renegotiated. This parameter is valid when the **keymanagement** parameter is set to **isakmp**. Default: **28800** (8 hours)

Examples To create an SA bundle for use with manual key management, that creates two SAs based on SA specifications 1 and 2, use the command:

```
cre ips bund=1 key=ma str=”1 and 2" expiryk=500000
```

The following command creates an SA bundle for use with ISAKMP key management. Two SA bundles are proposed; the first would create two SAs using either SA specification 1 or 2, and SA specification 3; and the second bundle would create two SAs based on SA specifications 4 and 3:

```
cre ips bund=2 key=is str="1 or 2 and 3, 4 and 3" expirys=7200
```

Related Commands **destroy ipsec bundlespecification**
set ipsec bundlespecification
show ipsec bundlespecification

create ipsec policy

Syntax

```
CREate IPSec POLicy=name INTerface=interface ACtion={DEny|
   IPsec|PErmit} [IPVersion={4|6}]
   [BUNDlespecification=bundlespecification-id]
   [DFBit={SEt|COpy|CLear}] [GROup={0|1|2}]
   [ICmptype={list|NDALL}] [IPROUtetemplate=template-name]
   [ISAkmppolicy=isakmp-policy-name]
   [KEYmanagement={ISakmp|MAnual}] [LADdress={ANy|
   ipv4add[-ipv4add]|ipv6add[/prefix-length]|ipv6add-
   ipv6add}] [LMAsk=ipv4add] [LNAme={ANy|system-name}]
   [LPort={ANy|OPaque|port}] [PEERaddress={ipv4add|
   ipv6add|ANy|DYnamic}] [POSition=1..100] [RADdress={ANY|
   ipv4add[-ipv4add]|ipv6add[/prefix-length]|ipv6add-
   ipv6add}] [RESPondbadspi={True|False}] [RMAsk=ipv4add]
   [RNAme={ANy|system-name}] [RPort={ANy|port|OPaque}]
   [SASElectorfrompkt={ALL|LADdress|LPort|NONE|RADdress|
   RPort|TRAnsportprotocol}] [SRCInterface=interface]
   [TRAnsportprotocol={ANy|EGp|ESp|GRe|ICmp|OPaque|OSpf|
   RSvp|TCp|UDp|protocol}] [UDPHeartbeat={True|False}]
   [UDPPort=port] [UDPTunnel={True|False}]
   [USEPFSKey={True|False}]
```

Description

This command creates an IPsec policy with the specified name in the IPsec Security Policy Database (SPD). It requires a user with security officer privilege when the router is in security mode.

Parameter	Description
POLicy	The name of the policy to create. A policy with the specified name must not already exist. *Name* is a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes. Default: no default
INTerface	The IP logical interface that the policy is attached to. *Interface* is an interface name formed by joining a layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15. The IP logical interface must exist. Valid interfaces are: ■ eth (such as eth0, eth0-1) ■ PPP (such as ppp0, ppp1-1) ■ VLAN (such as vlan1, vlan0-1) ■ FR (such as fr0, fr0-1) ■ X.25 DTE (such as x25t0, x25t0-1) ■ virtual tunnel (such as virt9) To see a list of current valid interfaces, use the commands **show interface** command on page 9-72 of Chapter 9, Interfaces. Default: no default

Parameter	Description	
ACtion	The action performed on packets that match the policy. Default: no default	
	DEny	Matching packets are discarded immediately.
	IPsec	Matching packets are processed by an SA bundle attached to the policy. If **ipsec** is specified, the **peeraddress** parameter is required.
	PErmit	Matching packets are allowed to bypass IPsec processing.
BUNDlespecification	A number from 0 to 255, which identifies the bundle specification to be used when creating an SA bundle for this policy. The bundle specification must already exist. The key management specified in the bundle specification must match the one for the policy. This parameter is required when the **action** parameter for the policy is **ipsec**. Default: no default	
DFBit	The action taken on the DF bit in the outer IP header. This option is valid for tunnel mode operation. Default: **clear**	
	CLear	The DF bit is cleared. If **ipversion** is 6, this parameter cannot be specified.
	COpy	The DF bit is copied from the inner IP header.
	SEt	The DF bit in the outer IP header is set.
GROup	The group used for the Diffie-Hellman key exchange by ISAKMP/IKE for Perfect Forward Secrecy. Group 0 is a MODP group. Groups 1 and 2 are Oakley groups, and are more secure than group 0. This parameter can be used if the **usepfskey** parameter is set to **true**. Default: **1**	
ICmptype	The ICMP type value of ICMP packets to be matched against, from 0 to 255. The values can be specified as a comma-separated list, or by specifying **ndall**, which is equivalent to specifying types 133,134,135, and 136 (the types that are required for IPv6 neighbour discovery). This parameter can be used if **ipversion** is **6**. Default: no default	
IPROUtetemplate	The name of an IP route template so that IPsec can add an IP route. This parameter is valid when the **peeraddress** is set to **any** or **dynamic,** which determines the actual IP address of a peer. If **ipversion** is 6, this parameter cannot be specified. The *template-name* is a string 1 to 31 characters long. It may contain any printable character and is case sensitive. If *template-name* contains spaces, it must be in double quotes. Default: no template	
IPVersion	The version of IP that all relevant addresses and network connections are to be checked against for validity. If **4** is specified, the version is IPv4. If **6** is specified, the version is IPv6. Default: **4**	

Parameter	Description	
ISAkmppolicy	The name of the ISAKMP policy used to negotiate SA bundles with the IPsec peer. This parameter is required when the **action** parameter is set to **ipsec**. The *isakmp-policy-name* is a string 1 to 24 characters long. Valid characters are any printable character. If the name contains spaces, it must be in double quotes. Default: no default	
KEYmanagement	The key management mechanism used when creating SA bundles for this policy. This parameter is required when the **action** parameter is **ipsec**. Default: no default	
	ISakmp	SA bundles are negotiated by ISAKMP/IKE with the IPsec peer.
	MAnual	SA bundles are created manually.
LADdress	Whether the policy processes packets based on the local address of the packets. Default: **any**	
	ANy	Packets with any local IP address are processed, as long as they match the IP version specified by the **ipversion** parameter, either IPv4 or IPv6.
	ipv4add	Only packets from specific IP addresses are processed. If **lmask** is not specified, the selection value is the specified IPv4 address. If **lmask** specifies a valid IP address mask, the selection value is a subnet of the IPv4 addresses. The IP address is written in dotted decimal notation.
	ipv4add-ipv4add	Only packets from the specified range of addresses are processed. The range is specified by two IPv4 address in dotted decimal notation, separated by a hyphen.
	ipv6add [/*prefix-length*]	Only IPv6 packets are processed. The IPv6 address must be written in colon-separated hexadecimal notation, with its prefix length optionally indication by slash notation. The *prefix-length* is a number between 1 and 128. If no prefix is specified, packets are only processed for the single specified IPv6 address. If a valid prefix is specified, packets are processed for the subnet of IP addresses.
	ipv6add-ipv6add	Only IPv6 packets from a specific range of addresses are processed. The range is specified by two IPv6 address in colon-separated hexadecimal notation, separated by a hyphen.
LMAsk	The mask value for **laddress**, as an IPv4 address in dotted decimal notation. If **ipversion** is 6, the **lmask** parameter cannot be specified. Default: no default	

Parameter	Description	
LNAme	The local system name, or user name, used when negotiating SA bundles. **Lname** uses the IP address from **interface** or **srcinterface** as the local IP address selector. The IP packet selection is the same as if **laddress** were used, however, **lname** can be used when the router's IP address is dynamic. Default: **any**	
	ANy	No local name will be sent during SA bundle negotiations.
	system-name	The name sent during SA bundle negotiations, a string from 1 to 119 characters long. Valid characters are any printable character. If *system-name* contains spaces, it must be in double quotes.
LPort	Whether the policy processes packets with any local port number, or with a specified port number. Default: **any**	
	ANy, OPaque	Packets with any local port number are processed.
	port	Only packets with the specific port number, from 0 to 65535, are processed.
PEERaddress	The IP address of the IPsec device acting as a peer for this IPsec policy. This parameter is required when the **action** parameter is set to **ipsec.** Default: no default	
	ANy	Allows multiple peers to connect simultaneously to this policy.
	ipv4add	Allows the specified IPv4 address, in dotted decimal notation, to connect to this policy.
	ipv6add	Allows the specified IPv6 address, in colon-separated hexadecimal notation, to connect to this policy.
	DYnamic	Allows one peer, with a dynamic address, to connect to this policy.
POSition	Attaches the policy to the IP logical interface in a specific position amongst the ordered list of policies for the interface. Policies with specific selection rules should have a lower position number than those with more general rules. Policy position numbers range from 1 to 100. Default: the policy will be placed at the end of the current list	

Parameter	Description	
RADdress	Whether the policy processes packets based on the remote address of the packets. Default: **any**	
	ANy	Packets with any remote IP address are processed, as long as they match the IP version specified by the **ipversion** parameter, either IPv4 or IPv6.
	ipv4add	Only packets from specific IP addresses are processed. If **lmask** is not specified, the selection value is the specified IPv4 address. If **lmask** specifies a valid IP address mask, the selection value is a subnet of the IPv4 addresses. The IP address is written in dotted decimal notation.
	ipv4add-ipv4add	Only packets from the specified range of addresses are processed. The range is specified by two IPv4 address in dotted decimal notation, separated by a hyphen.
	ipv6add [*/prefix-length*]	Only IPv6 packets are processed. The IPv6 address must be written in colon-separated hexadecimal notation, with its prefix length optionally indication by slash notation. The *prefix-length* is a number between 1 and 128. If no prefix is specified, packets are only processed for the single specified IPv6 address. If a valid prefix is specified, packets are processed for the subnet of IP addresses.
	ipv6add-ipv6add	Only IPv6 packets from a specific range of addresses are processed. The range is specified by two IPv6 address in colon-separated hexadecimal notation, separated by a hyphen.
RESPondbadspi	Whether the router sends a notification to the peer when an IPsec packet is received with an unknown SPI value. This establishes an ISAKMP SA to the sending peer. An initial contact notification message is then sent, which tells the peer to delete SAs associated with the router. This command is only valid when the **action** parameter is set to **ipsec**, the **keymanagement** parameter is set to **isakmp**, and the **peeraddress** parameter is set to an IPv4 address. Messages will only be sent if the ISAKMP policy for this peer has the **mode** parameter set to **main** and the **sendnotify** parameter set to **true**. Default: **false**	
	False	A notification is not sent.
	True	A notification is sent.
RMAsk	The mask value for **raddress**, as an IPv4 address in dotted decimal notation. If **ipversion** is 6, the **rmask** parameter cannot be specified. Default: no default	

Parameter	Description	
RNAme	The remote system name, or user name, to negotiate SA bundles with. **Rname** uses the remote system's IP address as the remote IP address selector. The IP packet selection is the same as if **raddress** were used, however, **rname** can be used when the peer's IP address is dynamic. Default: **any**	
	ANy	SA bundle negotiations are accepted when the remote name has any value.
	system-name	SA bundle negotiations are accepted only from this remote name. The *system-name* is a string 1 to 119 characters long. Valid characters are any printable character. If *system-name* contains spaces, it must be in double quotes
RPort	Whether the policy processes packets with any remote port number, or with a specified remote port number. Default: **any**	
	ANy, OPaque	Packets with any remote port number are processed.
	port	Only packets with the specific port number, from 0 to 65535, are processed.
SASElectorfrompkt	Whether SA bundles are dynamically created for differences in traffic within the policy. The selector defines which parts of the packet to differentiate the traffic by. Differences are based on the processed packets, rather than the policy's value for any selector. The relevant selector values for each SA bundle will be more specific than those on the policy, and so each SA bundle will only process a sub-set of the traffic that matches the policy. More than one selector can be specified with a comma-separated list. Default: **none**	
	ALL	Specific SA bundles are created for every different type of traffic processed.
	LADdress	Specific SA bundles are created based on the local address of the traffic.
	LPort	Specific SA bundles are created based on the local port of the traffic.
	NONE	No SA bundles are created for any traffic differences.
	RADdress	Specific SA bundles are created based on the remote address of the traffic.
	RPort	Specific SA bundles are created based on the remote port of the traffic.
	TRAnsportprotocol	Specific SA bundles are created based on the transport protocol of the traffic.
SRCInterface	The source interface on the router for tunnelled IPsec traffic. If the **srcinterface** parameter is not specified, the router defaults to the **interface** parameter. An interface name is formed by joining a layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15. If **ipversion** is 6, this parameter cannot be specified. Default: the value set by the **interface** parameter	

Parameter	Description	
TRAnsportprotocol	Whether the policy will process packets containing any transport protocol, or only process packets containing a defined transport protocol. Default: **any**	
	ANy, OPaque	The policy processes packets containing any protocol.
	EGp	Only Exterior Gateway Protocol packets are processed.
	ESp	Only IP Encapsulating Security Payload packets are processed.
	GRe	Only Generic Routing Encapsulation packets are processed.
	ICmp	Only Internet Control Message Protocol are processed.
	OSpf	Only Open Shortest Path First packets are processed.
	RSvp	Only Resource Reservation Protocol packets are processed.
	TCp	Only Transmission Control Protocol packets are processed.
	UDp	Only User Datagram Protocol packets are processed.
	protocol	Packets are only processed for the specified protocol, from 0 to 255.
UDPHeartbeat	Whether UDP heartbeats are sent. UDP heartbeats ensure that state information stored for the UDP tunnelled IPsec packets in intermediate devices is periodically refreshed. If **ipversion** is 6, this parameter cannot be specified. This parameter is ignored until UDP tunnelling is enabled. Default: **false**	
	True	UDP heartbeats are sent
	False	UDP heartbeats are not sent
UDPPort	The number of the UDP Internet service port that IPsec packets are tunnelled over, from 1 to 65535. If **ipversion** is 6, this parameter cannot be specified. This parameter is ignored until UDP tunnelling is enabled. Default: **2746**	
UDPTunnel	Whether traffic matching this policy is tunnelled over UDP. This is useful when there is a gateway in the communication path that does not understand the data streams created by IPsec. If **ipversion** is 6, this parameter cannot be specified. UDP tunnelling increases the packet overhead. Default: **false**	
	True	All traffic matching this policy is tunnelled over UDP.
	False	Traffic matching this policy remains as is.

Parameter	Description	
USEPFSKey	Whether ISAKMP/IKE uses Perfect Forward Secrecy when creating keys for SAs the policy uses. This parameter is valid when the specified key management mechanism for the policy is **isakmp**. Default: **false**	
	True	Perfect Forward Secrecy is used.
	False	Perfect Forward Secrecy is not used.

Examples

To create an IPsec policy, use the command:

```
cre ips pol="test" int=eth0 ac=ips peer=10.109.1.1 srci=eth1
   key=ma bund=1 rad=10.109.1.1
```

To create an IPsec policy with manual keying, use the command:

```
cre ips pol="my_vpn" int=ppp0 ac=ips peer=192.168.2.1 key=ma
   bund=1

set ips pol="my_vpn" lad=192.168.2.0 lma=255.255.255.0
   rad=192.167.2.0 rma=255.255.255.0
```

To create an IPsec policy with ISAKMP key management, use the command:

```
cre ips pol="my_vpn" int=ppp0 ac=ips key=isakmp bund=1
   peer=192.168.2.1

set ips pol="my_vpn" lad=192.168.2.0 lma=255.255.255.0
   rad=192.167.2.0 rma=255.255.255.0
```

Related Commands

destroy ipsec policy
disable ipsec policy debug
enable ipsec policy debug
set ipsec policy
show ipsec policy

create ipsec saspecification

Syntax

```
CREate IPSec SASpecification=spec-id
   KEYmanagement={ISAkmp|MAnual} PROTocol={AH|COmp|ESp}
   [ANTIReplayenabled={True|False}] [COMPalg=LZS]
   [ENCalg={3DES2key|3DESOuter|3DESInner|DES|AES128|
   AES192|AES256|NULl}] [ENCKey=key-id] [HASHAlg={DESMac|
   MD5|NULl|SHA}] [HASHKey=key-id] [INSPI=spi]
   [MODe={TRansport|TUnnel}] [OUTSPI=spi]
   [REPLAywindowsize={32|64|128|256}]
```

Description

This command creates an SA specification to be used as a template when IPsec SAs are created by IPsec or ISAKMP. An SA specification must use **esp** (encryption), **ah** (authentication) or **comp** (compression) protocols. If manual key management is to be used, **inspi**, **outspi,** and **enckey** must be specified for an **esp** SA; and **inspi**, **outspi** and **hashkey** must be specified for an **ah** SA. If ISAKMP is to be used, ISAKMP must be enabled and configured. Only algorithms must be specified because ISAKMP negotiates suitable SPIs and keys.

This command requires a user with security officer privilege when the router is in security mode.

Parameter	Description	
SASpecification	The identification number for the SA proposal. An SA specification with the specified identification number must not already exist. The number can range from 0 to 255. Default: no default	
KEYmanagement	Whether the keys and SPIs are to be manually entered or negotiated by ISAKMP. Default: no default	
	ISAKMP	Keys and SPIs are negotiated by ISAKMP. If ISAKMP is to be used, ISAKMP must be enabled and configured. Only algorithms must be specified because ISAKMP negotiates suitable SPIs and keys.
	MAnual	Keys and SPIs are manually entered. If manual key management is to be used, **inspi**, **outspi,** and **enckey** must be specified for an encryption SA; and **inspi**, **outspi** and **hashkey** must be specified for an authentication SA.
PROTocol	The IPsec protocol type negotiated in this proposal. Default: no default	
	AH	An authentication SA is negotiated.
	COmp	A compression SA is negotiated.
	ESp	An encryption SA is negotiated.
ANTIReplayenabled	Whether the anti-replay mechanism is enabled for the specified SA. This parameter is not valid for a compression SA or manual key management. Default: **false**	
	True	Anti-replay is enabled.
	False	Anti-replay is disabled.

Parameter	Description	
COMPalg	The compression algorithm to be negotiated in this proposal. This parameter is required if **protocol** is set to **comp**. Default: no default	
ENCalg	The encryption algorithm used by SAs created from this SA specification. This parameter is required if **protocol** is set to **esp**. Default: no default	
	3DES2key	Triple DES encryption algorithm is used in Outer CBC mode with two keys.
	3DESOuter	Triple DES Outer encryption algorithm is used.
	3DESInner	Triple DES Inner encryption algorithm is used.
	DES	Data Encryption Standard (DES) is used.
	AES128	Advanced Encryption Standard with 128 key length is used.
	AES192	Advanced Encryption Standard with 192 key length is used.
	AES256	Advanced Encryption Standard with 256 key length is used.
	NULl	No encryption algorithm is set in this proposal. **Null** can only be set if the **protocol** selected is **esp**, and **hashhalg** is not set to **null**.
ENCKey	The identification number of an encryption key used by SAs created from this SA specification. The number identifies an existing key in the ENCO key database, and can range from 0 to 65535. This parameter is required if **protocol** is set to **esp** and **keymanagement** is set to **manual**. Default: no default	
HASHHAlg	The hash algorithm used by SAs created from this SA specification. This parameter is required if **protocol** is set to **ah**, or if ESP is to be used with authentication. Default: no default	
	DESMac	The DES MAC algorithm is used.
	MD5	The MD5 algorithm is used.
	NULl	No hash algorithm is set in this proposal. **Null** can only be set if the **protocol** selected is **esp**, and **encalg** is not set to **null**.
	SHA	The SHA algorithm is used.
HASHKey	The identification number of a key used for authentication purposes by SAs created from this SA specification. The number identifies an existing key in the ENCO key database, and can range from 0 to 65535. This parameter is required if **protocol** is set to **ah** or **esp**, and **keymanagement** is set to **manual**. Default: no default	
INSPI	The Security Parameter Index (SPI) used by SAs created from this SA specification for inbound traffic. An SPI is a number from 256 to 4294967295. This parameter is required if **protocol** is set to **ah** or **esp**, and **keymanagement** is set to **manual**. Default: no default	

Parameter	Description
MODe	The mode of operation of the SA to be negotiated, either **transport** or **tunnel** mode. Default: **tunnel**
OUTSPI	The Security Parameter Index (SPI) used for outbound traffic. An SPI is a number from 256 to 4294967295. This parameter is required if **protocol** is set to **ah** or **esp**, and **keymanagement** is set to **manual**. Default: no default
REPLAywindowsize	The packet size of the anti-replay window. The packet size can be set to either **32**, **64**, **128** or **256**. This parameter is not valid for a compression SA or manual key management. Default: **32**

Examples

To create an SA specification for manual key management for ESP using DES and MD5, use the command:

```
cre ips sas=1 prot=es key=ma inspi=300 outspi=400 enc=des
   hashalg=md5 enck=1 hashkey=101
```

To create an SA specification for manual key management for AH using MD5, use the command:

```
cre ips sas=2 prot=ah key=ma inspi=300 outspi=400 hasha=md5
   hashk=10
```

To create an SA specification for ISAKMP key management for ESP using 168-bit 3DES and MD5, use the command:

```
cree ips sas=1 prot=es key=is enc=3desi hasha=md5
```

To create an SA specification for ISAKMP key management for AH using MD5, use the command:

```
cre ips sas=5 prot=ah key=is hasha=md5
```

Related Commands

destroy ipsec saspecification
set ipsec saspecification
show ipsec saspecification

create isakmp policy

Syntax

```
CREate ISAkmp POLicy=name PEer={ipv4add|ipv6add|ANy}
   [AUTHType={PREshared|RSAEncr|RSASig}]
   [DELETedelay=0..30] [DHExponentlength=160..1023]
   [ENCalg={3DES2key|3DESInner|3DESOuter|DES|AES128|
   AES192|AES256}] [EXPIRYKbytes=1..1000]
   [EXPIRYSeconds=600..31449600] [GROup={0|1|2}]
   [HAShalg={SHa|MD5}] [HEARtbeatmode={Both|None|Receive|
   Send}] [HYBRIDxauth={ON|OFf|TRue|FAlse}] [IPVersion={4|
   6}] [KEY=0..65535] [LOCALID={ipv4add|ipv6add|
   domainname|user-domainname|dist-name}]
   [LOCALRsakey=0..65535] [MODe={MAIn|AGGressive}]
   [MSGBACkoff={INCREMental|NONE}] [MSGRETrylimit=0..1024]
   [MSGTImeout=1..86400]
   [NATTraversal={ON|OFf|TRue|FAlse}]
   [PHASE2xchglimit={NOne|1..1024}]
   [POLICYFilename=filename] [PREnegotiate={ON|OFf|TRue|
   FAlse}] [REMOTEId={ipv4add|ipv6add|domainname|
   user-domainname|dist-name}] [RETRYIKEattempts={0..16|
   CONTinuous}] [SENDDeletes={ON|OFf|TRue|FAlse}]
   [SENDNotify={ON|OFf|TRue|FAlse}] [SENDIdalways={ON|OFf|
   TRue|FAlse}] [SETCommitbit={ON|OFf|TRue|FAlse}]
   [SRCInterface=interface] [XAUth={CLient|SErver|NONE}]
   [XAUTHName=username] [XAUTHPasswd=password]
   [XAUTHType={GEneric|RAdius}]
```

Description This command creates an ISAKMP policy. It requires a user with security officer privilege when the router is in security mode. An ISAKMP policy specifies parameters for creating and responding to an ISAKMP exchange with a peer.

Parameter	Description	
POLicy	The name of the policy to create. A policy with the specified name must not already exist. *Name* is a string 1 to 24 characters long, which may contain any printable character and is case sensitive. If *name* contains spaces, it must be in double quotes. Default: no default	
PEer	The IP address of the ISAKMP peer. Default: no default	
	ANy	Connections are accepted from any IP address, with the same IP version specified by the **ipversion** parameter, either IPv4 or IPv6.
	ipv4add	Connections are accepted only from peers with an IPv4 address, written in dotted decimal notation
	ipv6add	Connections are accepted only from peers with an IPv6 address, written in colon-separated hexadecimal notation.

Parameter	Description	
AUTHType	The method used to authenticate the ISAKMP peer. Default: **preshared**	
	PREshared	General keys are shared by both peers. The general key that the ISAKMP peers share needs to be specified with the **key** parameter.
	RSAEncr	RSA encryption is used. The RSA public key of the ISAKMP peer needs to be specified with the **key** parameter.
	RSASig	RSA Signatures are used.
DELETedelay	The number of seconds between the completion of an ISAKMP exchange and the deletion of the ISAKMP exchange information. This prevents a deadlock if the last message that the router sends in the exchange is lost - the exchange will be complete on the router's side but not on the ISAKMP peer's side. If a retransmission is received from the ISAKMP peer during the **deletedelay** period, then the router will resend its last message again, allowing the exchange to complete on both sides. Normally the **setcommitbit** parameter can be used to prevent such a deadlock, but the **deletedelay** period can also protect against the final connected isakmp message being lost. Default: **30**	
DHExponentlength	The length in bits of the Diffie-Hellman private exponent. A large private exponent increases the security of generated keys. A small private exponent shortens the time taken for the Diffie-Hellman key exchange. The minimum for all three Diffie-Hellman groups is 160 bits. The maximum allowable values are: 511 bits for group 0; 767 bits for group 1; and 1023 bits for group 2. Default: **160**	
ENCalg	The ISAKMP encryption algorithm to be used to encrypt ISAKMP messages. Default: **des**	
	AES128	Advanced Encryption Standard with 128 key length is used.
	AES192	Advanced Encryption Standard with 192 key length is used.
	AES256	Advanced Encryption Standard with 256 key length is used.
	DES	Data Encryption Standard (DES) is used.
	3DES2key	Triple DES encryption algorithm is used in Outer CBC mode with two keys.
	3DESInner	Triple DES Outer encryption algorithm is used.
	3DESOuter	Triple DES Inner encryption algorithm is used.
EXPIRYKbytes	The number of kilobytes of data that the ISAKMP SA, created from this policy, can process before the SA expires and must be re-negotiated. This can be set from 1 to 1000. If no value is set, the SA will never expire due to the volume of data processed. Default: no expiry	
EXPIRYSeconds	The maximum lifetime in seconds of the ISAKMP SA created from this policy before the SA expires and must be re-created. This can be set from 600 seconds (10 minutes) to 31449600 seconds (364 days). Default: **86400** (24 hours)	

Parameter	Description	
GROup	The Diffie-Hellman group to use when negotiating session keys. Group 0 is a MODP group. Groups 1 and 2 are Oakley groups, and are more secure than group 0. Default: **1**	
HAShalg	The ISAKMP hash algorithm used for authenticating ISAKMP messages. Default: **sha**	
	SHa	The SHA algorithm is used.
	MD5	The MD5 algorithm is used.
HEARtbeatmode	Whether ISAKMP heartbeat messages are exchanged. If the **ipversion** parameter is **6**, the **heartbeatmode** parameter cannot be specified. Default: **none**	
	Both	The router sends heartbeats messages every 20 seconds, and listens for incoming heartbeat messages. If the router does not receive three incoming messages in a row, the router deletes the SAs belonging to the sending peer.
	None	Heartbeat mode is not enabled.
	Receive	The router listens for incoming heartbeat messages, but does not send them. If three messages in a row are not received, the router deletes the SAs belonging to the sending peer.
	Send	The router sends a heartbeat message every 20 seconds, but does not listen for incoming messages.
HYBRIDxauth	Whether the hybrid form of extended authentication is used. This applies when the **authtype** parameter is set to **rsasig**. If **ipversion** is **6**, the **hybridxauth** parameter cannot be specified. Default: **false**	
	FAlse, OFf	The hybrid form of extended authentication is not used.
	TRue, ON	The hybrid form of extended authentication is used.
IPVersion	The version of IP that all relevant addresses and network connections are checked against for validity. If **4** is specified, the version is IPv4. If **6** is specified, the version is IPv6. Default: **4**	
KEY	The key identification number of the ENCO key used to authenticate the ISAKMP peer. When **authtype** is set to **preshared,** this parameter is required and specifies a **general** key shared by both ISAKMP peers. When **authtype** is set to **rsaencr**, this parameter specifies the RSA Public key of the ISAKMP peer; if no value is specified, a key matching the IP address of the peer is searched for in the ENCO key database. Default: no default	

Parameter	Description	
LOCALID	How the router identifies itself to the remote peer. The default is the local IP address, unless the **authtype** parameter is set to **rsasig**. If set to **rsasig**, the router tries to use the system's distinguished name as the local ID. Default: either **ipv4add**, **ipv6add**, or **dist-name**	
	domainname	A fully-qualified domain name in the format foo.bar.com.
	dist-name	An X.500 distinguished name, e.g. "cn=user, o=mycompany, c=us", as described in "Distinguished names (DN)" on page 49-4 of Chapter 49, Public Key Infrastructure (PKI).
	ipv4add	An IPv4 address in dotted decimal notation
	ipv6add	An IPv6 address in colon-separated hexadecimal notation.
	user-domainname	A user fully-qualified domain name in the format user@foo.bar.com.
LOCALRsakey	The key identification number, from 0 to 65535, of the ENCO Private RSA key with which to authenticate the local router to the peer. This parameter is used for RSA encryption and RSA signature authentication. When **authtype** is set to **rsaencr** or **rsasig**, this parameter is required unless a default has been set with the **enable isakmp** command. Default: no default	
MODe	Specifies the mode for phase 1 ISAKMP exchange. Default: **main**	
	AGGressive	SA, key exchange and authentication payloads are transmitted together, to reduce the amount of round-trips. This is at the expense of identity protection.
	MAIn	SA, key exchange and authentication payloads are transmitted separately over three two-way exchanges. This mode is slower than **aggressive** mode, but ensures identity protection.
MSGBACkoff	The back-off pattern used when ISAKMP messages are retransmitted. The initial transmission time is set using the **msgtimeout** parameter. See "Retransmitting ISAKMP Messages" on page 48-23 for further details. Default: **incremental**	
	INCREMental	The delay between retransmissions increases in a linear manner. Every retransmitted message is delayed by the last delay time plus twice the **msgtimeout** value.
	NONE	The delay between retransmissions is static. All subsequent retransmissions are sent after the delay set by the **msgtimeout** parameter.
MSGRETrylimit	The maximum number of times the router retransmits ISAKMP messages. If 0 is set, no retransmissions occur. If 1 to 1024 is set, the message is retransmitted until either the limit is reached, or the retransmission is successful. Default: **8**	

Parameter	Description	
MSGTImeout	The number of seconds between the initial transmission of an ISAKMP message and the first retransmission. The subsequent retransmission intervals are dependent on the back-off pattern specified with the **msgbackoff** parameter. Default: **4**	
NATTraversal	Whether NAT-T is enabled or disabled for the ISAKMP policy. NAT-T allows peers to negotiate a UDP-encapsulated mode so that IPsec traffic can flow through a NAT device. Default: **off**	
	OFf, FAlse	NAT-T is disabled for the ISAKMP policy.
	ON, TRue	NAT-T is enabled for the ISAKMP policy.
PHASE2xchglimit	The maximum number of phase 2 exchanges allowed over an ISAKMP SA created from this policy. Default: **none**	
	NOne	No limit is set on phase 2 exchanges.
	1..1024	The maximum number of phase 2 exchanges, from 1 to 1024.
POLICYFilename	The security policy to send to remote ISAKMP peers when requested. For this feature to work, the **policyserverenabled** parameter for the **enable isakmp** command must be set to **true**. This feature is designed for use with the AT-VPN Client for Windows. For more information on this parameter, refer to the AT-VPN Client documentation. A file name is in the format `device:filename.type`. Invalid characters are * + = "|\[\];:?/, <>, and wildcards are not allowed. Valid characters are uppercase and lowercase letters, digits (0–9) and the characters ~ ' ! @ # $ % ^ & ( ) _ - { } The *device* variable is optional, and specifies the physical memory device on which the file is stored, which is flash. If *device* is specified, it must be separated from the rest of the file name by a colon (:). If *device* is not specified, the default is flash. The file extension *type* must be SCP or CFG. Default: no default	
PREnegotiate	Whether to negotiate the ISAKMP SA at startup when the **enable isakmp** command is issued. When **prenegotiate** is **true** or **on**, the **create isakmp policy** command must be entered before the **enable isakmp** command on page 48-84. In boot scripts the **create isakmp policy** command should appear before the **enable isakmp** command. When the **create isakmp policy** command appears after the **enable isakmp** command, prenegotiation does not work. If **prenegotiate** is **true** or **on**, we recommend that you also specify **srcinterface**. If **srcinterface** is not specified, ISAKMP selects the local address for the SA from interfaces that are currently up and assigned an IP address. If the SA is configured over a dynamic PPP interface, the interface will not be up or have an IP address, and ISAKMP will select the address of another interface as the local address of the SA. If **srcinterface** is set to a PPP interface, the PPP interface will be brought up and an IP address assigned before SA negotiation begins. Default: **false**	
	OFf, FAlse	ISAKMP SAs will not negotiate at startup.
	ON, TRue	ISAKMP SAs negotiate at startup.

Parameter	Description	
REMOTEId	How the remote device is identified. Default: the source IP address of the ISAKMP messages from the peer	
	domainname	A fully-qualified domain name in the format foo.bar.com.
	dist-name	An X.500 distinguished name, e.g. "cn=user, o=mycompany, c=us", as described in "Distinguished names (DN)" on page 49-4 of Chapter 49, Public Key Infrastructure (PKI).
	ipv4add	An IPv4 address in dotted decimal notation.
	ipv6add	An IPv6 address in colon-separated hexadecimal notation.
	user-domainname	A user fully-qualified domain name in the format user@foo.bar.com.
RETRYIKEattempts	The number of consecutive attempts ISAKMP makes to establish a connection. This parameter should only be used for permanent VPNs. If an ISAKMP exchange fails, then ISAKMP will attempt the key exchange again. If a phase 2 exchange fails, the exchange is attempted over new ISAKMP SAs. Default: **0**	
	0	No retry attempts occur.
	1..16	The specified number of retry attempts occur.
	CONTinuous	Retry attempts occur continuously until either the connection is established, or 24 hours has passed. After the first 16 attempts, a five minute delay occurs between attempts.
SENDDeletes	Whether to send Delete messages. Delete messages ensure that traffic goes over valid SAs. Some ISAKMP implementations do not support this parameter. Default: **false**	
	OFf, FALse	When an SA is deleted, ISAKMP does not notify the ISAKMP peer.
	ON, TRue	When an SA is deleted, ISAKMP notifies the ISAKMP peer that the SA is no longer valid.
SENDIdalways	Whether ID messages are always sent when an ISAKMP SA is being negotiated. Default: **false**	
	OFf, FAlse	ID messages are not sent.
	ON, TRue	ID messages are always sent.
SENDNotify	Whether to send Notify Status and Error messages. Default: **false**	
	OFf, FAlse	Notify Status and Error messages are not sent.
	ON, TRue	Notify Status and Error messages are sent.

Parameter	Description	
SETCommitbit	Whether the commit bit is set when negotiating an ISAKMP SA. Setting the commit bit ensures that traffic is not sent over an SA until confirmation of SA establishment is received from the ISAKMP peer. This provides robustness when using aggressive mode exchanges over unreliable networks. Some ISAKMP implementations do not support this parameter. Default: **false**	
	OFf, FAlse	Traffic may be sent over an SA as soon as it has been established. Confirmation of the SA establishment from the ISAKMP peer is not necessary.
	ON, TRue	Traffic is not sent over an SA until confirmation of SA establishment is received from the ISAKMP peer
SRCInterface	The local interface to which the policy is attached. An interface name is formed by joining a layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15. If **ipversion** is **6**, this parameter cannot be specified. Valid interfaces are: ■ eth (such as eth0, eth0-1) ■ VLAN (such as vlan1, vlan0-1) ■ FR (such as fr0, fr0-1) ■ X.25 DTE (such as x25t0, x25t0-1) ■ PPP (such as ppp0, ppp1-1) To see a list of current valid interfaces, use the **show interface** command on page 9-72 of Chapter 9, Interfaces. Default: no default	
XAUth	Whether extended authentication is used, and the role the router plays in it. If **ipversion** is **6**, this parameter cannot be specified. Default: **none**	
	CLient	The router expects an XAUTH request from the remote server.
	SErver	The router initiates the XAUTH exchange.
	NONE	Extended authentication is not used.
XAUTHName	The user name used for extended authentication when the router is acting as the client. If **ipversion** is 6, this parameter cannot be specified. The *username* is 1 to 64 characters long, may contain any printable character, and is case sensitive. If the string contains spaces, it must be in double quotes. Default: no default	
XAUTHPasswd	The password used for extended authentication when the router is acting as the client. The password is 1 to 64 characters long, can contain any printable character, and is case sensitive. If the string contains spaces, it must be in double quotes. If **ipversion** is **6**, this parameter cannot be specified. Default: no default	

Parameter	Description	
XAUTHType	The type of authentication used in the extended authentication exchange. If **ipversion** is 6, this parameter cannot be specified. Default: **generic**	
	GEneric	The remote peer is authenticated by the User Authentication Facility (UAF).
	RAdius	The remote peer is authenticated by RADIUS server look-up.

Examples To create an ISAKMP policy called "my_isakmp_policy" that negotiates with a peer with the IP address 192.168.2.1 and uses ENCO key 5 as a shared key for authentication, use the command:

```
cre isa pol="my_isakmp_policy" pe=192.168.2.1 autht=pre key=5
```

To create an ISAKMP policy called "my_isakmp_policy" that negotiates with a peer with the IP address 3ffe::4 and uses ENCO key 5 as a shared key for authentication, use the command:

```
cre isa pol="my_isakmp_policy" ipv=6 pe=3ffe::4 autht=pre
   key=5
```

Related Commands

destroy isakmp policy
set isakmp policy
show isakmp policy

create sa

Syntax

```
CREate SA=sa-id ENCKEY=key-id SPI=spi [ENCalg={DES|
   3DES2key|3DESInner}] [DIrection={IN|OUT|BOTH}]
```

Description

This command creates a Security Association with the specified identification number, Security Parameter Index (SPI), and encryption key. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration. This command requires a user with security officer privilege when the router is in security mode.

Parameter	Description	
SA	The identification number, from 0 to 255, for the Security Association. A Security Association with the same identifier must not already exist on the router. Default: no default	
ENCKEY	The identification number, from 0 to 65535, of the encryption key that the SA uses. A key with the same identifier must exist. Default: no default	
SPI	The Security Parameters Index (SPI) for the SA. The SPI is used along with the destination address to identify a particular Security Association. An SPI is a number from 256 to 4294967295. Default: no default	
ENCalg	The DES encryption algorithm the SA uses. Default: **des**	
	DES	The standard DES encryption algorithm is used in CBC mode.
	3DES2key	The Triple DES encryption algorithm is used in Outer CBC mode with two keys.
	3DESInner	The Triple DES encryption algorithm is used in Inner CBC mode with three keys.
DIrection	The direction of traffic passing through the IP interface to which the Security Association applies. Default: **both**	
	IN	Incoming traffic is processed.
	OUT	Outgoing traffic is processed.
	BOTH	Both incoming and outgoing traffic is processed.

Examples

To create a Security Association with an identification number of 1, with an SPI of 1000, encryption key 4, and that applies to all traffic on an interface, use the command:

```
cre sa=1 spi=1000 enck=4 di=both
```

Related Commands

destroy sa
set sa
show sa

delete sa member

Syntax

```
DELete SA=sa-id MEMber={LOCal|REMote} IPaddress=ipadd
   MASK=ipadd
```

Description

This command deletes an existing member of a security association. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration. This command requires a user with Security Officer privilege when the router is in security mode.

Parameter	Description
SA	The identification number, from 0 to 255, for the security association. Default: no default
MEMber	Whether the member is local or remote. Default: no default
IPaddress	The base IP address of the member, in dotted decimal notation. Default: no default
MASK	The IP mask for the member, in dotted decimal notation. Default: no default

Examples

To delete a local member consisting of the IP addresses 192.168.1.0 to 192.168.1.15 to SA 1, use the command:

```
del sa=1 mem=loc ip=192.168.1.1 mask=255.255.255.240
```

Related Commands

add sa member
show sa

destroy ipsec bundlespecification

Syntax

```
DESTroy IPSec BUNDlespecification=bundlespecification-id
```

Description

This command destroys the specified bundle specification. It requires a user with security officer privilege when the router is in security mode.

The **bundlespecification** parameter specifies the identification number of the bundle. A bundle specification with the same identification number must already exist. The identification number can be from 0 to 255.

Examples

To destroy bundle specification 1, use the command:

```
dest ips bund=1
```

Related Commands

create ipsec bundlespecification
set ipsec bundlespecification
show ipsec bundlespecification

destroy ipsec policy

Syntax `DESTroy IPSec POLicy=`*`name`* `[SABundle=`*`bundle-id`*`]`

Description This command destroys an IPsec policy or one of its SA bundles. Destroying a policy also destroys the attached SA bundles, including active SA bundles. This command requires a user with security officer privilege when the router is in security mode.

Parameter	Description
POLicy	The name of the policy to destroy, or the name of the policy containing the bundle to destroy. The *name* can be a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes. Default: no default
SABundle	The SA bundle to be destroyed. The SA bundle must exist in the specified policy. The *bundle-id* is a number from 0 to 65535. Default: no default

The **sabundle** parameter specifies the SA bundle to be destroyed. The SA bundle must exist in the specified policy.

Examples To destroy the IPsec policy named "my_vpn", use the command:

```
dest ips pol="my_vpn"
```

To destroy SA bundle 0 attached to the IPsec policy named "my_vpn", use the command:

```
dest ips pol= "my_vpn" sab=0
```

Related Commands
create ipsec policy
disable ipsec policy debug
enable ipsec policy debug
set ipsec policy
show ipsec policy

destroy ipsec saspecification

Syntax `DESTroy IPSec SASpecification=`*`spec-id`*

Description This command destroys a specific SA specification. It requires a user with security officer privilege when the router is in security mode.

The **saspecification** parameter specifies the identification number, from 0 to 255, of the specification to destroy. The specification must already exist.

Examples To destroy SA specification 1, use the command:

```
dest ips sas=1
```

Related Commands
create ipsec saspecification
set ipsec saspecification
show ipsec saspecification

destroy isakmp policy

Syntax `DESTroy ISAkmp POLicy=`*`name`*

Description This command destroys the specified ISAKMP policy. This command requires a user with security officer privilege when the router is in security mode.

The **policy** parameter specifies the name of the policy to destroy. A policy with the same name must already exist. The policy *name* is a string 1 to 24 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes.

Examples To destroy the ISAKMP policy named "my_isakmp_policy", use the command:

```
dest isa pol="my_isakmp_policy"
```

Related Commands
create isakmp policy
show isakmp policy

destroy sa

Syntax `DESTroy SA=`*`sa-id`*

Description This command destroys the Security Association with a specific identification number. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration, and requires a user with security officer privilege when the router is in security mode.

The **sa** parameter specifies the identification number, from 0 to 255, for the Security Association. An SA with the same identifier must exist on the router.

Examples To destroy Security Association 1, use the command:

```
dest sa=1
```

Related Commands
create sa
set sa
show sa

disable ipsec

Syntax `DISable IPSec`

Description This command disables IPsec processing on the router. All SA bundles attached to IPsec policies are deleted and IPsec detaches from the IP routing module. IPsec policies are not deleted. IPsec processing is disabled by default.

This command requires a user with security officer privilege when the router is in security mode.

Examples To disable IPsec processing on the router, use the command:

```
dis ips
```

Related Commands
disable ipsec policy debug
disable isakmp
enable ipsec
enable ipsec policy debug
enable isakmp
purge ipsec
show ipsec

disable ipsec oldsa

Syntax `DISable IPSec OLDsa INTerface=`*`interface`*

Description This command disables the use of the old SA functionality on the specified interface. This command requires a user with security officer privilege when the router is in security mode. The old SA functionality is disabled by default.

The **interface** parameter specifies the name of the interface. An interface name is formed by joining a layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15.

The interface must already be assigned to the IP routing module. Valid interfaces are:

- eth (such as eth0, eth0-1)
- VLAN (such as vlan1, vlan0-1)
- FR (such as fr0, fr0-1)
- X.25 DTE (such as x25t0, x25t0-1)
- PPP (such as ppp0, ppp1-1)

To see a list of current valid interfaces, use the commands **show interface** command on page 9-72 of Chapter 9, Interfaces.

Examples To disable the old SA functionality on the ETH0 interface, use the command:

```
dis ips old int=eth0
```

Related Commands **activate ipsec convertoldsa**
enable ipsec oldsa

disable ipsec policy debug

Syntax

```
DISable IPSec POLicy={ALl|name} DEBug={ALl|FIlter|PAcket|
   TRace} [DIrection={ALl|IN|OUt}] [DISPLAY={ALL|
   BUFFERHEADER|DATA|IPHEADER}] [RESult={ALL|FAIL|PASS}]
   [SELector={ALL|LADdress|LNAme|LPort|RADdress|RNAme|
   RPort|TRAnsportprotocol}] [WHEre={ALl|IPSec|PROTocol}]
```

Description This command disables debugging for the specified IPsec policy or all IPsec policies. For all parameters, multiple options may be specified as a comma-separated list. This command requires a user with security officer privilege when the router is in security mode. IPsec policy debugging is disabled by default.

Parameter	Description	
POLicy	The name of the policy for which the debugging options are to be disabled. The specified policy must already exist. Default: no default	
	ALl	All IPsec policies are selected.
	name	The specified IPsec policy is selected. The *name* can be a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes.
DEBug	The debugging options to disable. Default: no default	
	ALl	All debugging options are disabled.
	FIlter	Policy filter debugging is disabled. This disables debugging based on the selection values specified in the policy.
	PAcket	Packet debugging is disabled. This disables debugging based on the properties of each packet.
	TRace	IPsec trace debugging is disabled.
DIrection	The direction for which packet debugging is disabled. This parameter is not valid when filter debugging is specified. Default: no default	
	ALl	Packet debugging is disabled for both inbound and outbound traffic.
	IN	Packet debugging is disabled for inbound traffic.
	OUt	Packet debugging is disabled for outbound traffic.
DISPLAY	The portions of packets **not** to be displayed. This parameter is not valid when filter debugging is specified. Default: no default	
	ALL	No packet debugging is displayed.
	BUFFERHEADER	Packet debugging does not display the original bufferheader.
	DATA	Packet debugging does not display the data portion of the packet.
	IPHEADER	Packet debugging does not display the IP header of the packet.

Parameter	Description	
RESult	Whether filter debugging is disabled on the selector pass or fail results. The selectors determine whether the policy will process a packet and are created from the parameter values set by **create ipsec policy** and **set ipsec policy** commands. Default: **pass**	
	ALl	Filter debugging is disabled for all packets.
	FAil	Filter debugging is disabled for packets that do not match the policy.
	PASS	Filter debugging is disabled for packets that match the policy.
SELector	Disables debugging of the packet selector processing for the policy or policies. When enabled this displays the processing that determines which SA bundle or policy is being used to process each IP packet. The selectors determine whether a policy will process a packet and are created from the parameter values set by **create ipsec policy** and **set ipsec policy** commands. Default: no default	
	ALl	Debugging is disabled on all packet selector processing.
	LADdress	Debugging is disabled on the local address selector processing.
	LNAme	Debugging is disabled on the local name selector processing.
	LPort	Debugging is disabled on the local port selector processing.
	RADdress	Debugging is disabled on the remote address selector processing.
	RNAme	Debugging is disabled on the remote name selector processing.
	RPort	Debugging is disabled on the remote port selector processing.
	TRAnsportprotocol	Debugging is disabled on the transport protocol selector processing.
WHEre	The stage of IPsec processing for which packet data debugging does not display. This parameter is not valid when filter debugging is specified. Default: no default	
	ALl	Packet data is not displayed for any stage.
	IPSec	Packet data is not displayed for the main IPsec inbound and outbound packet processing stage. When enabled this displays the packet header data.
	PROTocol	Packet data is not displayed for the protocol the policy specifies (ESP, AH or IPComp). When enabled this displays the raw packet data before and after the protocol-specific processing.

Examples To disable policy filter debugging for the policy "my_vpn", use the command:

```
dis ips pol="my_vpn" deb=fi
```

Related Commands

enable ipsec policy debug
show ipsec policy

disable isakmp

Syntax `DISable ISAkmp`

Description This command disables ISAKMP processing on the router. All ISAKMP SAs and exchanges are destroyed. It has no effect on IPsec processing. This command requires a user with security officer privilege when the router is in security mode. ISAKMP processing is disabled by default.

Examples To disable ISAKMP processing on the router, use the command:

```
dis isa
```

Related Commands
disable isakmp debug
enable isakmp
enable isakmp debug
show isakmp

disable isakmp debug

Syntax

```
DISable ISAkmp DEBug={ALL|DEFault|PAcket|PKT|PKTRaw|STAte|
   TRAce|TRACEMore}
```

Description

This command disables the specified ISAKMP debugging options. It requires a user with security officer privilege when the router is in security mode. ISAKMP debugging is disabled by default.

Parameter	Description	
DEBug	The debugging options to disable. Default: **default**	
	ALL	All debugging options are disabled.
	DEFault	Debugging is disabled for **trace**, **state**, and **packet**.
	PAcket	Debugging is disabled for ISAKMP messages.
	PKT	Debugging is disabled for ISAKMP messages.
	PKTRaw	Debugging is disabled for the raw hex contents of ISAKMP messages.
	STAte	Debugging is disabled for changes in the ISAKMP state machine.
	TRAce	Debugging is disabled for ISAKMP error and information messages.
	TRACEMore	Debugging is disabled for ISAKMP calculated values.

Examples

To disable the default ISAKMP debugging modes (Trace, State and Packet), use the command:

```
dis isa deb
```

To disable ISAKMP trace debugging only, use the command:

```
dis isa deb=tra
```

Related Commands

disable isakmp
enable isakmp
enable isakmp debug
show isakmp

disable sa debug

Syntax `DISable SA=`*`sa-id`* `DEBug={All|Pkt|Search}`

Description This command disables the display of debugging information for the Security Association with the specified identification number. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration, and requires a user with Security Officer privilege when the router is in security mode. SA debugging is disabled by default.

Parameter	Description	
SA	The identification number, from 0 to 255, for the Security Association. A Security Association with the specified identifier must exist on the router. Default: no default	
DEBug	The type of debugging information being disabled. Default: no default	
	All	All debugging is disabled.
	Pkt	Disables the display of packet debugging information.
	Search	Disables the display of IP address searching debugging information.

Examples To disable the display of all debugging information for Security Association 1, use the command:

```
dis sa=1 deb=a
```

Related Commands
enable sa debug
set sa

enable ipsec

Syntax `ENAble IPSec`

Description This command enables IPsec processing on the router. It requires a user with security officer privilege when the router is in security mode. If IPsec policies exist in the Security Policy Database (SPD), IPsec attaches to the IP module. SA bundles are created for policies with manual key management. IPsec processing is disabled by default.

Examples To enable IPsec processing on the router, use the command:

```
ena ips
```

Related Commands
disable ipsec
disable ipsec policy debug
disable isakmp
enable ipsec policy debug
enable isakmp
purge ipsec
show ipsec

enable ipsec oldsa

Syntax `ENAble IPSec OLDsa INTerface=`*`interface`*

Description This command enables the use of the old SA functionality on the given interface for backward compatibility. It requires a user with security officer privilege when the router is in security mode. By default, this functionality is disabled on all interfaces.

The **interface** parameter specifies the name of the interface. An interface name is formed by joining a layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15.

The interface must already be assigned to the IP routing module. Valid interfaces are:

- eth (such as eth0, eth0-1)
- VLAN (such as vlan1, vlan0-1)
- FR (such as fr0, fr0-1)
- X.25 DTE (such as x25t0, x25t0-1)
- PPP (such as ppp0, ppp1-1)

To see a list of current valid interfaces, use the commands **show interface** command on page 9-72 of Chapter 9, Interfaces.

Examples To enable the old SA functionality on the ETH0 interface, use the command:

```
ena ips old int=eth0
```

Related Commands **activate ipsec convertoldsa**
disable ipsec oldsa

enable ipsec policy debug

Syntax

```
ENAble IPSec POLicy[=name] DEBug={ALl|FIlter|PAcket|TRace}
   [DIrection={ALl|IN|OUt}] [DISplay={ALl|BUFFERHEADER|
   DATA|IPHEADER}] [RESult={ALl|FAIl|PASS}]
   [SELector={ALl|LADdress|LNAme|LPort|RADdress|RNAme|
   RPort|TRAnsportprotocol}] [WHEre={ALl|IPSec|PROTocol}]
```

Description This command enables debugging for the specified IPsec policy or all policies. For all parameters, multiple options may be specified as a comma-separated list. This command requires a user with security officer privilege when the router is in security mode. IPsec policy debugging is disabled by default.

Parameter	Description	
POL	The name of the policy for which the debugging options are to be enabled. The specified policy must already exist. The *name* can be a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes. Default: all policies are selected if *name* is not specified	
DEBug	The debugging options to enable. Default: no default	
	ALl	All debugging options are enabled.
	FIlter	Policy filter debugging is enabled. This enables debugging based on the selection values specified in the policy.
	PAcket	Packet debugging is enabled. This enables debugging based on the properties of each packet.
	TRace	IPsec trace debugging is enabled.
DIrection	The direction for which packet debugging is enabled. Default: **all**	
	ALl	Packet debugging is enabled for both inbound and outbound traffic.
	IN	Packet debugging is enabled for inbound traffic.
	OUt	Packet debugging is enabled for outbound traffic.
DISplay	The portion or portions of the packet that are displayed. Default: **ipheader, data**	
	ALl	Packet debugging displays all of the original buffer header, IP header, or data portions of the packet.
	BUFFERHEADER	Packet debugging displays the original bufferheader.
	DATA	Packet debugging displays the data portion of the packet.
	IPHEADER	Packet debugging displays the IP header of the packet.

Parameter	Description	
RESult	Whether filter debugging is enabled on the selector pass or fail results. The selectors determine whether the policy will process a packet and are created from the parameter values set by **create ipsec policy** and **set ipsec policy** commands. Default: **pass**	
	ALl	Filter debugging is enabled for all packets.
	FAIl	Filter debugging is enabled for packets that do not match the policy.
	PASS	Filter debugging is enabled for packets that match the policy.
SELector	Enables debugging of the packet selector processing for the policy or policies. This displays the processing that determines which SA bundle or policy is being used to process each IP packet. The selectors determine whether a policy will process a packet and are created from the parameter values set by **create ipsec policy** and **set ipsec policy** commands. Default: no default	
	ALl	Debugging is enabled on all packet selector processing.
	LADdress	Debugging is enabled on the local address selector processing.
	LNAme	Debugging is enabled on the local name selector processing.
	LPort	Debugging is enabled on the local port selector processing.
	RADdress	Debugging is enabled on the remote address selector processing.
	RNAme	Debugging is enabled on the remote name selector processing.
	RPort	Debugging is enabled on the remote port selector processing.
	TRAnsportprotocol	Debugging is enabled on the transport protocol selector processing.
WHEre	The stage of IPsec processing for which the debugging displays packet data. This parameter is not valid when filter debugging is specified. Default: **ipsec**	
	ALl	Displays packet data for all stages.
	IPSec	Displays packet data for the main IPsec inbound and outbound packet processing stage. This displays the packet header data.
	PROTocol	Displays packet data for the protocol the policy specifies (ESP, AH or IPComp). This displays the raw packet data before and after the protocol-specific processing.

Examples To enable policy filter debugging for the policy "my_vpn" use the command

```
ena ips pol="my_vpn" deb=fi
```

Related Commands **disable ipsec policy debug**
show ipsec policy

enable isakmp

Syntax

```
ENAble ISAkmp [LOCALRsakey=key-id]
   [POLICYServerenabled={ON|OFf|TRue|FAlse}]
   [POLICYFilename=filename] [UDPPort=1..65535]
```

Description

This command enables ISAKMP processing on the router. When ISAKMP policies exist with the **prenegotiate** parameter set to **true**, phase 1 exchanges start for those policies. This command requires a user with security officer privilege when the router is in security mode. ISAKMP processing is disabled by default.

If the ISAKMP SA is to be prenegotiated at startup, then the **create isakmp policy** command on page 48-62 must be entered before **enable isakmp**. In boot scripts **create isakmp policy** should appear before the **enable isakmp** command. In both cases, the **enable isakmp** command must be the last ISAKMP command or prenegotiation does not work.

Parameter	Description
LOCALRsakey	The ENCO key ID number, from 0 to 65535, that identifies the router's RSA private key. This is required when RSAENCR authentication is used by ISAKMP policies. Default: no default
POLICYServerenabled	Whether the router acts as a security policy server. This feature is designed for the AT-VPN Client for Windows. For more information on this parameter, refer to the AT-VPN Client product documentation. If it is set to **true** or **on**, the router listens for security policy requests from remote ISAKMP peers. The router responds by sending the security policy specified by the **policyfilename** parameter. The **policyfilename** parameter is required and an ISAKMP **policy** for the peer must exist. If **policyfilename** is specified on the matched ISAKMP policy, it is used. Otherwise, the **policyfilename** from the **enable isakmp** command is used. Default: **false**
OFf, FAlse	The router does not listen for security policy requests from remote ISAKMP peers.
ON, TRue	The router listens for security policy requests from remote ISAKMP peers.

Parameter	Description
POLICYFilename	The security policy sent to remote ISAKMP peers. This parameter specifies the default policy file and is used if the **policyfilename** parameter is not specified on the matched ISAKMP policy. This parameter must be specified when the **policyserverenabled** parameter is set to **true** or **on**. This feature is designed for the AT-VPN Client for Windows. For more information on this parameter, refer to the AT-VPN Client documentation. A file name is in the format `device:filename.type`. Invalid characters are * + = "| \ [ ] ; : ? / , < >, and wildcards are not allowed. Valid characters are uppercase and lowercase letters, digits (0–9) and the characters ~ ' ! @ # $ % ^ & ( ) _ - { } The *device* variable is optional, and specifies the physical memory device on which the file is stored, which is flash. If *device* is specified, it must be separated from the rest of the file name by a colon (:). If *device* is not specified, the default is flash. The file extension *type* must be SCP or CFG. Default: no default
UDPPort	The UDP port number, from 1 to 65535, where ISAKMP sends and receives messages. Default: 500

Examples

To enable ISAKMP processing on the router, use the command:

```
ena isa
```

Related Commands

disable isakmp
disable isakmp debug
enable isakmp debug
show isakmp

enable isakmp debug

Syntax

```
ENAble ISAkmp DEBug={ALl|DEFault|PAcket|PKT|PKTRaw|STAte|
   TRAce|TRACEMore}
```

Description

This command enables the specified ISAKMP debugging options. It requires a user with security officer privilege when the router is in security mode. ISAKMP debugging is disabled by default.

Parameter	Description	
DEBug	The debugging options to enable. Default: **default**	
	ALl	All debugging options are enabled.
	DEFault	Debugging is enabled for **trace**, **state**, and **packet**.
	PAcket	Debugging is enabled for ISAKMP messages.
	PKT	Debugging is enabled for ISAKMP messages.
	PKTRaw	Debugging is enabled for the raw hex contents of ISAKMP messages.
	STAte	Debugging is enabled for changes in the ISAKMP state machine.
	TRAce	Debugging is enabled for ISAKMP error and information messages.
	TRACEMore	Debugging is enabled for ISAKMP calculated values.

Examples

To enable default ISAKMP debugging modes (trace, state, packet), use the command:

```
ena isa deb
```

To enable ISAKMP trace debugging, use the command:

```
ena isa deb=tra
```

Related Commands

disable isakmp
disable isakmp debug
enable isakmp
show isakmp

enable sa debug

Syntax `ENAble SA=sa-id DEBug={All|Pkt|Search}`

Description This command enables the display of debugging information for the Security Association with the specified identification number. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration. This command requires a user with Security Officer privilege when the router is in security mode. SA debugging is disabled by default.

Parameter	Description	
SA	The identification number, from 0 to 255, for the Security Association. A Security Association with the specified identifier must exist on the router. Default: no default	
DEBug	The type of debugging information being enabled. Default: no default	
	All	All debugging is enabled.
	Pkt	Enables the display of packet debugging information.
	Search	Enables the display of IP address searching debugging information.

Examples To enable the display of all debugging information for Security Association 1, use the command:

```
ena sa=1 deb=a
```

Related Commands
disable sa debug
set sa

purge ipsec

Syntax `PURge IPSec`

Description This command destroys the existing IPsec configuration on the router. All SA bundles, including active ones, are destroyed and active IPsec connections are closed.

This command requires a user with Security Officer privilege when the router is in security mode.

Examples To destroy the IPsec configuration on the router, use the command:

```
pur ips
```

Related Commands
destroy ipsec policy
disable ipsec
enable ipsec
show ipsec

reset ipsec counter

Syntax `RESET IPSec COUnter[={AH|ALG|COMp|ESp|MAIn|SAD|SETUP|SPD}]`

Description This command clears all general IPsec counters, or one or more categories of IPsec counters. It requires a user with Security Officer privilege when the router is in security mode.

Parameter	Description	
COUnter	The types of counters to clear. Multiple categories can be specified as a comma-separated list. Default: all general IPsec counters are cleared	
	AH	Clears counters for the AH protocol.
	ALG	Clears counters for the encryption and authentication algorithm processing units.
	COMp	Clears counters for the IPComp protocol.
	ESp	Clears counters for the IPsec ESP protocol.
	MAIn	Clears counters for the main IPsec processing unit.
	SAD	Clears counters for the IPsec Security Association Database.
	SETUP	Clears counters for setting up and removing IPsec SAs.
	SPD	Clears counters for the IPsec security policy database.

Examples To clear the IPsec counters for SAD and SPD, use the command:

```
reset ips cou=sad,spd
```

To clear all IPsec counters, use the command:

```
reset ips cou
```

Related Commands **show ipsec counter**

reset ipsec policy

Syntax `RESET IPSec POLicy=`*`name`*

Description This command resets the specified policy, that is, it clears any open security bundles associated with the policy. It also resets the policy counters.

The **policy** parameter specifies the name of the IPsec policy to reset. The *name*:

- is a string 1 to 23 characters long
- consists of any printable characters
- if it contains spaces, is in double quotes.

Examples To reset the IPsec policy named "tester", use the command.

```
reset ips pol=tester
```

Related Commands **reset ipsec policy counter**

reset ipsec policy counter

Syntax `RESET IPSec POLicy=`*`name`* `COUnter`

Description This command clears counters for the specified IPsec policy. The **policy** parameter specifies the name of the policy to create. A policy with the same name must already exist. The *name* can be a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes.

This command requires a user with Security Officer privilege when the router is in security mode.

Examples To clear the counters for the IPsec policy named "my_vpn_policy", use the command:

```
reset ips pol="my_vpn_policy" cou
```

Related Commands **show ipsec policy**

reset ipsec sa counter

Syntax `RESET IPSec SA=`*`sa-id`* `COUnter`

Description This command clears the counters of the specified Security Association (SA). The **sa** parameter specifies the identification number, from 0 to 65535, of the Security Association. The Security Association must already exist. This command requires a user with Security Officer privilege when the router is in security mode.

Examples To clear the counters for SA with identification number 1, use the command:

```
reset ips sa=1 cou
```

Related Commands **show ipsec sa**

reset isakmp counters

Syntax

```
RESET ISAkmp COUnters[={AGGressive|GENeral|HEArtbeat|INFo|
   IPSec|MAIn|NETwork|QUIck|SAD|SPD|TRAnsaction|XDB}]
```

Description

This command clears all ISAKMP counters, or one or more categories of ISAKMP counters.

Parameter	Description	
COUnter	The category or categories of counters to clear. Multiple categories can be specified as a comma-separated list. Default: all counters under this command are cleared	
	AGGressive	Clears Aggressive mode counters.
	GENeral	Clears general ISAKMP counters.
	HEArtbeat	Clears heartbeat counters.
	INFo	Clears information exchange counters.
	IPSec	Clears the interface counters between ISAKMP and IPsec.
	MAIn	Clears ISAKMP Main mode counters.
	NETwork	Clears counters for the transmission of ISAKMP messages over the network.
	QUIck	Clears Quick mode counters.
	SAD	Clears ISAKMP Security Association Database counters.
	SPD	Clears ISAKMP Security Policy Database counters.
	TRAnsaction	Clears transaction exchange counters.
	XDB	Clears ISAKMP exchange database counters.

Examples

To clear the **main** and **quick** ISAKMP counters, use the command:

```
reset isa cou=main,quick
```

To clear all ISAKMP counters, use the command:

```
reset isa cou
```

Related Commands

show isakmp counters

reset isakmp policy

Syntax `RESET ISAkmp POLicy=`*`name`*

Description This command removes all Security Associations (SA) for the specified ISAKMP policy, and sets the policy into a state to restart.

The **policy** parameter specifies the name of the ISAKMP policy to reset. The *name*:

- is a string 1 to 24 characters long
- consists of any printable characters
- is case-sensitive
- if it contains spaces, is in double quotes.

Examples To reset the ISAKMP policy named "tester", use the command:

```
reset isa pol=tester
```

Related Commands reset isakmp counters

set ipsec bundlespecification

Syntax

```
SET IPSec BUNDlespecification=bundlespecification-id
   [EXPIRYKbytes=1..4193280] [EXPIRYSeconds=300..31449600]
```

Description

This command modifies the bundle specification with the specified identification number in the IPsec Security Policy Database (SPD). Bundle specifications are a template for creating SA bundles, and specify the number and order of SAs that the bundle contains. All SA bundles are created from a bundle specification.

This command requires a user with security officer privilege when the router is in security mode.

Parameter	Description
BUNDlespecification	The identification number, from 0 to 255, of the bundle. A bundle specification with the same identification number must already exist. Default: no default
EXPIRYKbytes	The number of kilobytes of data that the SAs in the bundle can process before the bundle expires and must be renegotiated. This parameter can be specified when the **keymanagement** parameter is set to **isakmp**. Default: **4193280**
EXPIRYSeconds	The maximum lifetime in seconds of the SAs in the bundle before the bundle expires and must be renegotiated. This parameter can be specified when the **keymanagement** parameter is set to **isakmp**. Default: **28800** (8 hours)

Examples

To modify bundle specification 2 to expire after 2 hours, use the command:

```
set ips bund=2 expirys=7200
```

Related Commands

create ipsec bundlespecification
destroy ipsec bundlespecification
show ipsec bundlespecification

set ipsec policy

Syntax

```
SET IPSec POLIcy=name [ACtion={DEny|IPSec|PErmit}]
   [BUNDlespecification=bundlespecification-id]
   [DFBit={SEt|COpy|CLear}] [GROup={0|1|2}]
   [ICmptype={list|NDall}] [IPROUtetemplate=template-name]
   [IPVersion={4|6}] [ISAkmppolicy=isakmp-policy-name]
   [LADdress={ANy|ipv4add[-ipv4add]|ipv6add[/prefix-
   length]|ipv6add-ipv6add}] [LMAsk=ipv4add] [LNAme={ANy|
   system-name}] [LPort={ANy|OPaque|port}]
   [PEERaddress={ipv4add|ipv6add|ANy|DYNAMIC}]
   [PKTDebuglength=1..1500] [POSition=1..100]
   [RADdress={ANy|ipv4add[-ipv4add]|ipv6add[/prefix-
   length]|ipv6add-ipv6add}] [RESPondbadspi={True|False}]
   [RMASK=ipv4add] [RNAme={ANy|system-name}] [RPort={ANy|
   port|OPaque}] [SASElectorfrompkt={ALL|LADdress|LPort|
   NONE|RADdress|RPort|TRAnsportprotocol}]
   [SRCInterface=interface] [TRAnsportprotocol={ANy|EGp|
   ESp|GRe|ICmp|OPaque|OSpf|RSvp|TCp|UDp|protocol}]
   [UDPHeartbeat={True|False}] [UDPPort=port]
   [UDPTunnel={True|False}] [USEPFSKey={True|False}]
```

Description This command modifies an IPsec policy with the specified name in the IPsec Security Policy Database (SPD). It requires a user with security officer privilege when the router is in security mode.

Parameter	Description	
POLicy	The name of the policy to create. A policy with the specified name must already exist. *Name* is a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes. Default: no default	
ACtion	The action performed on packets that match the policy. Default: no default	
	DEny	Matching packets are discarded immediately.
	IPsec	Matching packets are processed by an SA bundle attached to the policy. If **ipsec** is specified, the **peeraddress** parameter is required.
	PErmit	Matching packets are allowed to bypass IPsec processing.
BUNDlespecification	A number from 0 to 255, which identifies the bundle specification to be used when creating an SA bundle for this policy. The bundle specification must already exist. The key management specified in the bundle specification must match the one for the policy. This parameter is required when the **action** parameter for the policy is **ipsec**. Default: no default	

Parameter	Description	
DFBit	The action taken on the DF bit in the outer IP header. This option is valid for tunnel mode operation. Default: **clear**	
	CLear	The DF bit is cleared. If **ipversion** is 6, this parameter cannot be specified.
	COpy	The DF bit is copied from the inner IP header.
	SEt	The DF bit in the outer IP header is set.
GROup	The group used for the Diffie-Hellman key exchange by ISAKMP/IKE for Perfect Forward Secrecy. Group 0 is a MODP group. Groups 1 and 2 are Oakley groups, and are more secure than group 0. This parameter can be used if the **usepfskey** parameter is set to **true**. Default: **1**	
ICmptype	The ICMP type value of ICMP packets to be matched against, from 0 to 255. The values can be specified as a comma-separated list, or by specifying **ndall**, which is equivalent to specifying types 133,134,135, and 136 (the types that are required for IPv6 neighbour discovery). This parameter can be used if **ipversion** is **6**. Default: no default	
IPROUtetemplate	The name of an IP route template so that IPsec can add an IP route. This parameter is valid when the **peeraddress** is set to **any** or **dynamic,** which determines the actual IP address of a peer. If **ipversion** is 6, this parameter cannot be specified. The *template-name* is a string 1 to 31 characters long. It may contain any printable character and is case sensitive. If *template-name* contains spaces, it must be in double quotes. Default: no template	
IPVersion	The version of IP that all relevant addresses and network connections are to be checked against for validity. If **4** is specified, the version is IPv4. If **6** is specified, the version is IPv6. Default: **4**	
ISAkmppolicy	The name of the ISAKMP policy used to negotiate SA bundles with the IPsec peer. This parameter is required when the **action** parameter is set to **ipsec**. The *isakmp-policy-name* is a string 1 to 24 characters long. Valid characters are any printable character. If the name contains spaces, it must be in double quotes. Default: no default	

Parameter	Description	
LADdress	Whether the policy processes packets based on the local address of the packets. Default: **any**	
	ANy	Packets with any local IP address are processed, as long as they match the IP version specified by the **ipversion** parameter, either IPv4 or IPv6.
	ipv4add	Only packets from specific IP addresses are processed. If **lmask** is not specified, the selection value is the specified IPv4 address. If **lmask** specifies a valid IP address mask, the selection value is a subnet of the IPv4 addresses. The IP address is written in dotted decimal notation.
	ipv4add-ipv4add	Only packets from the specified range of addresses are processed. The range is specified by two IPv4 address in dotted decimal notation, separated by a hyphen.
	ipv6add [*/prefix-length*]	Only IPv6 packets are processed. The IPv6 address must be written in colon-separated hexadecimal notation, with its prefix length optionally indication by slash notation. The *prefix-length* is a number between 1 and 128. If no prefix is specified, packets are only processed for the single specified IPv6 address. If a valid prefix is specified, packets are processed for the subnet of IP addresses.
	ipv6add-ipv6add	Only IPv6 packets from a specific range of addresses are processed. The range is specified by two IPv6 address in colon-separated hexadecimal notation, separated by a hyphen.
LMAsk	The mask value for **laddress**, as an IPv4 address in dotted decimal notation. If **ipversion** is 6, the **lmask** parameter cannot be specified. Default: no default	
LNAme	The local system name, or user name, used when negotiating SA bundles. **Lname** uses the IP address from **interface** or **srcinterface** as the local IP address selector. The IP packet selection is the same as if **laddress** were used, however, **lname** can be used when the router's IP address is dynamic. Default: **any**	
	ANy	No local name will be sent during SA bundle negotiations.
	system-name	The name sent during SA bundle negotiations, a string from 1 to 119 characters long. Valid characters are any printable character. If *system-name* contains spaces, it must be in double quotes.

Parameter	Description	
LPort	Whether the policy processes packets with any local port number, or with a specified port number. Default: **any**	
	ANy, OPaque	Packets with any local port number are processed.
	port	Only packets with the specific port number, from 0 to 65535, are processed.
PEERaddress	The IP address of the IPsec device acting as a peer for this IPsec policy. This parameter is required when the **action** parameter is set to **ipsec.** Default: no default	
	ANy	Allows multiple peers to connect simultaneously to this policy.
	ipv4add	Allows the specified IPv4 address, in dotted decimal notation, to connect to this policy.
	ipv6add	Allows the specified IPv6 address, in colon-separated hexadecimal notation, to connect to this policy.
	DYNAMIC	Allows one peer, with a dynamic address, to connect to this policy.
PKTDebuglength	The number of data bytes from an IPsec packet that are displayed when IPsec policy debugging is enabled. The amount of bytes displayed can be set from 1 to 1500. Default: **72**	
POSition	Attaches the policy to the IP logical interface in a specific position amongst the ordered list of policies for the interface. Policies with specific selection rules should have a lower position number than those with more general rules. Policy position numbers range from 1 to 100. Default: the policy will be placed at the end of the current list	

Parameter	Description	
RADdress	Whether the policy processes packets based on the remote address of the packets. Default: **any**	
	ANy	Packets with any remote IP address are processed, as long as they match the IP version specified by the **ipversion** parameter, either IPv4 or IPv6.
	ipv4add	Only packets from specific IP addresses are processed. If **lmask** is not specified, the selection value is the specified IPv4 address. If **lmask** specifies a valid IP address mask, the selection value is a subnet of the IPv4 addresses. The IP address is written in dotted decimal notation.
	ipv4add-ipv4add	Only packets from the specified range of addresses are processed. The range is specified by two IPv4 address in dotted decimal notation, separated by a hyphen.
	ipv6add [*/prefix-length*]	Only IPv6 packets are processed. The IPv6 address must be written in colon-separated hexadecimal notation, with its prefix length optionally indication by slash notation. The *prefix-length* is a number between 1 and 128. If no prefix is specified, packets are only processed for the single specified IPv6 address. If a valid prefix is specified, packets are processed for the subnet of IP addresses.
	ipv6add-ipv6add	Only IPv6 packets from a specific range of addresses are processed. The range is specified by two IPv6 address in colon-separated hexadecimal notation, separated by a hyphen.
RESPondbadspi	Whether the router sends a notification to the peer when an IPsec packet is received with an unknown SPI value. This establishes an ISAKMP SA to the sending peer. An initial contact notification message is then sent, which tells the peer to delete SAs associated with the router. This command is only valid when the **action** parameter is set to **ipsec**, the **keymanagement** parameter is set to **isakmp**, and the **peeraddress** parameter is set to an IPv4 address. Messages will only be sent if the ISAKMP policy for this peer has the **mode** parameter set to **main** and the **sendnotify** parameter set to **true**. Default: **false**	
	False	A notification is not sent.
	True	A notification is sent.
RMAsk	The mask value for **raddress**, as an IPv4 address in dotted decimal notation. If **ipversion** is 6, the **rmask** parameter cannot be specified. Default: no default	

Parameter	Description	
RNAme	The remote system name, or user name, to negotiate SA bundles with. **Rname** uses the remote system's IP address as the remote IP address selector. The IP packet selection is the same as if **raddress** were used, however, **rname** can be used when the peer's IP address is dynamic. Default: **any**	
	ANy	SA bundle negotiations are accepted when the remote name has any value.
	system-name	SA bundle negotiations are accepted only from this remote name. The *system-name* is a string 1 to 119 characters long. Valid characters are any printable character. If *system-name* contains spaces, it must be in double quotes
RPort	Whether the policy processes packets with any remote port number, or with a specified port number. Default: **any**	
	ANy, OPaque	Packets with any remote port number are processed.
	port	Only packets with the specific port number, from 0 to 65535, are processed.
SASElectorfrompkt	Whether SA bundles are dynamically created for differences in traffic within the policy. The selector defines which part of the processed packet to differentiate the traffic by. Differences are based on the processed packets, rather than the policy's value for any selector. The relevant selector values for each SA bundle will be more specific than those on the policy, and so each SA bundle will only process a sub-set of the traffic that matches the policy. More than one selector can be specified with a comma-separated list. Default: **none**	
	ALL	Specific SA bundles are created for every different type of traffic processed.
	LADdress	Specific SA bundles are created based on the local address of the traffic.
	LPort	Specific SA bundles are created based on the local port of the traffic.
	NONE	No SA bundles are created for any traffic differences.
	RADdress	Specific SA bundles are created based on the remote address of the traffic.
	RPort	Specific SA bundles are created based on the remote port of the traffic.
	TRAnsportprotocol	Specific SA bundles are created based on the transport protocol of the traffic.

Parameter	Description	
SRCInterface	The source interface on the router for tunnelled IPsec traffic. If the **srcinterface** parameter is not specified, the router defaults to the **interface** parameter. If **ipversion** is **6**, this parameter cannot be specified. An interface name is formed by joining a layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15. Valid interfaces are: ■ eth (such as eth0, eth0-1) ■ VLAN (such as vlan1, vlan0-1) ■ FR (such as fr0, fr0-1) ■ X.25 DTE (such as x25t0, x25t0-1) ■ PPP (such as ppp0, ppp1-1) To see a list of current valid interfaces, use the commands **show interface** command on page 9-72 of Chapter 9, Interfaces. Default: the value set by the **interface** parameter	
TRAnsportprotocol	Whether the policy will process packets containing any transport protocol, or only process packets containing a defined transport protocol. Default: **any**	
	ANy, OPaque	The policy processes packets containing any protocol.
	EGp	Only Exterior Gateway Protocol packets are processed.
	ESp	Only IP Encapsulating Security Payload packets are processed.
	GRe	Only Generic Routing Encapsulation packets are processed.
	ICmp	Only Internet Control Message Protocol are processed.
	OSpf	Only Open Shortest Path First packets are processed.
	RSvp	Only Resource Reservation Protocol packets are processed.
	TCp	Only Transmission Control Protocol packets are processed.
	UDp	Only User Datagram Protocol packets are processed.
	protocol	Packets are only processed for the specified protocol, from 0 to 255.
UDPHeartbeat	Whether UDP heartbeats are sent. UDP heartbeats ensure that state information stored for the UDP tunnelled IPsec packets in intermediate devices is periodically refreshed. If **ipversion** is 6, this parameter cannot be specified. This parameter is ignored until UDP tunnelling is enabled. Default: **false**	
	True	UDP heartbeats are sent
	False	UDP heartbeats are not sent

Parameter	Description	
UDPPort	The number of the UDP Internet service port that IPsec packets are tunnelled over, from 1 to 65535. If **ipversion** is 6, this parameter cannot be specified. This parameter is ignored until UDP tunnelling is enabled. Default: **2746**	
UDPTunnel	Whether traffic matching this policy is tunnelled over UDP. This is useful when there is a gateway in the communication path that does not understand the data streams created by IPsec. If **ipversion** is 6, this parameter cannot be specified. UDP tunnelling increases the packet overhead. Default: **false**	
	True	All traffic matching this policy is tunnelled over UDP.
	False	Traffic matching this policy remains as is.
USEPFSKey	Whether ISAKMP/IKE uses Perfect Forward Secrecy when creating keys for SAs the policy uses. This parameter is valid when the specified key management mechanism for the policy is **isakmp**. Default: **false**	
	True	Perfect Forward Secrecy is used.
	False	Perfect Forward Secrecy is not used.

Examples

To set an IPsec policy, use the command:

```
set ips pol="test" int=eth0 ac=ips peer=10.109.1.1 srci=eth1
   key=ma bund=1 rad=10.109.1.1
```

To move the policy with the name "my_vpn" to position 3 on the interface, use the command:

```
set ips pol="my_vpn" pos=3
```

Related Commands

create ipsec policy
destroy ipsec policy
disable ipsec policy debug
enable ipsec policy debug
show ipsec policy

set ipsec saspecification

Syntax

```
SET IPSec SASpecification=spec-id
   [ANTIreplayenabled={True|False}] [COMPalg=LZS]
   [ENCalg={3DES2key|3DESInner|3DESOuter|DES|AES128|
   AES192|AES256|NULl}] [ENCKey=key-id] [HASHAlg={DESMac|
   MD5|NULl|SHA}] [HASHKey=key-id] [INSPI=spi]
   [MOde={TRansport|TUnnel}] [OUTSPI=spi]
   [REPLAywindowsize={32|64|128|256}]
```

Description This command modifies an SA specification that is used as a template when IPsec SAs are created by IPsec or ISAKMP. An SA specification must use **esp** (encryption), **ah** (authentication) or **comp** (compression) protocols. If manual key management is to be used, **inspi**, **outspi,** and **enckey** must be specified for an **esp** SA; and **inspi**, **outspi** and **hashkey** must be specified for an **ah** SA. If ISAKMP is to be used, ISAKMP must be enabled and configured. Only algorithms must be specified because ISAKMP negotiates suitable SPIs and keys.

This command requires a user with security officer privilege when the router is in security mode.

Parameter	Description	
SASpecification	The identification number for the SA proposal. The SA specification with the specified identification number must already exist. The number can range from 0 to 255. Default: no default	
ANTIReplayenabled	Whether the anti-replay mechanism is enabled for the specified SA. This parameter is not valid for a compression SA or manual key management. Default: **false**	
	True	Anti-replay is enabled.
	False	Anti-replay is disabled.
COMPalg	The compression algorithm to be negotiated in this proposal. This parameter is required if **protocol** is set to **comp**. Default: no default	

Parameter	Description (cont)	
ENCalg	The encryption algorithm used by SAs created from this SA specification. This parameter is required if **protocol** is set to **esp**. Default: no default	
	3DES2key	Triple DES encryption algorithm is used in Outer CBC mode with two keys.
	3DESOuter	Triple DES Outer encryption algorithm is used.
	3DESInner	Triple DES Inner encryption algorithm is used.
	DES	Data Encryption Standard (DES) is used.
	AES128	Advanced Encryption Standard with 128 key length is used.
	AES192	Advanced Encryption Standard with 192 key length is used.
	AES256	Advanced Encryption Standard with 256 key length is used.
	NULl	No encryption algorithm is set in this proposal. **Null** can only be set if the **protocol** selected is **esp**, and **hashhalg** is not set to **null**.
ENCKey	The identification number of an encryption key used by SAs created from this SA specification. The number identifies an existing key in the ENCO key database, and can range from 0 to 65535. This parameter is required if **protocol** is set to **esp** and **keymanagement** is set to **manual**. Default: no default	
HASHHAlg	The hash algorithm used by SAs created from this SA specification. This parameter is required if **protocol** is set to **ah**, or if ESP is to be used with authentication. Default: no default	
	DESMac	The DES MAC algorithm is used.
	MD5	The MD5 algorithm is used.
	NULl	No hash algorithm is set in this proposal. **Null** can only be set if the **protocol** selected is **esp**, and **encalg** is not set to **null**.
	SHA	The SHA algorithm is used.
HASHKey	The identification number of a key used for authentication purposes by SAs created from this SA specification. The number identifies an existing key in the ENCO key database, and can range from 0 to 65535. This parameter is required if **protocol** is set to **ah** or **esp**, and **keymanagement** is set to **manual**. Default: no default	
INSPI	The Security Parameter Index (SPI) used by SAs created from this SA specification for inbound traffic. An SPI is a number from 256 to 4294967295. This parameter is required if **protocol** is set to **ah** or **esp**, and **keymanagement** is set to **manual**. Default: no default	
MODe	The mode of operation of the SA to be negotiated, either **transport** or **tunnel** mode. Default: **tunnel**	

Parameter	Description (cont)
OUTSPI	The Security Parameter Index (SPI) used for outbound traffic. An SPI is a number from 256 to 4294967295. This parameter is required if **protocol** is set to **ah** or **esp**, and **keymanagement** is set to **manual**. Default: no default
REPLAywindowsize	The packet size of the anti-replay window. The packet size can be set to either **32**, **64**, **128** or **256**. This parameter is not valid for a compression SA or manual key management. Default: **32**

Examples To change the algorithms and keys used by SA specification 1 with manual key management, use the command:

```
set ips sas=1 enc=3des2 hasha=sha enck=2
```

To change the encryption and hash algorithms used by SA specification 2 with ISAKMP key management, use the command:

```
set ips sas=2 enc=3desi hasha=sha
```

Related Commands **create ipsec saspecification**
destroy ipsec saspecification
show ipsec saspecification

set ipsec udpport

Syntax

```
SET IPSec UDPPort=1..65535
```

Description This command changes the UDP port over which IPsec listens for UDP tunnelled IPsec traffic. This port is also the default port over which UDP encapsulated packets are sent to the remote peer. If this command is not used to set the listen port, then the router listens on the default port of 2746.

The **udpport** parameter specifies the UDP listen port.

Example To set the UDP listen port to port 4000 (a non-default) use the command:

```
set ips udpp=4000
```

Related Commands **show ipsec**

set isakmp policy

Syntax

```
SET ISAkmp POLicy=name [PEer={ipv4add|ipv6add|ANy}]
   [AUTHType={PREshared|RSAEncr|RSASig}] [DELETedelay=10]
   [DHExponentlength=160..1023] [ENCalg={3DES2key|
   3DESInner|3DESOuter|DES|AES128|AES192|AES256}]
   [EXPIRYKbytes=1..1000] [EXPIRYSeconds=600..31449600]
   [GROup={0|1|2}] [HAShalg={SHa|MD5}]
   [HEARtbeatmode={Both|None|Receive|Send}]
   [HYBRIDxauth={ON|OFf|TRue|FAlse}] [IPVersion={4|6}]
   [KEY=0..65535] [LOCALID={ipv4add|ipv6add|domainname|
   user-domainname|dist-name}] [LOCALRsakey=0..65535]
   [MODe={MAIn|AGGressive}] [MSGBACkoff={INCREMental|
   NONE}] [MSGREtrylimit=0..1024] [MSGTImeout=1..86400]
   [NATTraversal={ON|OFf|TRue|FAlse}]
   [PHASE2xchglimit={NOne|1..1024}]
   [POLICYFilename=filename] [PREnegotiate={ON|OFf|TRue|
   FAlse}] [REMOTEId={ipv4add|ipv6add|domainname|user-
   domainname|dist-name}] [RETRYIKEattempts={0..16|
   CONTinuous}] [SENDDeletes={ON|OFf|TRue|FAlse}]
   [SENDIdalways={ON|OFf|TRue|FAlse}] [SENDNotify={ON|OFf|
   TRue|FAlse}] [SETCommitbit={ON|OFf|TRue|FAlse}]
   [SRCInterface=interface] [XAUth={CLient|SErver|NOne}]
   [XAUTHName=username] [XAUTHPasswd=password]
   [XAUTHType={GEneric|RAdius}]
```

Description This command modifies an existing ISAKMP policy. An ISAKMP policy specifies the parameters for creating and responding to an ISAKMP exchange with a peer.

Parameter	Description	
POLicy	The name of the policy to create. A policy with the specified name must already exist. *Name* is a string 1 to 24 characters long, which may contain any printable character and is case sensitive. If *name* contains spaces, it must be in double quotes. Default: no default	
PEer	The IP address of the ISAKMP peer. Default: no default	
	ANy	Connections are accepted from any IP address, with the same IP version specified by the **ipversion** parameter, either IPv4 or IPv6.
	ipv4add	Connections are accepted only from peers with an IPv4 address, written in dotted decimal notation
	ipv6add	Connections are accepted only from peers with an IPv6 address, written in colon-separated hexadecimal notation.

Parameter	Description	
AUTHType	The method used to authenticate the ISAKMP peer. Default: **preshared**	
	PREshared	General keys are shared by both peers. The general key that the ISAKMP peers share needs to be specified with the **key** parameter.
	RSAEncr	RSA encryption is used. The RSA public key of the ISAKMP peer needs to be specified with the **key** parameter.
	RSASig	RSA Signatures are used.
DELETedelay	The number of seconds between the completion of an ISAKMP exchange and the deletion of the ISAKMP exchange information. This prevents a deadlock if the last message that the router sends in the exchange is lost - the exchange will be complete on the router's side but not on the ISAKMP peer's side. If a retransmission is received from the ISAKMP peer during the **deletedelay** period, then the router will resend its last message again, allowing the exchange to complete on both sides. Normally the **setcommitbit** parameter can be used to prevent such a deadlock, but the **deletedelay** period can also protect against the final connected isakmp message being lost. Default: **30**	
DHExponentlength	The length in bits of the Diffie-Hellman private exponent. A large private exponent increases the security of generated keys. A small private exponent shortens the time taken for the Diffie-Hellman key exchange. The minimum for all three Diffie-Hellman groups is 160 bits. The maximum allowable values are: 511 bits for group 0; 767 bits for group 1; and 1023 bits for group 2. Default: **160**	
ENCalg	The ISAKMP encryption algorithm to be used to encrypt ISAKMP messages. Default: **des**	
	AES128	Advanced Encryption Standard with 128 key length is used.
	AES192	Advanced Encryption Standard with 192 key length is used.
	AES256	Advanced Encryption Standard with 256 key length is used.
	DES	Data Encryption Standard (DES) is used.
	3DES2key	Triple DES encryption algorithm is used in Outer CBC mode with two keys.
	3DESInner	Triple DES Outer encryption algorithm is used.
	3DESOuter	Triple DES Inner encryption algorithm is used.
EXPIRYKbytes	The number of kilobytes of data that the ISAKMP SA, created from this policy, can process before the SA expires and must be re-negotiated. This can be set from 1 to 1000. If no value is set, the SA will never expire due to the volume of data processed. Default: no expiry	
EXPIRYSeconds	The maximum lifetime in seconds of the ISAKMP SA created from this policy before the SA expires and must be re-created. This can be set from 600 seconds (10 minutes) to 31449600 seconds (364 days). Default: **86400** (24 hours)	

Parameter	Description	
GROup	The Diffie-Hellman group to use when negotiating session keys. Group 0 is a MODP group. Groups 1 and 2 are Oakley groups, and are more secure than group 0. Default: **1**	
HAShalg	The ISAKMP hash algorithm used for authenticating ISAKMP messages. Default: **sha**	
	SHa	The SHA algorithm is used.
	MD5	The MD5 algorithm is used.
HEARtbeatmode	Whether ISAKMP heartbeat messages are exchanged. If the **ipversion** parameter is **6**, the **heartbeatmode** parameter cannot be specified. Default: **none**	
	Both	The router sends heartbeats messages every 20 seconds, and listens for incoming heartbeat messages. If the router does not receive three incoming messages in a row, the router deletes the SAs belonging to the sending peer.
	None	Heartbeat mode is not enabled.
	Receive	The router listens for incoming heartbeat messages, but does not send them. If three messages in a row are not received, the router deletes the SAs belonging to the sending peer.
	Send	The router sends a heartbeat message every 20 seconds, but does not listen for incoming messages.
HYBRIDxauth	Whether the hybrid form of extended authentication is used. This applies when the **authtype** parameter is set to **rsasig**. If **ipversion** is **6**, the **hybridxauth** parameter cannot be specified. Default: **false**	
	FAlse, OFf	The hybrid form of extended authentication is not used.
	TRue, ON	The hybrid form of extended authentication is used.
IPVersion	The version of IP that all relevant addresses and network connections are checked against for validity. If **4** is specified, the version is IPv4. If **6** is specified, the version is IPv6. Default: **4**	
KEY	The key identification number of the ENCO key used to authenticate the ISAKMP peer. When **authtype** is set to **preshared,** this parameter is required and specifies a **general** key shared by both ISAKMP peers. When **authtype** is set to **rsaencr**, this parameter specifies the RSA Public key of the ISAKMP peer; if no value is specified, a key matching the IP address of the peer is searched for in the ENCO key database. Default: no default	

Parameter	Description	
LOCALID	How the router identifies itself to the remote peer. The default is the local IP address, unless the **authtype** parameter is set to **rsasig**. If set to **rsasig**, the router tries to use the system's distinguished name as the local ID. Default: either **ipv4add**, **ipv6add**, or **dist-name**	
	domainname	A fully-qualified domain name in the format foo.bar.com.
	dist-name	An X.500 distinguished name, e.g. "cn=user, o=mycompany, c=us", as described in "Distinguished names (DN)" on page 49-4 of Chapter 49, Public Key Infrastructure (PKI).
	ipv4add	An IPv4 address in dotted decimal notation
	ipv6add	An IPv6 address in colon-separated hexadecimal notation.
	user-domainname	A user fully-qualified domain name in the format user@foo.bar.com.
LOCALRsakey	The key identification number, from 0 to 65535, of the ENCO Private RSA key with which to authenticate the local router to the peer. This parameter is used for RSA encryption and RSA signature authentication. When **authtype** is set to **rsaencr** or **rsasig**, this parameter is required unless a default has been set with the **enable isakmp** command. Default: no default	
MODe	Specifies the mode for phase 1 ISAKMP exchange. Default: **main**	
	AGGressive	SA, key exchange and authentication payloads are transmitted together, to reduce the amount of round-trips. This is at the expense of identity protection.
	MAIn	SA, key exchange and authentication payloads are transmitted separately over three two-way exchanges. This mode is slower than **aggressive** mode, but ensures identity protection.
MSGBACkoff	The back-off pattern used when ISAKMP messages are retransmitted. The initial transmission time is set using the **msgtimeout** parameter. See "Retransmitting ISAKMP Messages" on page 48-23 for further details. Default: **incremental**	
	INCREMental	The delay between retransmissions increases in a linear manner. Every retransmitted message is delayed by the last delay time plus twice the **msgtimeout** value.
	NONE	The delay between retransmissions is static. All subsequent retransmissions are sent after the delay set by the **msgtimeout** parameter.
MSGRETrylimit	The maximum number of times the router retransmits ISAKMP messages. If 0 is set, no retransmissions occur. If 1 to 1024 is set, the message is retransmitted until either the limit is reached, or the retransmission is successful. Default: **8**	

Parameter	Description	
MSGTImeout	The number of seconds between the initial transmission of an ISAKMP message and the first retransmission. The subsequent retransmission intervals are dependent on the back-off pattern specified with the **msgbackoff** parameter. Default: **4**	
NATTraversal	Whether NAT-T is enabled or disabled for the ISAKMP policy. NAT-T allows peers to negotiate a UDP-encapsulated mode so that IPsec traffic can flow through a NAT device. Default: **off**	
	OFf, FAlse	NAT-T is disabled for the ISAKMP policy.
	ON, TRue	NAT-T is enabled for the ISAKMP policy.
PHASE2xchglimit	The maximum number of phase 2 exchanges allowed over an ISAKMP SA created from this policy. Default: **none**	
	NOne	No limit is set on phase 2 exchanges.
	1..1024	The maximum number of phase 2 exchanges, from 1 to 1024.
POLICYFilename	The security policy to send to remote ISAKMP peers when requested. For this feature to work, the **policyserverenabled** parameter for the **enable isakmp** command must be set to **true**. This feature is designed for use with the AT-VPN Client for Windows. For more information on this parameter, refer to the AT-VPN Client documentation. A file name is in the format `device:filename.type`. Invalid characters are * + = "|\[\];:?/, <>, and wildcards are not allowed. Valid characters are uppercase and lowercase letters, digits (0–9) and the characters ~ ' ! @ # $ % ^ & ( ) _ - { } The *device* variable is optional, and specifies the physical memory device on which the file is stored, which is flash. If *device* is specified, it must be separated from the rest of the file name by a colon (:). If *device* is not specified, the default is flash. The file extension *type* must be SCP or CFG. Default: no default	
PREnegotiate	Whether to negotiate the ISAKMP SA at startup when the **enable isakmp** command is issued. When **prenegotiate** is **true** or **on**, the **create isakmp policy** command must be entered before the **enable isakmp** command on page 48-84. In boot scripts the **create isakmp policy** command should appear before the **enable isakmp** command. When the **create isakmp policy** command appears after the **enable isakmp** command, prenegotiation does not work. If **prenegotiate** is **true** or **on**, we recommend that you also specify **srcinterface**. If **srcinterface** is not specified, ISAKMP selects the local address for the SA from interfaces that are currently up and assigned an IP address. If the SA is configured over a dynamic PPP interface, the interface will not be up or have an IP address, and ISAKMP will select the address of another interface as the local address of the SA. If **srcinterface** is set to a PPP interface, the PPP interface will be brought up and an IP address assigned before SA negotiation begins. Default: **false**	
	OFf, FAlse	ISAKMP SAs will not negotiate at startup.
	ON, TRue	ISAKMP SAs negotiate at startup.

Parameter	Description	
REMOTEId	How the remote device is identified. Default: the source IP address of the ISAKMP messages from the peer	
	domainname	A fully-qualified domain name in the format foo.bar.com.
	dist-name	An X.500 distinguished name, e.g. "cn=user, o=mycompany, c=us", as described in "Distinguished names (DN)" on page 49-4 of Chapter 49, Public Key Infrastructure (PKI).
	ipv4add	An IPv4 address in dotted decimal notation.
	ipv6add	An IPv6 address in colon-separated hexadecimal notation.
	user-domainname	A user fully-qualified domain name in the format user@foo.bar.com.
RETRYIKEattempts	The number of consecutive attempts ISAKMP makes to establish a connection. This parameter should only be used for permanent VPNs. If an ISAKMP exchange fails, then ISAKMP will attempt the key exchange again. If a phase 2 exchange fails, the exchange is attempted over new ISAKMP SAs. Default: **0**	
	0	No retry attempts occur.
	1..16	The specified number of retry attempts occur.
	CONTinuous	Retry attempts occur continuously until either the connection is established, or 24 hours has passed. After the first 16 attempts, a five minute delay occurs between attempts.
SENDDeletes	Whether to send Delete messages. Delete messages ensure that traffic goes over valid SAs. Some ISAKMP implementations do not support this parameter. Default: **false**	
	OFf, FALse	When an SA is deleted, ISAKMP does not notify the ISAKMP peer.
	ON, TRue	When an SA is deleted, ISAKMP notifies the ISAKMP peer that the SA is no longer valid.
SENDIdalways	Whether ID messages are always sent when an ISAKMP SA is being negotiated. Default: **false**	
	OFf, FAlse	ID messages are not sent.
	ON, TRue	ID messages are always sent.
SENDNotify	Whether to send Notify Status and Error messages. Default: **false**	
	OFf, FAlse	Notify Status and Error messages are not sent.
	ON, TRue	Notify Status and Error messages are sent.

Parameter	Description	
SETCommitbit	Whether the commit bit is set when negotiating an ISAKMP SA. Setting the commit bit ensures that traffic is not sent over an SA until confirmation of SA establishment is received from the ISAKMP peer. This provides robustness when using aggressive mode exchanges over unreliable networks. Some ISAKMP implementations do not support this parameter. Default: **false**	
	OFf, FAlse	Traffic may be sent over an SA as soon as it has been established. Confirmation of the SA establishment from the ISAKMP peer is not necessary.
	ON, TRue	Traffic is not sent over an SA until confirmation of SA establishment is received from the ISAKMP peer
SRCInterface	The local interface to which the policy is attached. An interface name is formed by joining a layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15. If **ipversion** is **6**, this parameter cannot be specified. Valid interfaces are: ■ eth (such as eth0, eth0-1) ■ VLAN (such as vlan1, vlan0-1) ■ FR (such as fr0, fr0-1) ■ X.25 DTE (such as x25t0, x25t0-1) ■ PPP (such as ppp0, ppp1-1) To see a list of current valid interfaces, use the **show interface** command on page 9-72 of Chapter 9, Interfaces. Default: no default	
XAUth	Whether extended authentication is used, and the role the router plays in it. If **ipversion** is **6**, this parameter cannot be specified. Default: **none**	
	CLient	The router expects an XAUTH request from the remote server.
	SErver	The router initiates the XAUTH exchange.
	NONE	Extended authentication is not used.
XAUTHName	The user name used for extended authentication when the router is acting as the client. If **ipversion** is 6, this parameter cannot be specified. The *username* is 1 to 64 characters long, may contain any printable character, and is case sensitive. If the string contains spaces, it must be in double quotes. Default: no default	
XAUTHPasswd	The password used for extended authentication when the router is acting as the client. The password is 1 to 64 characters long, can contain any printable character, and is case sensitive. If the string contains spaces, it must be in double quotes. If **ipversion** is **6**, this parameter cannot be specified. Default: no default	

Parameter	Description	
XAUTHType	The type of authentication used in the extended authentication exchange. If **ipversion** is 6, this parameter cannot be specified. Default: **generic**	
	GEneric	The remote peer is authenticated by the User Authentication Facility (UAF).
	RAdius	The remote peer is authenticated by RADIUS server look-up.

Examples To modify an existing ISAKMP policy called "my_isakmp_policy" so that delete, notify status, and error messages are sent, use the command:

```
set isa pol="my_isakmp_policy" sendn=tr sendd=tr
```

Related Commands

create isakmp policy
destroy isakmp policy
show isakmp policy

set sa

Syntax

```
SET SA=sa-id [DEBUGPkttype={Short|Full}] [DIrection={IN|
   OUT|BOTH}] [ENCalg={DES|3DES2key|3DESInner}]
   [ENCKey=key-id] [SPI=spi]
```

Description

This command sets the parameters of an existing Security Association with the specified identification number. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration. It requires a user with Security Officer privilege when the router is in security mode.

Parameter	Description	
SA	The identification number, from 0 to 255, for the SA. An SA with the same identifier must exist on the router. Default: no default	
DEBUGPkttype	The amount and type of debugging information to display for each packet when packet debugging is enabled on the SA. Default: no default	
	Full	Full debugging information about each packet displays.
	Short	24 bytes of each packet displays.
DIrection	The direction of traffic passing through the IP interface to which the SA applies. Default: no default	
	BOTH	The SA processes both incoming and outgoing traffic.
	IN	The SA processes incoming traffic only.
	OUT	The SA processes outgoing traffic only.
ENCalg	The type of DES encryption algorithm the SA uses. Default no default:	
	DES	The standard DES encryption algorithm is used in CBC mode.
	3DES2key	The Triple DES encryption algorithm is used in Outer CBC mode with two keys.
	3DESInner	The Triple DES encryption algorithm is used in Inner CBC mode with three keys.
ENCKey	The identification number, from 0 to 65535, of the encryption key the SA uses. A key with the same identifier must exist. Default: no default	
SPI	The Security Parameters Index (SPI) for the security association. The SPI is used with the destination address to identify a particular security association. Default: no default	

Examples

To set the encryption key of SA 1 to key 5, use the command:

```
set sa=1 enckey=5
```

Related Commands

create sa
destroy sa
disable sa debug
enable sa debug
show sa

show ipsec

Syntax `SHow IPSec`

Description This command displays status information about IPsec (Figure 48-5, Table 48-1).

Figure 48-5: Example output from the **show ipsec** command

```
IPSEC Module Configuration

  Module Status ......................... ENABLED
  IPsec over UDP
     Status ............................. OPEN
     Listen Port ........................ 2746

  VPNs
    Current ............................. 0
    Peak ................................ 0
```

Table 48-1: Parameters in output of the **show ipsec** command

Parameter	Meaning
Module Status	Whether the IPsec module is enabled or disabled.
IPsec over UDP	
Status	Whether the UDP tunnelling listen port is open or closed.
Listen Port	The UDP port over which UDP tunnelled IPsec packets can be received.
VPNs	Information about Virtual Private Network (VPN) tunnels.
Maximum	The maximum number of concurrent VPN tunnels permitted. This is only displayed on your router if it is limited by licensing. You may be able to increase this number with a special feature licence—contact your authorised distributor or reseller.
Current	The number of VPN tunnels currently active.
Peak	The highest number of VPN tunnels active at any one time since the router started.

Examples To display the IPsec module status, use the command:

```
sh ips
```

Related Commands **disable ipsec**
enable ipsec

show ipsec bundlespecification

Syntax `SHow IPSec BUNDlespecification[=`*`bundlespecification-id`*`]`

Description This command displays information about all bundle specifications or a specific one.

The **bundlespecification** parameter specifies the identification number, from 0 to 255, of the bundle specification to be displayed. If a value is not specified, summary information is displayed for all bundle specifications (Figure 48-6, Table 48-2).

If a value is specified, details are displayed about that specific bundle specification (Figure 48-7 on page 48-116, Table 48-3 on page 48-116).

Figure 48-6: Example output from **show ipsec bundlespecification** command

```
Id KeyManagment ExpKBytes ExpSec  String
-------------------------------------------------------------
1  MANUAL       -         -       1 AND 3
2  ISAKMP       10000     86400   1 OR 2 AND 3
3  ISAKMP       100000    28800   1 AND 3, 2 AND 4
```

Table 48-2: Parameters in output of the **show ipsec bundlespecification** command

Parameter	Meaning
Id	Number used to identify the bundle specification.
keymanagement	Whether the key management method is manual or ISAKMP.
ExpKBytes	Maximum number of kilobytes of data that SAs, created from the bundle specification, may process before they expire and must be re-negotiated.
ExpSec	Seconds in the SAs' lifetime created by the bundle specification before they expire and must be re-negotiated.
String	List of SA specifications for this bundle as a string that contains *and*, *or*, spaces. commas, and integers.

Figure 48-7: Example output from the **show ipsec bundlespecification** command for a specific bundle.

```
Bundle Specification

Id ................... 2
Key Management ....... ISAKMP
String ............... 1 OR 2 AND 3
Expiry Kbytes ........ -
Expiry Seconds ....... 7200

Number of Proposals................ 2

  Proposal ....................... 1
      Proposal Number ............ 1
      Protocol ................... ESP
      Number Of Transfroms ....... 2
               Transform 0 ........... SA Spec Id    1
               Transform 1 ........... SA Spec Id    2


  Proposal ....................... 2
      Proposal Number ............ 1
      Protocol ................... AH
      Number Of Transfroms ....... 1
               Transform 0 ........... SA Spec Id    3
```

Table 48-3: Parameters in output of the **show ipsec bundlespecification** command for a specific bundle.

Parameter	Meaning
Id	Number used to identify this bundle specification.
Key Management	Whether the key management method is manual or ISAKMP.
String	List of SA specifications for this bundle, as a string that contains *and*, *or*, spaces. commas, and integers.
ExpiryKBytes	Maximum number of kilobytes of data that SAs, created by the bundle specification, may process before they expire and must be re-negotiated.
ExpirySeconds	Lifetime in seconds of SAs created by the bundle specification before they expire and must be re-negotiated.
Num of Proposals	Number of proposals in this bundle specification.
Proposal	Identification number for a proposal.
Proposal Number	Proposal number. The same proposal number may appear in multiple proposals and implies a logical AND operation (e.g. protocol 1 AND protocol 2).
Protocol	Whether the protocol to use for this proposal is ESP, AH, or COMP.
Number of Transforms	Number of transforms in this proposal.
Transform	Transform number and the SA specification to use for this transform.

Examples To display all bundle specifications, use the command:

```
show ipsec bundlespecification
```

To display bundle specification 1, use the command:

```
show ipsec bundlespecification=1
```

Related Commands

create ipsec bundlespecification
destroy ipsec bundlespecification
set ipsec bundlespecification

show ipsec counter

Syntax `SHow IPSec COUnter[={AH|ALG|COMp|ESp|MAIn|SAD|SETUP|SPD}]`

Description This command displays all information counters for IPsec, or one or more categories of IPsec counters.

Parameter	Description	
COUnter	The category or categories of counters to display. Multiple categories can be specified as a comma-separated list. Default: all IPsec counters under this command are displayed	
	AH	Displays counters for the AH protocol (Figure 48-8 on page 48-118, Table 48-4 on page 48-119).
	ALG	Displays counters for the encryption and authentication algorithm processing units (Figure 48-9 on page 48-120, Table 48-5 on page 48-121).
	COMp	Displays counters for the IPComp protocol (Figure 48-10 on page 48-126, Table 48-6 on page 48-126).
	ESp	Displays counters for the IPsec ESP protocol (Figure 48-11 on page 48-127, Table 48-7 on page 48-128).
	MAIn	Displays counters for the main IPsec processing unit (Figure 48-12 on page 48-130, Table 48-8 on page 48-130).
	SAD	Displays counters for the IPsec Security Association Database (Figure 48-13 on page 48-131, Table 48-9 on page 48-131).
	SETUP	Displays counters for setting up and removing IPsec SAs (Figure 48-14 on page 48-131, Table 48-10 on page 48-131).
	SPD	Displays counters for the IPsec security policy database (Figure 48-15 on page 48-132, Table 48-11 on page 48-132).

Figure 48-8: Example output from the **show ipsec counter=ah** command

```
AH setup/remove counters
  setupGetSaFailed            0    setupFailed               0
  setupDone                   0
  removeGetSaFailed           0    removeNothingDone         0
  removeDone                  0

AH outbound processing counters
  bufChainCopy                0    seqNumberCycled           0
  hashStart                   0    hashFailImm               0
  hashDoneGetSaFail           0    hashFail                  0
  hashDoneSaBadState          0    hashGood                  0

AH inbound processing counters
  bufChainCopy                0    replayedPacket            0
  icvInvalid                  0    badPayloadLength          0
  hashStart                   0    hashFailImm               0
  hashDoneGetSaFail           0    hashFail                  0
  hashDoneSaBadState          0    hashGood                  0
```

Table 48-4: Parameters in output of the **show ipsec counter=ah** command

Parameter	Meaning
AH setup/remove counter	Counter for setting up and removing AH SAs.
setupGetSaFailed	Number of times an AH SA setup was aborted because the SA no longer existed.
setupDone	Number of times an AH SA setup was completed successfully.
removeGetSaFailed	Number of attempts to remove an AH SA was aborted because the SA no longer existed.
removeDone	Number of times an AH SA was removed successfully.
setupFailed	Number of times an AH SA setup failed.
removeNothingDone	Number of times the removal of an AH SA required no action.
AH outbound processing counter	Counter for the processing of outbound AH SAs.
bufChainCopy	Number of outbound packets copied from a chain to a buffer prior to AH processing.
hashStart	Number of times AH hash processing started on an outbound packet.
hashDoneGetSaFail	Number of times the generation of an AH hash was aborted because the SA no longer existed.
hashDoneSaBadState	Number of times the generation of an AH hash was aborted because the SA was no longer valid.
seqNumberCycled	Number of times an outbound packet caused an AH sequence number to cycle.
hashFailImm	Number of times the generation of an AH hash failed immediately.
hashFail	Number of times the generation of an AH hash failed.
hashGood	Number of AH hashes generated successfully.
AH inbound processing counter	Counter for the processing of inbound AH SAs.
bufChainCopy	Number of inbound packets copied from a chain to a buffer prior to AH processing.
icvInvalid	Number of inbound AH packets seen with an invalid ICV.
hashStart	Number of times AH hash processing started on an inbound packet.
hashDoneGetSaFail	Number of times the generation of an AH hash was aborted because the SA no longer existed.
hashDoneSaBadState	Number of times the generation of an AH hash was aborted because the SA was no longer valid.
replayedPacket	Number of inbound ESP packets seen with an invalid sequence number.
badPayloadLength	Number of inbound ESP packets seen with an invalid payload length.
hashFailImm	Number of times the generation of an AH hash failed immediately.
hashFail	Number of times the generation of an AH hash failed.
hashGood	Number of AH hashes generated successfully.

Figure 48-9: Example output from the **show ipsec counter=alg** command

```
General Algorithm Counters
  nullKeymatProcessed       10
DES:
  desKeymatProcessed        10
  desAttachFail              0    desAttachGood             10
  desConfigureFail           0    desConfigureGood          10
  desRemove                  5    desDetached                5
  desEncodeGood             34    desDecodeGood             26
  desEncodeFail              0    desDecodeFail              0
  desEncodeDiscard           0    desDecodeDiscard           0
  desEncodeGetInfoFail      0
TRIPLE DES INNER:
 3DesInnerKeymatProcessed   0
 3DesInnerAttachFail        0   3DesInnerAttachGood        0
 3DesInnerConfigureFail     0   3DesInnerConfigureGood     0
 3DesInnerRemove            0   3DesInnerDetached          0
 3DesInnerEncodeGood        0   3DesInnerDecodeGood        0
 3DesInnerEncodeFail        0   3DesInnerDecodeFail        0
 3DesInnerEncodeDiscard     0   3DesInnerDecodeDiscard     0
 3DesInnerEncGetInfoFail    0
TRIPLE DES OUTER:
 3DesOuterKeymatProcessed   0
 3DesOuterAttachFail        0   3DesOuterAttachGood        0
 3DesOuterConfigureFail     0   3DesOuterConfigureGood     0
 3DesOuterRemove            0   3DesOuterDetached          0
 3DesOuterEncodeGood        0   3DesOuterDecodeGood        0
 3DesOuterEncodeFail        0   3DesOuterDecodeFail        0
 3DesOuterEncodeDiscard     0   3DesOuterDecodeDiscard     0
 3DesOuterEncGetInfoFail    0
TRIPLE DES 2KEY:
 3Des2KeyKeymatProcessed    0
 3Des2KeyAttachFail         0   3Des2KeyAttachGood         0
 3Des2KeyConfigureFail      0   3Des2KeyConfigureGood      0
 3Des2KeyRemove             0   3Des2KeyDetached           0
 3Des2KeyEncodeGood         0   3Des2KeyDecodeGood         0
 3Des2KeyEncodeFail         0   3Des2KeyDecodeFail         0
 3Des2KeyEncodeDiscard      0   3Des2KeyDecodeDiscard      0
 3Des2KeyEncGetInfoFail     0
AES:
 aesKeymatProcessed         0
 aesAttachFail              0    aesAttachGood              0
 aesConfigureFail           0    aesConfigureGood           0
 aesRemove                  0    aesDetached                0
 aesEncodeGood              0    aesDecodeGood              0
 aesEncodeFail              0    aesDecodeFail              0
 aesEncodeDiscard           0    aesDecodeDiscard           0
 aesEncGetInfoFail          0
```

Figure 48-9: Example output from the **show ipsec counter=alg** command(cont)

```
SHA:
 shaKeymatProcessed        0
 shaAttachFail             0    shaAttachGood            0
 shaConfigureFail          0    shaConfigureGood         0
 shaRemove                 0    shaDetached              0
 shaEncodeGood             0    shaDecodeGood            0
 shaEncodeFail             0    shaDecodeFail            0
 shaEncodeDiscard          0    shaDecodeDiscard         0
MD5:
 md5KeymatProcessed        0
 md5AttachFail             0    md5AttachGood            0
 md5ConfigureFail          0    md5ConfigureGood         0
 md5Remove                 0    md5Detached              0
 md5EncodeGood             0    md5DecodeGood            0
 md5EncodeFail             0    md5DecodeFail            0
 md5EncodeDiscard          0    md5DecodeDiscard         0
DES-MAC:
 desmacKeymatProcessed     0
 desmacAttachFail          0    desmacAttachGood         0
 desmacConfigureFail       0    desmacConfigureGood      0
 desmacRemove              0    desmacDetached           0
 desmacEncodeGood          0    desmacDecodeGood         0
 desmacEncodeFail          0    desmacDecodeFail         0
 desmacEncodeDiscard       0    desmacDecodeDiscard      0
LZS:
 lzsKeymatProcessed        0
 lzsAttachFail             0    lzsAttachGood            0
 lzsConfigureFail          0    lzsConfigureGood         0
 lzsRemove                 0    lzsDetached              0
 lzsEncodeGood             0    lzsDecodeGood            0
 lzsEncodeFail             0    lzsDecodeFail            0
 lzsEncodeDiscard          0    lzsDecodeDiscard         0
IPSec:
 ipsecKeymatProcessed      0
 ipsecAttachFail           0    ipsecAttachGood          0
 ipsecConfigureFail        0    ipsecConfigureGood       0
 ipsecRemove               0    ipsecDetached            0
 ipsecEncodeGood           0    ipsecDecodeGood          0
 ipsecEncodeFail           0    ipsecDecodeFail          0
 ipsecEncodeDiscard        0    ipsecDecodeDiscard       0
```

Table 48-5: Parameters in output of the **show ipsec counter=alg** command

Parameter	Meaning
nullKeymatProcessed	Number of times NULL key material has been processed.
DES	Counter for the DES algorithm processing unit.
desKeymatProcessed	Number of times DES key material has been processed.
desAttachFail	Number of times a DES attach failed.
desConfigureFail	Number of times a DES configure failed.
desRemove	Number of times a DES remove was completed.
desEncodeGood	Number of packets successfully encrypted with DES.
desEncodeFail	Number of times DES encryption failed on a packet.
desEncodeDiscard	Number of packets discarded by DES encryption.
desEncodeGetInfoFail	Number of times no DES info was found for an encrypted packet.

Table 48-5: Parameters in output of the **show ipsec counter=alg** command (cont)

Parameter	Meaning
desAttachGood	Number of times a DES attach was successful.
desConfigureGood	Number of times a DES configure was successful.
desDetached	Number of times a DES detach was completed.
desDecodeGood	Number of packets successfully decrypted using DES.
desDecodeFail	Number of times DES decryption failed on a packet.
desDecodeDiscard	Number of packets discarded by DES decryption.
TRIPLE DES INNER	Counter for the Triple DES Inner algorithm processing unit.
3DesInnerKeymatProcessed	Number of times Triple DES Inner key material has been processed.
3DesInnerAttachFail	Number of times a Triple DES Inner attach failed.
3DesInnerConfigureFail	Number of times a Triple DES Inner configure failed.
3DesInnerRemove	Number of times a Triple DES Inner remove was completed.
3DesInnerEncodeGood	Number of packets successfully encrypted with Triple DES Inner.
3DesInnerEncodeFail	Number of times Triple DES Inner encryption failed on a packet.
3DesInnerEncodeDiscard	Number of packets discarded by Triple DES Inner encryption.
3DesInnerEncGetInfoFail	Number of times no Triple DES Inner info was found for an encrypted packet.
3DesInnerAttachGood	Number of times a Triple DES Inner attach was successful.
3DesInnerConfigureGood	Number of times a Triple DES Inner configure was successful.
3DesInnerDetached	Number of times a Triple DES Inner detach was completed.
3DesInnerDecodeGood	Number of packets successfully decrypted with Triple DES Inner.
3DesInnerDecodeFail	Number of times Triple DES Inner decryption failed on a packet.
3DesInnerDecodeDiscard	Number of times a packet was discarded by Triple DES Inner decryption.
TRIPLE DES OUTER	Counter for the Triple DES Outer algorithm processing unit.
3DesOuterKeymatProcessed	Number of times Triple DES Outer key material has been processed.
3DesOuterAttachFail	Number of times a Triple DES Outer attach failed.
3DesOuterConfigureFail	Number of times a Triple DES Outer configure failed.
3DesOuterRemove	Number of times a Triple DES Outer remove was completed.
3DesOuterEncodeGood	Number of times a packet was successfully encrypted using Triple DES Outer.
3DesOuterEncodeFail	Number of times Triple DES Outer encryption failed on a packet.
3DesOuterEncodeDiscard	Number of packets discarded by Triple DES Outer encryption.
3DesOuterEncGetInfoFail	Number of times no Triple DES Outer info was found for an encrypted packet.

Table 48-5: Parameters in output of the **show ipsec counter=alg** command (cont)

Parameter	Meaning
3DesOuterAttachGood	Number of times a Triple DES Outer attach was successful.
3DesOuterConfigureGood	Number of times a Triple DES Outer configure was successful.
3DesOuterDetached	Number of times a Triple DES Outer detach was completed.
3DesOuterDecodeGood	Number of packets successfully decrypted with Triple DES Outer.
3DesOuterDecodeFail	Number of times Triple DES Outer decryption failed on a packet.
3DesOuterDecodeDiscard	Number of packets discarded by Triple DES Outer decryption.
TRIPLE DES 2KEY	Counter for the Triple DES 2 Key algorithm processing unit.
3Des2KeyKeymatProcessed	Number of times Triple DES 2 Key key material has been processed.
3Des2KeyAttachFail	Number of times a Triple DES 2 Key attach failed.
3Des2KeyConfigureFail	Number of times a Triple DES 2 Key configure failed.
3Des2KeyRemove	Number of times a Triple DES 2 Key remove was completed.
3Des2KeyEncodeGood	Number of packets successfully encrypted with Triple DES 2 Key.
3Des2KeyEncodeFail	Number of times Triple DES 2 Key encryption failed on a packet.
3Des2KeyEncodeDiscard	Number of packets discarded by Triple DES 2 Key encryption.
3Des2KeyEncGetInfoFail	Number of times no Triple DES 2 Key info was found for an encrypted packet.
3Des2KeyAttachGood	Number of times a Triple DES 2 Key attach was successful.
3Des2KeyConfigureGood	Number of times a Triple DES 2 Key configure was successful.
3Des2KeyDetached	Number of times a Triple DES 2 Key detach was completed.
3Des2KeyDecodeGood	Number of packets successfully decrypted with Triple DES 2 Key.
3Des2KeyDecodeFail	Number of times Triple DES 2 Key decryption failed on a packet.
3Des2KeyDecodeDiscard	Number of packets discarded by Triple DES 2 Key decryption.
AES	Counters for the AEs processing unit.
aesKeymatProcessed	Number of times AES key material has been processed.
aesAttachFail	Number of times an AES attach failed.
aesConfigureFail	Number of times an AES configure failed.
aesRemove	Number of times an AES remove was completed.
aesEncodeGood	Number of packets successfully encrypted with AES.
aesEncodeFail	Number of times AES encryption failed on a packet.
aesEncodeDiscard	Number of packets discarded by AES encryption.
aesEncodeGetInfoFail	Number of times no AES information was found for an encrypted packet.

Table 48-5: Parameters in output of the **show ipsec counter=alg** command (cont)

Parameter	Meaning
aesAttachGood	Number of times an AES attach was successful.
aesConfigureGood	Number of times an AES configure was good.
aesDetached	Number of times an AES detach was completed.
aesDecodeGood	Number of packets successfully decrypted using AES.
aesDecodeFail	Number of times AES decryption failed on a packet.
aesDecodeDiscard	Number of packets discarded by AES decryption.
SHA	Counter for the SHA algorithm processing unit.
shaKeymatProcessed	Number of times SHA key material has been processed.
shaAttachFail	Number of times an SHA attach failed.
shaConfigureFail	Number of times an SHA configure failed.
shaRemove	Number of times an SHA remove was completed.
shaEncodeGood	Number of packets successfully hashed with SHA.
shaEncodeFail	Number of times an SHA hash failed on a packet.
shaEncodeDiscard	Number of packets discarded during an SHA hash.
shaAttachGood	Number of times an SHA attach was successful.
shaConfigureGood	Number of times an SHA configure was successful.
shaDetached	Number of times an SHA detach was completed.
shaDecodeGood	Number of packets successfully hashed with SHA.
shaDecodeFail	Number of times an SHA hash failed on a packet.
shaDecodeDiscard	Number of packets discarded during an SHA hash.
MD5	Counter for the MD5 algorithm processing unit.
md5KeymatProcessed	Number of times MD5 key material has been processed.
md5AttachFail	Number of times an MD5 attach failed.
md5ConfigureFail	Number of times an MD5 configure failed.
md5Remove	Number of times an MD5 remove was completed.
md5EncodeGood	Number of packets successfully hashed with MD5.
md5EncodeFail	Number of times an MD5 hash failed on a packet.
md5EncodeDiscard	Number of packets discarded during an MD5 hash.
md5AttachGood	Number of times an MD5 attach was successful.
md5ConfigureGood	Number of times an MD5 configure was successful.
md5Detached	Number of times an MD5 detach was completed.
md5DecodeGood	Number of packets successfully hashed with MD5.
md5DecodeFail	Number of times an MD5 hash failed on a packet.
md5DecodeDiscard	Number of packets discarded during an MD5 hash.
DES-MAC	Counter for the DES MAC algorithm processing unit.
desmacKeymatProcessed	Number of times DES-MAC key material has been processed.
desmacAttachFail	Number of times a DES-MAC attach failed.
desmacConfigureFail	Number of times a DES-MAC configure failed.
desmacRemove	Number of times a DES-MAC remove was completed.
desmacEncodeGood	Number of packets successfully hashed with DES-MAC.

Table 48-5: Parameters in output of the **show ipsec counter=alg** command (cont)

Parameter	Meaning
desmacEncodeFail	Number of times a DES-MAC hash failed on a packet.
desmacEncodeDiscard	Number of packets discarded during a DES-MAC hash.
desmacAttachGood	Number of times a DES-MAC attach was successful.
desmacConfigureGood	Number of times a DES-MAC configure was successful.
desmacDetached	Number of times a DES-MAC detach was completed.
desmacDecodeGood	Number of packets successfully hashed with DES-MAC.
desmacDecodeFail	Number of times a DES-MAC hash failed on a packet.
desmacDecodeDiscard	Number of packets discarded during a DES-MAC hash.
LZS	Counter for the LZS algorithm processing unit.
lzsKeymatProcessed	Number of times LZS key material has been processed.
lzsAttachFail	Number of times an LZS attach failed.
lzsConfigureFail	Number of times an LZS configure failed.
lzsRemove	Number of times an LZS remove was completed.
lzsEncodeGood	Number of packets successfully compressed using LZS.
lzsEncodeFail	Number of times LZS compression failed on a packet.
lzsEncodeDiscard	Number of packets discarded during an LZS compression.
lzsAttachGood	Number of times an LZS attach was successful.
lzsConfigureGood	Number of times an LZS configure was successful.
lzsDetached	Number of times an LZS detach was completed.
lzsDecodeGood	Number of packets successfully decompressed with LZS.
lzsDecodeFail	Number of times LZS decompression failed on a packet.
lzsDecodeDiscard	Number of packets discarded during an LZS decompression.
IPSec	Counter for the IPSec algorithm processing unit.
IPSecKeymatProcessed	Number of times IPSec key material has been processed.
lIPSecAttachFail	Number of times an IPSec attach failed.
IPSecConfigureFail	Number of times an IPSec configure failed.
IPSecRemove	Number of times an IPSec remove was completed.
IPSecEncodeGood	Number of packets successfully compressed using IPSec.
IPSecEncodeFail	Number of times IPSec compression failed on a packet.
IPSecEncodeDiscard	Number of packets discarded during an IPSec compression.
IPSecAttachGood	Number of times an IPSec attach was successful.
IPSecConfigureGood	Number of times an IPSec configure was successful.
lzsDetached	Number of times an IPSec detach was completed.
IPSecDecodeGood	Number of packets successfully decompressed with IPSec.
IPSecDecodeFail	Number of times IPSec decompression failed on a packet.
IPSecDecodeDiscard	Number of packets discarded during an IPSec decompression.

Figure 48-10: Example output from the **show ipsec counter=comp** command

```
COMP setup/remove counters:
  setupGetSaFailed     0     setupFailed           0
  setupDone            0
  removeGetSaFailed    0     removeNothingDone     0
  removeDone           0

COMP outbound processing counters:
  bufChainCopy         0     compTooSmall          0
  nonExpansionBackoff  0     dataExpansion         0
  compressionStart     0     compressionFailImm    0
  compDoneGetSaFail    0     compressionFail       0
  compDoneSaBadState   0     compressionGood       0

COMP inbound processing counters:
  bufChainCopy         0
  decompressionStart   0     decompressionFailImm  0
  decompDoneGetSaFail  0     decompressionFail     0
  decompDoneSaBadState 0     decompressionGood     0
```

Table 48-6: Parameters in output of the **show ipsec counter=comp** command

Parameter	Meaning
COMP setup/remove counters	Counters for setting up and removing COMP SAs.
setupGetSaFailed	Number of attempts to setup an IPComp SA that were aborted because the SA no longer existed.
setupDone	Number of successful attempts to setup an IPComp SA.
removeGetSaFailed	Number of attempts to remove an IPComp SA that were aborted because the SA no longer existed.
removeDone	Number of successful attempts to remove an IPComp SA.
setupFailed	Number of failed attempts to set up an IPComp SA.
removeNothingDone	Number of attempts to remove an IPComp SA that required no action.
COMP outbound processing counters	Counters for the processing of outbound COMP SAs.
bufChainCopy	Number of outbound packets copied from a chain to a buffer prior to IPComp processing.
nonExpansionBackoff	Number of outbound packets not compressed due to a non-expansion backoff.
compressionStart	Number of times IPComp compression processing started on an outbound packet.
compDoneGetSaFail	Number of times an IPComp compression was aborted because the SA no longer existed.
compDoneSaBadState	Number of times an IPComp compression was aborted because the SA was no longer valid.
compTooSmall	Number of outbound packets not compressed because they were too small.
dataExpansion	Number of outbound packets expanded when they were compressed.
compressionFailImm	Number of times an IPComp compression failed immediately.

Table 48-6: Parameters in output of the **show ipsec counter=comp** command(cont)

Parameter	Meaning
compressionFail	Number of times an IPComp compression failed.
compressionGood	Number of times an IPComp compression was completed successfully.
COMP inbound processing counters	Counters for processing inbound COMP SAs.
bufChainCopy	Number of inbound packets copied from a chain to a buffer prior to IPComp processing.
decompressionStart	Number of times IPComp decompression processing started on an inbound packet.
decompDoneGetSaFail	Number of times IPComp decompression was aborted because the SA no longer existed.
decompDoneSaBadState	Number of times IPComp decompression was aborted because the SA was no longer valid.
decompressionFailImm	Number of times IPComp decompression failed immediately.
decompressionFail	Number of times IPComp decompression failed.
decompressionGood	Number of times IPComp decompression completed successfully.

Figure 48-11: Example output from the **show ipsec counter=esp** command

```
ESP setup/remove counters

  setupGetSaFailed           0  setupEncSetupFailed        0
  setupHashSetupFailImm      0  setupEncSetupBundleRm      0
  setupFailed                0  setupDone                 10
  removeGetSaFailed          0  removeNothingDone          0
  removeHashFailImm          0  removeDone                 5

ESP outbound processing counters
  bufChainCopy               0  seqNumberCycled            0
  encryptionStart           17  encryptionFailImm          0
  encDoneGetSaFail           0  encryptionFail             0
  encDoneSaBadState          0  encryptionGood            17
  hashStart                  0  hashFailImm                0
  hashDoneGetSaFail          0  hashFail                   0
  hashDoneSaBadState         0  hashGood                   0

ESP inbound processing counters
  bufChainCopy               0  icvInvalid                 0
  paddingInvalid             0  replayedPacket             0
  hashStart                  0  hashFailImm                0
  hashDoneGetSaFail          0  hashFail                   0
  hashDoneSaBadState         0  hashGood                   0
  decryptionStart           13  decryptionFailImm          0
  encDoneGetSaFail           0  decryptionFail             0
  encDoneSaBadState          0  decryptionGood            13
```

Table 48-7: Parameters in output of the **show ipsec counter=esp** command

Parameter	Meaning
ESP setup/remove counters	Counters for setting up and removing ESP SAs.
setupGetSaFailed	Number of times an attempt to setup an ESP SA was aborted because the SA no longer existed.
setupHashSetupFailImm	Number of times an attempt to setup an ESP SA hash algorithm failed immediately.
setupFailed	Number of times an attempt to setup an ESP SA failed.
removeGetSaFailed	Number of times an attempt to remove an ESP SA was aborted because the SA no longer existed.
removeHashFailImm	Number of attempts to remove an ESP SA hash algorithm that failed immediately.
setupEncSetupFailed	Number of failed attempts to setup an ESP SA encryption algorithm.
setupEncSetupBundleRm	Number of attempts to setup an ESP SA that were aborted because the SA was being removed.
setupDone	Number of successful attempts to setup an ESP SA.
removeNothingDone	Number of attempts to remove an ESP SA that required no action.
removeDone	Number of successful attempts to setup an ESP SA.
ESP outbound processing counters	Counters for the processing of outbound ESP SAs.
bufChainCopy	Number of outbound packets copied from a chain to a buffer prior to ESP processing.
encryptionStart	Number of times ESP encryption processing started on an outbound packet.
encDoneGetSaFail	Number of times an ESP encryption was aborted because the SA no longer existed.
encDoneSaBadState	Number of times an ESP encryption was aborted because the SA was no longer valid.
hashStart	Number of times ESP hash processing started on an outbound packet.
hashDoneGetSaFail	Number of times an ESP hash was aborted because the SA no longer existed.
hashDoneSaBadState	Number of times an ESP hash was aborted because the SA was no longer valid.
seqNumberCycled	Number of times an outbound packet caused an ESP sequence number to cycle.
encryptionFailImm	Number of times ESP encryption failed immediately.
encryptionFail	Number of times ESP encryption failed.
encryptionGood	Number of times ESP encryption was completed successfully.
hashFailImm	Number of times an ESP hash failed immediately.
hashFail	Number of times an ESP hash failed.
hashGood	Number of times an ESP hash was completed successfully.
ESP inbound processing counters	Counters for the processing of inbound ESP SAs.

Table 48-7: Parameters in output of the **show ipsec counter=esp** command(cont)

Parameter	Meaning
bufChainCopy	Number of inbound packets copied from a chain to a buffer prior to ESP processing.
paddingInvalid	Number of inbound ESP packets seen with invalid padding.
hashStart	Number of times ESP hash processing started on an inbound packet.
hashDoneGetSaFail	Number of times an ESP hash was aborted because the SA no longer existed.
hashDoneSaBadState	Number of times an ESP hash was aborted because the SA was no longer valid.
decryptionStart	Number of times ESP decryption processing started on an inbound packet.
encDoneGetSaFail	Number of times ESP decryption was aborted because the SA no longer existed.
encDoneSaBadState	Number of times ESP decryption was aborted because the SA was no longer valid.
icvInvalid	Number of inbound ESP packets seen with an invalid ICV.
replayedPacket	Number of inbound ESP packets seen with an invalid sequence number.
hashFailImm	Number of times an ESP hash failed immediately.
hashFail	Number of times an ESP hash failed.
hashGood	Number of times an ESP hash was completed successfully.
decryptionFailImm	Number of times ESP decryption failed immediately.
decryptionFail	Number of times ESP decryption failed.
decryptionGood	Number of times ESP decryption was completed successfully.

Figure 48-12: Example output from the **show ipsec counter=main** command

```
IPsec main packet processing counters:
  outProcessPkt           40    inProcessPkt             33
  outNoPolicyFound         0    inNoPolicyFound           0
  outProcessPktFinished   17    inProcessPktFinished     13
                                inProcessPktKeepalive   219


IPsec over UDP counters:
  outPkt                  10    inPkt                    10
  outPktFail               0    inPktBadVersion           0
                                inPktNoPolicy             0
  outUdpHeartBeat          0    in UdpHeartBeat           0
```

Table 48-8: Parameters in output of the **show ipsec counter=main** command

Parameter	Meaning
IPsec main packet processing counters	
outProcessPkt	Number of outbound packets seen by IPsec.
outNoPolicyFound	Number of outbound packets seen by IPsec that did not match an IPsec policy.
outProcessPktFinished	Number of times IPsec processing was completed on an outbound packet.
inProcessPkt	Number of inbound packets seen by IPsec.
inNoPolicyFound	Number of inbound packets seen by IPsec that did not match an IPsec policy.
inProcessPktFinished	Number of times IPsec processing was completed on an inbound packet.
inProcessPktKeepalive	Number of NAT keepalive packets received.
IPsec over UDP counters	
outPkt	Number of outbound packets transmitted over UDP.
outPktFail	Number of failed attempts to tunnel an IPsec packet over UDP.
outUdpHeartBeat	Number of UDP heartbeats transmitted.
inPkt	Number of inbound packets received over UDP.
inPktBadVersion	Number of UDP tunnelled packets received with bad version numbers.
inPktNoPolicy	Number of UDP tunnelled packets received without a policy with UDP tunnelling enabled.
inUdpHeartBeat	Number of UDP heartbeats received.

Figure 48-13: Example output from the **show ipsec counter=sad** command

```
SAD Counters
                      Good      Failed
  Find SA               13           0
  Get SA                64           1
  Add SA                10
  Delete SA              5           0
```

Table 48-9: Parameters in output of the **show ipsec counter=sad** command

Parameter	Meaning
Good	Number of successful operations.
Failed	Number of unsuccessful operations.
Find SA	Number of successful and unsuccessful searches of the Security Association Database (SAD).
Get SA	Number of successful and unsuccessful attempts to access the SAD.
Add SA	Number of successful attempts to add SAs to the SAD.
Delete SA	Number of successful and unsuccessful attempts to delete SAs from the SAD.

Figure 48-14: Example output from the **show ipsec counter=setup** command

```
IPsec bundle setup/remove counters:
  setupGetSaSpecFail        0   setupGetPolicyFail      0
  setupStarted             10   setupSaSetupFailImm     0
  setupSaSetupStarted      10   setupSaSetupFailed      0
  setupDone                10   setupFailed             0
  setupBundleRemoving       0   vpnLicenceExceeded      0
  removeStarted             5   removeSaSetupStarted    0
  removeDone                5
```

Table 48-10: Parameters in output of the **show ipsec counter=setup** command

Parameter	Meaning
setupGetSaSpecFail	Number of SA specifications not found during an SA bundle setup.
setupStarted	Number of attempts to set up an SA bundle.
setupSaSetupStarted	Number of attempts to set up an SA.
setupDone	Number of SA bundles successfully set up.
setupBundleRemoving	Number of aborted attempts to set up an SA bundle because the bundle was being removed.
VpnLicenceExceeded	Number of times a VPN tunnel was not established due to the licensed number of VPNs being reached or exceeded. This counter can only increase if VPN tunnels are limited by licensing.
removeStarted	Number of attempts to remove an SA bundle.
removeDone	Number of SA bundles successfully removed.

Table 48-10: Parameters in output of the **show ipsec counter=setup** command(cont)

Parameter	Meaning
setupGetPolicyFail	Number of attempts to set up an SA that failed because the IPsec policy was not found.
setupSaSetupFailImm	Number of attempts to set up an SA that failed immediately.
setupSaSetupFailed	Number of failed attempts to set up an SA.
setupFailed	Number of failed attempts to set up an SA bundle.
removeSaSetupStarted	Number of attempts to remove an SA.

Figure 48-15: Example output from the **show ipsec counter=spd** command

```
SPD Counters
                              Good          Failed
 policyMatchSelectors          59              17
 policyAdd                      2               0
 policyGet                     21               2
 policyDelete                   0               0
 policyGetConfig                1               0
 policySetConfig                1               0
 policyFindByPeer               0               0
 saSpecAdd                      1               0
 saSpecGet                     21               1
 saSpecDelete                   0               0
 bundlespecAdd                  1               0
 bundleSpecGet                 12               1
 bundleSpecDelete               0               0

Policy Filter Counters

 localAddressMaskFailed    0   localAddressRangeFailed    0
 remoteAddressMaskFailed   0   remoteAddressRangeFailed   0
 localPortFailed          17   remotePortFailed           0
 localNameFailed           0   remoteNameFailed           0
 transportProtoFailed      0
```

Table 48-11: Parameters in output of the **show ipsec counter=spd** command

Parameter	Meaning
Good	Number of successful operations.
Failed	Number of unsuccessful operations.
policyMatchSelectors	Number of successful and unsuccessful attempts to search the Security Policy Database (SPD).
policyAdd	Number of successful and unsuccessful attempts to add a policy to the SPD.
policyGet	Number of successful and unsuccessful attempts to access a policy in the SPD.
policyDelete	Number of successful and unsuccessful attempts to delete a policy from the SPD.
policyGetConfig	Number of successful and unsuccessful attempts to convert policy to policy configuration format when modifying policy parameters.

Table 48-11: Parameters in output of the **show ipsec counter=spd** command (cont)

Parameter	Meaning
policySetConfig	Number of successful and unsuccessful attempts to convert policy configuration format to policy when modifying policy parameters.
policyFindByPeer	Number of successful and unsuccessful attempts search the Security Policy Database (SPD) by peer IP address.
saSpecAdd	Number of successful and unsuccessful attempts to add an SA specification to the SPD.
saSpecGet	Number of successful and unsuccessful attempts to access an SA specification in the SPD.
saSpecDelete	Number of successful and unsuccessful attempts to delete an SA specification from the SPD.
bundleSpecAdd	Number of successful and unsuccessful attempts to add a bundle specification to the SPD.
bundleSpecGet	Number of successful and unsuccessful attempts to access a bundle specifications in the SPD.
bundleSpecDelete	Number of successful and unsuccessful attempts to delete a bundle specification from the SPD.
localAddressMaskFailed	Number of failures trying to match the local IP address and mask.
remoteAddressMaskFailed	Number of failures trying to match the remote IP address and mask.
localPortFailed	Number of failures trying to match the local port selector field.
localNameFailed	Number of failures trying to match the local name selector field.
transportProtoFailed	Number of failures trying to match the transport protocol field.
localAddressRangeFailed	Number of failures trying to match the local IP address range.
remoteAddressRangeFailed	Number of failures trying to match the remote IP address range.
remotePortFailed	Number of failures trying to match the remote port selector field.
remoteNameFailed	Number of failures trying to match the remote name selector field.

Examples To display all IPsec counters, use the command:

```
show ipsec counter
```

To display **spd** and **main** IPsec counter types, use the command:

```
show ipsec counter=spd,main
```

Related Commands **show ipsec sa**

show ipsec policy

Syntax `SHow IPSec POLIcy[=`*name*`]`

Description This command displays configuration details for IPsec policies.

When *name* is specified, the configuration details for the specified policy are displayed (Figure 48-17 on page 48-135, Table 48-13 on page 48-136). The policy name must already exist. *Name* is a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes.

When *name* is not specified, summary details about all policies are displayed (Figure 48-16, Table 48-12).

Figure 48-16: Example output from the **show ipsec policy** command

```
Interface Name              Action  KeyManagement Position
-------------------------------------------------------------
PPP0      MY_PPP_POLICY1    IPSEC   ISAKMP          1
PPP0      MY_PPP_POLICY2    IPSEC   ISAKMP          2
PPP0      MY_PPP_POLICY3    DENY    -               3
```

Table 48-12: Parameters in output of the **show ipsec policy** command

Parameter	Meaning
Interface	A interface name and logical index.
Name	A character string to identify the policy.
Action	Whether the required action is IPSEC, permit, or deny.
keymanagement	Whether the key management method is manual or ISAKMP.
Position	A number specifying the position of the policy.

Figure 48-17: Example output from the **show ipsec policy** command for a specific policy.

```
IPsec Policy Information

Name ........................... my_vpn
Interface ...................... PPP0
Source Interface ............... PPP0
Position ....................... 1
Action ......................... IPSEC

Key Management ................. ISAKMP
Isakmp Policy Name ............. my_isakmp_policy
Bundle Specification ........... 2
Peer IP Address Dynamic ........ FALSE
Peer IP address Any ............ FALSE
Local IP Address Dynamic ....... FALSE
Peer IP Address ................ 192.168.10.1
Local IP Address ............... 232.163.2.3
Use PFS Key .................... TRUE
Respond Bad SPI................. TRUE
Group .......................... 1
Filter:
  Local Address ................ 192.167.2.0
  Local Mask ................... 255.255.255.255
  Local Port ................... ANY
  Local Name ................... main_office
  Remote Address ............... 232.163.2.20
  Remote Mask .................. 255.255.255.255
  Remote Port .................. ANY
  Remote Name .................. ANY
  Transport Protocol ........... ANY
  SA Selector from Packet ...... 00000000

DF Bit ......................... COPY
UDP Tunnel ..................... TRUE
  Peer Port .................... 14997
  Peer IP Address .............. 202.36.163.204
  Internal IP Address .......... 192.168.1.1
  HeartBeats Enabled ........... FALSE
Debug device ................... 16
Filter debug flags ............. 00000000
Packet debug flags ............. 00000000
Trace debug flags .............. 00000000
Packet debug length ............ 72
Max Out Packet queue length .... 20
Number of Out Packets queued ... 0

Bundles
                          Expiry Limits - hard/soft/used
Bundle                    Bytes
Index  SAs       State    Seconds
0      1,2,5      VALID    1000000/900000/907835
                          36000/30000/32432
1      12,13,14   INVALID  1000000/900000/0
                          36000/30000/0
```

Table 48-13: Parameters in output of the **show ipsec policy** command for a specific policy

Parameter	Meaning
Name	The manager-assigned name of the policy.
Interface	The logical interface to which the policy is attached.
Position	The position of this policy in the list of policies attached to the interface.
Action	Whether the action for this policy is IPsec, permit, or deny.
Key Manage	Whether the key management method for this policy is MANUAL or ISAKMP.
Isakmp Policy Name	The name of the ISAKMP policy name to be used in phase 1 negotiations.
Bundle Specification	The identification number of the SA bundle specification to be used by this policy.
Peer IP Address Dynamic	Whether the peer IP address is dynamically assigned.
Peer IP Address Any	Whether the policy can be used to negotiate IPsec SAs for any peer.
Local IP Address Dynamic	Whether the policy is attached to a dynamic IP interface.
Peer IP Address	The IP address of the remote end of the IPsec tunnel.
IP Route Template	The name of the IP route template this policy uses
Local IP Address	The IP address of the local end of the IPsec tunnel
Use PFS Key	Whether to use Perfect Forward Security (PFS).
Respond Bad SPI	Whether the router sends a notification message to the peer, if the router receives an IPsec packet with an unknown SPI value.
Group	The Diffie-Hellman group to be used.
Filter	Information about the packet matching filter, or selectors, for this policy.
Local Address	The local address packet selector field for the policy. For IPv6 addresses, slash notation may be used to indicate the prefix length.
Local Mask	The local mask packet selector field for the policy, for IPv4.
Local Port	The local port packet selector field for the policy.
Local Name	The local name packet selector field for the policy.
Remote Address	The remote IP address packet selector field for the policy. For IPv6 addresses, slash notation may be used to indicate the prefix length.
Remote Mask	The remote mask packet selector field for the policy, for IPv4.
Remote Port	The remote port packet selector field for the policy.
Remote Name	The remote name packet selector field for the policy.
Transport Protocol	The transport protocol packet selector field for the policy.
SA Selector From Pkt	A flag specifying which packet selector fields from the packet are used to find a matching SA.
DF Bit	The value to be set for the Don't Fragment bit in the outer IP header. either COPY, SET, or CLEAR

Table 48-13: Parameters in output of the **show ipsec policy** command for a specific policy (cont)

Parameter	Meaning
UDP Tunnel	The status of UDP tunnelling for this policy; either TRUE (enabled) or FALSE (disabled).
Peer Port	The port to which UDP tunnelled traffic is sent.
Peer IP Address	The IP address to which UDP tunnelled traffic is sent.
Internal IP Address	The IP address to be used for the destination of the IPsec tunnelled packets.
HeartBeats Enabled	Whether UDP heartbeat mode is enabled or disabled.
Debug device	The device (port number) to which debugging output is sent.
Filter debug flags	A flag indicating the policy selectors and pass/fail results for which filter debugging is enabled.
Packet debug flags	A flag indicating the processing units and directions for which packet debugging is enabled, and the portions of packets to be displayed.
Trace debug flags	A flag indicating whether trace debugging is enabled.
Packet debug length	The length of the packet displayed for debugging.
Max Out Packet queue length	The maximum number of packets that can be queued before processing.
Number of Out Packets queued	The number of packets currently queued for processing.
Bundles	Information about the SA bundles attached to this policy.
Index	The identification number of an SA bundle attached to this policy.
SAs	The SA identification numbers of the SAs in the SA bundle.
State	The state of the SA bundle; either VALID, INVALID, CREATING, or REMOVING.
Expiry Limits - hard/soft/used	Information about the limits used to expire SAs created from this bundle. When a soft limit is exceed the SAs are renegotiated. When a hard limit is exceeded the SAs are removed from the Security Policy Database (SPD).
ExpiryBytes	The expiry information in bytes for each SA bundle. The first figure displays the hard expiry limit, the second figure displays the soft expiry limit and the third figure displays the number of bytes already used.
ExpirySeconds	The expiry information in seconds for each SA bundle. The first figure displays the hard expiry limit, the second figure displays the soft expiry limit and the third figure displays the seconds already used.

Examples To display a policy with the name "my_vpn", use the command:

```
show ipsec policy="my_vpn"
```

Related Commands

create ipsec policy
destroy ipsec policy
set ipsec policy

show ipsec policy counter

Syntax `SHow IPSec POLIcy[=name] COUnter`

Description This command displays the counters for IPsec policies (Figure 48-18, Table 48-14).

The **policy** parameter specifies the name of an existing policy. When *name* is specified, counters for the specified policy are displayed. The policy name must already exist. *Name* is a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes.

When *name* is not specified, counters for all policies are displayed.

Figure 48-18: Example output from the **show ipsec policy counter** command

```
Setup/Remove Counters:
  setupStarted                1   setupSaSetupFailImm         0
  setupSaSetupStarted         1   setupSaSetupFailed          0
  setupDone                   1   setupFailed                 0
  removeStarted               0   removeSaSetupStarted        0
  removeDone                  0

Outbound Packet Processing Counters:
  outDeny                     0   outPermit                   0
  outNoBundle                 1   outNoBundleFail             0
  outMakeSetupStrctFail       0   outSetupBundleFail          0
  outBundleSoftExpire         0   outBundleExpire             0
  outProcessStart          4373   outProcessFailImm           0
  outBundleStateBad           0   outProcessFail              0
  outProcessDone           4373   outBundleNotFound           0
  outNoBundleSqos             0

Inbound Packet Processing Counters:
  inDeny                      0   inPermit                    0
  inCompUncompressed          0   inActionIpsecFail           0
  inBundleStateBad            0   inNotFirstSaInBundle        0
  inProcessStart           4373   inProcessFailImm            0
  inProcessFail               0   inProcessDone            4373
  inEndOfBundle               0   inPrematureEndBundle        0
  inBundleSaMatchFail         0   inPolicyActionFail          0
  inPolSelectMatchFail        0   inBundleReplaced            0
  inBundleSoftExpire          0   inBundleExpire              0
  inBadDecryptedPkt           0   inBadSpiResponse            0
```

Table 48-14: Parameters in output of the **show ipsec policy counter** command

Parameter	Meaning
Setup/Remove Counters	Counters for creating and destroying SA bundles.
setupStarted	Number of attempts to set up an SA bundle.
setupSaSetupStarted	Number of attempts to set up an SA.
setupDone	Number of successful attempts to set up an SA bundle.
removeStarted	Number of attempts to remove an SA bundle.
removeDone	Number of SA bundles completed removed.

Table 48-14: Parameters in output of the **show ipsec policy counter** command(cont)

Parameter	Meaning
setupSaSetupFailImm	Number of attempts to set up an SA that failed immediately.
setupSaSetupFailed	Number of failed attempts to set up an SA.
setupFailed	Number of failed attempts to set up an SA bundle.
removeSaSetupStarted	Number of attempts to remove an SA.
Outbound Packet Processing Counters	Counters for processing outbound SA bundles.
outDeny	Number of outbound packets that matched an IPsec policy with **deny** action.
outNoBundle	Number of outbound packets that matched an IPsec policy with no bundles.
outMakeSetupStrctFail	Number of attempts to setup an SA bundle for an outbound packet that failed because the setup structure failed.
outBundleSoftExpire	Number of times an outbound packet caused the soft expiry kilobyte limit of an SA bundle to be reached.
outProcessStart	Number of times IPsec processing started on an outbound packet.
outBundleStateBad	Number of outbound packets that matched an IPsec policy with no valid bundles.
outProcessDone	Number of times IPsec processing finished successfully on an outbound packet.
outNoBundleSqos	Number of outbound packets discarded because the bundle was not found after SQoS processed the packet, and IPsec was unable to process the packet using another bundle. This can indicate that IPsec has removed a bundle suddenly, such as when the bundle reaches its **expirykbytes** limit.
outPermit	Number of outbound packets that matched an IPsec policy with PERMIT action.
outNoBundleFail	Number of outbound packets failed by IPsec because they matched an IPsec policy with no bundles.
outSetupBundleFail	Number of failed attempts to setup an SA bundle for an outbound packet.
outBundleExpire	Number of times an outbound packet caused the expiry kilobyte limit of an SA bundle to be reached.
outProcessFailImm	Number of times IPsec processing failed immediately on an outbound packet.
outProcessFail	Number of times IPsec processing failed on an outbound packet.
outBundleNotFound	Number of outbound packets where the bundle was not found after SQoS processed the packet. This can indicate that IPsec has removed a bundle suddenly, such as when the bundle reaches its **expirykbytes** limit.
Inbound Packet Processing Counters	Counters for processing inbound SA bundles.
inDeny	Number of inbound packets that matched an IPsec policy with DENY action.
inCompUncompressed	Number of uncompressed inbound packet seen on an IPComp SA.

Table 48-14: Parameters in output of the **show ipsec policy counter** command(cont)

Parameter	Meaning
inBundleStateBad	Number of inbound packets that matched an IPsec policy with no valid bundles.
inProcessStart	Number of times IPsec processing started on an inbound packet.
inProcessFail	Number of times IPsec processing failed on an inbound packet.
inEndOfBundle	Number of inbound packets the SA bundle did not completely process.
inBundleSaMatchFail	Number of inbound packets that did not match an SA in the chosen SA bundle.
inPolSelectMatchFail	Number of inbound packets that did not match the selectors of the IPsec policy by which it was processed.
inBundleSoftExpire	Number of times an inbound packet caused the soft expiry kilobyte limit of an SA bundle to be reached.
inBadDecryptedPkt	Number of times a decrypted inbound packet had an invalid IP version, i.e. neither IPv4 nor IPv6. This indicates that the packet was not decrypted correctly.
inPermit	Number of inbound packets that matched an IPsec policy with PERMIT action.
inActionIpsecFail	Number of plaintext inbound packets that matched an IPsec policy with IPSEC action.
inNotFirstSaInBundle	Number of inbound packets that matched an SA that was not the first SA in a bundle.
inProcessFailImm	Number of times IPsec processing failed immediately on an inbound packet.
inProcessDone	Number of times IPsec processing finished successfully on an inbound packet.
inPrematureEndBundle	Number of inbound packets completely processed before all the SAs in the chosen SA bundle were used.
inPolicyActionFail	Number of inbound IPsec packets seen that did not match an IPsec policy.
inBundleReplaced	Number of inbound packets that removed an obsolete SA bundle.
inBundleExpire	Number of times an inbound packet caused the soft expiry kilobyte limit of an SA bundle to be reached.
inBadSpiResponse	Number of bad SPI requests generated. These occur when an IPsec policy has the parameter **respondbadspi** set to **true** and packets processed by that policy have an unknown SPI value.

Examples

To display the counters for a policy with the name "my_vpn", use the command:

```
show ipsec policy="my_vpn" counter
```

Related Commands

create ipsec policy
reset ipsec policy counter
destroy ipsec policy
set ipsec policy

show ipsec policy sabundle

Syntax `SHow IPSec POLIcy[=name] SABundle`

Description This command displays information about SA bundles attached to IPsec policies (Figure 48-19, Table 48-15).

The **policy** parameter specifies the name of an existing policy. When *name* is specified, SA bundles for the specified policy are displayed. The policy name must already exist. *Name* is a string 1 to 23 characters long. Valid characters are any printable character. If *name* contains spaces, it must be in double quotes.

When *name* is not specified, SA bundles for all policies are displayed.

Figure 48-19: Example output from the **show ipsec policy sabundle** command

```
IPsec Policy SA Bundles

                          Expiry Limits - hard/soft/used
Bundle                    Bytes
Index  SAs       State    Seconds
-------------------------------------------------------
Policy ..... NY_OFFICE_GEN
0      1,2,5     VALID    1000000/900000/807835
                          36000/35500/35632
1      12,13,14  CREATING 1000000/900000/0
                          36000/35500/0

Policy ..... NZ_OFFICE_GEN
0      3,4,7     VALID    100000/90000/93783
                          18000/17500/9432
1      9,10,11   VALID    100000/90000/1274
                          18000/17500/0

Policy ..... NY_FINANCE
0      15,16     VALID    10000/9000/2384
                          3600/3000/987
```

Table 48-15: Parameters in output of the **show ipsec policy sabundle** command

Parameter	Meaning
Policy	The manager-assigned name of an IPsec policy.
Index	The identification number of an SA bundle attached to the policy.
SAs	The SA identification numbers of the SAs in the SA bundle.
State	The state of the SA bundle; either VALID, INVALID, CREATING, or REMOVING.
Expiry Limits - hard/soft/used	Information about the limits used to expire SAs created from this bundle. When a soft limit is exceed the SAs are renegotiated. When a hard limit is exceeded the SAs are removed from the Security Policy Database (SPD).
Bytes	The expiry information in bytes for each SA bundle. The first figure displays the hard expiry limit, the second figure displays the soft expiry limit and the third figure displays the number of bytes already used.

Table 48-15: Parameters in output of the **show ipsec policy sabundle** command(cont)

Parameter	Meaning
Seconds	The expiry information in seconds for each SA bundle. The first figure displays the hard expiry limit, the second figure displays the soft expiry limit and the third figure displays seconds already used.

Examples

To display the SA bundles for a policy with the name "my_vpn", use the command:

```
show ipsec policy="my_vpn" sabundle
```

Related Commands

create ipsec policy
destroy ipsec policy
set ipsec policy

show ipsec sa

Syntax `SHow IPSec SA[=sa-id]`

Description This command displays information about the specified SA or all SAs in the Security Association Database (SAD).

The **sa** parameter specifies the identification number, from 0 to 65535, of a Security Association. The SA must already exist on the Security Association Database. When *sa-id* is specified, details for the specified SA are displayed (Figure 48-21 on page 48-144, Table 48-17 on page 48-145). When *sa-id* is not specified, summary information for all SAs is displayed (Figure 48-20, Table 48-16).

Figure 48-20: Example output from the **show ipsec sa** command

```
SA Id  Policy                Bundle  State    Protocol    OutSPI       InSPI
-------------------------------------------------------------------------------
    5  MY_VPN1_POLICY             5  Valid    ESP      554781384  2776920516
    6  MY_VPN1_POLICY             4  Valid    AH      2684492123  2115024437
    7  MY_VPN1_POLICY             3  Valid    ESP      504032446   987203183
    8  MY_VPN1_POLICY             2  Valid    ESP      736637299  1499049187
    9  MY_VPN1_POLICY             1  Valid    AH      2387532688    89042001
```

Table 48-16: Parameters in output of the **show ipsec sa** command

Parameter	Meaning
SA Id	The identification number for the SA.
Policy	Name of the IPsec policy to which the SA is attached.
Bundle	The bundle identification number of the bundle attached to the policy.
State	The state of the SA; either UNDEF, VALID, CREATING, or REMOVING.
Protocol	Name of the IPsec protocol the SA uses; either ESP, AH, or IPComp.
OutSPI	The Security Parameter Index (SPI) for the outbound traffic.
InSPI	The Security Parameter Index (SPI) for the inbound traffic.

Figure 48-21: Example output from the **show ipsec sa** command for a specific SA.

```
SA Id ................................. 2
 Policy ................................ roaming1
 Bundle ................................ 1
 SA Specification Used ................. 1
 State ................................. Valid
 Protocol .............................. ESP
 Role .................................. RESPONDER
 Mode .................................. UDP_ENCAP_TRANSPORT
 Outbound SPI .......................... 736637299
 Inbound SPI ........................... 1499049187
 Encryption algorithm .................. DES
 Encryption ENCO channel................ 1
 Hash algorithm ........................ SHA
 Hash ENCO channel...................... 2
 NAT Traversal NAT-OA
  Peer original source IP address ...... 192.168.1.10
  Peer original destination IP address.. -
 Filters
  Local IP address ..................... 10.10.10.2
  Local IP address mask ................ 255.255.255.255
  Remote IP address .................... 10.10.10.1
  Remote IP address mask ............... 255.255.255.255
  Local port number .................... 1701
  Remote port number ................... 1701
  NAPT remote port number .............. 2
  Transport protocol ................... UDP
  Local Name ........................... ANY
  Remote Name .......................... atr02
 DF BIT ................................ CLEAR
 Last sent sequence number ............. 27
 Anti-replay checking enabled .......... TRUE
 Anti-replay window size ............... 32
 Last received sequence number ......... 5
 Anti-replay bitmap .................... 000000ff
 Debug device .......................... 16
 Filter debug flags .................... 000000ff
 Packet debug flags .................... 00000067
 Trace debug flags ..................... 00000001
 Packet debug length ................... 72
```

Table 48-17: Parameters in output of the **show ipsec sa** command for a specific Security Association

Parameter	Meaning
SA Id	The identification number for the SA.
Policy	Name of the IPsec policy to which this SA is attached.
Bundle	The identification number for the bundle attached to the policy.
SA Specification Used	The identification number of the SA specification used to create this SA.
State	Whether the current state of the SA is UNDEF, VALID, CREATING, or REMOVING.
Protocol	The IPsec protocol used by this SA is ESP, AH, or COMP.
CPI	The Compression Parameter Index. Displayed when Protocol is set to COMP.
Role	Whether this peer acted as the initiator or responder in order to create this SA.
Mode	The IPsec operational mode for this SA: TUNNEL TRANSPORT UDP_ENCAPSULATED_TUNNEL UDP_ENCAPSULATED_TRANSPORT
Outbound SPI	The Security Parameter Index (SPI) for outbound traffic.
Inbound SPI	The Security Parameter Index (SPI) for inbound traffic.
Encryption algorithm	The encryption algorithm used by this SA. Displayed when Protocol is set to ESP.
Encryption ENCO channel	The ENCO channel number for the encryption process. Displayed when Protocol is set to ESP.
Hash algorithm	The hash algorithm used by this SA. Displayed when Protocol is set to ESP or AH.
Hash ENCO channel	The ENCO channel number for the hash process. Displayed when Protocol is set to ESP or AH.
Compression algorithm	The compression algorithm used by this SA. Displayed when Protocol is set to COMP.
Compression ENCO channel	The ENCO channel number for the compression process. Displayed when Protocol is set to COMP.
NAT-Traversal NAT-OA	Information about original IP addresses.
Peer original source IP address	Source IP address that the remote peer uses when sending packets to this peer. UDP-encapsulated transport mode only.
Peer original destination IP address	Destination IP address that the remote peer uses when sending packets to this peer. UDP-encapsulated transport mode, and IETF draft v08, *Negotiation of NAT-T in the IKE*.
Filters	Information about the packet selectors for this SA.
Local IP address	The local IP address packet selector field of the policy to which this SA is attached.
Local IP address mask	The local IP address mask packet selector field of the policy to which this SA is attached.

Table 48-17: Parameters in output of the **show ipsec sa** command for a specific Security Association (cont)

Parameter	Meaning
Remote IP address	The remote IP address packet selector field of the policy to which this SA is attached.
Remote IP address mask	The remote IP address mask packet selector field of the policy to which this SA is attached.
Local port number	The local IP port number packet selector field of the policy to which this SA is attached.
Remote port number	The remote IP port number packet selector field of the policy to which this SA is attached.
NAPT remote port number	Network Address Port Translation number. Multiple clients in UDP-encapsulated transport mode appear to come from the same source. Therefore, NAT-T changes the source port to this value to maintain a distinction.
Transport protocol	The transport protocol packet selector field of the policy to which this SA is attached.
Local Name	The local name packet selector field of the policy to which this SA is attached.
Remote Name	The remote name packet selector field of the policy to which this SA is attached.
DF Bit	The value specified for the DF (Don't Fragment) bit in the DFBIT parameter of the policy to which this SA is attached. Either COPY, CLEAR, or SET.
Last sent sequence number	The sequence number of the last packet sent by this SA.
Anti-replay checking enabled	Whether anti-replay checking is enabled.
Anti-replay window size	The window size for anti-replay checking.
Last received sequence number	The sequence number of the last packet received by this SA.
Anti-replay bitmap	The bitmap of the anti-replay window. The bitmap is *n* bits long, where *n* is the anti-replay window size, and records the last *n* sequence numbers, up to and including the last sequence number received. A "1" means a packet with that sequence number has been received, and a "0" means a packet with that sequence number has not been received.
Debug device	The device (port number) to which debugging output is sent.
Filter debug flags	A flag indicating the policy selectors and pass/fail results for which filter debugging is enabled.
Packet debug flags	A flag indicating the processing units and directions for which packet debugging is enabled, and the portions of packets to be displayed.
Trace debug flags	A flag indicating whether trace debugging is enabled.
Packet debug length	The data length of the packet displayed for packet debugging.

Examples To display a list of all SA entries in the IPsec Security Association Database, use the command:

```
sh ips sa
```

To display information about Security Association 1 in the IPsec Security Association Database, use the command:

```
sh ips sa=1
```

Related Commands **show ipsec**

show ipsec sa counter

Syntax `SHow IPSec SA[=sa-id] COUnter`

Description This command displays the counters for Security Associations (SA) in the Security Association Database (Figure 48-22, Table 48-18 on page 48-149).

The **sa** parameter specifies the identification number, from 0 to 65535, of a Security Association. The SA must already exist on the Security Association Database. When *sa-id* is specified, counters for that SA are displayed. When *sa-id* is not specified, counters for all SAs are displayed.

Figure 48-22: Example output from the show **ipsec sa counter** command

```
SA: 8

Outbound packet processing counters:
  outProcessStart       0    outProcessFailImm     0
  outProcessFail        0    outProcessDone        0
ESP:
  espOutBufChainCopy    0
  espEncryptionStart    0    espEncryptionFailImm  0
  espEncryptionFail     0    espEncryptionGood     0
  espOutHashStart       0    espOutHashFailImm     0
  espOutHashFail        0    espOutHashGood        0
AH:
  ahOutBufChainCopy     0    ahSeqNumberCycled     0
  ahOutHashStart        0    ahOutHashFailImm      0
  ahOutHashFail         0    ahOutHashGood         0
IPCOMP:
  compOutBufChainCopy   0    compTooSmall          0
  nonExpansionBackoff   0    dataExpansion         0
  compressionStart      0    compressionFailImm    0
  compressionFail       0    compressionGood       0

Inbound packet processing counters:
  inProcessStart        0    inProcessFailImm      0
  inProcessFail         0    inProcessDone         0
ESP:
  espInBufChainCopy     0    espReplayedPacket     0
  espInHashStart        0    espInHashFailImm      0
  espInHashFail         0    espInHashGood         0
  espDecryptionStart    0    espDecryptionFailImm  0
  espDecryptionFail     0    espDecryptionGood     0
  espIcvInvalid         0    espPaddingInvalid     0
AH:
  ahInBufChainCopy      0    ahReplayedPacket      0
  ahBadPayloadLength    0    ahIcvInvalid          0
  ahInHashStart         0    ahInHashFailImm       0
  ahInHashFail          0    ahInHashGood          0
IPCOMP:
  compInBufChainCopy    0
  decompressionStart    0    decompressionFailImm  0
  decompressionFail     0    decompressionGood     0
```

Table 48-18: Parameters in output of the **show ipsec sa counter** command

Parameter	Meaning
outProcessStart	Number of outbound packets that processing started on.
outProcessFail	Number of outbound packets that processing failed on.
outProcessFailImm	Number of outbound packets that processing failed on immediately.
outProcessDone	Number of outbound packets that processing successfully completed on.
espOutBufChainCopy	Number of outbound packets copied from a chain to a buffer prior to ESP processing.
espEncryptionStart	Number of times ESP encryption started.
espEncryptionFail	Number of times ESP encryption failed.
espOutHashStart	Number of times ESP authentication started.
espOutHashFail	Number of times ESP authentication failed.
espEncryptionFailImm	Number of times ESP encryption failed immediately.
espEncryptionGood	Number of times ESP encryption successfully completed.
espOutHashFailImm	Number of times ESP authentication failed immediately.
espOutHashGood	Number of times ESP authentication successfully completed.
ahOutBufChainCopy	Number of outbound packets copied from a chain to a buffer prior to AH processing.
ahOutHashStart	Number of times AH authentication started.
ahOutHashFail	Number of times AH authentication failed.
ahSeqNumberCycled	Number of times the AH sequence number has cycled.
ahOutHashFailImm	Number of times AH authentication failed immediately.
ahOutHashGood	Number of times AH authentication successfully completed.
compOutBufChainCopy	Number of outbound packets copied from a chain to a buffer prior to IPComp processing.
nonExpansionBackoff	Number of packets not compressed due to a non-expansion backoff.
compressionStart	Number of times IPComp compression started.
compressionFail	Number of times IPComp compression failed.
compTooSmall	Number of packets not compressed because they were too small.
dataExpansion	Number of packets expanded when they were compressed.
compressionFailImm	Number of times IPComp compression failed immediately.
compressionGood	Number of times IPComp compression completed successfully.
inProcessStart	Number of inbound packets that processing started on.
inProcessFail	Number of inbound packets that processing failed on.
inProcessFailImm	Number of inbound packets that processing failed on immediately.
inProcessDone	Number of inbound packets that processing successfully completed on.
espInBufChainCopy	Number of inbound packets copied from a chain to a buffer prior to ESP processing.

Table 48-18: Parameters in output of the **show ipsec sa counter** command (cont)

Parameter	Meaning
espInHashStart	Number of times ESP authentication started.
espInHashFail	Number of times ESP authentication failed.
espDecryptionStart	Number of times ESP decryption started.
espDecryptionFail	Number of times ESP decryption failed.
espIcvInvalid	Number of ESP packets seen with an invalid ICV.
espReplayedPacket	Number of ESP packets seen with an invalid sequence number.
espInHashFailImm	Number of times ESP authentication failed immediately.
espInHashGood	Number of times ESP authentication successfully completed.
espDecryptionFailImm	Number of times ESP decryption failed immediately.
espDecryptionGood	Number of times ESP decryption successfully completed.
espPaddingInvalid	Number of ESP packets seen with invalid padding.
ahInBufChainCopy	Number of inbound packets copied from a chain to a buffer prior to AH processing.
ahBadPayloadLength	Number of AH packets seen with an invalid payload length.
ahInHashStart	Number of times AH authentication started.
ahInHashFail	Number of times AH authentication failed.
ahReplayedPacket	Number of AH packets seen with an invalid sequence number.
ahIcvInvalid	Number of AH packets seen with an invalid ICV.
ahInHashFailImm	Number of times AH authentication failed immediately.
ahInHashGood	Number of times AH authentication successfully completed.
compInBufChainCopy	Number of inbound packets copied from a chain to a buffer prior to IPComp processing.
decompressionStart	Number of times IPComp decompression started.
decompressionFail	Number of times IPComp decompression failed.
decompressionFailImm	Number of times IPComp decompression failed immediately.
decompressionGood	Number of times IPComp decompression completed successfully.

Examples

To display a list of all SA entries in the IPsec Security Association Database, use the command:

```
sh ips sa
```

To display counters for Security Association 1 in the IPsec Security Association Database, use the command:

```
sh ips sa=1 cou
```

Related Commands

reset ipsec sa counter
show ipsec

show ipsec saspecification

Syntax `SHow IPSec SASpecification[=spec-id]`

Description This command displays information about SA specifications.

The **saspecification** parameter specifies the identification number, from 0 to 255, of a SA specification. If a value is specified, details about that SA specification are displayed (Figure 48-24 on page 48-152, Table 48-20 on page 48-152). If a value is not specified, summary information about all SA specifications is displayed (Figure 48-23, Table 48-19).

Figure 48-23: Example output from the **show ipsec saspecification** command

```
SA Specifications

ID Proto  KeyMan  Mode       EncAlg      HashAlg CompAlg InSpi  EncKey HashKey
-------------------------------------------------------------------------------
 1 ESP    MANUAL  TUNNEL     3DESINNER   NULL    -         300       5       -
 2 AH     MANUAL  TUNNEL     NULL        SHA     -         301       -       6
 3 ESP    MANUAL  TUNNEL     3DES2KEY    MD5     -         302       7       8
 4 ESP    ISAKMP  TRANSP     DES         SHA     -           -       -       -
 5 COMP   ISAKMP  TUNNEL     NULL        NULL    LZS         -       -       -
```

Table 48-19: Parameters in output of the **show ipsec saspecification** command

Parameter	Meaning
ID	The identification number for the SA specification.
Protocol	Whether the IPsec protocol the SA specification uses is ESP, AH, or IPComp.
KeyMan	Whether the key management method the SA specification uses is manual or ISAKMP.
Mode	Whether the encapsulation mode the SA specification uses is tunnel or transport.
EncAlg	The encryption algorithm the SA specification uses; either AES128, AES192, AES256, DES, 3DES2KEY, 3DESINNER, 3DESOUTER, or NULL.
HashAlg	The hash algorithm the SA specification uses; either MD5, SHA, DESMAC, or NULL.
CompAlg	The compression algorithm the SA specification uses; only LZS is supported.
InSpi	The Security Parameter Index (SPI) for inbound traffic.
EncKey	The identification number of the ENCO key the encryption algorithm uses.
HashKey	The identification number of the ENCO key the hash algorithm uses.

Figure 48-24: Example output from the **show ipsec saspecification** command for an SA specification

```
SA Specification
Id ..................... 1
Protocol ............... ESP
Key Management ......... MANUAL
Mode ................... TUNNEL
Encryption Algorithm..... 3DES2KEY
Hash Algorithm ......... NULL
Compression Algorithm ... -
In SPI ................. 300
Out SPI ................ 400
Encryption Key ......... 5
Hash Key ............... -
AntiReplay Enabled ..... -
Replay Window Size ..... -
```

Table 48-20: Parameters in output of the **show ipsec saspecification** command for a specific SA specification

Parameter	Meaning
ID	Number used to identify the Sa specification.
Protocol	Whether the IPsec protocol used by the SA specification is ESP, AH, or IPComp.
Key Management	Whether the key management method used by the SA specification is manual or ISAKMP.
Mode	Whether the encapsulation mode used by the SA specification is tunnel or transport.
Encryption Algorithm	The encryption algorithm the SA specification uses; either AES128, AES192, AES256, DES, 3DES2KEY, 3DESINNER, 3DESOUTER, or NULL.
Hash Algorithm	Whether the hash algorithm the SA specification uses is MD5, SHA, DESMAC, or NULL.
Compression Algorithm	The compression algorithm the SA specification uses; only LZS is supported.
In SPI	The Security Parameter Index (SPI) for inbound traffic.
Out SPI	The Security Parameter Index (SPI) for outbound traffic.
Encryption Key	The identification number of the ENCO key to be used for the encryption algorithm.
Hash Key	The identification number of the ENCO key to be used for the hash algorithm.
AntiReplay Enabled	Whether the anti-replay mechanism is enabled.
Replay Window Size	The size of the anti replay window. Possible values are 32,64, 128, or 256.

Examples To display all SA specifications, use the command:

```
sh ips sas
```

To display an SA proposal with proposal id 1, use the command:

```
sh ips sas=1
```

Related Commands

create ipsec saspecification
destroy ipsec saspecification
set ipsec saspecification

show isakmp

Syntax `SHow ISAkmp`

Description This command shows the status of ISAKMP (Figure 48-25, Table 48-21).

Figure 48-25: Example output from the **show isakmp** command

```
ISAKMP Module Configuration

  Module Status ......................... DISABLED
  UDP Port .............................. 500
  Debug Flag ............................ 00000000
  Global Debug Device ................... 0
  Local RSA Key ......................... -
  VPN Client Policy Server Enabled ...... FALSE
  VPN Client Policy File Name ........... -
```

Table 48-21: Parameters in output of the **show isakmp** command

Parameter	Meaning
Module Status	Whether ISAKMP is enabled or disabled.
UDP Port	The UDP port used for sending and receiving ISAKMP messages.
Debug Flag	A bit flag specifying debug options that are enabled: PKTRAW debugging (bit 0) STATE debugging (bit 1) TRACE debugging (bit 2) TRACEMORE debugging (bit 3) PACKET debugging (bit 4) "0" means the option is disabled;"1" means the option is enabled.
Global Debug Device	The device (port number) to which debugging output is sent.
Local RSA key	The ENCO key identification number of the RSA private key used for RSAENCR authentication.
VPN Client Policy Server Enabled	Whether the router acts as a security policy server. If true, the router listens for security policy requests from remote ISAKMP peers. The router responds by sending the security policy specified by the **policyfilename** parameter. The **policyfilename** parameter is required and an ISAKMP policy for the peer must exist. The default is false. This feature is designed for the AT-VPN Client Windows software package. For more information on this parameter, see the AT-VPN Client documentation.
VPN Client Policy File Name	Specifies the security policy to be sent to remote ISAKMP peers when requested. This parameter must be specified when the **policyserverenabled** parameter is true or on. This feature is designed to use with the AT-VPN Client Windows software package. For more information on this parameter, see the AT-VPN Client documentation.

Examples To display the status of ISAKMP, use the command:

```
sh isa
```

Related Commands **disable isakmp**
enable isakmp

show isakmp counters

Syntax

```
SHow ISAkmp COUnters[={AGGressive|GENeral|HEArtbeat|INFo|
   IPSec|MAIn|NETwork|QUIck|SAD|SPD|TRAnsaction|XDB}]
```

Description

This command displays all information counters for ISAKMP, or one or more categories of ISAKMP counters.

Parameter	Description	
COUnter	The category or categories of counters to display. Multiple categories can be specified as a comma-separated list. Default: displays all ISAKMP counters under this command	
	AGGressive	This displays counters for Aggressive Mode (Figure 48-26 on page 48-156, Table 48-22 on page 48-157).
	GENeral	This displays general ISAKMP counters (Figure 48-27 on page 48-160, Table 48-23 on page 48-161).
	HEArtbeat	This displays heartbeat counters (Figure 48-28 on page 48-165, Table 48-24 on page 48-165)
	INFo	This displays counters for the informational exchanges (Figure 48-29 on page 48-166, Table 48-25 on page 48-166).
	IPSec	This displays the interface counters between ISAKMP and IPSEC (Figure 48-30 on page 48-168, Table 48-26 on page 48-168).
	MAIn	This displays counters for the ISAKMP Main mode unit (Figure 48-31 on page 48-169, Table 48-27 on page 48-170).
	NETwork	This displays counters for the transmission of ISAKMP messages over the network are displayed (Figure 48-32 on page 48-173, Table 48-28 on page 48-173).
	QUIck	This displays the ISAKMP Quick mode counters (Figure 48-33 on page 48-174, Table 48-29 on page 48-175)
	SAD	This displays the ISAKMP Security Association Database (SAD) counters (Figure 48-34 on page 48-180, Table 48-30 on page 48-180).
	SPD	This displays the ISAKMP Security Policy Database (SPD) counters (Figure 48-35 on page 48-181, Table 48-31 on page 48-181).
	TRAnsaction	This displays counters for transaction exchanges (Figure 48-36 on page 48-182, Table 48-32 on page 48-182).
	XDB	This displays the ISAKMP exchange database counters (Figure 48-37 on page 48-183, Table 48-33 on page 48-183)

Figure 48-26: Example output from the **show isakmp counter=aggressive** command

```
Aggressive Mode Counters:

 initSendSAKE                0   initSendSAKECallbackNoXchg  0
 initRecvSAKEAUTH            0   initRecvSAKEAUTHCbkNoXchg   0
 initSendAUTH                0   initSendAUTHCallbackNoXchg  0
 initSendNatD                0   initRecvNatD                0

 respRecvSAKE                0   respRecvSAKECallbackNoXchg  0
 respSendSAKEAUTH            0   respSendSAKEAUTHCbkNoXchg   0
 respRecvAUTH                0   respRecvAUTHCallbackNoXchg  0
 respSendNatD                0   respRecvNatD                0

 invalidSAKEMessage          0   invalidSAKEAUTHMessage      0
 invalidAUTHMessage          0   unexpectedMessage           0
 msgLengthIncorrect          0   reservedFieldNotZero        0
 nonceBadLen                 0   keBadLen                    0
 hashBadLen                  0   badIDirPayLoad              0
 badSALifeime                0

 generate3DESKeyFailed       0   generateDHPubFailed         0
 generateDHSecretFailed      0   generateKeysFailed          0
 generateKeysGood            0   generateLocalDHGood         0
 generateSharedSecretGood    0   generateSKEYIDaFailed       0
 generateSKEYIDdFailed       0   generateSKEYIDeFailed       0
 generateSKEYIDFailed        0

 decryptIDiiFailed           0   decryptIDiiGood             0
 decryptIDirFailed           0   decryptIDirGood             0
 decryptNiFailed             0   decryptNiGood               0
 decryptNrFaileD             0   decryptNrGood               0
 encryptIDiiFailed           0   encryptIDiiGood             0
 encryptIDirFailed           0   encryptIDirGood             0
 encryptNiFailed             0   encryptNiGood               0
 encryptNrFailed             0   encryptNrGood               0
 signFailed                  0   signGood                    0
 verifySigFailed             0

 invalidPolicy               0   noPolicy                    0
 noTransformChosen           0   saNotFirst                  0
 moreThanOneProposal         0   doiNotIpsec                 0
 situationNotSupported       0   proposalIdNotISAKMP         0
 proposalNumNotOne           0   tooManyTransforms           0
 transformInvalid            0   peerIdAndIpDifferent        0
 certNotSent                 0   certSent                    0
 authFailed                  0   authGood                    0
 cantFindLocalRSAKey         0   cantFindPeerRSAKey          0
 cantLoadSharedKey           0
```

Table 48-22: Parameters in output of the **show isakmp counter=aggressive** command

Parameter	Meaning
initSendSAKE	Number of Security Association/Key Exchange messages sent.
initRecvSAKEAUTH	Number of Security Association/Key Exchange/ Authentication messages received.
initSendAUTH	Number of authentication messages sent.
initSendNatD	Number of NAT-D messages sent.
respRecvSAKE	Number of Security Association/Key Exchange messages received.
respSendSAKEAUTH	Number of Security Association/Key Exchange/ Authentication messages sent.
respRecvAUTH	Number of authentication messages received.
respSendNatD	Number of NAT-D messages sent.
initSendSAKECallbackNoXchg	Number of times that a Security Association/Key Exchange message was not sent due to an invalid reference from ENCO.
initRecvSAKEAUTHCbkNoXchg	Number of times that a Security Association/Key Exchange/Authentication message was not received due to an invalid reference from ENCO.
initSendAUTHCallbackNoXchg	Number of times that an authentication message was not sent due to an invalid reference from ENCO.
initRecvNatD	Number of NAT-D messages received.
respRecvSAKECallbackNoXchg	Number of times that a Security Association/Key Exchange message was not received due to an invalid reference from ENCO.
respSendSAKEAUTHCbkNoXchg	Number of times that a Security Association/Key Exchange/Authentication message was not sent due to an invalid reference from ENCO.
respRecvAUTHCallbackNoXchg	Number of times that an authentication message was not received due to an invalid reference from ENCO.
respRecvNatD	Number of NAT-D messages received.
invalidSAKEMessage	Number of invalid SA/Key Exchange messages received.
invalidAUTHMessage	Number of invalid authentication messages received.
msgLengthIncorrect	Number of messages received with an invalid message length.
nonceBadLen	Number of messages received with a nonce payload with a bad length. The nonce must be 8 to 256 bytes long.
hashBadLen	Number of messages received with an unsupported hash length. The hash length must equal to the message digest used. The maximum supported message digest is 160-bits (20 bytes) log for the SHA algorithm.
badSALifetime	Number of messages received with an unsupported SA life duration attribute.
invalidSAKEAUTHMessage	Number of invalid SAKEAUTH messages received.
unexpectedMessage	Number of unexpected messages received.

Table 48-22: Parameters in output of the **show isakmp counter=aggressive** command (cont)

Parameter	Meaning
reservedFieldNotZero	Number of messages received with a non-zero reserved field.
keBadLen	Number of messages received with an unsupported Key Exchange (KE) payload length. The KE must be the length of the negotiated Diffie-Hellman group.
badIDirPayload	Number of messages received with an invalid or unsupported ID payload.
generate3DESKeyFailed	Number of attempts to generate a 3DES key that failed.
generateDHSecretFailed	Number of attempts to generate the DH shared secret that failed.
generateKeysGood	Number of keys successfully generated.
generateSharedSecretGood	Number of times the DH shared secret was successfully generated.
generateSKEYIDdFailed	Number of attempts to generate SKEYIDd that failed.
generateSKEYIDFailed	Number of attempts to generate SKEYID that failed.
generateDHPubFailed	Number of attempts to generate the local DH secret that failed.
generateKeysFailed	Number of attempts to generate keys that failed.
generateLocalDHGood	Number of times the local DH secret was successfully generated.
generateSKEYIDaFailed	Number of attempts to generate SKEYIDa that failed.
generateSKEYIDeFailed	Number of attempts to generate SKEYIDe that failed.
decryptIDiiFailed	Number of attempts to decrypt the IDii payload that failed.
decryptIDirFailed	Number of attempts to decrypt the IDir payload that failed.
decryptNiFailed	Number of attempts to decrypt the Ni payload that failed.
decryptNrFailed	Number of attempts to decrypt the Nr payload that failed.
encryptIDiiFailed	Number of attempts to encrypt the IDii payload that failed.
encryptIDirFailed	Number of attempts to encrypt the IDir payload that failed.
encryptNiFailed	Number of attempts to encrypt the Ni payload that failed.
encryptNrFailed	Number of attempts to encrypt the Nr payload that failed.
signFailed	Number of attempts to sign the hash that failed.
verifySigFailed	Number of attempts to verify a signature that failed.
decryptIDiiGood	Number of times the IDii payload was successfully decrypted with RSA.
decryptIDirGood	Number of times the IDir payload was successfully decrypted with RSA.
decryptNiGood	Number of times the Ni payload was successfully decrypted with RSA.
decryptNrGood	Number of times the Nr payload was successfully decrypted with RSA.

Table 48-22: Parameters in output of the **show isakmp counter=aggressive** command (cont)

Parameter	Meaning
encryptIDiiGood	Number of times the IDii payload was successfully encrypted with RSA.
encryptIDirGood	Number of times the IDir payload was successfully encrypted with RSA.
encryptNiGood	Number of times the Ni payload was successfully encrypted with RSA.
encryptNrGood	Number of times the Nr payload was successfully encrypted with RSA.
signGood	Number of times the hash was successfully signed.
invalidPolicy	Number of times an invalid policy was found.
noTransformChosen	Number of times a suitable policy could not be found.
moreThanOneProposal	Number of times more than one proposal was sent in an SA payload.
situationNotSupported	Number of SA payloads received with an unsupported situation.
proposalNumNotOne	Number of proposal payloads with ID not one.
transformInvalid	Number of invalid Transform payloads received.
certNotSent	Number of times a certificate could not be sent.
authFailed	Number of peer authentication attempts that failed.
cantFindLocalRSAKey	Number of attempts to load the local RSA key that failed.
cantLoadSharedKey	Number of attempts to load the shared key that failed.
noPolicy	Number of attempts to finds a suitable policy that failed.
saNotFirst	Number of times the SA payload was not the first payload in a received message.
doiNotIpsec	Number of times a received SA payload has an unsupported DOI.
proposalIdNotISAKMP	Number of times an invalid proposal ID has been received.
tooManyTransforms	Number of times that an invalid number of transforms have ben received.
peerIdAndIpDifferent	Number of times the source IP address differed from the peer ID.
certSent	Number of successful attempts to send a local certificate.
authGood	Number of successful peer authentications.
cantFindPeerRSAKey	Number of attempts to load the peer's RSA key that failed.

Figure 48-27: Example output from the **show isakmp counter=general** command

```
ISAKMP General Counters

  acquire                 0
  acquireNoPolicy         0    acquireNoSa             0
  acquireEquivFound       0    acqPh2EquivInProgress   0
  acqPh1XcgStartFailed    0    acqPh2XcgStartFailed    0
  acquireQueued           0    acqPeerAddrNameIncons   0

  acquirePrenegNoPolicy   0

  badSpiRequests          0    badSpiFromKnownPeer     0
  badSpiInAggrMode        0    badSpiSendNotifyUnset   0

  msgInitPh1p5StartFail   0

  doneGood                0    donePhase1Failed        0
  doneSendConNoSa         0

  msgTx                   0    msgTxd                  0
  txEncryptNoExchange     0    msgTxEncryptNoEncoPrc   0
  msgTxStartEncrypt       0
  txEncryptFail           0    txEncryptGood           0
  msgTxEncryptExpKBytes   0

  txRetryTxd              0    txRetryXchgTimedOut     0
  retryIkeAttemptsPh1     0    retryIkeAttemptsPh2     0

  msgRxd                  0
  msgRxInconsistLengths   0    msgRxBadLength          0
  msgRxBadReserved        0    msgRxBadVersion         0
  msgRxBadNextPayload     0    msgRxUnexpectedMsg      0
  msgRxNoExchange         0    msgRxNoExchangePhase1   0
  msgRxP1NoXcgNot1stMsg   0    msgRxPh1UnkwnXchgType   0
  msgRxPh1XchgStartFail   0    msgRxPh1MsgIdNotZero    0
  msgRxP15XchgStartFail   0
  msgRxPhase2NoSa         0    msgRxNoExchangePhase2   0
  msgRxPh2XchgStartFail   0    msgRxPh2UnkwonXchgType  0
  msgRxEncrypted          0    msgRxEncryptdUnexpect   0
  msgRxBadPad             0    msgRxBadPadLength       0
  msgRxPayBadNextPay      0    msgRxPayBadReserved     0
  msgRxDecryptNoEncoPrc   0    msgRxStartDecrypt       0
  msgRxPlain              0    msgRxPlainUnexpected    0
  msgRxBadPortIpChange    0    msgRxFailOldPort        0
  msgRxPayBadLength       0
  rxDecryptNoExchange     0    rxDecryptedBadLength    0
  rxDecryptGood           0    rxDecryptFail           0
  rxDecryptedBadPad       0    rxDecryptBadPadLength   0
  rxDecrptPayBadNextPay   0    rxDecryptPayBadRsvd     0
  rxDecryptPayBadLength   0

  infoNoMatchingPolicy    0    infoPh1NotifyDisabled   0
  infoPh1NoDelAllowed     0    infoPh1ExchgStartFail   0
  infoPh2SANotFound       0    infoPh2SANotActive      0
  infoPh2NotifyDisabled   0    infoPh2DeleteDisabled   0
  infoPh2XchgStartFail    0

  deleteDelayStarted      0    deleteDelayNotUsed      0
  deleteDelayPktsRxd      0    deleteDelayRetrySent    0
  deleteDelayConSent      0    deleteDelayConNoSA      0
  deleteDelayTxExceeded   0    deleteDelayPktDiff      0
```

Table 48-23: Parameters in output of the **show isakmp counter=general** command

Parameter	Meaning
acquire	Number of IPsec requests to negotiate IPsec SAs.
acquireNoPolicy	Number of IPsec requests without a valid ISAKMP policy.
acquireEquivFound	Number of IPsec requests received while an equivalent acquire request was already in progress.
acqPh1XchgStartFailed	Number of failures to create a phase 1 exchange.
acquireQueued	Number of IPsec requests queued for processing.
acquireNoSa	Number of IPsec acquire requests without a valid ISAKMP SA.
acqPh2EquivInProgress	Number of IPsec requests received while an equivalent acquire request was already queued for processing.
acqPh2XcgStartFailed	Number of failures to create phase 2 exchanges.
acqPeerAddrNameIncons	Number of IPsec requests received where the requested peer IP address is inconsistent with the ISAKMP policy's peer IP address. This applies when **isakmppolicyname** is configured for the **ipsec** policy.
acquirePrenegNoPolicy	Number of requests to prenegotiate a phase 1 SA without a valid policy.
badSpiRequests	Number of bad SPI requests that IPsec generated and sent to ISAKMP. These occur when an IPsec policy has the parameter **respondbadspi** set to **true** and packets processed by that policy have an unknown SPI value. If ISAKMP accepts the request, it establishes a new ISAKMP SA to the sending peer, then sends an initial contact notification message.
badSpiFromKnownPeer	Number of bad SPI response requests rejected because an ISAKMP SA for the sending peer already existed. This ensures that an established tunnel is not destroyed.
badSpiInAggrMode	Number of bad SPI requests rejected because the ISAKMP policy is configured to use **aggressive** mode for phase 1 exchanges. Bad SPI requests can only generate notification messages when the policy specifies **main** mode for phase 1 exchanges.
badSpiSendNotifyUnset	Number of bad SPI requests rejected because the ISAKMP policy is not configured to send notification messages.
msgInitPh1p5StartFail	Number of times where starting a phase 1.5 exchange failed because the exchange could not be created.
doneGood	Number of ISAKMP exchanges that completed successfully.
donePhase1Failed	Number of ISAKMP exchanges that failed.
doneSendConNoSa	When **setcommitbit** is configured, this is the number of times an exchange completed, but the SA could be used to send the **connected** notification message.
msgTx	Number of message transmissions started by ISAKMP.
txEncryptNoExchange	Number of messages encrypted without a valid exchange.
msgTxStartEncrypt	Number of messages passed to the encryption process.
txEncryptFail	Number of messages that failed the encryption process.

Table 48-23: Parameters in output of the **show isakmp counter=general** command (cont)

Parameter	Meaning
msgTxEncryptExpKBytes	Number of encrypted messages that caused the SA to expire.
msgTxd	Number of message transmissions completed by ISAKMP.
msgTxEncryptNoEncoPrc	Number of messages not encrypted because ENCO resources were not available.
txEncryptGood	Number of messages to be transmitted that were successfully encrypted.
txRetryTxd	Number of retransmits of ISAKMP messages.
retryIkeAttemptsPh1	Number of phase 1 exchanges initiated due to an exchange failing. These exchanges are only initiated for policies configured with **retryikeattempts**.
txRetryXchgTimedOut	Number of times an exchange timed out and failed due to the number of configured message retransmissions being exceeded.
retryIkeAttemptsPh2	Number of phase 2 exchanges initiated due to an exchange failing. These exchanges are only initiated for policies configured with **retryikeattempts**.
msgRxd	Number of messages received by ISAKMP.
msgRxInconsistLengths	Number of ISAKMP messages received with an invalid packet length.
msgRxBadReserved	Number of ISAKMP messages received in which the reserved field was not set to zero. This may indicate the decryption failed due to an invalid pre-shared key.
msgRxBadNextPayload	Number of ISAKMP messages received where the ISAKMP header contains an unknown payload type.
msgRxNoExchange	Number of messages received with no valid exchange.
msgRxP1NoXcgNot1stMsg	Number of messages received with no exchange that are not the first message of an exchange.
msgRxPh1XchgStartFail	Number of messages received where a phase 1 exchange could not be created.
msgRxP15XchgStartFail	Number of messages received where a phase 1.5 exchange could not be created.
msgRxPhase2NoSa	Number of Quick Mode messages received without a valid ISAKMP SA.
msgRxPh2XchgStartFail	Number of messages received where a phase 2 exchange could not be created.
msgRxEncrypted	Number of encrypted messages received.
msgRxBadPad	Number of ISAKMP messages received with invalid padding. ISAKMP expects the padding bytes in a packet to all be zero, except for the last byte, which is the padding length.
msgRxPayBadNextPay	Number of ISAKMP messages received with an unknown payload type.
msgRxDecryptNoEncoPrc	Number of encrypted messages received with no valid ENCO resources.
msgRxPlain	Number of messages received in plaintext.

Table 48-23: Parameters in output of the **show isakmp counter=general** command (cont)

Parameter	Meaning
msgRxBadPortIpChange	Number of ISAKMP packets received with an unexpected source IP address or source port and discarded.
msgRxPayBadLength	Number of messages received with a bad payload length.
rxDecryptNoExchange	Number of ISAKMP messages decrypted by ENCO without a valid existing exchange.
rxDecryptGood	Number of ISAKMP messages decrypted by ENCO.
rxDecryptBadPad	Number of encrypted ISAKMP messages received with invalid padding. ISAKMP expects the padding bytes in a packet to all be zero, except for the last byte, which is the padding length.
rxDecrptPayBadNextPay	Number of encrypted ISAKMP messages received with an unknown payload type.
rxDecryptPayBadLength	Number of messages decrypted with a bad payload length.
msgRxBadLength	Number of messages received with a bad length.
msgRxBadVersion	Number of messages received with a bad version number.
msgRxUnexpectedMsg	Number of unexpected ISAKMP messages received. For example, a retransmission of the first phase 1 message or retransmission of a message where a **connected** message is expected.
msgRxNoExchangePhase1	Number of messages received with no valid phase 1 exchange.
msgRxPh1UnkwnXchgType	Number of phase 1 ISAKMP messages received with an unknown exchange type.
msgRxPh1MsgIdNotZero	Number of phase 1 ISAKMP messages received with a non-zero message ID.
msgRxNoExchangePhase2	Number of messages received with no valid phase 2 exchange.
msgRxPh2UnkwnXchgType	Number of phase 2 ISAKMP messages received with an unknown exchange type.
msgRxEncryptdUnexpect	Number of encrypted messages received that should not have been encrypted.
msgRxBadPadLength	Number of ISAKMP messages received with an invalid number of padding bytes. ISAKMP expects a packet to be padded to the cryptographic algorithm's block size (8 bytes for DES algorithms and 16 bytes for AES).
msgRxPayBadReserved	Number of ISAKMP messages received that have a payload header with a non-zeroed Reserved field.
msgRxStartDecrypt	Number of messages received that started the decryption process.
msgRxPlainUnexpected	Number of messages received in plaintext that should have been encrypted.
msgRxFailOldPort	Number of ISAKMP packets discarded because they were received on port 500 after NAT-T had moved ISAKMP traffic to port 4500.
rxDecryptedBadLength	Number of messages decrypted with a bad payload length.

Table 48-23: Parameters in output of the **show isakmp counter=general** command (cont)

Parameter	Meaning
rxDecryptFail	Number of encrypted ISAKMP messages that were not successfully decrypted.
rxDecryptBadPadLength	Number of encrypted ISAKMP messages received with an invalid number of padding bytes. ISAKMP expects a packet to be padded to the cryptographic algorithm's block size (8 bytes for DES algorithms and 16 bytes for AES)
rxDecryptPayBadRsvd	Number of encrypted ISAKMP messages received that have a payload header with a non-zeroed Reserved field.
infoNoMatchingPolicy	Number of Info messages received without a matching policy.
infoPh1NoDelAllowed	Number of delete payloads received not in phase 2.
infoPh2SANotFound	Number of phase 2 messages received without a valid SA.
infoPh2NotifyDisabled	Number of Notify payloads received/sent when notifies are disabled in phase 2.
infoPh2XchgStartFail	Number of failed attempts to start an Info phase 2 exchange.
infoPh1NotifyDisabled	Number of Notify payloads received/sent when notifies are disabled in phase 2.
infoPh1ExchgStartFail	Number of failed attempts to start an Info phase 1 exchange.
infoPh2SANotActive	Number of failed attempts to start an Info exchange when the SA is not active.
infoPh2DeleteDisabled	Number of Delete payloads received/sent when deletes are disabled in phase 2.
deleteDelayStarted	Number of ISAKMP exchanges where a deletedelay period was started.
deleteDelayNotUsed	Number of ISAKMP exchanges where a deletedelay period was not used. This may occur if the deletedelay is zero, if the device did not send the last message in the exchange, or for informational exchanges, where the peer may not send a message in the exchange.
deleteDelayPktsRxd	Number of retransmissions received from ISAKMP peers during the deletedelay periods.
deleteDelayRetrySent	Number of retransmitted messages the device has sent during the deletedelay periods.
deleteDelayConSent	Number of retransmitted informational connected messages the device has sent during the deletedelay periods.
deleteDelayConNoSa	Number of informational connected messages the device failed to retransmit due to lack of a suitable ISAKMP SA.
deleteDelayTxExceeded	Number of deletedelay periods where the retries sent exceeds the ISAKMP policy's msgretrylimit.
deleteDelayPktDiff	Number of retransmissions received that have a different unencrypted length or next payload type compared to the last received packet.

Figure 48-28: Example output from the **show isakmp counter=heartbeat** command

```
Heartbeat Mode Counters:

  startXchgInitiator     0    startXchgResponder     0
  initXchgComplete       0    respXchgComplete       0
  txMsg                  0    rxMsg                  0
  startXchgInitNotCfgd   0    startXchgRespNotCfgd   0
  rxUnexpectedPayload    0    rxInvalidSeqno         0
  rxHashUnexpectedLen    0    rxNotifyPayInvalid     0
  rxBadHash              0    rxExtraPayloads        0
```

Table 48-24: Parameters in output of the **show isakmp counter=heartbeat** command

Parameter	Meaning
startXchgInitiator	Number of times a heartbeat exchange started as the initiator
startXchResponder	Number of times a heartbeat exchange started as the responder.
initXchgComplete	Number of times a heartbeat exchange successfully started as the initiator.
respXchgComplete	Number of times a heartbeat exchange successfully started as the responder.
txMsg	Number of heartbeat messages sent.
rxMsg	Number of heartbeat messages received.
rxUnexpectedPayload	Number of heartbeat messages received with an unexpected payload.
startXchgInitNotCfgd	Number of times a heartbeat exchange attempted to start when the local device was not configured to initiate heartbeats.
startXchgRespNotCfgd	Number of times a heartbeat exchange was initiated by a remote device when the local device was not configured to receive heartbeats.
rxInvalidSeqno	Number of heartbeat messages received with an invalid sequence number.
rxHashUnexpectedLen	Number of heartbeat messages received with a hash payload with an unexpected length.
rxNotifyPayInvalid	Number of heartbeat messages received with an invalid notify payload.
rxBadHash	Number of heartbeat messages received with a bad hash value.
rxExtraPayloads	Number of heartbeat messages received with unexpected extra payloads.

Figure 48-29: Example output from the **show isakmp counter=info** command

```
Informational Message Counters:

  startXchgInitiator              0  startXchgResponder              0
  startInfoXchgProtected          0  startInfoXchgUnprotected        0
  rxMsgWithHashNoCryptInfo        0  rxMsgHashFail                   0
  rxMsgHashSuccess                0  rxMsgUnexpectHashPayload        0
  rxMsgProcessNotifyPayload       0  rxMsgProcessDeletePayload       0
  rxMsgProcessNotifyPayloadErr    0  rxMsgProcessDeletePayloadErr    0
  rxMsgUnexpectedPayload          0  rxMsgDelPayloadUnprotect        0
  rxMsgNonZeroReservedField       0  rxMsgProcessingComplete         0
  txMsgNotifyDenyIkmpPolicy       0  txMsgDeleteDenyIkmpPolicy       0
  txMsgSentCallBack               0  txMsgCreateXchgFailed           0
  txMsgStartPhase1XchgFail        0  txMsgStartPhase2XchgFail        0
  txNotifyMsg                     0  txDeleteMsg                     0
  txMsgDeleteSANotFound           0  txMsgDeleteDOINotValid          0
  processNotify                   0  processDelete                   0
  processNotifyResNotZero         0  processNotifyDoiInvalid         0
  processNotifyInvalidProtId      0  processDeleteReservedNotZero    0
  processDeleteDoiInvalid         0  processDeleteInvalidProtId      0
  createNotifyDoiInvalid          0  createNotifyMsgTypeReserved     0
  createNotifyMsgTypePrivate      0  xchgCompleteSucessfull          0
```

Table 48-25: Parameters in output of the **show isakmp counter=info** command

Parameter	Meaning
startXchgInitiator	Number of information exchanges started as initiator.
startXchgResponder	Number of information exchanges started as responder.
startInfoXchgProtected	Number of Information exchanges started with SA protection.
startInfoXchgUnprotected	Number of Information exchanges started with no protection.
rxMsgWithHashNoCryptInfo	Number of Rx protected Information messages unable to validate the hash.
rxMsgHashFail	Number of Rx protected information messages with invalid hash information.
rxMsgHashSuccess	Number Rx protected information messages with valid hash information.
rxMsgUnexpectHashPayload	Number of Rx information messages with hash payload unexpected.
rxMsgProcessNotifyPayload	Number of Notify payloads processed successfully.
rxMsgProcessDeletePayload	Number of Delete payloads processed successfully.
rxMsgProcessNotifyPayloadErr	Number of Notify payloads processed with errors.
rxMsgProcessDeletePayloadErr	Number of Delete payloads processed with errors.
rxMsgUnexpectedPayload	Number of Information messages received with unexpected payloads.
rxMsgDelPayloadUnprotect	Number of Delete payloads received with no protection.
rxMsgNonZeroReservedField	Number of Information messages received with a non-zero reserved field.
rxMsgProcessingComplete	Number of Informational messages processed.

Table 48-25: Parameters in output of the **show isakmp counter=info** command (cont)

Parameter	Meaning
txMsgNotifyDenyIkmpPolicy	Number of attempts to send Notify messages that the ISAKMP policy has denied.
txMsgDeleteDenyIkmpPolicy	Number of attempts to send Delete messages denied by the ISAKMP policy.
txMsgSentCallBack	Number of Information messages transmitted.
txMsgCreateXchgFailed	Number of attempts to send Information messages that failed to create an exchange.
txMsgStartPhase1XchgFail	Number of failed attempts to start phase1 informational exchange.
txMsgStartPhase2XchgFail	Number of failed attempts to start phase2 informational exchange.
txNotifyMsg	Number of Notify messages transmitted.
txDeleteMsg	Number of Delete messages transmitted.
txmsgdeletesanotfound	Number of attempts to transmit Delete messages where no phase 1 SA was found.
txMsgDeleteDOINotValid	Number of attempts to transmit Delete messages with an invalid DOI.
processNotify	Number of Notify payloads processed.
processDelete	Number of Delete payloads processed.
processNotifyResNotZero	Number of Notify payloads processed with the reserved field not zero.
processNotifyDoiInvalid	Number of Notify payloads processed with an invalid DOI.
processNotifyInvalidProtId	Number of Notify payloads processed with the protocol identity number is not valid.
processDeleteReservedNotZero	Number of Delete payloads processed with the reserved field not zero.
processDeleteDoiInvalid	Number of Delete payloads processed with an invalid DOI.
processDeleteInvalidProtId	Number of Delete payloads processed with an invalid protocol identity number.
createNotifyDoiInvalid	Number of Notify payloads created with an invalid DOI.
createNotifyMsgTypeReserved	Number of attempts to create Notify payloads with Notify type in the reserved range.
createNotifyMsgTypePrivate	Number of attempts to create Notify payloads with Notify type in the private range.
xchgCompleteSucessful	Number of Information exchanges completed.

Figure 48-30: Example output from the **show isakmp counter=ipsec** command

```
IPSEC DOI Counters:

 acquire                    2   acquireFailedDisabled      0
 commit                     0   commitFailedDisabled       0
 deleteSaBadLength          0
 checkMatchAttrBadType      0   checkMatchAttrSeenTwice    0
 chkMtchAttrsBadLen         0   chkMtchAttrsLifValMsng     0
 chkMtchAttrLifValBadLen    0   chkMtchAttrsBadVal         0
 chkMtchAttrsLifTypeMsng    0   chkMtchAttrssUnsupp        0
 chkMtchAttrsVarUnexp       0
```

Table 48-26: Parameters in output of the **show isakmp counter=ipsec** command

Parameter	Meaning
acquire	Number of IPsec requests to negotiate IPsec SAs.
commit	Number of committed IPsec bundles.
deleteSaBadLength	Number of attempted SA deletions where the SPI length is invalid.
checkMatchAttrBadType	Number of bad attribute types received.
chkMtchAttrsBadLen	Number of attributes received with bad lengths.
chkMtchAttrLifValBadLen	Number of life duration attributes received where the attribute length is invalid.
chkMtchAttrsLifTypeMsng	Number of life duration attributes received without a matching life type attribute.
chkMtchAttrsVarUnexp	Number of unexpected attributes received.
acquireFailedDisabled	Number of times IPsec requested an SA negotiation and ISAKMP is disabled.
commitFailedDisabled	Number of IPsec bundles committed when ISAKMP is disabled.
checkMatchAttrSeenTwice	Number of attributes that have been seen twice.
chkMtchAttrsLifValMsng	Number of life type attributes received without a matching life duration attribute.
chkMtchAttrsBadVal	Number of attributes received with invalid values.
chkMtchAttrssUnsupp	Number of unsupported attributes received.

Figure 48-31: Example output from the **show isakmp counter=main** command

```
Main Mode Counters:

initSendSA                    0   initRecvSA                  0
initSendKE                    0   initSendKECallbackNoXchg    0
initSendNatD                  0   initRecvNatD                0
initRecvKE                    0   initRecvKECallbackNoXchg    0
initSendAUTH                  0   initSendAUTHCallbackNoXchg  0
initRecvAUTH                  0   initRecvAUTHCallbackNoXchg  0

respRecvSA                    0  respRecvSACallbackNoXchg     0
respSendSA                    0  respSendKE                   0
respSendNatD                  0  respRecvNatD                 0
respSendKECallbackNoXchg      0  respRecvKE                   0
respRecvKECallbackNoXchg      0  respRecvAUTH                 0
respRecvAUTHCallbackNoXchg    0  respSendAUTH                 0
respSendAUTHCallbackNoXchg    0

invalidSAMessage              0   invalidKEMessage            0
invalidAUTHMessage            0   unexpectedMessage           0
msgLengthIncorrect            0   reservedFieldNotZero        0
nonceBadLen                   0   keBadLen                    0
hashBadLen                    0   badIDirPayLoad              0
badSALifeime                  0

generate3DESKeyFailed         0   generateDHPubFailed         0
generateDHSecretFailed        0   generateKeysFailed          0
generateKeysGood              0   generateLocalDHGood         0
generateSharedSecretGood      0   generateSKEYIDaFailed       0
generateSKEYIDdFailed         0   generateSKEYIDeFailed       0
generateSKEYIDFailed          0

decryptIDiiFailed             0   decryptIDiiGood             0
decryptIDirFailed             0   decryptIDirGood             0
decryptNiFailed               0   decryptNiGood               0
decryptNrFailed               0   decryptNrGood               0
encryptIDiiFailed             0   encryptIDiiGood             0
encryptIDirFailed             0   encryptIDirGood             0
encryptNiFailed               0   encryptNiGood               0
encryptNrFailed               0   encryptNrGood               0
signFailed                    0   signGood                    0
verifySigFailed               0

invalidPolicy                 0   noPolicy                    0
noTransformChosen             0   saNotFirst                  0
moreThanOneProposal           0   doiNotIpsec                 0
situationNotSupported         0   proposalIdNotISAKMP         0
proposalNumNotOne             0   tooManyTransforms           0
transformInvalid              0   peerIdAndIpDifferent        0
certNotSent                   0   certSent                    0
authFailed                    0   authGood                    0
cantFindLocalRSAKey           0   cantFindPeerRSAKey          0
cantLoadSharedKey             0   certNotSupported            0
```

Table 48-27: Parameters in output of the **show isakmp counter=main** command

Parameter	Meaning
Initiator Counters	
initSendSA	Number of Security Association messages sent.
initSendKE	Number of key exchange messages sent.
initSendNatD	Number of NAT-D messages sent.
initRecvKE	Number of key exchange messages received.
initSendAUTH	Number of authentication messages sent.
initRecvAUTH	Number of authentication messages received.
initRecvSA	Number of Security Association messages received.
initSendKECallbackNoXchg	Number of times that a key exchange message was not sent due to an invalid reference from ENCO.
initRecvNatD	Number of NAT-D messages received.
initRecvKECallbackNoXchg	Number of times that a key exchange message was not received due to an invalid reference from ENCO.
initSendAUTHCallbackNoXchg	Number of times that an authentication payload was not sent due to an invalid reference from ENCO.
initRecvAUTHCallbackNoXchg	Number of times that an authentication payload was not received due to an invalid reference from ENCO.
Responder Counters	
respRecvSA	Number of Security Association messages received.
respSendSA	Number of Security Association messages sent.
respSendNatD	Number of NAT-D messages sent.
respSendKECallbackNoXchg	Number of times that a key exchange was not sent due to an invalid reference from ENCO.
respRecvKECallbackNoXchg	Number of times that a key exchange message was not received due to an invalid reference from ENCO.
respSendAUTHCallbackNoXchg	Number of times that an authentication payload was not sent due to an invalid reference from ENCO.
respRecvAUTHCallbackNoXchg	Number of times that an authentication payload was not received due to an invalid reference from ENCO.
respRecvSACallbackNoXchg	Number of times that an SA payload was not received due to an invalid reference from ENCO.
respSendKE	Number of key exchange messages sent.
respRecvNatD	Number of NAT-D messages received.
respRecvKE	Number of key exchange messages received.
respRecvAUTH	Number of authentication messages received.
respSendAUTH	Number of authentication messages sent.
invalidSAMessage	Number of invalid SA messages received.
invalidAUTHMessage	Number of invalid authentication messages received.
msgLengthIncorrect	Number of messages received with an invalid message length.
nonceBadLen	Number of message received with a nonce payload with a bad length. The nonce must be 8 to 256 bytes long.

Table 48-27: Parameters in output of the **show isakmp counter=main** command (cont)

Parameter	Meaning
hashBadLen	Number of messages received with an unsupported hash length. The hash length must equal to the message digest used. The maximum supported message digest is 160-bits (20 bytes) log for the SHA algorithm.
badSALifetime	Number of messages received with an unsupported SA life duration attribute.
invalidKEMessage	Number of invalid KE messages received.
unexpectedMessage	Number of unexpected messages received.
reservedFieldNotZero	Number of messages received with a non-zero reserved field.
keBadLen	Number of messages received with an unsupported Key Exchange (KE) payload length. The KE must be the length of the negotiated Diffie-Hellman group.
badIDirPayload	Number of messages received with an invalid or unsupported ID payload.
generate3DESKeyFailed	Number of failed attempts to generate a 3DES key.
generateDHSecretFailed	Number of attempts to generate the DH shared secret that failed.
generateKeysGood	Number of keys successfully generated.
generateSharedSecretGood	Number of times the DH shared secret was successfully generated.
generateSKEYIDdFailed	Number of failed attempts to generate SKEYIDd.
generateSKEYIDFailed	Number of failed attempts to generate SKEYID.
generateDHPubFailed	Number of attempts to generate the local DH secret that failed.
generateKeysFailed	Number of attempts to generate keys that failed.
generateLocalDHGood	Number of times the local DH secret was successfully generated.
generateSKEYIDaFailed	Number of attempts to generate SKEYIDa that failed.
generateSKEYIDeFailed	Number of attempts to generate SKEYIDe that failed.
decryptIDiiFailed	Number of attempts to decrypt the IDii payload that failed.
decryptIDirFailed	Number of attempts to decrypt the IDir payload that failed.
decryptNiFailed	Number of attempts to decrypt the Ni payload that failed.
decryptNrFailed	Number of attempts to decrypt the Nr payload that failed.
encryptIDiiFailed	Number of attempts to encrypt the IDii payload that failed.
encryptIDirFailed	Number of attempts to encrypt the IDir payload that failed.
encryptNiFailed	Number of attempts to encrypt the Ni payload that failed.
encryptNrFailed	Number of attempts to encrypt the Nr payload that failed.
signFailed	Number of attempts to sign the hash that failed.
verifySigFailed	Number of attempts to verify a signature that failed.
decryptIDiiGood	Number of times the IDii payload was successfully decrypted with RSA.
decryptIDirGood	Number of times the IDir payload was successfully decrypted with RSA.

Table 48-27: Parameters in output of the **show isakmp counter=main** command (cont)

Parameter	Meaning
decryptNiGood	Number of times the Ni payload was successfully decrypted with RSA.
decryptNrGood	Number of times the Nr payload was successfully decrypted with RSA.
encryptIDiiGood	Number of times the IDii payload was successfully encrypted with RSA.
encryptIDirGood	Number of times the IDir payload was successfully encrypted with RSA.
encryptNiGood	Number of times the Ni payload was successfully encrypted with RSA.
encryptNrGood	Number of times the Nr payload was successfully encrypted with RSA.
signGood	Number of times the hash was successfully signed.
invalidPolicy	Number of times an invalid policy was found.
noTransformChosen	Number of times a suitable policy could not be found.
moreThanOneProposal	Number of times more than one proposal was sent in an SA payload.
situationNotSupported	Number of times a received SA payload had an unsupported situation.
proposalNumNotOne	Number of times the proposal payload did not have an ID of one.
transformInvalid	Number of invalid transform payloads received.
certNotSent	Number of times a certificate could not be sent.
authFailed	Number of peer authentication attempts that failed.
cantFindLocalRSAKey	Number of attempts to load the local RSA key that failed.
cantLoadSharedKey	Number of attempts to load the shared key that failed.
noPolicy	Number of attempts to finds a suitable policy that failed.
saNotFirst	Number of times the SA payload was not the first payload in a received message.
doiNotIpsec	Number of times a received SA payload had an unsupported DOI.
proposalIdNotISAKMP	Number of times an invalid proposal ID was received.
tooManyTransforms	Number of times an invalid number of transforms was received.
peerIdAndIpDifferent	Number of times the source IP address differed from the peer ID.
certSent	Number of successful attempts to send a local certificate.
authGood	Number of successful peer authentications.
cantFindPeerRSAKey	Number of failed attempts to load the peer's RSA key.
certNotSupported	Number of times an unsupported type of certificate was received.

Figure 48-32: Example output from the **show isakmp counter=network** command

```
ISAKMP Network Counters

  opened                  0     openFail               0
  openAlreadyOpened       0
  closed                  0     closeFail              0
  closeNotOpened          0
  rx                      0     rxFailNoNonEspMarker   0
  tx                      0     txFail                 0
  txNotOpened             0
```

Table 48-28: Parameters in output of the **show isakmp counter=network** command

Parameter	Meaning
opened	Number of successful attempts to open the network interface.
openAlreadyOpened	Number of attempts to open the network interface when it was already open.
closed	Number of successful attempts to close the network interface.
closeNotOpened	Number of attempts to close the network interface when it was already closed.
rx	Number of ISAKMP messages received.
tx	Number of ISAKMP messages transmitted.
txNotOpened	Number of attempts to transmit an ISAKMP message when the network interface was not open.
openFail	Number of failed attempts to open the network interface.
closeFail	Number of failed attempts to close the network interface.
rxFailNoNonEspMarker	Number of packets ISAKMP dropped because they were received on NAT-T port 4500 without a non-ESP marker.
txFail	Number of failed attempts to transmit an ISAKMP message.

Figure 48-33: Example output from the **show isakmp counter=quick** command

```
Quick Mode Counters:

  General Counters: Initiator:

    startExchange                 0     exchangeGood                0
    hashSaNonceSent               0     hashSent                    0
    hashSaNonceReceived           0     hashSaNonceRcvdGood         0
    connectedReceived             1     connectedReceivedGood       1
    natOaSent                     0     natOaReceived               0
    hashSaNonceExpKByte           0     connectedExpKByte           0

                    Responder:

    startExchange                 0     exchangeGood                0
    hashSaNonceSent               0
    hashSaNonceReceived           0     hashSaNonceRcvdGood         0
    hashReceived                  0     hashReceivedGood            0
    hashSaNonceExpKByte           0     hashExpKByte                0
    natOaSent                     0     natOaReceived               0

  Error Counters: Initiator: General errors:

    initHash2Fail                 0     initDHGenFail               0
    initStartCBFailed             0     initStartCBNoXchg           0
    initProc1CBFailed             0     initProc1CBNoXchg           0
    initHash4Fail                 1     unexpectedMessage           0

                              Receive Hash SA Nonce message errors:

    invalidPayloadType            0     hashPayMissing              0
    hashUnexpectedLen             0
    saNoMatch                     0     saBadLen                    0
    saBadDoi                      0     saBadSituation              0
    saLenTooShort                 0     saPayMissing                0
    saPropInconsistLen            0
    propNoMatch                   0     propBadLen                  0
    propTranInconsistLen          0     propBadNextPayload          0
    propBadRsv                    0     propMultipleTrans           0
    propTooManyProps              0
    tranBadLen                    0     tranBadNextPayload          0
    tranBadRsv                    0     attrBad                     0
    nonceBadLen                   0     noncePayMissing             0
    nonceSeenTwice                0     idsSeenTwice                0
    idciBad                       0     idcrBad                     0
    idcrPayMissing                0     keSeenTwice                 0
    badNatOa                      0

                              Receive Connected message errors:

    hashPayMissing                0     invalidPayloadType          0
    hashBadLen                    0

                  Responder: General errors:

    respAcquireNoPolicy           0     respRemotePropNoMatch       0
    respHash1Fail                 0     respHash3Fail               0
    respProc2CBFailed             0     respProc2CBNoXchg           0
    respProc3CBFailed             0     respProc3CBNoXchg           0
    unexpectedMessage             0
```

Figure 48-33: Example output from the **show isakmp counter=quick** command (cont)

```
                        Receive Hash SA Nonce message errors:

invalidPayloadType              0     hashPayMissing              0
hashUnexpectedLen               0     noncePayMissing             0
nonceSeenTwice                  0     nonceBadLen                 0
saPayMissing                    0     saPayBad                    0
saLenTooLong                    0     saLenTooShort               0
saBadDoi                        0     saBadSituation              0
saPropInconsistLen              0
propLenTooLong                  0     propLenTooShort             0
propBadLen                      0     propBadRsv                  0
propBadNextPayload              0     propBadNumber               0
propBadProtid                   0     propBadSpiSize              0
propNoTransforms                0     propTranInconsistLen        0
tranBadLen                      0     tranBadNextPayload          0
tranBadNumber                   0     tranBadRsv2                 0
tranTransId                     0     attrBad                     0
idsSeenTwice                    0
idciBadType                     0     idcrBadType                 0
idcrPayMissing                  0     keSeenTwice                 0
badNatOa                        0

                        Receive Hash message errors:

hashPayMissing                  0     invalidPayloadType          0
hashBadLen                      0
```

Table 48-29: Parameters in output of the **show isakmp counter=quick** command

Parameter	Meaning
General counters for this router as initiator	
startExchange	Number of exchanges started.
exchangeGood	Number of exchanges successfully completed.
hashSaNonceSent	Number of hash SA nonce messages sent.
hashSent	Number of hash messages sent.
hashSaNonceReceived	Number of hash SA nonce messages received.
hashSaNonceRcvdGood	Number of valid hash SA nonce messages received and processed successfully.
connectedReceived	Number of Connected messages received in Quick mode.
connectedReceivedGood	Number of valid Connected messages received in Quick mode and processed successfully.
natOaSent	Number of NAT originating addresses sent.
natOaReceived	Number of NAT originating addresses received.
hashSaNonceExpKByte	Number of hash SA nonce messages received that caused the exchange to expire due to reaching its Kbyte limit.
connectedExpKByte	Number Connected messages received in Quick mode that caused the SA to expire due to reaching its Kbyte limit.
General counters for this router as responder	
startExchange	Number of exchanges started.
exchangeGood	Number of exchanges successfully completed.
hashSaNonceSent	Number of hash SA nonce messages sent.

Table 48-29: Parameters in output of the **show isakmp counter=quick** command (cont)

Parameter	Meaning
hashSaNonceReceived	Number of hash SA nonce messages received.
hashSaNonceRcvdGood	Number of valid hash SA nonce messages received and processed successfully.
hashReceived	Number of hash messages received.
hashReceivedGood	Number of valid hash messages received and processed successfully.
hashSaNonceExpKByte	Number of hash SA nonce messages received that caused the exchange to expire due to reaching its Kbyte limit.
hashExpKByte	Number of hash messages received that caused the exchange to expire due to reaching its Kbyte limit.
natOaSent	Number of NAT originating addresses sent.
natOaReceived	Number of NAT originating addresses received.
General error counters for this router as initiator	
initHash2Fail	Number of times the second hash check of an exchange failed.
initDHGenFail	Number of times the Diffie-Hellman generation for an exchange failed.
initStartCBFailed	Number of times a call to the ENCO module failed during the start of an exchange initiaited by this router.
initStartCBNoXchg	Number of times the specified exchange could not be found after returning from a call to the ENCO module during the start of an exchange initiaited by this router.
initProc1CBFailed	Number of times a call to the ENCO module failed during the processing of the first message of an exchange.
initProc1CBNoXchg	Number of times the specified exchange could not be found after returning from a call to the ENCO module during the processing of the first message of an exchange.
initHash4Fail	Number of times the fourth hash check of an exchange failed.
unexpectedMessage	Number of times the router received an unexpected message during a Quick mode exchange.
Receive Hash SA Nonce message error counters for this router as initiator	
invalidPayloadType	Number of messages received with an invalid payload type.
hashPayMissing	Number of messages received with a hash payload missing.
hashUnexpectedLen	Number of messages received with a hash payload with an unexpected length.
saNoMatch	Number of messages received with an SA payload that did not match any local ISAKMP policy.
saBadLen	Number of messages received with an SA payload with a bad length.
saBadDoi	Number of messages received with an SA payload with an invalid DOI field.
saBadSituation	Number of messages received with an SA payload with an invalid situation field.

Table 48-29: Parameters in output of the **show isakmp counter=quick** command (cont)

Parameter	Meaning
saLenTooShort	Number of messages received with an SA payload with a length that was too short.
saPayMissing	Number of messages received with no SA payload when one was expected.
saPropInconsistLen	Number of messages received with an SA payload with a length that was inconsistent with the lengths of the proposal payloads contained in the SA payload.
propNoMatch	Number of proposal payloads received that did not match a proposal in the local ISAKMP policy.
propBadLen	Number of messages received with a proposal payload with a bad length.
propTranInconsistLen	Number of messages received with a proposal payload with a length that was inconsistent with the lengths of the transform payloads contained in the proposal payload.
propBadNextPayload	Number of messages received with a proposal payload with a bad next payload field.
propBadRsv	Number of messages received with a proposal payload with a bad reserved field.
propMultipleTrans	Number of messages received by the initiator with a proposal payload with multiple transforms.
propTooManyProps	Number of messages received by the initiator with a proposal payload with too many proposals.
tranBadLen	Number of messages received with a transform payload with a bad length.
tranBadNextPayload	Number of messages received with a transform payload with a bad next payload field.
tranBadRsv	Number of messages received with a transform payload with a bad reserved field.
attrBad	Number of messages received with a bad attribute.
nonceBadLen	Number of messages received with a nonce payload with a bad length. The nonce must be 8 to 256 bytes long.
noncePayMissing	Number of messages received without a nonce payload when one was expected.
nonceSeenTwice	Number of messages received with more than one nonce payload.
idsSeenTwice	Number of messages received with more than one pair of ID payloads.
idciBad	Number of messages received with a bad IDci payload.
idcrBad	Number of messages received with a bad IDcr payload.
idcrPayMissing	Number of messages received with an IDci payload and no matching IDcr payload.
keSeenTwice	Number of messages received with more than one key exchange payload.
badNatOa	Number of non-conforming NAT-OA (originating address) messages received such as an unknown type.

Table 48-29: Parameters in output of the **show isakmp counter=quick** command (cont)

Parameter	Meaning
Receive Connected message error counters for this router as initiator	
hashPayMissing	Number of messages received with a hash payload missing.
invalidPayloadType	Number of messages received with an invalid payload type.
hashBadLen	Number of messages received with a hash payload with a bad length.
General error counters for this router as responder	
respAcquireNoPolicy	Number of times the first message of an exchange was received and an IPsec policy to match the policy proposed in the message could not be found.
respRemotePropNoMatch	Number of times the first message of an exchange was received and a proposal in the message did not match any proposal in the selected IPsec policy.
respHash1Fail	Number of times the first hash check of an exchange failed.
respHash3Fail	Number of times the third hash check of an exchange failed.
respProc2CBFailed	Number of times a call to the ENCO module failed during the processing of the second message of an exchange.
respProc2CBNoXchg	Number of times the specified exchange could not be found after returning from a call to the ENCO module during the processing of the second message of an exchange.
respProc3CBFailed	Number of times a call to the ENCO module failed during the processing of the third message of an exchange.
respProc3CBNoXchg	Number of times the specified exchange could not be found after returning from a call to the ENCO module during the processing of the third message of an exchange.
unexpectedMessage	Number of times the router received an unexpected message during a Quick mode exchange.
Receive hash SA nonce message error counters for this router as responder	
invalidPayloadType	Number of messages received with an invalid payload type.
hashPayMissing	Number of messages received with a hash payload missing.
hashUnexpectedLen	Number of messages received with a hash payload with an unexpected length.
noncePayMissing	Number of messages received without a nonce payload when one was expected
nonceSeenTwice	Number of messages received with more than one nonce payload.
nonceBadLen	Number of messages received with a nonce payload with a bad length. The nonce must be 8 to 256 bytes long.
saPayMissing	Number of messages received with no SA payload when one was expected.
saPayBad	Number of messages received with a bad SA payload.
saLenTooLong	Number of messages received with an SA payload with a length that was too long.
saLenTooShort	Number of messages received with an SA payload with a length that was too short.

Table 48-29: Parameters in output of the **show isakmp counter=quick** command (cont)

Parameter	Meaning
saBadDoi	Number of messages received with an SA payload with an invalid DOI field.
saBadSituation	Number of messages received with an SA payload with an invalid situation field.
saPropInconsistLen	Number of messages received with an SA payload with a length that was inconsistent with the lengths of the proposal payloads contained in the SA payload.
propLenTooLong	Number of messages received with a proposal payload with a length that was too long.
propLenTooShort	Number of messages received with a proposal payload with a length that was too short.
propBadLen	Number of messages received with a proposal payload with a bad length.
propBadRsv	Number of messages received with a proposal payload with a bad reserved field.
propBadNextPayload	Number of messages received with a proposal payload with a bad next payload field.
propBadNumber	Number of messages received with a proposal payload with a bad proposal number.
propBadProtid	Number of messages received with a proposal payload with a bad protocol Id field.
propBadSpiSize	Number of messages received with a proposal payload with a bad SPI size field.
propNoTransforms	Number of messages received with a proposal payload with no transforms.
propTranInconsistLen	Number of messages received with a proposal payload with a length that was inconsistent with the lengths of the transform payloads contained in the proposal payload.
tranBadLen	Number of messages received with a transform payload with a bad length.
tranBadNextPayload	Number of messages received with a transform payload with a bad next payload field.
tranBadNumber	Number of messages received with a transform payload with a bad transform number field.
tranBadRsv2	Number of messages received with a transform payload with a bad reserved2 field.
tranTransId	Number of messages received with a transform payload with a bad transform ID field.
attrBad	Number of messages received with a bad attribute.
idsSeenTwice	Number of messages received with more than one pair of ID payloads.
idciBadType	Number of messages received with a IDci payload with a bad ID type field.
idcrBadType	Number of messages received with a IDcr payload with a bad ID type field.

Table 48-29: Parameters in output of the **show isakmp counter=quick** command (cont)

Parameter	Meaning
idcrPayMissing	Number of messages received with an IDci payload and no matching IDcr payload.
keSeenTwice	Number of messages received with more than one key exchange payload.
badNatOa	Number of non-conforming NAT-OA (originating address) messages received such as an unknown type.
Receive hash message error counters for this router as responder	
hashPayMissing	Number of messages received with a hash payload missing.
invalidPayloadType	Number of messages received with an invalid payload type.
hashBadLen	Number of messages received with a hash payload with a bad length.

Figure 48-34: Example output from the **show isakmp counter=sad** command

```
SAD Counters
  createGood           0
  deleteGood           0      deleteFailed         0
  expireNoSa           0      softExpireNoSa       0
  Find SA Counters:    success               fail
    by Id                    0                  0
    by peer address          0                  0
    by cookies               0                  0
    by policy name           0                  0
    by peer Notify           0                  0
    by peer Delete           0                  0
```

Table 48-30: Parameters in output of the **show isakmp counter=sad** command

Parameter	Meaning
createGood	Number of Security Associations (SAs) created successfully.
deleteGood	Number of Security Associations deleted successfully.
expireNoSa	Number of times the matching SA could not be found during an expiry event.
deleteFailed	Number of delete SA operations that failed.
softExpireNoSa	Number of times the matching SA could not be fould during a soft expiry event.
Find SA Counters	Counters for SA search operations.
success	Number of successful searches of a given type.
fail	Number of unsuccessful searches of a given type.
by Id	Number of searches for a SA with a specified ID.
by peer address	Number of searches for a SA with a specified peer address.
by cookies	Number of searches for a SA with a specified cookies.
by policy name	Number of searches for a SA with a specified IPsec policy name.

Table 48-30: Parameters in output of the **show isakmp counter=sad** command

Parameter	Meaning
by peer Notify	Number of searches for an active SA suitable for protecting an informational notify exchange to a specified peer address.
by peer Delete	Number of searches for an active SA suitable for protecting an informational delete exchange to a specified peer address.

Figure 48-35: Example output from the **show isakmp counter=spd** command

```
ISAKMP Policy Counters

  getPolicyGood         0    getPolicyFailed         1
  deletePolicyGood      0    deletePolicyFailed      0
  addPolicyGood         0    addPolicyFailed         0
  getPolicyByPeerGood   0    getPolicyByPeerFailed   0
  usePolIkeRetryGood    0    usePolIkeRetryFailed    0
```

Table 48-31: Parameters in output of the **show isakmp counter=spd** command

Parameter	Meaning
getPolicyGood	Number of successful attempts to retrieve a policy from the ISAKMP SPD.
deletePolicyGood	Number of successful attempts to delete a policy from the ISAKMP SPD.
addPolicyGood	Number of successful attempts to add a policy to the ISAKMP SPD.
getPolicyByPeerGood	Number of successful attempts to retrieve a policy using the peer IP address.
usePolIkeRetryGood	Number of times IKE exchange retry was used by a policy to retry a failed IKE exchange.
getPolicyFailed	Number of unsuccessful attempts to retrieve a policy from the ISAKMP SPD.
deletePolicyFailed	Number of unsuccessful attempts to delete a policy from the ISAKMP SPD.
addPolicyFailed	Number of unsuccessful attempts to add a policy to the ISAKMP SPD.
getPolicyByPeerFailed	Number of unsuccessful attempts to retrieve a policy using the peer IP address.
UsePolIkeRetryFailed	Number of times IKE exchange retry could not be used for a policy, because the policy had exceeded its retry limits. The retry limits are set using the **retryikeattempts** parameter.

Figure 48-36: Example output from the **show isakmp counter=transaction** command

```
Transaction Exchange Counters:

  msgLengthIncorrect          0   reservedFieldNotZero       0
  tooManyAttributes           0   unexpectedAttributes       0
  hashNotFirst                0   hashTooBig                 0
  hashInvalid                 0   unexpectedMessage          0
  unexpectedCfgMessage        0   unexpectedHashPayload      0

  authGood                    0   authFailed                 0
  xAuthNoSA                   0   xAuthNotEncrypted          0
  proccessXAuthCallbackNoSa   0   unsupportedAttribute       0

  ackRecv                     0   ackSent                    0
  repRecv                     0   repSent                    0
  reqRecv                     0   reqSent                    0
  setRecv                     0   setSent                    0
```

Table 48-32: Parameters in output of the **show isakmp counter=transaction** command

Parameter	Meaning
msgLengthIncorrect	Number of messages received with an invalid message length.
tooManyAttributes	Number of unsupported number of attributes received.
hashNotFirst	Number of hash payloads that were not the first payload in a message.
hashInvalid	Number of invalid hash payloads received.
unexpectedCfgMessage	Number of configuration messages received when not expected.
authGood	Number of successful XAUTH authentications.
xAuthNoSA	Number of XAUTH messages received with no SA.
proccessXAuthCallbackNoSa	Number of Authentication callbacks with no SA.
ackRecv	Number of Acknowledge message received.
repRecv	Number of Reply messages received.
reqRecv	Number of Request messages received.
setRecv	Number of Set messages received.
reservedFieldNotZero	Number of messages received with a non-zero reserved field.
unexpectedAttributes	Number of messages received with unexpected attributes.
hashTooBig	Number of messages received with an unsupported hash length.
unexpectedMessage	Number of messages received when not expected.
unexpectedHashPayload	Number of hash payloads received when not expected.
authFailed	Number of failed attempts at XAUTH authentication.
xAuthNotEncrypted	Number of XAUTH messages received that were not encrypted as they should have been.
unsupportedAttribute	Number of messages received with an unsupported attribute.
ackSent	Number of Acknowledge messages sent.

Table 48-32: Parameters in output of the **show isakmp counter=transaction** command

Parameter	Meaning
repSent	Number of Reply messages sent.
reqSent	Number of Request messages sent.
setSent	Number of Set messages sent.

Figure 48-37: Example output from the **show isakmp counter=xde** command

```
ISAKMP Xdb Counters
                                    Good        Failed
  createXchg                           2             0
  deleteXchgById                       1             0
  getXchgById                         16             0
  getXchgByiCookie                     0             0
  getXchgByrCookie                     0             0
  getXchgByCookies                     1             0
  getXchgByMsgId                       0             0
  getXchgByMsgIdAndCookies             2             1
  getXchgByPolicy                      0             0
  getXchgByPeer                        0             1
  getXchgBySaIdSelectPol               0             0
```

Table 48-33: Parameters in output of the **show isakmp counter=xde** command

Parameter	Meaning
createXchg	Number of successful and unsuccessful attempts to create an exchange in the ISAKMP exchange database.
deleteXchgById	Number of successful and unsuccessful attempts to remove an exchange from the ISAKMP exchange database.
getXchgById	Number of successful and unsuccessful attempts to get an exchange by ID from the ISAKMP exchange database.
getXchgByiCookie	Number of successful and unsuccessful attempts to retrieve an exchange by initiator cookie from the ISAKMP exchange database.
getXchgByrCookie	Number of successful and unsuccessful attempts to get an exchange by responder cookie from the ISAKMP exchange database.
getXchgByCookies	Number of successful and unsuccessful attempts to get an exchange by initiator and responder cookies from the ISAKMP exchange database.
getXchgByMsgId	Number of successful and unsuccessful attempts to get an exchange by message ID from the ISAKMP exchange database.
getXchgByMsgIdAndCookies	Number of successful and unsuccessful attempts to get an exchange by message ID and cookies from the ISAKMP exchange database.
getXchgByPolicy	Number of successful and unsuccessful attempts to get exchange by ISAKMP policy name from the ISAKMP exchange database.
getXchgByPeer	Number of successful and unsuccessful attempts to get exchange by peer IP address from the ISAKMP exchange database.

Table 48-33: Parameters in output of the **show isakmp counter=xde** command (cont)

Parameter	Meaning
getXchgBySaIdSelectPol	Number of successful and unsuccessful attempts to get exchange by said, selector fields and policy name from the ISAKMP exchange database.

Examples

To display the SPD and XPD counters, use the command:

```
sh isa cou=spd,xpd
```

To display all ISAKMP counters, use the command:

```
sh isa cou
```

Related Commands

show isakmp exchange
show isakmp sa

show isakmp exchange

Syntax `SHow ISAkmp EXChange[=`*`exchange-id`*`]`

Description This command displays information about the specified or all current ISAKMP exchanges.

The **exchange** parameter specifies the identification number, from 0 to 4294967295, of the exchange to display. If a value is not specified, summary information is displayed about all current ISAKMP exchanges (Figure 48-38, Table 48-34 on page 48-186). If a value is specified, detailed configuration and state information is displayed about the specified exchange (Figure 48-39 on page 48-187, Table 48-35 on page 48-188).

Figure 48-38: Example output from the **show isakmp exchange** command

```
ISAKMP Exchanges

   Id  Phase  State    PeerAddress               Type
   ------------------------------------------------------------
   12      1  KESENT   192.168.1.45              IDPROTECT
   13      2  WAIT_HSN 3ffe:2dde:3ff2:7777::3    QUICK
```

Table 48-34: Parameters in output of the **show isakmp exchange** command

Parameter	Meaning
Id	Identification number used to identify the Exchange.
Phase	Current phase of the exchange; either 1, 1.5, or 2.
State	Current state of the exchange. For Main mode exchanges: IDLE SASENT SARECV KESENT KERECV AUTHSENT AUTHRECV UP For Quick mode exchanges: STARTING WAIT_HASH_SA_NONCE WAIT_HASH RECEIVING_MESSAGE SENDING_HASH_SA_NONCE SENDING_HASH DONE For Aggressive mode exchanges: IDLE SAKESENT SAKERECV SAKEAUTHSENT SAKEAUTHRECV AUTHSENT AUTHRECV UP For Transaction exchanges: IDLE REQSENT REQRECV REPSENT REPRECV SETSENT SETRECV ACKSENT ACKRECV UP For Informational exchanges, the State is IDLE.
Peer Address/Peer IP Address	IP address of the peer for this exchange.
Type	Type of exchange: MAIN AGGRESSIVE TRANSACTION INFO QUICK

Figure 48-39: Example output from the **show isakmp exchange** command for a specific exchange in Main mode

```
ISAKMP Exchange

  Id ..................................... 4
  Type ................................... MAIN
  State .................................. SASENT
  Phase .................................. 1
  Initiator .............................. TRUE
  DOI .................................... IPSEC
  Policy name ............................ main
  SA ..................................... 1
  Peer IP Address ........................ 202.36.163.201
  Local IP Address ....................... 202.36.163.161
  Encrypted .............................. FALSE
  Expecting message ...................... TRUE
  Has SA ................................. TRUE
  Initiator Cookie ....................... d464cc30b348efa7
  Responder Cookie ....................... 0000000000000000
  Message Id ............................. 00000000
  Set Commit bit ......................... FALSE
  Commit bit received .................... FALSE
  Send notifies .......................... TRUE
  Send deletes ........................... FALSE
  Message Retry Limit .................... 5
  Packet Retry Counter ................... 5
  Message Back-off ....................... Incremental
  Delete Delay Time (s) .................. 30
  Delete Delay Timer (time left (s)) .... 8
  Initial Message Retry Timeout (s) ..... 20
  Packet Retry Timer (time left(s)) ..... 10

Main Mode Status:

  ENCO Pass .............................. 0
  Shared Key Id .......................... 30
  Peer RSA Key Id ........................ 30
  Local RSA Key Id ....................... -
  Peer Certificate Id .................... -
  Local Certificate Id ................... -
  Local Policy
      Transform 0:
       Transform Number ............... 1
       Transform Id ................... 1
       Encryption Algorithm ........... DES - 56 bit
       Authentication Algorithm ...... SHA
       Authentication Method ......... PRESHARED
       Group Description .............. 768
       Group Type ..................... MODP
       Expiry Seconds ................. 86400
       Expiry KBytes .................. 1000
  Remote Policy

Sa Definition Information:
  Authentication Type ................. INVALID
  Encryption Algorithm ................ INVALID
  Hash Algorithm ...................... INVALID
  group Type .......................... INVALID
  group Description ................... INVALID
  DH Private Exponent Bits ............ 767
  expiry seconds ...................... 0
  expiry kilobytes .................... 0
```

Table 48-35: Parameters in output of the **show isakmp exchange** command for a specific exchange

Parameter	Meaning
ISAKMP Exchange	**General information about the exchange**
Id	Identification number used to identify the Exchange.
Phase	Current phase of the exchange; either 1, 1.5, or 2.
State	Current state of the exchange. For Main mode exchanges: IDLE SASENT SARECV KESENT KERECV AUTHSENT AUTHRECV UP For Quick mode exchanges: STARTING WAIT_HASH_SA_NONCE WAIT_HASH RECEIVING_MESSAGE SENDING_HASH_SA_NONCE SENDING_HASH DONE For Aggressive mode exchanges: IDLE SAKESENT SAKERECV SAKEAUTHSENT SAKEAUTHRECV AUTHSENT AUTHRECV UP For Transaction exchanges: IDLE REQSENT REQRECV REPSENT REPRECV SETSENT SETRECV ACKSENT ACKRECV UP For informational exchanges, the State is IDLE. For completed exchanges awaiting deletion, the State is DELETEDELAY.
Type	The type of exchange: MAIN AGGRESSIVE TRANSACTION INFO QUICK
Initiator	Whether this router was the initiator of the exchange.

Table 48-35: Parameters in output of the **show isakmp exchange** command for a specific exchange (cont)

Parameter	Meaning
DOI	The domain of interpretation to be used by the exchange. Currently only IPsec is allowed.
Policy name	The name of the ISAKMP policy.
SA	The ID of the ISAKMP SA associated with this exchange.
Peer Address/Peer IP Address	The IP address of the peer for this exchange.
Local IP Address	The IP address of the local device for this exchange.
Encrypted	Whether the exchange is under the protection of an ISAKMP SA and is encrypting messages.
Expecting message	Whether the exchange is waiting for a new message.
Has SA	Whether the exchange has an ISAKMP SA associated with it.
Initiator Cookie	The 8-byte random number the initiator generates to identify the exchange.
Responder Cookie	The 8-byte random number the responder generates to identify the exchange.
Message Id	The 4-byte random number that identifies the exchange.
Set Commit bit	Whether the messages transmitted by this exchange set the commit bit.
Commit bit received	Whether messages received by this exchange set the commit bit.
Send notifies	Whether Notify payloads are sent with this exchange.
Send deletes	Whether Delete payloads are sent with this exchange.
Message Retry Limit	Number of times each message is retransmitted before the exchange expires.
Packet Retry Counter	Number retries left with the current sent message.
Message Back-off	The back-off pattern used when ISAKMP messages are retransmitted. Either the back-off time between message retransmissions gets larger (Incremental), or remains the same (None).
Delete Delay Time (s)	Number of seconds between the completion of the exchange and its deletion.
Delete Delay Timer (time left (s))	Number of seconds left before a completed exchange is deleted.
Initial Message Retry Timeout (s)	Number of seconds between the first message and the first retransmission.
Packet Retry Timer (time left(s))	Number of seconds left before next retransmission.
Main and Aggressive Mode	**Information about a Main mode or Aggressive mode exchange**
ENCO Pass	Number of passes to the ENCO processing unit.
Shared Key Id	The ENCO key identification number of the shared key used for PRESHARED authentication.
Peer RSA Key Id	The ENCO key identification number of the RSA key used for RSAENCR authentication.
Local RSA Key Id	The ENCO ID of the key to be used as the local RSA key.

Table 48-35: Parameters in output of the **show isakmp exchange** command for a specific exchange (cont)

Parameter	Meaning
Peer Certificate Id	The ENCO ID of the certificate to be used as the peer's certificate.
Local Certificate Id	The ENCO ID of the certificate to be used as the local certificate.
Local Policy	A description of the local policy used in this exchange.
Remote Policy	A description of the local policy used in this exchange.
Transform	A description of the transform payload.
Transform Number	Number of the transform payload as it appears in an SA payload.
Transform Id	The ID for a transform payload.
Encryption Algorithm	The encryption algorithm to be used protect messages generated or received by this exchange.
Authentication Algorithm	The hash algorithm to be used to authenticate messages generated or received by this exchange.
Authentication Method	The method of authentication used in phase 1; either PRESHARED, RSAENCR, or RSASIG.
Group Description	The Diffie-Hellman group identification: 512 768 1024 INVALID
Group Type	The group type to perform Diffie-Hellman key exchange.
DH Private Exponent Bits	The length in bits of the DH private exponent.
Expiry Seconds	The expiry seconds as specified by local policy.
Expiry KBytes	The expiry kilobytes as specified by local policy.
Transaction Mode	**Information about a Quick mode exchange**
Mode	The mode of the transaction exchange; either XAUTH, SET, or REQ.
Id	An identifier to link separate exchanges together.
Quick Mode Status	**Information about a Quick mode exchange**
SA id	The ID of the ISAKMP SA this exchange is using.
local address	The local IP address of the exchange.
policy name	The name of the ISAKMP policy from which the SA this exchange is using was created.
use PFS-KEY	Whether the exchange is using Perfect Forward Security for keys.
use PFS-ID	Whether the exchange is using Perfect Forward Security for IDs.
DH group ID	The ID of the Diffie-Hellman group being used by this exchange.
msg retry limit	Number of times the exchange tries to retransmit messages.
msg retry timeout	The initial time period after which the exchange tries to retransmit a message.

Table 48-35: Parameters in output of the **show isakmp exchange** command for a specific exchange (cont)

Parameter	Meaning
IPSEC exchange info	**IPsec information about the exchange**
IDi	Information about the initiator ID.
type	The ID type.
protocol Id	The protocol identifier of the ID.
port	The port number of the ID.
data	The ID data.
IDr	Information about the responder ID.
group Id	The IPsec group ID.
Sa Definition Information:	**Information about the Security Association definition for the exchange**
Authentication Type	The method of authentication used for this SA.
Encryption Algorithm	The encryption algorithm used by this SA; either DES, 3DES2KEY, 3DESOUTER, or 3DESINNER.
Hash Algorithm	Whether to use the SHA or MD5 hash algorithm to authenticate data for this SA.
group Type	The Diffie-Hellman type used for key exchange; only MODP groups are supported.
group Description	The Diffie-Hellman group identification; either MODP512, MODP768, MODP1024, or INVALID.
expiry seconds	The negotiated expiry seconds for this SA.
expiry kilobytes	The negotiated expiry kilobytes for this SA.

Examples

To display a list of all ISAKMP exchanges, use the command:

```
sh isa exc
```

Related Commands

show isakmp counters
show isakmp sa

show isakmp policy

Syntax `SHow ISAkmp POLicy[=`*`name`*`]`

Description This command displays information about the specified or all ISAKMP policies.

The **policy** parameter specifies the name of the IAKMP policy. *Name* is a string from 1 to 24 characters long. It may contain any printable character and is case sensitive. If the string contains spaces, it must be in double quotes. If *name* is specified, details about that ISAKMP policy are displayed (Figure 48-41 on page 48-193, Table 48-37 on page 48-193).

If *name* is not specified, summary information for all ISAKMP policies is displayed (Figure 48-40, Table 48-36). IPv6 addresses may be too long to display in the summary, but you can view the full address in the output for the particular policy.

Figure 48-40: Example output from the **show isakmp policy** command

```
Name                 PeerAddress
                     Mode    AuthType   EncAlg  HashAlg
-------------------------------------------------------------
my_isakmp_policy     192.168.2.1
                     ID_PROT PRESHARED  DES     SHA
```

Table 48-36: Parameters in output of the **show isakmp policy** command

Parameter	Meaning
Name	The manager-assigned name for the ISAKMP policy.
PeerAdresss	The IP address of the peer for this policy, or ANY when the policy is used for remote peers whose IP address is not known at startup.
Mode	Whether the phase 1mode for the policy is IDPROT or AGGR.
AuthType	Whether the authentication type for the policy is PRESHARED, RSAENCR, or RSASIG.
EncAlg	The encryption algorithm to be used by the ISAKMP SAs created by this policy; either DES, 3DES2KEY, 3DESOUTER, or 3DESINNER.
HashAlg	Whether to use SHA or MD5 as the hash algorithm by the ISAKMP SAs created by this policy.

Figure 48-41: Example output from the **show isakmp policy** command for a specific policy.

```
ISAKMP Policy
  Name ................................ my_isakmp_policy
  Peer Address ........................ 202.36.163.201
  Phase1 Mode ......................... IDPROT
  Authentication Type ................. PRESHARED
  Extended Authentication ............. NONE
  Extended Authentication Type ........ -
  Extended Authentication User Name ..... -
  Extended Authentication Password ..... -
  Key Id .............................. 30
  Local RSA key ....................... -
  Peer Certificate Id ................. -
  Phase 2 Exchanges Limit ............. NONE
  PreNegotiate ........................ TRUE
  DOI ................................. IPSEC
  Send Notify Messages ................ TRUE
  Send Delete Messages ................ FALSE
  Always Send ID Messages ............. FALSE
  Commit Bit .......................... FALSE
  Message Retry Limit ................. 5
  Message Time Out .................... 20
  Message Back-off .................... Incremental
  Exchange Delete Delay ............... 30
  Source Interface .................... -
  VPN Client Policy File Name ......... -
  Local ID ............................ -
  Remote ID ........................... IPv4:192.68.1.2
  DebugFlag ........................... 00000000
  Retry IKE Attempts .................. 0
  Current IKE Retries ................. 0
  Required IKE Retry Phase ............ No Phases

SA Specification
  Encryption Algorithm ................ DES - 56 bit
  Hash Algorithm ...................... SHA
  Group Description ................... 1
  DH Private Exponent Bits ............ 767
  Heartbeat Mode ...................... NONE
  Group Type .......................... MODP
  Expiry Seconds ...................... 86400
  Expiry Kilobytes .................... 1000
  NAT Traversal ....................... TRUE
```

Table 48-37: Parameters in output of the **show isakmp policy** command for specific policy

Parameter	Meaning
Name	The manager-assigned name for the ISAKMP policy.
Peer Adresss	The IP address of the peer for this policy, or ANY when the policy is used for remote peers whose IP address is not known at startup.
Phase1 Mode	Whether the phase 1 mode for the policy is IDPROT or AGGR.
Authentication Type	Whether the authentication type for the policy is PRESHARED, RSAENCR, or RSASIG.
Extended Authentication	Whether the extended authentication (XAUTH) role for the router is CLIENT, SERVER, or NONE.

Table 48-37: Parameters in output of the **show isakmp policy** command for specific policy (cont)

Parameter	Meaning
Extended Authentication Type	Whether the type of XAUTH is RADIUS_CHAP or GENERIC.
Extended Authentication User Name	The user name for XAUTH. Used when the router acts as an XAUTH client.
Extended Authentication Password	The password for XAUTH. Used when the router acts as an XAUTH client.
Key Id	The key identification number for the authentication key.
Local RSA key	The ID of the local RSA key used for authentication.
Peer Certificate Id	The ID of the certificate used to authenticate the peer.
Phase 2 Exchanges Limit	Number of phase 2 exchanges allowed before renegotiating a new ISAKMP SA.
PreNegotiate	Whether an ISAKMP SA is to be prenegotiated.
DOI	The Domain of Interpretation for the ISAKMP policy; only IPSEC is supported.
Send Notify Messages	Whether Notify messages are allowed.
Send Delete Messages	Whether Delete messages are allowed.
Always Send ID Messages	Whether ID messages are always sent when an ISAKMP SA is being negotiated.
Commit Bit	Whether the commit bit is set.
Message Retry Limit	Number of retries for each message before the exchange expires.
Message Time Out	Number of seconds before retranmission of the message.
Message Back-off	The back-off pattern used when ISAKMP messages are retransmitted. Either the delay between message retransmissions gets larger (Incremental), or remains the same (None).
Exchange Delete Delay (s)	The delay period in seconds between the completion and the deletion of ISAKMP exchanges notified for this policy.
Source Interface	The source interface the messages are sent to and received from.
VPN Client Policy File Name	Specifies the policy to be sent to remote ISAKMP peers when requested. For this feature to work, the **policyserverenabled** parameter on the **enable isakmp** command must be **true**. This parameter is for the AT-VPN Client Windows software package. For more information on this, see the AT-VPN Client documentation.
Local ID	The ID to be used when identifying the local device: IPv4: followed by an IP address IPv6: followed by an IPv6 address FQDN: followed by a fully-qualified domain name USER_FQDN: followed by a user fully-qualified domain name DN: followed by an X.500 distinguished name

Table 48-37: Parameters in output of the **show isakmp policy** command for specific policy (cont)

Parameter	Meaning
Remote ID	The ID used when identifying the remote device: IPv4: followed by an IP address IPv6: followed by an IPv6 address FQDN: followed by a fully-qualified domain name USER_FQDN: followed by a user fully-qualified domain name DN: followed by an X.500 distinguished name
DebugFlag	A flag indicating the ISAKMP debugging options enabled.
Retry IKE Attempts	Number of consecutive times that IKE attempts to complete an exchange if exchange failures are occurring, either a number from 0 to 16, or "continuous". The value is set using the **retryikeattempts** parameter in the **set isakmp policy** command.
Current IKE Retries	Number of times that IKE has attempted to complete an exchange and has been unsuccessful. This counter is for consecutive attempts and is reset once an exchange is successful. If the exchange is never successfully completed, the number reached remains on this counter.
Required IKE Retry Phases	The phase or phases of IKE negotiation that have failed, and need to be repeated, one of "No Phases", "Phase 1", "Phase 2", or "Phases 1 & 2". "No Phases" indicates that there are no outstanding IKE negotiations.
SA Specification	Information about the Security Association specification for the policy.
Encryption Algorithm	The encryption algorithm to be used by the ISAKMP SAs created by this policy: AES - 128 bit AES - 192 bit AES - 256 bit DES - 56 bit 3DES - 112 bit -outer CBC 3DES - 168 bit -inner CBC
Hash Algorithm	Whether to use SHA or MD5 as the hash algorithm by the ISAKMP SAs created by this policy.
Group Description	Whether the Diffie-Hellman group number is 0, 1, or 2.
DH Private Exponent Bits	The length in bits of the DH private exponent.
Heartbeat Mode	Specifies whether the policy is configured to send or receive ISAKMP heartbeats; either NONE, SEND, RECEIVE, or BOTH.
Group Type	The Diffie-Hellman group type. Only MODP is supported.
Expiry Seconds	The lifetime in seconds for the ISAKMP SAs created by this policy.
Expiry Kilobytes	The maximum number of kilobytes of data that can be processed by the ISAKMP SAs created by this policy.
NAT Traversal	Whether NAT-T is enabled or disabled.

Examples To display a list of all ISAKMP policies, use the command:

```
sh isa pol
```

Related Commands **show isakmp**
show isakmp counters

show isakmp sa

Syntax `SHow ISAkmp SA[=sa-id]`

Description This command displays information about all ISAKMP Security Associations (SA) or a specific SA.

The **sa** parameter specifies the identification number, from 0 to 4294967295, of a ISAKMP Security Association. If *sa-id* is specified, detailed configuration and state information are displayed about the specific SA (Figure 48-43 on page 48-198, Table 48-39 on page 48-199).

If *sa-id* is not specified, summary information is displayed for all ISAKMP Security Associations (Figure 48-42, Table 48-38).

Figure 48-42: Example output from the **show isakmp sa** command

```
SA Id PeerAddress     EncA.  HashA. Bytes                Seconds
-------------------------------------------------------------------------
    1 192.168.1.45    DES    SHA    100000/100000/88     86400/86400/21353
    2 202.124.2.68    DES    MD5    100000/100000/96     86400/86400/17353
```

Table 48-38: Parameters in output of the **show isakmp sa** command

Parameter	Meaning
SA Id	The identification number for the SA.
PeerAddress	The IP address of the peer for this SA.
EncA	The encryption algorithm used by this SA: AES128 AES192 AES256 DES 3DES2KEY 3DESOUTER 3DESINNER
HashA	The hash algorithm used by this SA to authenticate data; either SHA or MD5.
Bytes	The expiry information in bytes. The first value is the hard expiry limit and displays the number of bytes of data that can be processed before the SA is destroyed. The second value is the soft expiry limit and displays the number of bytes of data that can be processed before an attempt is made to negotiate a new SA. The third value is the number of bytes of data already processed.
Seconds	The expiry information in seconds. The first value is the hard expiry limit after which the SA is destroyed. The second value is the soft expiry limit after which an attempt to negotiate a new SA is made. The third value is the number of seconds already used.

Figure 48-43: Example output from the **show isakmp sa** command for a specific SA.

```
 SA Id ................................ 1
  Initiator Cookie ..................... e418dba372510e53
  Responder Cookie ..................... 80c30ff4f2cb3f29
  DOI .................................. IPSEC
  Policy name .......................... main
  State ................................ ACTIVE
  Local address ........................ 202.36.163.161
  Remote Address ....................... 202.36.163.201
  Time of establishment ..............
  Commit bit set ....................... FALSE
  Send notifies ........................ TRUE
  Send deletes ......................... FALSE
  Message Retry Limit .................. 5
  Initial Message Retry Timeout (s) ... 20
  Message Back-off ..................... None
  Exchange Delete Delay (s) ............ 30
  Do Xauth ............................. FALSE
    Xauth Finished ..................... TRUE
  Expiry Limit (bytes) ................. 1024000
  Soft Expiry Limit (bytes) ............ 896000
  Bytes seen ........................... 304
  Expiry Limit (seconds) ............... 86400
  Soft Expiry Limit (seconds) .......... 75600
  Seconds since creation ............... 2117
  Number of Phase 2 exchanges allowed . 4294967295
  Number of acquires queued ............ 0

Sa Definition Information:
  Authentication Type .................. PRESHARED
  Encryption Algorithm ................. DES - 56 bit
  Hash Algorithm ....................... SHA
  group Type ........................... MODP
  group Description .................... MODP768
  DH Private Exponent Bits ............. 767
  expiry seconds ....................... 86400
  expiry kilobytes ..................... 1000
XAuth Information:
  Id ................................... 0
  Next Message ......................... UNKNOWN
  Status ............................... FAIL
  Type ................................. Generic
  Max Failed Attempts .................. 0
  Failed Attempts ...................... 0
NAT-Traversal Information:
  NAT-T enabled ........................ YES
  Peer NAT-T capable ................... YES
  NAT discovered ....................... REMOTE
Heartbeat information:
  Send Heartbeats ...................... NO
  Next sequence number tx .............. 1
  Receive Heartbeats ................... NO
  Last sequence number rx .............. 0
```

Table 48-39: Parameters in output of the **show isakmp sa** command for a specific Security Association

Parameter	Meaning
SA Id	The identification number for the SA.
Initiator Cookie	An 8-byte random number generated by the initiator.
Responder Cookie	An 8-byte random number generated by the responder.
DOI	The domain of interpretation. Currently only IPSEC.
Policy name	The ISAKMP policy name.
State	State of the ISAKMP SA: ACTIVE EXPIRED DOING_NEW_GROUP DOING_XAUTH
Local Address	The local IP address for this SA.
Remote Address	The IP address of the peer for this SA.
Time of establishment	The time when the SA was created.
Commit bit set	Whether exchanges using this SA are committed.
Send notifies	Whether Notify messages are allowed using this SA.
Send deletes	Whether Delete messages are allowed using this SA.
Message Retry Limit	Number of times a message is resent when no reply is received.
Initial Message Retry Timeout(s)	The initial timeout, in seconds, before a message is resent.
Message Back-off	The back-off pattern used when ISAKMP messages are retransmitted. Either the delay between message retransmissions gets larger (Incremental), or remains the same (None).
Exchange Delete Delay (s)	The delay period, in seconds, between the completion and the deletion of ISAKMP exchanges over this SA.
Do Xauth	Whether this SA is authenticated using XAUTH.
Xauth Finished	Whether XAUTH authentication has been completed.
Expiry Limit (bytes)	Number of bytes processed by this SA before it is deleted.
Soft Expiry Limit (bytes)	Number of bytes processed by this SA before it is renegotiated.
Bytes seen	Number of bytes processed by this SA to date.
Expiry Limit (seconds)	Time before this SA is deleted.
Soft Expiry Limit (seconds)	Time before this SA is renegotiated.
Seconds since creation	Number of seconds since this SA was created.
Number of Phase 2 exchanges allowed	The maximum number of phase 2 exchanges allowed over this SA.
Number of acquires queued	Number of IPSEC acquire requests waiting to be processed.
Sa Definition Information	Information about the Security Associations definition
Authentication Type	The authentication method used for this SA.

Table 48-39: Parameters in output of the **show isakmp sa** command for a specific Security Association (cont)

Parameter	Meaning
Encryption Algorithm	The encryption algorithm used by this SA: AES128 AES192 AES256 DES 3DES2KEY 3DESOUTER 3DESINNER
Hash Algorithm	The hash algorithm used by this SA to authenticate data; either SHA or MD5.
group Type	The Diffie-Hellman type used for key exchange; only MODP groups are supported.
group Description	The Diffie-Hellman group identification: MODP512 MODP768 MODP1024 INVALID
DH Private Exponent Bits	The length in bits of the DH private exponent.
expiry seconds	The negotiated expiry seconds for this SA.
expiry kilobytes	The negotiated expiry kilobytes for this SA.
XAuth Information	Information about Extended Authentication
Id	The ID used to identify messages from an XAUTH authentication.
Next Message	Whether the next XAUTH message to be sent is REQ or SET.
Status	Whether XAUTH authentication is okay or has failed.
Type	Whether the type of XAUTH authentication is generic or RADIUS-CHAP.
Max Failed Attempts	The maximum number of failed XAUTH attempts before the SA is deleted.
Failed Attempts	The current number of failed XAUTH attempts.
NAT-Traversal Information	Information about NAT-T capability.
NAT-T enabled	Whether NAT-T is enabled on the router.
Peer NAT-T capable	Whether the remote peer sent a valid NAT-T vendor ID.
NAT discovered	Whether a NAT device has been detected between peers: No - Not detected Remote - Detected at the remote site Local - Detected at this site Both - Local and remote Unknown -The peer is not NAT-T capable or the NAT discovery process is incomplete
Heartbeat Information	Information about ISAKMP heartbeats
Send Heartbeats	Whether the ISAKMP SA is configured to send ISAKMP heartbeats.
Next sequence number tx	Sequence number to be used in the next heartbeats sent.

Table 48-39: Parameters in output of the **show isakmp sa** command for a specific Security Association (cont)

Parameter	Meaning
Receive Heartbeats	Whether the ISAKMP SA is configured to receive ISAKMP heartbeats.
Last sequence number rx	Sequence number received in the last heartbeats.

Examples To display a list of all ISAKMP SAs, use the command:

```
sh isa sa
```

Related Commands **show isakmp counters**
show isakmp exchange

show sa

Syntax `SHow SA[={sa-id|ALL}]`

where *sa-id* is a number from 0 to 255

Description This command displays information about existing Security Associations. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration.

The **sa** parameter specifies the identification number, from 0 to 255, of a Security Association (SA). If *sa-id* is specified, details are displayed about that SA (Figure 48-45 on page 48-203, Table 48-41 on page 48-203). If **all** is specified, detailed information about all SAs is displayed. If no value is specified, a summary of all SAs is displayed (Figure 48-44, Table 48-40).

Figure 48-44: Example output from the **show sa** command

```
Summary SA output

ID   Dir   Expires          SPI  Process
-------------------------------------------------------------
  1  Both  None           1000
```

Table 48-40: Parameters in output of the **show sa** command

Parameter	Meaning
ID	The identification number of the SA.
Dir	Whether the direction of the SA is in, out, or both.
Expires	The expiry date of the SA, if any.
SPI	The Security Parameters Index (SPI) of the SA.
Comp	Whether compression is enabled on this SA.
Encryption/key	The encryption algorithm (either DES-CBC, 3DES-CBC, or NONE) and the identification number of the encryption key used by the SA.

Figure 48-45: Example output from the **show sa** command for a specific SA

```
ID ..................... 1
SPI .................... 1000
User ................... IP
Expiry date ........... None
Direction ............. Both
Compression ........... OFF
Encryption ............ DES-CBC
  Key ID 1 ............ 1
Local members:
  202.36.163.21    255.255.255.255
Remote members:
  192.168.70.2     255.255.255.255

State:
Encode Channel ........ 0
Decode Channel ........ 0
Encode State .......... Attached
Decode State .......... Attached
```

Table 48-41: Parameters in output of the **show sa** command for a specific SA

Parameter	Meaning
ID	The identification number of the SA.
SPI	The Security Parameters Index (SPI) of the SA.
User	The user module attached to this SA.
Expiry date	The expiry date of the SA, if any.
Direction	Whether the direction of the SA is in, out, or both.
Compression	Whether compression is enabled on this SA.
Encryption	The encryption algorithm used by the SA: DES-CBC 3DES-112bit-OuterCBC 3DES-168bit-InnerCBC NONE
Key ID 1	Identification number of the encryption key the SA uses.
Local members	A list of ranges of IP addresses that are local members of the SA.
Remote members	A list of ranges of IP addresses that are remote members of the SA.
State:	The state of the SA's ENCO channels.
Encode Channel	Number of the ENCO encoding channel to which the SA is attached.

Table 48-41: Parameters in output of the **show sa** command for a specific SA (cont)

Parameter	Meaning
Decode Channel	Number of the ENCO decoding channel to which the SA is attached.
Encode State	The state of the ENCO encoding channel: Initial Attaching Attach Fail Attached
Decode State	The state of the ENCO decoding channel: Initial Attaching Attach Fail Attached

Related Commands

create sa
set sa
show sa counter

show sa counter

Syntax `SHow SA[=sa-id] COUnter`

Description This command displays information counters for the Security Association module. This command configures pre-IPsec SA functionality only. It is not used for IPsec or ISAKMP configuration.

The **sa** parameter specifies the identification number, from 0 to 255, of a Security Association (SA). If *sa-id* is specified, counters for the specified Security Association are displayed (Figure 48-47 on page 48-208, Table 48-43 on page 48-208).

If *sa-id* is not specified, summary counters for all Security Associations are displayed (Figure 48-46 on page 48-205, Table 48-42 on page 48-206).

Figure 48-46: Example output from the **show sa counter** command

```
SA Counters
 addrSearchBadIndex          0   addrSearchCacheHit          0
 addrSearchNotExist          0   addUserNotExist             0
 attachBadBPMode             0   attachGood                  0
 attachUserCreateFail        0   callBackBadIndex            0
 callBackNotExist            0   confBadBPMode               0
 confUserNotExist            0   decodeUserNotExist          0
 deletUserNotExist           0   detachGood                  0
 detachUserNotExist          0   encodeUserNotExist          0
 hasAddrDUserNotExist        0   ipAddAlreadyExists          0
 ipAddGood                   2   ipAddUnknownClass           0
 ipDeleteGood                0   ipDeleteNotFound            0
 processUserDecodeCAFailed   0    processUserDecodeNoAddr    0
 processUserDecodeNoSpi      0    processUserEncodeCAFailed  0
 processUserEncodeGood       0   processUserEncodeNoAddr     0
 secAssAddBadIndex           0   secAssAddNotExist           0
 secAssActBadIndex           0   secAssActNotExist           0
 secAssEncoHandBadIndex      0   secAssEncoHandNotExist      0
 secAssCreateAlreadyExist    0   secAssDeleteBadIndex        0
 secAssDeleteNotExist        0   secAssFindSpiFail           0
 secAssDestroyBadIndex       0   secAssDestroyNotExist       0
 secAssDestroyGood           0
 secAssFindSpiGood           0   secAssGetConfigBadIndex     0
 secAssGetConfigNotExist     1   secAssModifyBadIndex        0
 secAssModifyNotExist        0   userAddSecAssBadIndex       0
 userAddSecAssNotExist       0   userCreateGood              0
 userCreateNoSlot            0   userCreateUserExists        0
 userDelSecAssBadIndex       0   userDelSecAssNotExist       0
 userDestroyBadIndex         0   userDestroyGood             0
 userDestroyNotExist         0   userModifyBadIndex          0
 userModifyNotExist          0   userModifyGood              0
```

Table 48-42: Parameters in output of the **show sa counter** command

Parameter	Meaning
addrSearchBadIndex	Number of address searches attempted with an invalid user.
addrSearchCacheHit	Number of address searches a cache hit resolved.
addrSearchNotExist	Number of address searches attempted with an unused user.
addUserNotExist	Number of attempts to add an SA to a user that did not exist.
attachBadBPMode	Number of attach requests received from user modules with a bad BP mode specified.
attachGood	Number of successful attaches from user modules.
attachUserCreateFail	Number of attach requests that failed because the user object could not be created.
callBackBadIndex	Number of user call backs attempted that failed due to an invalid user id.
callBackNotExist	Number of user call backs attempted that failed due to an unused user.
confBadBPMode	Number of configure requests received from user modules with a bad BP mode specified.
confUserNotExist	Number of configure requests received from user modules for an invalid user.
decodeUserNotExist	Number of decode requests received from user modules for an invalid user.
deletUserNotExist	Number of attempts to delete an SA from a user that did not exist.
detachGood	Number of successful detaches by user modules.
detachUserNotExist	Number of detach attempts by user modules that failed because the user did not exist.
encodeUserNotExist	Number of encode requests received from user modules for an invalid user.
hasAddrDUserNotExist	Number of has address searches that failed due to an invalid user.
ipAddAlreadyExists	Number of add IP member requests that failed because the member already existed.
ipAddGood	Number of successful IP member adds.
ipAddUnknownClass	Number of add IP member requests that failed due to an unknown class.
ipDeleteGood	Number of successful IP member deletes.
ipDeleteNotFound	Number of delete IP member requests that failed because the member did not exist.
processUserDecodeCAFailed	Number of user decode requests that failed because an ENCO action failed.
processUserDecodeNoAddr	Number of user decode requests that failed because the address search failed.
processUserDecodeNoSpi	Number of user decode requests that failed because no SPI existed.
processUserEncodeCAFailed	Number of user encode requests that failed because an ENCO action failed.

Table 48-42: Parameters in output of the **show sa counter** command (cont)

Parameter	Meaning
processUserEncodeGood	Number of successful user encode requests.
processUserEncodeNoAddr	Number of user encode requests that failed because the address search failed.
secAssAddBadIndex	Number of attempts to add an SA to a user that failed because the SA was invalid.
secAssAddNotExist	Number of attempts to add an SA to a user that failed because the SA did not exist.
secAssActBadIndex	Number of ENCO actions that failed because the SA was invalid.
secAssActNotExist	Number of ENCO actions that failed because the SA did not exist.
secAssEncoHandBadIndex	Number of ENCO actions returned with an invalid SA.
secAssEncoHandNotExist	Number of ENCO actions returned with an unused SA.
secAssCreateAlreadyExist	Number of create SA operations that failed because the SA already existed.
secAssDeleteBadIndex	Number of delete SA operations that failed because the SA was invalid.
secAssDeleteNotExist	Number of delete SA operations that failed because the SA did not exist.
secAssFindSpiFail	Number of find SPI operations that failed.
secAssDestroyBadIndex	Number of destroy SA operations that failed because the SA was invalid.
secAssDestroyNotExist	Number of destroy SA operations that failed because the SA did not exist.
secAssDestroyGood	Number of successful destroy SA operations.
secAssFindSpiGood	Number of successful find SPI operations.
secAssGetConfigBadIndex	Number of get configuration operations that failed because the SA was invalid.
secAssGetConfigNotExist	Number of get configuration operations that failed because the SA did not exist.
secAssModifyBadIndex	Number of modify SA operations that failed because the SA was invalid.
secAssModifyNotExist	Number of modify SA operations that failed because the SA did not exist.
userAddSecAssBadIndex	Number of add SA operations that failed because the SA was invalid.
userAddSecAssNotExist	Number of add SA operations that failed because the SA did not exist.
userCreateGood	Number of successful create user operations.
userCreateNoSlot	Number of create user operations that failed because there was no spare user slot.
userCreateUserExists	Number of create user operations that failed because the user already existed.
userDelSecAssBadIndex	Number of delete SA operations that failed because the SA was invalid.

Table 48-42: Parameters in output of the **show sa counter** command (cont)

Parameter	Meaning
userDelSecAssNotExist	Number of delete SA operations that failed because the SA did not exist.
userDestroyBadIndex	Number of destroy user operations that failed because the SA was invalid.
userDestroyGood	Number of successful destroy user operations.
userDestroyNotExist	Number of destroy user operations that failed because the SA did not exist.
userModifyBadIndex	Number of modify user operations that failed because the SA did not exist.
userModifyNotExist	Number of modify user operations that failed because the SA was invalid.
userModifyGood	Number of successful modify user operations.

Figure 48-47: Example output from the **show sa counter** command for a specific SA.

```
addAlreadyExist              0   addGood                    0
addUserNotExist              0   deleteAlreadyIndex         0
deleteGood                   0   getConfigGood              0
encoCreateDAttachDead        0   encoCreateDAttachFail      1
encoCreateDAttachGood        0   encoCreateEAttachDead      0
encoCreateEAttachFail        1   encoCreateEAttachGood      0
encoModifyDReconfDead        0   encoModifyDReconfFail      0
encoModifyDReconfGood        0   encoModifyEReconfDead      0
encoModifyEReconfFail        0   encoModifyEReconfGood      0
encoActDecode                0   encoActDecodeNotAttached   0
encoActEncode                0   encoActEncodeNotAttached   0
encoActUnknownType           0   encoHandUnknownEvent       0
encoHandEncodeConfigured     0   encoHandEncodeConfigFail   1
encoHandEncodeChanAttached   0   encoHandEncodeDetached      0
encoHandEncoded              0   encoHandEncodeFail         0
encoHandDecodeConfigured     0   encoHandDecodeConfigFail   1
encoHandEncodeDiscard        0   encoHandDecodeDiscard      0
encoHandDecodeChanAttached   0   encoHandDecodeDetached      0
encoHandDecoded              0   encoHandDecodeFail         0
```

Table 48-43: Parameters in output of the **show sa counter command** for a specific SA

Parameter	Meaning
addAlreadyExist	Number of requests to add a member to an SA that failed because the member already existed.
addGood	Number of successful requests to add a member to an SA.
addUserNotExist	Number of requests to add a user to an SA that failed because the user did not exist.
deleteAlreadyIndex	Number of delete member requests that failed because the member did not exist.
deleteGood	Number of successful delete member requests.
getConfigGood	Number of successful get configuration operations.

Table 48-43: Parameters in output of the **show sa counter command** for a specific SA (cont)

Parameter	Meaning
encoCreateDAttachDead	Number of dead events detected while attaching a decoding channel to the ENCO module.
encoCreateDAttachFail	Number of unsuccessful attempts to attach a decoding channel to the ENCO module.
encoCreateDAttachGood	Number of successful attempts to attach a decoding channel to the ENCO module.
encoCreateEAttachDead	Number of dead events detected while attaching a encoding channel to the ENCO module.
encoCreateEAttachFail	Number of unsuccessful attempts to attach a encoding channel to the ENCO module.
encoCreateEAttachGood	Number of successful attempts to attach a encoding channel to the ENCO module.
encoModifyDReconfDead	Number of dead events detected while modifying a decoding channel to the ENCO module.
encoModifyDReconfFail	Number of unsuccessful attempts to modify a decoding channel to the ENCO module.
encoModifyDReconfGood	Number of successful attempts to modify a decoding channel to the ENCO module.
encoModifyEReconfDead	Number of dead events detected while modifying a encoding channel to the ENCO module.
encoModifyEReconfFail	Number of unsuccessful attempts to modify a encoding channel to the ENCO module.
encoModifyEReconfGood	Number of successful attempts to modify a encoding channel to the ENCO module.
encoActDecode	Number of decode ENCO actions sent.
encoActDecodeNotAttached	Number of decode ENCO actions not sent because the SA was not attached to the ENCO module.
encoActEncode	Number of encode ENCO actions sent.
encoActEncodeNotAttached	Number of encode ENCO actions not sent because the SA was not attached to the ENCO module.
encoActUnknownType	Number of unknown ENCO actions sent.
encoHandUnknownEvent	Number of unknown actions returned from the ENCO module.
encoHandEncodeConfigured	Number of good encode channel configure ENCO actions.
encoHandEncodeConfigFail	Number of bad encode channel attach ENCO actions.
encoHandEncodeChanAttached	Number of good encode channel attach ENCO actions.
encoHandEncodeDetached	Number of good encode channel detach ENCO actions.
encoHandEncoded	Number of good encode ENCO actions.
encoHandEncodeFail	Number of bad encode ENCO actions.
encoHandDecodeConfigured	Number of good decode channel configure ENCO actions.
encoHandDecodeConfigFail	Number of decode channel attach ENCO actions.
encoHandEncodeDiscard	Number of destroy encode ENCO actions.

Table 48-43: Parameters in output of the **show sa counter command** for a specific SA (cont)

Parameter	Meaning
encoHandDecodeDiscard	Number of destroy decode ENCO actions.
encoHandDecodeChanAttached	Number of good decode channel attach ENCO actions.
encoHandDecodeDetached	Number of good decode channel detach ENCO actions.
encoHandDecoded	Number of good decode ENCO actions.
encoHandDecodeFail	Number of bad decode ENCO actions.

Related Commands

create sa
set sa
show sa

show sa user

Syntax `SHow SA USER`

Description This command displays information counters about user objects of the Security Association (SA) module (Figure 48-48, Table 48-44).

This command configures pre-IPsec old functionality only. It is not used for IPsec or ISAKMP configuration.

Figure 48-48: Example output from the **show sa user** command

```
IP User:    1
 addGood                    1   addrSearchFail             2
 addrSearchGood             0   addSecAssNotExist          0
 callBackBlock              0   callBackDecode             0
 callBackDecoded            0   callBackDecodeFail         0
 callBackEncode             0   callBackEncoded            0
 callBackEncodeFail         0   callBackIndFailed          0
 callBackUnknownType        0   decodeNoAddress            0
 decodeNoBuffer             0
 decodeReceiveGood          0   deleteGood                 0
 deleteSecAssNotExist       0   encodeNoAddress            0
 encodeNoBuffer             0   hasAddrDNoAddress          0
 addSecAssAlreadyPresent    0   addSecAssGood              1
 addSecAssNotExistSecAss    0   delSecAssAlreadyPresent    0
 delSecAssGood              0   encodeReceiveGood          0
```

Table 48-44: Parameters in output of the **show sa user** command

Parameter	Meaning
addGood	Number of good add user requests.
addrSearchFail	Number of unsuccessful address searches.
addrSearchGood	Number of successful address searches.
addSecAssNotExist	Number of requests to add a SA to the user that failed because the SA did not exist.
callBackBlock	Number of user packets that were blocked.
callBackDecode	Number of packets received to decode.
callBackDecoded	Number of packets successfully decoded.
callBackDecodeFail	Number of packets unsuccessfully decoded.
callBackEncode	Number of packets received to encode.
callBackEncoded	Number of packets successfully encoded.
callBackEncodeFail	Number of packets unsuccessfully encoded.
callBackIndFailed	Number of user operations that failed.
callBackUnknownType	Number of unknown user call back events.
decodeNoAddress	Number of decode packet requests received from the user with no address.
decodeNoBuffer	Number of decode packet requests received from the user with no buffer.
decodeReceiveGood	Number of good decode packet requests received from the user.

Table 48-44: Parameters in output of the **show sa user** command (cont)

Parameter	Meaning
deleteGood	Number of good delete requests.
deleteSecAssNotExist	Number of requests to delete an SA from the user that failed because the SA did not exist.
encodeNoAddress	Number of encode packet requests received from the user with no address.
encodeNoBuffer	Number of encode packet requests received from the user with no buffer.
hasAddrDNoAddress	Number of has address operations that failed.
addSecAssAlreadyPresent	Number of add SA requests that failed because the SA was already present.
addSecAssGood	Number of good add SA requests received from the user.
addSecAssNotExistSecAss	Number of add SA requests that failed because the SA did not exist.
delSecAssAlreadyPresent	Number of delete SA requests that failed because the SA was not already present.
delSecAssGood	Number of good delete SA requests received from the user.
encodeReceiveGood	Number of good encode packet requests received from the user.

Related Commands

create sa
set sa
show sa
show sa counter