Konfiguration von IPSec Router-to-Router Hub and Spoke mit Kommunikation zwischen den Spokes

Inhalt

Einführung

Diese Beispielkonfiguration zeigt ein Hub-and-Spoke-IPsec-Design zwischen drei Routern. Diese Konfiguration unterscheidet sich von anderen Hub-and-Spoke-Konfigurationen, da in diesem Beispiel die Kommunikation zwischen den Spoke-Standorten durch den Hub aktiviert wird. Mit anderen Worten, es gibt keinen direkten IPsec-Tunnel zwischen den beiden Spoke-Routern. Alle Pakete werden über den Tunnel an den Hub-Router gesendet, wo er sie über den IPsec-Tunnel verteilt, der mit dem anderen Spoke-Router gemeinsam genutzt wird. Diese Konfiguration ist als Ergebnis der Lösung für die Cisco Bug ID CSCdp09904 möglich (nur registrierte Kunden). Diese Korrektur wurde in die Cisco IOS® Software-Version 12.2(5) integriert. Diese Version ist die Mindestanforderung für diese Konfiguration.

Informationen zum Konfigurieren des GRE-Tunnels (Generic Routing Encapsulation) über IPSec mit OSPF finden Sie unter Konfigurieren eines GRE-Tunnels über IPSec mit OSPF.

Informationen zum Konfigurieren der grundlegenden Cisco IOS® Firewall-Konfiguration auf einem GRE-Tunnel mit Network Address Translation (NAT) finden Sie unter Konfigurieren von Router-zu-Router IPSec (Pre-shared Keys) auf GRE-Tunnel mit IOS-Firewall und NAT.

Voraussetzungen

Anforderungen

Dieses Dokument erfordert ein grundlegendes Verständnis des IPsec-Protokolls. Weitere Informationen zu IPsec finden Sie unter Einführung in die IP-Sicherheit (IPSec)-Verschlüsselung.

Dieses Dokument soll sicherstellen, dass die Verschlüsselung zwischen diesen Routern erfolgt:

- 172.16.1.0/24 (Spoke 1) bis 10.1.1.0/24 (Hub)
- 192.168.1.0/24 (Spoke 2) bis 10.1.1.0/24 (Hub)
- 172.16.1.0/24 (Spoke 1) bis 192.168.1.0/24 (Spoke 2)

Verwendete Komponenten

Die Informationen in diesem Dokument basieren auf diesen Software- und Hardwareversionen.

- Cisco IOS Softwareversion 12.2(24a) (c2500-ik8s-l.122-24a.bin)
- Cisco Router der Serie 2500

Die Informationen in diesem Dokument wurden von den Geräten in einer bestimmten Laborumgebung erstellt. Alle in diesem Dokument verwendeten Geräte haben mit einer leeren (Standard-)Konfiguration begonnen. Wenn Ihr Netzwerk in Betrieb ist, stellen Sie sicher, dass Sie die potenziellen Auswirkungen eines Befehls verstehen.

Konventionen

Weitere Informationen zu Dokumentkonventionen finden Sie unter Cisco Technical Tips Conventions (Technische Tipps zu Konventionen von Cisco).

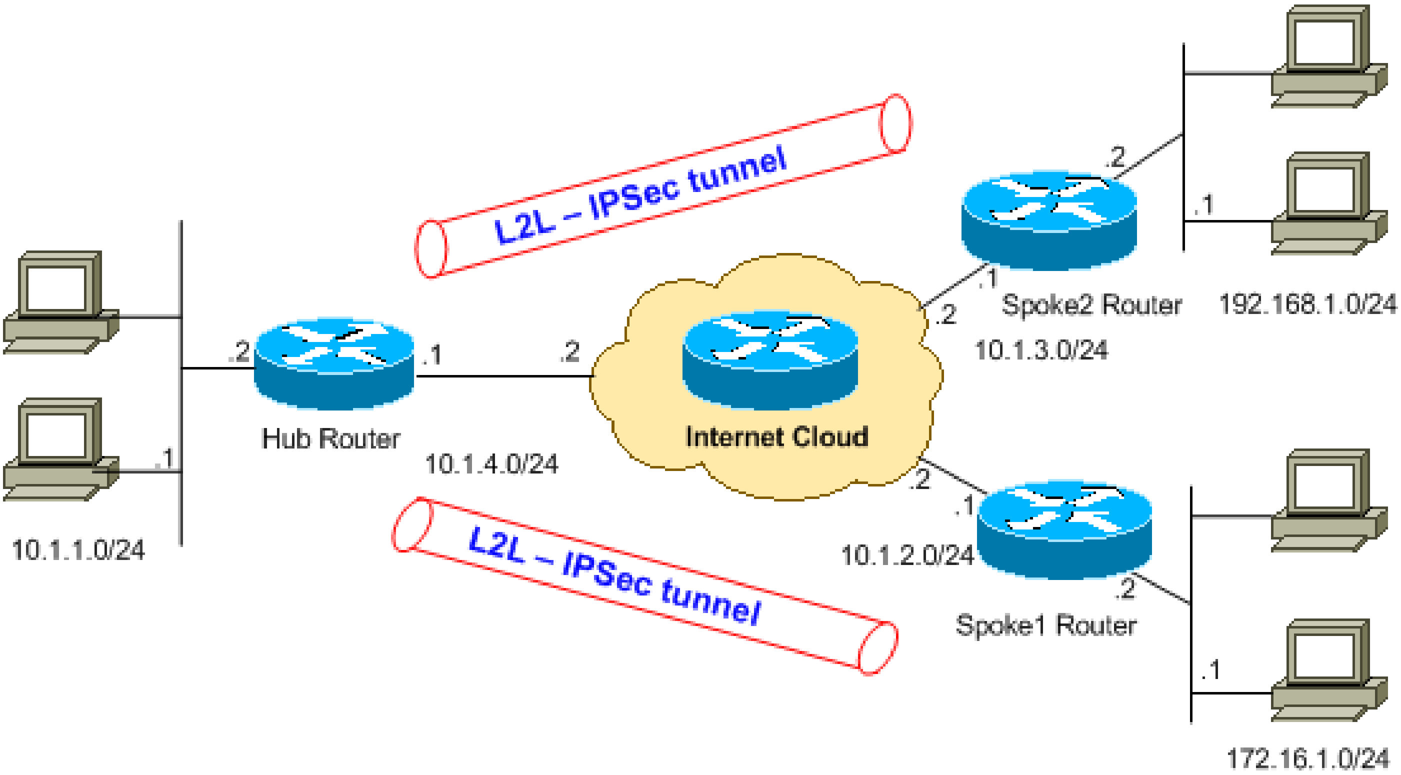
Konfigurieren

In diesem Abschnitt erhalten Sie Informationen zum Konfigurieren der in diesem Dokument beschriebenen Funktionen.

Hinweis: Verwenden Sie das Command Lookup Tool (nur registrierte Kunden), um weitere Informationen zu den in diesem Dokument verwendeten Befehlen zu erhalten.

Netzwerkdiagramm

In diesem Dokument wird die in diesem Diagramm dargestellte Netzwerkeinrichtung verwendet.



Hinweis: Die in dieser Konfiguration verwendeten IP-Adressierungsschemata sind im Internet nicht rechtlich routbar. Sie sind RFC 1918 -Adressen, die in einer Laborumgebung verwendet werden.

Konfigurationen

In diesem Dokument werden diese Konfigurationen verwendet.

Der **Befehl** **show running-config** zeigt die aktuelle Konfiguration auf dem Router an.

- Hub-Router
- Spoke-1-Router
- Spoke-2-Router

Hub-Router

```
Hub#show running-config
Building configuration...
Current configuration : 1466 bytes
!
version 12.2

service timestamps debug datetime msec
service timestamps log uptime
no service password-encryption
!
hostname Hub
!



!
ip subnet-zero
!

!
```

```
!--- Configuration for IKE policies. crypto isakmp
policy 10
!--- Enables the IKE policy configuration (config-
isakmp) !--- command mode, where you can specify the
parameters that !--- are used during an IKE negotiation.
hash md5
authentication pre-share
crypto isakmp key cisco123 address 10.1.2.1
crypto isakmp key cisco123 address 10.1.3.1
!--- Specifies the preshared key "cisco123" which should
!--- be identical at both peers. This is a global !---
configuration mode command. ! !--- Configuration for
IPsec policies. crypto ipsec transform-set myset esp-des
esp-md5-hmac
!--- Enables the crypto transform configuration mode, !-
-- where you can specify the transform sets that are
used !--- during an IPsec negotiation. ! crypto map
mymap 10 ipsec-isakmp
!--- Indicates that IKE is used to establish !--- the
IPsec security association for protecting the !---
traffic specified by this crypto map entry. set peer
10.1.2.1
!--- Sets the IP address of the remote end. set
transform-set myset
!--- Configures IPsec to use the transform-set !---
"myset" defined earlier in this configuration. match
address 110
!--- Specifies the traffic to be encrypted. crypto map
mymap 20 ipsec-isakmp
set peer 10.1.3.1
set transform-set myset
match address 120
!
!
!
!
interface Ethernet0
ip address 10.1.1.1 255.255.255.0
!
interface Ethernet1
ip address 10.1.4.1 255.255.255.0
no ip route-cache
!--- You must enable process switching for IPsec !--- to
encrypt outgoing packets. This command disables fast
switching. no ip mroute-cache crypto map mymap
!--- Configures the interface to use the !--- crypto map
"mymap" for IPsec. ! !--- Output suppressed. ip
classless ip route 172.16.1.0 255.255.255.0 Ethernet1
ip route 192.168.1.0 255.255.255.0 Ethernet1
ip route 10.1.0.0 255.255.0.0 Ethernet1
ip http server

!
access-list 110 permit ip 10.1.1.0 0.0.0.255 172.16.1.0
0.0.0.255
access-list 110 permit ip 192.168.1.0 0.0.0.255
172.16.1.0 0.0.0.255
access-list 120 permit ip 10.1.1.0 0.0.0.255 192.168.1.0
0.0.0.255
access-list 120 permit ip 172.16.1.0 0.0.0.255
192.168.1.0 0.0.0.255
!--- This crypto ACL-permit identifies the !--- matching
traffic flows to be protected via encryption.
```

Spoke-1-Router

```
Spoke1#show running-config
Building configuration...
Current configuration : 1203 bytes
!
version 12.2

service timestamps debug datetime msec
service timestamps log uptime
no service password-encryption
!
hostname Spoke1
!
enable secret 5 $1$DOX3$rIrxEnTVTw/7LNbxi.akz0

!
ip subnet-zero
no ip domain-lookup
!

!
crypto isakmp policy 10
hash md5
authentication pre-share
crypto isakmp key cisco123 address 10.1.4.1
!
!
crypto ipsec transform-set myset esp-des esp-md5-hmac
!
crypto map mymap 10 ipsec-isakmp
set peer 10.1.4.1
set transform-set myset
match address 110
!
!
!
!
interface Ethernet0
ip address 172.16.1.1 255.255.255.0
!
interface Ethernet1
ip address 10.1.2.1 255.255.255.0
no ip route-cache
no ip mroute-cache
crypto map mymap
!

.
.
!--- Output suppressed. . . ip classless
ip route 192.168.1.0 255.255.255.0 Ethernet1
ip route 10.1.0.0 255.255.0.0 Ethernet1
no ip http server

!
access-list 110 permit ip 172.16.1.0 0.0.0.255 10.1.1.0
0.0.0.255
access-list 110 permit ip 172.16.1.0 0.0.0.255
192.168.1.0 0.0.0.255
!

end
```

```
2509a#
```

Spoke-2-Router

```

Spoke2#show running-config
Building configuration...
Current configuration : 1117 bytes
!
version 12.2

service timestamps debug datetime msec
service timestamps log uptime
service password-encryption
!
hostname Spoke2
!

!
ip subnet-zero
no ip domain-lookup
!

!
crypto isakmp policy 10
hash md5
authentication pre-share
crypto isakmp key cisco123 address 10.1.4.1
!
!
crypto ipsec transform-set myset esp-des esp-md5-hmac
!
crypto map mymap 10 ipsec-isakmp
set peer 10.1.4.1
set transform-set myset
match address 120
!
!
!
!
interface Ethernet0
ip address 192.168.1.1 255.255.255.0
!
interface Ethernet1
ip address 10.1.3.1 255.255.255.0
!--- No ip route-cache. no ip mroute-cache crypto map
mymap
!


.
.
!--- Output suppressed. . . ip classless
ip route 172.16.0.0 255.255.0.0 Ethernet1
ip route 10.1.0.0 255.255.0.0 Ethernet1
no ip http server

!
access-list 120 permit ip 192.168.1.0 0.0.0.255
172.16.1.0 0.0.0.255
access-list 120 permit ip 192.168.1.0 0.0.0.255 10.1.1.0
0.0.0.255
!

end
```

```
VPN2509#
```

Hinzufügen eines weiteren Spokes

Wenn Sie neben Spoke1 und Spoke2 dem vorhandenen Hub-Router einen weiteren Spoke-Router (Spoke3) hinzufügen müssen, ist lediglich die Erstellung eines neuen LAN-to-LAN (L2L)-Tunnels vom Hub zu Spoke3 erforderlich. Da jedoch nur eine Crypto Map pro physischer Schnittstelle konfiguriert werden kann, müssen Sie beim Hinzufügen dieses Tunnels denselben Namen für die Crypto Map verwenden. Dies ist möglich, wenn Sie für jeden Remote-Standort unterschiedliche Leitungsnummern verwenden.

Hinweis: Möglicherweise muss die Crypto Map entfernt und bei Hinzufügen des neuen Tunneleintrags erneut auf die Schnittstelle angewendet werden. Wenn die Crypto Map entfernt wird, werden alle aktiven Tunnel gelöscht.

Hub-Router

```

Hub#show running-config
Building configuration...
Current configuration : 1466 bytes
!
version 12.2

service timestamps debug datetime msec
service timestamps log uptime
no service password-encryption
!
hostname Hub
!



!
ip subnet-zero
!

!
crypto isakmp policy 10

hash md5
authentication pre-share
crypto isakmp key cisco123 address 10.1.2.1
crypto isakmp key cisco123 address 10.1.3.1
crypto isakmp key cisco123 address 10.1.5.1
!

crypto ipsec transform-set myset esp-des esp-md5-hmac
!
crypto map mymap 10 ipsec-isakmp
set peer 10.1.2.1
set transform-set myset
match address 110

crypto map mymap 20 ipsec-isakmp
set peer 10.1.3.1
set transform-set myset
match address 120

!--- It is important to specify crypto map line number
30 for !--- the Spoke 3 router with the same crypto map
```

```
name "mymap" crypto map mymap 30 ipsec-isakmp
set peer 10.1.5.1
set transform-set myset
match address 130
!
!
!
!
interface Ethernet0
ip address 10.1.1.1 255.255.255.0
!
interface Ethernet1
ip address 10.1.4.1 255.255.255.0
no ip route-cache
no ip mroute-cache

!--- It is important to remove and re-apply the crypto
!--- map to this interface if it is used for the
termination of other !--- spoke VPN tunnels. crypto map
mymap
!

!--- Output suppressed. ip classless ip route 172.16.1.0
255.255.255.0 Ethernet1 ip route 192.168.1.0
255.255.255.0 Ethernet1 ip route 10.1.0.0 255.255.0.0
Ethernet1 ip route 172.16.2.0 255.255.255.0 Ethernet1 ip
http server ! access-list 110 permit ip 10.1.1.0
0.0.0.255 172.16.1.0 0.0.0.255 access-list 110 permit ip
192.168.1.0 0.0.0.255 172.16.1.0 0.0.0.255 access-list
110 permit ip 172.16.2.0 0.0.0.255 172.16.1.0 0.0.0.255
access-list 120 permit ip 10.1.1.0 0.0.0.255 192.168.1.0
0.0.0.255 access-list 120 permit ip 172.16.2.0 0.0.0.255
192.168.1.0 0.0.0.255 access-list 120 permit ip
172.16.1.0 0.0.0.255 192.168.1.0 0.0.0.255 access-list
130 permit ip 10.1.1.0 0.0.0.255 172.16.2.0 0.0.0.255
access-list 130 permit ip 192.168.1.0 0.0.0.255
172.16.2.0 0.0.0.255
access-list 130 permit ip 172.16.1.0 0.0.0.255
172.16.2.0 0.0.0.255
```

Spoke-3-Router

```
Spoke3#show running-config
Building configuration...
Current configuration : 1117 bytes
!
version 12.2

service timestamps debug datetime msec
service timestamps log uptime
service password-encryption
!
hostname Spoke3
!

!
ip subnet-zero
no ip domain-lookup
!

!
crypto isakmp policy 10
hash md5
```

```
authentication pre-share
crypto isakmp key cisco123 address 10.1.4.1
!
!
crypto ipsec transform-set myset esp-des esp-md5-hmac
!
crypto map mymap 10 ipsec-isakmp
set peer 10.1.4.1
set transform-set myset
match address 130
!
!
!
!
interface Ethernet0
ip address 172.16.2.1 255.255.255.0
!
interface Ethernet1
ip address 10.1.5.1 255.255.255.0
no ip mroute-cache
crypto map mymap
!

.
.
!--- Output suppressed. . . ip classless
ip route 172.16.0.0 255.255.0.0 Ethernet1
ip route 10.1.0.0 255.255.0.0 Ethernet1
no ip http server

!
access-list 130 permit ip 172.168.2.0 0.0.0.255
172.16.1.0 0.0.0.255
access-list 130 permit ip 172.168.2.0 0.0.0.255 10.1.1.0
0.0.0.255
access-list 130 permit ip 172.168.2.0 0.0.0.255
192.168.1.0 0.0.0.255
!

end
VPN2509#
```

Überprüfen

In diesem Abschnitt überprüfen Sie, ob Ihre Konfiguration ordnungsgemäß funktioniert.

Das Output Interpreter Tool (nur registrierte Kunden) (OIT) unterstützt bestimmte **show**-Befehle. Verwenden Sie das OIT, um eine Analyse der **Ausgabe des** Befehls **show anzuzeigen**.

Um diese Konfiguration zu überprüfen, versuchen Sie einen erweiterten Ping-**Befehl, der von der Ethernet1-Schnittstellenadresse auf Spoke 1 stammt und für die Ethernet1-Schnittstellenadresse in Spoke 2 bestimmt ist.**

- **Ping** - Dient zur Diagnose grundlegender Netzwerkverbindungen.

```
Spoke1#ping
Protocol [ip]:
Target IP address: 192.168.1.1
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
```

```
Extended commands [n]: y
Source address or interface: 172.16.1.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 64/64/68 ms
```

- show crypto ipsec sa: Zeigt die Einstellungen an, die von aktuellen (IPSec) Sicherheitszuordnungen (SAs) verwendet werden.
- show crypto isakmp sa**: Zeigt alle aktuellen IKE-SAs in einem Peer an.**
- show crypto engine **connections** - Zeigt die Anzahl der Pakete an, die über jede IPSec SA übertragen werden.

Beispielausgabe

Diese Ausgabe stammt aus dem Befehl **show crypto engine connections active**, der auf dem Hub-Router ausgegeben wird.

```
Hub#show crypto engine connections active

ID Interface IP-Address State Algorithm Encrypt Decrypt
5 Ethernet0 10.1.4.1 set HMAC_MD5+DES_56_CB 0 0
6 <none> <none>  set HMAC_MD5+DES_56_CB 0 0
2000 Ethernet0 10.1.4.1 set HMAC_MD5+DES_56_CB 0 10
2001 Ethernet0 10.1.4.1 set HMAC_MD5+DES_56_CB 10 0
2002 Ethernet0 10.1.4.1 set HMAC_MD5+DES_56_CB 0 10
2003 Ethernet0 10.1.4.1 set HMAC_MD5+DES_56_CB 10 0
```

In diesem Beispiel sehen Sie, dass jeder Tunnel 10 Pakete verschlüsselt und entschlüsselt hat, was beweist, dass der Datenverkehr über den Hub-Router geleitet wurde.

Hinweis: Für jeden Peer werden zwei IPsec-SAs erstellt (einer in jede Richtung). Im Hub-Router sind beispielsweise vier IPsec-SAs für zwei Peers erstellt.

Fehlerbehebung

Dieser Abschnitt enthält Informationen zur Fehlerbehebung in Ihrer Konfiguration.

Befehle zur Fehlerbehebung

Hinweis: Beachten Sie vor der Verwendung von **Debug-**Befehlen die Informationen zu Debug-Befehlen.

- debug crypto ipsec - Zeigt die IPsec-Aushandlungen für Phase 2.
- debug crypto isakmp - Zeigt die ISAKMP-Verhandlungen für Phase 1.
- debug crypto engine - Zeigt den verschlüsselten Datenverkehr an.
- clear crypto isakmp: Löscht die SAs für Phase 1.
- clear crypto sa: Löscht die SAs für Phase 2.

Beispielausgabe für Debugging

Dies ist die Hub-Router-Ausgabe aus den **Debug-Krypto-ipsec-** und **Debug-Crypto isakmp-** Befehlen.

```
*Mar  1 00:03:46.887: ISAKMP (0:0): received packet
  from 10.1.2.1 (N) NEW SA
*Mar  1 00:03:46.887: ISAKMP: local port 500, remote port 500
*Mar  1 00:03:46.899: ISAKMP (0:1): processing SA payload. message ID = 0
*Mar  1 00:03:46.899: ISAKMP (0:1): found peer pre-shared key matching 10.1.2.1
*Mar  1 00:03:46.903: ISAKMP (0:1): Checking ISAKMP transform 1 against priority
 10 policy
*Mar  1 00:03:46.903: ISAKMP:      encryption DES-CBC
*Mar  1 00:03:46.907: ISAKMP:      hash MD5
*Mar  1 00:03:46.907: ISAKMP:      default group 1
*Mar  1 00:03:46.911: ISAKMP:      auth pre-share
*Mar  1 00:03:46.911: ISAKMP:      life type in seconds
*Mar  1 00:03:46.911: ISAKMP:      life duration (VPI) of  0x0 0x1 0x51 0x80
*Mar  1 00:03:46.915: ISAKMP (0:1): atts are acceptable. Next payload is 0
!--- The initial IKE parameters have been !--- successfully exchanged between Spoke 1 and Hub.
*Mar 1 00:03:48.367: ISAKMP (0:1): SA is doing pre-shared key authentication using id type
ID_IPV4_ADDR *Mar 1 00:03:48.371: ISAKMP (0:1): sending packet to 10.1.2.1 (R) MM_SA_SETUP *Mar
1 00:03:56.895: ISAKMP (0:1): received packet from 10.1.2.1 (R) MM_SA_SETUP *Mar 1 00:03:56.899:
ISAKMP (0:1): phase 1 packet is a duplicate of a previous packet. *Mar 1 00:03:56.899: ISAKMP
(0:1): retransmitting due to retransmit phase 1 *Mar 1 00:03:56.903: ISAKMP (0:1):
retransmitting phase 1 MM_SA_SETUP... *Mar 1 00:03:57.403: ISAKMP (0:1): retransmitting phase 1
MM_SA_SETUP... *Mar 1 00:03:57.403: ISAKMP (0:1): incrementing error counter on sa: retransmit
phase 1 *Mar 1 00:03:57.407: ISAKMP (0:1): retransmitting phase 1 MM_SA_SETUP *Mar 1
00:03:57.407: ISAKMP (0:1): sending packet to 10.1.2.1 (R) MM_SA_SETUP *Mar 1 00:03:58.923:
ISAKMP (0:1): received packet from 10.1.2.1 (R) MM_SA_SET UP *Mar 1 00:03:58.931: ISAKMP (0:1):
processing KE payload. message ID = 0 *Mar 1 00:04:00.775: ISAKMP (0:1): processing NONCE
payload. message ID = 0 *Mar 1 00:04:00.783: ISAKMP (0:1): found peer pre-shared key matching
10.1.2.1 *Mar 1 00:04:00.795: ISAKMP (0:1): SKEYID state generated *Mar 1 00:04:00.799: ISAKMP
(0:1): processing vendor id payload *Mar 1 00:04:00.803: ISAKMP (0:1): speaking to another IOS
box! *Mar 1 00:04:00.811: ISAKMP (0:1): sending packet to 10.1.2.1 (R) MM_KEY_EXCH *Mar 1
00:04:02.751: ISAKMP (0:1): received packet from 10.1.2.1 (R) MM_KEY_EXCH *Mar 1 00:04:02.759:
ISAKMP (0:1): processing ID payload. message ID = 0 *Mar 1 00:04:02.759: ISAKMP (0:1):
processing HASH payload. message ID = 0 *Mar 1 00:04:02.767: ISAKMP (0:1): SA has been
authenticated with 10.1.2.1 *Mar 1 00:04:02.771: ISAKMP (1): ID payload next-payload : 8 type :
1 protocol : 17 port : 500 length : 8 *Mar 1 00:04:02.775: ISAKMP (1): Total payload length: 12
*Mar 1 00:04:02.783: ISAKMP (0:1): sending packet to 10.1.2.1 (R) QM_IDLE *Mar 1 00:04:02.871:
ISAKMP (0:1): received packet from 10.1.2.1 (R) QM_IDLE
!--- IKE phase 1 SA has been sucessfully negotiated !--- between Spoke 1 and Hub. *Mar 1
00:04:02.891: ISAKMP (0:1): processing HASH payload. message ID = 581713929 *Mar 1 00:04:02.891:
ISAKMP (0:1): processing SA payload. message ID = 581713929 *Mar 1 00:04:02.895: ISAKMP (0:1):
Checking IPSec proposal 1
!--- IKE exchanges IPsec phase 2 parameters !--- between Spoke 1 and Hub. *Mar 1 00:04:02.895:
ISAKMP: transform 1, ESP_DES *Mar 1 00:04:02.899: ISAKMP: attributes in transform: *Mar 1
00:04:02.899: ISAKMP: encaps is 1 *Mar 1 00:04:02.899: ISAKMP: SA life type in seconds *Mar 1
00:04:02.903: ISAKMP: SA life duration (basic) of 3600 *Mar 1 00:04:02.903: ISAKMP: SA life type
in kilobytes *Mar 1 00:04:02.907: ISAKMP: SA life duration (VPI) of 0x0 0x46 0x50 0x0 *Mar 1
00:04:02.911: ISAKMP: authenticator is HMAC-MD5 *Mar 1 00:04:02.915: ISAKMP (0:1): atts are
acceptable.
!--- IPsec phase 2 parameters have been !--- successfully exchanged between Spoke 1 and Hub.
*Mar 1 00:04:02.915: IPSEC(validate_proposal_request): proposal part #1, (key eng. msg.) INBOUND
local= 10.1.4.1, remote= 10.1.2.1, local_proxy= 192.168.1.0/255.255.255.0/0/0 (type=4),
remote_proxy= 172.16.1.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-
hmac , lifedur= 0s and 0kb, spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4 *Mar 1 00:04:02.931:
ISAKMP (0:1): processing NONCE payload. message ID = 581713929 *Mar 1 00:04:02.935: ISAKMP
(0:1): processing ID payload. message ID = 581713929 *Mar 1 00:04:02.935: ISAKMP (0:1):
processing ID payload. message ID = 581713929 *Mar 1 00:04:02.939: ISAKMP (0:1): asking for 1
```

```
spis from ipsec *Mar 1 00:04:02.943: IPSEC(key_engine): got a queue event... *Mar 1
00:04:02.951: IPSEC(spi_response): getting spi 4208568169 for SA from 10.1.4.1 to 10.1.2.1 for
prot 3 *Mar 1 00:04:02.955: ISAKMP: received ke message (2/1) *Mar 1 00:04:03.207: ISAKMP (0:1):
sending packet to 10.1.2.1 (R) QM_IDLE *Mar 1 00:04:03.351: ISAKMP (0:1): received packet from
10.1.2.1 (R) QM_IDLE *Mar 1 00:04:03.387: ISAKMP (0:1): Creating IPSec SAs *Mar 1 00:04:03.387:
inbound SA from 10.1.2.1 to 10.1.4.1 (proxy 172.16.1.0 to 192.168.1.0) *Mar 1 00:04:03.391: has
spi 0xFAD9A769 and conn_id 2000 and flags 4 *Mar 1 00:04:03.395: lifetime of 3600 seconds *Mar 1
00:04:03.395: lifetime of 4608000 kilobytes *Mar 1 00:04:03.399: outbound SA from 10.1.4.1 to
10.1.2.1 (proxy 192.168.1.0 to 172.16.1.0 ) *Mar 1 00:04:03.403: has spi -732960388 and conn_id
2001 and flags C *Mar 1 00:04:03.407: lifetime of 3600 seconds *Mar 1 00:04:03.407: lifetime of
4608000 kilobytes *Mar 1 00:04:03.411: ISAKMP (0:1): deleting node 581713929 error FALSE reason
" quick mode done (await()" *Mar 1 00:04:03.415: IPSEC(key_engine): got a queue event... *Mar 1
00:04:03.415: IPSEC(initialize_sas): , (key eng. msg.) INBOUND local= 10.1.4.1, remote=
10.1.2.1, local_proxy= 192.168.1.0/255.255.255.0/0/0 (type=4), remote_proxy=
172.16.1.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-hmac , lifedur=
3600s and 4608000kb, spi= 0xFAD9A769(4208568169), conn_id= 2000, keysize= 0, flags= 0x4 *Mar 1
00:04:03.427: IPSEC(initialize_sas): , (key eng. msg.) OUTBOUND local= 10.1.4.1, remote=
10.1.2.1, local_proxy= 192.168.1.0/255.255.255.0/0/0 (type=4), remote_proxy=
172.16.1.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-hmac , lifedur=
3600s and 4608000kb, spi= 0xD44FE97C(3562006908), conn_id= 2001, keysize= 0, flags= 0xC *Mar 1
00:04:03.443: IPSEC(create_sa): sa created,
  (sa) sa_dest= 10.1.4.1, sa_prot= 50,
    sa_spi= 0xFAD9A769(4208568169),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2000
*Mar  1 00:04:03.447: IPSEC(create_sa): sa created,
  (sa) sa_dest= 10.1.2.1, sa_prot= 50,
    sa_spi= 0xD44FE97C(3562006908),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2001
!--- IPsec tunnel has been created between !--- routers Spoke 1 and Hub. *Mar 1 00:05:02.387:
IPSEC(sa_request): , !--- Since an IPsec tunnel is created between Spoke 1 !--- and Spoke 2
through the Hub, the Hub router !--- initializes a new IPsec tunnel between itself and Spoke 2.
(key eng. msg.) OUTBOUND local= 10.1.4.1, remote= 10.1.3.1, local_proxy=
172.16.1.0/255.255.255.0/0/0 (type=4), remote_proxy= 192.168.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac , lifedur= 3600s and 4608000kb, spi=
0x1B7A414E(460996942), conn_id= 0, keysize= 0, flags= 0x400C *Mar 1 00:05:02.399: ISAKMP:
received ke message (1/1) *Mar 1 00:05:02.403: ISAKMP: local port 500, remote port 500 *Mar 1
00:05:02.411: ISAKMP (0:2): beginning Main Mode exchange *Mar 1 00:05:02.415: ISAKMP (0:2):
sending packet to 10.1.3.1 (I) MM_NO_STATE *Mar 1 00:05:12.419: ISAKMP (0:2): retransmitting
phase 1 MM_NO_STATE... *Mar 1 00:05:12.419: ISAKMP (0:2): incrementing error counter on sa:
retransmit phase 1 *Mar 1 00:05:12.423: ISAKMP (0:2): retransmitting phase 1 MM_NO_STATE *Mar 1
00:05:12.423: ISAKMP (0:2): sending packet to 10.1.3.1 (I) MM_NO_STATE *Mar 1 00:05:22.427:
ISAKMP (0:2): retransmitting phase 1 MM_NO_STATE... *Mar 1 00:05:22.427: ISAKMP (0:2):
incrementing error counter on sa: retransmit phase 1 *Mar 1 00:05:22.431: ISAKMP (0:2):
retransmitting phase 1 MM_NO_STATE *Mar 1 00:05:22.431: ISAKMP (0:2): sending packet to 10.1.3.1
(I) MM_NO_STATE *Mar 1 00:05:22.967: ISAKMP (0:2): received packet from 10.1.3.1 (I) MM_NO_STATE
*Mar 1 00:05:22.975: ISAKMP (0:2): processing SA payload. message ID = 0 *Mar 1 00:05:22.975:
ISAKMP (0:2): found peer pre-shared key matching 10.1.3.1 *Mar 1 00:05:22.979: ISAKMP (0:2):
Checking ISAKMP transform 1 against priority 10 policy *Mar 1 00:05:22.979: ISAKMP: encryption
DES-CBC *Mar 1 00:05:22.983: ISAKMP: hash MD5 *Mar 1 00:05:22.983: ISAKMP: default group 1 *Mar
1 00:05:22.987: ISAKMP: auth pre-share *Mar 1 00:05:22.987: ISAKMP: life type in seconds *Mar 1
00:05:22.987: ISAKMP: life duration (VPI) of 0x0 0x1 0x51 0x80 *Mar 1 00:05:22.991: ISAKMP
(0:2): atts are acceptable.
 Next payload is 0
!--- IKE phase 1 parameters have been successfully !--- exchanged between Hub and Spoke 2. *Mar
1 00:05:24.447: ISAKMP (0:2): SA is doing pre-shared key authentication using id type
ID_IPV4_ADDR *Mar 1 00:05:24.455: ISAKMP (0:2): sending packet to 10.1.3.1 (I) MM_SA_SETUP *Mar
1 00:05:26.463: ISAKMP (0:2): received packet from 10.1.3.1 (I) MM_SA_SETUP *Mar 1 00:05:26.471:
ISAKMP (0:2): processing KE payload. message ID = 0 *Mar 1 00:05:28.303: ISAKMP (0:2):
processing NONCE payload. message ID = 0 *Mar 1 00:05:28.307: ISAKMP (0:2): found peer pre-
shared key matching 10.1.3.1 *Mar 1 00:05:28.319: ISAKMP (0:2): SKEYID state generated *Mar 1
00:05:28.323: ISAKMP (0:2): processing vendor id payload *Mar 1 00:05:28.327: ISAKMP (0:2):
speaking to another IOS box! *Mar 1 00:05:28.331: ISAKMP (2): ID payload next-payload : 8 type :
1 protocol : 17 port : 500 length : 8 *Mar 1 00:05:28.335: ISAKMP (2): Total payload length: 12
*Mar 1 00:05:28.343: ISAKMP (0:2): sending packet to 10.1.3.1 (I) MM_KEY_EXCH *Mar 1
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00:05:28.399: ISAKMP (0:2): received packet from 10.1.3.1 (I) MM_KEY_EXCH *Mar 1 00:05:28.407:
ISAKMP (0:2): processing ID payload. message ID = 0 *Mar 1 00:05:28.411: ISAKMP (0:2):
processing HASH payload. message ID = 0 *Mar 1 00:05:28.419: ISAKMP (0:2): SA has been
authenticated with 10.1.3.1 *Mar 1 00:05:28.419: ISAKMP (0:2): beginning Quick Mode exchange, M-
ID of -1872859789 *Mar 1 00:05:28.439: ISAKMP (0:2): sending packet to 10.1.3.1 (I) QM_IDLE *Mar
1 00:05:28.799: ISAKMP (0:2): received packet from 10.1.3.1 (I) QM_IDLE
!--- The IKE phase 1 SA has been successfully !--- negotiated between Hub and Spoke 2. *Mar 1
00:05:28.815: ISAKMP (0:2): processing HASH payload. message ID = -1872859789 *Mar 1
00:05:28.815: ISAKMP (0:2): processing SA payload. message ID = -1872859789 *Mar 1 00:05:28.819:
ISAKMP (0:2): Checking IPSec proposal 1
!--- IKE exchanges IPsec phase 2 parameters !--- between Hub and Spoke 2. *Mar 1 00:05:28.819:
ISAKMP: transform 1, ESP_DES *Mar 1 00:05:28.823: ISAKMP: attributes in transform: *Mar 1
00:05:28.823: ISAKMP: encaps is 1 *Mar 1 00:05:28.827: ISAKMP: SA life type in seconds *Mar 1
00:05:28.827: ISAKMP: SA life duration (basic) of 3600 *Mar 1 00:05:28.827: ISAKMP: SA life type
in kilobytes *Mar 1 00:05:28.831: ISAKMP: SA life duration (VPI) of 0x0 0x46 0x50 0x0 *Mar 1
00:05:28.835: ISAKMP: authenticator is HMAC-MD5 *Mar 1 00:05:28.839: ISAKMP (0:2): atts are
acceptable.
!--- IPsec phase 2 parameters have been successfully !--- exchanged between Hub and Spoke 2.
*Mar 1 00:05:28.843: IPSEC(validate_proposal_request): proposal part #1, (key eng. msg.) INBOUND
local= 10.1.4.1, remote= 10.1.3.1, local_proxy= 172.16.1.0/255.255.255.0/0/0 (type=4),
remote_proxy= 192.168.1.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-
hmac , lifedur= 0s and 0kb, spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4 *Mar 1 00:05:28.855:
ISAKMP (0:2): processing NONCE payload. message ID = -1872859789 *Mar 1 00:05:28.859: ISAKMP
(0:2): processing ID payload. message ID = -1872859789 *Mar 1 00:05:28.863: ISAKMP (0:2):
processing ID payload. message ID = -1872859789 *Mar 1 00:05:28.891: ISAKMP (0:2): Creating
IPSec SAs *Mar 1 00:05:28.891: inbound SA from 10.1.3.1 to 10.1.4.1 (proxy 192.168.1.0 to
172.16.1.0) *Mar 1 00:05:28.895: has spi 0x1B7A414E and conn_id 2002 and flags 4 *Mar 1
00:05:28.899: lifetime of 3600 seconds *Mar 1 00:05:28.899: lifetime of 4608000 kilobytes *Mar 1
00:05:28.903: outbound SA from 10.1.4.1 to 10.1.3.1 (proxy 172.16.1.0 to 192.168.1.0 ) *Mar 1
00:05:28.907: has spi -385025107 and conn_id 2003 and flags C *Mar 1 00:05:28.911: lifetime of
3600 seconds *Mar 1 00:05:28.911: lifetime of 4608000 kilobytes *Mar 1 00:05:28.915: ISAKMP
(0:2): sending packet to 10.1.3.1 (I) QM_IDLE *Mar 1 00:05:28.919: ISAKMP (0:2): deleting node -
1872859789 error FALSE reason "" *Mar 1 00:05:28.923: IPSEC(key_engine): got a queue event...
*Mar 1 00:05:28.927: IPSEC(initialize_sas): , (key eng. msg.) INBOUND local= 10.1.4.1, remote=
10.1.3.1, local_proxy= 172.16.1.0/255.255.255.0/0/0 (type=4), remote_proxy=
192.168.1.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb, spi= 0x1B7A414E(460996942), conn_id= 2002, keysize= 0, flags= 0x4
*Mar 1 00:05:28.939: IPSEC(initialize_sas): , (key eng. msg.) OUTBOUND local= 10.1.4.1, remote=
10.1.3.1, local_proxy= 172.16.1.0/255.255.255.0/0/0 (type=4), remote_proxy=
192.168.1.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 3600s and 4608000kb, spi= 0xE90CFBAD(3909942189), conn_id= 2003, keysize= 0, flags= 0xC
*Mar 1 00:05:28.951: IPSEC(create_sa): sa created,
  (sa) sa_dest= 10.1.4.1, sa_prot= 50,
    sa_spi= 0x1B7A414E(460996942),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2002
*Mar  1 00:05:28.959: IPSEC(create_sa): sa created,
  (sa) sa_dest= 10.1.3.1, sa_prot= 50,
    sa_spi= 0xE90CFBAD(3909942189),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2003
!--- IPsec tunnel has been created between routers !--- Hub and Spoke 2. This establishes a
tunnel between Spoke 1 !--- and Spoke 2 through Hub.
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Dies ist die Spoke 1-Router-Ausgabe von den **Befehlen debug crypto isakmp** und **debug crypto ipsec**.

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*Mar  1 00:03:28.771: IPSEC(sa_request): ,
  (key eng. msg.) OUTBOUND local= 10.1.2.1, remote= 10.1.4.1,
    local_proxy= 172.16.1.0/255.255.255.0/0/0 (type=4),
    remote_proxy= 192.168.1.0/255.255.255.0/0/0 (type=4),
    protocol= ESP, transform= esp-des esp-md5-hmac ,
    lifedur= 3600s and 4608000kb,
    spi= 0xD44FE97C(3562006908), conn_id= 0, keysize= 0, flags= 0x400C
!--- Request sent after the ping. *Mar 1 00:03:28.787: ISAKMP: received ke message (1/1) *Mar 1
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00:03:28.791: ISAKMP: local port 500, remote port 500 *Mar 1 00:03:28.799: ISAKMP (0:1):
beginning Main Mode exchange
!--- Initial IKE phase 1 parameters are exchanged !--- between Spoke 1 and Hub. *Mar 1
00:03:28.803: ISAKMP (0:1): sending packet to 10.1.4.1 (I) MM_NO_STATE. *Mar 1 00:03:38.807:
ISAKMP (0:1): retransmitting phase 1 MM_NO_STATE... *Mar 1 00:03:38.807: ISAKMP (0:1):
incrementing error counter on sa: retransmit phase 1 *Mar 1 00:03:38.811: ISAKMP (0:1):
retransmitting phase 1 MM_NO_STATE *Mar 1 00:03:38.811: ISAKMP (0:1): sending packet to 10.1.4.1
(I) MM_NO_STATE *Mar 1 00:03:48.815: ISAKMP (0:1): retransmitting phase 1 MM_NO_STATE... *Mar 1
00:03:48.815: ISAKMP (0:1): incrementing error counter on sa: retransmit phase 1 *Mar 1
00:03:48.819: ISAKMP (0:1): retransmitting phase 1 MM_NO_STATE *Mar 1 00:03:48.819: ISAKMP
(0:1): sending packet to 10.1.4.1 (I) MM_NO_STATE *Mar 1 00:03:49.355: ISAKMP (0:1): received
packet from 10.1.4.1 (I) MM_NO_STATE *Mar 1 00:03:49.363: ISAKMP (0:1): processing SA payload.
message ID = 0 *Mar 1 00:03:49.363: ISAKMP (0:1): found peer pre-shared key matching 10.1.4.1
*Mar 1 00:03:49.367: ISAKMP (0:1): Checking ISAKMP transform 1 against priority 10 policy *Mar 1
00:03:49.367: ISAKMP: encryption DES-CBC *Mar 1 00:03:49.371: ISAKMP: hash MD5 *Mar 1
00:03:49.371: ISAKMP: default group 1 *Mar 1 00:03:49.375: ISAKMP: auth pre-share *Mar 1
00:03:49.375: ISAKMP: life type in seconds *Mar 1 00:03:49.375: ISAKMP: life duration (VPI) of
0x0 0x1 0x51 0x80 *Mar 1 00:03:49.379: ISAKMP (0:1): atts are acceptable.
 Next payload is 0
!--- IKE phase 1 parameters have been sucessfully !--- negotiated between Spoke 1 and Hub. *Mar
1 00:03:50.835: ISAKMP (0:1): SA is doing pre-shared key authentication using id type
ID_IPV4_ADDR *Mar 1 00:03:50.851: ISAKMP (0:1): sending packet to 10.1.4.1 (I) MM_SA_SETUP *Mar
1 00:03:52.759: ISAKMP (0:1): received packet from 10.1.4.1 (I) MM_SA_SETUP *Mar 1 00:03:52.763:
ISAKMP (0:1): processing KE payload. message ID = 0 *Mar 1 00:03:54.635: ISAKMP (0:1):
processing NONCE payload. message ID = 0 *Mar 1 00:03:54.639: ISAKMP (0:1): found peer pre-
shared key matching 10.1.4.1 *Mar 1 00:03:54.651: ISAKMP (0:1): SKEYID state generated *Mar 1
00:03:54.655: ISAKMP (0:1): processing vendor id payload *Mar 1 00:03:54.663: ISAKMP (0:1):
speaking to another IOS box! *Mar 1 00:03:54.663: ISAKMP (1): ID payload next-payload : 8 type :
1 protocol : 17 port : 500 length : 8 *Mar 1 00:03:54.667: ISAKMP (1): Total payload length: 12
*Mar 1 00:03:54.675: ISAKMP (0:1): sending packet to 10.1.4.1 (I) MM_KEY_EXCH *Mar 1
00:03:54.759: ISAKMP (0:1): received packet from 10.1.4.1 (I) MM_KEY_EXCH *Mar 1 00:03:54.767:
ISAKMP (0:1): processing ID payload. message ID = 0 *Mar 1 00:03:54.767: ISAKMP (0:1):
processing HASH payload. message ID = 0 *Mar 1 00:03:54.775: ISAKMP (0:1): SA has been
authenticated with 10.1.4.1 *Mar 1 00:03:54.779: ISAKMP (0:1): beginning Quick Mode exchange, M-
ID of 581713929 *Mar 1 00:03:54.799: ISAKMP (0:1): sending packet to 10.1.4.1 (I) QM_IDLE *Mar 1
00:03:55.155: ISAKMP (0:1): received packet from 10.1.4.1 (I) QM_IDLE *Mar 1 00:03:55.171:
ISAKMP (0:1): processing HASH payload. message ID = 581713929 *Mar 1 00:03:55.175: ISAKMP (0:1):
processing SA payload. message ID = 581713929 *Mar 1 00:03:55.179: ISAKMP (0:1): Checking IPSec
proposal 1
!--- IKE exchanges the IPsec phase 2 parameters between !--- Spoke 1 and Hub. *Mar 1
00:03:55.179: ISAKMP: transform 1, ESP_DES *Mar 1 00:03:55.183: ISAKMP: attributes in transform:
*Mar 1 00:03:55.183: ISAKMP: encaps is 1 *Mar 1 00:03:55.183: ISAKMP: SA life type in seconds
*Mar 1 00:03:55.187: ISAKMP: SA life duration (basic) of 3600 *Mar 1 00:03:55.187: ISAKMP: SA
life type in kilobytes *Mar 1 00:03:55.191: ISAKMP: SA life duration (VPI) of 0x0 0x46 0x50 0x0
*Mar 1 00:03:55.195: ISAKMP: authenticator is HMAC-MD5 *Mar 1 00:03:55.199: ISAKMP (0:1): atts
are acceptable.
!--- IKE has successfully negotiated phase 2 IPsec !--- SA between Hub and Spoke 2. *Mar 1
00:03:55.203: IPSEC(validate_proposal_request): proposal part #1, (key eng. msg.) INBOUND local=
10.1.2.1, remote= 10.1.4.1, local_proxy= 172.16.1.0/255.255.255.0/0/0 (type=4), remote_proxy=
192.168.1.0/255.255.255.0/0/0 (type=4), protocol= ESP, transform= esp-des esp-md5-hmac ,
lifedur= 0s and 0kb, spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4 *Mar 1 00:03:55.219: ISAKMP
(0:1): processing NONCE payload. message ID = 581713929 *Mar 1 00:03:55.219: ISAKMP (0:1):
processing ID payload. message ID = 581713929 *Mar 1 00:03:55.223: ISAKMP (0:1): processing ID
payload. message ID = 581713929 *Mar 1 00:03:55.251: ISAKMP (0:1): Creating IPSec SAs *Mar 1
00:03:55.255: inbound SA from 10.1.4.1 to 10.1.2.1 (proxy 192.168.1.0 to 172.16.1.0) *Mar 1
00:03:55.259: has spi 0xD44FE97C and conn_id 2000 and flags 4 *Mar 1 00:03:55.263: lifetime of
3600 seconds *Mar 1 00:03:55.263: lifetime of 4608000 kilobytes *Mar 1 00:03:55.267: outbound SA
from 10.1.2.1 to 10.1.4.1 (proxy 172.16.1.0 to 192.168.1.0 ) *Mar 1 00:03:55.271: has spi -
86399127 and conn_id 2001 and flags C *Mar 1 00:03:55.271: lifetime of 3600 seconds *Mar 1
00:03:55.275: lifetime of 4608000 kilobytes *Mar 1 00:03:55.279: ISAKMP (0:1): sending packet to
10.1.4.1 (I) QM_IDLE *Mar 1 00:03:55.283: ISAKMP (0:1): deleting node 581713929 error FALSE
reason " " *Mar 1 00:03:55.287: IPSEC(key_engine): got a queue event... *Mar 1 00:03:55.291:
IPSEC(initialize_sas): , (key eng. msg.) INBOUND local= 10.1.2.1, remote= 10.1.4.1, local_proxy=
172.16.1.0/255.255.255.0/0/0 (type=4), remote_proxy= 192.168.1.0/255.255.255.0/0/0 (type=4),
protocol= ESP, transform= esp-des esp-md5-hmac , lifedur= 3600s and 4608000kb, spi=
0xD44FE97C(3562006908), conn_id= 2000, keysize= 0, flags= 0x4 *Mar 1 00:03:55.303:
IPSEC(initialize_sas): , (key eng. msg.) OUTBOUND local= 10.1.2.1, remote= 10.1.4.1,
local_proxy= 172.16.1.0/255.255.255.0/0/0 (type=4), remote_proxy= 192.168.1.0/255.255.255.0/0/0
(type=4), protocol= ESP, transform= esp-des esp-md5-hmac , lifedur= 3600s and 4608000kb, spi=
0xFAD9A769(4208568169), conn_id= 2001, keysize= 0, flags= 0xC *Mar 1 00:03:55.319:
IPSEC(create_sa): sa created,
  (sa) sa_dest= 10.1.2.1, sa_prot= 50,
    sa_spi= 0xD44FE97C(3562006908),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2000
*Mar  1 00:03:55.323: IPSEC(create_sa): sa created,
  (sa) sa_dest= 10.1.4.1, sa_prot= 50,
    sa_spi= 0xFAD9A769(4208568169),
    sa_trans= esp-des esp-md5-hmac , sa_conn_id= 2001
!--- The IPsec tunnel between Spoke 1 and Hub is set up.
```

Zugehörige Informationen

- IP Security Troubleshooting - Understanding and Using debug Commands
- IPsec-Konfigurationsbeispiele
- IPsec-Aushandlung/IKE-Protokoll
- Technischer Support und Dokumentation - Cisco Systems