电缆上的 IPSec 示例配置和调试

目录

简介

互联网协议安全(IPsec)是开放标准的框架，可确保IP网络上的私有通信安全。IPsec基于互联网工程任务组(IETF)制定的标准，确保公共IP网络中数据通信的机密性、完整性和真实性。IPsec为基于标准的灵活解决方案部署网络范围安全策略提供了必要的组件。

本文档提供两个思科电缆调制解调器之间的IPsec配置示例。此配置在两台思科uBR9xx系列电缆调制解调器路由器之间创建跨电缆网络的加密隧道。两个网络之间的所有流量都已加密。但是，发往其他网络的流量可以未经加密而通过。对于小型办公室、家庭办公室(SOHO)用户，这允许在有线网络中创建虚拟专用网络(VPN)。

先决条件

要求

本文档没有任何特定的要求。

使用的组件

调制解调器必须符合以下要求才能在两个电缆调制解调器上配置IPsec:

- 路由模式下的思科uBR904、uBR905或uBR924
- IPsec 56功能集
- 思科IOS®软件版本12.0(5)T或更高版本

此外，您必须拥有电缆调制解调器端接系统(CMTS)，该系统是任何符合有线数据服务接口规范(DOCSIS)的头端电缆路由器，例如Cisco uBR7246、Cisco uBR7223或Cisco uBR7246VXR

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您使用的是真实网络，请确保您已经了解所有命令的潜在影响。

规则

有关文档规则的详细信息，请参阅 Cisco 技术提示规则。

背景理论

本文档中的示例使用uBR904电缆调制解调器、uBR924电缆调制解调器和uBR7246VXR CMTS。电缆调制解调器运行Cisco IOS软件版本12.1(6),CMTS运行Cisco IOS软件版本12.1(4)EC。

注意：本示例通过控制台端口在电缆调制解调器上手动配置完成。如果通过DOCSIS配置文件执行自动化进程（使用IPsec配置创建ios.cfg脚本），则无法使用访问列*表100*和101。这是因为思科实施的简单网络管理协议(SNMP)docsDevNmAccess表使用思科IOS访问列表。它为每个接口创建一个访问列表。在uBR904、924和905上，通常使用前两个访问列表（100和101）。 在支持通用串行总线(USB)的电缆调制解调器（如CVA120）上，使用三个访问列表（100、101和102）。

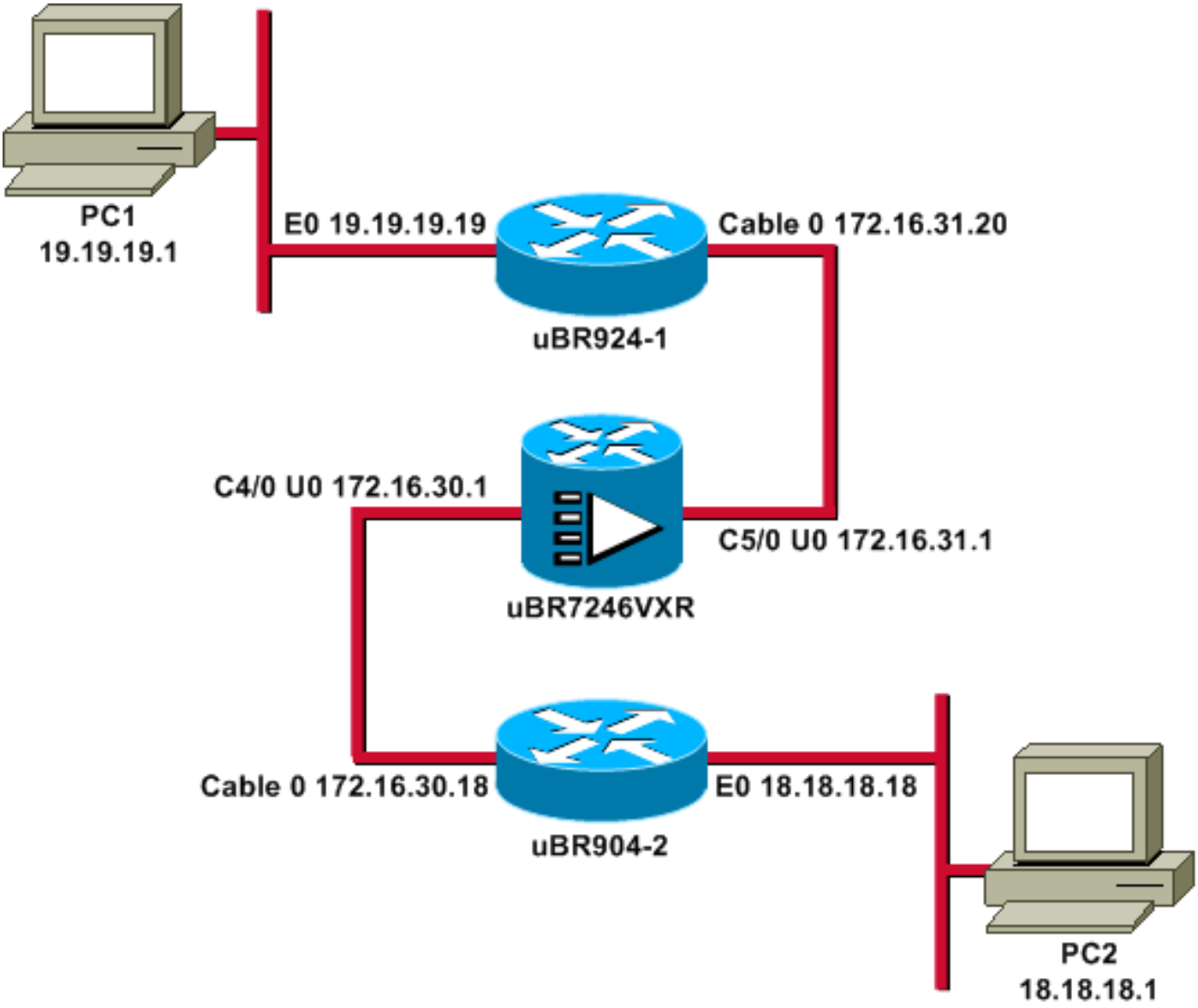
配置

本部分提供有关如何配置本文档所述功能的信息。

注意：使用命令查找工具(仅限注册客户)可查找有关本文档中命令的其他信息。

网络图

本文档使用以下网络设置：



注意：此图中的所有IP地址都有24位掩码。

配置

本文档使用以下配置：

- uBR924-1
- uBR904-2
- uBR7246VXR

uBR924-1

```
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname ubr924-1
!
enable password ww
!
!
!
```

```
!
clock timezone - -8
ip subnet-zero
no ip finger
!
ip audit notify log
ip audit po max-events 100
!
!
crypto isakmp policy 10
!--- Creates an Internet Key Exchange (IKE) policy with
the specified priority !--- number of 10. The range for
the priority is 1 to 10000, where 1 is the !--- highest
priority. This command also enters Internet Security
Association !--- and Key Management Protocol (ISAKMP)
policy configuration command mode. hash md5
!--- Specifies the MD5 (HMAC variant) hash algorithm for
packet authentication. authentication pre-share
!--- Specifies that the authentication keys are pre-
shared, as opposed to !--- dynamically negotiated using
Rivest, Shamir, and Adelman (RSA) public !--- key
signatures. group 2
!--- Diffie-Hellman group for key negotiation. lifetime
3600
!--- Defines how long, in seconds, each security
association should exist before !--- it expires. Its
range is 60 to 86400, and in this case, it is 1 hour.
crypto isakmp key mykey address 18.18.18.18
!--- Specifies the pre-shared key that should be used
with the peer at the !--- specific IP address. The key
can be any arbitrary alphanumeric key up to !--- 128
characters. The key is case-sensitive and must be
entered identically !--- on both routers. In this case,
the key is mykey and the peer is the !--- Ethernet
address of uBR904-2
.
!
crypto IPSec transform-set TUNNELSET ah-md5-hmac esp-des
!--- Establishes the transform set to use for IPsec
encryption. As many as !--- three transformations can be
specified for a set. Authentication Header !--- and ESP
are in use. Another common transform set used in
industry is !--- esp-des esp-md5-hmac.

!
crypto map MYMAP local-address Ethernet0
!--- Creates the MYMAP crypto map and applies it to the
Ethernet0 interface.

crypto map MYMAP 10 ipsec-isakmp
!--- Creates a crypto map numbered 10 and enters crypto
map configuration mode. set peer 18.18.18.18
!--- Identifies the IP address for the destination peer
router. In this case, !--- the Ethernet interface of the
remote cable modem (ubr904-2) is used. set transform-set
TUNNELSET
!--- Sets the crypto map to use the transform set
previously created. match address 101
!--- Sets the crypto map to use the access list that
specifies the type of !--- traffic to be encrypted. !---
Do not use access lists 100, 101, and 102 if the IPsec
config is !--- downloaded through the ios.cfg in the
DOCSIS configuration file.
```

```
!
!
!
!
voice-port 0
 input gain -2
 output attenuation 0
!
voice-port 1
 input gain -2
 output attenuation 0
!
!
!
interface Ethernet0
 ip address 19.19.19.19 255.255.255.0
 ip rip send version 2
 ip rip receive version 2
 no ip route-cache
 no ip mroute-cache
!
interface cable-modem0
 ip rip send version 2
 ip rip receive version 2
 no ip route-cache
 no ip mroute-cache
 cable-modem downstream saved channel 525000000 39 1
 cable-modem mac-timer t2 40000
 no cable-modem compliant bridge
 crypto map MYMAP
!--- Applies the previously created crypto map to the
cable interface. ! router rip version 2 network 19.0.0.0
network 172.16.0.0 ! ip default-gateway 172.16.31.1 ip
classless ip http server ! access-list 101 permit ip
19.19.19.0 0.0.0.255 18.18.18.0 0.0.0.255
!--- Access list that identifies the traffic to be
encrypted. In this case, !--- it is setting traffic from
the local Ethernet network to the remote !--- Ethernet
network. snmp-server manager ! line con 0 transport
input none line vty 0 4 password ww login ! end
```

另一个电缆调制解调器的配置非常相似，因此先前配置中的大多数注释都会被省略。

uBR904-2

```
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname ubr904-2
!
enable password ww
!
!
!
!
!
clock timezone - -8
ip subnet-zero
no ip finger
```

```
!
!
!
crypto isakmp policy 10
 hash md5
 authentication pre-share
 group 2
 lifetime 3600
crypto isakmp key mykey address 19.19.19.19
!
!
crypto IPSec transform-set TUNNELSET ah-md5-hmac ESP-Des
!
crypto map MYMAP local-address Ethernet0
crypto map MYMAP 10 ipsec-isakmp
 set peer 19.19.19.19
!--- Identifies the IP address for the destination peer
router. In this case, !--- the Ethernet interface of the
remote cable modem (uBR924-1) is used. set transform-set
TUNNELSET
 match address 101
!
!
!
!
interface Ethernet0
 ip address 18.18.18.18 255.255.255.0
 ip rip send version 2
 ip rip receive version 2
!
interface cable-modem0
 ip rip send version 2
 ip rip receive version 2
 no keepalive
 cable-modem downstream saved channel 555000000 42 1
 cable-modem Mac-timer t2 40000
 no cable-modem compliant bridge
 crypto map MYMAP
!
router rip
 version 2
 network 18.0.0.0
 network 172.16.0.0
!
ip default-gateway 172.16.30.1
ip classless
no ip http server
!
access-list 101 permit ip 18.18.18.0 0.0.0.255
19.19.19.0 0.0.0.255
snmp-server manager
!
line con 0
 transport input none
line vty 0 4
 password ww
 login
!
end
```

CMTS uBR7246VXR还运行路由信息协议(RIP)第2版，因此路由工作正常。以下是CMTS上使用的RIP配置：

uBR7246VXR
router rip version 2 network 172.16.0.0 no auto-summary

验证

使用本部分可确认配置能否正常运行。

要验证IPsec是否有效，请执行以下操作：

- 验证以下事项：Cisco IOS软件支持IPsec。运行配置正确。接口已启用。路由有效。为加密流量而定义的访问列表是正确的。
- 创建流量并查看“加密和解密”(Encrypt and Decrypt)，以查看正在增加的流量。
- 启用加密调试。

命令输出解释程序（仅限注册用户）(OIT) 支持某些 show 命令。使用 OIT 可查看对 show 命令输出的分析。

在两个电缆调制解调器上发出**show version**命令。

```
ubr924-1#show version
Cisco Internetwork Operating System Software
IOS (tm) 920 Software (UBR920-K1O3SV4Y556I-M), Version 12.1(6),
RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2000 by Cisco Systems, Inc.
Compiled Wed 27-Dec-00 16:36 by kellythw
Image text-base: 0x800100A0, data-base: 0x806C1C20

ROM: System Bootstrap, Version 12.0(6r)T3, RELEASE SOFTWARE (fc1)

ubr924-1 uptime is 1 hour, 47 minutes
System returned to ROM by reload at 10:39:05 - Fri Feb 9 2001
System restarted at 10:40:05 - Fri Feb 9 2001
System image file is "flash:ubr920-k1o3sv4y556i-mz.121-6"

cisco uBR920 CM (MPC850) processor (revision 3.e)
with 15872K/1024K bytes of memory.
Processor board ID FAA0422Q04F
Bridging software.
1 Ethernet/IEEE 802.3 interface(s)
1 Cable Modem network interface(s)
3968K bytes of processor board System flash (Read/Write)
1536K bytes of processor board Boot flash (Read/Write)

Configuration register is 0x2102
```

uBR924-1运行Cisco IOS软件版本12.1(6)，具有VALUE SMALL OFFICE/VOICE/FW IPSec 56功能集。

```
ubr904-2#show version
Cisco Internetwork Operating System Software
IOS (TM) 900 Software (UBR900-K1OY556I-M), Version 12.1(6),
RELEASE SOFTWARE (fc1)
```

```
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Wed 27-DEC-00 11:06 by kellythw
Image text-base: 0x08004000, database: 0x085714DC

ROM: System Bootstrap, Version 11.2(19980518:195057), RELEASED SOFTWARE
ROM: 900 Software (UBR900-RBOOT-M), Version 11.3(11)NA,
EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)

ubr904-2 uptime is 1 hour, 48 minutes
System returned to ROM by reload at 10:38:44 - Fri Feb 9 2001
System restarted at 10:40:37 - Fri Feb 9 2001
System image file is "flash:ubr900-k1oy556i-mz.121-6"

cisco uBR900 CM (68360) processor (revision D)
with 8192K bytes of memory.
Processor board ID FAA0235Q0ZS
Bridging software.
1 Ethernet/IEEE 802.3 interface(s)
1 Cable Modem network interface(s)
4096K bytes of processor board System flash (Read/Write)
2048K bytes of processor board Boot flash (Read/Write)

Configuration register is 0x2102
```

uBR904-2运行Cisco IOS软件版本12.1(6)，带SMALL OFFICE/FW IPSec 56功能集。

```
ubr924-1#show ip interface brief
Interface            IP-Address      OK? Method Status          Protocol
Ethernet0            19.19.19.19     YES NVRAM  up              up
cable-modem0         172.16.31.20    YES unset  up              up

ubr904-2#show ip interface brief
Interface            IP-Address      OK? Method Status          Protocol
Ethernet0            18.18.18.18     YES NVRAM  up              up
cable-modem0         172.16.30.18    YES unset  up              up
```

从最后一条命令中，您可以看到以太网接口已打开。以太网接口的IP地址是手动输入的。电缆接口也处于工作状态，它们通过DHCP获取了IP地址。由于这些电缆地址是动态分配的，因此它们不能用作IPSec配置中的对等体。

```
ubr924-1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - ISIS level-1, L2 - ISIS level-2, ia - ISIS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 172.16.31.1 to network 0.0.0.0

     19.0.0.0/24 is subnetted, 1 subnets
C       19.19.19.0 is directly connected, Ethernet0
R    18.0.0.0/8 [120/2] via 172.16.31.1, 00:00:23, cable-modem0
     172.16.0.0/16 is variably subnetted, 4 subnets, 3 masks
R       172.16.135.0/25 [120/1] via 172.16.31.1, 00:00:23, cable-modem0
R       172.16.29.0/27 [120/1] via 172.16.31.1, 00:00:23, cable-modem0
R       172.16.30.0/24 [120/1] via 172.16.31.1, 00:00:23, cable-modem0
C       172.16.31.0/24 is directly connected, cable-modem0
R    192.168.99.0/24 [120/3] via 172.16.31.1, 00:00:24, cable-modem0
     10.0.0.0/24 is subnetted, 2 subnets
```

```
R       10.10.10.0 [120/2] via 172.16.31.1, 00:00:24, cable-modem0
S*   0.0.0.0/0 [1/0] via 172.16.31.1
```

从此输出中您可以看到uBR924-1正在学习路由18.18.18.0，该路由是uBR904-2的以太网接口。

```
ubr904-2#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - ISIS, L1 - ISIS level-1, L2 - ISIS level-2, IA - ISIS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 172.16.30.1 to network 0.0.0.0

R    19.0.0.0/8 [120/2] via 172.16.30.1, 00:00:17, cable-modem0
     18.0.0.0/24 is subnetted, 1 subnets
C       18.18.18.0 is directly connected, Ethernet0
     172.16.0.0/16 is variably subnetted, 4 subnets, 3 masks
R       172.16.135.0/25 [120/1] via 172.16.30.1, 00:00:17, cable-modem0
R       172.16.29.224/27 [120/1] via 172.16.30.1, 00:00:17, cable-modem0
C       172.16.30.0/24 is directly connected, cable-modem0
R       172.16.31.0/24 [120/1] via 172.16.30.1, 00:00:17, cable-modem0
R    192.168.99.0/24 [120/3] via 172.16.30.1, 00:00:18, cable-modem0
     10.0.0.0/24 is subnetted, 1 subnets
R       10.10.10.0 [120/2] via 172.16.30.1, 00:00:18, cable-modem0
S*   0.0.0.0/0 [1/0] via 172.16.30.1
```

从uBR904-2的路由表中，您可以看到uBR924-1以太网的网络位于路由表中。

注意：在两个电缆调制解调器之间可能无法运行路由协议。在这种情况下，必须在CMTS上添加静态路由，以定向电缆调制解调器以太网接口的流量。

接下来要检查的是访问列表的认证；在两台路由器上发出**show access-lists**命令。

```
ubr924-1#show access-lists
Extended IP access list 101
    permit ip 19.19.19.0 0.0.0.255 18.18.18.0 0.0.0.255 (2045 matches)

ubr904-2#show access-lists
Extended IP access list 101
    permit ip 18.18.18.0 0.0.0.255 19.19.19.0 0.0.0.255 (2059 matches)
```

当uBR924-1(19.19.19.0)后的LAN将IP流量发送到uBR904-2(18.18.18.0)后的LAN时，访问列表会设置IPsec会话，反之亦然。请*不*要在访问列表中使用“any”，因为它会产生问题。有关详细信息，请参阅配置IPsec网络安全。

没有IPsec流量。发出**show crypto engine connection active**命令。

```
ubr924-1#show crypto engine connection active
ID Interface    IP-Address    State    Algorithm           Encrypt  Decrypt
1                              set     HMAC_MD5+DES_56_CB        0        0

ubr904-2#show crypto engine connection active
ID Interface    IP-Address    State    Algorithm           Encrypt  Decrypt
1                              set     HMAC_MD5+DES_56_CB        0        0
```

没有IPsec连接，因为没有与访问列表匹配的流量。

注意：在使用debug命令之前，请参阅有关**debug命**令的重要信息。

下一步是打开一些加密调试以生成相关流量。

在本例中，这些调试已打开：

- **debug crypto engine**
- **debug crypto IPsec**
- **debug crypto key-exchange**
- **debug crypto isakmp**

您必须首先生成一些相关流量才能查看调试的输出。从uBR904-2的以太网端口向uBR924-1上的PC发出扩展ping(IP地址19.19.19.1)。

```
ubr904-2#ping ip
Target IP address: 19.19.19.1
!--- IP address of PC1 behind the Ethernet of uBR924-1. Repeat count [5]: 100
!--- Sends 100 pings. Datagram size [100]: Timeout in seconds [2]: Extended commands [n]: y
Source address or interface: 18.18.18.18
!--- IP address of the Ethernet behind uBR904-2. 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 100, 100-byte
ICMP Echos to 19.19.19.1, timeout is 2 seconds:
```

uBR924-2显示以下调试输出：

```
ubr904-2#
01:50:37: IPSec(sa_request): ,
 (key eng. msg.) src= 18.18.18.18, dest= 19.19.19.19,
    src_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    dest_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    protocol= AH, transform= ah-md5-hmac ,
    lifedur= 3600s and 4608000kb,
    spi= 0x19911A16(428939798), conn_id= 0, keysize= 0, flags= 0x4004
01:50:37: IPSec(sa_request): ,
  (key Eng. msg.) src= 18.18.18.18, dest= 19.19.19.19,
    src_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    dest_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    protocol= ESP, transform= ESP-Des ,
    lifedur= 3600s and 4608000kb,
    spi= 0x7091981(118036865), conn_id= 0, keysize= 0, flags= 0x4004
01:50:37: ISAKMP: received ke message (1/2)
01:50:37: ISAKMP (0:1): sitting IDLE. Starting QM immediately (QM_IDLE)
01:50:37: ISAKMP (0:1): beginning Quick Mode exchange, M-ID of 1108017901
01:50:37: CryptoEngine0: generate hmac context for conn id 1
01:50:37: ISAKMP (1): sending packet to 19.19.19.19 (I) QM_IDLE
01:50:37: ISAKMP (1): received packet from 19.19.19.19 (I) QM_IDLE
01:50:37: CryptoEngine0: generate hmac context for conn id 1
01:50:37: ISAKMP (0:1): processing SA payload. message ID = 1108017901
01:50:37: ISAKMP (0:1): Checking IPSec proposal 1
01:50:37: ISAKMP: transform 1, AH_MD5
01:50:37: ISAKMP:   attributes in transform:
01:50:3.!!!!!!!!!!!!!!!!!!!!!!!7: ISAKMP:      encaps is 1
01:50:37: ISAKMP:      SA life type in seconds
01:50:37: ISAKMP:      SA life duration (basic) of 3600
01:50:37: ISAKMP:      SA life type in kilobytes
01:50:37: ISAKMP:      SA life duration (VPI) of  0x0 0x46 0x50 0x0
01:50:37: ISAKMP:      authenticator is HMAC-MD5
01:50:37: validate proposal 0
```

```
01:50:37: ISAKMP (0:1): atts are acceptable.
01:50:37: ISAKMP (0:1): Checking IPSec proposal 1
01:50:37: ISAKMP: transform 1, ESP_DES
01:50:37: ISAKMP:   attributes in transform:
01:50:37: ISAKMP:      encaps is 1
01:50:37: ISAKMP:      SA life type in seconds
01:50:37: ISAKMP:      SA life duration (basic) of 3600
01:50:37: ISAKMP:      SA life type in kilobytes
01:50:37: ISAKMP:      SA life duration (VPI) of  0x0 0x46 0x50 0x0
01:50:37: validate proposal 0
01:50:37: ISAKMP (0:1): atts are acceptable.
01:50:37: IPSec(validate_proposal_request): proposal part #1,
  (key Eng. msg.) dest= 19.19.19.19, src= 18.18.18.18,
  dest_proxy= 19.19.1!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 99 percent (99/100), round-trip min/avg/max = 30/40/70 ms
ubr904-2#
```

请注意，第一个ping失败。这是因为它需要建立连接。

uBR924-1显示以下调试输出：

```
ubr924-1#
01:50:24: ISAKMP (1): received packet from 18.18.18.18 (R) QM_IDLE
01:50:24: CryptoEngine0: generate hmac context for conn id 1
01:50:24: ISAKMP (0:1): processing SA payload. Message ID = 1108017901
01:50:24: ISAKMP (0:1): Checking IPSec proposal 1
01:50:24: ISAKMP: transform 1, AH_MD5
01:50:24: ISAKMP:   attributes in transform:
01:50:24: ISAKMP:      encaps is 1
01:50:24: ISAKMP:      SA life type in seconds
01:50:24: ISAKMP:      SA life duration (basic) of 3600
01:50:24: ISAKMP:      SA life type in kilobytes
01:50:24: ISAKMP:      SA life duration (VPI) of  0x0 0x46 0x50 0x0
01:50:24: ISAKMP:      authenticator is HMAC-MD5
01:50:24: validate proposal 0
01:50:24: ISAKMP (0:1): atts are acceptable.
01:50:24: ISAKMP (0:1): Checking IPSec proposal 1
01:50:24: ISAKMP: transform 1, ESP_DES
01:50:24: ISAKMP:   attributes in transform:
01:50:24: ISAKMP:      encaps is 1
01:50:24: ISAKMP:      SA life type in seconds
01:50:24: ISAKMP:      SA life duration (basic) of 3600
01:50:24: ISAKMP:      SA life type in kilobytes
01:50:24: ISAKMP:      SA life duration (VPI) of  0x0 0x46 0x50 0x0
01:50:24: validate proposal 0
01:50:24: ISAKMP (0:1): atts are acceptable.
01:50:24: IPSec(validate_proposal_request): proposal part #1,
  (key Eng. msg.) dest= 19.19.19.19, src= 18.18.18.18,
    dest_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    src_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    protocol= AH, transform= ah-md5-hmac ,
    lifedur= 0s and 0kb,
    spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4
01:50:24: IPSec(validate_proposal_request): proposal part #2,
  (key Eng. msg.) dest= 19.19.19.19, src= 18.18.18.18,
    dest_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    src_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    protocol= ESP, transform= ESP-Des ,
    lifedur= 0s and 0kb,
    spi= 0x0(0), conn_id= 0, keysize= 0, flags= 0x4
01:50:24: validate proposal request 0
01:50:24: ISAKMP (0:1): processing NONCE payload. Message ID = 1108017901
```

```
01:50:24: ISAKMP (0:1): processing ID payload. Message ID = 1108017901
01:50:24: ISAKMP (1): ID_IPV4_ADDR_SUBNET src 18.18.18.0/255.255.255.0
   prot 0 Port 0
01:50:24: ISAKMP (0:1): processing ID payload. Message ID = 1108017901
01:50:24: ISAKMP (1): ID_IPV4_ADDR_SUBNET dst 19.19.19.0/255.255.255.0
   prot 0 Port 0
01:50:24: ISAKMP (0:1): asking for 2 spis from IPSec
01:50:24: IPSec(key_engine): got a queue event...
01:50:24: IPSec(spi_response): getting spi 393021796 for SA
        from 18.18.18.18     to 19.19.19.19     for prot 2
01:50:24: IPSec(spi_response): getting spi 45686884 for SA
        from 18.18.18.18     to 19.19.19.19     for prot 3
01:50:24: ISAKMP: received ke message (2/2)
01:50:24: CryptoEngine0: generate hmac context for conn id 1
01:50:24: ISAKMP (1): sending packet to 18.18.18.18 (R) QM_IDLE
01:50:24: ISAKMP (1): received packet from 18.18.18.18 (R) QM_IDLE
01:50:24: CryptoEngine0: generate hmac context for conn id 1
01:50:24: IPSec allocate flow 0
01:50:24: IPSec allocate flow 0
01:50:24: ISAKMP (0:1): Creating IPSec SAs
01:50:24:         inbound SA from 18.18.18.18 to 19.19.19.19
                  (proxy 18.18.18.0 to 19.19.19.0)
01:50:24:         has spi 393021796 and conn_id 2000 and flags 4
01:50:24:         lifetime of 3600 seconds
01:50:24:         lifetime of 4608000 kilobytes
01:50:24:         outbound SA from 19.19.19.19 to 18.18.18.18
                  (proxy 19.19.19.0 to 18.18.18.0)
01:50:24:         has spi 428939798 and conn_id 2001 and flags 4
01:50:24:         lifetime of 3600 seconds
01:50:24:         lifetime of 4608000 kilobytes
01:50:24: ISAKMP (0:1): Creating IPSec SAs
01:50:24:         inbound SA from 18.18.18.18 to 19.19.19.19
                  (proxy 18.18.18.0 to 19.19.19.0)
01:50:24:         has spi 45686884 and conn_id 2002 and flags 4
01:50:24:         lifetime of 3600 seconds
01:50:24:         lifetime of 4608000 kilobytes
01:50:24:         outbound SA from 19.19.19.19 to 18.18.18.18
                  (proxy 19.19.19.0 to 18.18.18.0)
01:50:24:         has spi 118036865 and conn_id 2003 and flags 4
01:50:25:         lifetime of 3600 seconds
01:50:25:         lifetime of 4608000 kilobytes
01:50:25: ISAKMP (0:1): deleting node 1108017901 error FALSE reason
          "quick mode done (await()"
01:50:25: IPSec(key_engine): got a queue event...
01:50:25: IPSec(initialize_sas): ,
  (key Eng. msg.) dest= 19.19.19.19, src= 18.18.18.18,
    dest_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    src_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    protocol= AH, transform= ah-md5-hmac ,
    lifedur= 3600s and 4608000kb,
    spi= 0x176D0964(393021796), conn_id= 2000, keysize= 0, flags= 0x4
01:50:25: IPSec(initialize_sas): ,
  (key Eng. msg.) src= 19.19.19.19, dest= 18.18.18.18,
    src_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    dest_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    protocol= AH, transform= ah-md5-hmac ,
    lifedur= 3600s and 4608000kb,
    spi= 0x19911A16(428939798), conn_id= 2001, keysize= 0, flags= 0x4
01:50:25: IPSec(initialize_sas): ,
  (key Eng. msg.) dest= 19.19.19.19, src= 18.18.18.18,
    dest_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    src_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    protocol= ESP, transform= ESP-Des ,
    lifedur= 3600s and 4608000kb,
```

```
    spi= 0x2B92064(45686884), conn_id= 2002, keysize= 0, flags= 0x4
01:50:25: IPSec(initialize_sas): ,
  (key Eng. msg.) src= 19.19.19.19, dest= 18.18.18.18,
    src_proxy= 19.19.19.0/255.255.255.0/0/0 (type=4),
    dest_proxy= 18.18.18.0/255.255.255.0/0/0 (type=4),
    protocol= ESP, transform= ESP-Des ,
    lifedur= 3600s and 4608000kb,
    spi= 0x7091981(118036865), conn_id= 2003, keysize= 0, flags= 0x4
01:50:25: IPSec(create_sa): sa created,
  (sa) sa_dest= 19.19.19.19, sa_prot= 51,
    sa_spi= 0x176D0964(393021796),
    sa_trans= ah-md5-hmac , sa_conn_id= 2000
01:50:25: IPSec(create_sa): sa created,
  (sa) sa_dest= 18.18.18.18, sa_prot= 51,
    sa_spi= 0x19911A16(428939798),
    sa_trans= ah-md5-hmac , sa_conn_id= 2001
01:50:25: IPSec(create_sa): sa created,
  (sa) sa_dest= 19.19.19.19, sa_prot= 50,
    sa_spi= 0x2B92064(45686884),
    sa_trans= ESP-Des , sa_conn_id= 2002
01:50:25: IPSec(create_sa): sa created,
  (sa) sa_dest= 18.18.18.18, sa_prot= 50,
    sa_spi= 0x7091981(118036865),
    sa_trans= ESP-Des , sa_conn_id= 2003
ubr924-1#
```

创建IPsec隧道后，您可以看到连接以及加密和解密的数据包。

```
ubr924-1#show crypto engine connection active
ID   Interface      IP-Address     State  Algorithm          Encrypt  Decrypt
   1                               set    HMAC_MD5+DES_56_CB       0        0
2000 cable-modem0   172.16.31.20   set    HMAC_MD5                 0       99
2001 cable-modem0   172.16.31.20   set    HMAC_MD5                99        0
2002 cable-modem0   172.16.31.20   set    DES_56_CBC               0       99
2003 cable-modem0   172.16.31.20   set    DES_56_CBC              99        0
```

前200x行显示收到的99个数据包。它必须解密数据包才能将其发送到PC1。第二行显示99个已发送的数据包。它必须在将数据包发送到uBR904-2之前对数据包进行加密。第三行和第四行执行相同的过程，但使用ESP-DES转换而不是AH-MD5-HMAC。

注意：如果电缆调制解调器上配置的转换集是ESP-DES ESP-MD5-HMAC，则您只能看到两个自治系统(AS)，而不是前面的**show命**令。

```
ubr904-2#show crypto engine connection active
ID   Interface      IP-Address     State  Algorithm          Encrypt  Decrypt
   1                               set    HMAC_MD5+DES_56_CB       0        0
2000 cable-modem0   172.16.30.18   set    HMAC_MD5                 0       99
2001 cable-modem0   172.16.30.18   set    HMAC_MD5                99        0
2002 cable-modem0   172.16.30.18   set    DES_56_CBC               0       99
2003 cable-modem0   172.16.30.18   set    DES_56_CBC              99        0
```

从uBR924-1向PC2发出扩展ping命令，查看已加密和解密数据包的计数器是否增加。

```
ubr924-1#ping ip
Target IP address: 18.18.18.1
Repeat count [5]: 50
Datagram size [100]:
Timeout in seconds [2]:
```

```
Extended commands [n]: y
Source address or interface: 19.19.19.19
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 50, 100-byte ICMP Echos to 18.18.18.1, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (50/50), round-trip min/avg/max = 28/30/33 ms

ubr924-1#show crypto engine connection active
ID   Interface      IP-Address     State  Algorithm          Encrypt  Decrypt
   1                               set    HMAC_MD5+DES_56_CB       0        0
2000 cable-modem0   172.16.31.20   set    HMAC_MD5                 0      149
2001 cable-modem0   172.16.31.20   set    HMAC_MD5               149        0
2002 cable-modem0   172.16.31.20   set    DES_56_CBC               0      149
2003 cable-modem0   172.16.31.20   set    DES_56_CBC             149        0

ubr904-2#show crypto engine connection active
ID   Interface      IP-Address     State  Algorithm          Encrypt  Decrypt
   1                               set    HMAC_MD5+DES_56_CB       0        0
2000 cable-modem0   172.16.30.18   set    HMAC_MD5                 0      149
2001 cable-modem0   172.16.30.18   set    HMAC_MD5               149        0
2002 cable-modem0   172.16.30.18   set    DES_56_CBC               0      149
2003 cable-modem0   172.16.30.18   set    DES_56_CBC             149        0
```

可以发出另一个扩展ping，以查看计数器再次递增。此时，从uBR904-2向uBR924-1(19.19.19.19)的以太网接口发送一个500数据包ping。

```
ubr904-2#ping ip
Target IP address: 19.19.19.19
Repeat count [5]: 500
Datagram size [100]: 1000
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 18.18.18.18
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 500, 1000-byte ICMP Echos to 19.19.19.19, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
01:59:06: IPSec(encapsulate): encaps area too small, moving to new buffer:
idbtype 0, encaps_size 26, header size 60, avail 84!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!
Success rate is 100 percent (500/500), round-trip min/avg/max = 98/135/352 ms

ubr904-2#show crypto engine connection active
ID   Interface      IP-Address     State  Algorithm          Encrypt  Decrypt
```

```
   1                                set    HMAC_MD5+DES_56_CB       0        0
2000 cable-modem0   172.16.30.18    set    HMAC_MD5                 0      649
2001 cable-modem0   172.16.30.18    set    HMAC_MD5               649        0
2002 cable-modem0   172.16.30.18    set    DES_56_CBC               0      649
2003 cable-modem0   172.16.30.18    set    DES_56_CBC             649        0

ubr924-1#show crypto engine connection active
ID   Interface      IP-Address      State  Algorithm          Encrypt  Decrypt
   1                                set    HMAC_MD5+DES_56_CB       0        0
2000 cable-modem0   172.16.31.20    set    HMAC_MD5                 0      649
2001 cable-modem0   172.16.31.20    set    HMAC_MD5               649        0
2002 cable-modem0   172.16.31.20    set    DES_56_CBC               0      649
2003 cable-modem0   172.16.31.20    set    DES_56_CBC             649        0
```

您可以发出**clear crypto isakmp**和**clear crypto sa**命令来清除连接。此外，如果在过期时间内没有通过IPsec隧道的流量，IPsec会自动重置连接。

故障排除

当前没有故障排除此配置的特定可用资料。

相关信息

- IPsec网络安全命令
- IP安全(IPsec)加密简介 — 调试信息
- IPSec 配置示例
- 配置 IPSec 网络安全
- 配置思科uBR900系列有线接入路由器
- Cisco 有线/宽频下载(注册用户)
- 宽带有线支持
- 技术支持和文档 - Cisco Systems