

CS581 (Computer & Network Security)

Lab-04

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IPSec VPN

Setup a site-to-site IPSec VPN tunnel between your Cisco router and your Cisco ASA firewall. Submit (i) the configuration files used on the two Cisco devices and (ii) evidence that the IPSec tunnel works via output of debug ipsec, show crypto isakmp sa, and show crypto ipsec on both Cisco ASA firewall and on Cisco router.

We, Group No. 5, performed this lab on GNS3 in below steps:

Step 1: Draw a Network Topology Diagram

Step 2: Configuring PC & Router Configuration

Step 3: Checking Network Connectivity

Step 4: Configuring IKE & IPSec

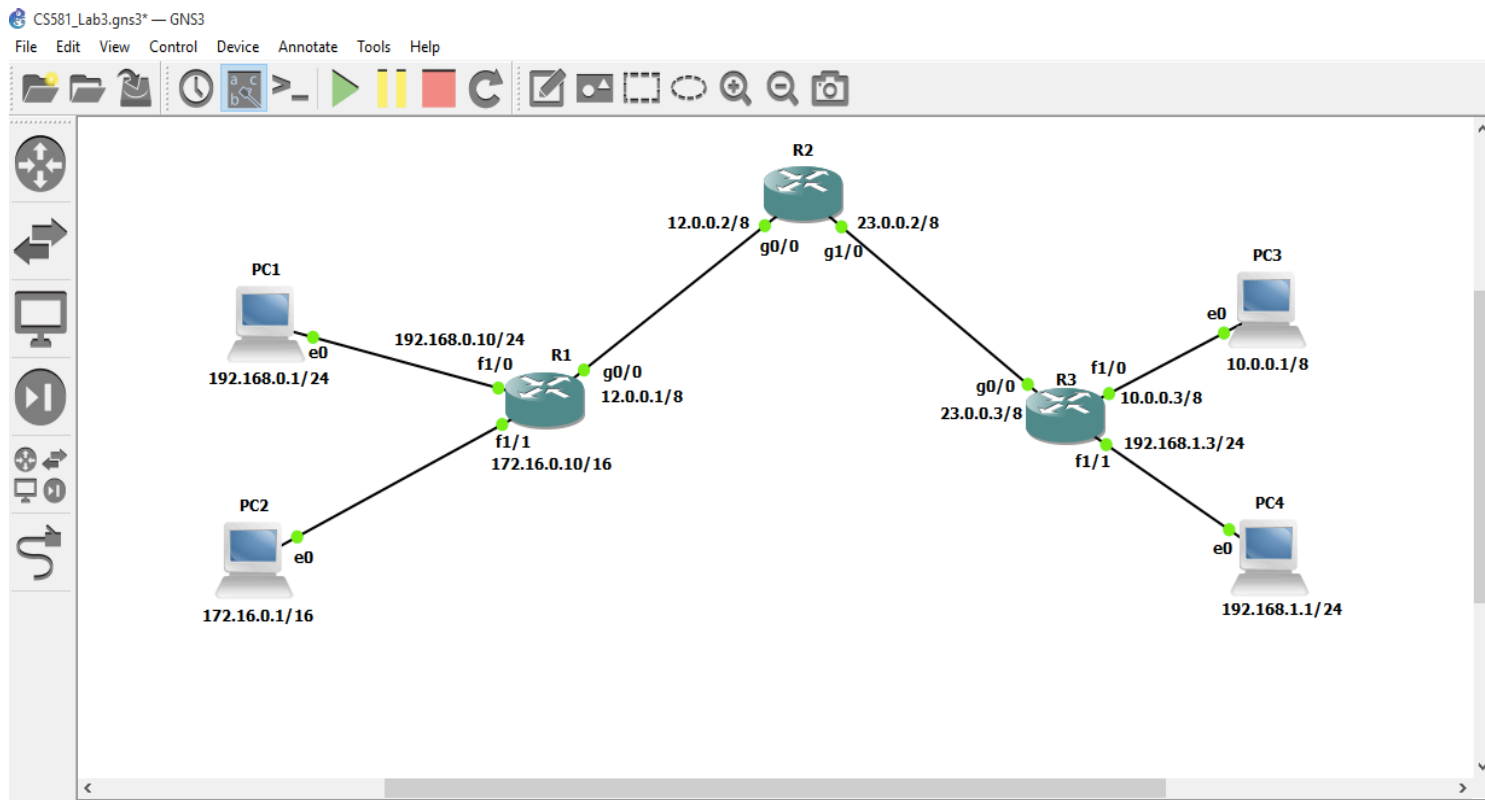
Step 5: Screenshots

Step 1: Draw a Network Topology Diagram

So, we kept 3 routers: R1, R2 and R3 and 4 PCs: PC1, PC2, PC3 and PC4

- R2 will simulate like as public network / cloud
- R1 and R3 will be connected to a public network i.e. R2
- R1 has two PCs i.e. PC1 and PC2
- R3 has also two PCs i.e. PC3 and PC4
- PC1 has an IP a/c to diagram is 192.168.0.1 and PC4 has an IP a/c to diagram is 192.168.1.1
- PC1 and PC4 has been connected to two different network i.e. one is in 192.168.0.0 network and another is in 192.168.1.0
- So, our aim is nothing but traffic going from PC1 (192.168.0.1) to PC4 (192.168.1.1) only should use VPN. In other words, no VPN should be available for PC1 – PC3.
- Only PC1 to PC4 should be a secured communication.
- The tunneling point is R1 and R3.
- We have formed a VPN tunnel between R1 to R3.

This is the below network diagram:



PC1 (e0): 192.168.0.1/24

PC2 (e0): 172.16.0.1/16

R1 (f1/0): 192.168.0.10/24

R1 (f1/1): 172.16.0.10/16

R1 (g0/0): 12.0.0.1/8

R2 (g0/0): 12.0.0.2/8

R2 (g1/0): 23.0.0.2/8

R3 (g0/0): 23.0.0.3/8

R3 (f1/0): 10.0.0.3/8

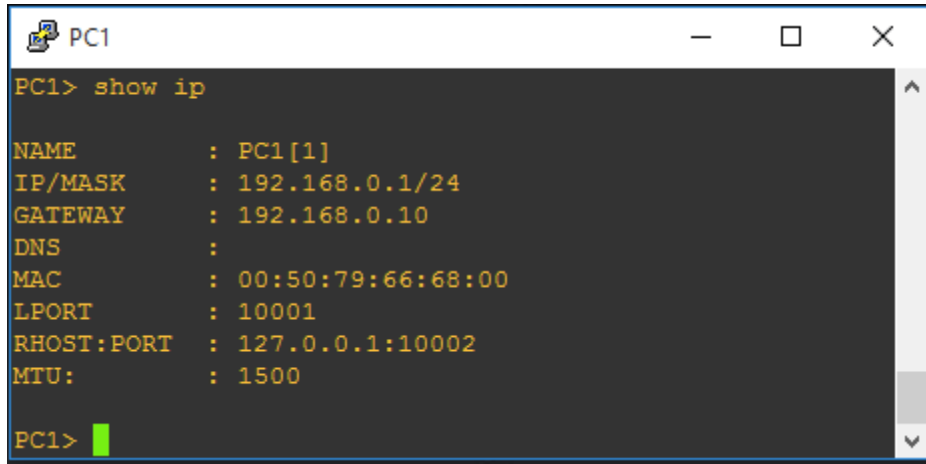
R3 (f1/1): 192.168.1.3/24

PC3 (e0): 10.0.0.1/8

PC4 (e0): 192.168.1.1/24

Step 2: Configuring PC & Router Configuration

PC1 Configuration:

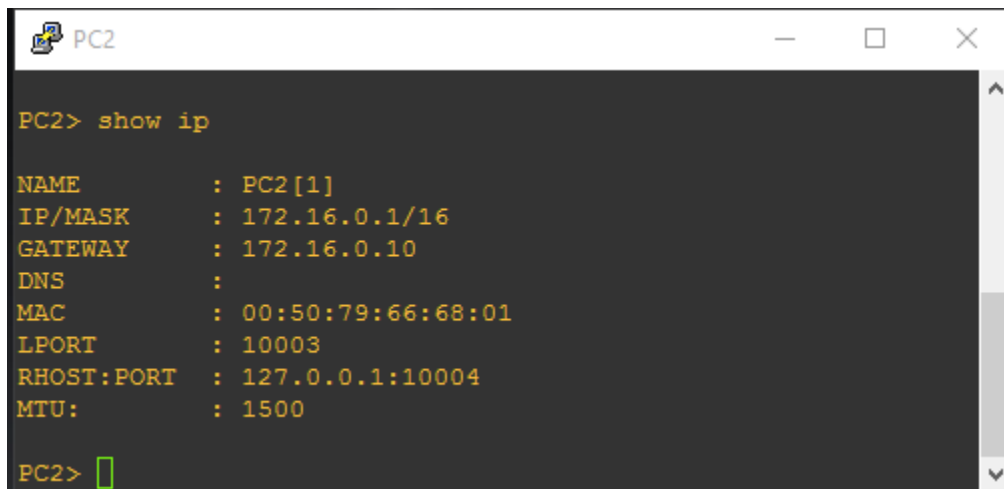
A screenshot of a terminal window titled "PC1". The window has a dark background and a light-colored title bar with standard window controls. The terminal displays the output of the "show ip" command. The output shows the following configuration: NAME: PC1[1], IP/MASK: 192.168.0.1/24, GATEWAY: 192.168.0.10, DNS: (empty), MAC: 00:50:79:66:68:00, LPORT: 10001, RHOST:PORT: 127.0.0.1:10002, and MTU: 1500. A green cursor is visible at the bottom of the terminal, indicating the prompt "PC1>".

```
PC1> show ip

NAME       : PC1[1]
IP/MASK    : 192.168.0.1/24
GATEWAY    : 192.168.0.10
DNS        :
MAC        : 00:50:79:66:68:00
LPORT      : 10001
RHOST:PORT : 127.0.0.1:10002
MTU        : 1500

PC1>
```

PC2 Configuration:

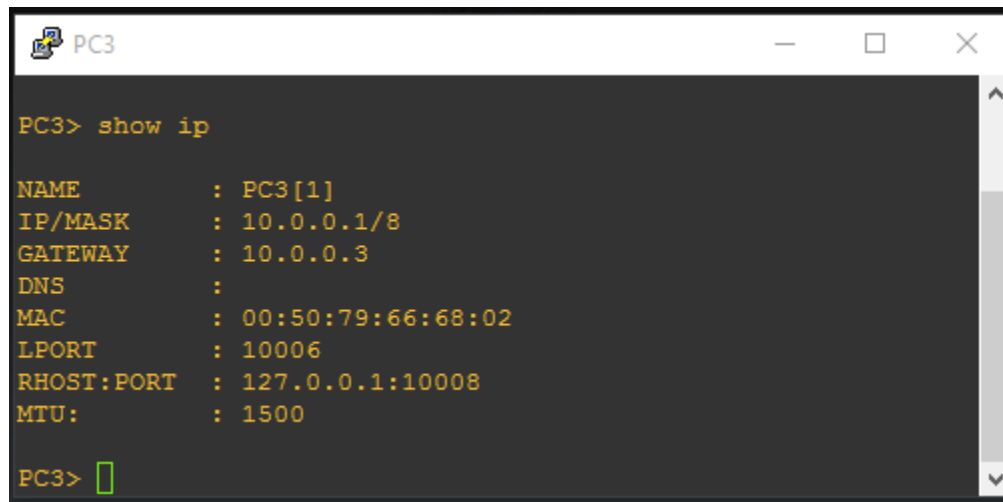
A screenshot of a terminal window titled "PC2". The window has a dark background and a light-colored title bar with standard window controls. The terminal displays the output of the "show ip" command. The output shows the following configuration: NAME: PC2[1], IP/MASK: 172.16.0.1/16, GATEWAY: 172.16.0.10, DNS: (empty), MAC: 00:50:79:66:68:01, LPORT: 10003, RHOST:PORT: 127.0.0.1:10004, and MTU: 1500. A green cursor is visible at the bottom of the terminal, indicating the prompt "PC2>".

```
PC2> show ip

NAME       : PC2[1]
IP/MASK    : 172.16.0.1/16
GATEWAY    : 172.16.0.10
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 10003
RHOST:PORT : 127.0.0.1:10004
MTU        : 1500

PC2>
```

PC3 Configuration:

A screenshot of a terminal window titled "PC3". The window has a dark background and a light-colored title bar with standard window controls. The terminal displays the output of the "show ip" command. The output is as follows:

```
PC3> show ip

NAME       : PC3[1]
IP/MASK    : 10.0.0.1/8
GATEWAY    : 10.0.0.3
DNS        :
MAC        : 00:50:79:66:68:02
LPORT      : 10006
RHOST:PORT : 127.0.0.1:10008
MTU        : 1500

PC3> 
```

A green cursor is visible at the end of the last line.

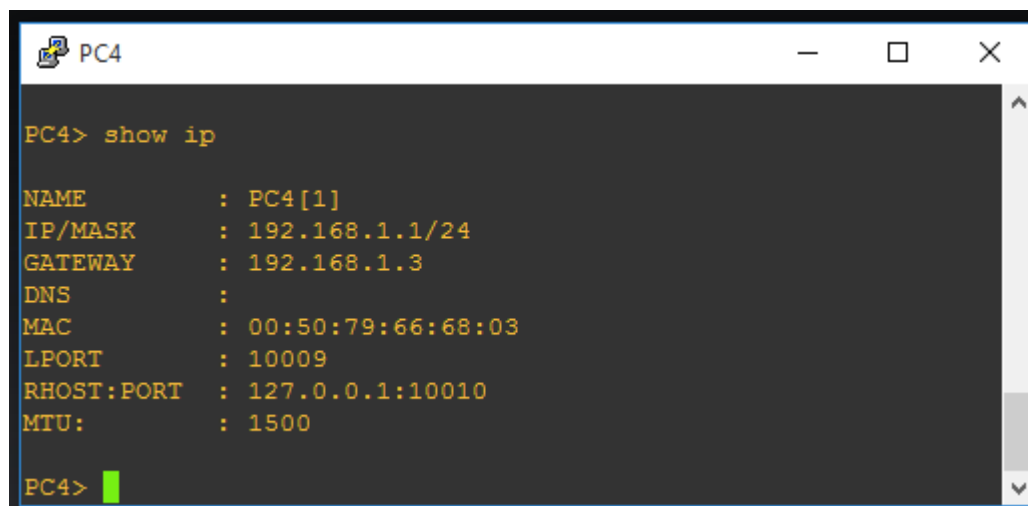
PC3

```
PC3> show ip

NAME       : PC3[1]
IP/MASK    : 10.0.0.1/8
GATEWAY    : 10.0.0.3
DNS        :
MAC        : 00:50:79:66:68:02
LPORT      : 10006
RHOST:PORT : 127.0.0.1:10008
MTU        : 1500

PC3> 
```

PC4 Configuration:

A screenshot of a terminal window titled "PC4". The window has a dark background and a light-colored title bar with standard window controls. The terminal displays the output of the "show ip" command. The output is as follows:

```
PC4> show ip

NAME       : PC4[1]
IP/MASK    : 192.168.1.1/24
GATEWAY    : 192.168.1.3
DNS        :
MAC        : 00:50:79:66:68:03
LPORT      : 10009
RHOST:PORT : 127.0.0.1:10010
MTU        : 1500

PC4> 
```

A green cursor is visible at the end of the last line.

PC4

```
PC4> show ip

NAME       : PC4[1]
IP/MASK    : 192.168.1.1/24
GATEWAY    : 192.168.1.3
DNS        :
MAC        : 00:50:79:66:68:03
LPORT      : 10009
RHOST:PORT : 127.0.0.1:10010
MTU        : 1500

PC4> 
```

R1 (Interface Configuration):

```
R1# conf t
R1(config)# int f1/0
R1(config-if)# ip add 192.168.0.10 255.255.255.0
R1(config-if)# no sh
R1(config-if)# ip ospf 1 area 0
R1(config-if)# exit
R1(config)# int f1/1
R1(config-if)# ip add 172.16.0.10 255.255.0.0
R1(config-if)# no sh
R1(config-if)# ip ospf 1 area 0
R1(config-if)# exit
R1(config)# int g0/0
R1(config-if)# ip add 12.0.0.1 255.0.0.0
R1(config-if)# no sh
R1(config-if)# ip ospf 1 area 0
R1(config-if)# exit
R1(config)# exit
R1# wr me
```

```
R1
R1#show interfaces f1/0
FastEthernet1/0 is up, line protocol is up
  Hardware is i82543 (Livengood), address is ca01.1020.001c (bia ca01.1020.001c)
  Internet address is 192.168.0.10/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 02:50:05, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    20 packets input, 1718 bytes
      Received 6 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog
    0 input packets with dribble condition detected
  3017 packets output, 287223 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
R1#
R1#
```

```
R1
R1#show interfaces f1/1
FastEthernet1/1 is up, line protocol is up
  Hardware is i82543 (Livengood), address is ca01.1020.001d (bia ca01.1020.001d)
  Internet address is 172.16.0.10/16
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 03:39:23, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    5 packets input, 452 bytes
      Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog
    0 input packets with dribble condition detected
  3009 packets output, 286769 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
R1#
R1#
```

```
R1
R1#show interfaces g0/0
GigabitEthernet0/0 is up, line protocol is up
  Hardware is i82543 (Livengood), address is ca01.1020.0008 (bia ca01.1020.0008)
  Internet address is 12.0.0.1/8
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 1000Mb/s, link type is autonegotiation, media type is SX
  output flow-control is XON, input flow-control is XON
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:07, output 00:00:07, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    3002 packets input, 293794 bytes, 0 no buffer
    Received 1619 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog, 0 multicast, 0 pause input
    0 input packets with dribble condition detected
    3061 packets output, 298960 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier, 0 pause output
    0 output buffer failures, 0 output buffers swapped out
R1#
```

R2 (Interface Configuration):

```
R2# conf t
```

```
R2(config)# int g0/0
```

```
R2(config-if)# ip add 12.0.0.2 255.0.0.0
```

```
R2(config-if)# no sh
```

```
R2(config-if)# ip ospf 1 area 0
```

```
R2(config-if)# exit
```

```
R2(config)# int g1/0
```

```
R2(config-if)# ip add 23.0.0.2 255.0.0.0
```

```
R2(config-if)# no sh
```

```
R2(config-if)# ip ospf 1 area 0
```

```
R2(config-if)# exit
```

```
R2(config)# exit
```

```
R2# wr me
```



```
R2
R2#show interfaces g0/0
GigabitEthernet0/0 is up, line protocol is up
  Hardware is i82543 (Livengood), address is ca02.051c.0008 (bia ca02.051c.0008)
  Internet address is 12.0.0.2/8
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 1000Mb/s, link type is autonegotiation, media type is SX
  output flow-control is XON, input flow-control is XON
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:04, output 00:00:03, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    3086 packets input, 301044 bytes, 0 no buffer
    Received 1669 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog, 0 multicast, 0 pause input
    0 input packets with dribble condition detected
    3092 packets output, 302572 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier, 0 pause output
    0 output buffer failures, 0 output buffers swapped out
R2#
```

```
R2
R2#show interfaces g1/0
GigabitEthernet1/0 is up, line protocol is up
  Hardware is 82543, address is ca02.051c.001c (bia ca02.051c.001c)
  Internet address is 23.0.0.2/8
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 1000Mb/s, link type is autonegotiation, media type is SX
  output flow-control is unsupported, input flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:03, output 00:00:03, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    3087 packets input, 301367 bytes, 0 no buffer
    Received 1666 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog, 0 multicast, 0 pause input
    0 input packets with dribble condition detected
    3078 packets output, 301190 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier, 0 pause output
    0 output buffer failures, 0 output buffers swapped out
R2#
```

R3 (Interface Configuration):

```
R3# conf t
R3(config)# int f1/0
R3(config-if)# ip add 10.0.0.3 255.0.0.0
R3(config-if)# no sh
R3(config-if)# ip ospf 1 area 0
R3(config-if)# exit
R3(config)# int f1/1
R3(config-if)# ip add 192.168.1.3 255.255.255.0
R3(config-if)# no sh
R3(config-if)# ip ospf 1 area 0
R3(config-if)# exit
R3(config)# int g0/0
R3(config-if)# ip add 12.0.0.1 255.0.0.0
R3(config-if)# no sh
R3(config-if)# ip ospf 1 area 0
R3(config-if)# exit
R3(config)# exit
R3# wr me
```

```
R3
R3#show interfaces g0/0
GigabitEthernet0/0 is up, line protocol is up
  Hardware is i82543 (Livengood), address is ca03.0808.0008 (bia ca03.0808.0008)
  Internet address is 23.0.0.3/8
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 1000Mb/s, link type is autonegotiation, media type is SX
  output flow-control is XON, input flow-control is XON
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:05, output 00:00:04, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    3093 packets input, 302609 bytes, 0 no buffer
    Received 1669 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog, 0 multicast, 0 pause input
    0 input packets with dribble condition detected
    3137 packets output, 306681 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier, 0 pause output
    0 output buffer failures, 0 output buffers swapped out
R3#
```

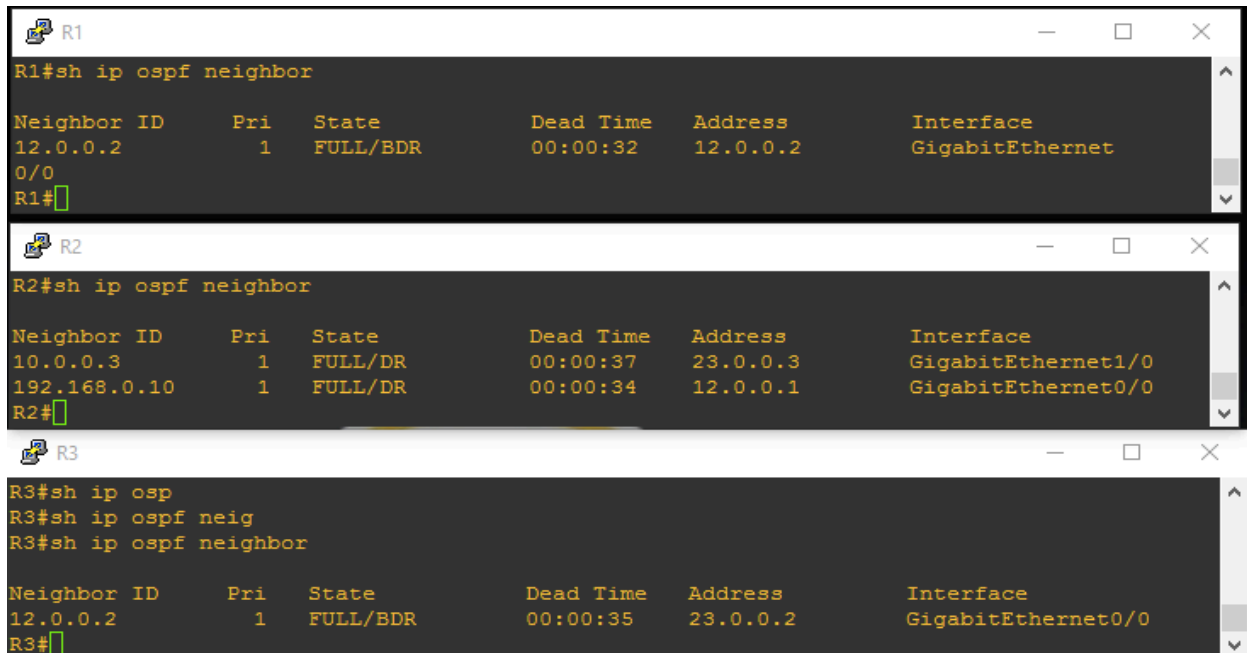
```
R3
R3#show interfaces f1/0
FastEthernet1/0 is up, line protocol is up
  Hardware is i82543 (Livengood), address is ca03.0808.001c (bia ca03.0808.001c)
  Internet address is 10.0.0.3/8
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    0 packets input, 0 bytes
    Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog
    0 input packets with dribble condition detected
    3095 packets output, 294970 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
R3#
R3#
```

```
R3
R3#show interfaces f1/1
FastEthernet1/1 is up, line protocol is up
  Hardware is i82543 (Livengood), address is ca03.0808.001d (bia ca03.0808.001d)
  Internet address is 192.168.1.3/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 03:00:56, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    34 packets input, 3196 bytes
      Received 4 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog
    0 input packets with dribble condition detected
  3120 packets output, 297158 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
R3#
R3#
```

Step 3: Checking Network Connectivity

We configured ospf for network connectivity.

Following screenshot shows the ospf neighbor of each router:



The image displays three separate terminal windows for routers R1, R2, and R3, each showing the output of the 'show ip ospf neighbor' command. The windows are titled 'R1', 'R2', and 'R3' respectively.

R1 Output:

Neighbor ID	Pri	State	Dead Time	Address	Interface
12.0.0.2	1	FULL/BDR	00:00:32	12.0.0.2	GigabitEthernet 0/0

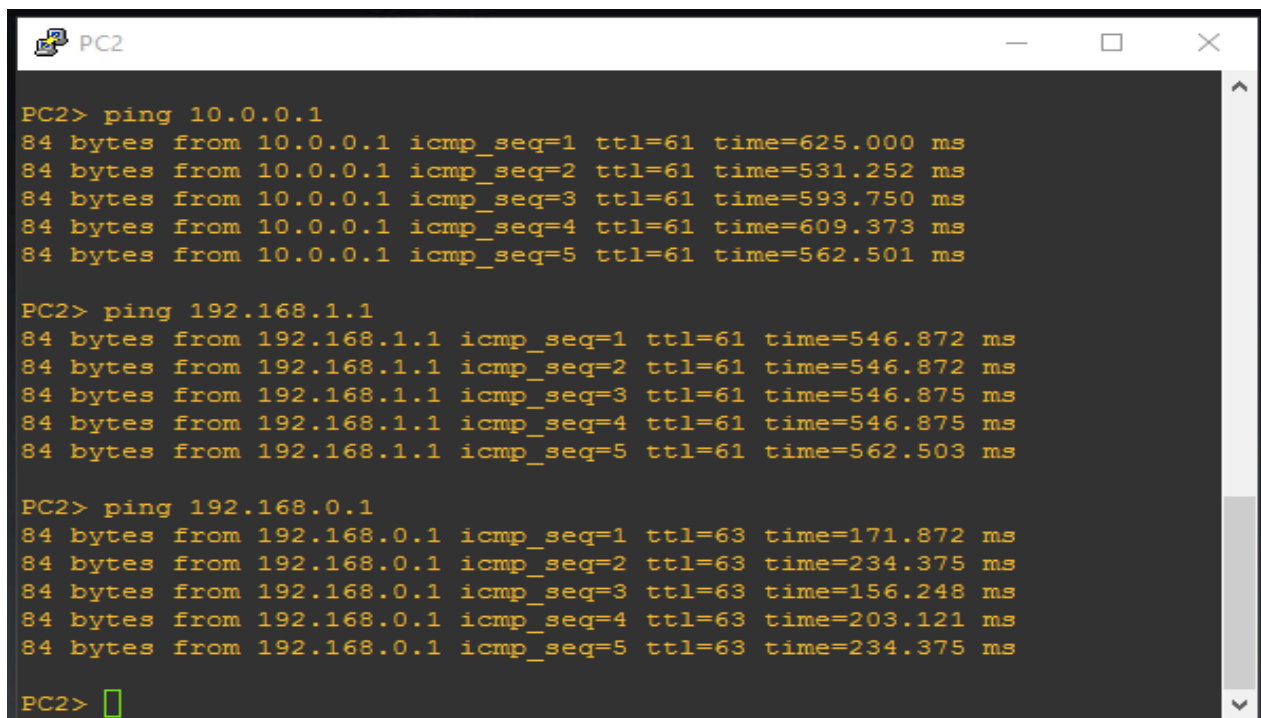
R2 Output:

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.0.0.3	1	FULL/DR	00:00:37	23.0.0.3	GigabitEthernet1/0
192.168.0.10	1	FULL/DR	00:00:34	12.0.0.1	GigabitEthernet0/0

R3 Output:

Neighbor ID	Pri	State	Dead Time	Address	Interface
12.0.0.2	1	FULL/BDR	00:00:35	23.0.0.2	GigabitEthernet0/0

Network Connectivity:



The image shows a terminal window for PC2 with the title 'PC2'. It displays the results of three ping commands: 'ping 10.0.0.1', 'ping 192.168.1.1', and 'ping 192.168.0.1'. Each command is followed by five successful ping responses, each showing '84 bytes from' and a response time in milliseconds.

PC2 Output:

```
PC2> ping 10.0.0.1
84 bytes from 10.0.0.1 icmp_seq=1 ttl=61 time=625.000 ms
84 bytes from 10.0.0.1 icmp_seq=2 ttl=61 time=531.252 ms
84 bytes from 10.0.0.1 icmp_seq=3 ttl=61 time=593.750 ms
84 bytes from 10.0.0.1 icmp_seq=4 ttl=61 time=609.373 ms
84 bytes from 10.0.0.1 icmp_seq=5 ttl=61 time=562.501 ms

PC2> ping 192.168.1.1
84 bytes from 192.168.1.1 icmp_seq=1 ttl=61 time=546.872 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=61 time=546.872 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=61 time=546.875 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=61 time=546.875 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=61 time=562.503 ms

PC2> ping 192.168.0.1
84 bytes from 192.168.0.1 icmp_seq=1 ttl=63 time=171.872 ms
84 bytes from 192.168.0.1 icmp_seq=2 ttl=63 time=234.375 ms
84 bytes from 192.168.0.1 icmp_seq=3 ttl=63 time=156.248 ms
84 bytes from 192.168.0.1 icmp_seq=4 ttl=63 time=203.121 ms
84 bytes from 192.168.0.1 icmp_seq=5 ttl=63 time=234.375 ms

PC2>
```

Step 4: Configuring IKE & IPSec

- Configure ISAKMP
- Create Crypto ACL
- Define Transform Sets
- Create Crypto map entries
- Set global lifetime for IPSec Sa
- Apply crypto map to the interfaces

Step 1:

R1 Configuration:

```
R1# conf t
R1(config)# crypto isakmp policy 1
R1(config-isakmp)# authentication pre-share
R1(config-isakmp)# encryption des
R1(config-isakmp)# group 2
R1(config-isakmp)# hash md5
R1(config-isakmp)# exit
R1(config)# crypto isakmp key cisco123 address 23.0.0.3
```

R3 Configuration:

```
R3# conf t
R3(config)# crypto isakmp policy 1
R3(config-isakmp)# authentication pre-share
R3(config-isakmp)# encryption des
R3(config-isakmp)# group 2
R3(config-isakmp)# hash md5
R3(config-isakmp)# exit
R3(config)# crypto isakmp key cisco123 address 12.0.0.1
```

Step 2:

R1 Configuration:

```
R1(config)# crypto ipsec transform-set TR_SET esp-3des esp-md5-hmac
R1(cfg-crypto-trans)# exit
R1(config)#
```

R3 Configuration:

```
R3(config)# crypto ipsec transform-set TR_SET esp-3des esp-md5-hmac
R3(cfg-crypto-trans)# exit
R3(config)#
```

Step 3:

R1 Configuration:

```
R1(config)# access-list 101 permit ip host 192.168.0.1 host 192.168.1.1
R1(config)# crypto map cmap 1 ipsec-isakmp
R1(config-crypto-map)# set peer 23.0.0.3
R1(config-crypto-map)# set transform-set TR_SET
R1(config-crypto-map)# match address 101
R1(config-crypto-map)# exit
R1(config)# interface g0/0
R1(config-if)# crypto map cmap
R1(config-if)# exit
R1(config)#
```

R3 Configuration:

```
R3(config)# access-list 101 permit ip host 192.168.1.1 host 192.168.0.1
```

```
R3(config)# crypto map cmap 1 ipsec-isakmp
```

```
R3(config-crypto-map)# set peer 12.0.0.1
```

```
R3(config-crypto-map)# set transform-set TR_SET
```

```
R3(config-crypto-map)# match address 101
```

```
R3(config-crypto-map)# exit
```

```
R3(config)# interface g0/0
```

```
R3(config-if)# crypto map cmap
```

```
R3(config-if)# exit
```

```
R3(config)#
```


A screenshot of a terminal window titled "R1". The prompt is "R1#show running-config". Below it, the text "Building configuration..." appears. Then, "Current configuration : 1464 bytes" is shown. This is followed by several exclamation marks (!) indicating sections of the configuration are being displayed or omitted. Visible configurations include:
`version 12.4`
`service timestamps debug datetime msec`
`service timestamps log datetime msec`
`no service password-encryption`
`hostname R1`
`boot-start-marker`
`boot-end-marker`
`no aaa new-model`
`no ip icmp rate-limit unreachable`
`ip cef`
`no ip domain lookup`
`ip tcp synwait-time 5`
`crypto isakmp policy 1`
 `hash md5`
 `authentication pre-share`
 `group 2`
`crypto isakmp key cisco123 address 23.0.0.3`

```
!
!
crypto ipsec transform-set TR_SET esp-3des esp-md5-hmac
!
crypto map cmap 1 ipsec-isakmp
  set peer 23.0.0.3
  set transform-set TR_SET
  match address 101
!
!
!
!
interface Ethernet0/0
  no ip address
  shutdown
  duplex auto
!
interface GigabitEthernet0/0
  ip address 12.0.0.1 255.0.0.0
  ip ospf 1 area 0
  duplex full
  speed 1000
  media-type gbic
  negotiation auto
  crypto map cmap
!
interface FastEthernet1/0
  ip address 192.168.0.10 255.255.255.0
  ip ospf 1 area 0
  duplex auto
  speed auto
!
interface FastEthernet1/1
  ip address 172.16.0.10 255.255.0.0
  ip ospf 1 area 0
  duplex auto
  speed auto
!
router ospf 1
  log-adjacency-changes
!
!
no ip http server
no ip http secure-server
!
!
access-list 101 permit ip host 192.168.0.1 host 192.168.1.1
no cdp log mismatch duplex
!
--More--
```

```
R1
!
!
!
control-plane
!
!
!
!
!
!
gatekeeper
 shutdown
!
!
line con 0
  exec-timeout 0 0
  privilege level 15
  logging synchronous
  stopbits 1
line aux 0
  exec-timeout 0 0
  privilege level 15
  logging synchronous
  stopbits 1
line vty 0 4
  login
!
!
end

R1#
R1#
```

- [illegible]

```
R3
!
!
crypto ipsec transform-set TR_SET esp-3des esp-md5-hmac
!
crypto map cmap 1 ipsec-isakmp
  set peer 12.0.0.1
  set transform-set TR_SET
  match address 101
!
!
!
!
interface Ethernet0/0
  no ip address
  shutdown
  duplex auto
!
interface GigabitEthernet0/0
  ip address 23.0.0.3 255.0.0.0
  ip ospf 1 area 0
  duplex full
  speed 1000
  media-type gbic
  negotiation auto
  crypto map cmap
!
interface FastEthernet1/0
  ip address 10.0.0.3 255.0.0.0
  ip ospf 1 area 0
  duplex auto
  speed auto
!
interface FastEthernet1/1
  ip address 192.168.1.3 255.255.255.0
  ip ospf 1 area 0
  duplex auto
  speed auto
!
router ospf 1
  log-adjacency-changes
!
!
no ip http server
no ip http secure-server
!
!
access-list 101 permit ip host 192.168.1.1 host 192.168.0.1
no cdp log mismatch duplex
!
!
--More--
```

```
R3
!
!
!
!
control-plane
!
!
!
!
!
!
gatekeeper
shutdown
!
!
line con 0
  exec-timeout 0 0
  privilege level 15
  logging synchronous
  stopbits 1
line aux 0
  exec-timeout 0 0
  privilege level 15
  logging synchronous
  stopbits 1
line vty 0 4
  login
!
!
end
R3#
```

2. Output of **debug crypto isakmp** and **debug crypto ipsec** on both cisco devices i.e. for R1 and R3

R1: <debug crypto isakmp>

A terminal window titled 'R1' with standard window controls (minimize, maximize, close). The terminal text shows the command 'R1#debug crypto isakmp' being entered, followed by the system response 'Crypto ISAKMP debugging is on', and then the prompt 'R1#' with a cursor.

```
R1#debug crypto isakmp
Crypto ISAKMP debugging is on
R1#
```

R1: <debug crypto ipsec>

A terminal window titled 'R1' with standard window controls. The terminal text shows the command 'R1#debug crypto ipsec' being entered, followed by the system response 'Crypto IPSEC debugging is on', and then the prompt 'R1#' with a cursor.

```
R1#debug crypto ipsec
Crypto IPSEC debugging is on
R1#
```

R3: <debug crypto isakmp>

A terminal window titled 'R3' with standard window controls. The terminal text shows the command 'R3#debug crypto isakmp' being entered, followed by the system response 'Crypto ISAKMP debugging is on', and then the prompt 'R3#' with a cursor.

```
R3#debug crypto isakmp
Crypto ISAKMP debugging is on
R3#
```

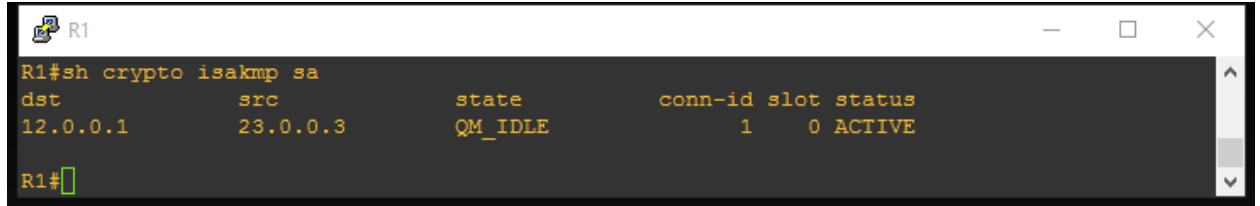
R3: <debug crypto ipsec>

A terminal window titled 'R3' with standard window controls. The terminal text shows the command 'R3#debug crypto ipsec' being entered, followed by the system response 'Crypto IPSEC debugging is on', and then the prompt 'R3#' with a cursor.

```
R3#debug crypto ipsec
Crypto IPSEC debugging is on
R3#
```

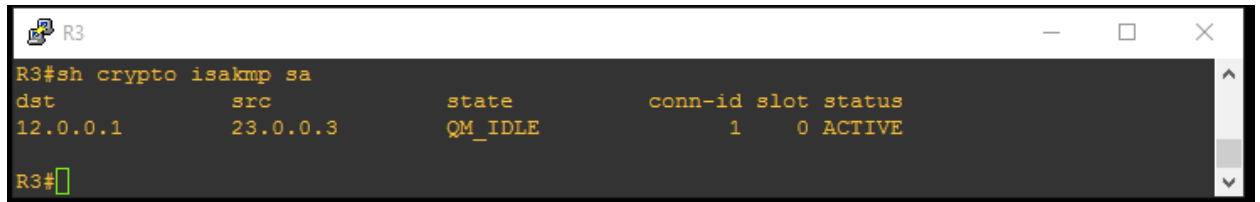
3. Output of **show crypto isakmp sa** for both cisco devices

R1:



```
R1#sh crypto isakmp sa
dst          src          state          conn-id slot status
12.0.0.1     23.0.0.3     QM_IDLE              1    0 ACTIVE
R1#
```

R3:



```
R3#sh crypto isakmp sa
dst          src          state          conn-id slot status
12.0.0.1     23.0.0.3     QM_IDLE              1    0 ACTIVE
R3#
```


4. Output of **show crypto ipsec sa** for both cisco devices i.e. for R1 and R3

R1:

```
R1#sh crypto ipsec sa

interface: GigabitEthernet0/0
  Crypto map tag: cmap, local addr 12.0.0.1

protected vrf: (none)
local  ident (addr/mask/prot/port): (192.168.0.1/255.255.255.255/0/0)
remote ident (addr/mask/prot/port): (192.168.1.1/255.255.255.255/0/0)
current_peer 23.0.0.3 port 500
  PERMIT, flags={origin_is_acl,}
  #pkts encaps: 13, #pkts encrypt: 13, #pkts digest: 13
  #pkts decaps: 14, #pkts decrypt: 14, #pkts verify: 14
  #pkts compressed: 0, #pkts decompressed: 0
  #pkts not compressed: 0, #pkts compr. failed: 0
  #pkts not decompressed: 0, #pkts decompress failed: 0
  #send errors 0, #recv errors 0

local crypto endpt.: 12.0.0.1, remote crypto endpt.: 23.0.0.3
path mtu 1500, ip mtu 1500, ip mtu idb GigabitEthernet0/0
current outbound spi: 0x0(0)
```

R3:

```
R3#sh crypto ipsec sa

interface: GigabitEthernet0/0
  Crypto map tag: cmap, local addr 23.0.0.3

protected vrf: (none)
local  ident (addr/mask/prot/port): (192.168.1.1/255.255.255.255/0/0)
remote ident (addr/mask/prot/port): (192.168.0.1/255.255.255.255/0/0)
current_peer 12.0.0.1 port 500
  PERMIT, flags={origin_is_acl,}
  #pkts encaps: 14, #pkts encrypt: 14, #pkts digest: 14
  #pkts decaps: 13, #pkts decrypt: 13, #pkts verify: 13
  #pkts compressed: 0, #pkts decompressed: 0
  #pkts not compressed: 0, #pkts compr. failed: 0
  #pkts not decompressed: 0, #pkts decompress failed: 0
  #send errors 1, #recv errors 0

local crypto endpt.: 23.0.0.3, remote crypto endpt.: 12.0.0.1
path mtu 1500, ip mtu 1500, ip mtu idb GigabitEthernet0/0
current outbound spi: 0x0(0)
```