

VPN(GRE)

Virtual Private Network

Private IP address

10.0.0.0/8	main A
172.16.0.0/16 – 172.31.0.0/16	main B
192.168.0.0/24 – 192.168.255.0/24	main C

Overlay VPN

PPTP L2TP IPsec SSLVPN GETVPN GRE VPN DMVPN/DSVPN

GRE Generic Routing Encapsulation (not safe but easy)

Tunnel interface(**a virtual logical interface doing overlay** on Router), this interface does not have the capability to transmit data, the interface that transmit data is still through a physical interface.

Boarder devices will do overlay operation, to let original 3 layer package add the public address header. Tunnel Source IP addr(SIP) & Tunnel Destination IP addr(DIP)

Ethernet2	Tunnel IPv4	GRE	Private IPv4	TCP	HTTP	FCS
-----------	-------------	-----	--------------	-----	------	-----

Default router ip 0.0.0.0/0

PC(A)-Router 1-----ISP-----Router 2-PC(B)

Logically directly connect: Tunnel IP on Router 1 and 2 must be in the same subnetwork(same NetID)

Steps

1. Two sides' boarders public net interfaces connect(static default)
2. Tunnel interfaces of R1 and R2 configure Tunnel Source and Tunnel Destination
3. Set Tunnel interfaces in the same subnet, and run IGP route between R1 and R2

Config

R1

% Please answer 'yes' or 'no'.

Would you like to enter the initial configuration dialog? [yes/no]: no

Router>en

Router#conf t

Router(config)#hostname R1

R1(config)#interface ethernet 0/1

R1(config-if)#no shutdown

R1(config-if)#ip address 13.1.1.1 255.255.255.0

R1(config-if)#no shutdown

R1(config-if)#exit

R1(config)#interface ethernet 0/0

R1(config-if)#no shutdown

R1(config-if)#ip address 12.1.1.1 255.255.255.0

R1(config-if)#no shutdown

R1(config-if)#exit

R1#show ip interface brief

```
R1#show ip interface brief
Interface          IP-Address      OK? Method Status        Protocol
Ethernet0/0        12.1.1.1        YES manual  up            up
Ethernet0/1        13.1.1.1        YES manual  up            up
Ethernet0/2        unassigned      YES unset   administratively down down
Ethernet0/3        unassigned      YES unset   administratively down down
```

R2

Router>en

Router#conf t

Router(config)#hostname R2

R2(config)#interface ethernet 0/1

R2(config-if)#ip address 12.1.1.2 255.255.255.0

R2(config-if)#no shutdown

R2(config-if)#exit

```
R2(config)#ip route 0.0.0.0 0.0.0.0 ethernet 0/1 12.1.1.1
```

```
R2(config)#interface ethernet 0/1
```

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

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

```
R2(config)#interface ethernet 0/0
```

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

```
R2(config-if)#ip address 172.16.24.2 255.255.255.0
```

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

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

```
R2(config)#end
```

```
R2#show ip interface brief
```

```
R2#show ip interface brief
Interface      IP-Address      OK? Method Status      Protocol
Ethernet0/0    172.16.24.2     YES manual    up          up
Ethernet0/1    12.1.1.2        YES manual    up          up
Ethernet0/2    unassigned      YES unset    administratively down down
Ethernet0/3    unassigned      YES unset    administratively down down
```

R3

% Please answer 'yes' or 'no'.

Would you like to enter the initial configuration dialog? [yes/no]: no

```
Router>en
```

```
Router#conf t
```

```
Router(config)#hostname R3
```

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

```
R3(config-if)#no shutdown
```

```
R3(config-if)#ip address 13.1.1.3 255.255.255.0
```

```
R3(config-if)#no shutdown
```

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

```
R3(config)#interface ethernet 0/1
```

```
R3(config-if)#no shutdown
```

```
R3(config-if)#ip address 192.168.35.3 255.255.255.0
```

```
R3(config-if)#no shutdown
```

R3(config-if)#exit

R3(config)#ip route 0.0.0.0 0.0.0.0 ethernet 0/0 13.1.1.1

R3(config)#end

R3#show ip interface brief

```
R3#show ip interface brief
Interface          IP-Address      OK? Method Status        Protocol
Ethernet0/0        13.1.1.3        YES manual  up            up
Ethernet0/1        192.168.35.3    YES manual  up            up
Ethernet0/2        unassigned      YES unset   administratively down down
Ethernet0/3        unassigned      YES unset   administratively down down
```

R4

Router>en

Router#conf t

Router(config)#hostname R4

R4(config)#interface ethernet 0/1

R4(config-if)#no shutdown

R4(config-if)#ip address 172.16.24.4 255.255.255.0

R4(config-if)#exit

R4(config)#interface loopback 0

R4(config-if)#ip address 172.16.4.4 255.255.255.255

R4(config-if)#exit

R4(config)#end

R4#show ip interface brief

```
R4#show ip interface brief
Interface          IP-Address      OK? Method Status        Protocol
Ethernet0/0        unassigned      YES unset   administratively down down
Ethernet0/1        172.16.24.4     YES manual  up            up
Ethernet0/2        unassigned      YES unset   administratively down down
Ethernet0/3        unassigned      YES unset   administratively down down
Loopback0          172.16.4.4      YES manual  up            up
```

R5

% Please answer 'yes' or 'no'.

Would you like to enter the initial configuration dialog? [yes/no]: no

Router>en

Router#conf t

Router(config)#hostname R5

R5(config)#interface ethernet 0/0

R5(config-if)#no shutdown

R5(config-if)#ip address 192.168.35.5 255.255.255.0

R5(config-if)#no shutdown

R5(config-if)#exit

R5(config)#interface loopback 0

R5(config-if)#ip address 192.168.5.5 255.255.255.255

R5(config-if)#exit

R5(config)#end

R5#show ip interface brief

```
R5#show ip interface brief
Interface      IP-Address      OK? Method Status      Protocol
Ethernet0/0    192.168.35.5    YES manual up          up
Ethernet0/1    unassigned      YES unset  administratively down down
Ethernet0/2    unassigned      YES unset  administratively down down
Ethernet0/3    unassigned      YES unset  administratively down down
Loopback0      192.168.5.5     YES manual up          up
```

EIGRP

R2&R4

R2

R2(config)#router eigrp 90

R2(config-router)#eigrp router-id 2.2.2.2

R2(config-router)#network 172.16.24.2 0.0.0.0

R2(config-router)#exit

R2(config)#end

R4

R4(config)#router eigrp 90

R4(config-router)#eigrp router-id 4.4.4.4

R4(config-router)#network 172.16.24.4 0.0.0.0

R4(config-router)#network 172.16.4.4 0.0.0.0

R4(config-router)#exit

R4(config)#end

R3&R5

R3

```
R3(config)#router eigrp 90
```

```
R3(config-router)#eigrp router-id 3.3.3.3
```

```
R3(config-router)#network 192.168.35.3 0.0.0.0
```

```
R3(config-router)#end
```

R5

```
R5(config)#router eigrp 90
```

```
R5(config-router)#eigrp router-id 5.5.5.5
```

```
R5(config-router)#network 192.168.35.5 0.0.0.0
```

```
R5(config-router)#network 192.168.5.5 0.0.0.0
```

```
R5(config-router)#exit
```

Tunnel

At this time, try to let R2 ping R2, it is successful, because use a default route ip 0.0.0.0

```
R3#show run | section eigrp
router eigrp 90
  network 192.168.35.3 0.0.0.0
  eigrp router-id 3.3.3.3
R3#ping 12.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 12.1.1.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

```
R2#ping 13.1.1.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 13.1.1.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

```

R3#show ip route
Codes: L - local, C - connected, S - static, 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
        i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
        ia - IS-IS inter area, * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
        a - application route
        + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 13.1.1.1 to network 0.0.0.0

S*   0.0.0.0/0 [1/0] via 13.1.1.1, Ethernet0/0
      13.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C     13.1.1.0/24 is directly connected, Ethernet0/0
L     13.1.1.3/32 is directly connected, Ethernet0/0
D     192.168.5.0/32 is subnetted, 1 subnets
      192.168.5.5 [90/409600] via 192.168.35.5, 00:11:20, Ethernet0/1
C     192.168.35.0/24 is variably subnetted, 2 subnets, 2 masks
      192.168.35.0/24 is directly connected, Ethernet0/1
L     192.168.35.3/32 is directly connected, Ethernet0/1

```

R2

R2#conf t

R2(config)#interface tunnel 23

R2(config-if)#tunnel source 12.1.1.2

R2(config-if)#tunnel destination 13.1.1.3

R2(config-if)#ip address 10.1.23.2 255.255.255.0

R3

R3#conf t

R3(config)#interface tunnel 23

R3(config-if)#tunnel source 13.1.1.3

R3(config-if)#tunnel destination 12.1.1.2

R3(config-if)#ip address 10.1.23.3 255.255.255.0

R3(config-if)#end

Tunnel itself has a ip address, and this ip must be in a same subnet with R3, so that they can communicate, 10.1.23.x

```

R3#show ip interface brief
Interface      IP-Address      OK? Method Status  Protocol
Ethernet0/0    13.1.1.3        YES manual up      up
Ethernet0/1    192.168.35.3    YES manual up      up
Ethernet0/2    unassigned      YES unset  administratively down down
Ethernet0/3    unassigned      YES unset  administratively down down
Tunnel23       10.1.23.3       YES manual up      up
R3#ping 10.1.23.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.23.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R3#

```

```

R2#show ip interface brief
Interface      IP-Address      OK? Method Status      Protocol
Ethernet0/0    172.16.24.2     YES manual up          up
Ethernet0/1    12.1.1.2        YES manual up          up
Ethernet0/2    unassigned      YES unset  administratively down down
Ethernet0/3    unassigned      YES unset  administratively down down
Loopback0      172.16.2.2      YES manual up          up
Tunnel23       10.1.23.2       YES manual up          up
R2#ping 10.1.23.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.23.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms

```

Claim tunnel interface

R2

R2(config)#router ei

R2(config)#router eigrp 90

R2(config-router)#net

R2(config-router)#network 10.1.23.2 0.0.0.0

R3

R3(config)#router ei

R3(config)#router eigrp 90

R3(config-router)#net

R3(config-router)#network 10.1.23.3 0.0.0.0

```

R3#show ip route
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 13.1.1.1 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 13.1.1.1, Ethernet0/0
C     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C     10.1.23.0/24 is directly connected, Tunnel23
L     10.1.23.3/32 is directly connected, Tunnel23
C     13.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C     13.1.1.0/24 is directly connected, Ethernet0/0
L     13.1.1.3/32 is directly connected, Ethernet0/0
D     172.16.0.0/16 is variably subnetted, 3 subnets, 2 masks
D     172.16.2.2/32 [90/27008000] via 10.1.23.2, 00:01:26, Tunnel23
D     172.16.4.4/32 [90/27033600] via 10.1.23.2, 00:01:26, Tunnel23
D     172.16.24.0/24 [90/26905600] via 10.1.23.2, 00:01:26, Tunnel23
D     192.168.5.0/32 is subnetted, 1 subnets
D     192.168.5.5 [90/409600] via 192.168.35.5, 00:32:47, Ethernet0/1
C     192.168.35.0/24 is variably subnetted, 2 subnets, 2 masks
C     192.168.35.0/24 is directly connected, Ethernet0/1
L     192.168.35.3/32 is directly connected, Ethernet0/1

```

R3 learned the 172.16 ip through Tunnel23


```

R2#show run interface tunnel 23
Building configuration...

Current configuration : 115 bytes
!
interface Tunnel23
 ip address 10.1.23.2 255.255.255.0
 tunnel source 12.1.1.2
 tunnel destination 13.1.1.3
end

```

AGAIN!!!! Tunnel interface does not have the capability of transmitting data package.

```

R4#ping 192.168.5.5 source 172.16.4.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.5.5, timeout is 2 seconds:
Packet sent with a source address of 172.16.4.4
!!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms

```

Capture package

R4#ping 192.168.5.5 source 172.16.4.4 repeat 100000

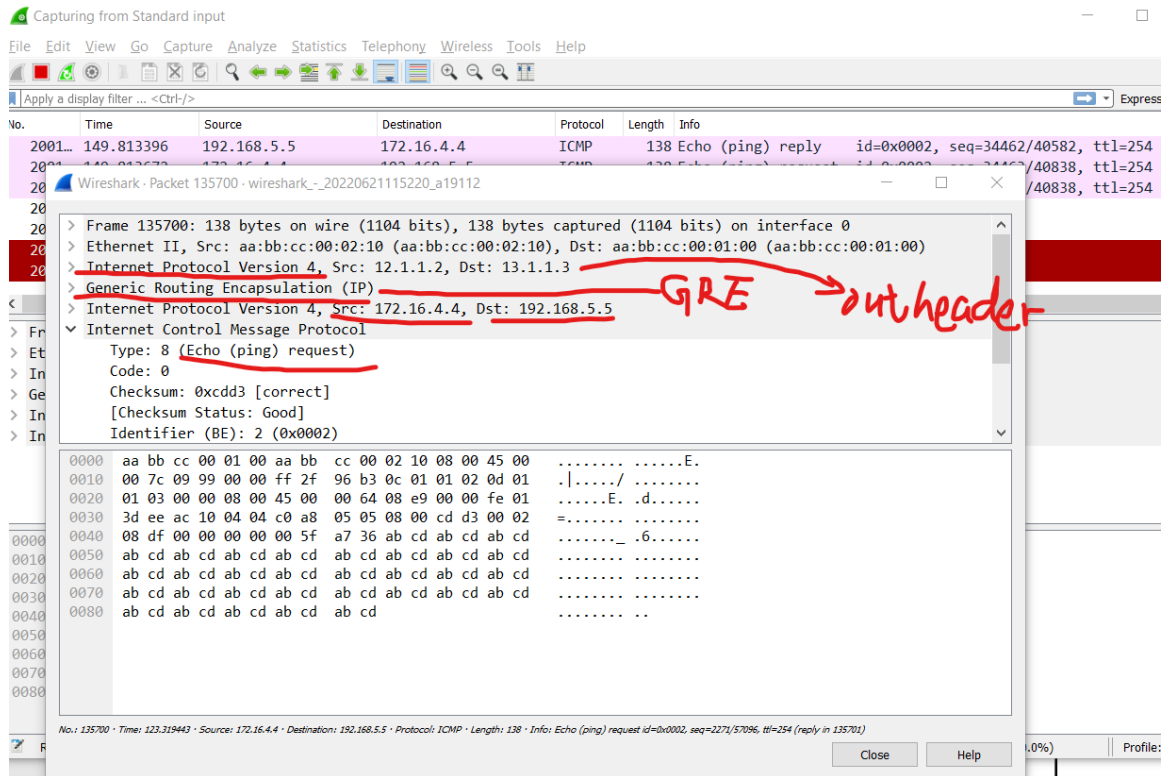
The image shows a Wireshark packet capture window. The left pane displays a list of captured packets, all of which are ICMP Echo (ping) requests and replies. The right pane shows the details of the selected packet (Frame 1), indicating it is an Ethernet II frame with a source MAC of aa:bb:cc:00:01:00 and a destination MAC of aa:bb:cc:00:01:00. The data field shows the raw bytes of the packet, which are hexadecimal values representing the ICMP Echo request and reply.

No.	Time	Source	Destination	Protocol	Length	Info
14022	70.537069	192.168.5.5	172.16.4.4	ICMP	138	Echo (ping) reply id=0x0002, seq=6985/18715, ttl=254 (requ...
14023	70.537583	172.16.4.4	192.168.5.5	ICMP	138	Echo (ping) request id=0x0002, seq=6986/18971, ttl=254 (repl...
14024	70.538450	192.168.5.5	172.16.4.4	ICMP	138	Echo (ping) reply id=0x0002, seq=6986/18971, ttl=254 (requ...
14025	70.538768	172.16.4.4	192.168.5.5	ICMP	138	Echo (ping) request id=0x0002, seq=6987/19227, ttl=254 (repl...
14026	70.539188	192.168.5.5	172.16.4.4	ICMP	138	Echo (ping) reply id=0x0002, seq=6987/19227, ttl=254 (requ...
14027	70.539463	172.16.4.4	192.168.5.5	ICMP	138	Echo (ping) request id=0x0002, seq=6988/19483, ttl=254 (repl...
14028	70.539922	192.168.5.5	172.16.4.4	ICMP	138	Echo (ping) reply id=0x0002, seq=6988/19483, ttl=254 (requ...
14029	70.540743	172.16.4.4	192.168.5.5	ICMP	138	Echo (ping) request id=0x0002, seq=6989/19739, ttl=254 (repl...

Frame 1: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
 Ethernet II, Src: aa:bb:cc:00:01:00 (aa:bb:cc:00:01:00), Dst: aa:bb:cc:00:01:00 (aa:bb:cc:00:01:00)
 Configuration Test Protocol (loopback)
 Data (40 bytes)

0000 aa bb cc 00 01 00 aa bb cc 00 01 00 90 00 00 00
 0010 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Packets: 15198 * Displayed: 15198 (100.0%) Profile: Default

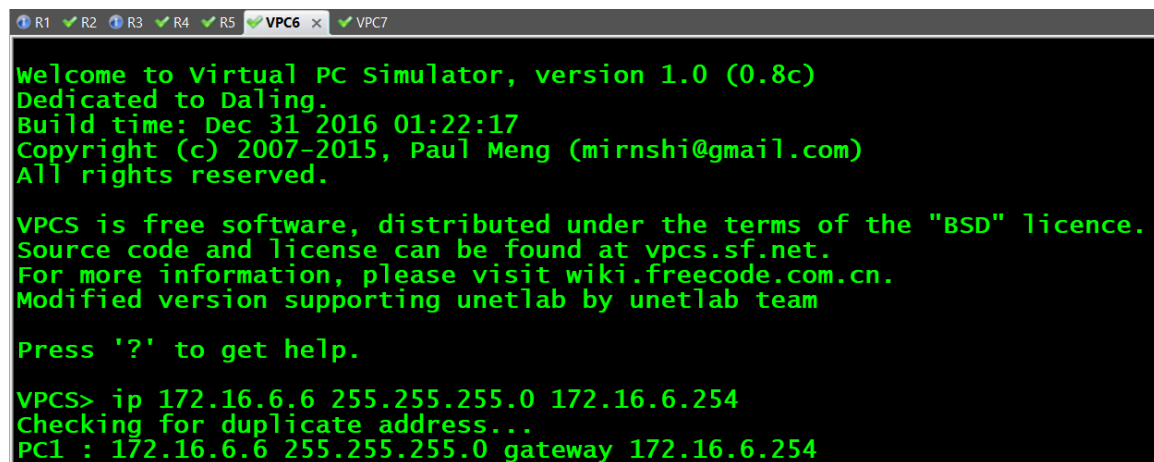


Can see that the outer header is using the public ip, cheating ISP.

And have a GRE 4 bit between the inner ip and outer ip

Config the PCv

PCV6 and 7



```

Welcome to Virtual PC Simulator, version 1.0 (0.8c)
Dedicated to Daling.
Build time: Dec 31 2016 01:22:17
Copyright (c) 2007-2015, Paul Meng (mirnshi@gmail.com)
All rights reserved.

VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.
Modified version supporting unetlab by unetlab team

Press '?' to get help.

VPCS> ip 192.168.7.7 255.255.255.0 192.168.7.254
Checking for duplicate address...
PC1 : 192.168.7.7 255.255.255.0 gateway 192.168.7.254

```

R4

R4#conf t

R4(config)#interface ethernet 0/0

R4(config-if)#no shutdown

R4(config-if)#ip address 172.16.6.254 255.255.255.0

R4(config-if)#no shutdown

R4(config-if)#exit

R4(config)#router eigrp 90

R4(config-router)#network 172.16.6.254 0.0.0.0

R4(config-router)#end

R5

R5>en

R5#conf t

R5(config)#interface ethernet 0/1

R5(config-if)#no shutdown

R5(config-if)#ip address 192.168.7.254 255.255.255.0

R5(config-if)#no shutdown

R5(config-if)#exit

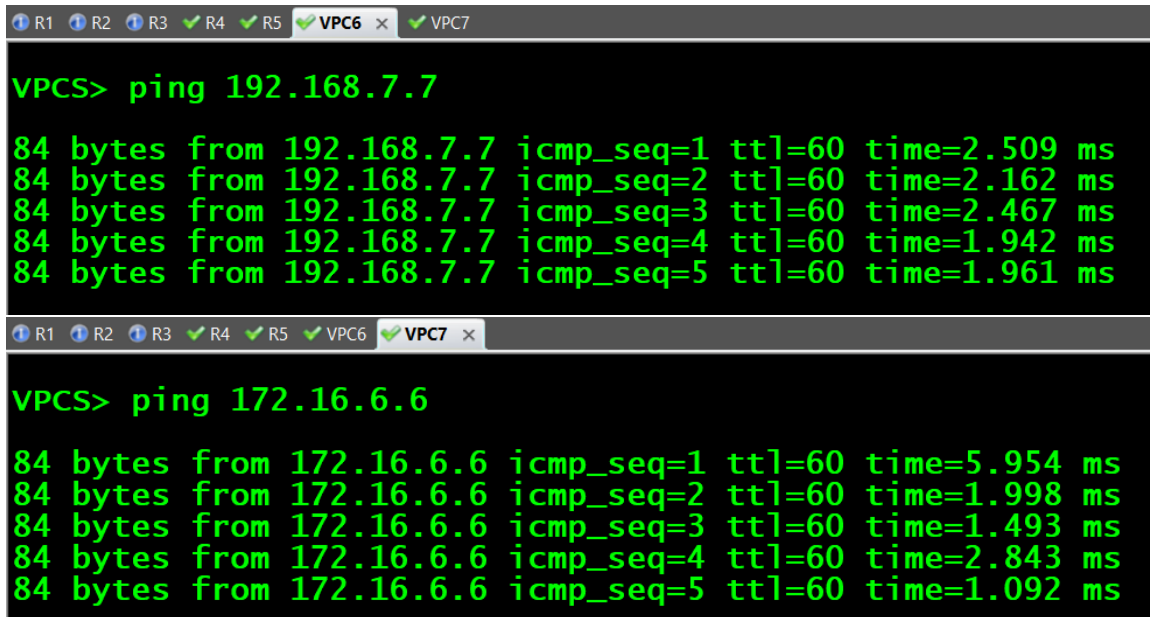
R5(config)#router eigrp 90

R5(config-router)#network 192.168.7.254 0.0.0.0

R5(config-router)#exit

R5(config)#end

Result



The screenshot shows a terminal window with a dark background and green text. At the top, a tab bar displays icons for R1, R2, R3, R4, R5, VPC6, and VPC7. The active tab is VPC6. The terminal content shows a 'VPCS>' prompt followed by a 'ping 192.168.7.7' command. Below this, five lines of output show successful ping results with 84 bytes, icmp_seq values 1 through 5, ttl=60, and various time values. A second terminal window is visible below the first, with a similar tab bar and active VPC7 tab. It shows a 'VPCS>' prompt followed by a 'ping 172.16.6.6' command and five lines of successful ping output with 84 bytes, icmp_seq values 1 through 5, ttl=60, and various time values.

```
VPCS> ping 192.168.7.7

84 bytes from 192.168.7.7 icmp_seq=1 ttl=60 time=2.509 ms
84 bytes from 192.168.7.7 icmp_seq=2 ttl=60 time=2.162 ms
84 bytes from 192.168.7.7 icmp_seq=3 ttl=60 time=2.467 ms
84 bytes from 192.168.7.7 icmp_seq=4 ttl=60 time=1.942 ms
84 bytes from 192.168.7.7 icmp_seq=5 ttl=60 time=1.961 ms

VPCS> ping 172.16.6.6

84 bytes from 172.16.6.6 icmp_seq=1 ttl=60 time=5.954 ms
84 bytes from 172.16.6.6 icmp_seq=2 ttl=60 time=1.998 ms
84 bytes from 172.16.6.6 icmp_seq=3 ttl=60 time=1.493 ms
84 bytes from 172.16.6.6 icmp_seq=4 ttl=60 time=2.843 ms
84 bytes from 172.16.6.6 icmp_seq=5 ttl=60 time=1.092 ms
```