Part 1

```
eric070021@ubuntu:~/Desktop$ sudo python topology.py
h1 doesn't have connectivity to 192.168.1.129
h1 doesn't have connectivity to 192.168.1.130
h1 doesn't have connectivity to 192.168.3.2
h1 doesn't have connectivity to 192.168.3.3
h2 doesn't have connectivity to 192.168.1.129
h2 doesn't have connectivity to 192.168.1.130
h2 doesn't have connectivity to 192.168.3.2
h2 doesn't have connectivity to 192.168.3.3
h3 doesn't have connectivity to 192.168.3.2
h3 doesn't have connectivity to 192.168.3.3
h4 doesn't have connectivity to 192.168.3.2
h4 doesn't have connectivity to 192.168.3.3
h5 doesn't have connectivity to 192.168.1.129
h5 doesn't have connectivity to 192.168.1.130
h6 doesn't have connectivity to 192.168.1.129
h6 doesn't have connectivity to 192.168.1.130
WRONG ANSWER
```

Software Updater

(the connect status after complete step 1-1)

1(a).

Yes, it can. Since h3 and h4 are in the same subnet.

1(b).

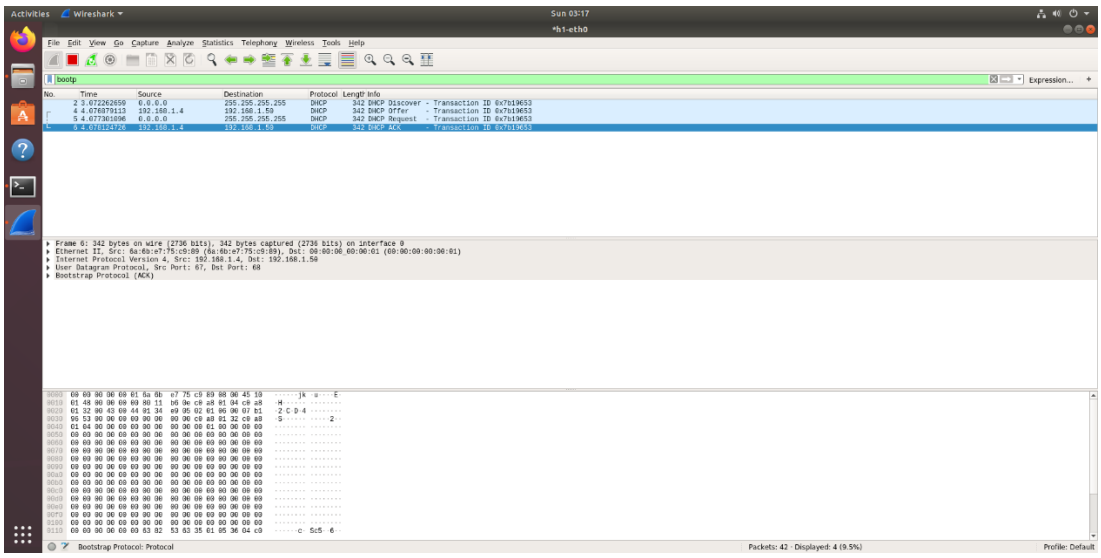
No, it can’t. Since h3 and h5 are not in the same subnet and we haven’t configured static routing rules yet.

2.

```
eric070021@ubuntu:~/Desktop$ sudo python topology.py
h1 doesn't have connectivity to 192.168.1.129
h1 doesn't have connectivity to 192.168.1.130
h1 doesn't have connectivity to 192.168.3.2
h1 doesn't have connectivity to 192.168.3.3
h2 doesn't have connectivity to 192.168.1.129
h2 doesn't have connectivity to 192.168.1.130
h2 doesn't have connectivity to 192.168.3.2
h2 doesn't have connectivity to 192.168.3.3
WRONG ANSWER
```

Part 2

3.



4.

No, since the one who need DHCP service has no ip yet, it can only broadcast the DHCP discover message in its subnet. So, it can only acquire IP address from DHCP server in its subnet.

5.

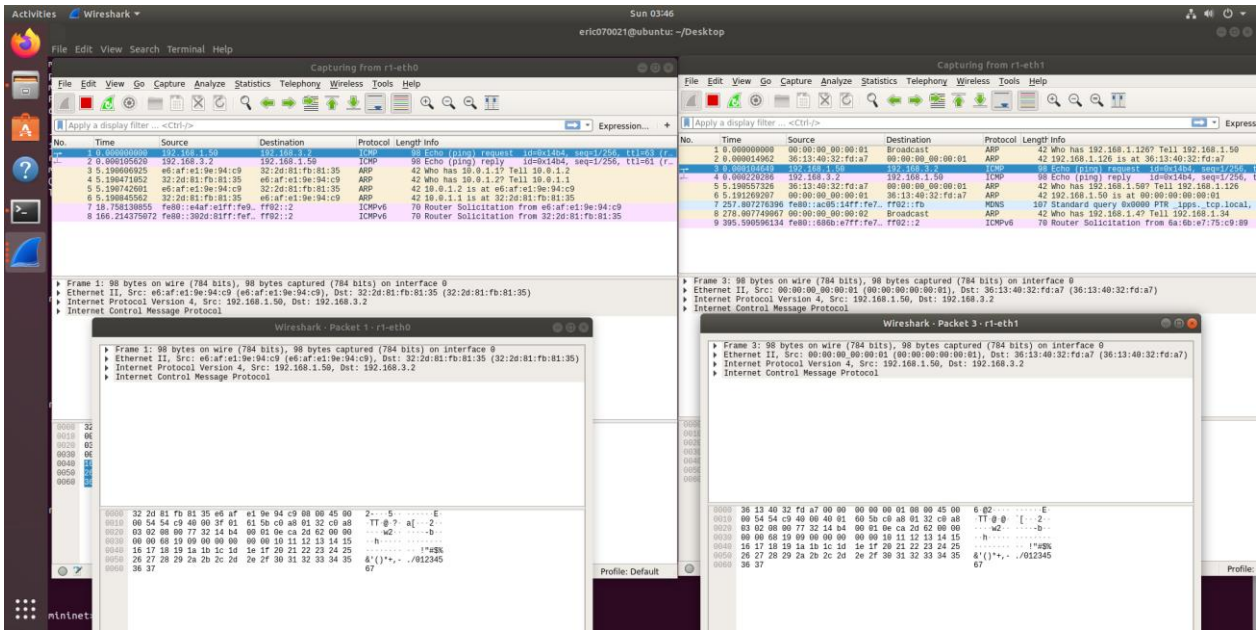
```
mininet> h2 dhclient h2-eth0
mininet> h2 ifconfig
h2-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.34  netmask 255.255.255.128  broadcast 192.168.1.127
        inet6 fe80::200:ff:fe00:2  prefixlen 64  scopeid 0x20<link>
        ether 00:00:00:00:00:02  txqueuelen 1000  (Ethernet)
        RX packets 67  bytes 7239 (7.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 15  bytes 1750 (1.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

6.

I use “host” statement in dhcpd.conf to assign fixed address to h2. It can recognize host by mac address, since h2’s mac address is fixed (00:00:00:00:00:02)

Part 3

7.

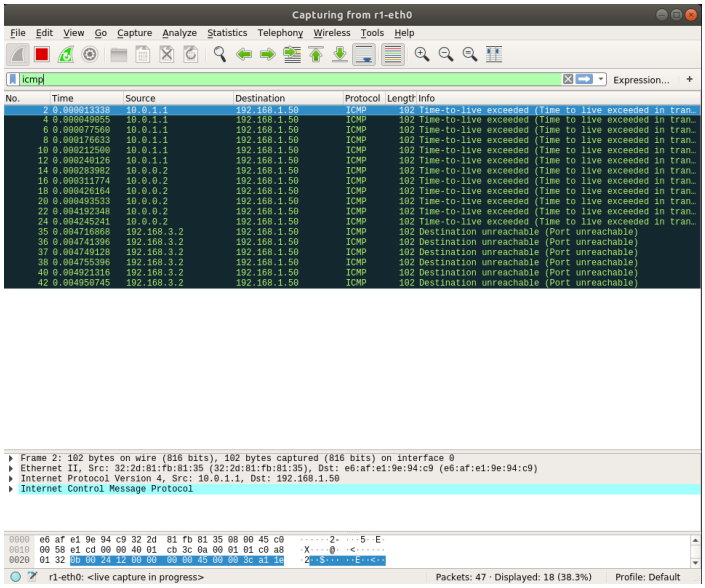


H1 to h5: h1 send packet to r1, r1 substitute the source mac address r1’s mac address, relay the packet to r2.

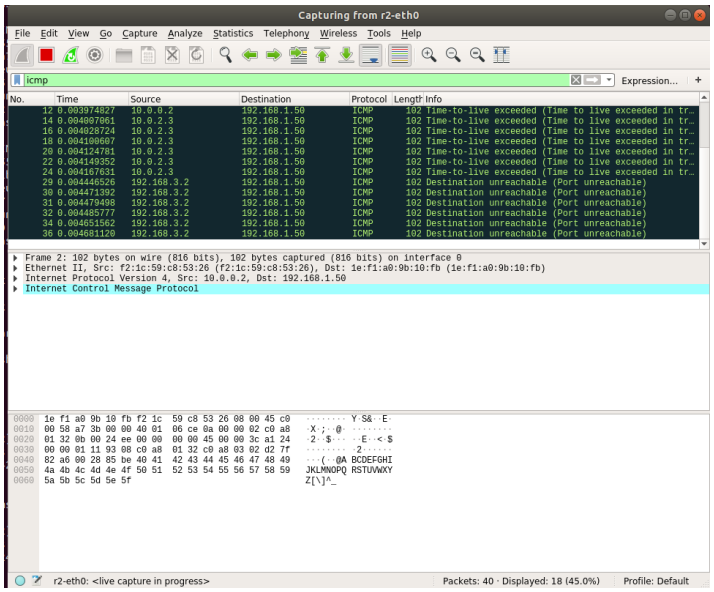
H5 to h1: r2 send packet to r1, substitute the source mac address r1’s mac address, r1 send the packet to h1.

8(a)(b).

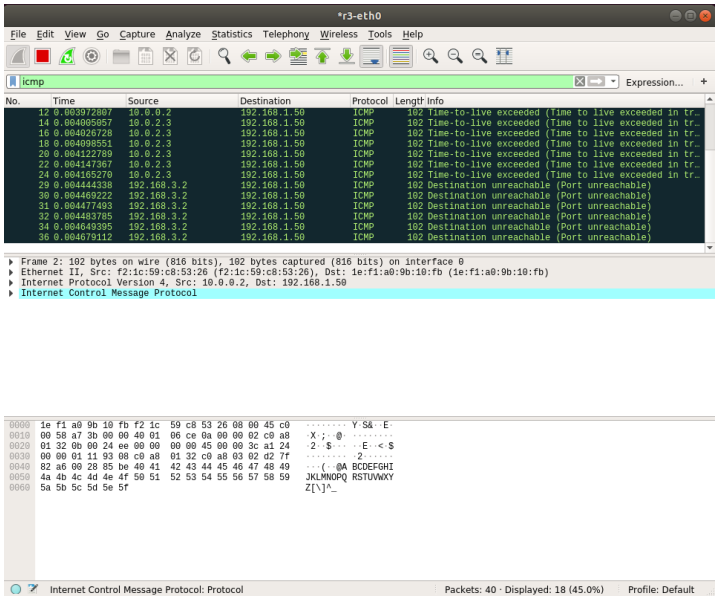
R1:


Capturing from r1-eth0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
Expression...
No. Time Source Destination Protocol Length Info
2 0.000013338 10.0.1.1 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
4 0.000049055 10.0.1.1 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
6 0.000077560 10.0.1.1 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
8 0.000176633 10.0.1.1 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
10 0.000212500 10.0.1.1 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
12 0.000240126 10.0.1.1 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
14 0.000283982 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
16 0.000311774 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
18 0.000426164 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
20 0.000493533 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
22 0.004192348 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
24 0.004245241 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
35 0.004716868 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
36 0.004741396 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
37 0.004749128 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
38 0.004755396 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
40 0.004921316 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
42 0.004950745 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
Frame 2: 102 bytes on wire (816 bits), 102 bytes captured (816 bits) on interface 0
Ethernet II, Src: 32:2d:81:fb:81:35 (32:2d:81:fb:81:35), Dst: e6:af:e1:9e:94:c9 (e6:af:e1:9e:94:c9)
Internet Protocol Version 4, Src: 10.0.1.1, Dst: 192.168.1.50
Internet Control Message Protocol
0000 e6 af e1 9e 94 c9 32 2d 81 fb 81 35 08 00 45 c0
0010 00 58 e1 cd 00 00 40 01 cb 3c 0a 00 01 01 c0 a8
0020 01 32 0b 00 24 12 00 00 00 00 45 00 00 3c a1 1e
r1-eth0: <live capture in progress>
Packets: 47 · Displayed: 18 (38.3%)
Profile: Default

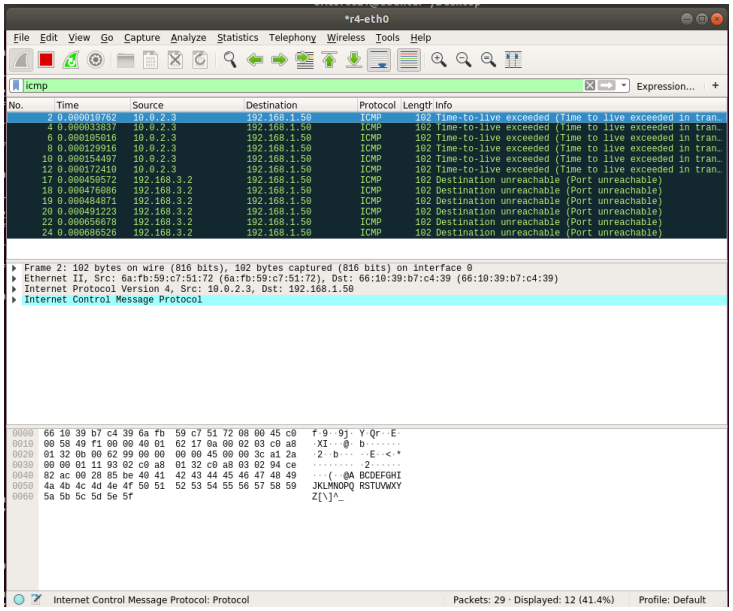
R2:


Capturing from r2-eth0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
Expression...
No. Time Source Destination Protocol Length Info
12 0.003974827 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
14 0.004007061 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
16 0.004028724 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
18 0.004100607 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
20 0.004124781 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
22 0.004149352 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
24 0.004167631 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
29 0.004446526 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
30 0.004471392 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
31 0.004479498 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
32 0.004485777 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
34 0.004651562 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
36 0.004681120 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
Frame 2: 102 bytes on wire (816 bits), 102 bytes captured (816 bits) on interface 0
Ethernet II, Src: f2:1c:59:c8:53:26 (f2:1c:59:c8:53:26), Dst: 1e:f1:a0:9b:10:fb (1e:f1:a0:9b:10:fb)
Internet Protocol Version 4, Src: 10.0.0.2, Dst: 192.168.1.50
Internet Control Message Protocol
0000 1e f1 a0 9b 10 fb f2 1c 59 c8 53 26 08 00 45 c0
0010 00 58 a7 3b 00 00 40 01 06 ce 0a 00 00 02 c0 a8
0020 01 32 0b 00 24 ee 00 00 00 00 45 00 00 3c a1 24
0030 00 00 01 11 93 08 c0 a8 01 32 c0 a8 03 02 d2 7f
0040 82 a6 00 28 85 be 40 41 42 43 44 45 46 47 48 49
0050 4a 4b 4c 4d 4e 4f 50 51 52 53 54 55 56 57 58 59
0060 5a 5b 5c 5d 5e 5f
r2-eth0: <live capture in progress>
Packets: 40 · Displayed: 18 (45.0%)
Profile: Default

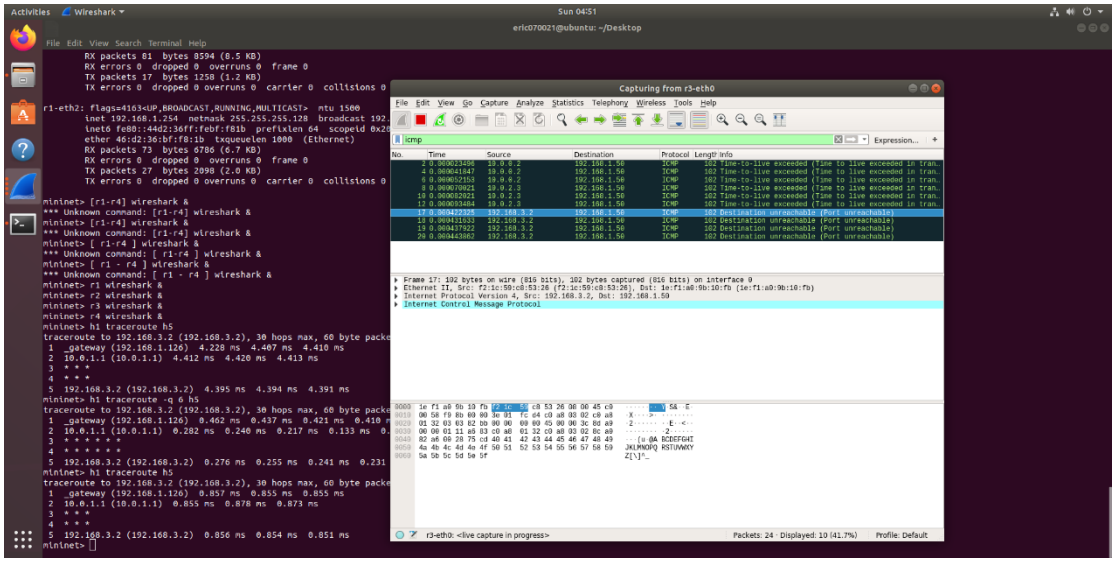
R3:


*r3-eth0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
Expression...
No. Time Source Destination Protocol Length Info
12 0.003972807 10.0.0.2 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
14 0.004005057 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
16 0.004026728 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
18 0.004098551 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
20 0.004122789 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
22 0.004147367 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
24 0.004165270 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tr…
29 0.004444338 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
30 0.004469222 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
31 0.004477493 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
32 0.004483785 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
34 0.004649395 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
36 0.004679112 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
Frame 2: 102 bytes on wire (816 bits), 102 bytes captured (816 bits) on interface 0
Ethernet II, Src: f2:1c:59:c8:53:26 (f2:1c:59:c8:53:26), Dst: 1e:f1:a0:9b:10:fb (1e:f1:a0:9b:10:fb)
Internet Protocol Version 4, Src: 10.0.0.2, Dst: 192.168.1.50
Internet Control Message Protocol
0000 1e f1 a0 9b 10 fb f2 1c 59 c8 53 26 08 00 45 c0 .... Y.S&..E.
0010 00 58 a7 3b 00 00 40 01 06 ce 0a 00 00 02 c0 a8 .X.;..@. ....
0020 01 32 0b 00 24 ee 00 00 00 00 45 00 00 3c a1 24 .2..$..... E..<.$
0030 00 00 01 11 93 08 c0 a8 01 32 c0 a8 03 02 d2 7f .... .2......
0040 82 a6 00 28 85 be 40 41 42 43 44 45 46 47 48 49 ...(..@A BCDEFGHI
0050 4a 4b 4c 4d 4e 4f 50 51 52 53 54 55 56 57 58 59 JKLMNOPQ RSTUVWXY
0060 5a 5b 5c 5d 5e 5f Z[\]^_
Internet Control Message Protocol: Protocol
Packets: 40 · Displayed: 18 (45.0%)
Profile: Default

R4:


*r4-eth0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
Expression...
No. Time Source Destination Protocol Length Info
2 0.000010762 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
4 0.000033837 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
6 0.000105016 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
8 0.000129916 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
10 0.000154497 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
12 0.000172410 10.0.2.3 192.168.1.50 ICMP 102 Time-to-live exceeded (Time to live exceeded in tran…
17 0.000450572 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
18 0.000476086 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
19 0.000484871 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
20 0.000491223 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
22 0.000656678 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
24 0.000686526 192.168.3.2 192.168.1.50 ICMP 102 Destination unreachable (Port unreachable)
Frame 2: 102 bytes on wire (816 bits), 102 bytes captured (816 bits) on interface 0
Ethernet II, Src: 6a:fb:59:c7:51:72 (6a:fb:59:c7:51:72), Dst: 66:10:39:b7:c4:39 (66:10:39:b7:c4:39)
Internet Protocol Version 4, Src: 10.0.2.3, Dst: 192.168.1.50
Internet Control Message Protocol
0000 66 10 39 b7 c4 39 6a fb 59 c7 51 72 08 00 45 c0 f.9..9j. Y.Qr..E.
0010 00 58 49 f1 00 00 40 01 62 17 0a 00 02 03 c0 a8 .XI...@. b.......
0020 01 32 0b 00 62 99 00 00 00 00 45 00 00 3c a1 2a .2..b..... E..<.*
0030 00 00 01 11 93 02 c0 a8 01 32 c0 a8 03 02 94 ce .... .2......
0040 82 ac 00 28 85 be 40 41 42 43 44 45 46 47 48 49 ...(..@A BCDEFGHI
0050 4a 4b 4c 4d 4e 4f 50 51 52 53 54 55 56 57 58 59 JKLMNOPQ RSTUVWXY
0060 5a 5b 5c 5d 5e 5f Z[\]^_
Internet Control Message Protocol: Protocol
Packets: 29 · Displayed: 12 (41.4%)
Profile: Default

9.



Traceroute requires a response from the target server and each of the intermediate hops to create its output. If a router doesn't generate a Time-to-leave exceeded response, traceroute will not know anything about that hop. So, the *** means that router didn’t response.
In the picture, we can see we only have 6 Time-to-leave exceeded response, meaning there are definitely some routers didn’t response.