Network Systems Capstone Lab 2 Report

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1 Part 1

1.1 After you complete Steps 1–1

1.1.1 Can h2 ping h3? Briefly explain why or why not.

At the first step, each router has their static IP address configured. However, there are yet no rules as to how to send a packet from one subnet to another. Since these two hosts are on the same subnet, similar to Lab 1 we can use the ARP protocol with Ethernet to send data. This only relies on the IP and MAC address of the hosts, which is independent from the routing tables in the router.

1.1.2 Can h2 ping h4? Briefly explain why or why not.

When a packet reaches r1, there is still no routing information for how to get to r4 to deliver the packet. At the beginning, none of the routers know exactly how to route the packages or what interface to use and what address should receive thte packet.

Thus, whenever we attempt to send the packet each router will not have a specified routing behavior.

1.2 Complete `topology.py` so that all hosts, except h1, can ping one another. Take a screenshot to show that your topology is correct.

Once we set the IP addresses of the routers for each of their interfaces, and add the routing connections with the `route add -net` …command, our routers know which interface should receive the incoming packets.

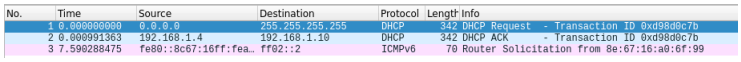
```
DHCPServer.cmd('ifconfig DHCPServer-eth0 192.168.1.4/26')
hosts['h2'].cmd('ifconfig h2-eth0 192.168.1.65/26')
#hosts['h2'].cmd('route add default gw 192.168.1.2/26 eth
hosts['h2'].cmd('route add default gw 192.168.1.126')

hosts['h3'].cmd('ifconfig h3-eth0 192.168.1.66/26')
#hosts['h3'].cmd('route add default gw 192.168.1.2/26')
hosts['h3'].cmd('route add default gw 192.168.1.126')

hosts['h4'].cmd('ifconfig h4-eth0 192.168.3.1/24')
hosts['h4'].cmd('route add default gw 192.168.3.254')

hosts['h5'].cmd('ifconfig h5-eth0 192.168.3.2/24')
hosts['h5'].cmd('route add default gw 192.168.3.254')

# ...
#Routers interface IP configuration
routers['r1'].cmd('ifconfig r1-eth0 %s' % (r1['eth0']))
routers['r1'].cmd('ifconfig r1-eth1 %s' % (r1['eth1']))
routers['r1'].cmd('ifconfig r1-eth2 %s' % (r1['eth2']))

routers['r2'].cmd('ifconfig r2-eth0 %s' % (r2['eth0']))
routers['r2'].cmd('ifconfig r2-eth1 %s' % (r2['eth1']))

routers['r3'].cmd('ifconfig r3-eth0 %s' % (r3['eth0']))
routers['r3'].cmd('ifconfig r3-eth1 %s' % (r3['eth1']))

routers['r4'].cmd('ifconfig r4-eth0 %s' % (r4['eth0']))
routers['r4'].cmd('ifconfig r4-eth1 %s' % (r4['eth1']))
```

Figure 1: Output of the network after setting routing tables.

In Fig 1.2, the ping commands can successfully link all the hosts in the network, and only h1 remains isolated.

2 Part2

2.1 Capture DHCP messages and show the IPs and MACs



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	0.0.0.0	255.255.255.255	DHCP	342	DHCP Request - Transaction ID 0xd98d0c7b
2	0.000991363	192.168.1.4	192.168.1.10	DHCP	342	DHCP ACK - Transaction ID 0xd98d0c7b
3	7.590288475	fe80::8c67:16ff:fea…	ff02::2	ICMPv6	70	Router Solicitation from 8e:67:16:a0:6f:99

Figure 2: The messges sent from h1-eth0 when we attempt a DHCP request.

2.2 Can hosts other than h1 acquire IP addresses from the DHCP server? Briefly explain your answer.

No, if we attempt to do `h5 dhclient h5-eth0`, the IP address of the host will remain the same, and this happens for all the remaining hosts. They already have a defined IP address, so connecting to a DHCP will not result in any new address. Also, the DHCP server is located in another local network.

2.3 What does r1 do on the packets from h1 to h5, and h5 to h1, respectively? Capture packets to explain your answer.

To see the effects of passing through a router, we can run the `h1 ping h5` command. In 2.3, we are sending the packet to our default gateway with our destination set to `h5`'s address.

In 2.3, we see the router r1 asking for the address of the other routers on the way to h5. However, the router will be the one in charge of sending the packet rather than the host. So h1 is only responsible for getting the packet to the router.

3 Part 3

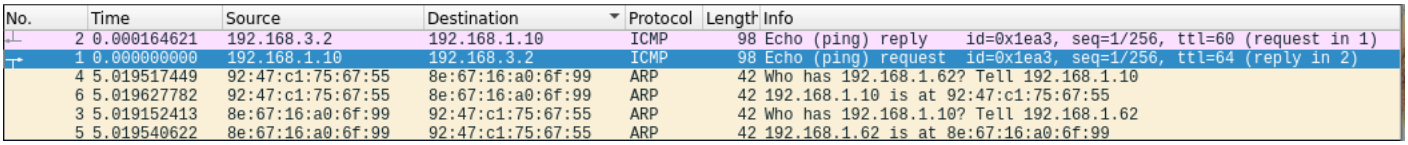
3.1 Capture all ICMP messages received y h1 and explain why h1 can only derive only 1st, 2nd, and 5th hop details.

H1 can only receive the first and second hops due to the fact that the router is going to send the packet using its own IP address, which is why we cannot see any of the packets from the middle of the route.

We can also see the messges from the fifth hop, because on the fifth hop, h5 is responding directly to h1. When the return packets go through the router, the router will again replace h1's address in the destination. That's why we can see the packet sent from h5 to h1, but not r4 to r1.

3.2 H1 uses some ICMP messages to derive 1st and 2nd hop details. What are the type(s) and sender(s) of the ICMP messages?

Traceroute works by incrementally increasing the TTL of each packet. When the TTL is exceeded, the router will respond to h1 with an ICMP TTL exceeded message. Then h1 will know to increase this value.



No.	Time	Source	Destination	Protocol	Length	Info
2	0.000164621	192.168.3.2	192.168.1.10	ICMP	98	Echo (ping) reply id=0x1ea3, seq=1/256, ttl=60 (request in 1)
1	0.000000000	192.168.1.10	192.168.3.2	ICMP	98	Echo (ping) request id=0x1ea3, seq=1/256, ttl=64 (reply in 2)
4	5.019517449	92:47:c1:75:67:55	8e:67:16:a0:6f:99	ARP	42	Who has 192.168.1.62? Tell 192.168.1.10
6	5.019627782	92:47:c1:75:67:55	8e:67:16:a0:6f:99	ARP	42	192.168.1.10 is at 92:47:c1:75:67:55
3	5.019152413	8e:67:16:a0:6f:99	92:47:c1:75:67:55	ARP	42	Who has 192.168.1.10? Tell 192.168.1.62
5	5.019540622	8e:67:16:a0:6f:99	92:47:c1:75:67:55	ARP	42	192.168.1.62 is at 8e:67:16:a0:6f:99

Figure 3: Capturing the packets on **r1-eth1**.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	192.168.1.10	192.168.3.2	ICMP	98	Echo (ping) request id=0x1ea3, seq=1/2
2	0.000144051	192.168.3.2	192.168.1.10	ICMP	98	Echo (ping) reply id=0x1ea3, seq=1/2
3	5.019211188	46:b3:2b:d5:7c:64	b6:78:71:83:bf:fa	ARP	42	Who has 10.0.1.1? Tell 10.0.1.2
4	5.019162141	b6:78:71:83:bf:fa	46:b3:2b:d5:7c:64	ARP	42	Who has 10.0.1.2? Tell 10.0.1.1
5	5.019359944	46:b3:2b:d5:7c:64	b6:78:71:83:bf:fa	ARP	42	10.0.1.2 is at 46:b3:2b:d5:7c:64
6	5.019416211	b6:78:71:83:bf:fa	46:b3:2b:d5:7c:64	ARP	42	10.0.1.1 is at b6:78:71:83:bf:fa

Figure 4: Capturing the packets on **r1-eth0**.

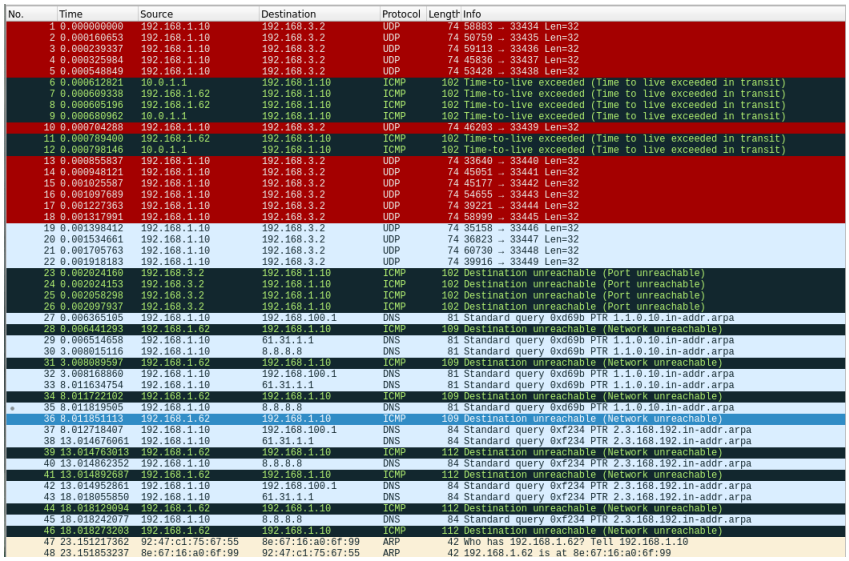


Figure 5: All the messages needed to trace a path from h1 to h5.

3.3 H1 uses some ICMP messages to derive 5th What are the type(s) and sender(s) of the ICMP messages?

In this case, the sender is h5, and the message is a Destination Unreachable ICMP message.