

EE357 Computer Networks Lab 4

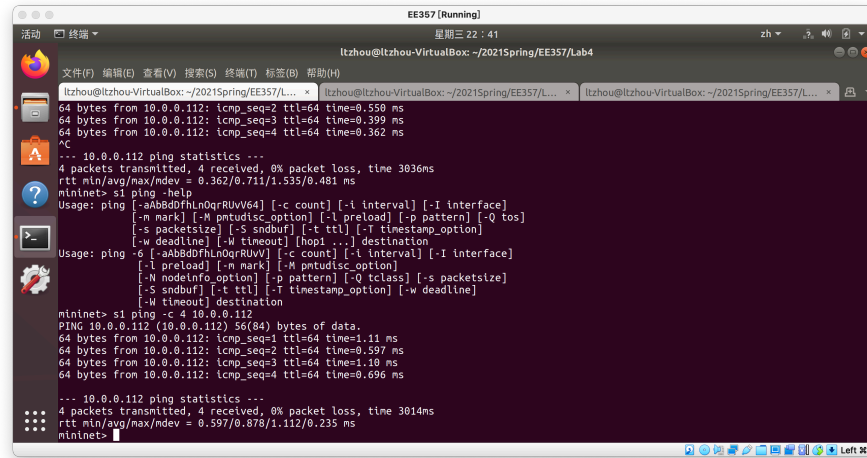
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Exercise 1 (30 points) Ping 10.0.0.111 from 10.0.0.112 (in your terminal of VM2) and use Wireshark to monitor the interfaces s2 and enp0s8, and describe the protocols used in this procedure and your findings.

Solution. As has been shown in Figure 1, we can ping 10.0.0.111 from 10.0.0.112. Figure 2 shows that interface s2 uses ICMP protocol for requesting and replying the ping command. For interface enp0s8, besides ICMP protocol, ARP protocol is also used in 3.

The Address Resolution Protocol (ARP) is a communication protocol used for discovering the link layer address, such as a MAC address, associated with a given internet layer address, typically an IPv4 address. Therefore s1 in our host can know how to reach s2 in the network.



```
ltzhou@ltzhou-VirtualBox: ~/2021Spring/EE357/Lab4
ltzhou@ltzhou-VirtualBox: ~/2021Spring/EE357/Lab4
64 bytes from 10.0.0.112: icmp_seq=2 ttl=64 time=0.550 ms
64 bytes from 10.0.0.112: icmp_seq=3 ttl=64 time=0.399 ms
64 bytes from 10.0.0.112: icmp_seq=4 ttl=64 time=0.362 ms
^C
--- 10.0.0.112 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3036ms
rtt min/avg/max/ndev = 0.362/0.711/1.535/0.481 ms
mininet> s1 ping -help
Usage: ping [-a] [-b] [-c count] [-i interval] [-I interface]
           [-m mark] [-M pmtudisc_option] [-l preload] [-p pattern] [-Q tos]
           [-s packetsize] [-S sndbuf] [-t ttl] [-T timestamp_option]
           [-w deadline] [-W timeout] [hop1...] destination
mininet> s1 ping -c 4 10.0.0.112
PING 10.0.0.112 (10.0.0.112) 56(84) bytes of data:
64 bytes from 10.0.0.112: icmp_seq=1 ttl=64 time=1.11 ms
64 bytes from 10.0.0.112: icmp_seq=2 ttl=64 time=0.597 ms
64 bytes from 10.0.0.112: icmp_seq=3 ttl=64 time=1.10 ms
64 bytes from 10.0.0.112: icmp_seq=4 ttl=64 time=0.696 ms
--- 10.0.0.112 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3014ms
rtt min/avg/max/ndev = 0.597/0.878/1.112/0.235 ms
mininet>
```

Figure 1: ping 10.0.0.112 from 10.0.0.111

□

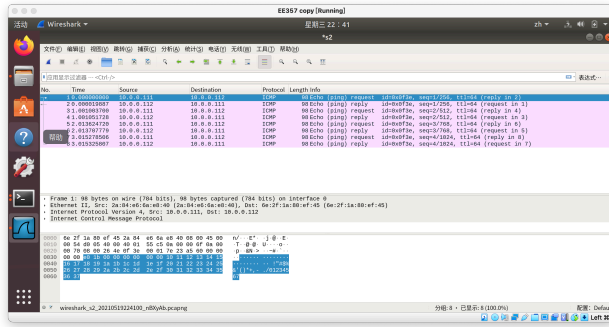


Figure 2: Wireshark result of s2 interface

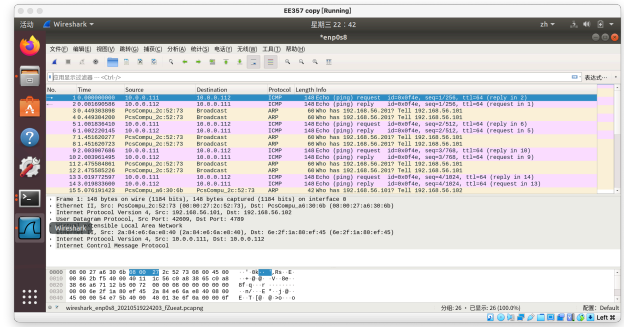


Figure 3: Wireshark result of enp0s8 interface

Exercise 2 (50 points) Use iperf to test the network bandwidth between the two virtual machines

1. Test the bandwidth between 192.168.56.101 and 192.168.56.102
2. Test the bandwidth between 10.0.0.1/10.0.0.2/10.0.0.111 and 10.0.0.3

Compare the above results and explain the reason. (Hint: you may need to specify a reasonable MTU size in order for your iperf to work in this case. Please also think about why.)

Solution.

We first test the bandwidth between 192.168.56.101 and 192.168.56.102 directly on the virtual machine, which shows that the bandwidth is about 3.38 Gbits/sec in Figure 4, 5.

Then we test the bandwidth between 10.0.0.1/10.0.0.2/10.0.0.111 and 10.0.0.3 using xterm in the MiniNet. However, the iperf fails in Figure 6, 7. This is because VXLAN adds 50 to 54 bytes of additional header information to the original Ethernet frame. We must increase the MTU of the underlying network.

In this case, configure the MTU of the physical interfaces that participate in the VXLAN network to be 2000 greater than the typical MTU of 1500, indicated in Figure 8. After the configuration, the iperf command succeeds and the bandwidths between 10.0.0.3 and 10.0.0.1/10.0.0.2/10.0.0.111 are 918 Mbits/sec, 839 Mbits/sec, and 930 Mbits/sec respectively, in Figure 9, 10.

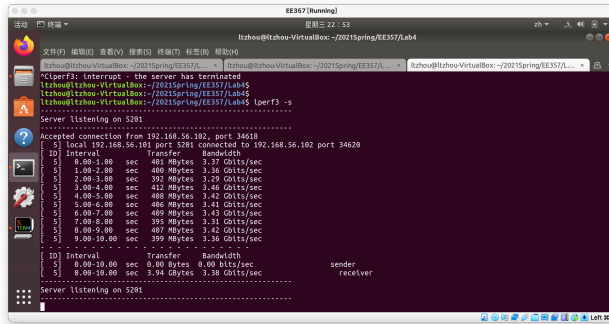


Figure 4: iperf result of 192.168.56.101

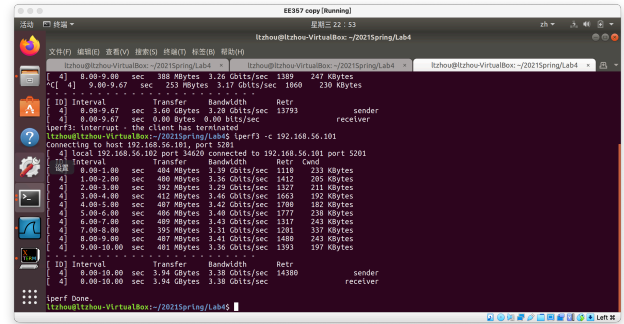


Figure 5: iperf result of 192.168.56.102

```

"Node: s1" (root)
root@ltzhou-VirtualBox:~/2021Spring/EE357/Lab4# iperf -c 10.0.0.3
connect failed: Connection refused
root@ltzhou-VirtualBox:~/2021Spring/EE357/Lab4# iperf3 -c 10.0.0.3
Connecting to host 10.0.0.3, port 5201
[ 6] local 10.0.0.111 port 35368 connected to 10.0.0.3 port 5201
[ ID] Interval           Transfer     Bandwidth   Retr  cwnd
[ 6] 0.00-1.00 sec    77.8 KBytes  636 Kbits/sec    2    1.41 KBytes
[ 6] 1.00-2.00 sec    0.00 Bytes  0.00 bits/sec    1    1.41 KBytes
[ 6] 2.00-3.00 sec    0.00 Bytes  0.00 bits/sec    0    1.41 KBytes
[ 6] 3.00-4.00 sec    0.00 Bytes  0.00 bits/sec    1    1.41 KBytes
[ 6] 4.00-5.00 sec    0.00 Bytes  0.00 bits/sec    0    1.41 KBytes
[ 6] 5.00-6.00 sec    0.00 Bytes  0.00 bits/sec    0    1.41 KBytes
[ 6] 6.00-7.00 sec    0.00 Bytes  0.00 bits/sec    1    1.41 KBytes
[ 6] 7.00-8.00 sec    0.00 Bytes  0.00 bits/sec    0    1.41 KBytes
[ 6] 8.00-9.00 sec    0.00 Bytes  0.00 bits/sec    0    1.41 KBytes
[ 6] 9.00-10.00 sec   0.00 Bytes  0.00 bits/sec    0    1.41 KBytes
-----
[ ID] Interval           Transfer     Bandwidth   Retr  sender receiver
[ 6] 0.00-10.00 sec    77.8 KBytes  63.7 Kbits/sec    5
iperf Done.
root@ltzhou-VirtualBox:~/2021Spring/EE357/Lab4#

```

Figure 6: Failure of iperf measurement for 10.0.0.111

```

"Node: h3"
Server listening on 5201
Accepted connection from 10.0.0.111, port 35368
[ ID] Interval           Transfer     Bandwidth
[ 15] 0.00-1.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 1.00-2.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 2.00-3.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 3.00-4.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 4.00-5.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 5.00-6.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 6.00-7.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 7.00-8.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 8.00-9.00 sec    0.00 Bytes  0.00 bits/sec
[ 15] 9.00-10.00 sec   0.00 Bytes  0.00 bits/sec
[ 15] 10.00-10.01 sec   0.00 Bytes  0.00 bits/sec
-----
[ ID] Interval           Transfer     Bandwidth
[ 15] 0.00-10.01 sec    0.00 Bytes  0.00 bits/sec
[ 15] 0.00-10.01 sec    0.00 Bytes  0.00 bits/sec
Server listening on 5201

```

Figure 7: Failure of iperf measurement for 10.0.0.3

```

ltzhou@ltzhou-VirtualBox:~/2021Spring/EE357/Lab4$ ifconfig | grep mtu
br1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1600
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
s1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
s1-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
s1-eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
vxlan_sys_4789: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 65000
ltzhou@ltzhou-VirtualBox:~/2021Spring/EE357/Lab4$ sudo ifconfig enp0s8 mtu 2000 up

```

Figure 8: Change the MTU of the underlying physical interface

Exercise 3 (20 points) Similar to Q2, use ping to test the network latency and analyze your results.

Solution.

The latency between 192.168.56.101 and 192.168.56.102 is 0.836ms on average, shown in Figure 11.

The latency between 10.0.0.3 and 10.0.0.1/10.0.0.2/10.0.0.111 is 0.905ms, 2.054ms, and 1.941ms on average respectively, shown in Figure 12. Note that receiving the first ping reply usually takes a much longer time than others.

□

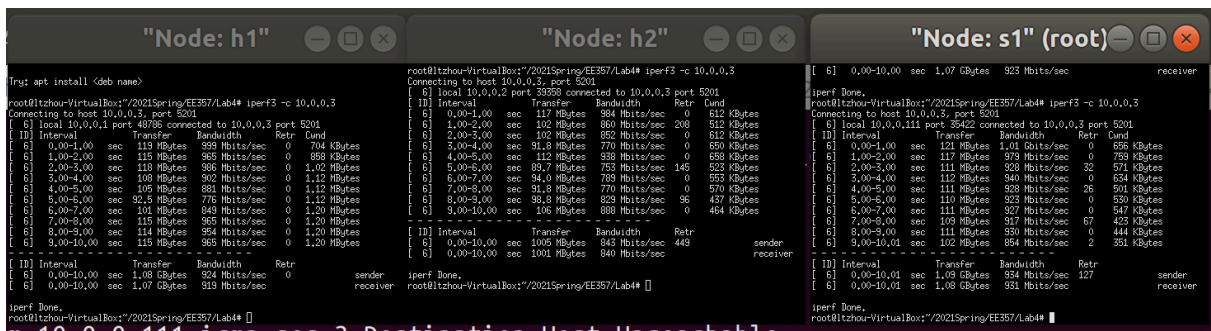


Figure 9: iperf measurement for 10.0.0.1, 10.0.0.2, 10.0.0.111 as clients

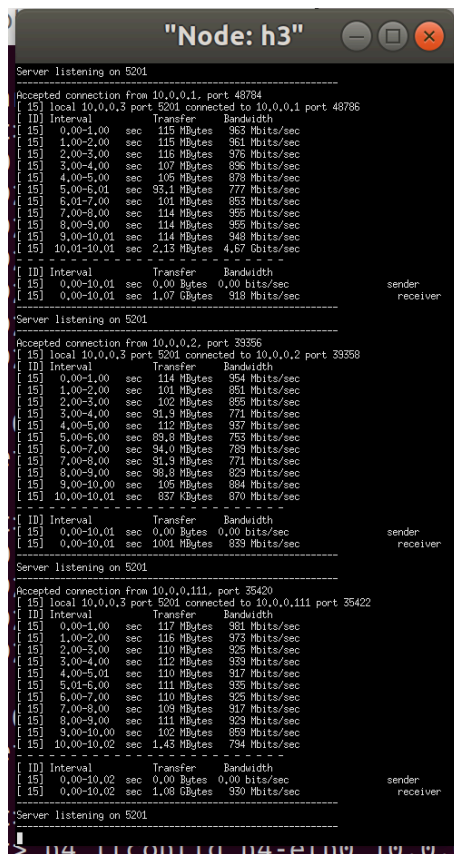


Figure 10: iperf measurement for 10.0.0.3 as server

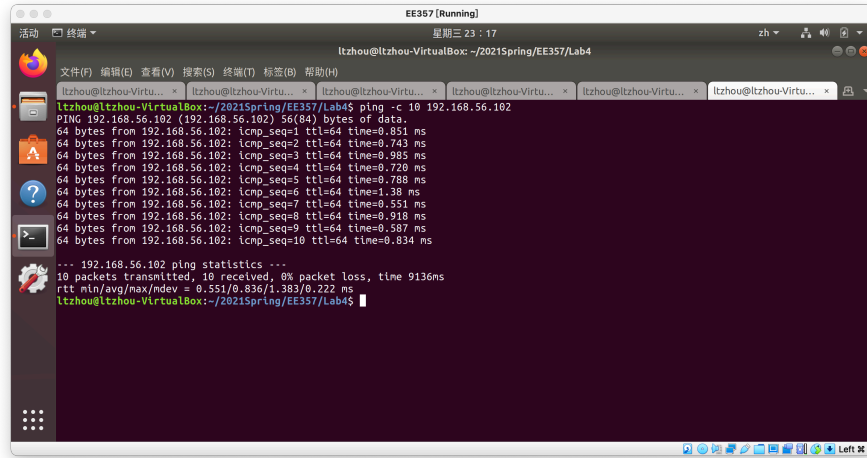


Figure 11: Ping latency between 192.168.56.101 and 192.168.56.102

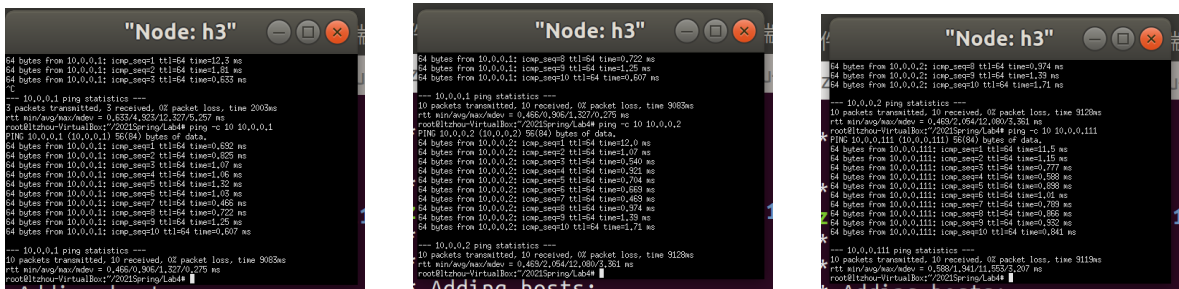


Figure 12: Ping latency from 10.0.0.3 to 10.0.0.1/10.0.0.2/10.0.0.111