Task 1

1.

```
C:\Users\linda>ping

Usage: ping [-t] [-a] [-n count] [-l size] [-f] [-i TTL] [-v TOS]
            [-r count] [-s count] [[-j host-list] | [-k host-list]]
            [-w timeout] [-R] [-S srcaddr] [-c compartment] [-p]
            [-4] [-6] target_name

Options:
    -t             Ping the specified host until stopped.
                   To see statistics and continue - type Control-Break;
                   To stop - type Control-C.
    -a             Resolve addresses to hostnames.
    -n count       Number of echo requests to send.
    -l size        Send buffer size.
    -f             Set Don't Fragment flag in packet (IPv4-only).
    -i TTL         Time To Live.
    -v TOS         Type Of Service (IPv4-only. This setting has been deprecated
                   and has no effect on the type of service field in the IP
                   Header).
    -r count       Record route for count hops (IPv4-only).
    -s count       Timestamp for count hops (IPv4-only).
    -j host-list   Loose source route along host-list (IPv4-only).
    -k host-list   Strict source route along host-list (IPv4-only).
    -w timeout     Timeout in milliseconds to wait for each reply.
    -R             Use routing header to test reverse route also (IPv6-only).
                   Per RFC 5095 the use of this routing header has been
                   deprecated. Some systems may drop echo requests if
                   this header is used.
    -S srcaddr     Source address to use.
    -c compartment Routing compartment identifier.
    -p             Ping a Hyper-V Network Virtualization provider address.
    -4             Force using IPv4.
    -6             Force using IPv6.
```

Figure 1:Module1_Task1_Q1

2. I used the command **ping localhost** and yes, the ping was successful, and the following was returned:

```
C:\Users\linda>ping localhost

Pinging LAPTOP-DLS2JD25 [::1] with 32 bytes of data:
Reply from ::1: time<1ms
Reply from ::1: time<1ms
Reply from ::1: time<1ms
Reply from ::1: time<1ms

Ping statistics for ::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\linda>
```

Figure 2: Module 1_task1_Q2

3. - The addresses obtained through ipconfig/all

```
DNS Servers . . . . . . . . . . . : 172.23.32.1
                                    129.100.74.79
```

Figure 3: Module1_Task1_Q3 (i) DNS server addresses

```
Default Gateway . . . . . . . . . : 172.23.32.1
```

Figure 4:Module1_Task1_Q3 (ii) Default Gateway address

- Ping of Default Gateway

```
C:\Users\linda>ping 172.23.32.1

Pinging 172.23.32.1 with 32 bytes of data:
Reply from 172.23.32.1: bytes=32 time=28ms TTL=64
Reply from 172.23.32.1: bytes=32 time=8ms TTL=64
Reply from 172.23.32.1: bytes=32 time=4ms TTL=64
Reply from 172.23.32.1: bytes=32 time=4ms TTL=64

Ping statistics for 172.23.32.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 28ms, Average = 11ms
```

Figure 5: Module1_Task1_Q3 (iii) Default Gateway ping

- Ping of DNS Servers

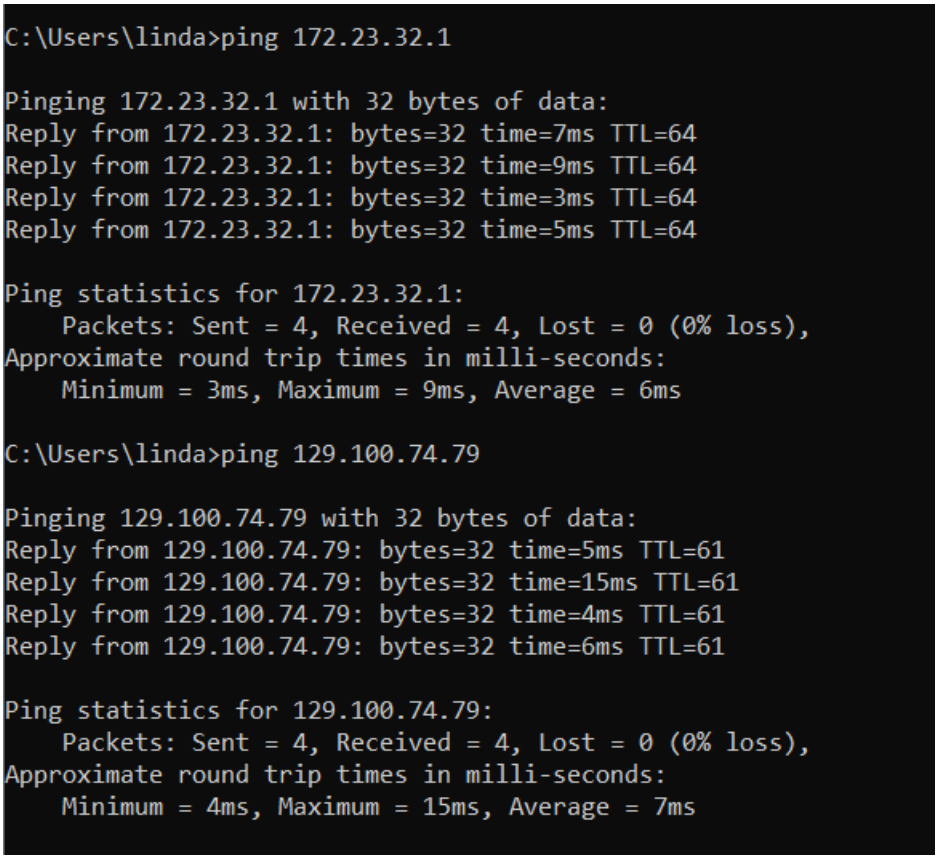


Figure 6:Module1_Task1_Q3 (iv) DNS server pings

4. The IP address pinged is 151.101.130.216. The ping was successful, and the round-trip times are as follows:
   - Maximum = 20ms
   - Minimum = 11ms
   - Average = 13ms

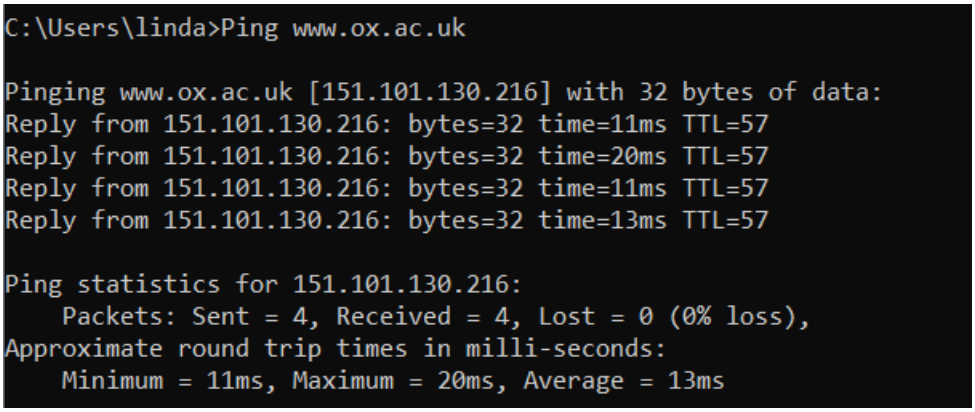


Figure 7: Module1_Task1_Q4 | Oxford university ping

5. The ping was successful, and the round-trip times are as follows:
   - Maximum = 65ms
   - Minimum = 12ms
   - Average = 22ms

```
C:\Users\linda>Ping -n 10 www.ox.ac.uk

Pinging www.ox.ac.uk [151.101.66.216] with 32 bytes of data:
Reply from 151.101.66.216: bytes=32 time=20ms TTL=57
Reply from 151.101.66.216: bytes=32 time=13ms TTL=57
Reply from 151.101.66.216: bytes=32 time=12ms TTL=57
Reply from 151.101.66.216: bytes=32 time=14ms TTL=57
Reply from 151.101.66.216: bytes=32 time=12ms TTL=57
Reply from 151.101.66.216: bytes=32 time=14ms TTL=57
Reply from 151.101.66.216: bytes=32 time=65ms TTL=57
Reply from 151.101.66.216: bytes=32 time=28ms TTL=57
Reply from 151.101.66.216: bytes=32 time=12ms TTL=57
Reply from 151.101.66.216: bytes=32 time=39ms TTL=57

Ping statistics for 151.101.66.216:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 65ms, Average = 22ms
```

Figure 8: Module1_Task1_Q5 | 10x Oxford ping

The results differ in that the 10x ping has slightly longer round-trip times.

6. I used this command to generate the average round trip times listed.
   >ping -l {size} -n 10 -f {address}

	uwo.ca	**ox.ac.uk**
Size	**Average Round Trip Times**	
512	7	13
724	12	14
1024	Request timed out	Request timed out
4072	Packet needs to be fragmented but DF set	Packet needs to be fragmented but DF set
Average	9.5	13.5
Standard Deviation	3.535533906	0.707106781

Figure 9: Module1_Task1_Q6 | RTTs

I have noticed that there is a larger difference (deviation) between pings times for uwo when the size changes than there is for ox. However, the ping times for uwo are overall faster than those of ox. Lastly it has not been possible to ping with large message sizes without fragmenting.

7. i) in North America

```
C:\Users\linda>tracert spectrum.com

Tracing route to spectrum.com [142.136.168.7]
over a maximum of 30 hops:

  1     2 ms     2 ms     2 ms  172.30.96.2
  2     *        *        *     Request timed out.
  3     4 ms     2 ms     2 ms  199.71.2.185
  4     *        *        *     Request timed out.
  5     *        *        *     Request timed out.
  6    12 ms    13 ms    12 ms  10ge11-20.core2.chi1.he.net [216.66.74.193]
  7    12 ms    12 ms    17 ms  port-channel4.core3.chi1.he.net [184.104.196.218]
  8    12 ms    12 ms    10 ms  twc-7843-bb-as7843.port-channel8.core3.chi1.he.net [184.105.20.86]
  9    34 ms    35 ms    35 ms  66.109.5.224
 10    34 ms    35 ms    45 ms  66.109.5.137
 11    36 ms    36 ms    34 ms  be5.ar3.pkv01.tbone.rr.com [66.109.10.99]
 12    34 ms    35 ms    35 ms  be3.ar0.pkv01.tbone.rr.com [66.109.10.93]
 13    37 ms    35 ms    35 ms  66.109.6.245
 14    57 ms    58 ms    62 ms  165-237-4-135.twcable.com [165.237.4.135]
 15    51 ms    43 ms    41 ms  165-237-25-109.twcable.com [165.237.25.109]
 16     *        *        *     Request timed out.
 17    41 ms    43 ms    43 ms  elpaq.com [142.136.168.7]

Trace complete.
```

Figure 10: Module1_Task1_Q7 | NA

It took 17 hops to reach spectrum.com a us server, and approximately 3 ISP's were traversed.

ii) in Europe

```
C:\Users\linda>tracert telecomitalia.it

Tracing route to telecomitalia.it [156.54.50.76]
over a maximum of 30 hops:

  1   103 ms     3 ms     2 ms  172.30.96.2
  2     *        *        *     Request timed out.
  3     3 ms     4 ms     2 ms  199.71.2.185
  4     *        *        *     Request timed out.
  5     *        *        *     Request timed out.
  6    13 ms    11 ms    22 ms  10ge11-20.core2.chi1.he.net [216.66.74.193]
  7    28 ms    29 ms    39 ms  100ge15-1.core1.ash1.he.net [184.105.64.134]
  8    26 ms    26 ms    28 ms  seabone-net-as6762.10gigabitethernet2-18.core1.ash1.he.net [216.66.30.21
4]
  9   129 ms   129 ms   130 ms  etrunk0.milano50.mil.seabone.net [195.22.209.103]
 10   127 ms   127 ms   127 ms  ibs-asr.milano50.mil.seabone.net [195.22.205.117]
 11     *        *        *     Request timed out.
 12     *        *        *     Request timed out.
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16   134 ms   133 ms     *     host-62-77-38-117.business.telecomitalia.it [62.77.38.117]
 17   170 ms   141 ms   143 ms  host-62-77-38-118.business.telecomitalia.it [62.77.38.118]
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20   132 ms   131 ms   132 ms  156.54.50.76

Trace complete.
```

Figure 11: Module1_Task1_Q7 | EU

It took 16 hops to reach a telecomitalia.it server and approximately 3 ISP's were traversed.

iii) in Australia

```
C:\Users\linda>tracert 106.69.162.127

Tracing route to 106-69-162-127.dyn.iinet.net.au [106.69.162.127]
over a maximum of 30 hops:

  1   111 ms     2 ms     2 ms  172.23.32.2
  2     *        *        *     Request timed out.
  3     7 ms    21 ms    41 ms  199.71.2.185
  4     *        *        *     Request timed out.
  5     *        *        *     Request timed out.
  6    35 ms    18 ms    17 ms  he-as6939.torix.ca [206.108.34.112]
  7    15 ms    15 ms    14 ms  port-channel3.core2.tor1.he.net [184.105.80.6]
  8    19 ms    35 ms    17 ms  port-channel4.core3.chi1.he.net [184.104.196.218]
  9    14 ms    13 ms    15 ms  100ge9-2.core2.chi1.he.net [184.104.196.217]
 10    29 ms    56 ms    68 ms  100ge8-2.core1.mci3.he.net [184.105.222.77]
 11    59 ms    62 ms    37 ms  100ge7-2.core1.den1.he.net [184.104.195.213]
 12    61 ms    70 ms    87 ms  100ge0-29.core2.sjc2.he.net [184.105.64.69]
 13    59 ms    60 ms    62 ms  100ge16-1.core1.sjc2.he.net [184.104.192.213]
 14     *        *     2081 ms  100ge13-2.core1.sjc1.he.net [184.105.65.113]
 15   252 ms   218 ms  2489 ms  tpg-internet-pty-ltd.100gigabitethernet11-1.core1.sjc1.he.net [216.218.139.234]
 16   876 ms     *        *     syd-apt-ros-crt1-he-0-3-0-2.tpgi.com.au [203.29.134.1]
 17     *        *      308 ms  syd-pwk-dym-crt2-ge-8-0.static.tpgi.com.au [203.26.22.126]
 18  1007 ms   935 ms  1826 ms  per-apt-stg-crt1-be10.tpgi.com.au [203.219.58.177]
 19  1817 ms   469 ms  1032 ms  203-219-57-224.tpgi.com.au [203.219.57.224]
 20     *        *     3520 ms  106-69-162-127.dyn.iinet.net.au [106.69.162.127]

Trace complete.
```

Figure 12: Module1_Task1_Q7 | AU

It took 16 hops to reach a com.au server and 20 hops to reach a net.au server and approximately 8 ISP‘s were traversed.

8. There are 5 columns in the tracert output, and the columns are for the following:

- Hop number

- The following 3 columns are round trip times (RTT) of three pings.

- The last column is the IP address of the router that is pinged. The domain name is also listed here if it is available.

The asterisks means that no response was received before the time out interval. In my trace route results there are some hops that timed out on all three pings while others just timed out on one or two pings.

9. -
10. -

Task 2

11. The web host www.sydney.edu.au has 4 IP addresses:
    2600:140a::687b:c49b
    2600:140a::687b:c472
    104.124.10.97
    104.124.10.41

```
C:\Users\linda>nslookup www.sydney.edu.au
Server:  dlinkrouter
Address:  192.168.0.1

Non-authoritative answer:
Name:    e37219.dsca.akamaiedge.net
Addresses:  2600:140a::687b:c49b
          2600:140a::687b:c472
          104.124.10.97
          104.124.10.41
Aliases:  www.sydney.edu.au
          www.sydney.edu.au.edgekey.net
```

Figure 13: Module1_Task2_Q 11

12. (i) The authoritative name server for www.uwo.ca is ns1.uwo.ca

```
> www.uwo.ca
Server:  dlinkrouter
Address:  192.168.0.1

Non-authoritative answer:
www.uwo.ca      canonical name = web3.uwo.ca

uwo.ca
        primary name server = ns1.uwo.ca
        responsible mail addr = noc.uwo.ca
        serial  = 2012099916
        refresh = 3600 (1 hour)
        retry   = 900 (15 mins)
        expire  = 3600000 (41 days 16 hours)
        default TTL = 3600 (1 hour)
```

Figure 14: Module1_Task2_Q 12i

(ii) The authoritative name server for www.sydney.edu.au is n0dsca.akamaiedge.net

```
C:\Users\linda>nslookup
Default Server:  dlinkrouter
Address:  192.168.0.1

> set querytype=NS
> www.sydney.edu.au
Server:  dlinkrouter
Address:  192.168.0.1

Non-authoritative answer:
www.sydney.edu.au       canonical name = www.sydney.edu.au.edgekey.net
www.sydney.edu.au.edgekey.net   canonical name = e37219.dsca.akamaiedge.net

dsca.akamaiedge.net
        primary name server = n0dsca.akamaiedge.net
        responsible mail addr = hostmaster.akamai.com
        serial  = 1635968531
        refresh = 1000 (16 mins 40 secs)
        retry   = 1000 (16 mins 40 secs)
        expire  = 1000 (16 mins 40 secs)
        default TTL = 1800 (30 mins)
>
```

Figure 15: Module1_Task2_Q 12ii

13. The IP address is 129.100.0.79

```
C:\Users\linda>nslookup  mail.google.com www.uwo.ca
DNS request timed out.
    timeout was 2 seconds.
Server:  UnKnown
Address:  129.100.0.79

DNS request timed out.
    timeout was 2 seconds.
DNS request timed out.
    timeout was 2 seconds.
DNS request timed out.
    timeout was 2 seconds.
DNS request timed out.
    timeout was 2 seconds.
*** Request to UnKnown timed-out
```

Figure 16: Module1_Task2_Q 13

Task 3

14. They are sent over UDP

15. The source port is 503 and the destination port is 58072

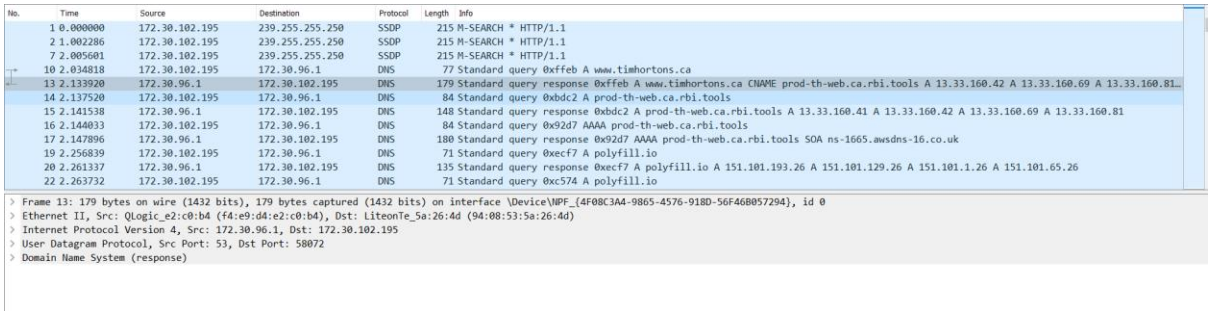
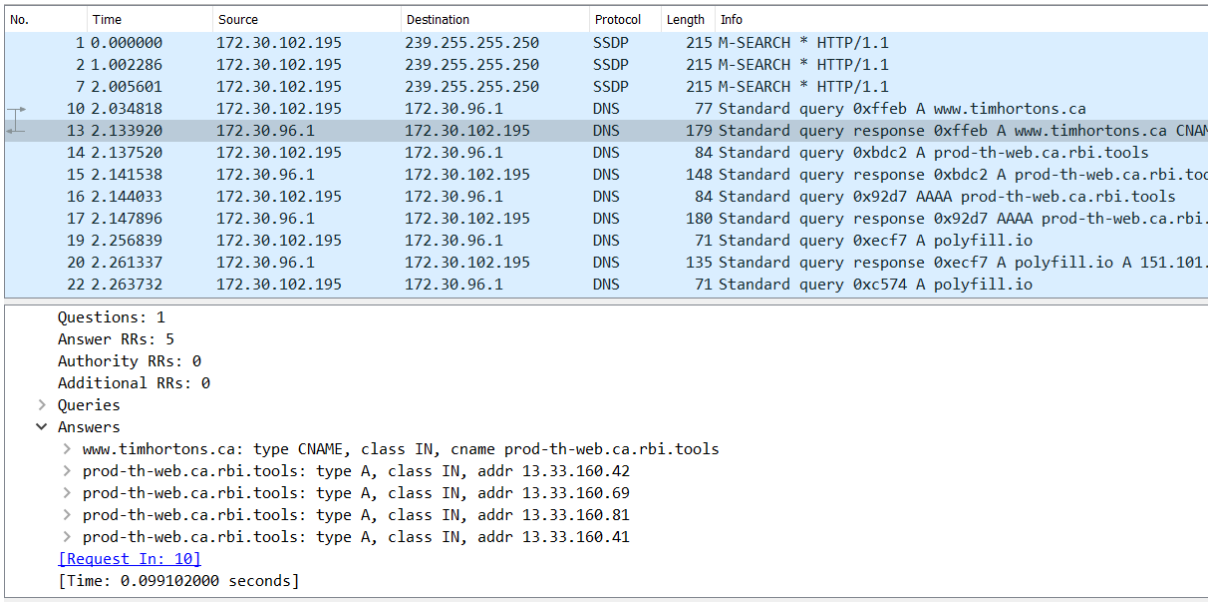


Figure 17: Module1_Task3_Q15

16. 172.30.102.195

17. It is a type ‘A’ DNS query

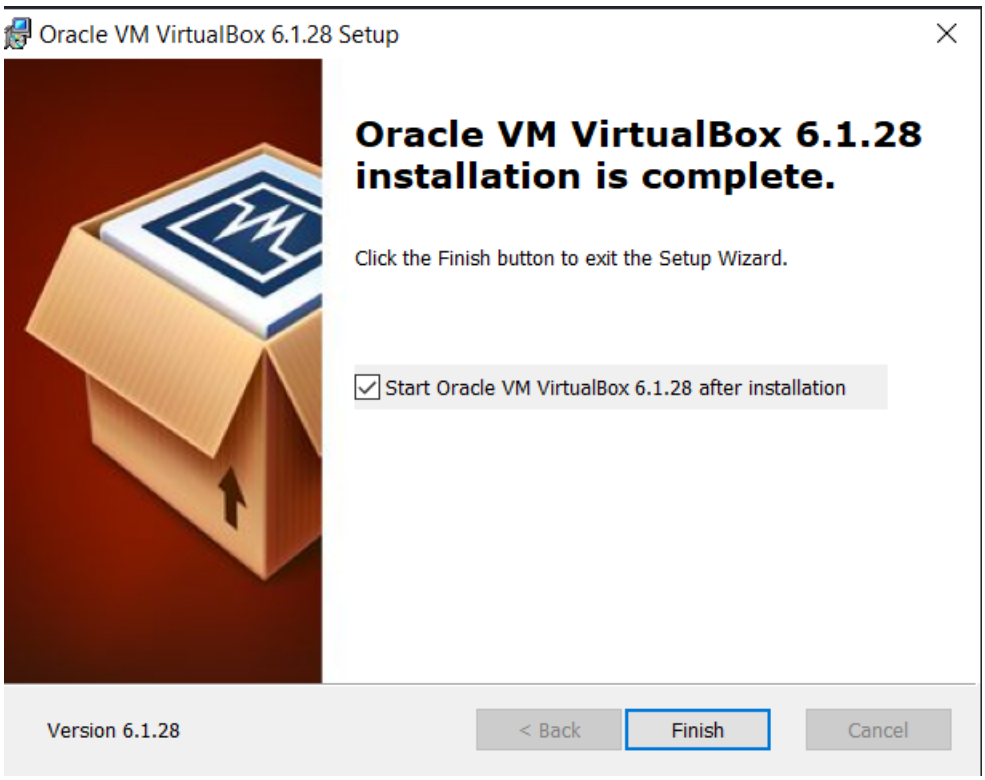
18. Yes, the query response contains 5 answers.



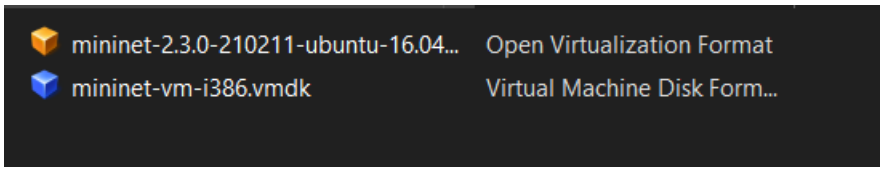
Lab Module 2

Task 1

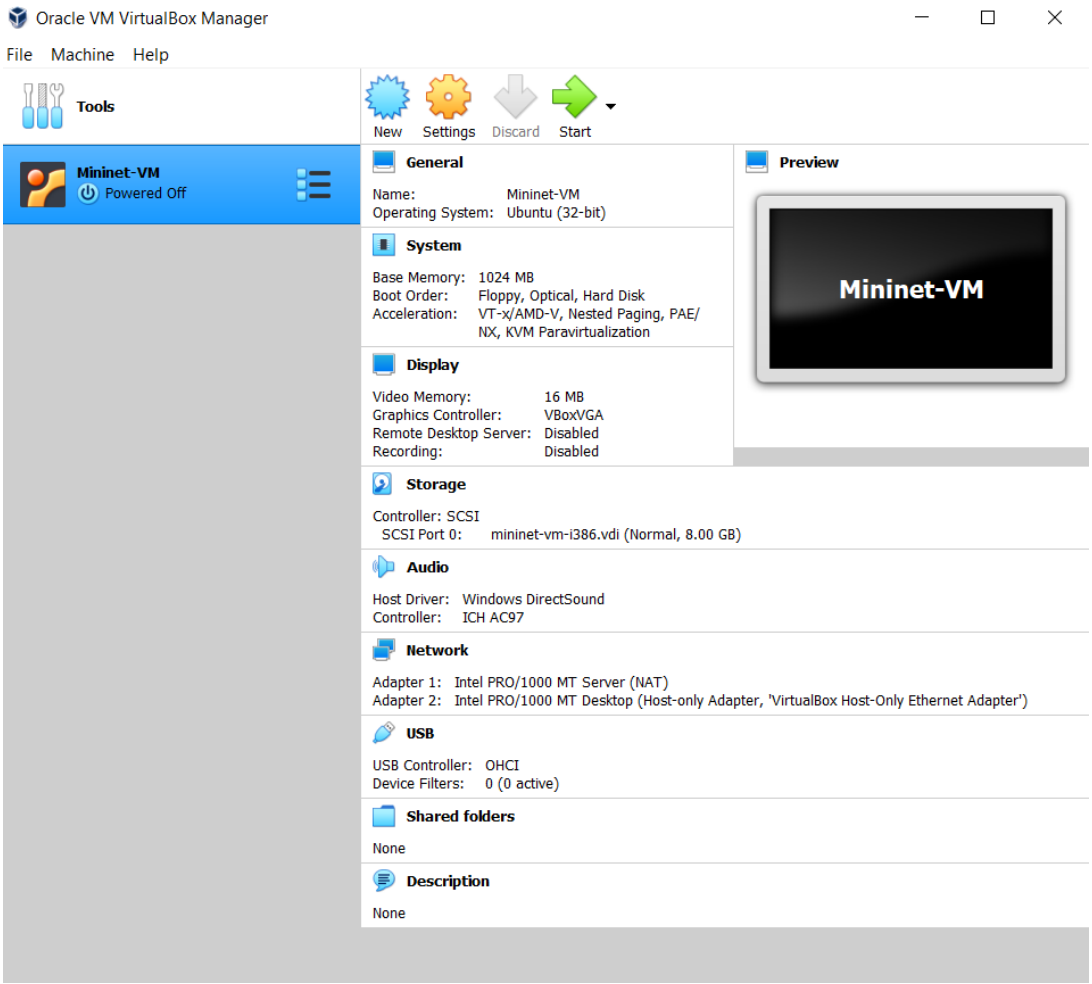
a)


Oracle VM VirtualBox 6.1.28 Setup
Oracle VM VirtualBox 6.1.28 installation is complete.
Click the Finish button to exit the Setup Wizard.
Start Oracle VM VirtualBox 6.1.28 after installation
Version 6.1.28
< Back
Finish
Cancel

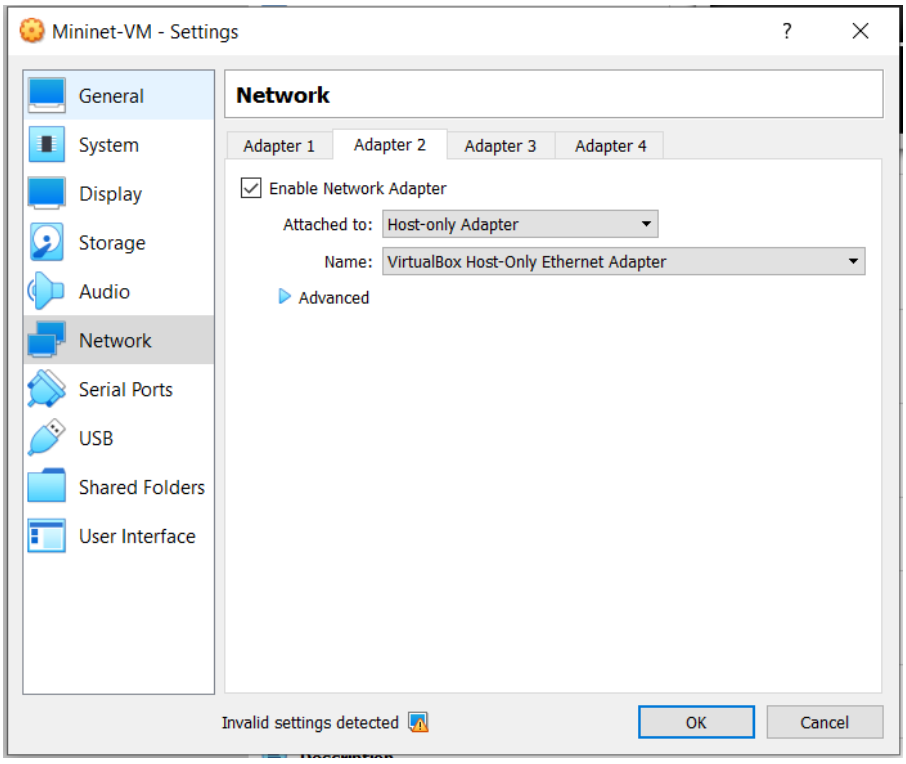
b)


mininet-2.3.0-210211-ubuntu-16.04...
Open Virtualization Format
mininet-vm-i386.vmdk
Virtual Machine Disk Form...

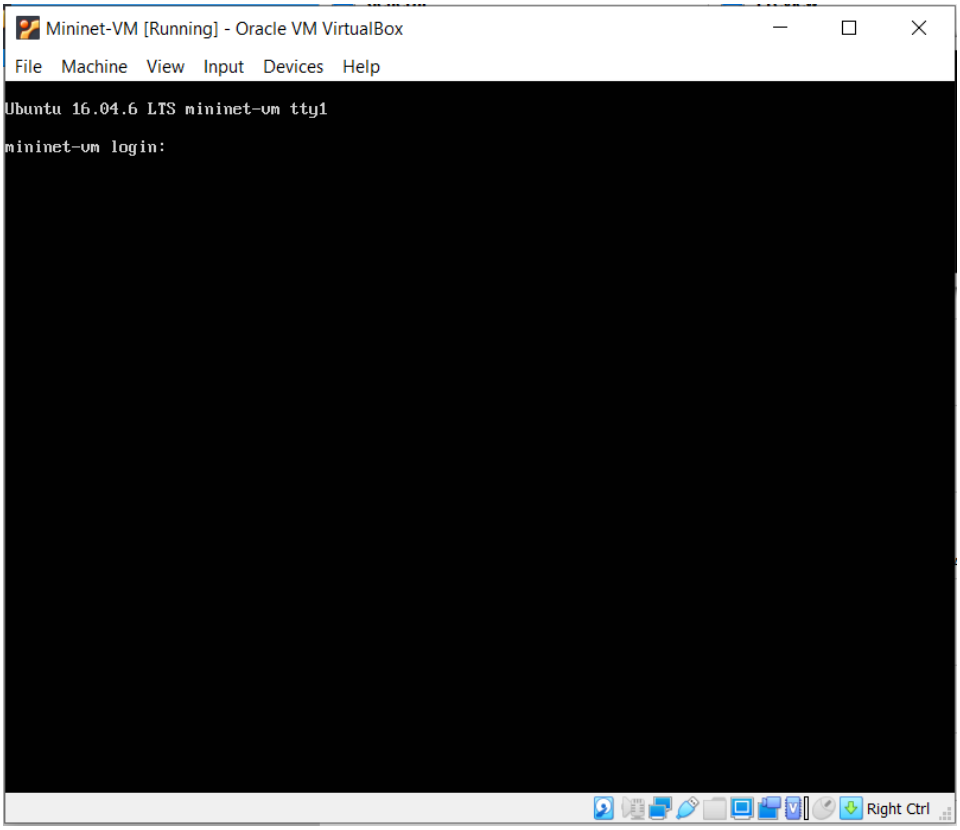
c)


Oracle VM VirtualBox Manager
File Machine Help
Tools
Mininet-VM
Powered Off
New Settings Discard Start
General
Name: Mininet-VM
Operating System: Ubuntu (32-bit)
System
Base Memory: 1024 MB
Boot Order: Floppy, Optical, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging, PAE/ NX, KVM Paravirtualization
Display
Video Memory: 16 MB
Graphics Controller: VBoxVGA
Remote Desktop Server: Disabled
Recording: Disabled
Preview
Mininet-VM
Storage
Controller: SCSI
SCSI Port 0: mininet-vm-i386.vdi (Normal, 8.00 GB)
Audio
Host Driver: Windows DirectSound
Controller: ICH AC97
Network
Adapter 1: Intel PRO/1000 MT Server (NAT)
Adapter 2: Intel PRO/1000 MT Desktop (Host-only Adapter, 'VirtualBox Host-Only Ethernet Adapter')
USB
USB Controller: OHCI
Device Filters: 0 (0 active)
Shared folders
None
Description
None

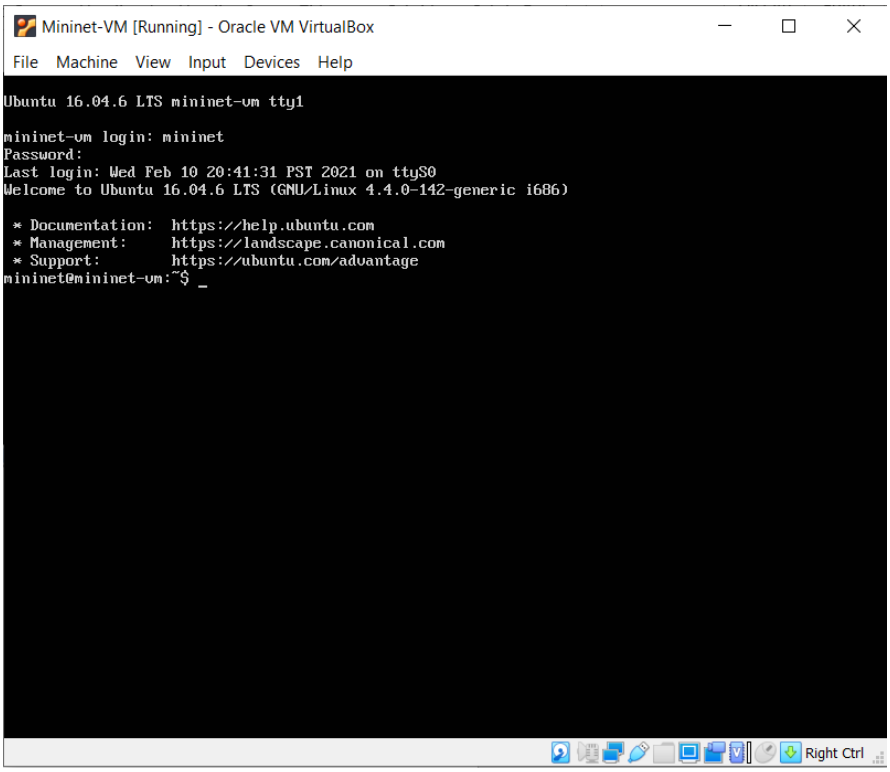
d)


Mininet-VM - Settings
General
System
Display
Storage
Audio
Network
Serial Ports
USB
Shared Folders
User Interface
Network
Adapter 1 Adapter 2 Adapter 3 Adapter 4
Enable Network Adapter
Attached to: Host-only Adapter
Name: VirtualBox Host-Only Ethernet Adapter
Advanced
Invalid settings detected
OK
Cancel

e)


Mininet-VM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Ubuntu 16.04.6 LTS mininet-vm tty1
mininet-vm login:
Right Ctrl

f)


Mininet-VM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Ubuntu 16.04.6 LTS mininet-vm tty1
mininet-vm login: mininet
Password:
Last login: Wed Feb 10 20:41:31 PST 2021 on ttyS0
Welcome to Ubuntu 16.04.6 LTS (GNU/Linux 4.4.0-142-generic i686)
* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage
mininet@mininet-vm:~$ _
Right Ctrl

g)

```
C:\Users\linda>ipconfig

Windows IP Configuration


Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . : C3-WDS12.COM

Ethernet adapter VirtualBox Host-Only Network:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::3098:4b7c:c0aa:7793%18
   IPv4 Address. . . . . . . . . . . : 192.168.56.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

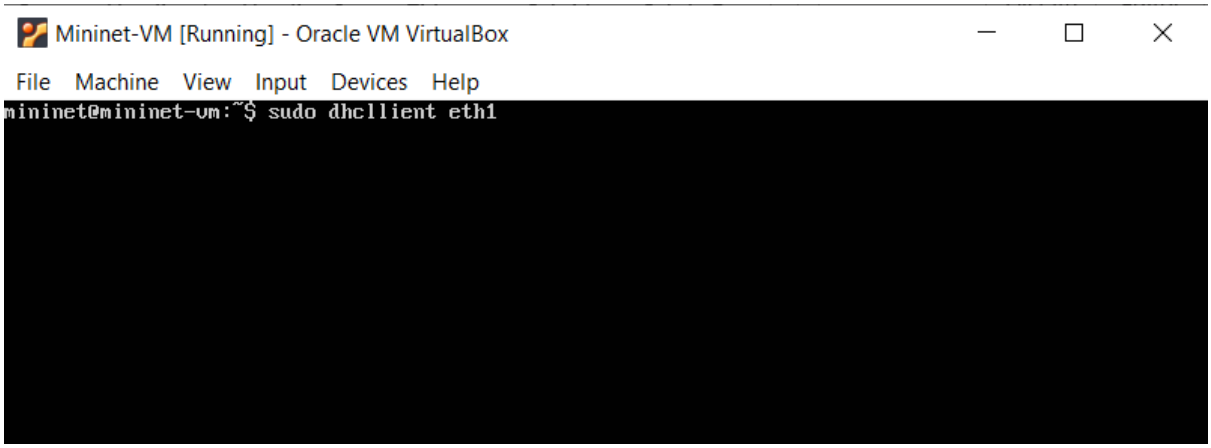
Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . : uwo-x-13.wireless.uwo.pri
   Link-local IPv6 Address . . . . . : fe80::4480:a25b:ca61:8bbf%11
   IPv4 Address. . . . . . . . . . . : 172.30.103.65
   Subnet Mask . . . . . . . . . . . : 255.255.248.0
   Default Gateway . . . . . . . . . : 172.30.96.1

Ethernet adapter Bluetooth Network Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
```

h)



i)

```
mininet@mininet-vm:~$ sudo dhclient eth1
mininet@mininet-vm:~$ ifconfig eth1
eth1      Link encap:Ethernet  HWaddr 08:00:27:74:e5:d1
          inet addr:10.0.2.15  Bcast:10.0.2.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1180 (1.1 KB)  TX bytes:684 (684.0 B)
```

19. No they are not in the same subnet because the virtual machine is created on a different network.

j)

```
C:\Users\linda>ping 192.168.56.1

Pinging 192.168.56.1 with 32 bytes of data:
Reply from 192.168.56.1: bytes=32 time<1ms TTL=128
Reply from 192.168.56.1: bytes=32 time<1ms TTL=128
Reply from 192.168.56.1: bytes=32 time<1ms TTL=128
Reply from 192.168.56.1: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.56.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
mininet@mininet-vm:~$ ping 172.30.103.65
PING 172.30.103.65 (172.30.103.65) 56(84) bytes of data.
64 bytes from 172.30.103.65: icmp_seq=1 ttl=127 time=0.863 ms
64 bytes from 172.30.103.65: icmp_seq=2 ttl=127 time=1.03 ms
64 bytes from 172.30.103.65: icmp_seq=3 ttl=127 time=1.02 ms
64 bytes from 172.30.103.65: icmp_seq=4 ttl=127 time=1.45 ms
64 bytes from 172.30.103.65: icmp_seq=5 ttl=127 time=0.799 ms
64 bytes from 172.30.103.65: icmp_seq=6 ttl=127 time=0.849 ms
64 bytes from 172.30.103.65: icmp_seq=7 ttl=127 time=0.769 ms
64 bytes from 172.30.103.65: icmp_seq=8 ttl=127 time=0.868 ms
64 bytes from 172.30.103.65: icmp_seq=9 ttl=127 time=0.965 ms
64 bytes from 172.30.103.65: icmp_seq=10 ttl=127 time=0.746 ms
64 bytes from 172.30.103.65: icmp_seq=11 ttl=127 time=0.904 ms
64 bytes from 172.30.103.65: icmp_seq=12 ttl=127 time=0.795 ms
64 bytes from 172.30.103.65: icmp_seq=13 ttl=127 time=0.874 ms
64 bytes from 172.30.103.65: icmp_seq=14 ttl=127 time=1.09 ms
64 bytes from 172.30.103.65: icmp_seq=15 ttl=127 time=0.846 ms
64 bytes from 172.30.103.65: icmp_seq=16 ttl=127 time=1.01 ms
64 bytes from 172.30.103.65: icmp_seq=17 ttl=127 time=0.775 ms
64 bytes from 172.30.103.65: icmp_seq=18 ttl=127 time=0.843 ms
64 bytes from 172.30.103.65: icmp_seq=19 ttl=127 time=1.08 ms
64 bytes from 172.30.103.65: icmp_seq=20 ttl=127 time=0.843 ms
64 bytes from 172.30.103.65: icmp_seq=21 ttl=127 time=0.660 ms
64 bytes from 172.30.103.65: icmp_seq=22 ttl=127 time=1.07 ms
64 bytes from 172.30.103.65: icmp_seq=23 ttl=127 time=1.05 ms
64 bytes from 172.30.103.65: icmp_seq=24 ttl=127 time=0.899 ms
64 bytes from 172.30.103.65: icmp_seq=25 ttl=127 time=1.03 ms
64 bytes from 172.30.103.65: icmp_seq=26 ttl=127 time=0.843 ms
64 bytes from 172.30.103.65: icmp_seq=27 ttl=127 time=0.966 ms
64 bytes from 172.30.103.65: icmp_seq=28 ttl=127 time=1.19 ms
^C
--- 172.30.103.65 ping statistics ---
28 packets transmitted, 28 received, 0% packet loss, time 27048ms
rtt min/avg/max/mdev = 0.660/0.934/1.451/0.163 ms
mininet@mininet-vm:~$ _
```

Task 2

1.

```
 08/11/2021  14:18.31  /home/mobaxterm  ssh mininet@192.168.56.102
mininet@192.168.56.102's password:
Welcome to Ubuntu 16.04.6 LTS (GNU/Linux 4.4.0-142-generic i686)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage
Last login: Mon Nov  8 05:28:58 2021
/usr/bin/xauth:  file /home/mininet/.Xauthority does not exist
mininet@mininet-vm:~$
```

2.

```
mininet@mininet-vm:~$ sudo mn -h
Usage: mn [options]
(type mn -h for details)

The mn utility creates Mininet network from the command line. It can create
parametrized topologies, invoke the Mininet CLI, and run tests.

Options:
  -h, --help            show this help message and exit
  --switch=SWITCH       default|ivs|lxbr|ovs|ovsbr|ovsk|user[,param=value...]
                        ovs=OVSSwitch default=OVSSwitch ovsk=OVSSwitch
                        lxbr=LinuxBridge user=UserSwitch ivs=IVSSwitch
                        ovsbr=OVSBridge
  --host=HOST           cfs|proc|rt[,param=value...]
                        rt=CPULimitedHost{'sched': 'rt'} proc=Host
                        cfs=CPULimitedHost{'sched': 'cfs'}
  --controller=CONTROLLER
                        default|none|nox|ovsc|ref|remote|ryu[,param=value...]
                        ovsc=OVSController none=NullController
                        remote=RemoteController default=DefaultController
                        nox=NOX ryu=Ryu ref=Controller
  --link=LINK           default|ovs|tc|tcu[,param=value...] default=Link
                        ovs=OVSLink tcu=TCULink tc=TCLink
  --topo=TOPO           linear|minimal|reversed|single|torus|tree[,param=value
                        ...] linear=LinearTopo
                        reversed=SingleSwitchReversedTopo tree=TreeTopo
                        single=SingleSwitchTopo torus=TorusTopo
                        minimal=MinimalTopo
  -c, --clean           clean and exit
  --custom=CUSTOM       read custom classes or params from .py file(s)
  --test=TEST           none|build|all|iperf|pingpair|iperfudp|pingall
  -x, --xterms          spawn xterms for each node
  -i IPBASE, --ipbase=IPBASE
                        base IP address for hosts
  --mac                 automatically set host MACs
  --arp                 set all-pairs ARP entries
  -v VERBOSITY, --verbosity=VERBOSITY
                        info|warn|warning|critical|error|debug|output
  --innamespace         sw and ctrl in namespace?
  --listenport=LISTENPORT
                        base port for passive switch listening
  --nolistenport        don't use passive listening port
```

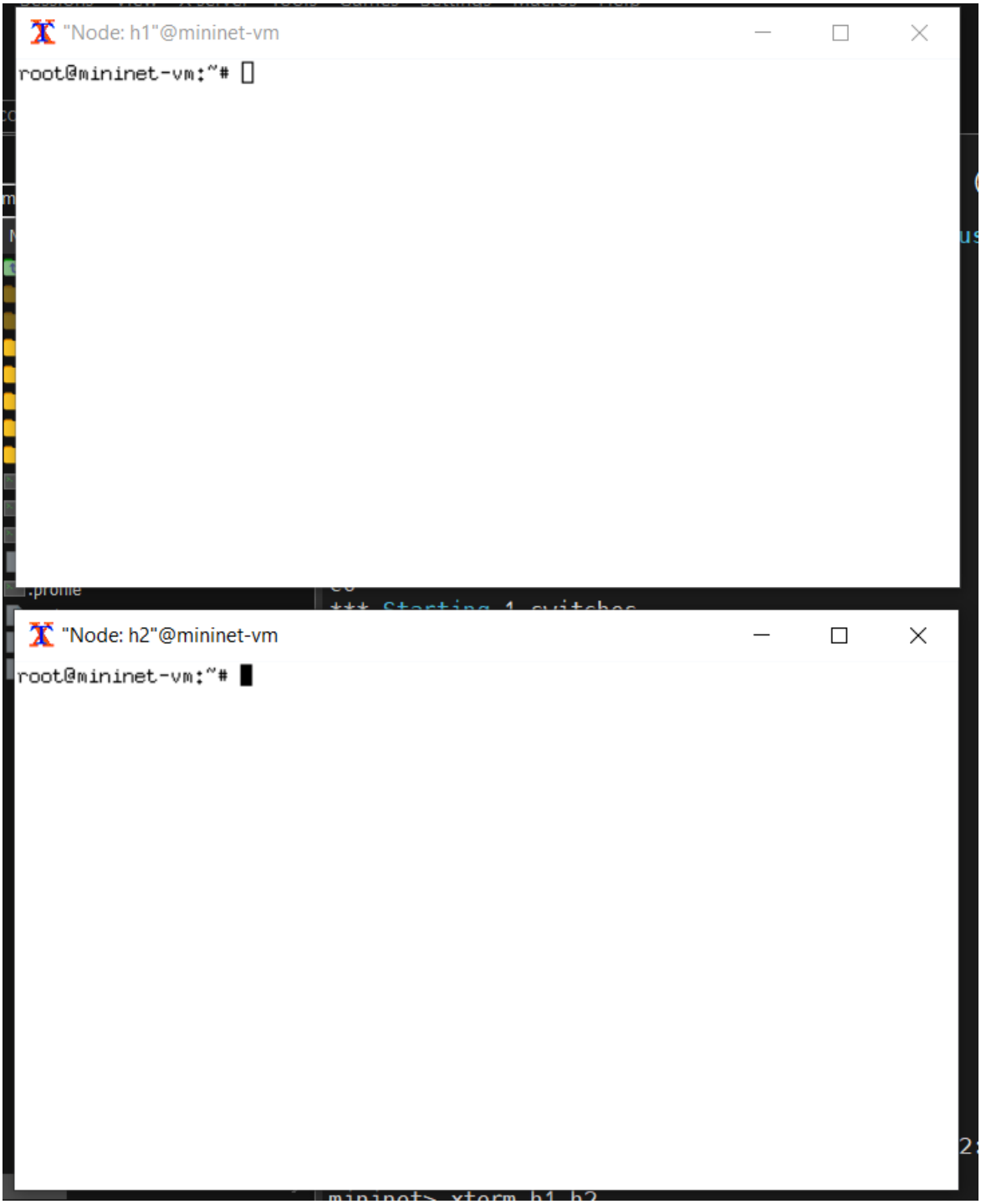
3.

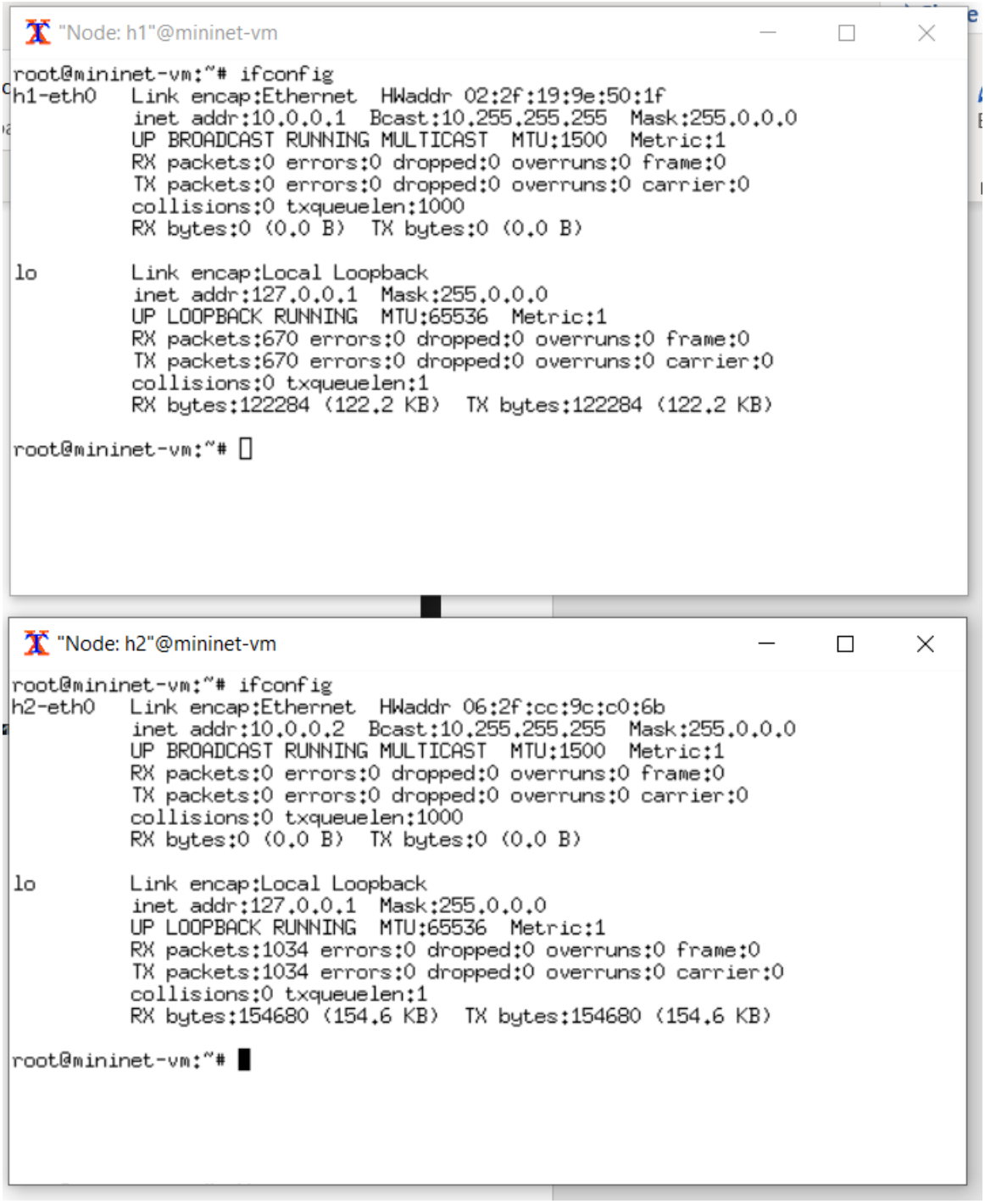
```
mininet@mininet-vm:~$ sudo mn
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet>
```

4. -
5.

```
mininet> nodes
available nodes are:
c0 h1 h2 s1
mininet> net
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
s1 lo:  s1-eth1:h1-eth0 s1-eth2:h2-eth0
c0
mininet> dump
<Host h1: h1-eth0:10.0.0.1 pid=3196>
<Host h2: h2-eth0:10.0.0.2 pid=3199>
<OVSSwitch s1: lo:127.0.0.1,s1-eth1:None,s1-eth2:None pid=3205>
<Controller c0: 127.0.0.1:6653 pid=3189>
mininet>
```

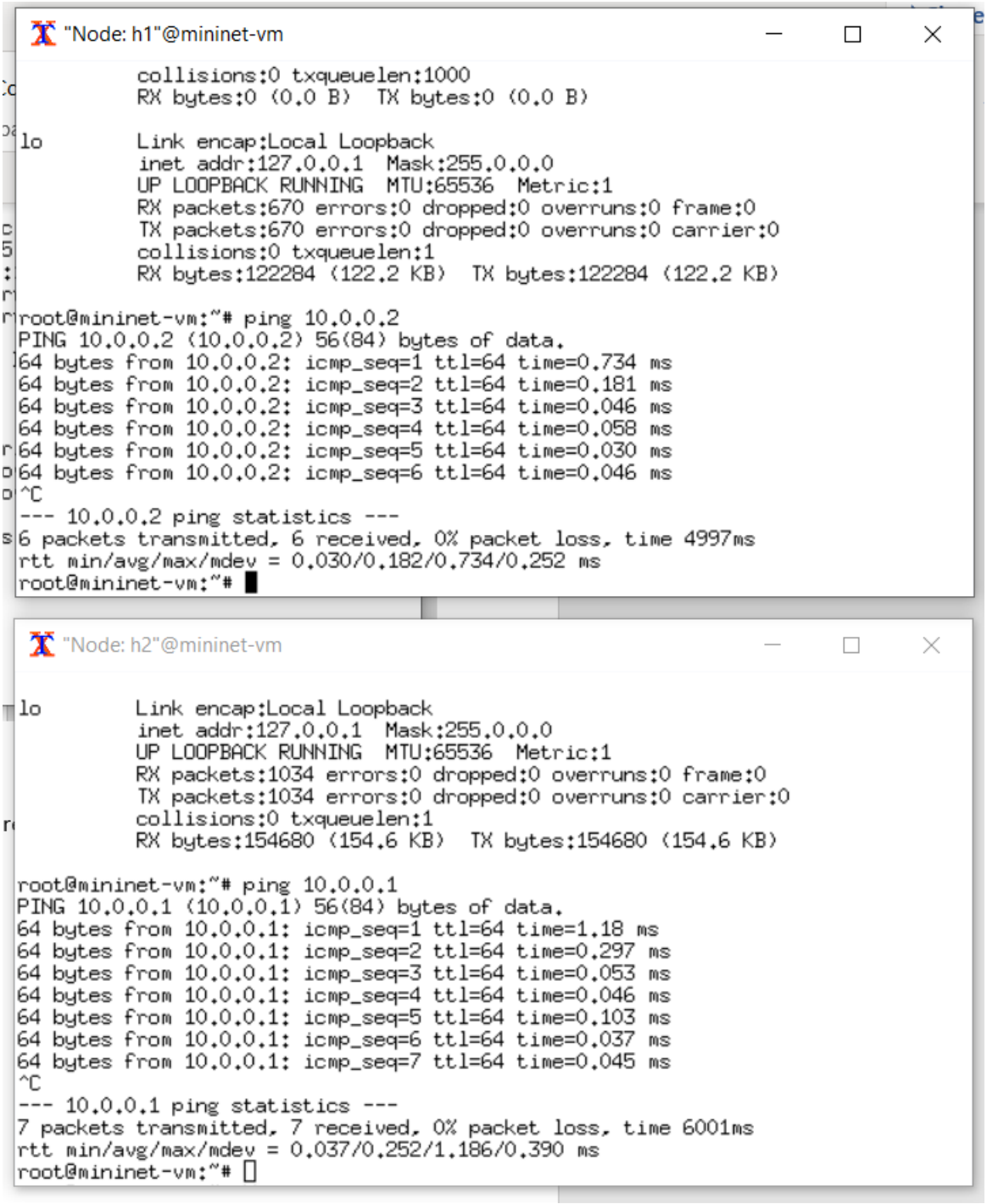
6.

7. 
"Node: h1"@mininet-vm
root@mininet-vm:~#
"Node: h2"@mininet-vm
root@mininet-vm:~#

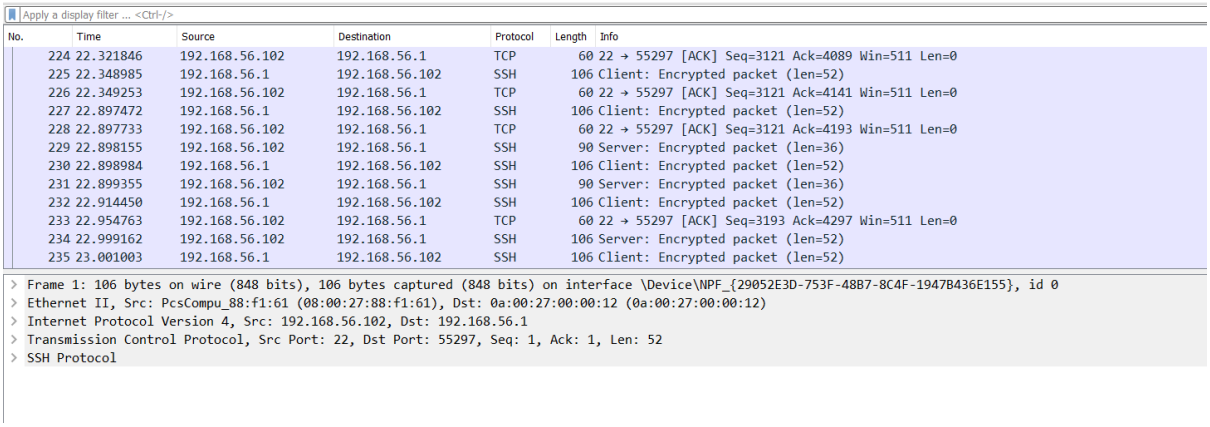


20. Yes they are in the same subnet. This is because they are created in the same network.

8.



9. Yes there is traffic between the h1 and h2


Apply a display filter ... <Ctrl-/>
No. Time Source Destination Protocol Length Info
224 22.321846 192.168.56.102 192.168.56.1 TCP 60 22 → 55297 [ACK] Seq=3121 Ack=4089 Win=511 Len=0
225 22.348985 192.168.56.1 192.168.56.102 SSH 106 Client: Encrypted packet (len=52)
226 22.349253 192.168.56.102 192.168.56.1 TCP 60 22 → 55297 [ACK] Seq=3121 Ack=4141 Win=511 Len=0
227 22.897472 192.168.56.1 192.168.56.102 SSH 106 Client: Encrypted packet (len=52)
228 22.897733 192.168.56.102 192.168.56.1 TCP 60 22 → 55297 [ACK] Seq=3121 Ack=4193 Win=511 Len=0
229 22.898155 192.168.56.102 192.168.56.1 SSH 90 Server: Encrypted packet (len=36)
230 22.898984 192.168.56.1 192.168.56.102 SSH 106 Client: Encrypted packet (len=52)
231 22.899355 192.168.56.102 192.168.56.1 SSH 90 Server: Encrypted packet (len=36)
232 22.914450 192.168.56.1 192.168.56.102 SSH 106 Client: Encrypted packet (len=52)
233 22.954763 192.168.56.102 192.168.56.1 TCP 60 22 → 55297 [ACK] Seq=3193 Ack=4297 Win=511 Len=0
234 22.999162 192.168.56.102 192.168.56.1 SSH 106 Server: Encrypted packet (len=52)
235 23.001003 192.168.56.1 192.168.56.102 SSH 106 Client: Encrypted packet (len=52)
Frame 1: 106 bytes on wire (848 bits), 106 bytes captured (848 bits) on interface \Device\NPF_{29052E3D-753F-48B7-8C4F-1947B436E155}, id 0
Ethernet II, Src: PcsCompu_88:f1:61 (08:00:27:88:f1:61), Dst: 0a:00:27:00:00:12 (0a:00:27:00:00:12)
Internet Protocol Version 4, Src: 192.168.56.102, Dst: 192.168.56.1
Transmission Control Protocol, Src Port: 22, Dst Port: 55297, Seq: 1, Ack: 1, Len: 52
SSH Protocol