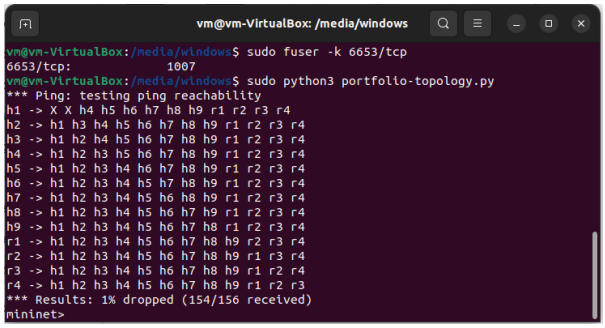
SETUP

(Only for Virtual Box Config when using a shared directory where .py files are located)
$ sudo mkdir /media/shared
$ sudo mount -t vboxsf shared /media/shared

$ sudo apt install python3-pip
$ pip install mininet
$ sudo apt-get install mininet
$ sudo apt-get install xterm
$ sudo apt-get install -y openvswitch-testcontroller
$ sudo mn -c
$ sudo fuser -k 6653/tcp
$ sudo python3 portfolio-topology.py

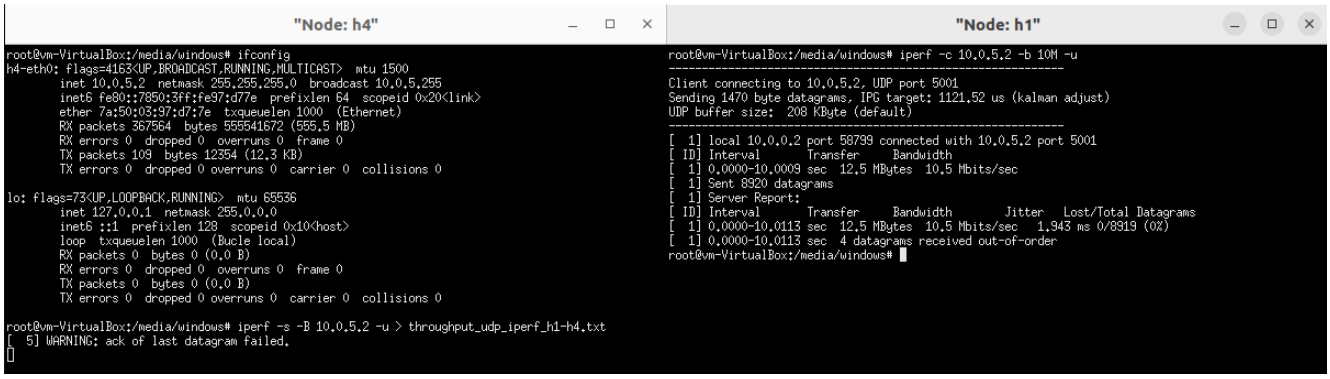


TEST Case 1: Measuring bandwidth with iperf in UDP mode

iperf tests with udp mode (h1->h4)

mininet> xterm h4
ifconfig
iperf -s -B 10.0.5.2 -u > throughput_udp_iperf_h1-h4.txt

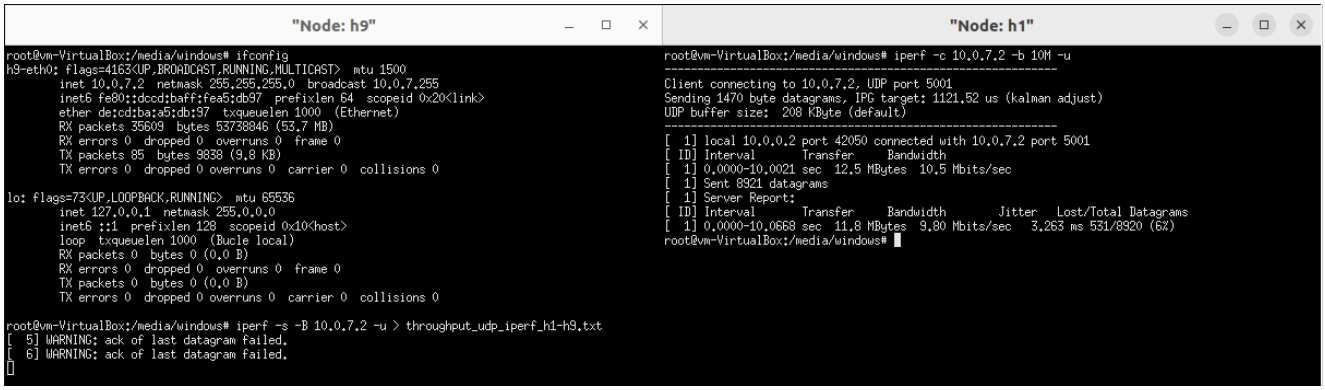
mininet> xterm h1
iperf -c 10.0.5.2 -b 10M -u



iperf tests with udp mode (h1->h9)

mininet> xterm h9
ifconfig
iperf -s -B 10.0.7.2 -u > throughput_udp_iperf_h1-h9.txt

mininet> xterm h1
iperf -c 10.0.7.2 -b 10M -u

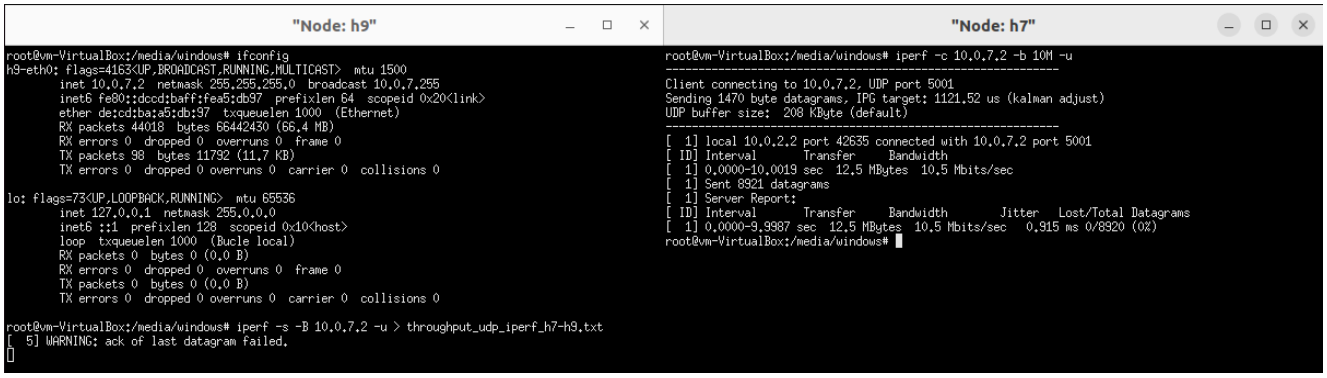


iperf tests with udp mode (h7->h9)

mininet> xterm h9
ifconfig
iperf -s -B 10.0.7.2 -u > throughput_udp_iperf_h7-h9.txt

mininet> xterm h7
iperf -c 10.0.7.2 -b 10M -u

iperf tests with udp mode (h7->h9)

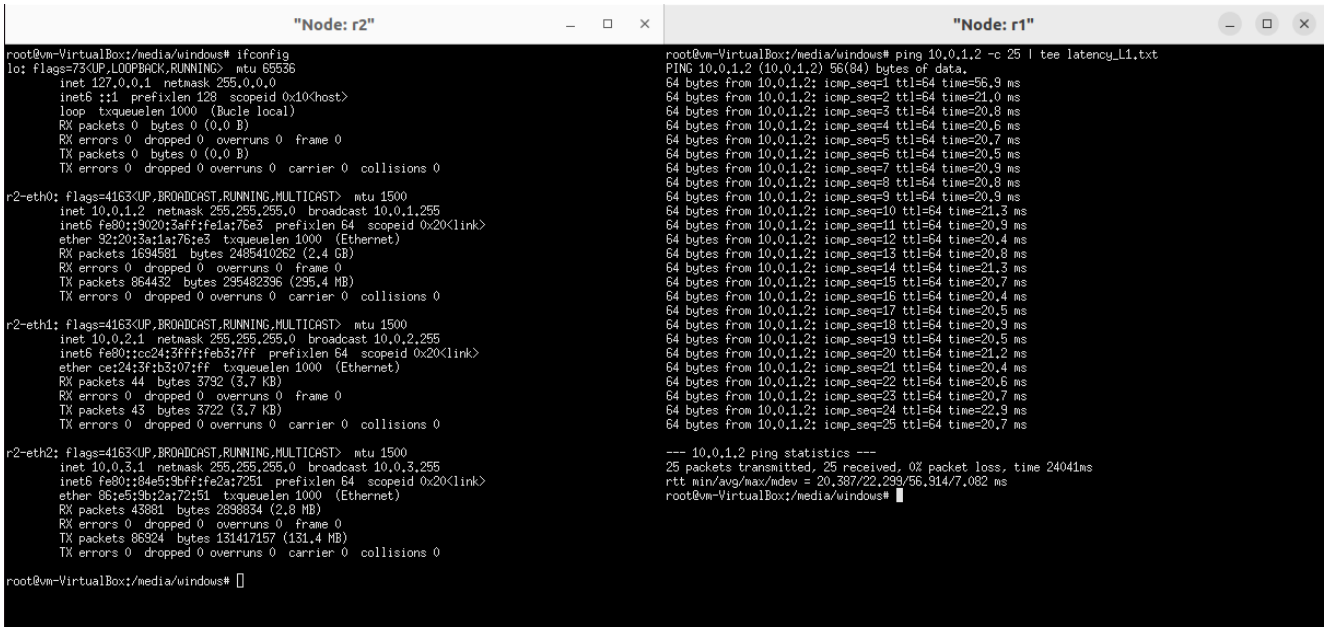


TEST Case 2: Link Latency and Throughput

Link Latency and Throughput for L1:

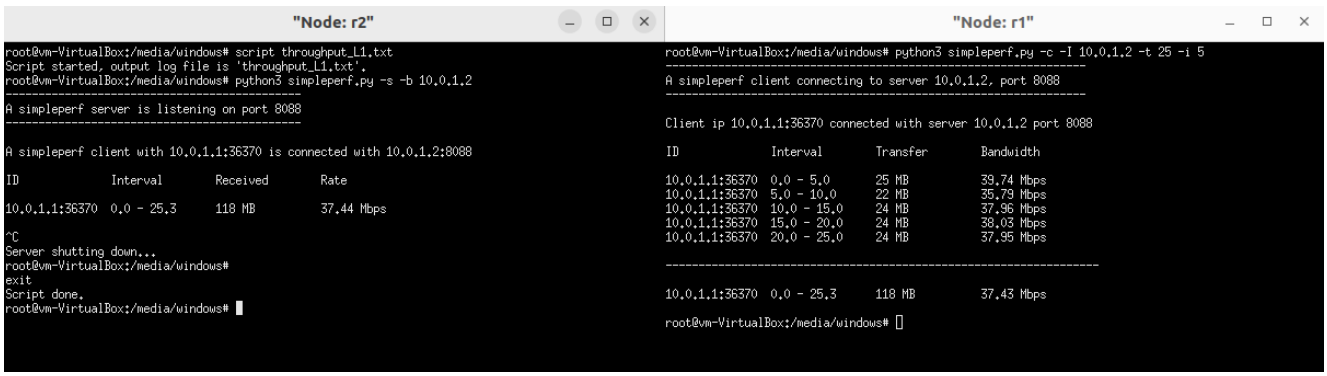
mininet> xterm r2
ifconfig

mininet> xterm r1
ping 10.0.1.2 -c 25 | tee latency_L1.txt



script throughput_L1.txt
python3 simpleperf.py -s -b 10.0.1.2
(Press Ctrl+C and Ctrl+D after measuring)

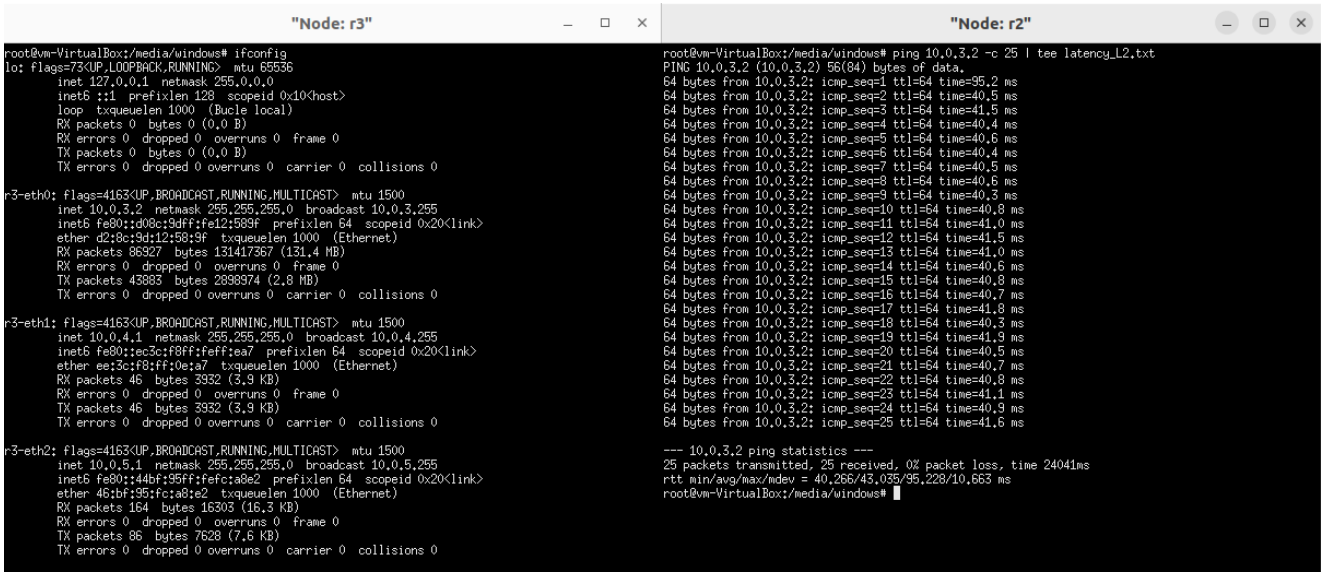
python3 simpleperf.py -c -I 10.0.1.2 -t 25 -i 5



Link Latency and Throughput for L2:

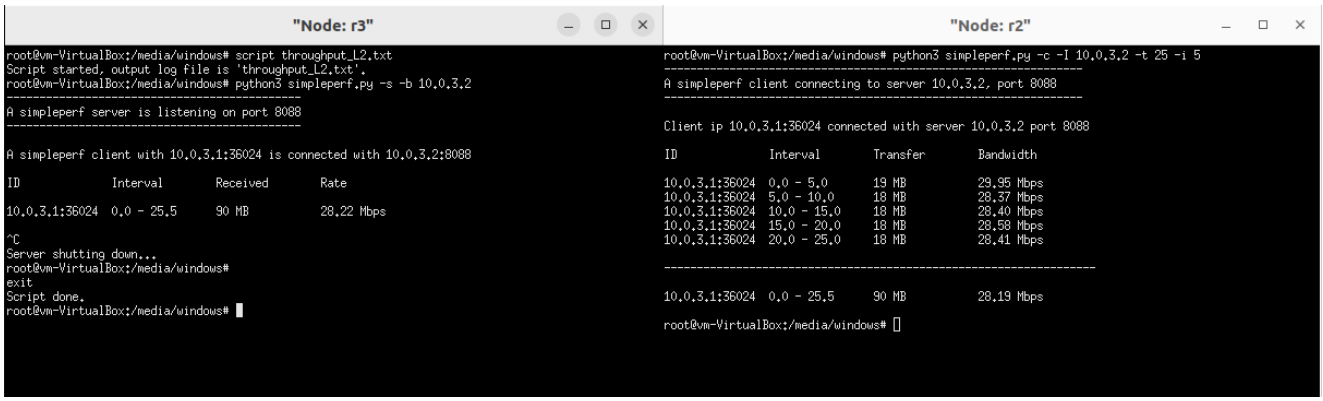
mininet> xterm r3
ifconfig

mininet> xterm r2
ping 10.0.3.2 -c 25 | tee latency_L2.txt



script throughput_L2.txt
python3 simpleperf.py -s -b 10.0.3.2
(Press Ctrl+C and Ctrl+D after measuring)

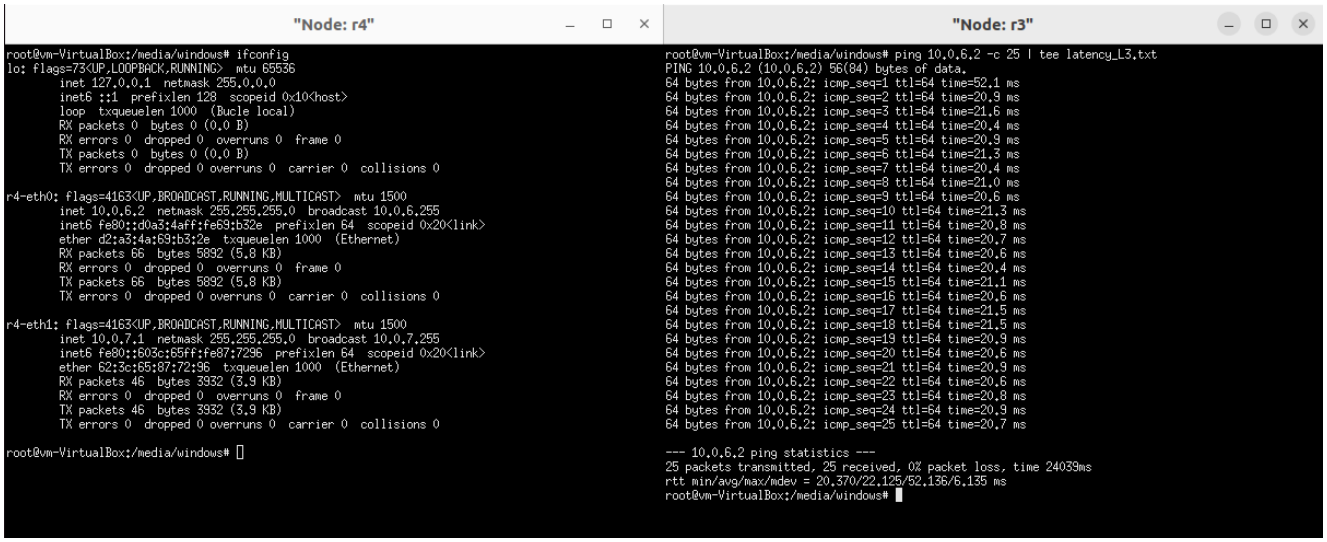
python3 simpleperf.py -c -I 10.0.3.2 -t 25 -i 5



Link Latency and Throughput for L3:

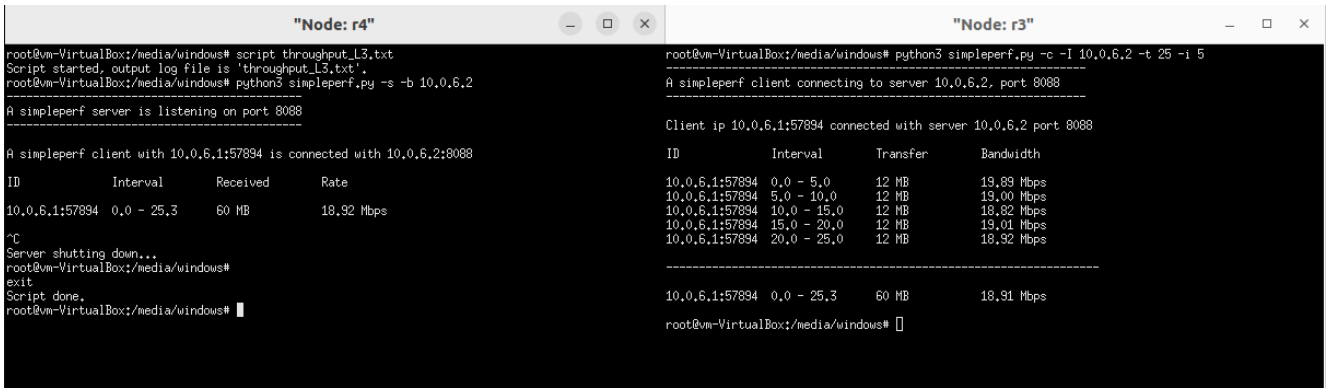
mininet> xterm r4
ifconfig

mininet> xterm r3
ping 10.0.6.2 -c 25 | tee latency_L3.txt



script throughput_L3.txt
python3 simpleperf.py -s -b 10.0.6.2
(Press Ctrl+C and Ctrl+D after measuring)

python3 simpleperf.py -c -I 10.0.6.2 -t 25 -i 5

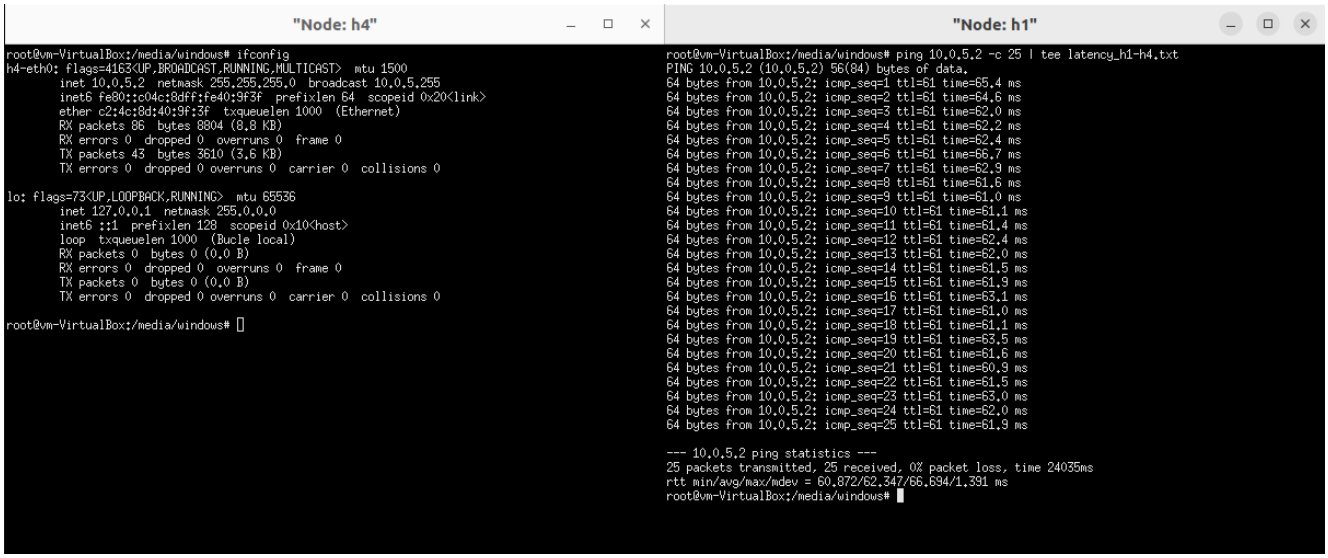


TEST Case 3: Path Latency and Throughput

Path Latency and Throughput for h1->h4:

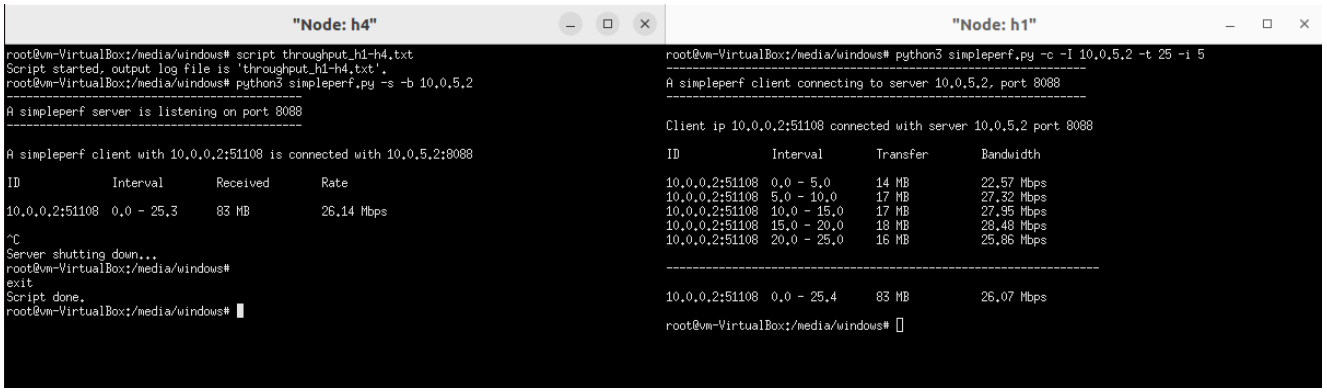
mininet> xterm h4
ifconfig

mininet> xterm h1
ping 10.0.5.2 -c 25 | tee latency_h1-h4.txt



script throughput_h1-h4.txt
python3 simpleperf.py -s -b 10.0.5.2
(Press Ctrl+C and Ctrl+D after measuring)

python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5



Path Latency and Throughput for h7-h9:

mininet> xterm h9
ifconfig

mininet> xterm h7
ping 10.0.7.2 -c 25 | tee latency_h7-h9.txt

"Node: h9"

```
root@vm-VirtualBox:/media/windows# ifconfig
h9-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.7.2  netmask 255.255.255.0  broadcast 10.0.7.255
        inet6 fe80::f873:e2ff:fe81:f831  prefixlen 64  scopeid 0x20<link>
        ether fa:73:e2:81:f8:31  txqueuelen 1000  (Ethernet)
        RX packets 40  bytes 3512 (3.5 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 40  bytes 3512 (3.5 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  (Bucle local)
        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

root@vm-VirtualBox:/media/windows#
```

"Node: h7"

```
root@vm-VirtualBox:/media/windows# ping 10.0.7.2 -c 25 | tee latency_h7-h9.txt
PING 10.0.7.2 (10.0.7.2) 56(84) bytes of data.
64 bytes from 10.0.7.2: icmp_seq=1 ttl=61 time=62.3 ms
64 bytes from 10.0.7.2: icmp_seq=2 ttl=61 time=61.6 ms
64 bytes from 10.0.7.2: icmp_seq=3 ttl=61 time=62.0 ms
64 bytes from 10.0.7.2: icmp_seq=4 ttl=61 time=62.0 ms
64 bytes from 10.0.7.2: icmp_seq=5 ttl=61 time=61.9 ms
64 bytes from 10.0.7.2: icmp_seq=6 ttl=61 time=62.2 ms
64 bytes from 10.0.7.2: icmp_seq=7 ttl=61 time=61.5 ms
64 bytes from 10.0.7.2: icmp_seq=8 ttl=61 time=63.2 ms
64 bytes from 10.0.7.2: icmp_seq=9 ttl=61 time=61.3 ms
64 bytes from 10.0.7.2: icmp_seq=10 ttl=61 time=61.2 ms
64 bytes from 10.0.7.2: icmp_seq=11 ttl=61 time=62.4 ms
64 bytes from 10.0.7.2: icmp_seq=12 ttl=61 time=61.3 ms
64 bytes from 10.0.7.2: icmp_seq=13 ttl=61 time=63.1 ms
64 bytes from 10.0.7.2: icmp_seq=14 ttl=61 time=62.2 ms
64 bytes from 10.0.7.2: icmp_seq=15 ttl=61 time=60.8 ms
64 bytes from 10.0.7.2: icmp_seq=16 ttl=61 time=61.5 ms
64 bytes from 10.0.7.2: icmp_seq=17 ttl=61 time=62.1 ms
64 bytes from 10.0.7.2: icmp_seq=18 ttl=61 time=61.9 ms
64 bytes from 10.0.7.2: icmp_seq=19 ttl=61 time=61.5 ms
64 bytes from 10.0.7.2: icmp_seq=20 ttl=61 time=61.8 ms
64 bytes from 10.0.7.2: icmp_seq=21 ttl=61 time=61.8 ms
64 bytes from 10.0.7.2: icmp_seq=22 ttl=61 time=61.9 ms
64 bytes from 10.0.7.2: icmp_seq=23 ttl=61 time=63.8 ms
64 bytes from 10.0.7.2: icmp_seq=24 ttl=61 time=61.3 ms
64 bytes from 10.0.7.2: icmp_seq=25 ttl=61 time=61.6 ms

--- 10.0.7.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24033ms
rtt min/avg/max/mdev = 60.799/61.921/63.837/0.665 ms
root@vm-VirtualBox:/media/windows#
```

script throughput_h7-h9.txt
python3 simpleperf.py -s -b 10.0.7.2
(Press Ctrl+C and Ctrl+D after measuring)

python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5

"Node: h9"

```
root@vm-VirtualBox:/media/windows# script throughput_h7-h9.txt
Script started, output log file is 'throughput_h7-h9.txt'.
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -s -b 10.0.7.2
------------------------------------------------
A simpleperf server is listening on port 8088
------------------------------------------------

A simpleperf client with 10.0.2.2:55346 is connected with 10.0.7.2:8088

ID              Interval        Received        Rate

10.0.2.2:55346  0.0 - 25.3      52 MB           16.53 Mbps

^C
Server shutting down...
root@vm-VirtualBox:/media/windows#
exit
Script done.
root@vm-VirtualBox:/media/windows#
```

"Node: h7"

```
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5
------------------------------------------------------------
A simpleperf client connecting to server 10.0.7.2, port 8088
------------------------------------------------------------

Client ip 10.0.2.2:55346 connected with server 10.0.7.2 port 8088

ID              Interval        Transfer        Bandwidth

10.0.2.2:55346  0.0 - 5.0       9 MB            15.03 Mbps
10.0.2.2:55346  5.0 - 10.0      11 MB           17.80 Mbps
10.0.2.2:55346  10.0 - 15.0     11 MB           18.21 Mbps
10.0.2.2:55346  15.0 - 20.0     9 MB            14.07 Mbps
10.0.2.2:55346  20.0 - 25.0     12 MB           18.45 Mbps

------------------------------------------------------------------

10.0.2.2:55346  0.0 - 25.3      52 MB           16.49 Mbps

root@vm-VirtualBox:/media/windows#
```

Path Latency and Throughput for h1-h9:

mininet> xterm h9
ifconfig

mininet> xterm h1
ping 10.0.7.2 -c 25 | tee latency_h1-h9.txt

"Node: h9"

```
root@vm-VirtualBox:/media/windows# ifconfig
h9-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.7.2  netmask 255.255.255.0  broadcast 10.0.7.255
        inet6 fe80::f873:e2ff:fe81:f831  prefixlen 64  scopeid 0x20<link>
        ether fa:73:e2:81:f8:31  txqueuelen 1000  (Ethernet)
        RX packets 36199  bytes 54619254 (54.6 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 19073  bytes 1273422 (1.2 MB)
        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  (Bucle local)
        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

root@vm-VirtualBox:/media/windows#
```

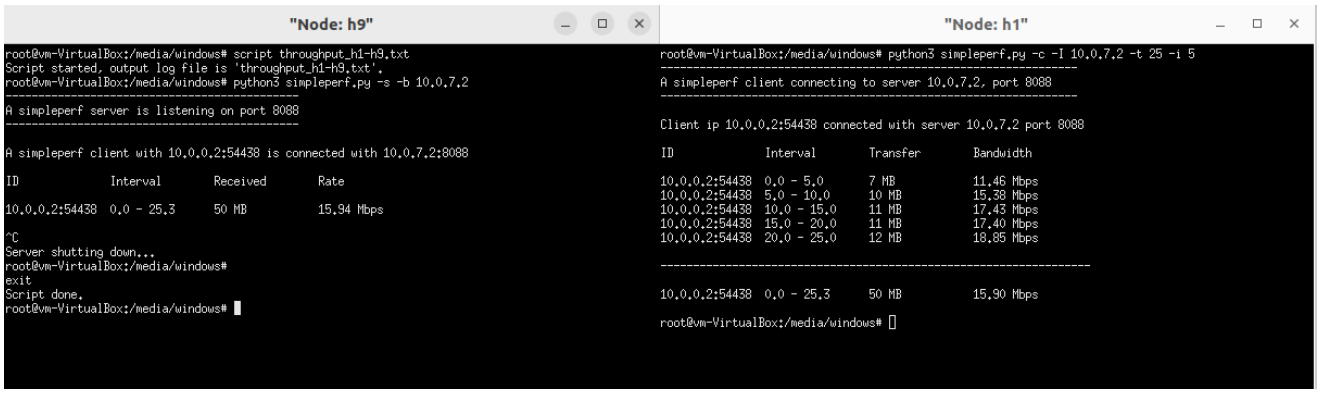
"Node: h1"

```
root@vm-VirtualBox:/media/windows# ping 10.0.7.2 -c 25 | tee latency_h1-h9.txt
PING 10.0.7.2 (10.0.7.2) 56(84) bytes of data.
64 bytes from 10.0.7.2: icmp_seq=1 ttl=60 time=84.6 ms
64 bytes from 10.0.7.2: icmp_seq=2 ttl=60 time=84.5 ms
64 bytes from 10.0.7.2: icmp_seq=3 ttl=60 time=82.5 ms
64 bytes from 10.0.7.2: icmp_seq=4 ttl=60 time=84.1 ms
64 bytes from 10.0.7.2: icmp_seq=5 ttl=60 time=83.1 ms
64 bytes from 10.0.7.2: icmp_seq=6 ttl=60 time=82.6 ms
64 bytes from 10.0.7.2: icmp_seq=7 ttl=60 time=83.1 ms
64 bytes from 10.0.7.2: icmp_seq=8 ttl=60 time=87.7 ms
64 bytes from 10.0.7.2: icmp_seq=9 ttl=60 time=81.9 ms
64 bytes from 10.0.7.2: icmp_seq=10 ttl=60 time=82.1 ms
64 bytes from 10.0.7.2: icmp_seq=11 ttl=60 time=81.3 ms
64 bytes from 10.0.7.2: icmp_seq=12 ttl=60 time=82.0 ms
64 bytes from 10.0.7.2: icmp_seq=13 ttl=60 time=81.6 ms
64 bytes from 10.0.7.2: icmp_seq=14 ttl=60 time=84.5 ms
64 bytes from 10.0.7.2: icmp_seq=15 ttl=60 time=82.7 ms
64 bytes from 10.0.7.2: icmp_seq=16 ttl=60 time=84.6 ms
64 bytes from 10.0.7.2: icmp_seq=17 ttl=60 time=83.6 ms
64 bytes from 10.0.7.2: icmp_seq=18 ttl=60 time=81.6 ms
64 bytes from 10.0.7.2: icmp_seq=19 ttl=60 time=83.1 ms
64 bytes from 10.0.7.2: icmp_seq=20 ttl=60 time=81.7 ms
64 bytes from 10.0.7.2: icmp_seq=21 ttl=60 time=83.1 ms
64 bytes from 10.0.7.2: icmp_seq=22 ttl=60 time=81.6 ms
64 bytes from 10.0.7.2: icmp_seq=23 ttl=60 time=82.3 ms
64 bytes from 10.0.7.2: icmp_seq=24 ttl=60 time=82.4 ms
64 bytes from 10.0.7.2: icmp_seq=25 ttl=60 time=82.5 ms

--- 10.0.7.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24035ms
rtt min/avg/max/mdev = 81.260/83.004/87.699/1.392 ms
root@vm-VirtualBox:/media/windows#
```

script throughput_h1-h9.txt
python3 simpleperf.py -s -b 10.0.7.2
(Press Ctrl+C and Ctrl+D after measuring)

python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5

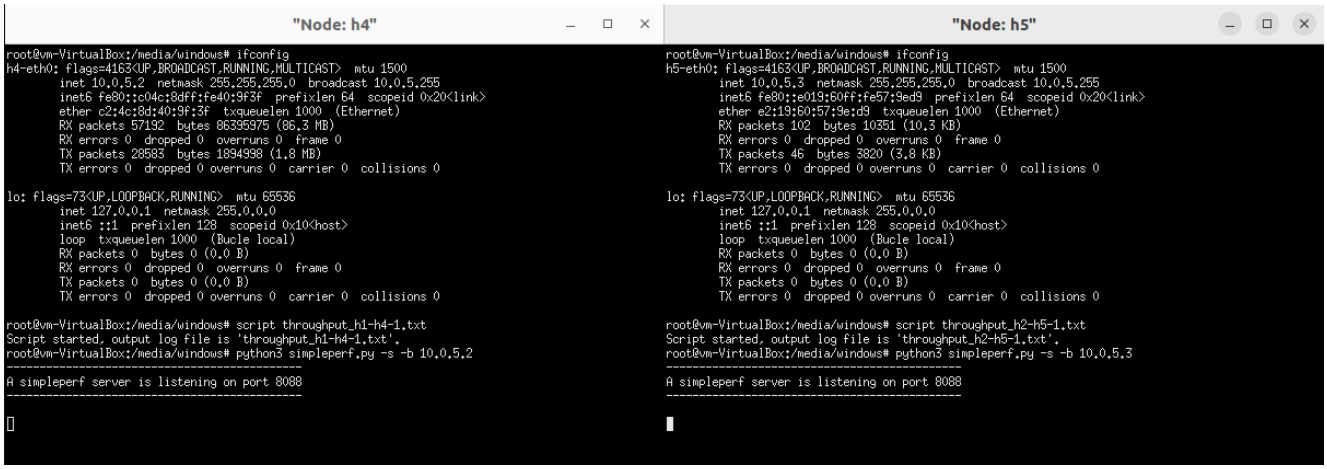


TEST Case 4: Effects of Multiplexing and Latency

Path Latency and Throughput for h1->h4, h2->h5:

mininet> xterm h4
ifconfig
script throughput_h1-h4-1.txt
python3 simpleperf.py -s -b 10.0.5.2

mininet> xterm h5
ifconfig
script throughput_h2-h5-1.txt
python3 simpleperf.py -s -b 10.0.5.3



mininet> xterm h1
python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5 (wait)

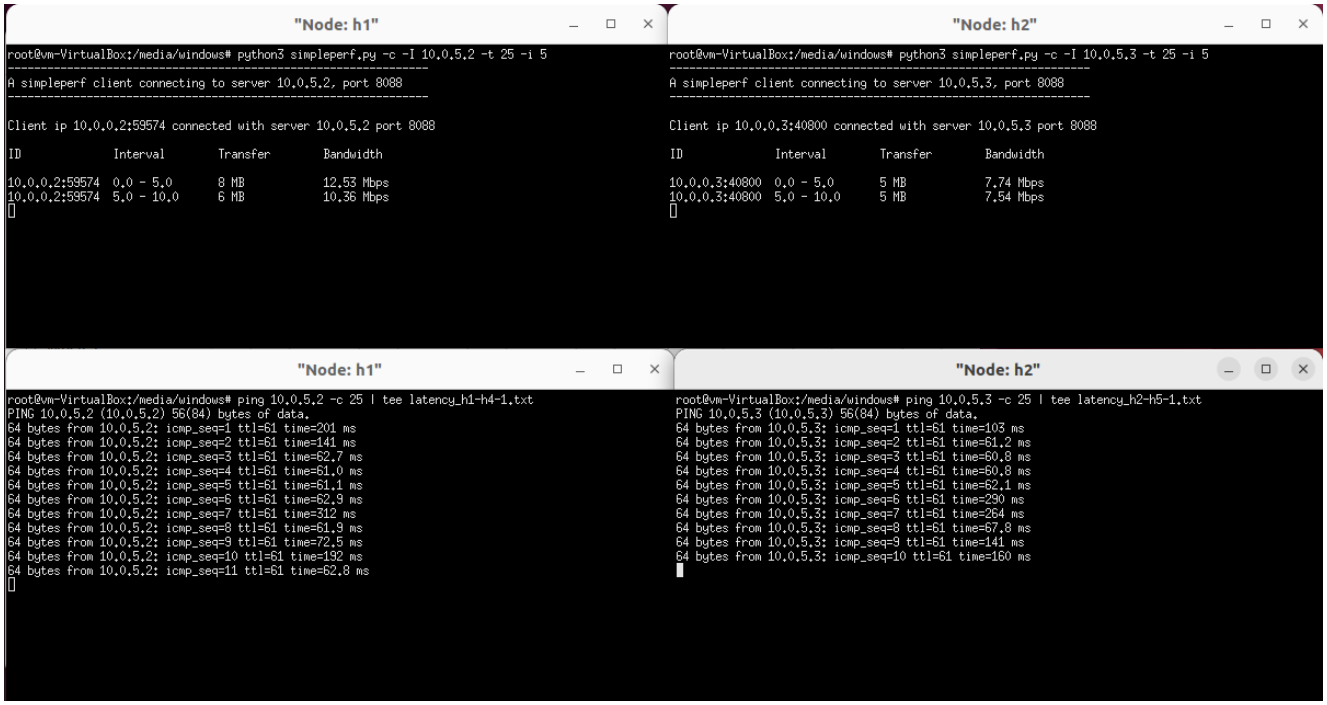
mininet> xterm h2
python3 simpleperf.py -c -I 10.0.5.3 -t 25 -i 5 (wait)

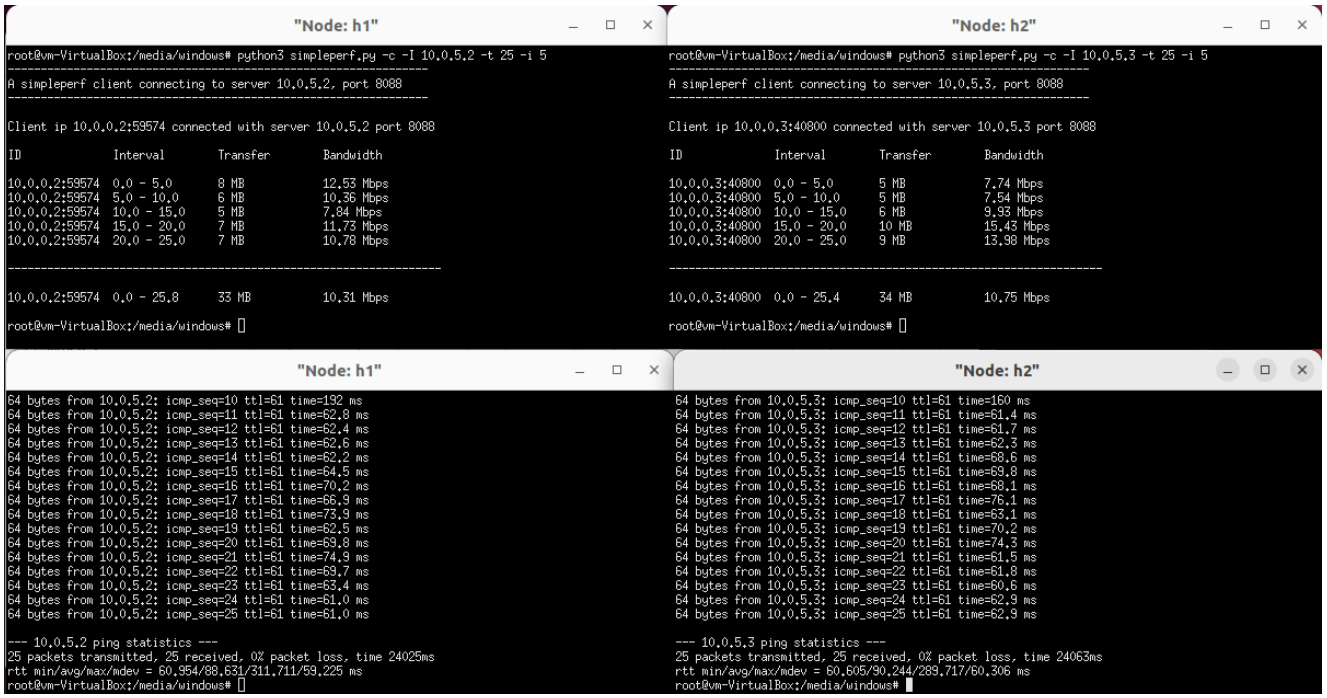
(open new xterm to measure latency while running simpleperf)

mininet> xterm h1
ping 10.0.5.2 -c 25 | tee latency_h1-h4-1.txt (wait)

mininet> xterm h2
ping 10.0.5.3 -c 25 | tee latency_h2-h5-1.txt (wait)

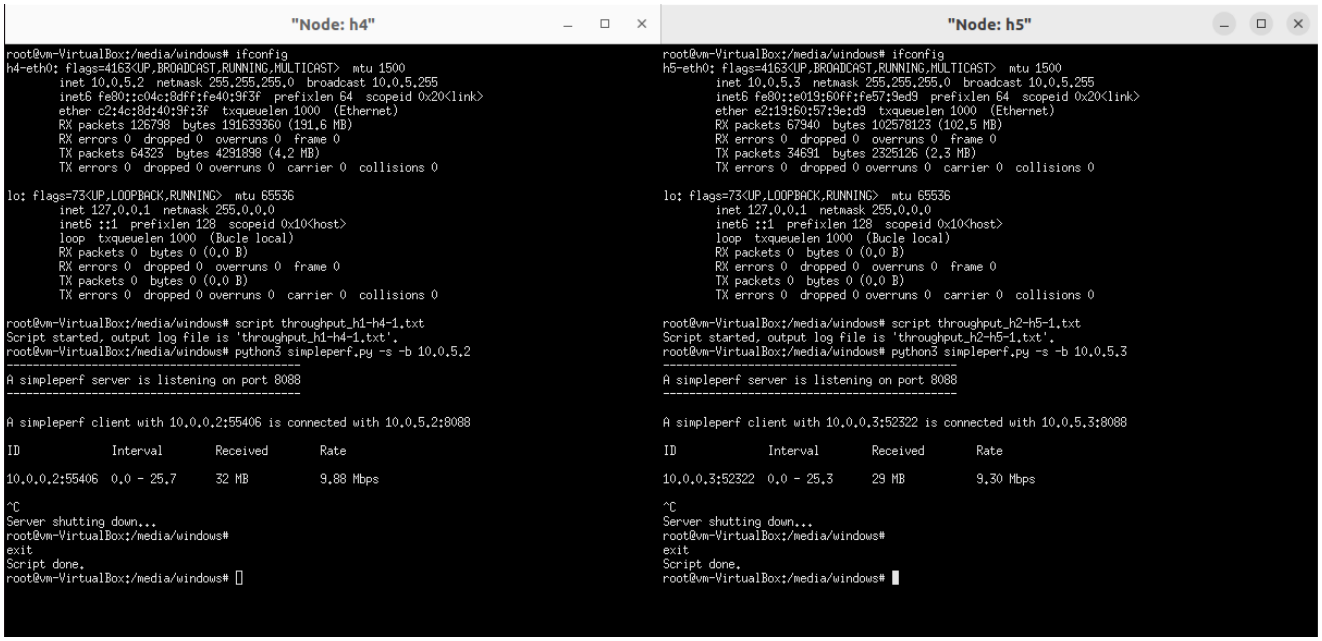
Execute the commands one after other.


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:59574 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:59574 0.0 - 5.0 8 MB 12.53 Mbps
10.0.0.2:59574 5.0 - 10.0 6 MB 10.36 Mbps
"Node: h2"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.3 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.3, port 8088
Client ip 10.0.0.3:40800 connected with server 10.0.5.3 port 8088
ID Interval Transfer Bandwidth
10.0.0.3:40800 0.0 - 5.0 5 MB 7.74 Mbps
10.0.0.3:40800 5.0 - 10.0 5 MB 7.54 Mbps
"Node: h1"
root@vm-VirtualBox:/media/windows# ping 10.0.5.2 -c 25 | tee latency_h1-h4-1.txt
PING 10.0.5.2 (10.0.5.2) 56(84) bytes of data.
64 bytes from 10.0.5.2: icmp_seq=1 ttl=61 time=201 ms
64 bytes from 10.0.5.2: icmp_seq=2 ttl=61 time=141 ms
64 bytes from 10.0.5.2: icmp_seq=3 ttl=61 time=62.7 ms
64 bytes from 10.0.5.2: icmp_seq=4 ttl=61 time=61.0 ms
64 bytes from 10.0.5.2: icmp_seq=5 ttl=61 time=61.1 ms
64 bytes from 10.0.5.2: icmp_seq=6 ttl=61 time=62.9 ms
64 bytes from 10.0.5.2: icmp_seq=7 ttl=61 time=312 ms
64 bytes from 10.0.5.2: icmp_seq=8 ttl=61 time=61.9 ms
64 bytes from 10.0.5.2: icmp_seq=9 ttl=61 time=72.5 ms
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=192 ms
64 bytes from 10.0.5.2: icmp_seq=11 ttl=61 time=62.8 ms
"Node: h2"
root@vm-VirtualBox:/media/windows# ping 10.0.5.3 -c 25 | tee latency_h2-h5-1.txt
PING 10.0.5.3 (10.0.5.3) 56(84) bytes of data.
64 bytes from 10.0.5.3: icmp_seq=1 ttl=61 time=103 ms
64 bytes from 10.0.5.3: icmp_seq=2 ttl=61 time=61.2 ms
64 bytes from 10.0.5.3: icmp_seq=3 ttl=61 time=60.8 ms
64 bytes from 10.0.5.3: icmp_seq=4 ttl=61 time=60.8 ms
64 bytes from 10.0.5.3: icmp_seq=5 ttl=61 time=62.1 ms
64 bytes from 10.0.5.3: icmp_seq=6 ttl=61 time=290 ms
64 bytes from 10.0.5.3: icmp_seq=7 ttl=61 time=264 ms
64 bytes from 10.0.5.3: icmp_seq=8 ttl=61 time=67.8 ms
64 bytes from 10.0.5.3: icmp_seq=9 ttl=61 time=141 ms
64 bytes from 10.0.5.3: icmp_seq=10 ttl=61 time=160 ms


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:59574 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:59574 0.0 - 5.0 8 MB 12.53 Mbps
10.0.0.2:59574 5.0 - 10.0 6 MB 10.36 Mbps
10.0.0.2:59574 10.0 - 15.0 5 MB 7.84 Mbps
10.0.0.2:59574 15.0 - 20.0 7 MB 11.73 Mbps
10.0.0.2:59574 20.0 - 25.0 7 MB 10.78 Mbps
10.0.0.2:59574 0.0 - 25.8 33 MB 10.31 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h2"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.3 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.3, port 8088
Client ip 10.0.0.3:40800 connected with server 10.0.5.3 port 8088
ID Interval Transfer Bandwidth
10.0.0.3:40800 0.0 - 5.0 5 MB 7.74 Mbps
10.0.0.3:40800 5.0 - 10.0 5 MB 7.54 Mbps
10.0.0.3:40800 10.0 - 15.0 6 MB 9.93 Mbps
10.0.0.3:40800 15.0 - 20.0 10 MB 15.43 Mbps
10.0.0.3:40800 20.0 - 25.0 9 MB 13.98 Mbps
10.0.0.3:40800 0.0 - 25.4 34 MB 10.75 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h1"
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=192 ms
64 bytes from 10.0.5.2: icmp_seq=11 ttl=61 time=62.8 ms
64 bytes from 10.0.5.2: icmp_seq=12 ttl=61 time=62.4 ms
64 bytes from 10.0.5.2: icmp_seq=13 ttl=61 time=62.6 ms
64 bytes from 10.0.5.2: icmp_seq=14 ttl=61 time=62.2 ms
64 bytes from 10.0.5.2: icmp_seq=15 ttl=61 time=64.5 ms
64 bytes from 10.0.5.2: icmp_seq=16 ttl=61 time=70.2 ms
64 bytes from 10.0.5.2: icmp_seq=17 ttl=61 time=66.9 ms
64 bytes from 10.0.5.2: icmp_seq=18 ttl=61 time=73.9 ms
64 bytes from 10.0.5.2: icmp_seq=19 ttl=61 time=62.5 ms
64 bytes from 10.0.5.2: icmp_seq=20 ttl=61 time=69.8 ms
64 bytes from 10.0.5.2: icmp_seq=21 ttl=61 time=74.9 ms
64 bytes from 10.0.5.2: icmp_seq=22 ttl=61 time=69.7 ms
64 bytes from 10.0.5.2: icmp_seq=23 ttl=61 time=63.4 ms
64 bytes from 10.0.5.2: icmp_seq=24 ttl=61 time=61.0 ms
64 bytes from 10.0.5.2: icmp_seq=25 ttl=61 time=61.0 ms
--- 10.0.5.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24025ms
rtt min/avg/max/mdev = 60.954/88.631/311.711/59.225 ms
root@vm-VirtualBox:/media/windows#
"Node: h2"
64 bytes from 10.0.5.3: icmp_seq=10 ttl=61 time=160 ms
64 bytes from 10.0.5.3: icmp_seq=11 ttl=61 time=61.4 ms
64 bytes from 10.0.5.3: icmp_seq=12 ttl=61 time=61.7 ms
64 bytes from 10.0.5.3: icmp_seq=13 ttl=61 time=62.3 ms
64 bytes from 10.0.5.3: icmp_seq=14 ttl=61 time=68.6 ms
64 bytes from 10.0.5.3: icmp_seq=15 ttl=61 time=69.8 ms
64 bytes from 10.0.5.3: icmp_seq=16 ttl=61 time=68.1 ms
64 bytes from 10.0.5.3: icmp_seq=17 ttl=61 time=76.1 ms
64 bytes from 10.0.5.3: icmp_seq=18 ttl=61 time=63.1 ms
64 bytes from 10.0.5.3: icmp_seq=19 ttl=61 time=70.2 ms
64 bytes from 10.0.5.3: icmp_seq=20 ttl=61 time=74.3 ms
64 bytes from 10.0.5.3: icmp_seq=21 ttl=61 time=61.5 ms
64 bytes from 10.0.5.3: icmp_seq=22 ttl=61 time=61.8 ms
64 bytes from 10.0.5.3: icmp_seq=23 ttl=61 time=60.6 ms
64 bytes from 10.0.5.3: icmp_seq=24 ttl=61 time=62.9 ms
64 bytes from 10.0.5.3: icmp_seq=25 ttl=61 time=62.9 ms
--- 10.0.5.3 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24063ms
rtt min/avg/max/mdev = 60.605/90.244/289.717/60.306 ms
root@vm-VirtualBox:/media/windows#

Press Ctrl+C and Ctrl+D after measuring:

Press Ctrl+C and Ctrl+D after measuring:

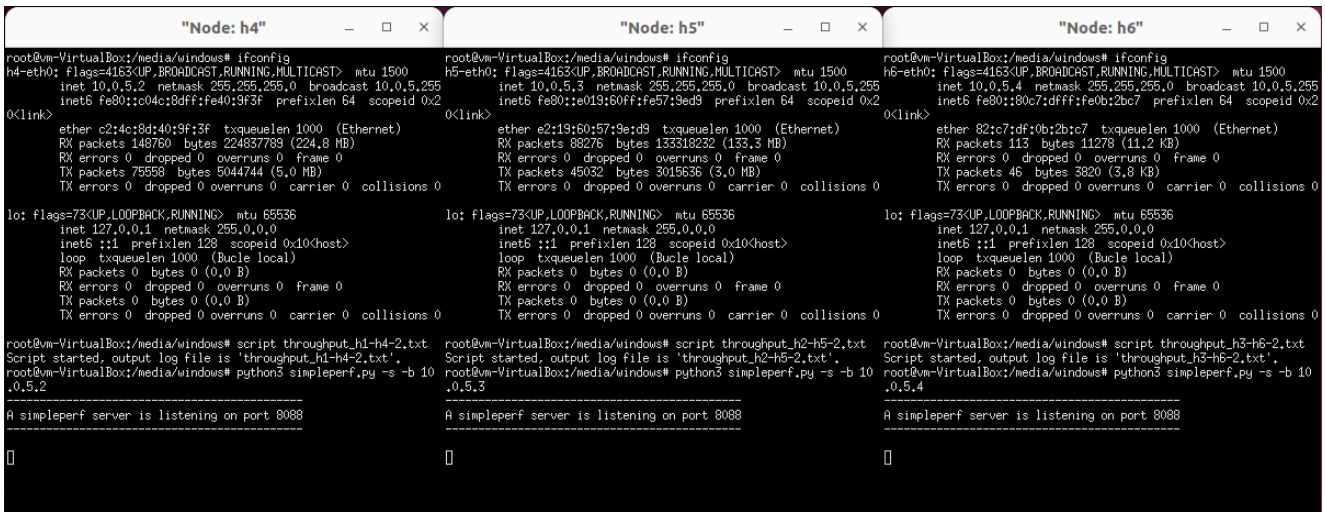


Path Latency and Throughput for h1->h4, h2->h5, h3->h6

mininet> xterm h4
ifconfig
script throughput_h1-h4-2.txt
python3 simpleperf.py -s -b 10.0.5.2

mininet> xterm h5
ifconfig
script throughput_h2-h5-2.txt
python3 simpleperf.py -s -b 10.0.5.3

mininet> xterm h6
ifconfig
script throughput_h3-h6-2.txt
python3 simpleperf.py -s -b 10.0.5.4



mininet> xterm h1
python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5

mininet> xterm h2
python3 simpleperf.py -c -I 10.0.5.3 -t 25 -i 5

mininet> xterm h3
python3 simpleperf.py -c -I 10.0.5.4 -t 25 -i 5

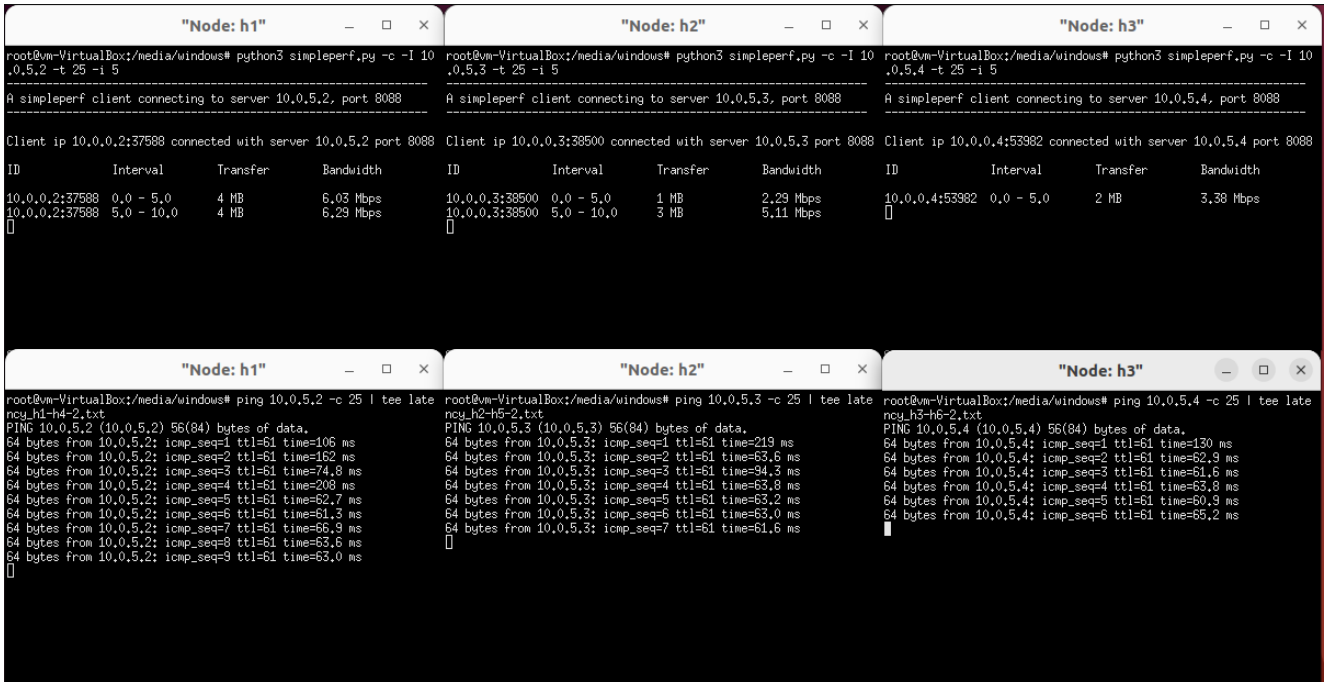
(open new xterm to measure latency while running simpleperf)

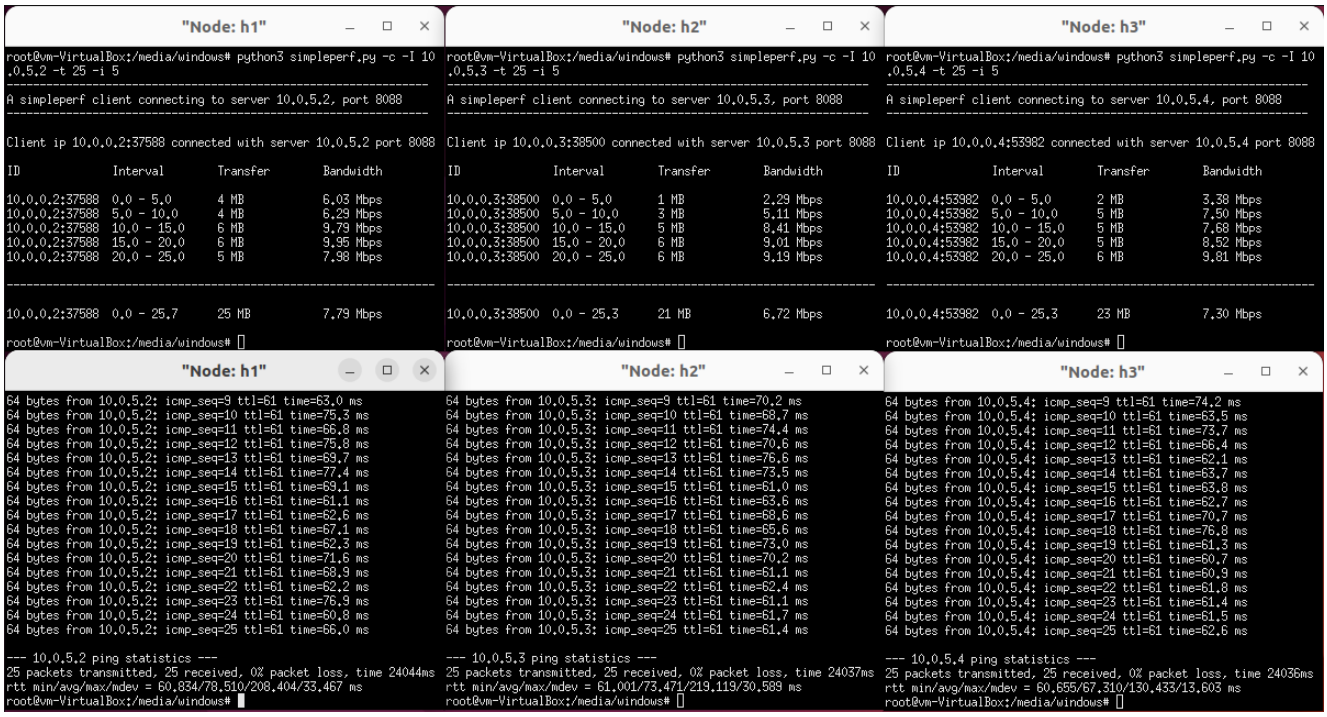
mininet> xterm h1
ping 10.0.5.2 -c 25 | tee latency_h1-h4-2.txt

mininet> xterm h2
ping 10.0.5.3 -c 25 | tee latency_h2-h5-2.txt

mininet> xterm h3
ping 10.0.5.4 -c 25 | tee latency_h3-h6-2.txt

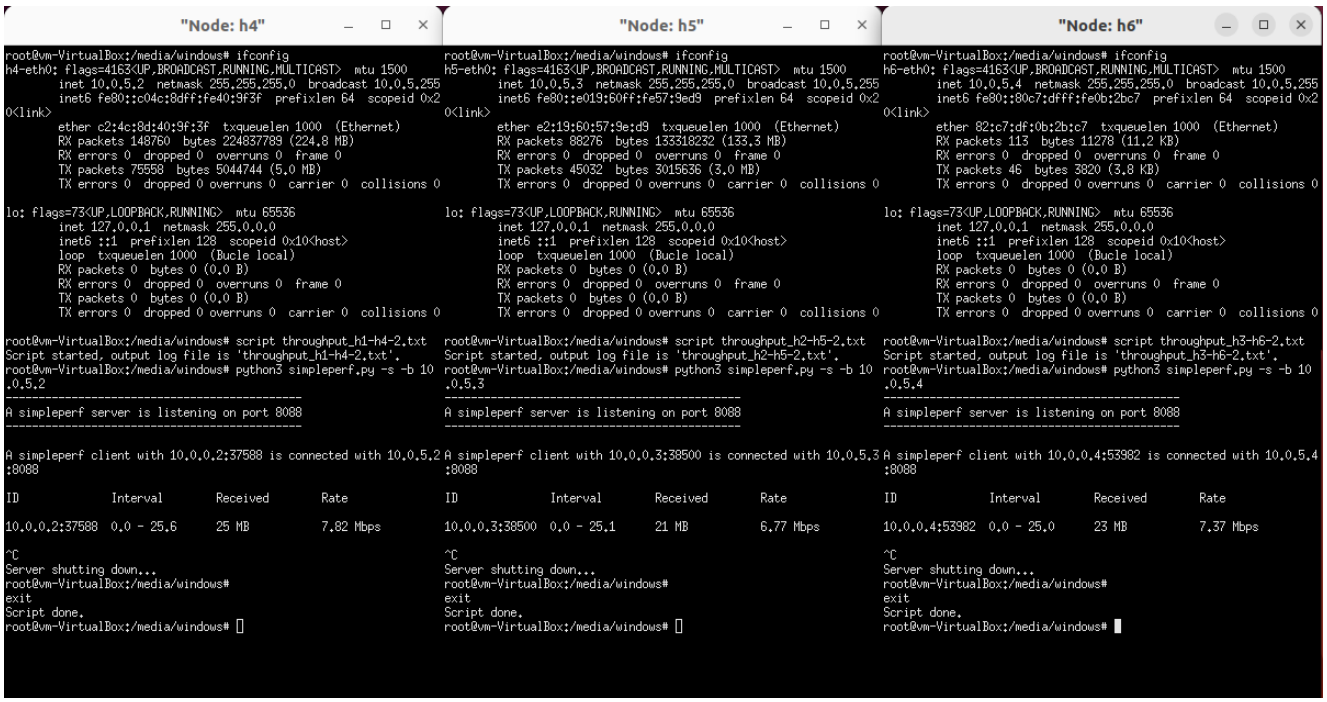
Execute the commands one after other.


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:37588 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:37588 0.0 - 5.0 4 MB 6.03 Mbps
10.0.0.2:37588 5.0 - 10.0 4 MB 6.29 Mbps
"Node: h2"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.3 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.3, port 8088
Client ip 10.0.0.3:38500 connected with server 10.0.5.3 port 8088
ID Interval Transfer Bandwidth
10.0.0.3:38500 0.0 - 5.0 1 MB 2.29 Mbps
10.0.0.3:38500 5.0 - 10.0 3 MB 5.11 Mbps
"Node: h3"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.4 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.4, port 8088
Client ip 10.0.0.4:53982 connected with server 10.0.5.4 port 8088
ID Interval Transfer Bandwidth
10.0.0.4:53982 0.0 - 5.0 2 MB 3.38 Mbps
"Node: h1"
root@vm-VirtualBox:/media/windows# ping 10.0.5.2 -c 25 | tee late
ncy_h1-h4-2.txt
PING 10.0.5.2 (10.0.5.2) 56(84) bytes of data.
64 bytes from 10.0.5.2: icmp_seq=1 ttl=61 time=106 ms
64 bytes from 10.0.5.2: icmp_seq=2 ttl=61 time=162 ms
64 bytes from 10.0.5.2: icmp_seq=3 ttl=61 time=74.8 ms
64 bytes from 10.0.5.2: icmp_seq=4 ttl=61 time=208 ms
64 bytes from 10.0.5.2: icmp_seq=5 ttl=61 time=62.7 ms
64 bytes from 10.0.5.2: icmp_seq=6 ttl=61 time=61.3 ms
64 bytes from 10.0.5.2: icmp_seq=7 ttl=61 time=66.9 ms
64 bytes from 10.0.5.2: icmp_seq=8 ttl=61 time=63.6 ms
64 bytes from 10.0.5.2: icmp_seq=9 ttl=61 time=63.0 ms
"Node: h2"
root@vm-VirtualBox:/media/windows# ping 10.0.5.3 -c 25 | tee late
ncy_h2-h5-2.txt
PING 10.0.5.3 (10.0.5.3) 56(84) bytes of data.
64 bytes from 10.0.5.3: icmp_seq=1 ttl=61 time=219 ms
64 bytes from 10.0.5.3: icmp_seq=2 ttl=61 time=63.6 ms
64 bytes from 10.0.5.3: icmp_seq=3 ttl=61 time=94.3 ms
64 bytes from 10.0.5.3: icmp_seq=4 ttl=61 time=63.8 ms
64 bytes from 10.0.5.3: icmp_seq=5 ttl=61 time=63.2 ms
64 bytes from 10.0.5.3: icmp_seq=6 ttl=61 time=63.0 ms
64 bytes from 10.0.5.3: icmp_seq=7 ttl=61 time=61.6 ms
"Node: h3"
root@vm-VirtualBox:/media/windows# ping 10.0.5.4 -c 25 | tee late
ncy_h3-h6-2.txt
PING 10.0.5.4 (10.0.5.4) 56(84) bytes of data.
64 bytes from 10.0.5.4: icmp_seq=1 ttl=61 time=130 ms
64 bytes from 10.0.5.4: icmp_seq=2 ttl=61 time=62.9 ms
64 bytes from 10.0.5.4: icmp_seq=3 ttl=61 time=61.6 ms
64 bytes from 10.0.5.4: icmp_seq=4 ttl=61 time=63.8 ms
64 bytes from 10.0.5.4: icmp_seq=5 ttl=61 time=60.9 ms
64 bytes from 10.0.5.4: icmp_seq=6 ttl=61 time=65.2 ms


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:37588 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:37588 0.0 - 5.0 4 MB 6.03 Mbps
10.0.0.2:37588 5.0 - 10.0 4 MB 6.29 Mbps
10.0.0.2:37588 10.0 - 15.0 6 MB 9.79 Mbps
10.0.0.2:37588 15.0 - 20.0 6 MB 9.95 Mbps
10.0.0.2:37588 20.0 - 25.0 5 MB 7.98 Mbps
10.0.0.2:37588 0.0 - 25.7 25 MB 7.79 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h2"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.3 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.3, port 8088
Client ip 10.0.0.3:38500 connected with server 10.0.5.3 port 8088
ID Interval Transfer Bandwidth
10.0.0.3:38500 0.0 - 5.0 1 MB 2.29 Mbps
10.0.0.3:38500 5.0 - 10.0 3 MB 5.11 Mbps
10.0.0.3:38500 10.0 - 15.0 5 MB 8.41 Mbps
10.0.0.3:38500 15.0 - 20.0 6 MB 9.01 Mbps
10.0.0.3:38500 20.0 - 25.0 6 MB 9.19 Mbps
10.0.0.3:38500 0.0 - 25.3 21 MB 6.72 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h3"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.4 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.4, port 8088
Client ip 10.0.0.4:53982 connected with server 10.0.5.4 port 8088
ID Interval Transfer Bandwidth
10.0.0.4:53982 0.0 - 5.0 2 MB 3.38 Mbps
10.0.0.4:53982 5.0 - 10.0 5 MB 7.50 Mbps
10.0.0.4:53982 10.0 - 15.0 5 MB 7.68 Mbps
10.0.0.4:53982 15.0 - 20.0 5 MB 8.52 Mbps
10.0.0.4:53982 20.0 - 25.0 6 MB 9.81 Mbps
10.0.0.4:53982 0.0 - 25.3 23 MB 7.30 Mbps
root@vm-VirtualBox:/media/windows#

"Node: h1"
64 bytes from 10.0.5.2: icmp_seq=9 ttl=61 time=63.0 ms
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=75.3 ms
64 bytes from 10.0.5.2: icmp_seq=11 ttl=61 time=66.8 ms
64 bytes from 10.0.5.2: icmp_seq=12 ttl=61 time=75.8 ms
64 bytes from 10.0.5.2: icmp_seq=13 ttl=61 time=69.7 ms
64 bytes from 10.0.5.2: icmp_seq=14 ttl=61 time=77.4 ms
64 bytes from 10.0.5.2: icmp_seq=15 ttl=61 time=69.1 ms
64 bytes from 10.0.5.2: icmp_seq=16 ttl=61 time=61.1 ms
64 bytes from 10.0.5.2: icmp_seq=17 ttl=61 time=62.5 ms
64 bytes from 10.0.5.2: icmp_seq=18 ttl=61 time=67.1 ms
64 bytes from 10.0.5.2: icmp_seq=19 ttl=61 time=62.3 ms
64 bytes from 10.0.5.2: icmp_seq=20 ttl=61 time=71.6 ms
64 bytes from 10.0.5.2: icmp_seq=21 ttl=61 time=68.9 ms
64 bytes from 10.0.5.2: icmp_seq=22 ttl=61 time=62.2 ms
64 bytes from 10.0.5.2: icmp_seq=23 ttl=61 time=76.9 ms
64 bytes from 10.0.5.2: icmp_seq=24 ttl=61 time=60.8 ms
64 bytes from 10.0.5.2: icmp_seq=25 ttl=61 time=66.0 ms
--- 10.0.5.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24044ms
rtt min/avg/max/mdev = 60.834/78.510/208.404/33.467 ms
root@vm-VirtualBox:/media/windows#
"Node: h2"
64 bytes from 10.0.5.3: icmp_seq=9 ttl=61 time=70.2 ms
64 bytes from 10.0.5.3: icmp_seq=10 ttl=61 time=68.7 ms
64 bytes from 10.0.5.3: icmp_seq=11 ttl=61 time=74.4 ms
64 bytes from 10.0.5.3: icmp_seq=12 ttl=61 time=70.6 ms
64 bytes from 10.0.5.3: icmp_seq=13 ttl=61 time=76.6 ms
64 bytes from 10.0.5.3: icmp_seq=14 ttl=61 time=73.5 ms
64 bytes from 10.0.5.3: icmp_seq=15 ttl=61 time=61.0 ms
64 bytes from 10.0.5.3: icmp_seq=16 ttl=61 time=63.6 ms
64 bytes from 10.0.5.3: icmp_seq=17 ttl=61 time=68.6 ms
64 bytes from 10.0.5.3: icmp_seq=18 ttl=61 time=65.6 ms
64 bytes from 10.0.5.3: icmp_seq=19 ttl=61 time=73.0 ms
64 bytes from 10.0.5.3: icmp_seq=20 ttl=61 time=70.2 ms
64 bytes from 10.0.5.3: icmp_seq=21 ttl=61 time=61.1 ms
64 bytes from 10.0.5.3: icmp_seq=22 ttl=61 time=62.4 ms
64 bytes from 10.0.5.3: icmp_seq=23 ttl=61 time=61.1 ms
64 bytes from 10.0.5.3: icmp_seq=24 ttl=61 time=61.7 ms
64 bytes from 10.0.5.3: icmp_seq=25 ttl=61 time=61.4 ms
--- 10.0.5.3 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24037ms
rtt min/avg/max/mdev = 61.001/73.471/219.119/30.589 ms
root@vm-VirtualBox:/media/windows#
"Node: h3"
64 bytes from 10.0.5.4: icmp_seq=9 ttl=61 time=74.2 ms
64 bytes from 10.0.5.4: icmp_seq=10 ttl=61 time=63.5 ms
64 bytes from 10.0.5.4: icmp_seq=11 ttl=61 time=73.7 ms
64 bytes from 10.0.5.4: icmp_seq=12 ttl=61 time=66.4 ms
64 bytes from 10.0.5.4: icmp_seq=13 ttl=61 time=62.1 ms
64 bytes from 10.0.5.4: icmp_seq=14 ttl=61 time=63.7 ms
64 bytes from 10.0.5.4: icmp_seq=15 ttl=61 time=63.8 ms
64 bytes from 10.0.5.4: icmp_seq=16 ttl=61 time=62.7 ms
64 bytes from 10.0.5.4: icmp_seq=17 ttl=61 time=70.7 ms
64 bytes from 10.0.5.4: icmp_seq=18 ttl=61 time=76.8 ms
64 bytes from 10.0.5.4: icmp_seq=19 ttl=61 time=61.3 ms
64 bytes from 10.0.5.4: icmp_seq=20 ttl=61 time=60.7 ms
64 bytes from 10.0.5.4: icmp_seq=21 ttl=61 time=60.9 ms
64 bytes from 10.0.5.4: icmp_seq=22 ttl=61 time=61.8 ms
64 bytes from 10.0.5.4: icmp_seq=23 ttl=61 time=61.4 ms
64 bytes from 10.0.5.4: icmp_seq=24 ttl=61 time=61.5 ms
64 bytes from 10.0.5.4: icmp_seq=25 ttl=61 time=62.6 ms
--- 10.0.5.4 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24036ms
rtt min/avg/max/mdev = 60.655/67.310/130.433/13.603 ms
root@vm-VirtualBox:/media/windows#

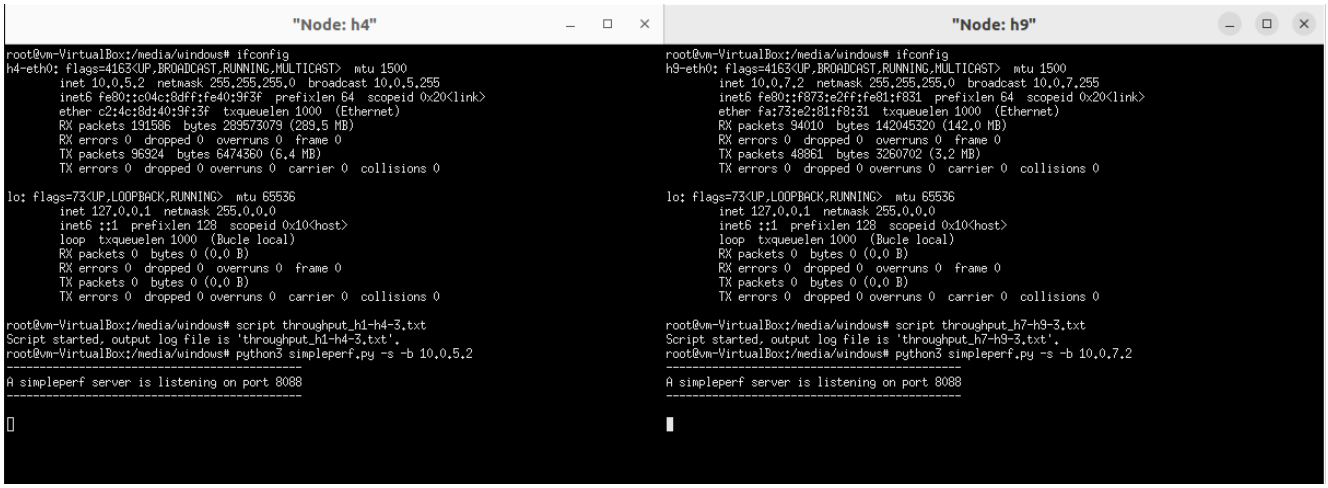
Press Ctrl+C and Ctrl+D after measuring: Press Ctrl+C and Ctrl+D after measuring: Press Ctrl+C and Ctrl+D after measuring:



Path Latency and Throughput for h1->h4, h7->h9:

mininet> xterm h4
ifconfig
script throughput_h1-h4-3.txt
python3 simpleperf.py -s -b 10.0.5.2

mininet> xterm h9
ifconfig
script throughput_h7-h9-3.txt
python3 simpleperf.py -s -b 10.0.7.2



mininet> xterm h1
python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5 (wait)

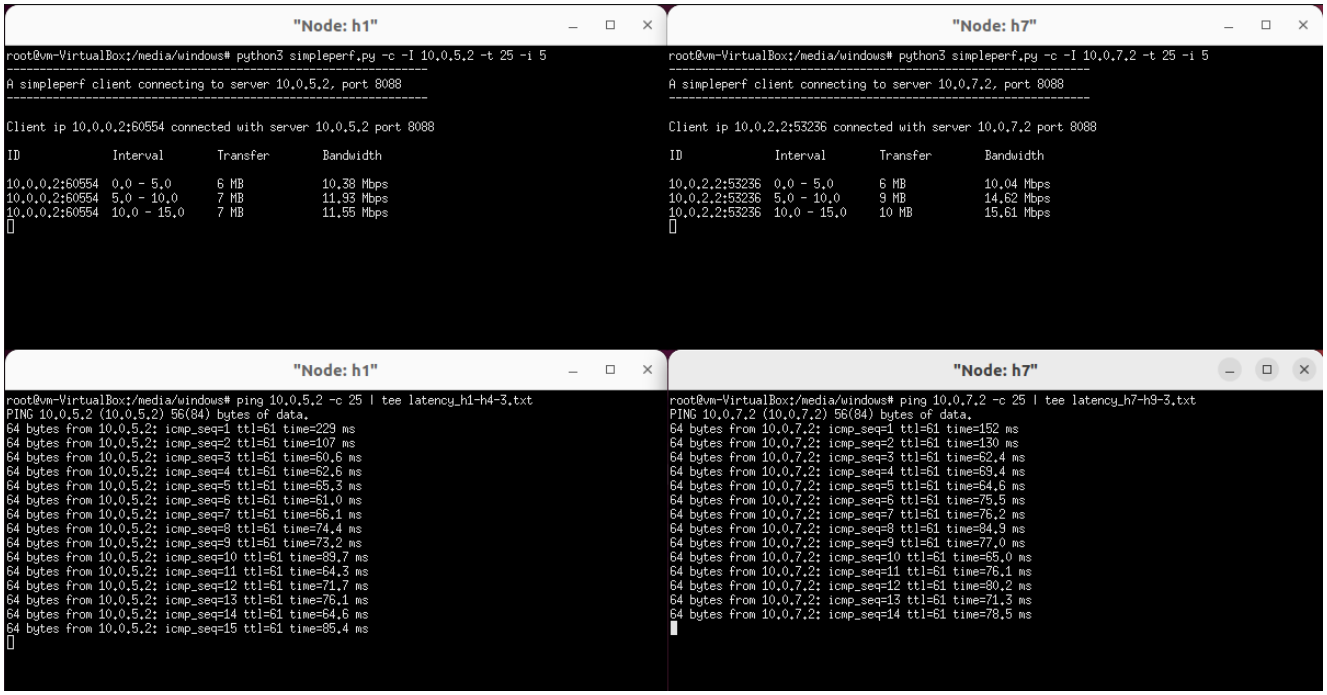
mininet> xterm h7
python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5 (wait)

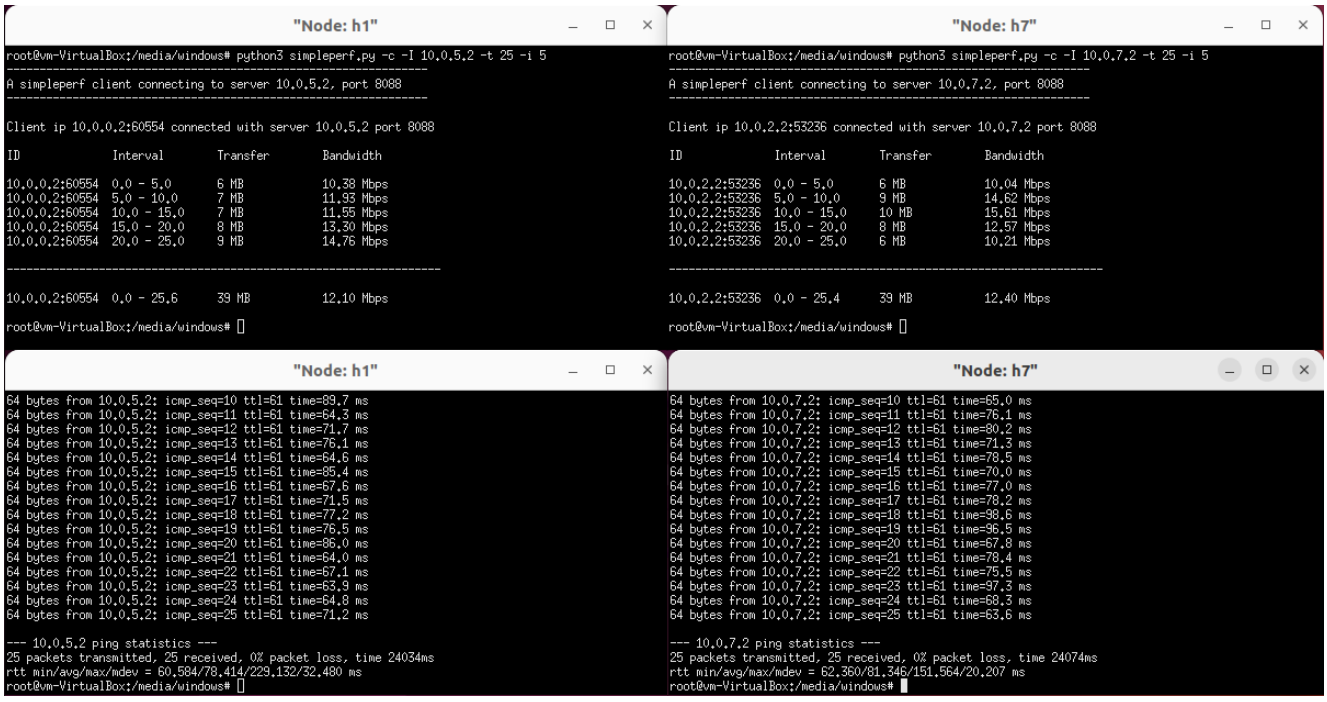
(open new xterm to measure latency while running simpleperf)

mininet> xterm h1
ping 10.0.5.2 -c 25 | tee latency_h1-h4-3.txt (wait)

mininet> xterm h7
ping 10.0.7.2 -c 25 | tee latency_h7-h9-3.txt (wait)

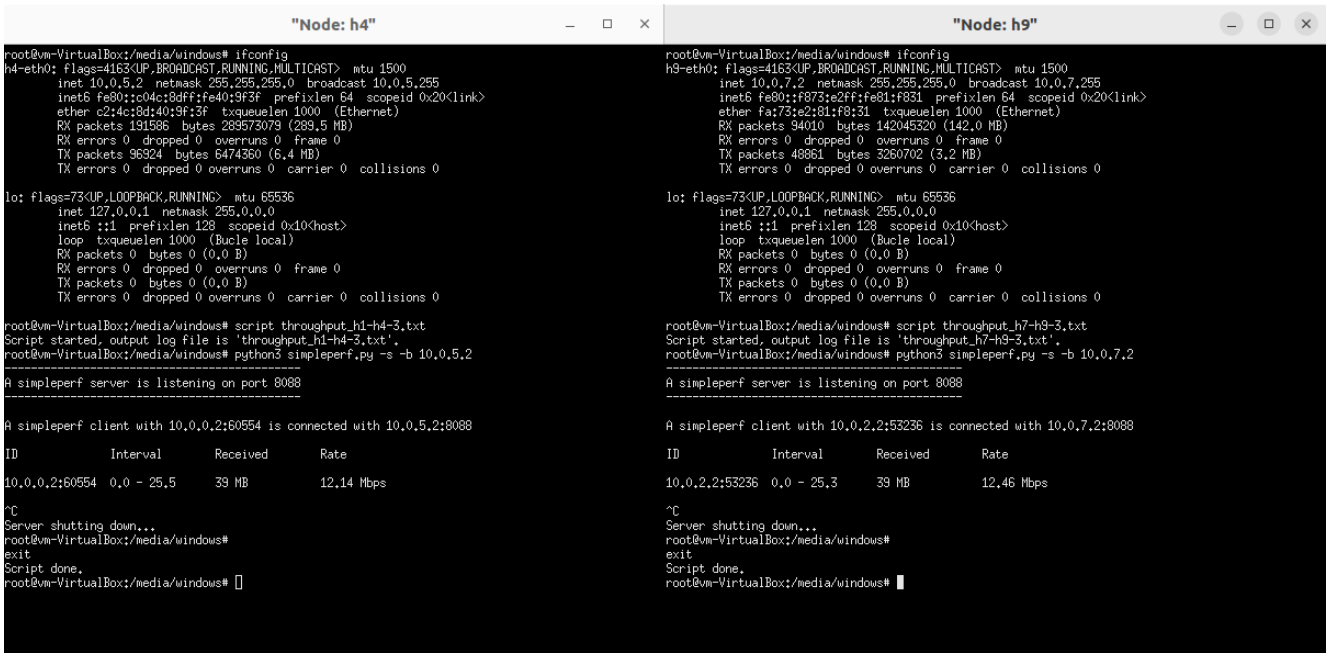
Execute the commands one after other.


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:60554 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:60554 0.0 - 5.0 6 MB 10.38 Mbps
10.0.0.2:60554 5.0 - 10.0 7 MB 11.93 Mbps
10.0.0.2:60554 10.0 - 15.0 7 MB 11.55 Mbps
"Node: h7"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.7.2, port 8088
Client ip 10.0.2.2:53236 connected with server 10.0.7.2 port 8088
ID Interval Transfer Bandwidth
10.0.2.2:53236 0.0 - 5.0 6 MB 10.04 Mbps
10.0.2.2:53236 5.0 - 10.0 9 MB 14.62 Mbps
10.0.2.2:53236 10.0 - 15.0 10 MB 15.61 Mbps
"Node: h1"
root@vm-VirtualBox:/media/windows# ping 10.0.5.2 -c 25 | tee latency_h1-h4-3.txt
PING 10.0.5.2 (10.0.5.2) 56(84) bytes of data.
64 bytes from 10.0.5.2: icmp_seq=1 ttl=61 time=229 ms
64 bytes from 10.0.5.2: icmp_seq=2 ttl=61 time=107 ms
64 bytes from 10.0.5.2: icmp_seq=3 ttl=61 time=60.6 ms
64 bytes from 10.0.5.2: icmp_seq=4 ttl=61 time=62.6 ms
64 bytes from 10.0.5.2: icmp_seq=5 ttl=61 time=65.3 ms
64 bytes from 10.0.5.2: icmp_seq=6 ttl=61 time=61.0 ms
64 bytes from 10.0.5.2: icmp_seq=7 ttl=61 time=66.1 ms
64 bytes from 10.0.5.2: icmp_seq=8 ttl=61 time=74.4 ms
64 bytes from 10.0.5.2: icmp_seq=9 ttl=61 time=73.2 ms
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=88.7 ms
64 bytes from 10.0.5.2: icmp_seq=11 ttl=61 time=64.3 ms
64 bytes from 10.0.5.2: icmp_seq=12 ttl=61 time=71.7 ms
64 bytes from 10.0.5.2: icmp_seq=13 ttl=61 time=76.1 ms
64 bytes from 10.0.5.2: icmp_seq=14 ttl=61 time=64.6 ms
64 bytes from 10.0.5.2: icmp_seq=15 ttl=61 time=85.4 ms
"Node: h7"
root@vm-VirtualBox:/media/windows# ping 10.0.7.2 -c 25 | tee latency_h7-h9-3.txt
PING 10.0.7.2 (10.0.7.2) 56(84) bytes of data.
64 bytes from 10.0.7.2: icmp_seq=1 ttl=61 time=152 ms
64 bytes from 10.0.7.2: icmp_seq=2 ttl=61 time=130 ms
64 bytes from 10.0.7.2: icmp_seq=3 ttl=61 time=62.4 ms
64 bytes from 10.0.7.2: icmp_seq=4 ttl=61 time=69.4 ms
64 bytes from 10.0.7.2: icmp_seq=5 ttl=61 time=64.6 ms
64 bytes from 10.0.7.2: icmp_seq=6 ttl=61 time=75.5 ms
64 bytes from 10.0.7.2: icmp_seq=7 ttl=61 time=76.2 ms
64 bytes from 10.0.7.2: icmp_seq=8 ttl=61 time=84.9 ms
64 bytes from 10.0.7.2: icmp_seq=9 ttl=61 time=77.0 ms
64 bytes from 10.0.7.2: icmp_seq=10 ttl=61 time=65.0 ms
64 bytes from 10.0.7.2: icmp_seq=11 ttl=61 time=76.1 ms
64 bytes from 10.0.7.2: icmp_seq=12 ttl=61 time=80.2 ms
64 bytes from 10.0.7.2: icmp_seq=13 ttl=61 time=71.3 ms
64 bytes from 10.0.7.2: icmp_seq=14 ttl=61 time=78.5 ms


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:60554 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:60554 0.0 - 5.0 6 MB 10.38 Mbps
10.0.0.2:60554 5.0 - 10.0 7 MB 11.93 Mbps
10.0.0.2:60554 10.0 - 15.0 7 MB 11.55 Mbps
10.0.0.2:60554 15.0 - 20.0 8 MB 13.30 Mbps
10.0.0.2:60554 20.0 - 25.0 9 MB 14.76 Mbps
10.0.0.2:60554 0.0 - 25.6 39 MB 12.10 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h7"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.7.2, port 8088
Client ip 10.0.2.2:53236 connected with server 10.0.7.2 port 8088
ID Interval Transfer Bandwidth
10.0.2.2:53236 0.0 - 5.0 6 MB 10.04 Mbps
10.0.2.2:53236 5.0 - 10.0 9 MB 14.62 Mbps
10.0.2.2:53236 10.0 - 15.0 10 MB 15.61 Mbps
10.0.2.2:53236 15.0 - 20.0 8 MB 12.57 Mbps
10.0.2.2:53236 20.0 - 25.0 6 MB 10.21 Mbps
10.0.2.2:53236 0.0 - 25.4 39 MB 12.40 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h1"
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=89.7 ms
64 bytes from 10.0.5.2: icmp_seq=11 ttl=61 time=64.3 ms
64 bytes from 10.0.5.2: icmp_seq=12 ttl=61 time=71.7 ms
64 bytes from 10.0.5.2: icmp_seq=13 ttl=61 time=76.1 ms
64 bytes from 10.0.5.2: icmp_seq=14 ttl=61 time=64.6 ms
64 bytes from 10.0.5.2: icmp_seq=15 ttl=61 time=85.4 ms
64 bytes from 10.0.5.2: icmp_seq=16 ttl=61 time=67.6 ms
64 bytes from 10.0.5.2: icmp_seq=17 ttl=61 time=71.5 ms
64 bytes from 10.0.5.2: icmp_seq=18 ttl=61 time=77.2 ms
64 bytes from 10.0.5.2: icmp_seq=19 ttl=61 time=76.5 ms
64 bytes from 10.0.5.2: icmp_seq=20 ttl=61 time=86.0 ms
64 bytes from 10.0.5.2: icmp_seq=21 ttl=61 time=64.0 ms
64 bytes from 10.0.5.2: icmp_seq=22 ttl=61 time=67.1 ms
64 bytes from 10.0.5.2: icmp_seq=23 ttl=61 time=63.9 ms
64 bytes from 10.0.5.2: icmp_seq=24 ttl=61 time=64.8 ms
64 bytes from 10.0.5.2: icmp_seq=25 ttl=61 time=71.2 ms
--- 10.0.5.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24034ms
rtt min/avg/max/mdev = 60.584/78.414/229.132/32.480 ms
root@vm-VirtualBox:/media/windows#
"Node: h7"
64 bytes from 10.0.7.2: icmp_seq=10 ttl=61 time=65.0 ms
64 bytes from 10.0.7.2: icmp_seq=11 ttl=61 time=76.1 ms
64 bytes from 10.0.7.2: icmp_seq=12 ttl=61 time=80.2 ms
64 bytes from 10.0.7.2: icmp_seq=13 ttl=61 time=71.3 ms
64 bytes from 10.0.7.2: icmp_seq=14 ttl=61 time=78.5 ms
64 bytes from 10.0.7.2: icmp_seq=15 ttl=61 time=70.0 ms
64 bytes from 10.0.7.2: icmp_seq=16 ttl=61 time=77.0 ms
64 bytes from 10.0.7.2: icmp_seq=17 ttl=61 time=78.2 ms
64 bytes from 10.0.7.2: icmp_seq=18 ttl=61 time=98.6 ms
64 bytes from 10.0.7.2: icmp_seq=19 ttl=61 time=96.5 ms
64 bytes from 10.0.7.2: icmp_seq=20 ttl=61 time=67.8 ms
64 bytes from 10.0.7.2: icmp_seq=21 ttl=61 time=78.4 ms
64 bytes from 10.0.7.2: icmp_seq=22 ttl=61 time=75.5 ms
64 bytes from 10.0.7.2: icmp_seq=23 ttl=61 time=97.3 ms
64 bytes from 10.0.7.2: icmp_seq=24 ttl=61 time=68.3 ms
64 bytes from 10.0.7.2: icmp_seq=25 ttl=61 time=63.6 ms
--- 10.0.7.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24074ms
rtt min/avg/max/mdev = 62.360/81.346/151.564/20.207 ms
root@vm-VirtualBox:/media/windows#

Press Ctrl+C and Ctrl+D after measuring:

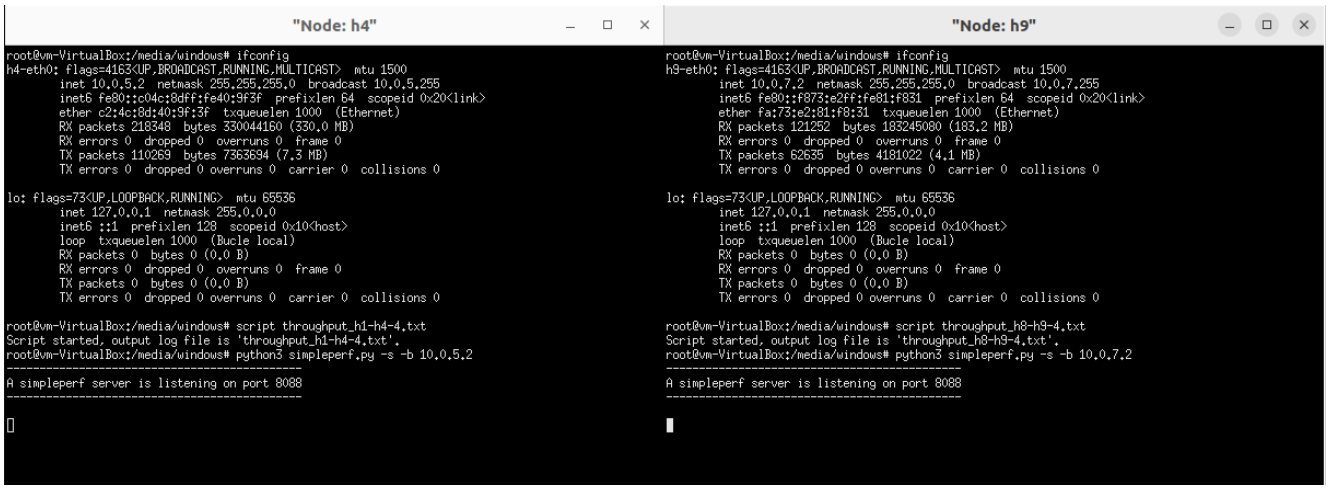
Press Ctrl+C and Ctrl+D after measuring:



Path Latency and Throughput for h1->h4, h8->h9:

mininet> xterm h4
ifconfig
script throughput_h1-h4-4.txt
python3 simpleperf.py -s -b 10.0.5.2

mininet> xterm h9
ifconfig
script throughput_h8-h9-4.txt
python3 simpleperf.py -s -b 10.0.7.2



mininet> xterm h1
python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5 (wait)

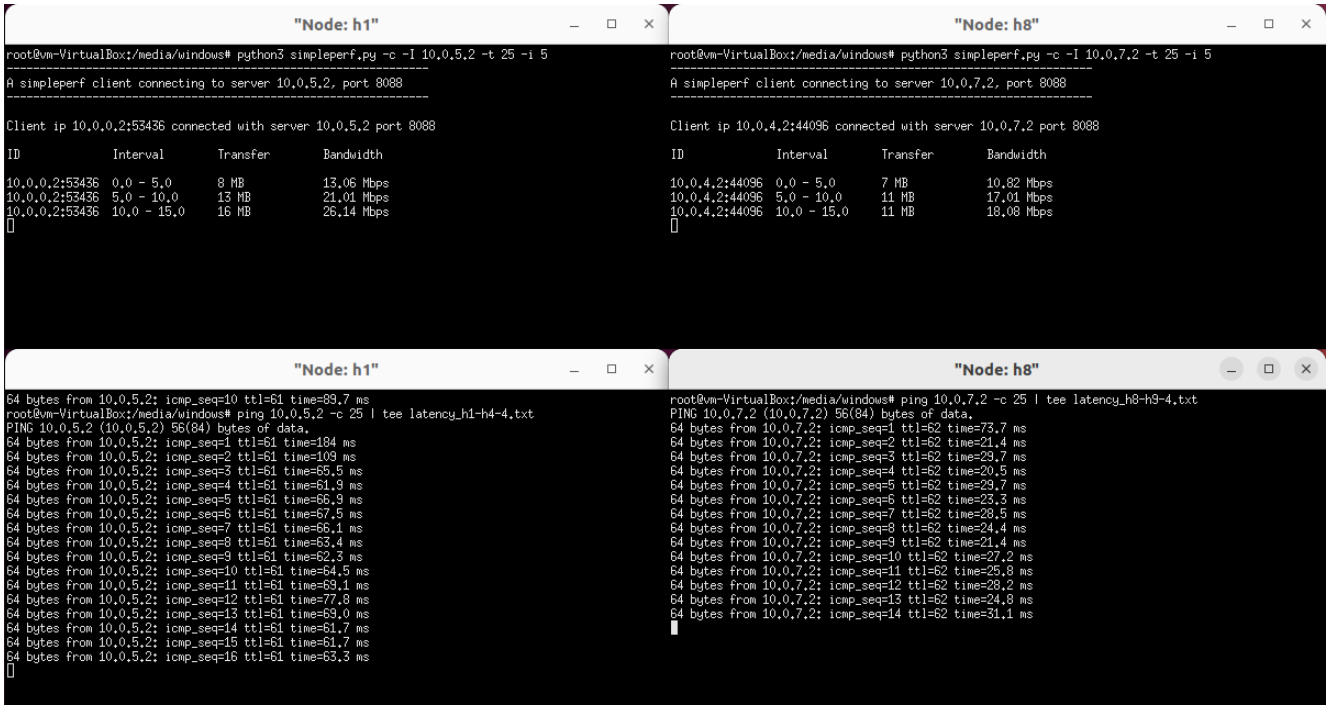
mininet> xterm h8
python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5 (wait)

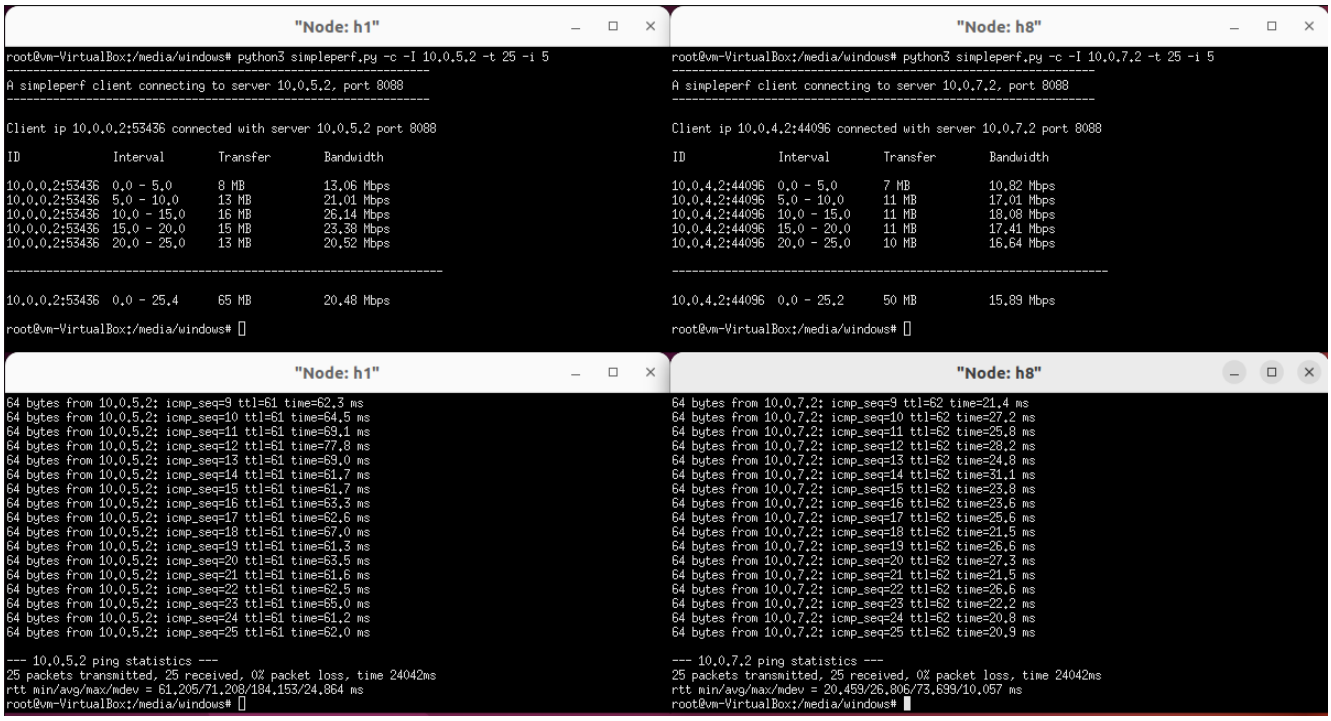
(open new xterm to measure latency while running simpleperf)

mininet> xterm h1
ping 10.0.5.2 -c 25 | tee latency_h1-h4-4.txt (wait)

mininet> xterm h8
ping 10.0.7.2 -c 25 | tee latency_h8-h9-4.txt (wait)

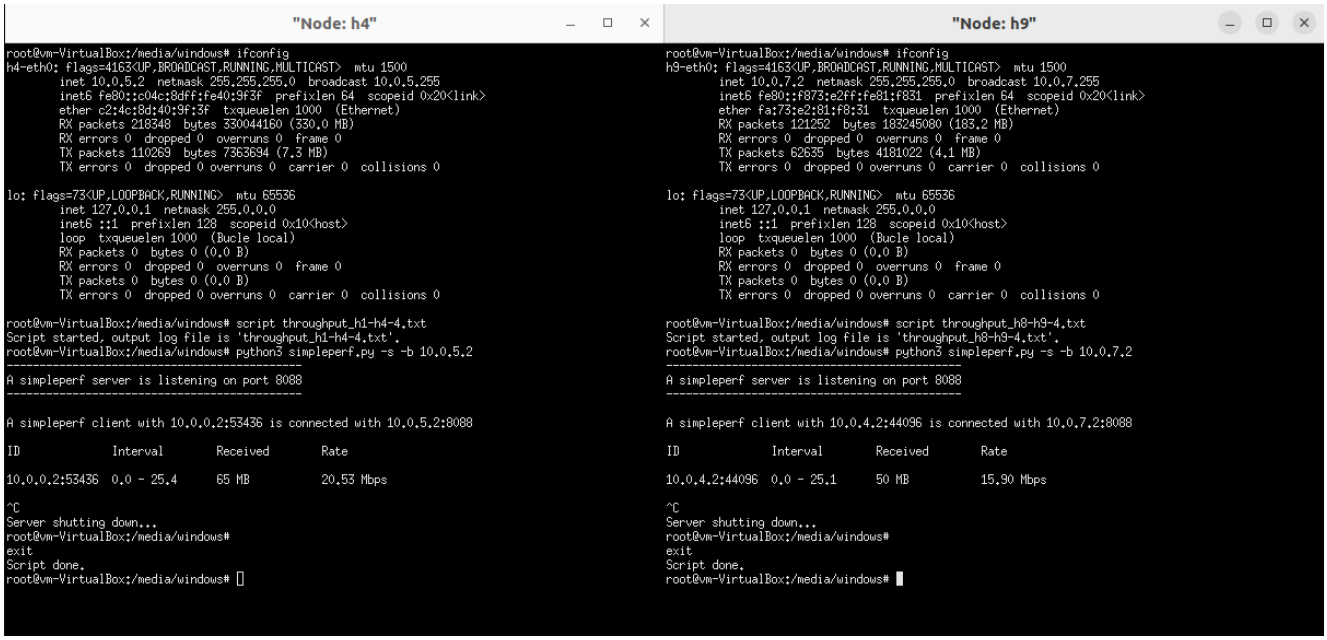
Execute the commands one after other.


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:53436 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:53436 0.0 - 5.0 8 MB 13.06 Mbps
10.0.0.2:53436 5.0 - 10.0 13 MB 21.01 Mbps
10.0.0.2:53436 10.0 - 15.0 16 MB 26.14 Mbps
"Node: h8"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.7.2, port 8088
Client ip 10.0.4.2:44096 connected with server 10.0.7.2 port 8088
ID Interval Transfer Bandwidth
10.0.4.2:44096 0.0 - 5.0 7 MB 10.82 Mbps
10.0.4.2:44096 5.0 - 10.0 11 MB 17.01 Mbps
10.0.4.2:44096 10.0 - 15.0 11 MB 18.08 Mbps
"Node: h1"
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=89.7 ms
root@vm-VirtualBox:/media/windows# ping 10.0.5.2 -c 25 | tee latency_h1-h4-4.txt
PING 10.0.5.2 (10.0.5.2) 56(84) bytes of data.
64 bytes from 10.0.5.2: icmp_seq=1 ttl=61 time=184 ms
64 bytes from 10.0.5.2: icmp_seq=2 ttl=61 time=109 ms
64 bytes from 10.0.5.2: icmp_seq=3 ttl=61 time=85.5 ms
64 bytes from 10.0.5.2: icmp_seq=4 ttl=61 time=61.9 ms
64 bytes from 10.0.5.2: icmp_seq=5 ttl=61 time=86.9 ms
64 bytes from 10.0.5.2: icmp_seq=6 ttl=61 time=67.5 ms
64 bytes from 10.0.5.2: icmp_seq=7 ttl=61 time=66.1 ms
64 bytes from 10.0.5.2: icmp_seq=8 ttl=61 time=63.4 ms
64 bytes from 10.0.5.2: icmp_seq=9 ttl=61 time=62.3 ms
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=64.5 ms
64 bytes from 10.0.5.2: icmp_seq=11 ttl=61 time=69.1 ms
64 bytes from 10.0.5.2: icmp_seq=12 ttl=61 time=77.8 ms
64 bytes from 10.0.5.2: icmp_seq=13 ttl=61 time=69.0 ms
64 bytes from 10.0.5.2: icmp_seq=14 ttl=61 time=61.7 ms
64 bytes from 10.0.5.2: icmp_seq=15 ttl=61 time=61.7 ms
64 bytes from 10.0.5.2: icmp_seq=16 ttl=61 time=63.3 ms
"Node: h8"
root@vm-VirtualBox:/media/windows# ping 10.0.7.2 -c 25 | tee latency_h8-h9-4.txt
PING 10.0.7.2 (10.0.7.2) 56(84) bytes of data.
64 bytes from 10.0.7.2: icmp_seq=1 ttl=62 time=73.7 ms
64 bytes from 10.0.7.2: icmp_seq=2 ttl=62 time=21.4 ms
64 bytes from 10.0.7.2: icmp_seq=3 ttl=62 time=29.7 ms
64 bytes from 10.0.7.2: icmp_seq=4 ttl=62 time=20.5 ms
64 bytes from 10.0.7.2: icmp_seq=5 ttl=62 time=29.7 ms
64 bytes from 10.0.7.2: icmp_seq=6 ttl=62 time=23.3 ms
64 bytes from 10.0.7.2: icmp_seq=7 ttl=62 time=28.5 ms
64 bytes from 10.0.7.2: icmp_seq=8 ttl=62 time=24.4 ms
64 bytes from 10.0.7.2: icmp_seq=9 ttl=62 time=21.4 ms
64 bytes from 10.0.7.2: icmp_seq=10 ttl=62 time=27.2 ms
64 bytes from 10.0.7.2: icmp_seq=11 ttl=62 time=25.8 ms
64 bytes from 10.0.7.2: icmp_seq=12 ttl=62 time=28.2 ms
64 bytes from 10.0.7.2: icmp_seq=13 ttl=62 time=24.8 ms
64 bytes from 10.0.7.2: icmp_seq=14 ttl=62 time=31.1 ms


"Node: h1"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.5.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.5.2, port 8088
Client ip 10.0.0.2:53436 connected with server 10.0.5.2 port 8088
ID Interval Transfer Bandwidth
10.0.0.2:53436 0.0 - 5.0 8 MB 13.06 Mbps
10.0.0.2:53436 5.0 - 10.0 13 MB 21.01 Mbps
10.0.0.2:53436 10.0 - 15.0 16 MB 26.14 Mbps
10.0.0.2:53436 15.0 - 20.0 15 MB 23.38 Mbps
10.0.0.2:53436 20.0 - 25.0 13 MB 20.52 Mbps
10.0.0.2:53436 0.0 - 25.4 65 MB 20.48 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h8"
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10.0.7.2 -t 25 -i 5
A simpleperf client connecting to server 10.0.7.2, port 8088
Client ip 10.0.4.2:44096 connected with server 10.0.7.2 port 8088
ID Interval Transfer Bandwidth
10.0.4.2:44096 0.0 - 5.0 7 MB 10.82 Mbps
10.0.4.2:44096 5.0 - 10.0 11 MB 17.01 Mbps
10.0.4.2:44096 10.0 - 15.0 11 MB 18.08 Mbps
10.0.4.2:44096 15.0 - 20.0 11 MB 17.41 Mbps
10.0.4.2:44096 20.0 - 25.0 10 MB 16.64 Mbps
10.0.4.2:44096 0.0 - 25.2 50 MB 15.89 Mbps
root@vm-VirtualBox:/media/windows#
"Node: h1"
64 bytes from 10.0.5.2: icmp_seq=9 ttl=61 time=62.3 ms
64 bytes from 10.0.5.2: icmp_seq=10 ttl=61 time=64.5 ms
64 bytes from 10.0.5.2: icmp_seq=11 ttl=61 time=69.1 ms
64 bytes from 10.0.5.2: icmp_seq=12 ttl=61 time=77.8 ms
64 bytes from 10.0.5.2: icmp_seq=13 ttl=61 time=69.0 ms
64 bytes from 10.0.5.2: icmp_seq=14 ttl=61 time=61.7 ms
64 bytes from 10.0.5.2: icmp_seq=15 ttl=61 time=61.7 ms
64 bytes from 10.0.5.2: icmp_seq=16 ttl=61 time=63.3 ms
64 bytes from 10.0.5.2: icmp_seq=17 ttl=61 time=62.6 ms
64 bytes from 10.0.5.2: icmp_seq=18 ttl=61 time=67.0 ms
64 bytes from 10.0.5.2: icmp_seq=19 ttl=61 time=61.3 ms
64 bytes from 10.0.5.2: icmp_seq=20 ttl=61 time=63.5 ms
64 bytes from 10.0.5.2: icmp_seq=21 ttl=61 time=61.6 ms
64 bytes from 10.0.5.2: icmp_seq=22 ttl=61 time=62.5 ms
64 bytes from 10.0.5.2: icmp_seq=23 ttl=61 time=65.0 ms
64 bytes from 10.0.5.2: icmp_seq=24 ttl=61 time=61.2 ms
64 bytes from 10.0.5.2: icmp_seq=25 ttl=61 time=62.0 ms
--- 10.0.5.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24042ms
rtt min/avg/max/mdev = 61.205/71.208/184.153/24.864 ms
"Node: h8"
64 bytes from 10.0.7.2: icmp_seq=9 ttl=62 time=21.4 ms
64 bytes from 10.0.7.2: icmp_seq=10 ttl=62 time=27.2 ms
64 bytes from 10.0.7.2: icmp_seq=11 ttl=62 time=25.8 ms
64 bytes from 10.0.7.2: icmp_seq=12 ttl=62 time=28.2 ms
64 bytes from 10.0.7.2: icmp_seq=13 ttl=62 time=24.8 ms
64 bytes from 10.0.7.2: icmp_seq=14 ttl=62 time=31.1 ms
64 bytes from 10.0.7.2: icmp_seq=15 ttl=62 time=23.8 ms
64 bytes from 10.0.7.2: icmp_seq=16 ttl=62 time=23.6 ms
64 bytes from 10.0.7.2: icmp_seq=17 ttl=62 time=25.6 ms
64 bytes from 10.0.7.2: icmp_seq=18 ttl=62 time=21.5 ms
64 bytes from 10.0.7.2: icmp_seq=19 ttl=62 time=26.6 ms
64 bytes from 10.0.7.2: icmp_seq=20 ttl=62 time=27.3 ms
64 bytes from 10.0.7.2: icmp_seq=21 ttl=62 time=21.5 ms
64 bytes from 10.0.7.2: icmp_seq=22 ttl=62 time=26.6 ms
64 bytes from 10.0.7.2: icmp_seq=23 ttl=62 time=22.2 ms
64 bytes from 10.0.7.2: icmp_seq=24 ttl=62 time=20.8 ms
64 bytes from 10.0.7.2: icmp_seq=25 ttl=62 time=20.9 ms
--- 10.0.7.2 ping statistics ---
25 packets transmitted, 25 received, 0% packet loss, time 24042ms
rtt min/avg/max/mdev = 20.459/26.806/73.699/10.057 ms

Press Ctrl+C and Ctrl+D after measuring:

Press Ctrl+C and Ctrl+D after measuring:



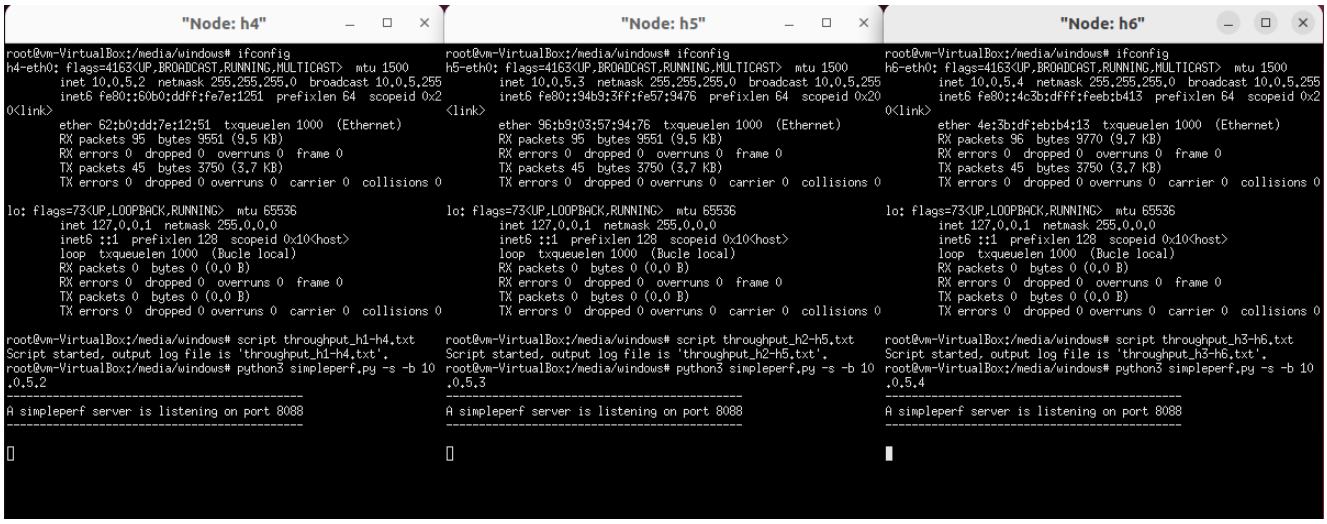
TEST Case 5: Effects of parallel connection

Servers:

mininet> xterm h4
ifconfig
script throughput_h1-h4.txt
python3 simpleperf.py -s -b 10.0.5.2

mininet> xterm h5
ifconfig
script throughput_h2-h5.txt
python3 simpleperf.py -s -b 10.0.5.3

mininet> xterm h6
ifconfig
script throughput_h3-h6.txt
python3 simpleperf.py -s -b 10.0.5.4



mininet> xterm h1
python3 simpleperf.py -c -I 10.0.5.2 -P 2 -t 25 -i 5

mininet> xterm h2
python3 simpleperf.py -c -I 10.0.5.3 -t 25 -i 5

mininet> xterm h3
python3 simpleperf.py -c -I 10.0.5.4 -t 25 -i 5

Execute the commands one after other.

"Node: h1"

```
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.2 -P 2 -t 25
------------------------------------------------------------
A simpleperf client connecting to server 10.0.5.2, port 8088
------------------------------------------------------------

Client ip 10.0.0.2:38430 connected with server 10.0.5.2 port 8088
Client ip 10.0.0.2:38436 connected with server 10.0.5.2 port 8088

ID              Interval        Transfer        Bandwidth

10.0.0.2:38436  0.0 - 25.3      16 MB           4.92 Mbps
10.0.0.2:38430  0.0 - 26.0      21 MB           6.40 Mbps

root@vm-VirtualBox:/media/windows#
```

"Node: h2"

```
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.3 -t 25 -i 5
------------------------------------------------------------
A simpleperf client connecting to server 10.0.5.3, port 8088
------------------------------------------------------------

Client ip 10.0.0.3:34694 connected with server 10.0.5.3 port 8088

ID              Interval        Transfer        Bandwidth

10.0.0.3:34694  0.0 - 5.0       6 MB            10.36 Mbps
10.0.0.3:34694  5.0 - 10.0      6 MB            10.39 Mbps
10.0.0.3:34694  10.0 - 15.0     5 MB            8.28 Mbps
10.0.0.3:34694  15.0 - 20.0     4 MB            6.14 Mbps
10.0.0.3:34694  20.0 - 25.0     5 MB            7.80 Mbps

------------------------------------------------------------

10.0.0.3:34694  0.0 - 25.7      27 MB           8.37 Mbps

root@vm-VirtualBox:/media/windows#
```

"Node: h3"

```
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -c -I 10
.0.5.4 -t 25 -i 5
------------------------------------------------------------
A simpleperf client connecting to server 10.0.5.4, port 8088
------------------------------------------------------------

Client ip 10.0.0.4:59014 connected with server 10.0.5.4 port 8088

ID              Interval        Transfer        Bandwidth

10.0.0.4:59014  0.0 - 5.0       7 MB            10.68 Mbps
10.0.0.4:59014  5.0 - 10.0      4 MB            6.30 Mbps
10.0.0.4:59014  10.0 - 15.0     5 MB            8.20 Mbps
10.0.0.4:59014  15.0 - 20.0     5 MB            8.62 Mbps
10.0.0.4:59014  20.0 - 25.0     7 MB            10.54 Mbps

------------------------------------------------------------

10.0.0.4:59014  0.0 - 25.4      28 MB           8.75 Mbps

root@vm-VirtualBox:/media/windows#
```

Press Ctrl+C and Ctrl+D after measuring:

Press Ctrl+C and Ctrl+D after measuring:

(Press Ctrl+C and Ctrl+D after measuring:

"Node: h4"

```
root@vm-VirtualBox:/media/windows# ifconfig
h4-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.5.2  netmask 255.255.255.0  broadcast 10.0.5.255
        inet6 fe80::60b0:ddff:fe7e:1251  prefixlen 64  scopeid 0x2
0<link>
        ether 62:b0:dd:7e:12:51  txqueuelen 1000  (Ethernet)
        RX packets 29956  bytes 45194397 (45.1 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 15463  bytes 1042166 (1.0 MB)
        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  (Bucle local)
        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

root@vm-VirtualBox:/media/windows# script throughput_h1-h4.txt
Script started, output log file is 'throughput_h1-h4.txt'.
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -s -b 10
.0.5.2
------------------------------------------------
A simpleperf server is listening on port 8088
------------------------------------------------

A simpleperf client with 10.0.0.2:38430 is connected with 10.0.5.2
:8088
A simpleperf client with 10.0.0.2:38436 is connected with 10.0.5.2
:8088

ID              Interval        Received        Rate

10.0.0.2:38436  0.0 - 25.3      16 MB           4.94 Mbps
10.0.0.2:38430  0.0 - 26.0      21 MB           6.42 Mbps

^C
Server shutting down...
root@vm-VirtualBox:/media/windows#
exit
Script done.
root@vm-VirtualBox:/media/windows#
```

"Node: h5"

```
root@vm-VirtualBox:/media/windows# ifconfig
h5-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.5.3  netmask 255.255.255.0  broadcast 10.0.5.255
        inet6 fe80::94b9:3ff:fe57:9476  prefixlen 64  scopeid 0x20
<link>
        ether 96:b9:03:57:94:76  txqueuelen 1000  (Ethernet)
        RX packets 11870  bytes 17823729 (17.8 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 5997  bytes 400354 (400.3 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  (Bucle local)
        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

root@vm-VirtualBox:/media/windows# script throughput_h2-h5.txt
Script started, output log file is 'throughput_h2-h5.txt'.
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -s -b 10
.0.5.3
------------------------------------------------
A simpleperf server is listening on port 8088
------------------------------------------------

A simpleperf client with 10.0.0.3:34694 is connected with 10.0.5.3
:8088
ID              Interval        Received        Rate

10.0.0.3:34694  0.0 - 25.5      27 MB           8.43 Mbps

^C
Server shutting down...
root@vm-VirtualBox:/media/windows#
exit
Script done.
root@vm-VirtualBox:/media/windows#
```

"Node: h6"

```
root@vm-VirtualBox:/media/windows# ifconfig
h6-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.5.4  netmask 255.255.255.0  broadcast 10.0.5.255
        inet6 fe80::4c3b:dfff:feeb:b413  prefixlen 64  scopeid 0x2
0<link>
        ether 4e:3b:df:eb:b4:13  txqueuelen 1000  (Ethernet)
        RX packets 19575  bytes 29489416 (29.4 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 10186  bytes 682628 (682.6 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  (Bucle local)
        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

root@vm-VirtualBox:/media/windows# script throughput_h3-h6.txt
Script started, output log file is 'throughput_h3-h6.txt'.
root@vm-VirtualBox:/media/windows# python3 simpleperf.py -s -b 10
.0.5.4
------------------------------------------------
A simpleperf server is listening on port 8088
------------------------------------------------

A simpleperf client with 10.0.0.4:59014 is connected with 10.0.5.4
:8088
ID              Interval        Received        Rate

10.0.0.4:59014  0.0 - 25.1      28 MB           8.82 Mbps

^C
Server shutting down...
root@vm-VirtualBox:/media/windows#
exit
Script done.
root@vm-VirtualBox:/media/windows#
```