

Lab 3

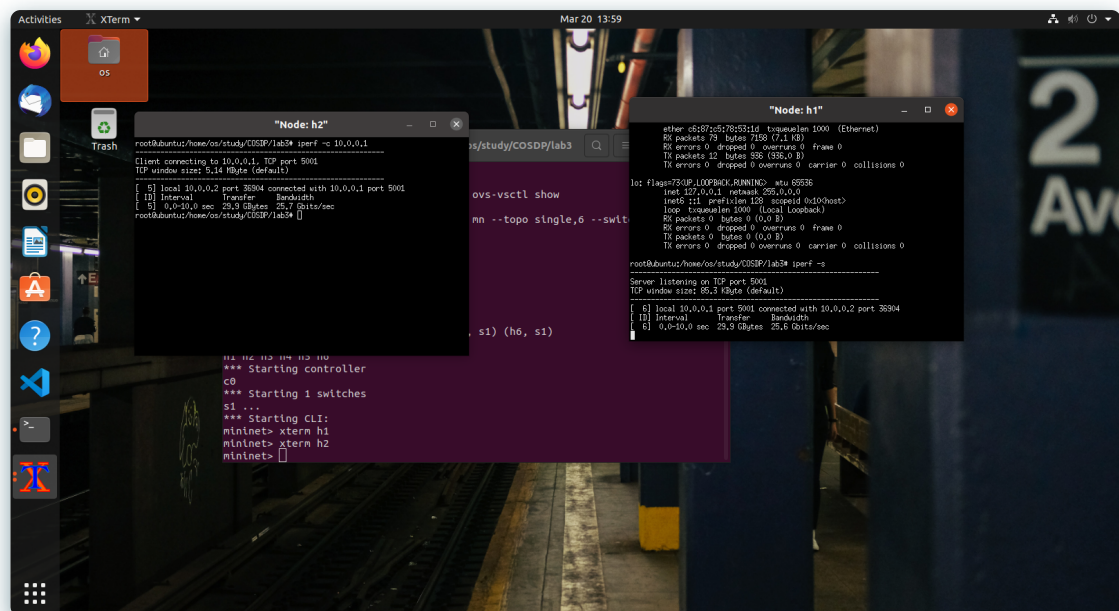
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✓ Part1：创建网络拓扑

Task1 请在你自己的环境中完成上面的连通性测试，并以截图的形式分别记录Node:h1和Node:h2中 iperf的输出结果。

整体如下：



虚拟机截图不是很清晰，带系统时间的细节截图如下：

Mar 20 14:05

"Node: h1"

```
ether c6:87:c5:78:53:1d txqueuelen 1000 (Ethernet)
RX packets 79 bytes 7158 (7.1 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 12 bytes 936 (936.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

root@ubuntu:/home/os/study/COSDP/lab3# iperf -s
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
-----
[ 6] local 10.0.0.1 port 5001 connected with 10.0.0.2 port 36904
[ ID] Interval      Transfer      Bandwidth
[ 6] 0.0-10.0 sec  29.9 GBytes  25.6 Gbits/sec
[]
```

Mar 20 14:06

"Node: h2"

```
root@ubuntu:/home/os/study/COSDP/lab3# iperf -c 10.0.0.1
-----
Client connecting to 10.0.0.1, TCP port 5001
TCP window size: 5.14 MByte (default)
-----
[ 5] local 10.0.0.2 port 36904 connected with 10.0.0.1 port 5001
[ ID] Interval      Transfer      Bandwidth
[ 5] 0.0-10.0 sec  29.9 GBytes  25.7 Gbits/sec
root@ubuntu:/home/os/study/COSDP/lab3#
```

✓ Part2: 三种限速方式

Task2.1 请截图记录输出结果，截图要求同Task1，并着重关注其中的带宽、抖动、丢包率等数据。

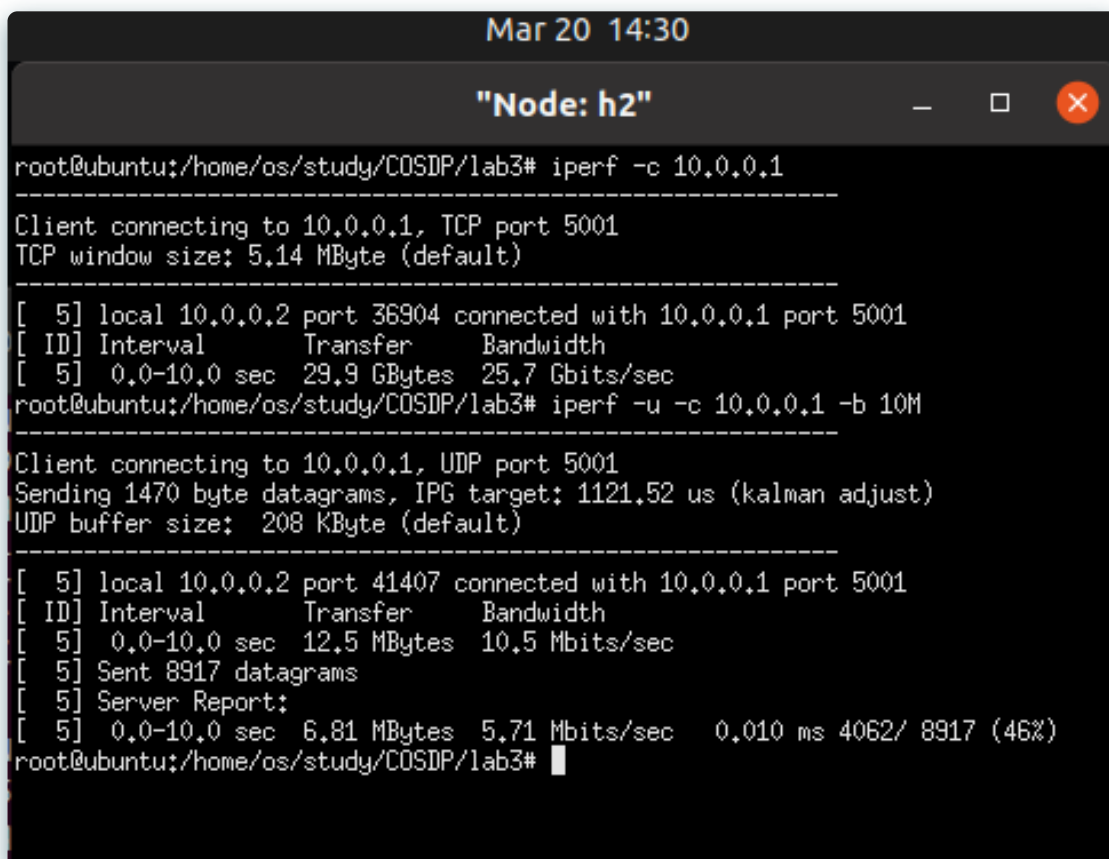
查看h1和h2对应的网卡如下：

```
s1-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 fe80::449a:a4ff:fe15:2114 prefixlen 64 scopeid 0x20<link>
    ether 46:9a:a4:15:21:14 txqueuelen 1000 (Ethernet)
    RX packets 514118 bytes 33932080 (33.9 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 732862 bytes 32126152108 (32.1 GB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

s1-eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 fe80::50f5:e0ff:feb8:3d4f prefixlen 64 scopeid 0x20<link>
    ether 52:f5:e0:b8:3d:4f txqueuelen 1000 (Ethernet)
    RX packets 732767 bytes 32126143810 (32.1 GB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 514204 bytes 33939780 (33.9 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

最后输出截图如下：

h2:



```
Mar 20 14:30
"Node: h2"
root@ubuntu:/home/os/study/COSDP/lab3# iperf -c 10.0.0.1
-----
Client connecting to 10.0.0.1, TCP port 5001
TCP window size: 5.14 MByte (default)
-----
[  5] local 10.0.0.2 port 36904 connected with 10.0.0.1 port 5001
[ ID] Interval      Transfer    Bandwidth
[  5] 0.0-10.0 sec  29.9 GBytes 25.7 Gbits/sec
root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -c 10.0.0.1 -b 10M
-----
Client connecting to 10.0.0.1, UDP port 5001
Sending 1470 byte datagrams, IPG target: 1121.52 us (kalman adjust)
UDP buffer size: 208 KByte (default)
-----
[  5] local 10.0.0.2 port 41407 connected with 10.0.0.1 port 5001
[ ID] Interval      Transfer    Bandwidth
[  5] 0.0-10.0 sec  12.5 MBytes 10.5 Mbits/sec
[  5] Sent 8917 datagrams
[  5] Server Report:
[  5] 0.0-10.0 sec  6.81 MBytes  5.71 Mbits/sec    0.010 ms 4062/ 8917 (46%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h1:

```
Mar 20 14:29
"Node: h1"
loop txqueuelen 1000 (Local Loopback)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@ubuntu:/home/os/study/COSDP/lab3# iperf -s
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
-----
[  6] local 10.0.0.1 port 5001 connected with 10.0.0.2 port 36904
[ ID] Interval      Transfer    Bandwidth
[  6] 0.0-10.0 sec  29.9 GBytes 25.6 Gbits/sec
^Croot@ubuntu:/home/os/study/COSDP/lab3# iperf -u -s
-----
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
-----
[  5] local 10.0.0.1 port 5001 connected with 10.0.0.2 port 41407
[ ID] Interval      Transfer    Bandwidth      Jitter    Lost/Total Datagrams
[  5] 0.0-10.0 sec  6.81 MBytes 5.71 Mbits/sec  0.011 ms  4062/ 8917 (46%)
```

可以看见，带宽为5.71Mbits/sec，得到了有效的限速。抖动为0.011ms。由于设置的丢包机制，丢包率较高，为46%。

Task2.2 同上，此处也需要截图记录实验结果。

查看队列信息，得到：

```
root@ubuntu:/home/os# ovs-vsctl list qos
_uuid          : 969e31ad-92ef-42aa-ae3-dc4318ddb71f
external_ids   : {}
other_config   : {}
queues         : {0=f599d2be-4d8b-4d55-819a-446cb88d2f82}
type           : linux-htb
root@ubuntu:/home/os# ovs-vsctl list queue
_uuid          : f599d2be-4d8b-4d55-819a-446cb88d2f82
dscp           : []
external_ids   : {}
other_config   : {max-rate="5000000"}
```

根据文档操作，得到h3：

```
Mar 20 15:10
"Node: h3"
root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -c 10.0.0.4 -b 10M
-----
Client connecting to 10.0.0.4, UDP port 5001
Sending 1470 byte datagrams, IPG target: 1121.52 us (kalman adjust)
UDP buffer size: 208 KByte (default)
-----
[  5] local 10.0.0.3 port 52569 connected with 10.0.0.4 port 5001
[ ID] Interval      Transfer    Bandwidth
[  5] 0.0-10.1 sec  5.90 MBytes  4.92 Mbits/sec
[  5] Sent 4210 datagrams
[  5] Server Report:
[  5] 0.0-10.2 sec  5.90 MBytes  4.86 Mbits/sec  58.153 ms    0/ 4210 (0%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h4:

```
Mar 20 15:09
"Node: h4"
root@ubuntu:/home/os/study/COSDP/lab3# ifconfig
h4-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.4 netmask 255.0.0.0 broadcast 10.255.255.255
    inet6 fe80::dc63:66ff:fe3c:7f4b prefixlen 64 scopeid 0x20<link>
    ether de:63:66:3c:7f:4b txqueuelen 1000 (Ethernet)
    RX packets 112 bytes 9625 (9.6 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 15 bytes 1146 (1.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -s
-----
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
```

```
Mar 20 15:09
"Node: h4"
RX packets 112 bytes 9625 (9.6 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 15 bytes 1146 (1.1 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -s
-----
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
-----
[ 5] local 10.0.0.4 port 5001 connected with 10.0.0.3 port 52569
[ ID] Interval      Transfer      Bandwidth      Jitter    Lost/Total Datagrams
[ 5] 0.0-10.2 sec   5.90 MBytes   4.86 Mbits/sec  58.153 ms  0/ 4210 (0%)
```

可得到带宽为4.86Mbits/sec，抖动为58.153ms，丢包率为0%。

Question 1 尝试理解Line15,16两条指令，指出每条指令的具体工作是什么，并逐个分析其中各个参数的具体含义。

```
ovs-ofctl add-flow s1 in_port=5,action=meter:1,output:6 -O openflow13
```

下发转发的流表。匹配进端口为5，转发动作为meter:1,output:6。meter:1表示匹配到的流表首先交给meter表处理，就是超过5M的数据包丢弃掉，然后再交给output:6，从6端口转发出去。-O参数后面跟协议，s1表示交换机的id。

```
ovs-ofctl dump-flows s1 -O openflow13
```

查看交换机中的流表项，-O参数后面跟协议，s1表示交换机的id。

Task2.3 同上，请将此处的实验结果按要求截图。

h5:

```
Mar 20 16:30

"Node: h5"

root@ubuntu:/home/os/study/COSDP/lab3# ifconfig
h5-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.5 netmask 255.0.0.0 broadcast 10.255.255.255
    inet6 fe80::9823:9bff:fe9c:7f2b prefixlen 64 scopeid 0x20<link>
    ether 9a:23:9b:9c:7f:2b txqueuelen 1000 (Ethernet)
    RX packets 121 bytes 10284 (10.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 17 bytes 1286 (1.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

root@ubuntu:/home/os/study/COSDP/lab3# ethtool -K h5-eth0 tx off
Actual changes:
tx-checksumming: off
    tx-checksum-ip-generic: off
    tx-checksum-sctp: off
```

```
Mar 20 16:31

"Node: h5"

TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@ubuntu:/home/os/study/COSDP/lab3# ethtool -K h5-eth0 tx off
Actual changes:
tx-checksumming: off
    tx-checksum-ip-generic: off
    tx-checksum-sctp: off
tcp-segmentation-offload: off
    tx-tcp-segmentation: off [requested on]
    tx-tcp-ecn-segmentation: off [requested on]
    tx-tcp-mangleid-segmentation: off [requested on]
    tx-tcp6-segmentation: off [requested on]
root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -c 10.0.0.6 -b 10M
-----
Client connecting to 10.0.0.6, UDP port 5001
Sending 1470 byte datagrams, IPG target: 1121.52 us (kalman adjust)
UDP buffer size: 208 KByte (default)
-----
[  5] local 10.0.0.5 port 53201 connected with 10.0.0.6 port 5001
[  5] WARNING: did not receive ack of last datagram after 10 tries.
[ ID] Interval           Transfer     Bandwidth
[  5] 0.0-10.0 sec  12.5 MBytes  10.5 Mbits/sec
[  5] Sent 8917 datagrams
root@ubuntu:/home/os/study/COSDP/lab3#
```

h6:


```
Mar 20 16:32
"Node: h6"
root@ubuntu:/home/os/study/COSDP/lab3# ifconfig
h6-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.6 netmask 255.0.0.0 broadcast 10.255.255.255
    inet6 fe80::8486:cfff:fe75:6785 prefixlen 64 scopeid 0x20<link>
    ether 86:86:cf:75:67:85 txqueuelen 1000 (Ethernet)
    RX packets 120 bytes 10194 (10.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 17 bytes 1286 (1.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -s
-----
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
```

```
Mar 20 16:31
"Node: h6"

    RX packets 120 bytes 10194 (10.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 17 bytes 1286 (1.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -s
-----
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
-----
[  5] local 10.0.0.6 port 5001 connected with 10.0.0.5 port 53201
[ ID] Interval      Transfer      Bandwidth      Jitter    Lost/Total Datagrams
[  5] 0.0-10.2 sec  6.37 MBytes  5.22 Mbits/sec  15.707 ms  4372/ 8918 (49%)
```

可得到带宽为5.22Mbits/sec，抖动为15.707ms，丢包率为49%。

Question 2 到这里，你已经完成了三种限速方式的实验，并获得了三组测试数据，请你就三组数据中的带宽、抖动和丢包率等参数，对三种限速方式进行横向比较，并适当地分析原因。

整理以上实验数据得到：

	带宽	抖动	丢包率
网卡限速	5.71Mbits/sec	0.011ms	46%
队列限速	4.86Mbits/sec	58.153ms	0%
Meter表限速	5.22Mbits/sec	15.707ms	49%

可看出队列限速效果较好，因为其带宽最接近设定的5Mbits/sec，丢包率也最低，但是抖动较高。

网卡限速的带宽误差率较高，这与网卡限速的实现方式有关，其控制精度比较粗。

Meter表限速的表现中规中矩，这可能和ovs交换的流表控制能力有关，因为是软件实现的交换机，不如硬件交换机。交换机中流表的匹配，数据流计数，动作的执行等都是影响其控制力度的原因。

✓ Part3：拓展与应用

Task3 在限制Server端（h1）的带宽为10Mb的前提下，观察稳定后的三个Client的带宽，将结果截图并简单分析。

使用队列限速将h1的带宽限制为10M：

```
ovs-vsctl set port s1-eth1 qos=@newqos -- \
--id=@newqos create qos type=linux-htb queues=0=@q0 -- \
--id=@q0 create queue other-config:max-rate=10000000
```

得到结果如下：

h2:

```
Mar 21 21:51 •
"Node: h2"
[ 5] 0.0- 1.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 1.0- 2.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 2.0- 3.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 3.0- 4.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 4.0- 5.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 5.0- 6.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 6.0- 7.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 7.0- 8.0 sec 217 KBytes 1.78 Mbits/sec
[ 5] 8.0- 9.0 sec 303 KBytes 2.48 Mbits/sec
[ 5] 9.0-10.0 sec 455 KBytes 3.73 Mbits/sec
[ 5] 10.0-11.0 sec 353 KBytes 2.89 Mbits/sec
[ 5] 11.0-12.0 sec 406 KBytes 3.33 Mbits/sec
[ 5] 12.0-13.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 13.0-14.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 14.0-15.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 15.0-16.0 sec 471 KBytes 3.86 Mbits/sec
[ 5] 16.0-17.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 17.0-18.0 sec 406 KBytes 3.33 Mbits/sec
[ 5] 18.0-19.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 0.0-20.1 sec 13.5 MBytes 5.64 Mbits/sec
[ 5] Sent 9659 datagrams
[ 5] Server Report:
[ 5] 0.0-20.4 sec 10.2 MBytes 4.18 Mbits/sec 22.899 ms 2416/ 9659 (25%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h3:

```
Mar 21 21:52 •
"Node: h3"
[ 5] 0.0- 1.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 1.0- 2.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 2.0- 3.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 3.0- 4.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 4.0- 5.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 5.0- 6.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 6.0- 7.0 sec 946 KBytes 7.75 Mbits/sec
[ 5] 7.0- 8.0 sec 106 KBytes 870 Kbits/sec
[ 5] 8.0- 9.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 9.0-10.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 10.0-11.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 11.0-12.0 sec 448 KBytes 3.67 Mbits/sec
[ 5] 12.0-13.0 sec 360 KBytes 2.95 Mbits/sec
[ 5] 13.0-14.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 14.0-15.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 15.0-16.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 16.0-17.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 17.0-18.0 sec 471 KBytes 3.86 Mbits/sec
[ 5] 18.0-19.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 0.0-20.1 sec 13.2 MBytes 5.51 Mbits/sec
[ 5] Sent 9419 datagrams
[ 5] Server Report:
[ 5] 0.0-20.2 sec 7.19 MBytes 2.99 Mbits/sec 11.973 ms 4292/ 9419 (46%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h4:

```
Mar 21 21:52
"Node: h4"
[ 5] 0.0- 1.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 1.0- 2.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 2.0- 3.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 3.0- 4.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 4.0- 5.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 5.0- 6.0 sec 1.25 MBytes 10.5 Mbits/sec
[ 5] 6.0- 7.0 sec 399 KBytes 3.27 Mbits/sec
[ 5] 7.0- 8.0 sec 251 KBytes 2.06 Mbits/sec
[ 5] 8.0- 9.0 sec 445 KBytes 3.65 Mbits/sec
[ 5] 9.0-10.0 sec 432 KBytes 3.54 Mbits/sec
[ 5] 10.0-11.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 11.0-12.0 sec 403 KBytes 3.30 Mbits/sec
[ 5] 12.0-13.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 13.0-14.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 14.0-15.0 sec 471 KBytes 3.86 Mbits/sec
[ 5] 15.0-16.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 16.0-17.0 sec 337 KBytes 2.76 Mbits/sec
[ 5] 17.0-18.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 18.0-19.0 sec 405 KBytes 3.32 Mbits/sec
[ 5] 0.0-20.0 sec 13.0 MBytes 5.45 Mbits/sec
[ 5] Sent 9279 datagrams
[ 5] Server Report:
[ 5] 0.0-19.6 sec 6.92 MBytes 2.96 Mbits/sec 4.758 ms 4346/ 9279 (47%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h1:

```
Mar 21 21:53
"Node: h1"
root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -s
-----
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
-----
[ 5] local 10.0.0.1 port 5001 connected with 10.0.0.2 port 36306
[ 6] local 10.0.0.1 port 5001 connected with 10.0.0.3 port 54945
[ 7] local 10.0.0.1 port 5001 connected with 10.0.0.4 port 49946
[ ID] Interval      Transfer      Bandwidth      Jitter    Lost/Total Datagrams
[ 5] 0.0-20.4 sec  10.2 MBytes  4.18 Mbits/sec  22.900 ms  2416/ 9659 (25%)
[ 6] 0.0-20.2 sec   7.19 MBytes  2.99 Mbits/sec  11.974 ms  4292/ 9419 (46%)
[ 7] 0.0-19.6 sec   6.92 MBytes  2.96 Mbits/sec   4.759 ms  4346/ 9279 (47%)

```

可以看到，h2，h3，h4一开始带宽是10Mbits/sec，后来由于限速带宽开始立即下降，最终总和为10Mbits/sec左右，且比例为4:3:3，较为均匀。

Task4 你可以通过上述三种限速的方法来达成目标，请记录你的设计过程（思路及运行指令），并将你稳定后的三个Client的带宽结果截图。

思路：使用多队列限速，针对h2，h3，h4使用不同的队列。

指令如下：

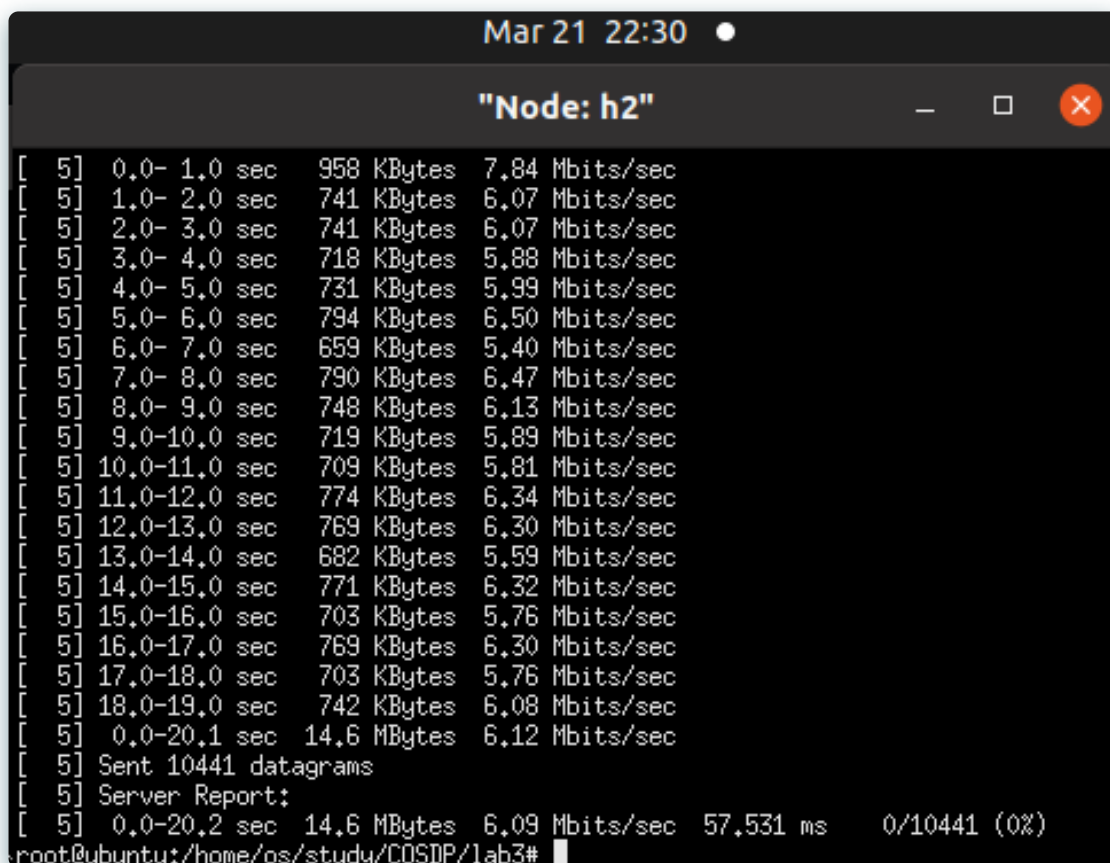
```
ovs-vsctl set port s1-eth1 qos=@newqos -- \
--id=@newqos create qos type=linux-htb other-config:max-rate=10000000 other-config:min-
rate=10000000 queues=0=@q0,1=@q1,2=@q2 -- \
--id=@q0 create queue other-config:min-rate=5000000 -- \
--id=@q1 create queue other-config:min-rate=3000000 -- \
--id=@q2 create queue other-config:max-rate=2000000
```

```
ovs-ofctl -O OpenFlow13 add-flow s1 in_port="s1-eth2",actions=set_queue:0,output:"s1-eth1"
ovs-ofctl -O OpenFlow13 add-flow s1 in_port="s1-eth3",actions=set_queue:1,output:"s1-eth1"
ovs-ofctl -O OpenFlow13 add-flow s1 in_port="s1-eth4",actions=set_queue:2,output:"s1-eth1"
```

可以看到，对于h1设置了带宽max-rate和min-rate都为10000000，对于h2和h3，分别设置了min-rate=5000000和3000000，对于h4则设置了max-rate=2000000。

得到结果如下：

h2:



```
Mar 21 22:30 •
"Node: h2"
[ 5] 0.0- 1.0 sec 958 KBytes 7.84 Mbits/sec
[ 5] 1.0- 2.0 sec 741 KBytes 6.07 Mbits/sec
[ 5] 2.0- 3.0 sec 741 KBytes 6.07 Mbits/sec
[ 5] 3.0- 4.0 sec 718 KBytes 5.88 Mbits/sec
[ 5] 4.0- 5.0 sec 731 KBytes 5.99 Mbits/sec
[ 5] 5.0- 6.0 sec 794 KBytes 6.50 Mbits/sec
[ 5] 6.0- 7.0 sec 659 KBytes 5.40 Mbits/sec
[ 5] 7.0- 8.0 sec 790 KBytes 6.47 Mbits/sec
[ 5] 8.0- 9.0 sec 748 KBytes 6.13 Mbits/sec
[ 5] 9.0-10.0 sec 719 KBytes 5.89 Mbits/sec
[ 5] 10.0-11.0 sec 709 KBytes 5.81 Mbits/sec
[ 5] 11.0-12.0 sec 774 KBytes 6.34 Mbits/sec
[ 5] 12.0-13.0 sec 769 KBytes 6.30 Mbits/sec
[ 5] 13.0-14.0 sec 682 KBytes 5.59 Mbits/sec
[ 5] 14.0-15.0 sec 771 KBytes 6.32 Mbits/sec
[ 5] 15.0-16.0 sec 703 KBytes 5.76 Mbits/sec
[ 5] 16.0-17.0 sec 769 KBytes 6.30 Mbits/sec
[ 5] 17.0-18.0 sec 703 KBytes 5.76 Mbits/sec
[ 5] 18.0-19.0 sec 742 KBytes 6.08 Mbits/sec
[ 5] 0.0-20.1 sec 14.6 MBytes 6.12 Mbits/sec
[ 5] Sent 10441 datagrams
[ 5] Server Report:
[ 5] 0.0-20.2 sec 14.6 MBytes 6.09 Mbits/sec 57,531 ms 0/10441 (0%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h3:

```
Mar 21 22:30 •
"Node: h3"
[ 5] 0.0- 1.0 sec 560 KBytes 4.59 Mbits/sec
[ 5] 1.0- 2.0 sec 418 KBytes 3.42 Mbits/sec
[ 5] 2.0- 3.0 sec 441 KBytes 3.61 Mbits/sec
[ 5] 3.0- 4.0 sec 436 KBytes 3.58 Mbits/sec
[ 5] 4.0- 5.0 sec 432 KBytes 3.54 Mbits/sec
[ 5] 5.0- 6.0 sec 487 KBytes 3.99 Mbits/sec
[ 5] 6.0- 7.0 sec 398 KBytes 3.26 Mbits/sec
[ 5] 7.0- 8.0 sec 497 KBytes 4.07 Mbits/sec
[ 5] 8.0- 9.0 sec 429 KBytes 3.52 Mbits/sec
[ 5] 9.0-10.0 sec 431 KBytes 3.53 Mbits/sec
[ 5] 10.0-11.0 sec 454 KBytes 3.72 Mbits/sec
[ 5] 11.0-12.0 sec 431 KBytes 3.53 Mbits/sec
[ 5] 12.0-13.0 sec 429 KBytes 3.52 Mbits/sec
[ 5] 13.0-14.0 sec 432 KBytes 3.54 Mbits/sec
[ 5] 14.0-15.0 sec 485 KBytes 3.97 Mbits/sec
[ 5] 15.0-16.0 sec 402 KBytes 3.29 Mbits/sec
[ 5] 16.0-17.0 sec 497 KBytes 4.07 Mbits/sec
[ 5] 17.0-18.0 sec 429 KBytes 3.52 Mbits/sec
[ 5] 18.0-19.0 sec 429 KBytes 3.52 Mbits/sec
[ 5] 0.0-20.1 sec 8.82 MBytes 3.69 Mbits/sec
[ 5] Sent 6295 datagrams
[ 5] Server Report:
[ 5] 0.0-20.1 sec 8.82 MBytes 3.68 Mbits/sec 4.742 ms 0/ 6295 (0%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h4:

```
Mar 21 22:30 •
"Node: h4"
[ 5] 0.0- 1.0 sec 141 KBytes 1.15 Mbits/sec
[ 5] 1.0- 2.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 2.0- 3.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 3.0- 4.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 4.0- 5.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 5.0- 6.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 6.0- 7.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 7.0- 8.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 8.0- 9.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 9.0-10.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 10.0-11.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 11.0-12.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 12.0-13.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 13.0-14.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 14.0-15.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 15.0-16.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 16.0-17.0 sec 2.87 KBytes 23.5 Kbits/sec
[ 5] 17.0-18.0 sec 4.31 KBytes 35.3 Kbits/sec
[ 5] 18.0-19.0 sec 5.74 KBytes 47.0 Kbits/sec
[ 5] 0.0-20.1 sec 233 KBytes 94.9 Kbits/sec
[ 5] Sent 162 datagrams
[ 5] Server Report:
[ 5] 0.0-20.4 sec 233 KBytes 93.5 Kbits/sec 296.524 ms 0/ 162 (0%)
root@ubuntu:/home/os/study/COSDP/lab3#
```

h1:

```
Mar 21 22:29 •
"Node: h1"
root@ubuntu:/home/os/study/COSDP/lab3# iperf -u -s
-----
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
-----
[  5] local 10.0.0.1 port 5001 connected with 10.0.0.2 port 42852
[  6] local 10.0.0.1 port 5001 connected with 10.0.0.3 port 48755
[  7] local 10.0.0.1 port 5001 connected with 10.0.0.4 port 36871
[ ID] Interval      Transfer      Bandwidth      Jitter    Lost/Total Datagrams
[  5] 0.0-20.2 sec   14.6 MBytes   6.09 Mbits/sec  57.531 ms  0/10441 (0%)
[  6] 0.0-20.1 sec    8.82 MBytes   3.68 Mbits/sec   4.743 ms  0/ 6295 (0%)
[  7] 0.0-20.4 sec    233 KBytes    93.5 Kbits/sec 296.524 ms  0/  162 (0%)
█
```

可以得到带宽如下：

h2	h3	h4
6.09Mbits/sec	3.68Mbits/sec	93.5Kbits/sec

可以看到，h2与h3的带宽均满足要求，而h4的带宽仅为93.5Kbits/sec，与h2和h3已经占用了大多数带宽有关。总体还算符合要求。