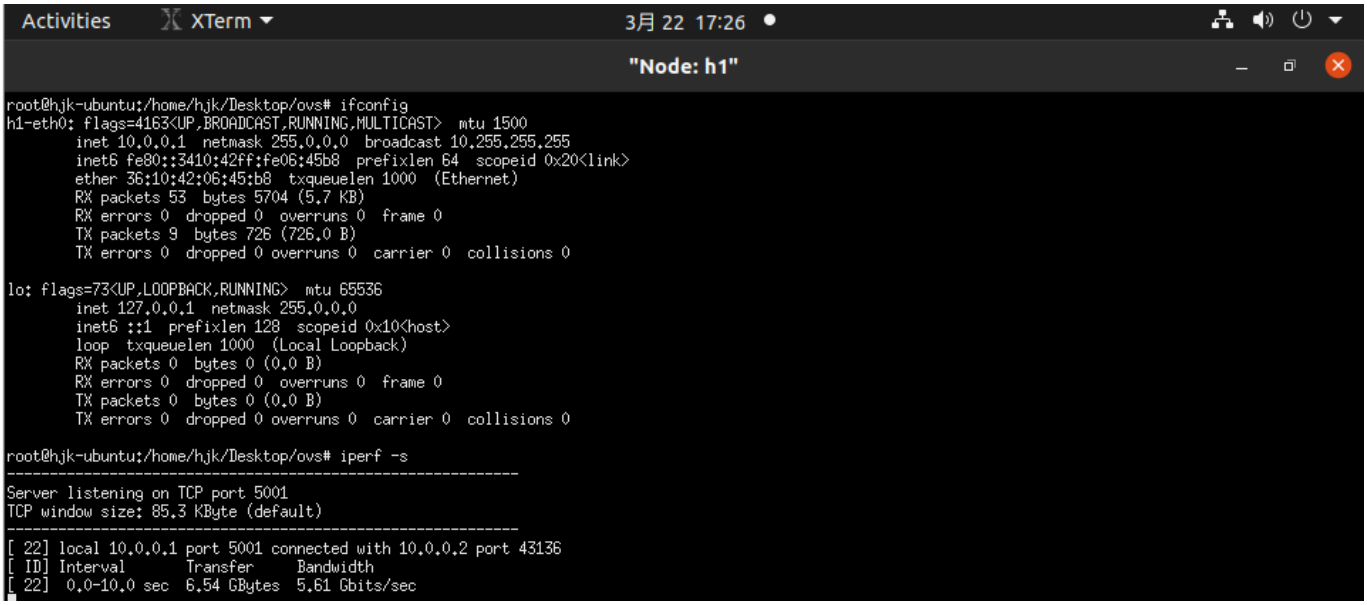
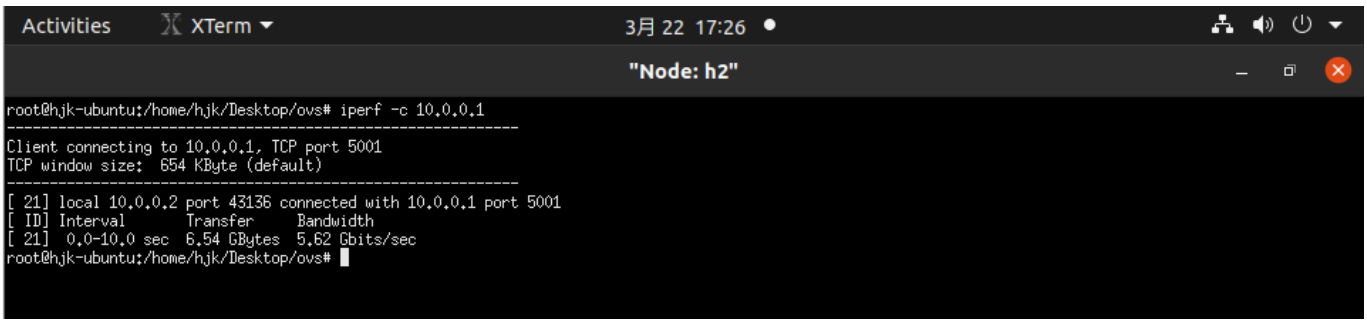
Lab3: QoS Implementation with OvS

Part1

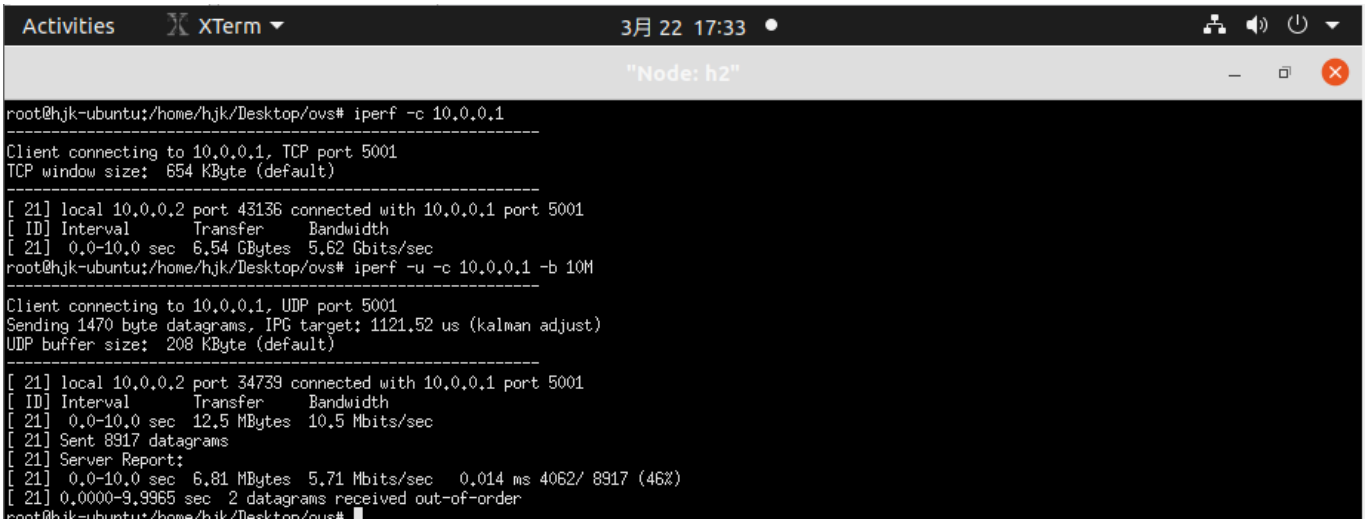
Task1

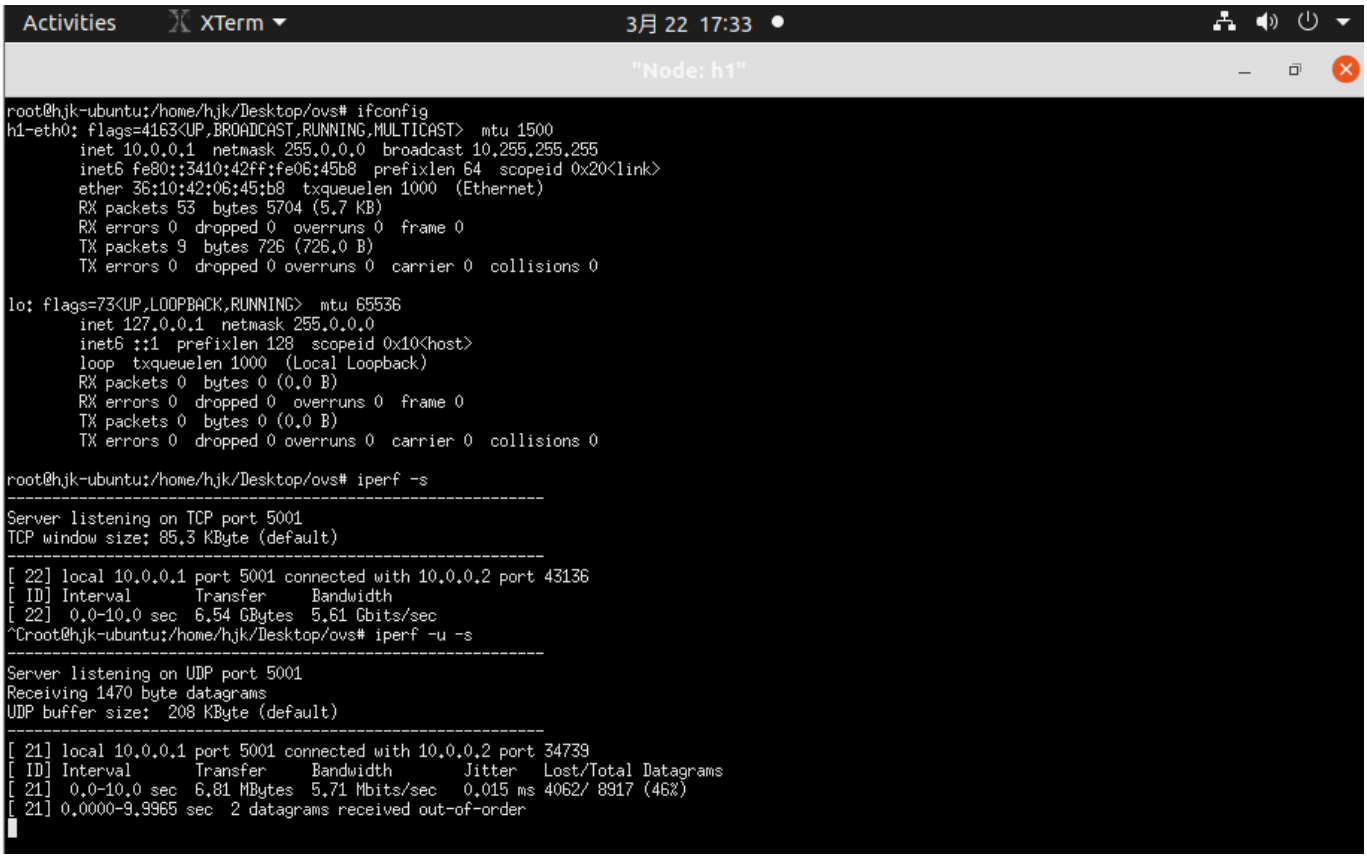




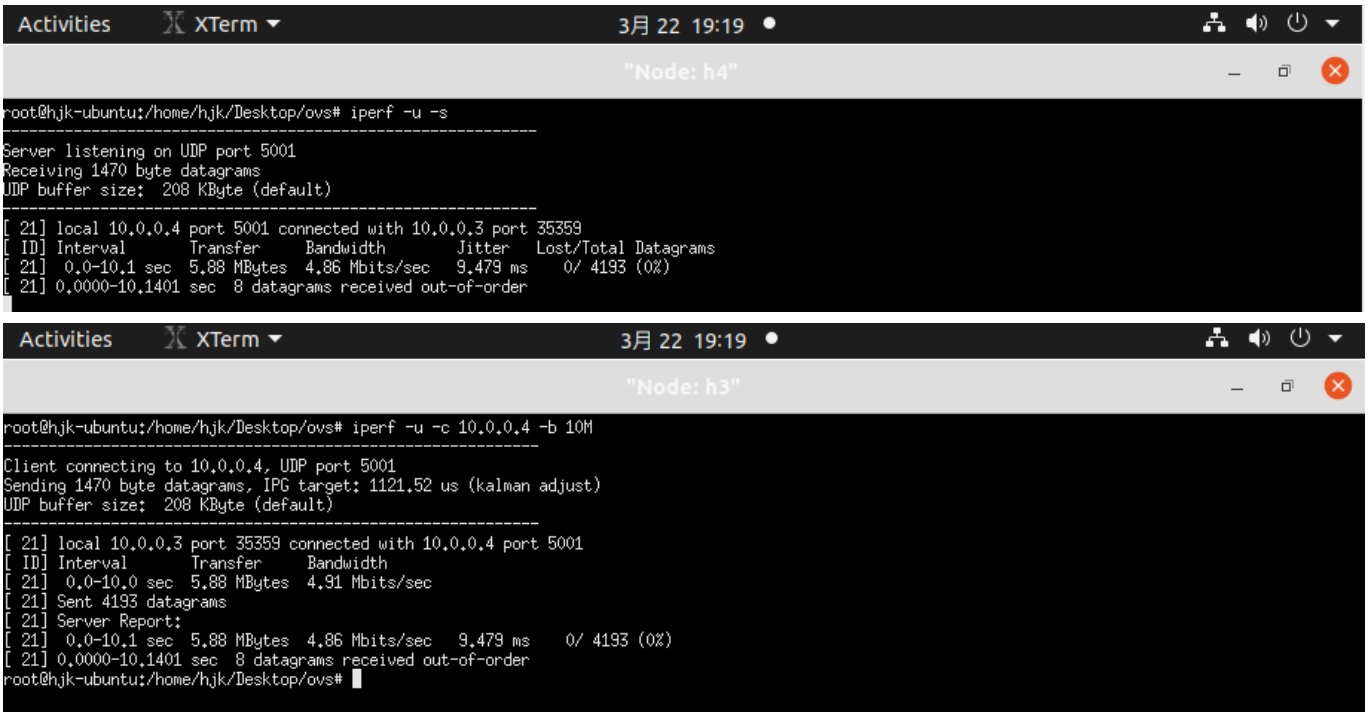
Part2

Task2.1


Activities
XTerm
3月 22 17:33
"Node: h2"
root@hjk-ubuntu:/home/hjk/Desktop/ovs# iperf -c 10.0.0.1
Client connecting to 10.0.0.1, TCP port 5001
TCP window size: 654 KByte (default)
[21] local 10.0.0.2 port 43136 connected with 10.0.0.1 port 5001
[ID] Interval Transfer Bandwidth
[21] 0.0-10.0 sec 6.54 GBytes 5.62 Gbits/sec
root@hjk-ubuntu:/home/hjk/Desktop/ovs# 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)
[21] local 10.0.0.2 port 34739 connected with 10.0.0.1 port 5001
[ID] Interval Transfer Bandwidth
[21] 0.0-10.0 sec 12.5 MBytes 10.5 Mbits/sec
[21] Sent 8917 datagrams
[21] Server Report:
[21] 0.0-10.0 sec 6.81 MBytes 5.71 Mbits/sec 0.014 ms 4062/ 8917 (46%)
[21] 0.0000-9.9965 sec 2 datagrams received out-of-order


Activities
XTerm
3月 22 17:33
"Node: h1"
root@hjk-ubuntu:/home/hjk/Desktop/ovs# ifconfig
h1-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 10.0.0.1 netmask 255.0.0.0 broadcast 10.255.255.255
inet6 fe80::3410:42ff:fe06:45b8 prefixlen 64 scopeid 0x20<link>
ether 36:10:42:06:45:b8 txqueuelen 1000 (Ethernet)
RX packets 53 bytes 5704 (5.7 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 9 bytes 726 (726.0 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@hjk-ubuntu:/home/hjk/Desktop/ovs# iperf -s
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
[22] local 10.0.0.1 port 5001 connected with 10.0.0.2 port 43136
[ID] Interval Transfer Bandwidth
[22] 0.0-10.0 sec 6.54 GBytes 5.61 Gbits/sec
^Croot@hjk-ubuntu:/home/hjk/Desktop/ovs# iperf -u -s
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size: 208 KByte (default)
[21] local 10.0.0.1 port 5001 connected with 10.0.0.2 port 34739
[ID] Interval Transfer Bandwidth Jitter Lost/Total Datagrams
[21] 0.0-10.0 sec 6.81 MBytes 5.71 Mbits/sec 0.015 ms 4062/ 8917 (46%)
[21] 0.0000-9.9965 sec 2 datagrams received out-of-order

Task2.2



Question1

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

作用:下发流表

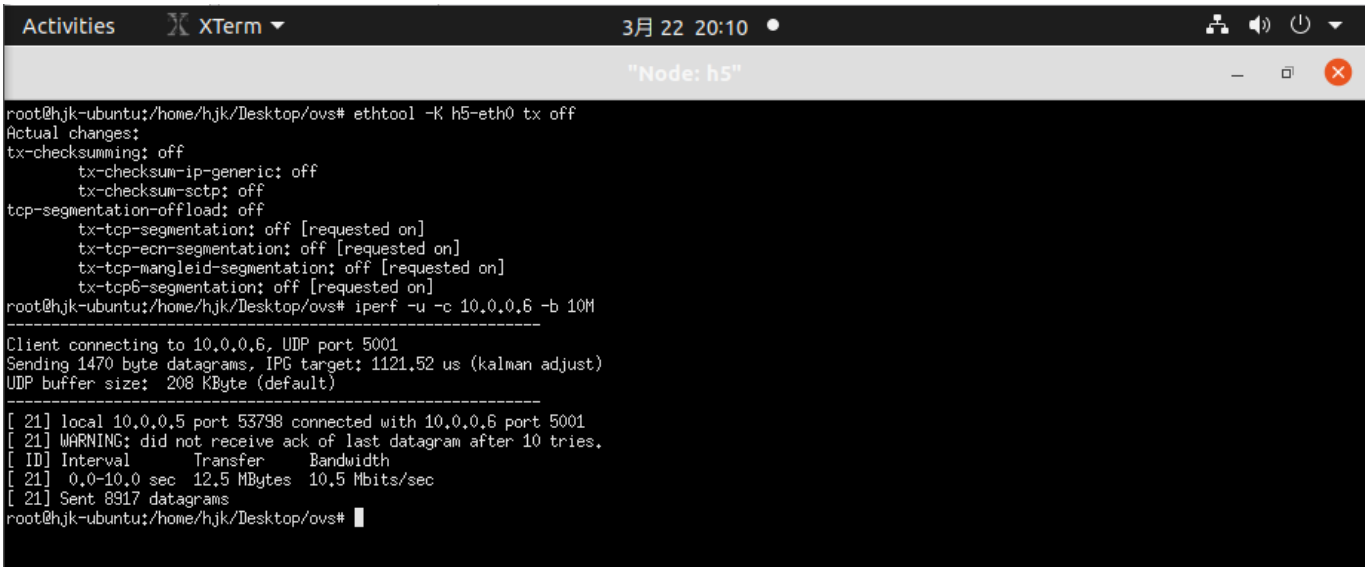
- `ovs-ofctl`是流表操作指令
- `add-flow`表示添加流表
- `s1`表示向switch s1添加流表
- `in_port=5, action=meter:1,output:6`描述了要添加的流表项, 具体表示数据包从5号端口进入, 使用1号meter表, 然后从2号端口转发出去
- `-O openflow13`表示使用的OpenFlow版本为openflow13

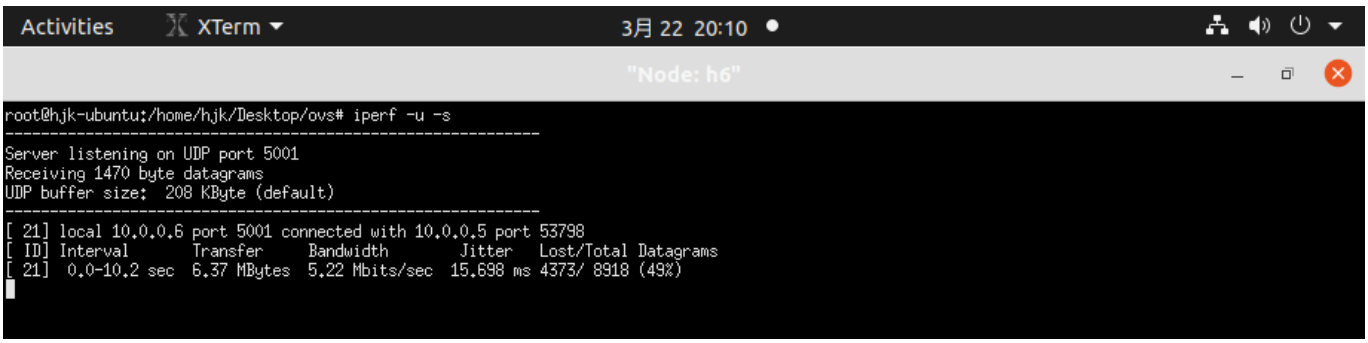
```
$ ovs-ofctl dump-flows s1 -O openflow13
```

作用:查看流表

- `ovs-ofctl`是流表操作指令
- `dump-flows`表示查看当前流表
- `s1`表示对应的switch为s1
- `-O openflow13`表示使用的OpenFlow版本为openflow13

Task2.3





Question2

限速方式	带宽/(Mb/s)	抖动/ms	丢包率
网卡限速	5.71	0.015	46%
队列限速	4.86	9.479	0
Meter表限速	5.22	15.698	49%

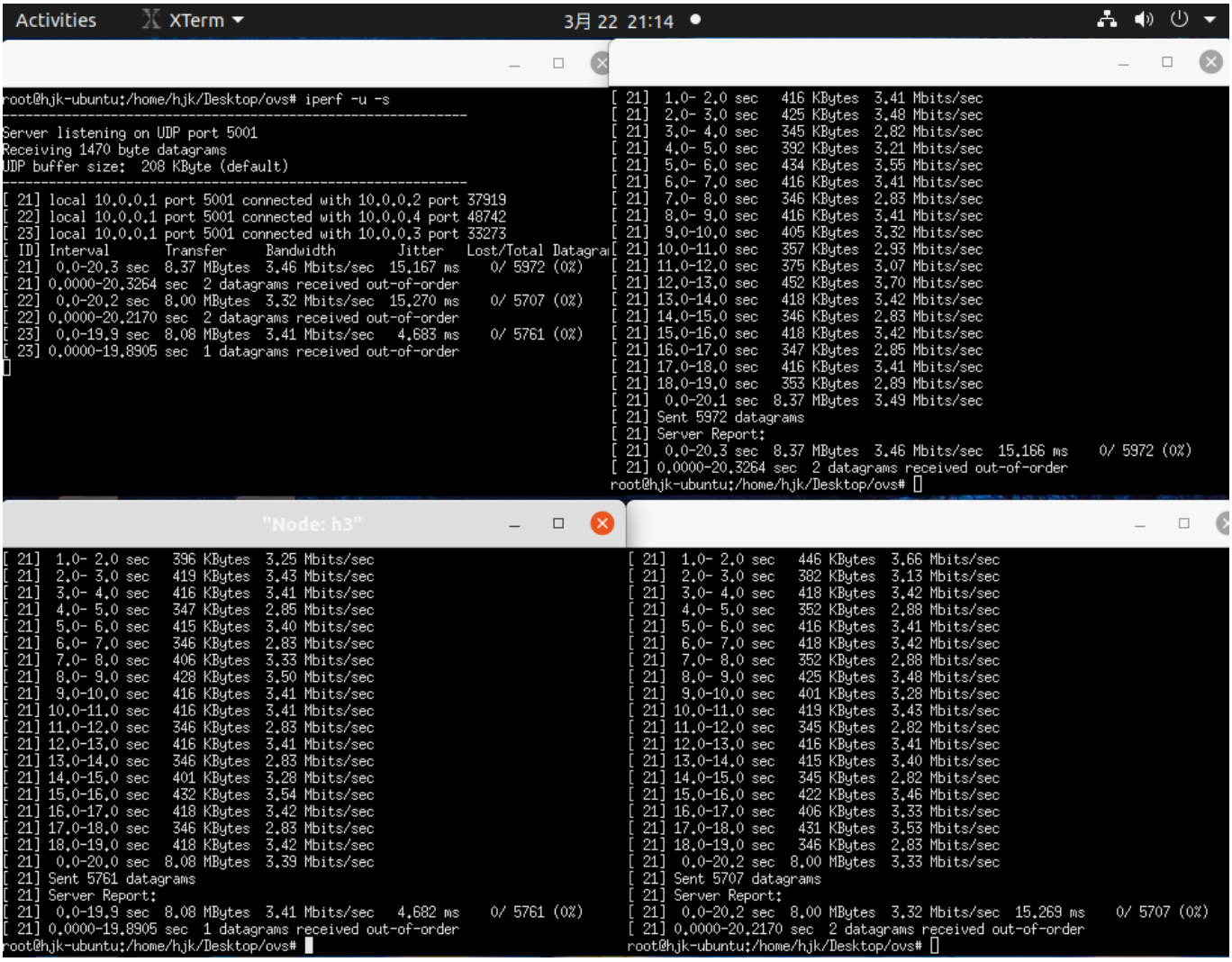
- 丢包率:网卡限速和Meter表限速都是通过丢弃多于数据包实现限速, 因此丢包率相近, 且接近于(发送带宽(10M)-实际测量带宽)/发送带宽(50%),队列限速通过缓存数据包实现限速, 不会丢弃包, 因此丢包率为0;
- 带宽:三者带宽接近, 约等于限制的最大带宽, 其中网卡限速测量带宽最大, 队列限速测量带宽最小, 网卡限速偏离最大限速带宽最多, 表明网卡的限速准确度最低, 队列限速的准确度最高;带宽控制准确率的不同可能与不同速度测量方式和控制方式有关，队列限速直接控制发送队列的速率, 比Meter表限速在switch控制和网卡限速在网卡限速控制更加精准, 受传输等其他因素影响更小, 对网速的测量可能也更准确.
- 抖动: 抖动描述了最大端到端延迟和最小端到端延迟的极差; Meter表限速抖动最高, 网卡限速抖动最低; 网卡限速由于在发送端、switch和接收端都几乎没有任何处理工作和拥塞而抖动几乎为0; Meter表限速由于数据包要被switch处理(由于进程调度和switch处理能力限制不同数据包处理时间可能差异较大)而抖动最高; 队列限速由于不同包在队列中的延迟时间不同也具有较高抖动, 但仍小于Meter表限速.

Task3

限速方式: 队列限速

```
sudo 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
```

测量结果



client对三个server的带宽基本相同, 由于三个网路流优先级相同, 限速算法的公平性和丢包的随机性保证了三者带宽相同

Task4

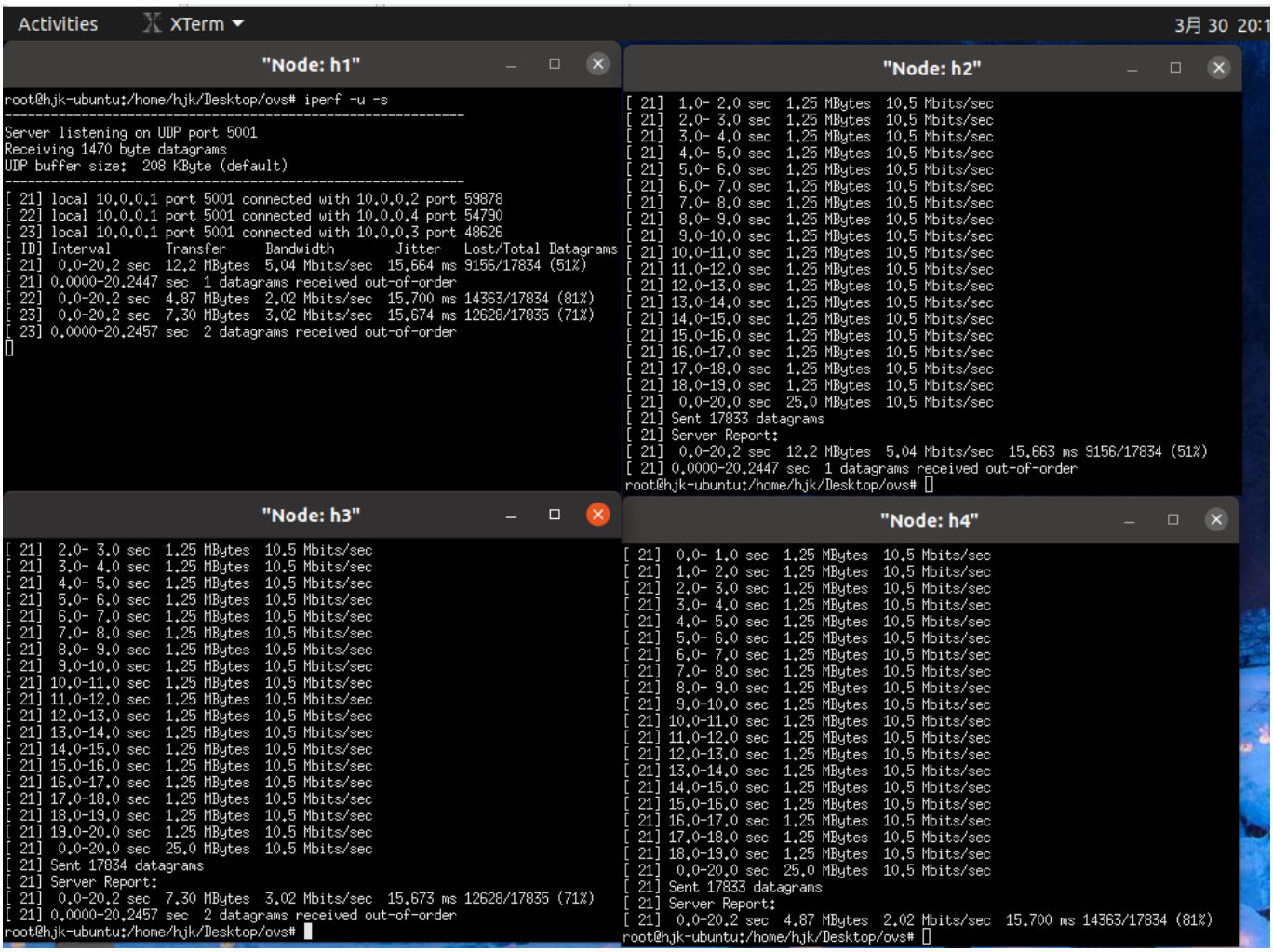
```
# 使用队列限制client带宽为10M
$ sudo ovs-vsctl set port s1-eth1 qos=@newqos --  --id=@newqos create qos
type=linux-htb queues=0=@q0 -- --id=@q0 create queue other-config:max-
rate=10000000

# 添加2号端口进入转发到1号端口的meter表，带宽限制为5M
$ sudo ovs-ofctl add-meter s1 meter=1,kbps,band=type=drop,rate=5000 -O OpenFlow13
$ sudo ovs-ofctl add-flow s1 in_port=2,action=meter:1,output:1 -O openflow13

# 添加3号端口进入转发到1号端口的meter表，带宽限制为3M
$ sudo ovs-ofctl add-meter s1 meter=2,kbps,band=type=drop,rate=3000 -O OpenFlow13
$ sudo ovs-ofctl add-flow s1 in_port=3,action=meter:2,output:1 -O openflow13
```

```
# 添加4号端口进入转发到1号端口的meter表，带宽限制为2M
$ sudo ovs-ofctl add-meter s1 meter=3,kbps,band=type=drop,rate=2000 -O OpenFlow13
$ sudo ovs-ofctl add-flow s1 in_port=4,action=meter:3,output:1 -O openflow13
```

实验结果:



注:

题目要求保证h2和h3的带宽下限, 但使用上述三种限速方式只能设置带宽上限, 但是在发送带宽大于switch限制带宽的情况下, 限速的带宽上限应等于实际保证的带宽下限, 因此使用限速手段可以实现题目需求.