

**Laporan  
Tugas Akhir Jaringan Komputer**

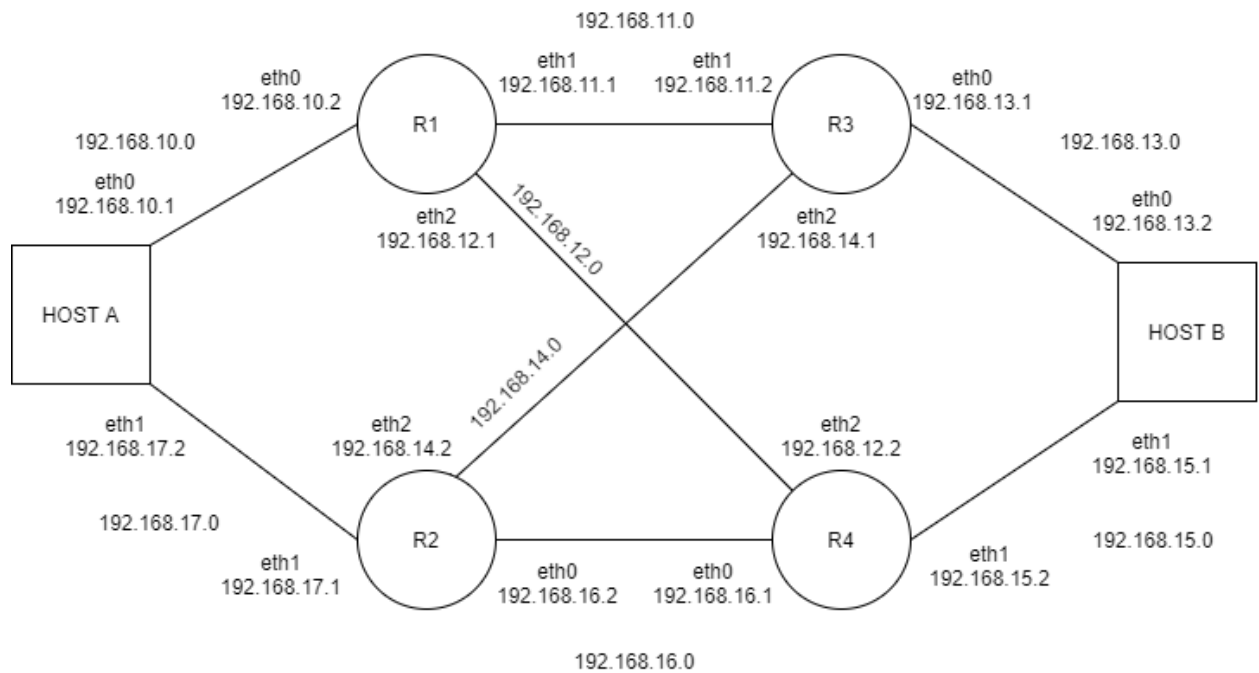


**Membangun Topologi Jaringan  
Menggunakan Mininet & iPerf**

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BANDUNG  
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## 1. Desain Topologi dan Subnet



Pada topologi yang dipakai menggunakan 2 PC yaitu Host A dan Host B. lalu, router yang dipakai ada 4 yaitu R1, R2, R3, dan R4. Host A terhubung ke R1 dan R2. Sedangkan Host B terhubung ke R3 dan R4. lalu masing masing router saling terhubung dengan router lainnya R1 dengan R3 dan R4, R2 dengan R4 dan R3, dan seterusnya.

Name	Hosts Needed	Hosts Available	Unused Hosts	Network Address	Slash	Mask	Usable Range	Broadcast	Wildcard
Host A1	254	254	0	192.168.1.0	/24	255.255.255.0	192.168.1.1 - 192.168.1.254	192.168.1.255	0.0.0.255
Host A2	254	254	0	192.168.2.0	/24	255.255.255.0	192.168.2.1 - 192.168.2.254	192.168.2.255	0.0.0.255
Host B1	254	254	0	192.168.3.0	/24	255.255.255.0	192.168.3.1 - 192.168.3.254	192.168.3.255	0.0.0.255
Host B2	254	254	0	192.168.4.0	/24	255.255.255.0	192.168.4.1 - 192.168.4.254	192.168.4.255	0.0.0.255
R1	254	254	0	192.168.5.0	/24	255.255.255.0	192.168.5.1 - 192.168.5.254	192.168.5.255	0.0.0.255
R2	254	254	0	192.168.6.0	/24	255.255.255.0	192.168.6.1 - 192.168.6.254	192.168.6.255	0.0.0.255
R3	254	254	0	192.168.7.0	/24	255.255.255.0	192.168.7.1 - 192.168.7.254	192.168.7.255	0.0.0.255
R4	254	254	0	192.168.8.0	/24	255.255.255.0	192.168.8.1 - 192.168.8.254	192.168.8.255	0.0.0.255

Untuk IP yang saya gunakan pada topologi adalah seperti gambar tabel diatas. Host A1 untuk Host A yang eth0 dan Host A2 untuk Host A yang eth1, lalu Host B1 untuk Host B yang eth0 dan Host B2 untuk Host B yang eth1, lalu tabel yang R1 sampai R4 digunakan IP pada router.

## 2. Konfigurasi Host, Router, Bandwidth, dan Link pada Mininet

Berikut adalah konfigurasi untuk menambah host, router, bandwidth, dan link pada topologi:

```
Activities Text Editor Jun 16 18:33
tubes.py
~/mininet

1#!/usr/bin/env python
2
3from mininet.net import Mininet
4from mininet.cli import CLI
5from mininet.link import Link, TCLink, Intf
6from subprocess import Popen, PIPE
7from mininet.log import setLogLevel
8
9if '__main__' == __name__:
10    setLogLevel('info')
11    net = Mininet(link=TCLink) # buat kabel
12    value = 0
13
14    # Tambah Host
15    h1 = net.addHost('h1')
16    h2 = net.addHost('h2')
17
18    # Tambah Router
19    r1 = net.addHost('r1')
20    r2 = net.addHost('r2')
21    r3 = net.addHost('r3')
22    r4 = net.addHost('r4')
23
24    # Konfigurasi Bandwidth
25    bw1={'bw':1} # Untuk 1Mbps
26    bw2={'bw':0.5} # Untuk 0.5 Mbps
27
28    # Konfigurasi Link
29    net.addLink(r1, h1, max_queue_size=60, use_htb = True, intfName1 = 'r1-eth0', intfName2 = 'h1-eth0', cls=TCLink, **bw1)
30    net.addLink(r2, h1, max_queue_size=60, use_htb = True, intfName1 = 'r2-eth1', intfName2 = 'h1-eth1', cls=TCLink, **bw1)
31    net.addLink(r1, r3, max_queue_size=60, use_htb = True, intfName1 = 'r1-eth1', intfName2 = 'r3-eth1', cls=TCLink, **bw2)
32    net.addLink(r1, r4, max_queue_size=60, use_htb = True, intfName1 = 'r1-eth2', intfName2 = 'r4-eth2', cls=TCLink, **bw1)
33    net.addLink(r2, r4, max_queue_size=60, use_htb = True, intfName1 = 'r2-eth0', intfName2 = 'r4-eth0', cls=TCLink, **bw1)
34    net.addLink(r2, r3, max_queue_size=60, use_htb = True, intfName1 = 'r2-eth2', intfName2 = 'r3-eth2', cls=TCLink, **bw2)
35    net.addLink(r3, h2, max_queue_size=60, use_htb = True, intfName1 = 'r3-eth0', intfName2 = 'h2-eth0', cls=TCLink, **bw1)
36    net.addLink(r4, h2, max_queue_size=60, use_htb = True, intfName1 = 'r4-eth1', intfName2 = 'h2-eth1', cls=TCLink, **bw1)
37    net.build()
38
Python Tab Width: 8 Ln 104, Col 1 INS
```

Untuk host saya menggunakan variabel h1 dan h2, h1 untuk Host A dan h2 untuk Host B. lalu router yang saya gunakan ada 4 sesuai pada soal penamaan yang saya gunakan yaitu r1, r2, r3, dan r4.

### 3. Konfigurasi Host dan Router

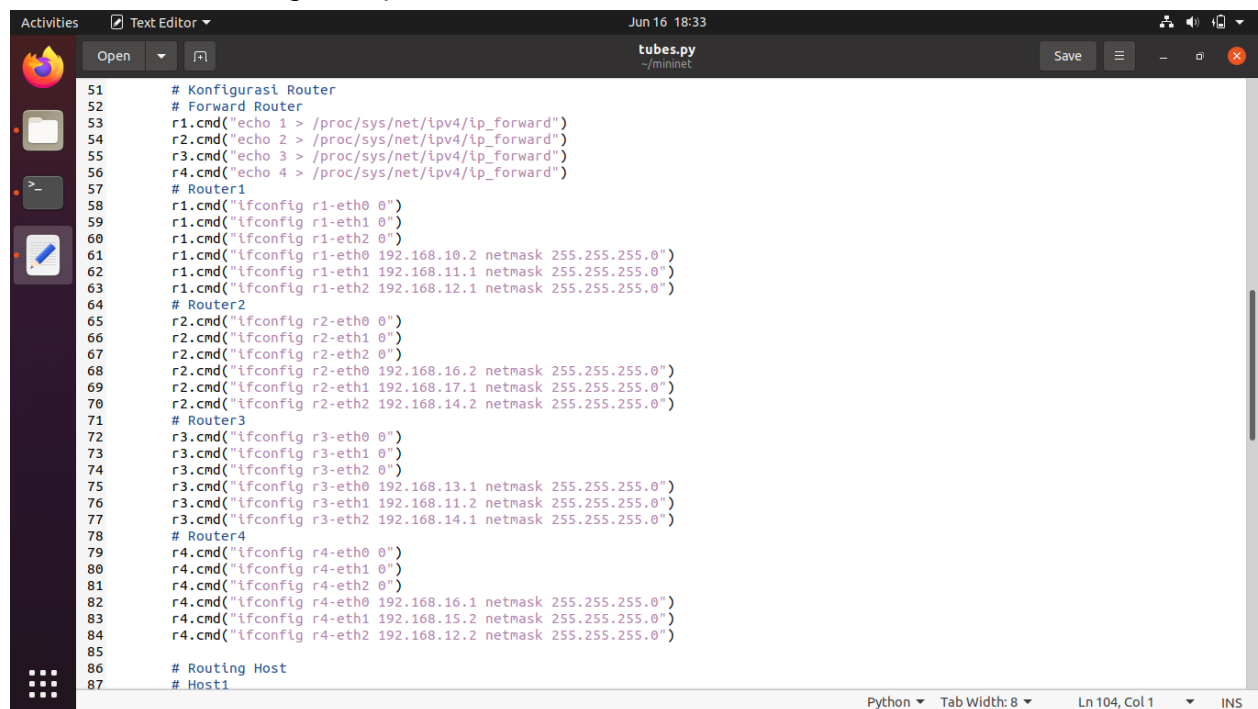
Berikut adalah konfigurasi pada host:

```
Activities Text Editor Jun 16 18:33
tubes.py
~/mininet

38
39 # Konfigurasi Host
40 # HOST1
41 h1.cmd("ifconfig h1-eth0 0")
42 h1.cmd("ifconfig h1-eth1 0")
43 h1.cmd("ifconfig h1-eth0 192.168.10.1 netmask 255.255.255.0")
44 h1.cmd("ifconfig h1-eth1 192.168.17.2 netmask 255.255.255.0")
45 #HOST2
46 h2.cmd("ifconfig h2-eth0 0")
47 h2.cmd("ifconfig h2-eth1 0")
48 h2.cmd("ifconfig h2-eth0 192.168.13.2 netmask 255.255.255.0")
49 h2.cmd("ifconfig h2-eth1 192.168.15.1 netmask 255.255.255.0")
50
51 # Konfigurasi Router
52 # Forward Router
53 r1.cmd("echo 1 > /proc/sys/net/ipv4/ip_forward")
54 r2.cmd("echo 2 > /proc/sys/net/ipv4/ip_forward")
55 r3.cmd("echo 3 > /proc/sys/net/ipv4/ip_forward")
56 r4.cmd("echo 4 > /proc/sys/net/ipv4/ip_forward")
57 # Router1
58 r1.cmd("ifconfig r1-eth0 0")
59 r1.cmd("ifconfig r1-eth1 0")
60 r1.cmd("ifconfig r1-eth2 0")
61 r1.cmd("ifconfig r1-eth0 192.168.10.2 netmask 255.255.255.0")
62 r1.cmd("ifconfig r1-eth1 192.168.11.1 netmask 255.255.255.0")
63 r1.cmd("ifconfig r1-eth2 192.168.12.1 netmask 255.255.255.0")
64 # Router2
65 r2.cmd("ifconfig r2-eth0 0")
66 r2.cmd("ifconfig r2-eth1 0")
67 r2.cmd("ifconfig r2-eth2 0")
68 r2.cmd("ifconfig r2-eth0 192.168.16.2 netmask 255.255.255.0")
69 r2.cmd("ifconfig r2-eth1 192.168.17.1 netmask 255.255.255.0")
70 r2.cmd("ifconfig r2-eth2 192.168.14.2 netmask 255.255.255.0")
71 # Router3
72 r3.cmd("ifconfig r3-eth0 0")
73 r3.cmd("ifconfig r3-eth1 0")
74 r3.cmd("ifconfig r3-eth2 0")
75 r3.cmd("ifconfig r3-eth0 192.168.13.1 netmask 255.255.255.0")
76 r3.cmd("ifconfig r3-eth1 192.168.14.1 netmask 255.255.255.0")
77 r3.cmd("ifconfig r3-eth2 192.168.15.1 netmask 255.255.255.0")
78
Python Tab Width: 8 Ln 104, Col 1 INS
```

Pada konfigurasi host ini mendefinisikan port ethernet apa saja yang digunakan pada pc dan juga memberikan IP address pada tiap portnya. Disini Host 1 menggunakan ethernet 0 dengan IP 192.168.10.1/24 dan ethernet 1 dengan IP 192.168.17.2/24. Lalu untuk Host 2 menggunakan ethernet 0 dengan IP 192.168.13.2/24 dan ethernet 1 dengan IP 192.168.15.1/24.

Berikut adalah konfigurasi pada router:



```
51 # Konfigurasi Router
52 # Forward Router
53 r1.cmd("echo 1 > /proc/sys/net/ipv4/ip_forward")
54 r2.cmd("echo 2 > /proc/sys/net/ipv4/ip_forward")
55 r3.cmd("echo 3 > /proc/sys/net/ipv4/ip_forward")
56 r4.cmd("echo 4 > /proc/sys/net/ipv4/ip_forward")
57 # Router1
58 r1.cmd("ifconfig r1-eth0 0")
59 r1.cmd("ifconfig r1-eth1 0")
60 r1.cmd("ifconfig r1-eth2 0")
61 r1.cmd("ifconfig r1-eth0 192.168.10.2 netmask 255.255.255.0")
62 r1.cmd("ifconfig r1-eth1 192.168.11.1 netmask 255.255.255.0")
63 r1.cmd("ifconfig r1-eth2 192.168.12.1 netmask 255.255.255.0")
64 # Router2
65 r2.cmd("ifconfig r2-eth0 0")
66 r2.cmd("ifconfig r2-eth1 0")
67 r2.cmd("ifconfig r2-eth2 0")
68 r2.cmd("ifconfig r2-eth0 192.168.16.2 netmask 255.255.255.0")
69 r2.cmd("ifconfig r2-eth1 192.168.17.1 netmask 255.255.255.0")
70 r2.cmd("ifconfig r2-eth2 192.168.14.2 netmask 255.255.255.0")
71 # Router3
72 r3.cmd("ifconfig r3-eth0 0")
73 r3.cmd("ifconfig r3-eth1 0")
74 r3.cmd("ifconfig r3-eth2 0")
75 r3.cmd("ifconfig r3-eth0 192.168.13.1 netmask 255.255.255.0")
76 r3.cmd("ifconfig r3-eth1 192.168.11.2 netmask 255.255.255.0")
77 r3.cmd("ifconfig r3-eth2 192.168.14.1 netmask 255.255.255.0")
78 # Router4
79 r4.cmd("ifconfig r4-eth0 0")
80 r4.cmd("ifconfig r4-eth1 0")
81 r4.cmd("ifconfig r4-eth2 0")
82 r4.cmd("ifconfig r4-eth0 192.168.16.1 netmask 255.255.255.0")
83 r4.cmd("ifconfig r4-eth1 192.168.15.2 netmask 255.255.255.0")
84 r4.cmd("ifconfig r4-eth2 192.168.12.2 netmask 255.255.255.0")
85
86 # Routing Host
87 # Host1
```

Konfigurasi diatas digunakan untuk forward router untuk r1 sampai r4. Lalu pada masing masing router diberikan konfigurasi port ethernet untuk masing masing router dan juga IPnya sesuai gambar yang ada diatas.

#### 4. Konfigurasi Routing Host dan Router

Berikut adalah konfigurasi routing host:

```
Activities Text Editor Jun 16 18:34
tubes.py ~/mininet Save
85
86 # Routing Host
87 # Host1
88 h1.cmd("ip rule add from 192.168.10.1 table 1")
89 h1.cmd("ip rule add from 192.168.17.2 table 2")
90 h1.cmd("ip route add 192.168.10.0/24 dev h1-eth0 scope link table 1")
91 h1.cmd("ip route add default via 192.168.10.2 dev h1-eth0 table 1")
92 h1.cmd("ip route add 192.168.17.0/24 dev h1-eth1 scope link table 2")
93 h1.cmd("ip route add default via 192.168.17.1 dev h1-eth1 table 2")
94 h1.cmd("ip route add default scope global nexthop via 192.168.10.2 dev h1-eth0")
95 h1.cmd("ip route add default scope global nexthop via 192.168.17.1 dev h1-eth1")
96 # Host2
97 h2.cmd("ip rule add from 192.168.13.2 table 3")
98 h2.cmd("ip rule add from 192.168.15.1 table 4")
99 h2.cmd("ip route add 192.168.13.0/24 dev h2-eth0 scope link table 1")
100 h2.cmd("ip route add default via 192.168.13.1 dev h2-eth0 table 1")
101 h2.cmd("ip route add 192.168.15.0/24 dev h2-eth1 scope link table 2")
102 h2.cmd("ip route add default via 192.168.15.2 dev h2-eth1 table 2")
103 h2.cmd("ip route add default scope global nexthop via 192.168.13.1 dev h2-eth0")
104 h2.cmd("ip route add default scope global nexthop via 192.168.15.2 dev h2-eth1")
105 # Konfigurasi Jalur Keluar
106 # Host 1
107 h1.cmd("route default gw 192.168.10.2 dev h1-eth0")
108 h1.cmd("route default gw 192.168.17.1 dev h1-eth1")
109 # HOST 2
110 h2.cmd("route default gw 192.168.13.1 dev h2-eth0")
111 h2.cmd("route default gw 192.168.15.2 dev h2-eth1")
112
113 # Konfigurasi Routing Static
114 # Router 1
115 r1.cmd("route add -net 192.168.13.0/24 gw 192.168.11.2")
116 r1.cmd("route add -net 192.168.14.0/24 gw 192.168.11.2")
117 r1.cmd("route add -net 192.168.15.0/24 gw 192.168.12.2")
118 r1.cmd("route add -net 192.168.16.0/24 gw 192.168.12.2")
119 r1.cmd("route add -net 192.168.17.0/24 gw 192.168.11.2")
120 # Router 2
121 r2.cmd("route add -net 192.168.10.0/24 gw 192.168.14.1")
122
```

Konfigurasi ini digunakan untuk routing pada host 1 da host 2.

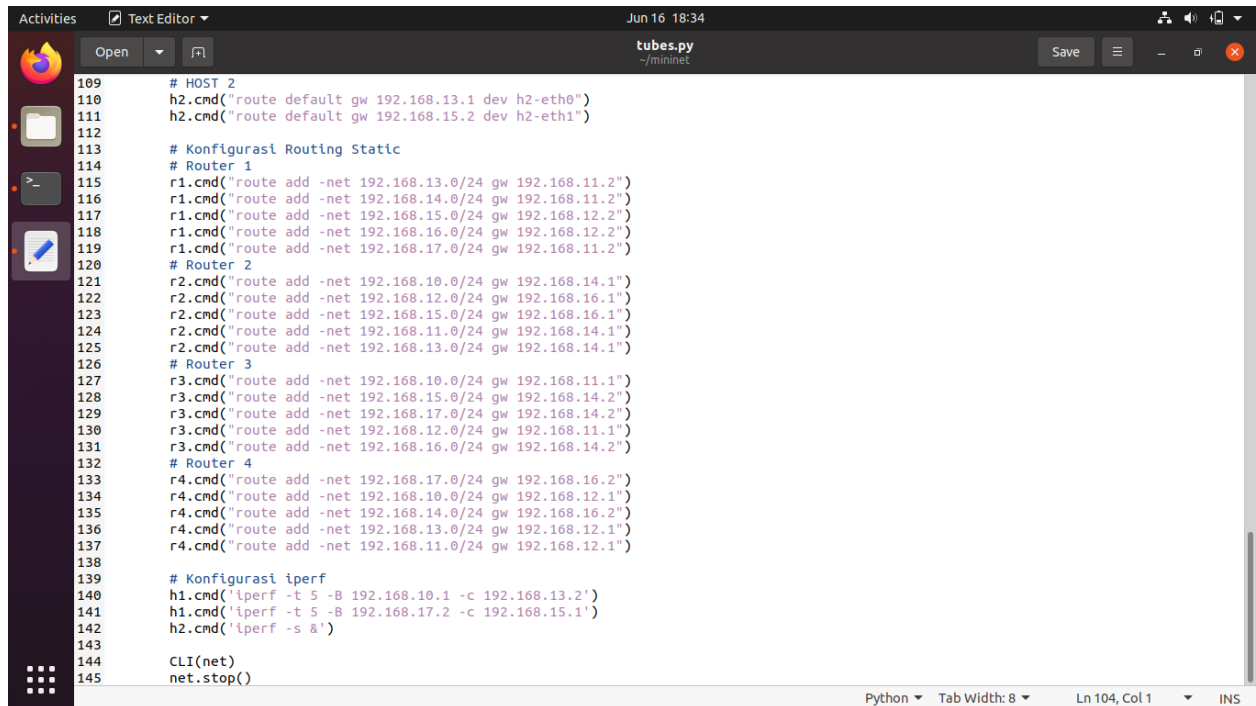
Berikut adalah konfigurasi routing router:

```
Activities Text Editor Jun 16 18:34
tubes.py ~/mininet Save
109 # HOST 2
110 h2.cmd("route default gw 192.168.13.1 dev h2-eth0")
111 h2.cmd("route default gw 192.168.15.2 dev h2-eth1")
112
113 # Konfigurasi Routing Static
114 # Router 1
115 r1.cmd("route add -net 192.168.13.0/24 gw 192.168.11.2")
116 r1.cmd("route add -net 192.168.14.0/24 gw 192.168.11.2")
117 r1.cmd("route add -net 192.168.15.0/24 gw 192.168.12.2")
118 r1.cmd("route add -net 192.168.16.0/24 gw 192.168.12.2")
119 r1.cmd("route add -net 192.168.17.0/24 gw 192.168.11.2")
120 # Router 2
121 r2.cmd("route add -net 192.168.10.0/24 gw 192.168.14.1")
122 r2.cmd("route add -net 192.168.12.0/24 gw 192.168.16.1")
123 r2.cmd("route add -net 192.168.15.0/24 gw 192.168.16.1")
124 r2.cmd("route add -net 192.168.11.0/24 gw 192.168.14.1")
125 r2.cmd("route add -net 192.168.13.0/24 gw 192.168.14.1")
126 # Router 3
127 r3.cmd("route add -net 192.168.10.0/24 gw 192.168.11.1")
128 r3.cmd("route add -net 192.168.15.0/24 gw 192.168.14.2")
129 r3.cmd("route add -net 192.168.17.0/24 gw 192.168.14.2")
130 r3.cmd("route add -net 192.168.12.0/24 gw 192.168.11.1")
131 r3.cmd("route add -net 192.168.16.0/24 gw 192.168.14.2")
132 # Router 4
133 r4.cmd("route add -net 192.168.17.0/24 gw 192.168.16.2")
134 r4.cmd("route add -net 192.168.10.0/24 gw 192.168.12.1")
135 r4.cmd("route add -net 192.168.14.0/24 gw 192.168.16.2")
136 r4.cmd("route add -net 192.168.13.0/24 gw 192.168.12.1")
137 r4.cmd("route add -net 192.168.11.0/24 gw 192.168.12.1")
138
139 # Konfigurasi iperf
140 h1.cmd('iperf -t 5 -B 192.168.10.1 -c 192.168.13.2')
141 h1.cmd('iperf -t 5 -B 192.168.17.2 -c 192.168.15.1')
142 h2.cmd('iperf -s &')
143
144 CLI(net)
145 net.stop()
```

Konfigurasi routing static pada router.

## 5. Konfigurasi iPerf

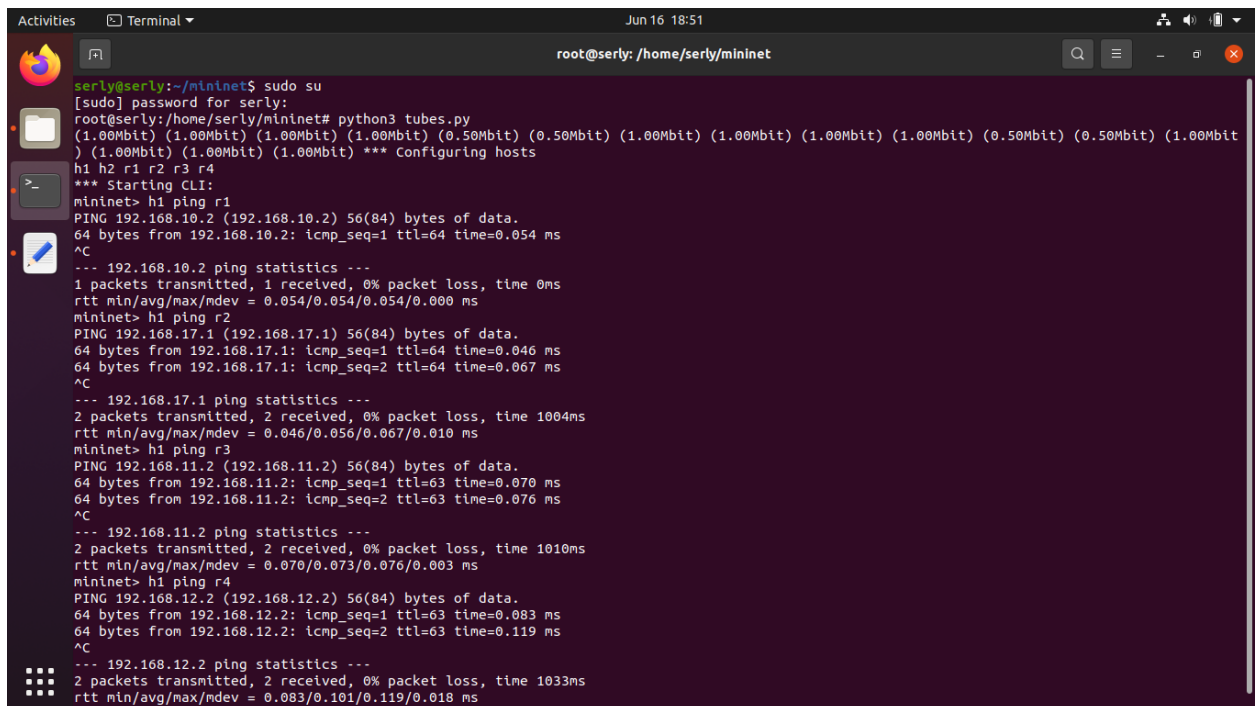
Berikut adalah konfigurasi iPerf:



```
109 # HOST 2
110 h2.cmd("route default gw 192.168.13.1 dev h2-eth0")
111 h2.cmd("route default gw 192.168.15.2 dev h2-eth1")
112
113 # Konfigurasi Routing Static
114 # Router 1
115 r1.cmd("route add -net 192.168.13.0/24 gw 192.168.11.2")
116 r1.cmd("route add -net 192.168.14.0/24 gw 192.168.11.2")
117 r1.cmd("route add -net 192.168.15.0/24 gw 192.168.12.2")
118 r1.cmd("route add -net 192.168.16.0/24 gw 192.168.12.2")
119 r1.cmd("route add -net 192.168.17.0/24 gw 192.168.11.2")
120 # Router 2
121 r2.cmd("route add -net 192.168.10.0/24 gw 192.168.14.1")
122 r2.cmd("route add -net 192.168.12.0/24 gw 192.168.16.1")
123 r2.cmd("route add -net 192.168.15.0/24 gw 192.168.16.1")
124 r2.cmd("route add -net 192.168.11.0/24 gw 192.168.14.1")
125 r2.cmd("route add -net 192.168.13.0/24 gw 192.168.14.1")
126 # Router 3
127 r3.cmd("route add -net 192.168.10.0/24 gw 192.168.11.1")
128 r3.cmd("route add -net 192.168.15.0/24 gw 192.168.14.2")
129 r3.cmd("route add -net 192.168.17.0/24 gw 192.168.14.2")
130 r3.cmd("route add -net 192.168.12.0/24 gw 192.168.11.1")
131 r3.cmd("route add -net 192.168.16.0/24 gw 192.168.14.2")
132 # Router 4
133 r4.cmd("route add -net 192.168.17.0/24 gw 192.168.16.2")
134 r4.cmd("route add -net 192.168.10.0/24 gw 192.168.12.1")
135 r4.cmd("route add -net 192.168.14.0/24 gw 192.168.16.2")
136 r4.cmd("route add -net 192.168.13.0/24 gw 192.168.12.1")
137 r4.cmd("route add -net 192.168.11.0/24 gw 192.168.12.1")
138
139 # Konfigurasi iPerf
140 h1.cmd('iperf -t 5 -B 192.168.10.1 -c 192.168.13.2')
141 h1.cmd('iperf -t 5 -B 192.168.17.2 -c 192.168.15.1')
142 h2.cmd('iperf -s &')
143
144 CLI(net)
145 net.stop()
```

## 6. Uji Coba Mininet

a. h1 mencoba ping ke semua router menggunakan mininet:



```
serly@serly:~/mininet$ sudo su
[sudo] password for serly:
root@serly:/home/serly/mininet# python3 tubes.py
(1.00Mbit) (1.00Mbit) (1.00Mbit) (1.00Mbit) (0.50Mbit) (0.50Mbit) (1.00Mbit) (1.00Mbit) (1.00Mbit) (1.00Mbit) (0.50Mbit) (0.50Mbit) (1.00Mbit)
(1.00Mbit) (1.00Mbit) (1.00Mbit) (1.00Mbit) *** Configuring hosts
h1 h2 r1 r2 r3 r4
*** Starting CLI:
mininet> h1 ping r1
PING 192.168.10.2 (192.168.10.2) 56(84) bytes of data.
64 bytes from 192.168.10.2: icmp_seq=1 ttl=64 time=0.054 ms
^C
--- 192.168.10.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.054/0.054/0.054/0.000 ms
mininet> h1 ping r2
PING 192.168.17.1 (192.168.17.1) 56(84) bytes of data.
64 bytes from 192.168.17.1: icmp_seq=1 ttl=64 time=0.046 ms
64 bytes from 192.168.17.1: icmp_seq=2 ttl=64 time=0.067 ms
^C
--- 192.168.17.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1004ms
rtt min/avg/max/mdev = 0.046/0.056/0.067/0.010 ms
mininet> h1 ping r3
PING 192.168.11.2 (192.168.11.2) 56(84) bytes of data.
64 bytes from 192.168.11.2: icmp_seq=1 ttl=63 time=0.070 ms
64 bytes from 192.168.11.2: icmp_seq=2 ttl=63 time=0.076 ms
^C
--- 192.168.11.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1010ms
rtt min/avg/max/mdev = 0.070/0.073/0.076/0.003 ms
mininet> h1 ping r4
PING 192.168.12.2 (192.168.12.2) 56(84) bytes of data.
64 bytes from 192.168.12.2: icmp_seq=1 ttl=63 time=0.083 ms
64 bytes from 192.168.12.2: icmp_seq=2 ttl=63 time=0.119 ms
^C
--- 192.168.12.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1033ms
rtt min/avg/max/mdev = 0.083/0.101/0.119/0.018 ms
```

Telah dilakukan uji ping dari h1 ke semua router. Hasilnya berhasil dilakukan

ping h1 ke semua router berhasil tersambung.

b. h2 mencoba ping ke semua router menggunakan mininet:

The image shows a terminal window titled "Terminal" with a dark background. The prompt is "root@serly: /home/serly/mininet". The user enters the command "mininet> mininet> h2 ping r1". The output shows "Server listening on TCP port 5001" and "TCP window size: 85.3 KByte (default)". Then, it shows the results of a ping to r1: "PING 192.168.10.2 (192.168.10.2) 56(84) bytes of data. 64 bytes from 192.168.10.2: icmp\_seq=1 ttl=63 time=0.087 ms". This is followed by ping statistics for r1. The user then enters "h2 ping r2", "h2 ping r3", and "h2 ping r4", each followed by similar output and statistics. The terminal also shows a "mininet>" prompt at the bottom.

```
mininet>
mininet>
mininet> h2 ping r1
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
-----
PING 192.168.10.2 (192.168.10.2) 56(84) bytes of data.
64 bytes from 192.168.10.2: icmp_seq=1 ttl=63 time=0.087 ms
^C
--- 192.168.10.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.087/0.087/0.087/0.000 ms
mininet> h2 ping r2
PING 192.168.17.1 (192.168.17.1) 56(84) bytes of data.
64 bytes from 192.168.17.1: icmp_seq=1 ttl=63 time=0.077 ms
64 bytes from 192.168.17.1: icmp_seq=2 ttl=63 time=0.080 ms
^C
--- 192.168.17.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1020ms
rtt min/avg/max/mdev = 0.077/0.078/0.080/0.001 ms
mininet> h2 ping r3
PING 192.168.11.2 (192.168.11.2) 56(84) bytes of data.
64 bytes from 192.168.11.2: icmp_seq=1 ttl=64 time=0.067 ms
64 bytes from 192.168.11.2: icmp_seq=2 ttl=64 time=0.047 ms
^C
--- 192.168.11.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1010ms
rtt min/avg/max/mdev = 0.047/0.057/0.067/0.010 ms
mininet> h2 ping r4
PING 192.168.12.2 (192.168.12.2) 56(84) bytes of data.
64 bytes from 192.168.12.2: icmp_seq=1 ttl=62 time=0.107 ms
64 bytes from 192.168.12.2: icmp_seq=2 ttl=62 time=0.072 ms
^C
--- 192.168.12.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1021ms
rtt min/avg/max/mdev = 0.072/0.089/0.107/0.017 ms
mininet>
```

Telah dilakukan uji ping dari h2 ke semua router. Hasilnya berhasil dilakukan ping h1 ke semua router berhasil tersambung.

c. h1 mencoba ping ke h2 menggunakan mininet dan sebaliknya:

The screenshot shows a terminal window titled "Terminal" with a dark theme. The prompt is "root@serly: /home/serly/mininet". The user has entered a series of commands to test network connectivity between two hosts, h1 and h2, in a mininet environment. The output shows successful ping tests with 0% packet loss and round-trip times around 0.07 to 0.10 ms.

```

root@serly: /home/serly/mininet
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet> h1 ping h2
PING 192.168.13.2 (192.168.13.2) 56(84) bytes of data.
64 bytes from 192.168.13.2: icmp_seq=1 ttl=62 time=0.108 ms
64 bytes from 192.168.13.2: icmp_seq=2 ttl=62 time=0.076 ms
64 bytes from 192.168.13.2: icmp_seq=3 ttl=62 time=0.084 ms
^C
--- 192.168.13.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2051ms
rtt min/avg/max/mdev = 0.076/0.089/0.108/0.013 ms
mininet> h2 ping h1
PING 192.168.10.1 (192.168.10.1) 56(84) bytes of data.
64 bytes from 192.168.10.1: icmp_seq=1 ttl=62 time=0.069 ms
64 bytes from 192.168.10.1: icmp_seq=2 ttl=62 time=0.075 ms
64 bytes from 192.168.10.1: icmp_seq=3 ttl=62 time=0.076 ms
^C
--- 192.168.10.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2054ms
rtt min/avg/max/mdev = 0.069/0.073/0.076/0.003 ms
mininet>

```

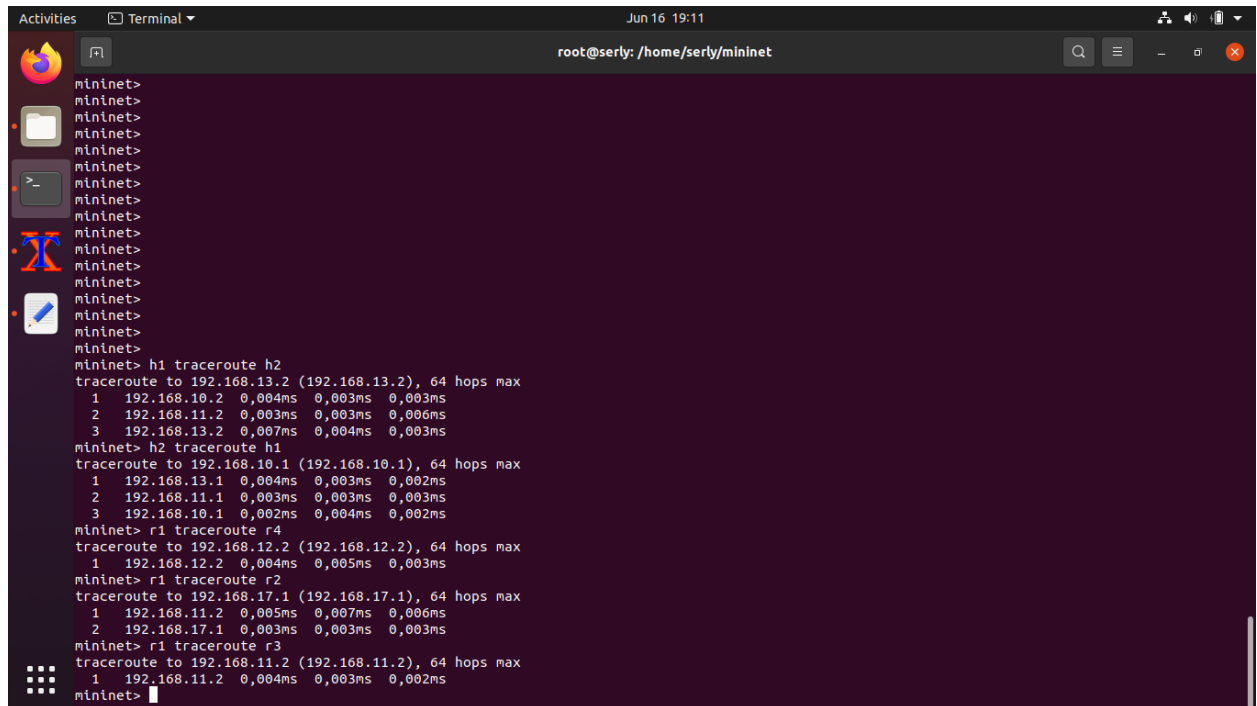
d. Uji coba pingall:

The screenshot shows a Linux desktop with a dark theme. On the left is a vertical dock containing icons for Activities, Terminal, Firefox, Files, LibreOffice Writer, and a custom icon representing a terminal window. The main area is occupied by a terminal window titled "root@serly: /home/serly/mininet". The terminal has a black background with green text. It displays a series of "mininet&gt;" prompts. After several blank lines, the user enters "xterm h1", followed by "pingall". This triggers a series of ping tests from hosts h1 through h4 to each other. The output shows successful pings for all connections. Finally, the user enters another "mininet&gt;" prompt, which is followed by a cursor. At the bottom left of the desktop, there is a grid of application shortcuts. The system status bar at the top right indicates the time as 19:22 on June 16, along with icons for network, volume, and power.

Telah dilakukan uji ping dengan pingall. Hasilnya berhasil dilakukan pingall dan semuanya tersambung.



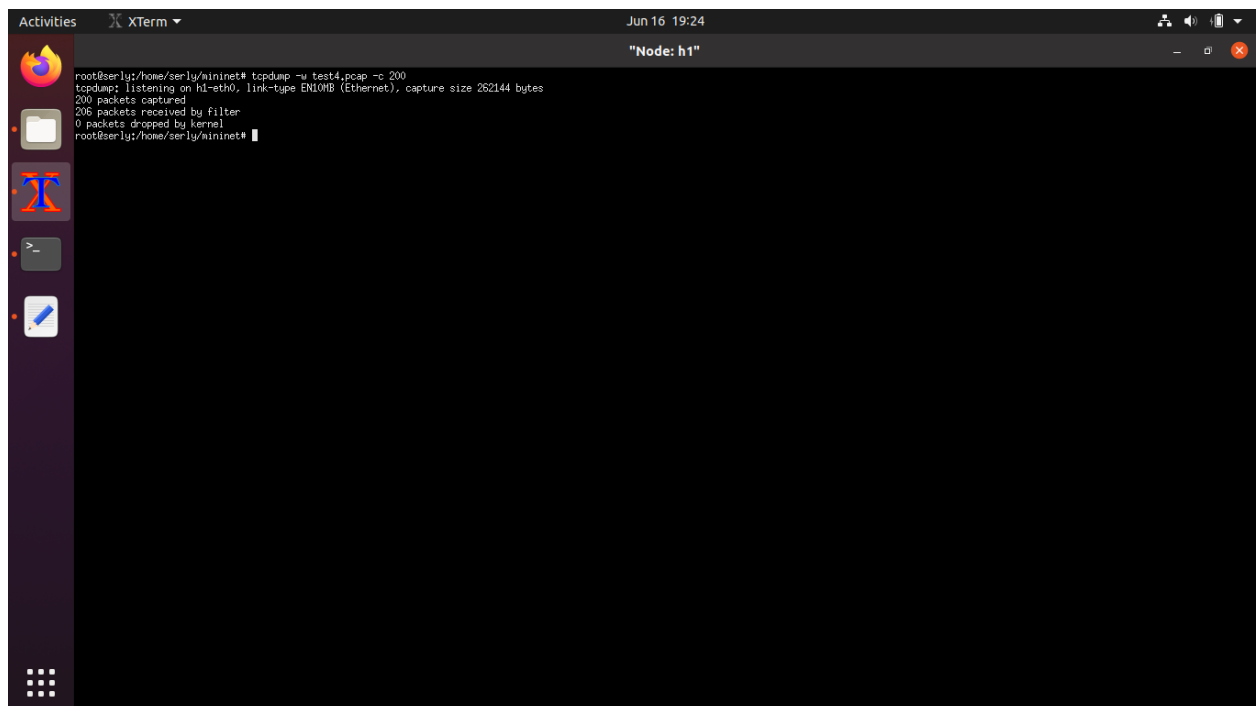
e. Uji coba menggunakan traceroute:



```
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet>
mininet> h1 traceroute h2
traceroute to 192.168.13.2 (192.168.13.2), 64 hops max
 1 192.168.10.2 0,004ms 0,003ms 0,003ms
 2 192.168.11.2 0,003ms 0,003ms 0,006ms
 3 192.168.13.2 0,007ms 0,004ms 0,003ms
mininet> h2 traceroute h1
traceroute to 192.168.10.1 (192.168.10.1), 64 hops max
 1 192.168.13.1 0,004ms 0,003ms 0,002ms
 2 192.168.11.1 0,003ms 0,003ms 0,003ms
 3 192.168.10.1 0,002ms 0,004ms 0,002ms
mininet> r1 traceroute r4
traceroute to 192.168.12.2 (192.168.12.2), 64 hops max
 1 192.168.12.2 0,004ms 0,005ms 0,003ms
mininet> r1 traceroute r2
traceroute to 192.168.17.1 (192.168.17.1), 64 hops max
 1 192.168.11.2 0,005ms 0,007ms 0,006ms
 2 192.168.17.1 0,003ms 0,003ms 0,003ms
mininet> r1 traceroute r3
traceroute to 192.168.11.2 (192.168.11.2), 64 hops max
 1 192.168.11.2 0,004ms 0,003ms 0,002ms
mininet>
```

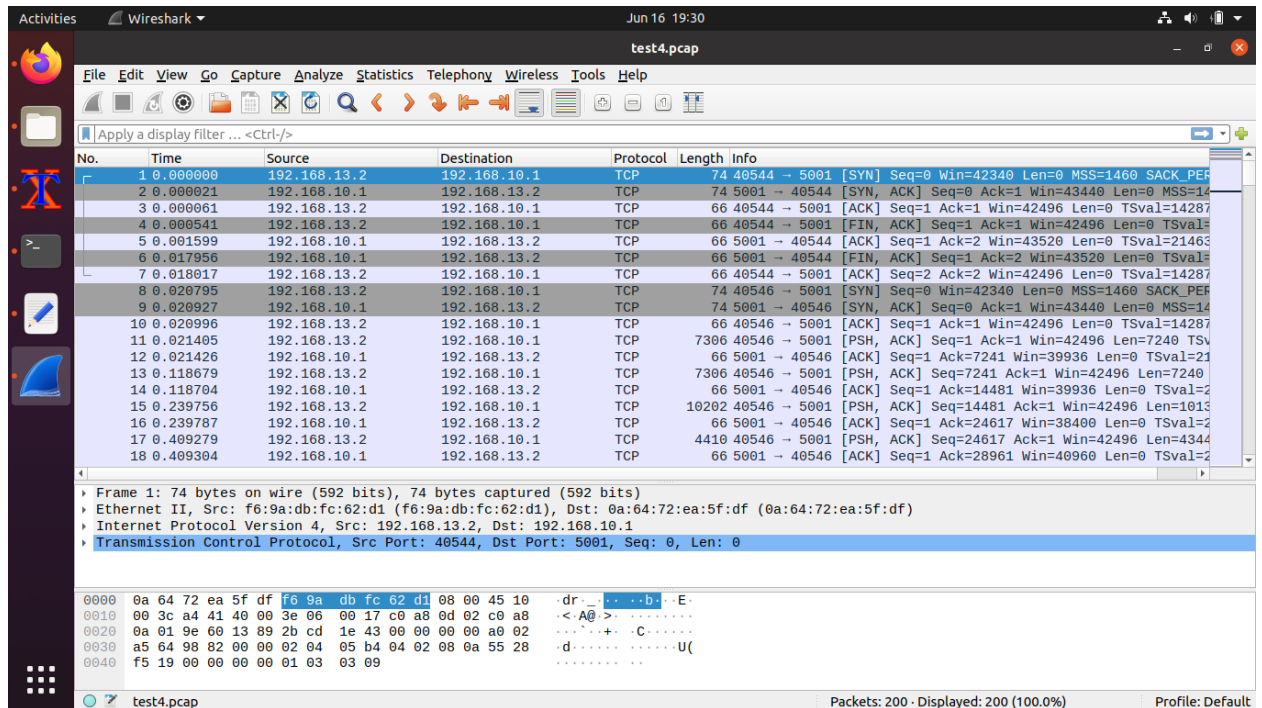
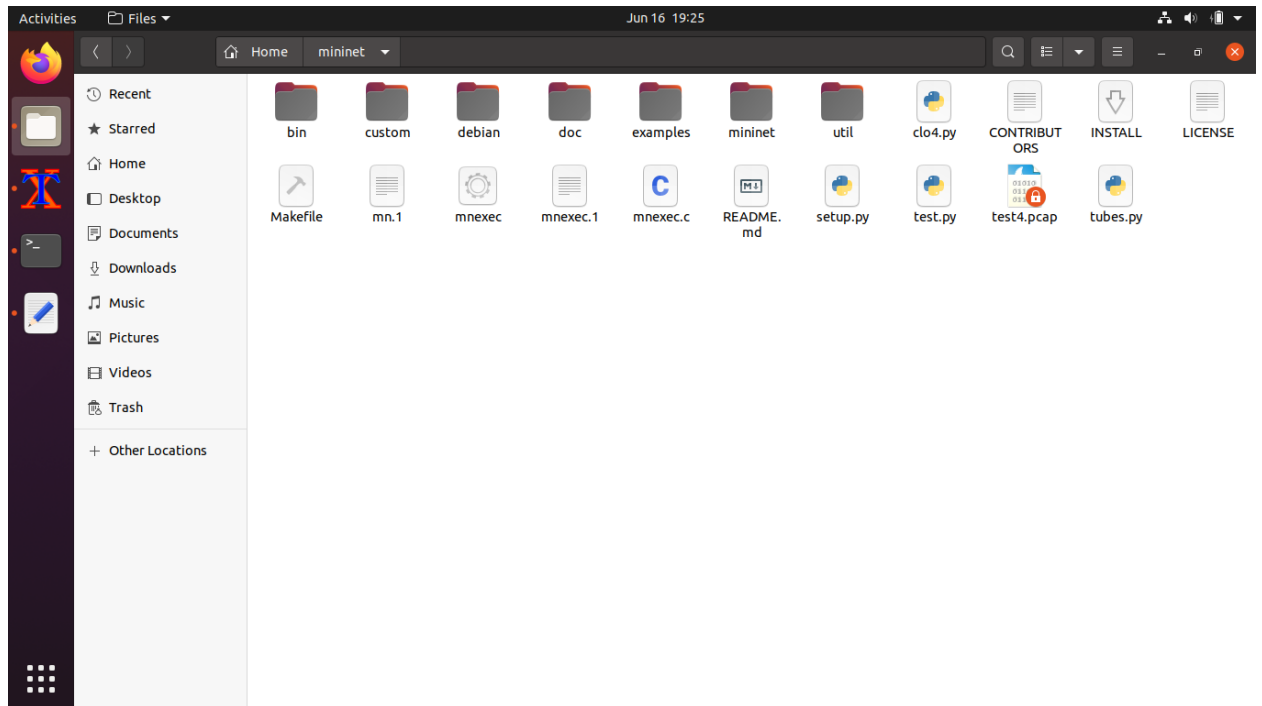
Berikut adalah hasil traceroute pada topologi.

f. Uji coba iPerf:



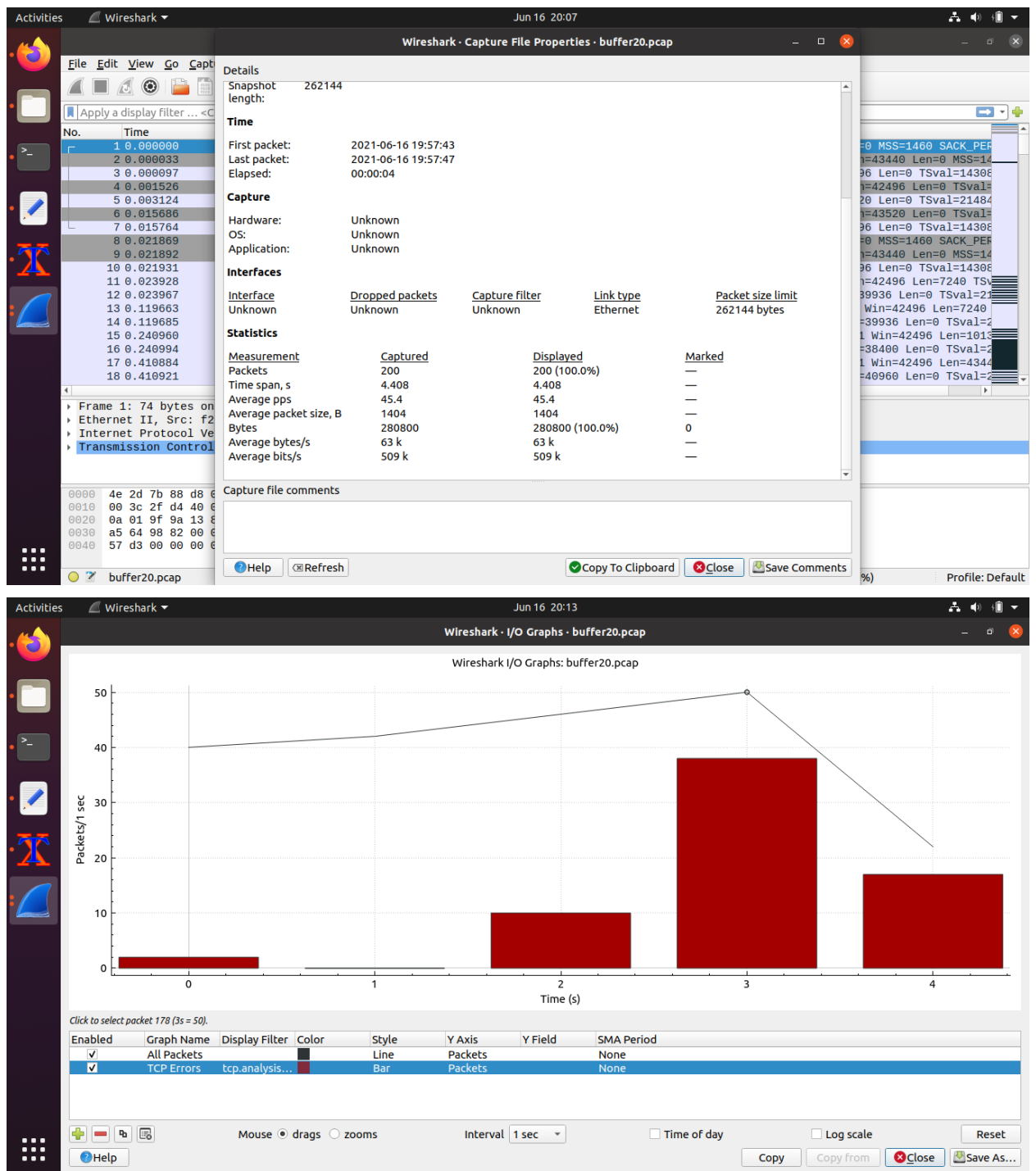
```
root@serly:/home/serly/mininet# tcpdump -u test4.pcap -c 200
tcpdump: listening on h1-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
200 packets captured
206 packets received by filter
0 packets dropped by kernel
root@serly:/home/serly/mininet#
```

A screenshot of a Linux desktop environment. The top panel shows the date and time as "Sun 16 19:24". Below it is a dock with icons for Activities, Terminal, Files, LibreOffice Writer, and a web browser. The main window is a terminal titled "root@serly: /home/serly/mininet". It displays the output of several commands in a Mininet environment. The first command is "mininet> xterm h1", which opens a new terminal window. The second command is "mininet> pingall", which outputs "\*\*\* Ping: testing ping reachability" followed by successful ping results for nodes h1, h2, r1, r2, r3, and r4. The third command is "mininet> iperf h2 h1", which outputs "\*\*\* Iperf: testing TCP bandwidth between h2 and h1" followed by results showing a throughput of approximately 478 Kbits/sec. The terminal has a dark purple background and white text.



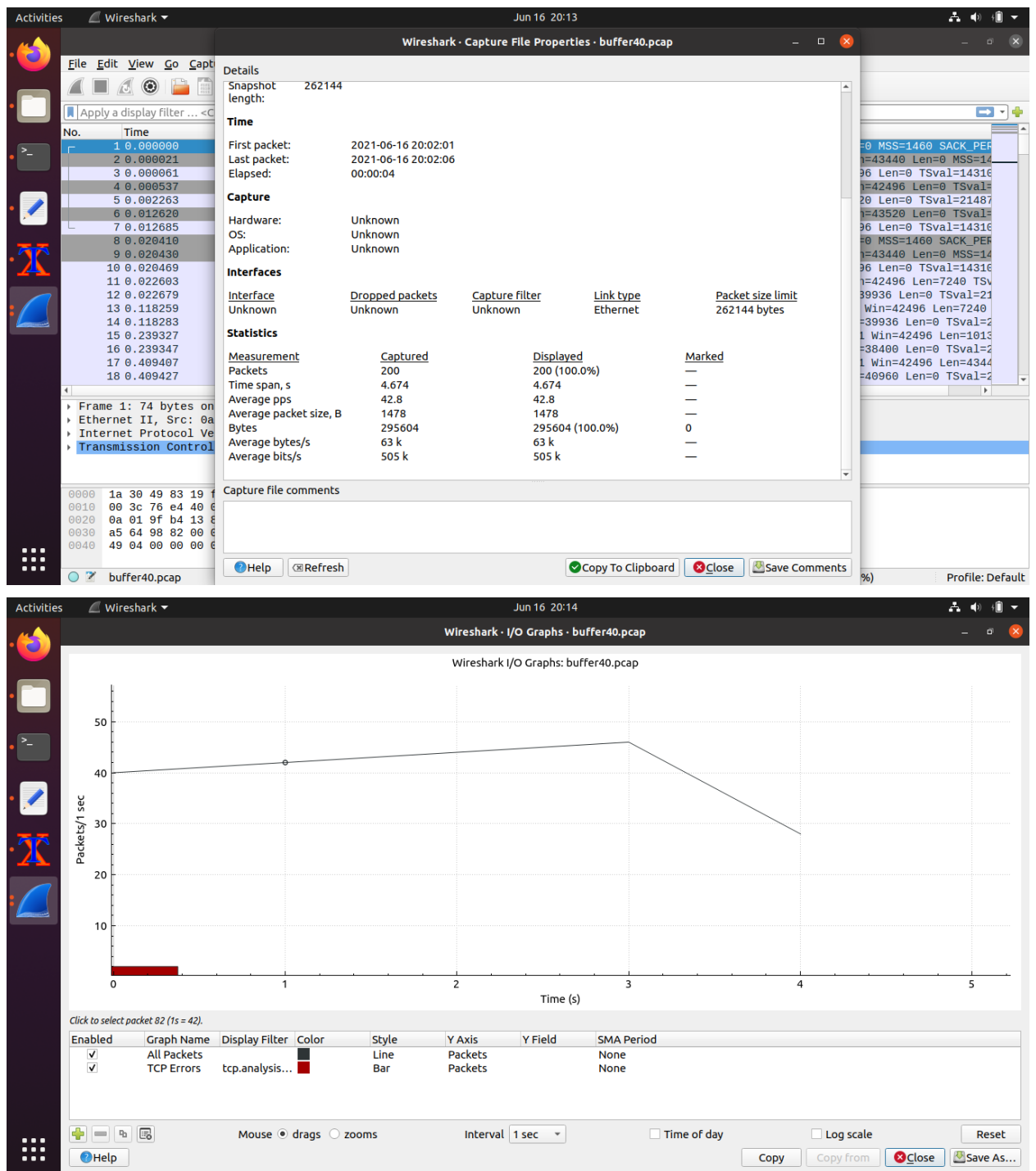
## 7. Analisis Buffer

a. Buffer 20:



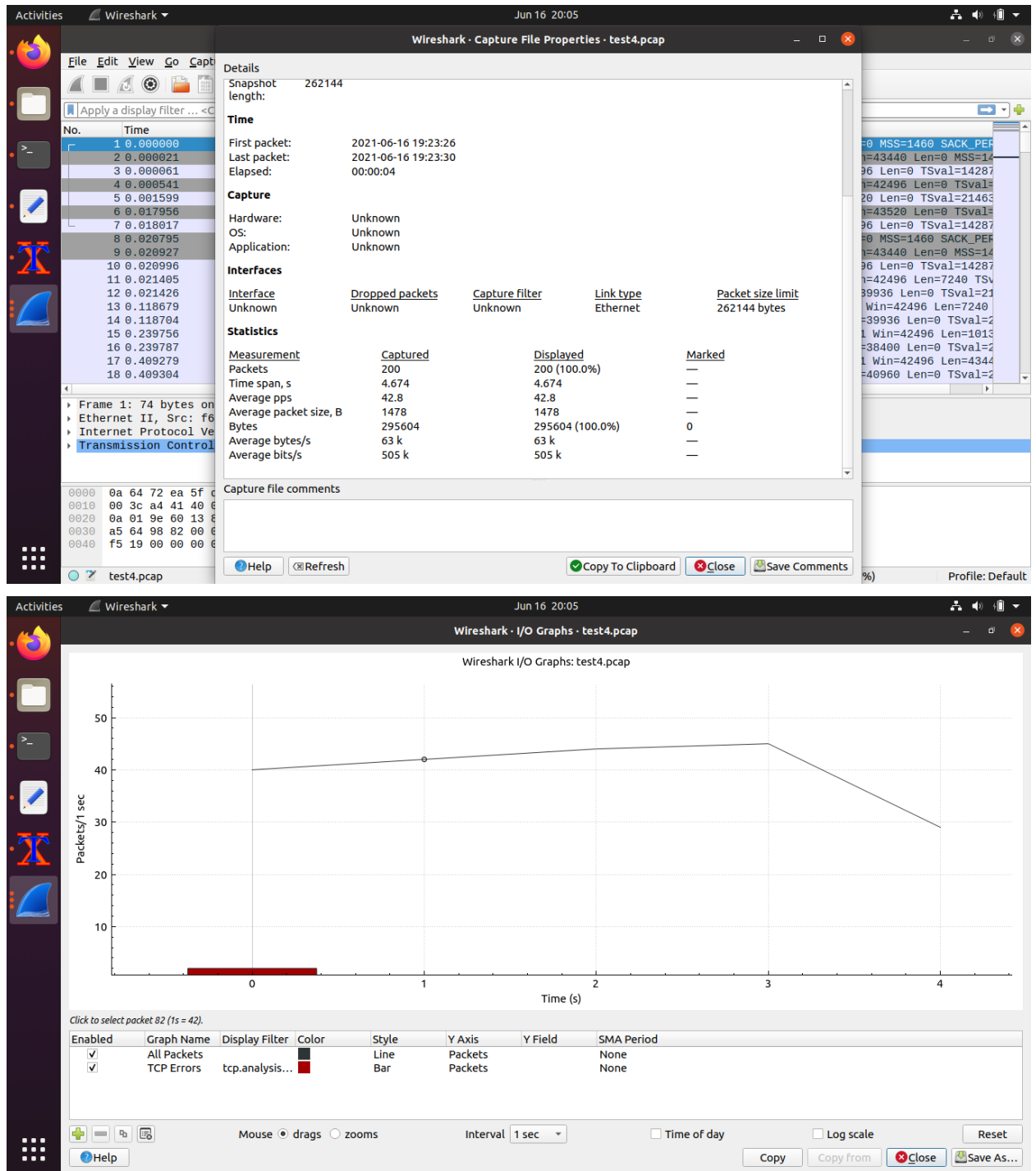
Dengan buffer 20 didapat:  $4,408/200 = 0,02204$

b. Buffer 40:



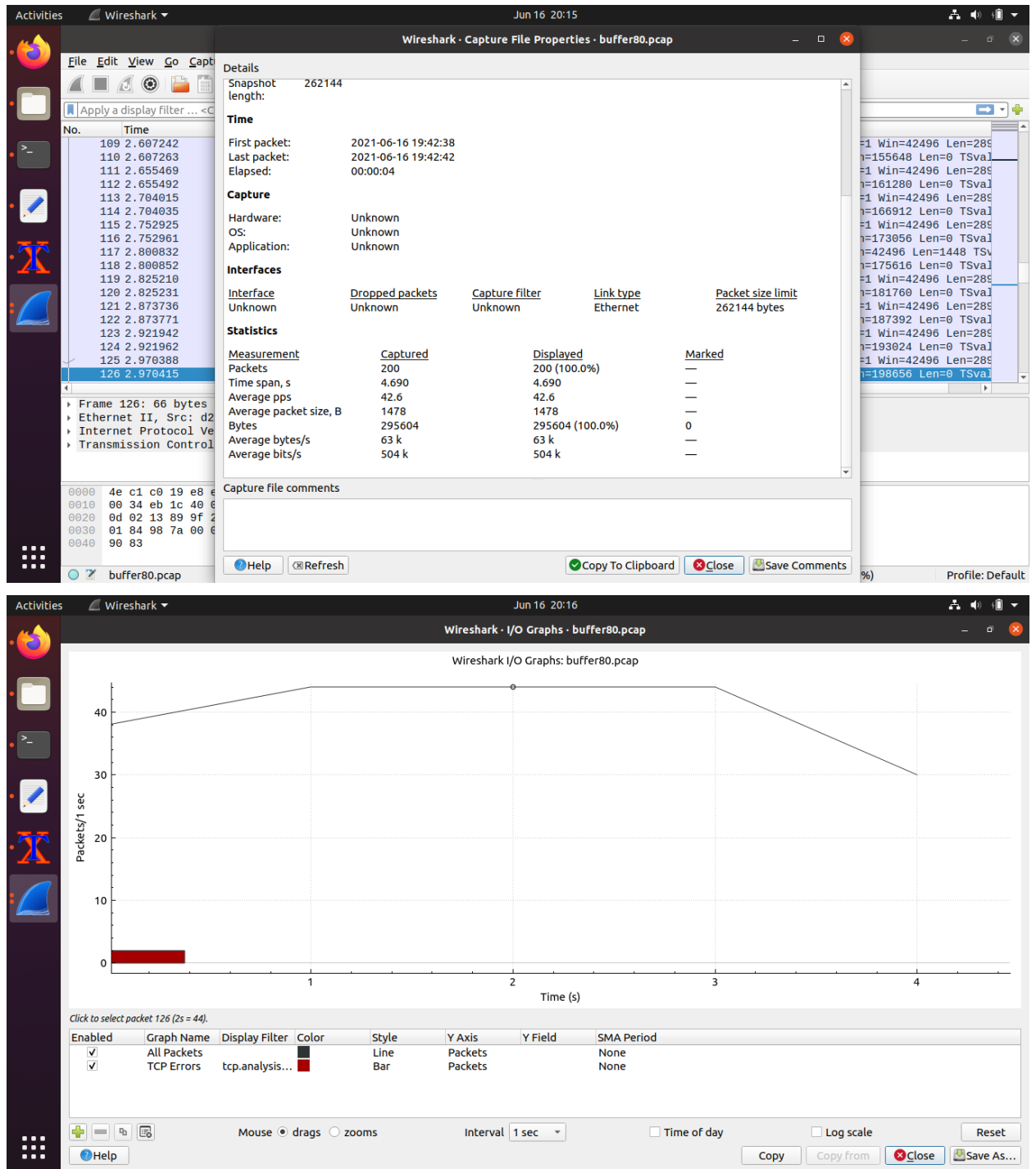
Dengan buffer 40 didapat:  $4,674/200 = 0,02337$

c. Buffer 60:



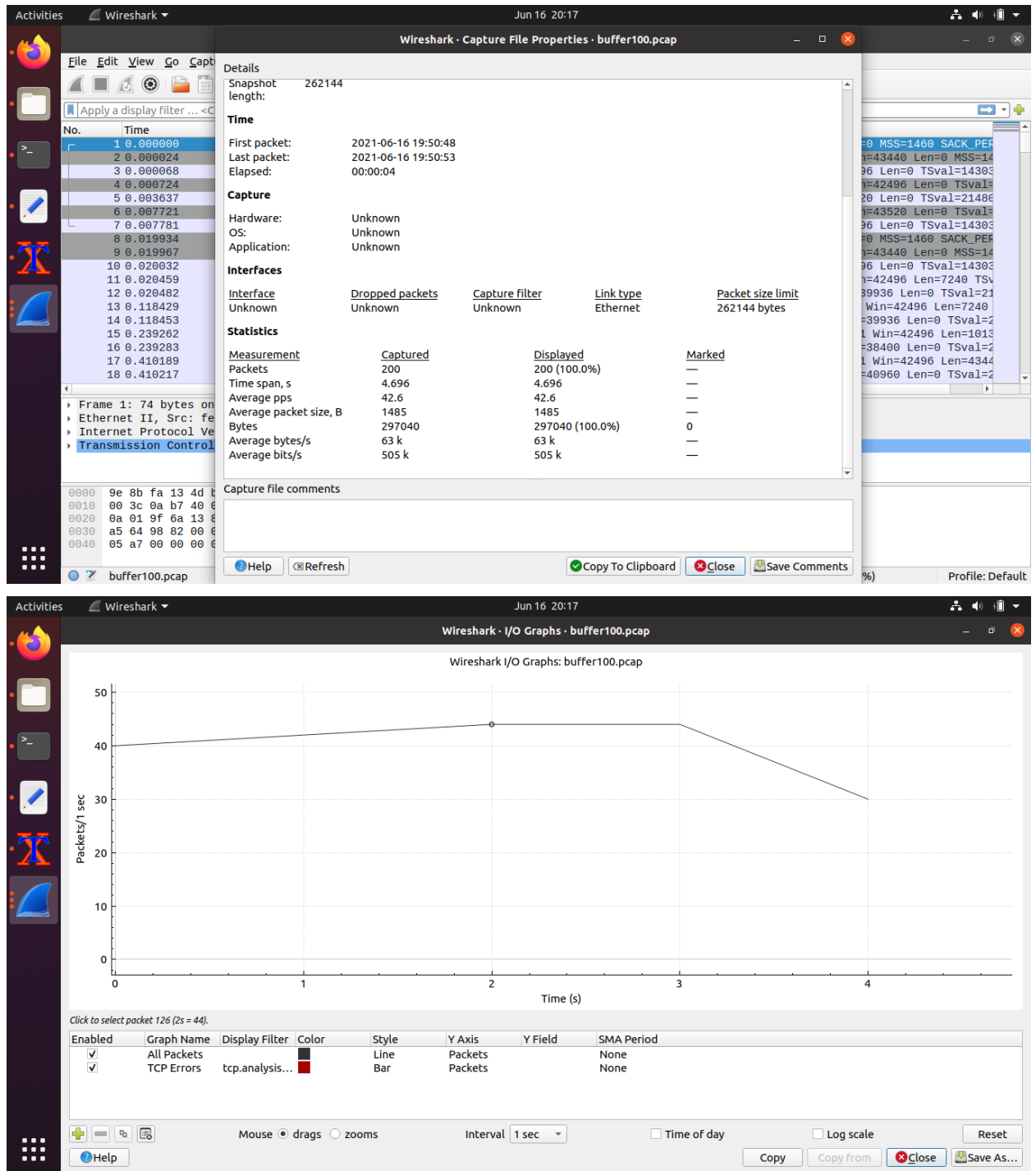
Dengan buffer 60 didapat:  $4,674/200 = 0.02337$

d. Buffer 80:



Dengan buffer 80 didapat:  $4,960/200 = 0,02345$

e. Buffer 100:



Dengan buffer 100 didapat:  $4,696/200 = 0.02348$

f. Kesimpulan analisis

Dari hasil uji coba buffer diatas didapat bahwa buffer akan mempengaruhi delay. Semakin besar buffer maka akan semakin besar juga delaynya begitu juga sebaliknya.



