

# SIMULASI JARINGAN DENGAN MININET

Disusun Untuk Memenuhi Tugas Besar Jaringan Komputer



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# CLO 1

Link github project:

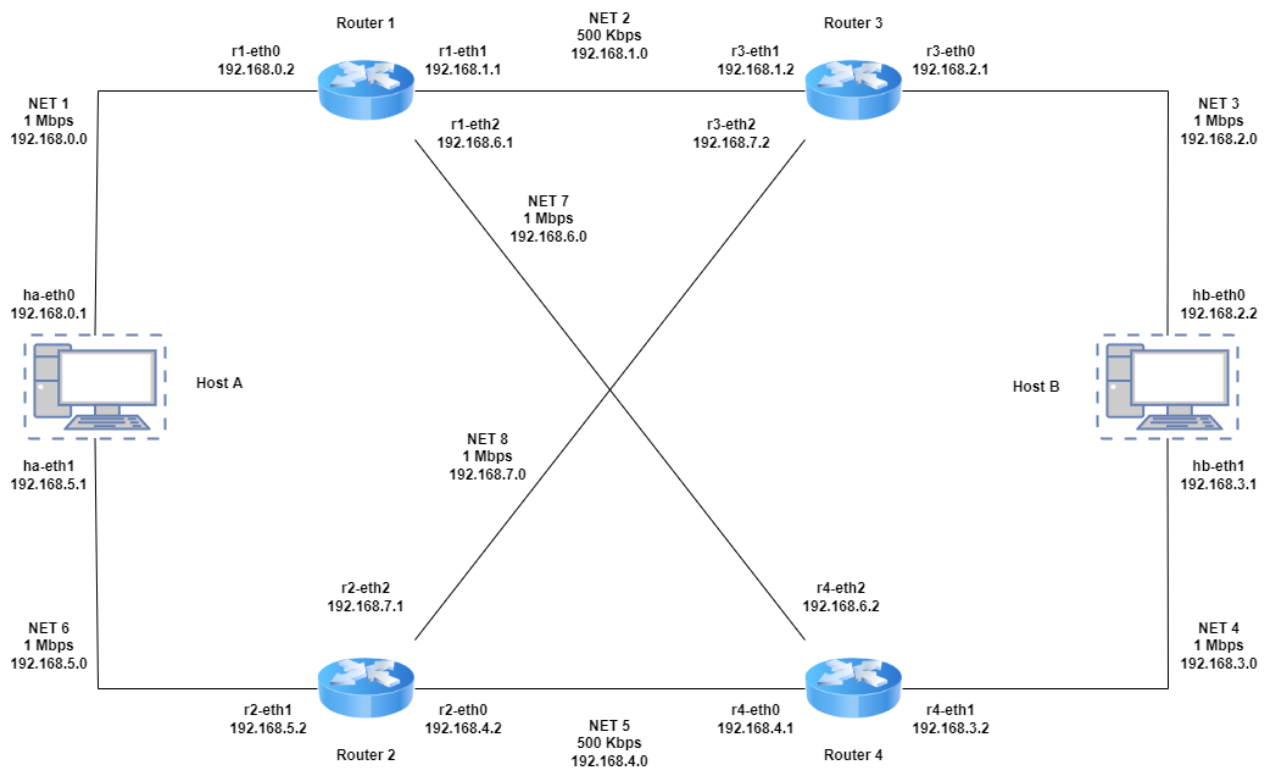
<https://github.com/Hilmantm/tubes-mininet-jarkom>

## Desain subnet masing-masing network

IP yang digunakan adalah 192.168.0.0. Dibawah ini adalah desain subnet yang akan digunakan pada topologi:

1	Ip yang digunakan :							
2	192.168.0.0							
3								
4								
5	Nama	Needs	Alokasi	Network ID	Host Range	Broadcast	Prefix	Subnet Mask
6	NET 1	2	256	192.168.0.0	192.168.0.1 – 192.168.0.254	192.168.0.255	24	255.255.255.0
7	NET 2	2	256	192.168.1.0	192.168.1.1 – 192.168.1.254	192.168.1.255	24	255.255.255.0
8	NET 3	2	256	192.168.2.0	192.168.2.1 – 192.168.2.254	192.168.2.255	24	255.255.255.0
9	NET 4	2	256	192.168.3.0	192.168.3.1 – 192.168.3.254	192.168.3.255	24	255.255.255.0
10	NET 5	2	256	192.168.4.0	192.168.4.1 – 192.168.4.254	192.168.4.255	24	255.255.255.0
11	NET 6	2	256	192.168.5.0	192.168.5.1 – 192.168.5.254	192.168.5.255	24	255.255.255.0
12	NET 7	2	256	192.168.6.0	192.168.6.1 – 192.168.6.254	192.168.6.255	24	255.255.255.0
13	NET 8	2	256	192.168.7.0	192.168.7.1 – 192.168.7.254	192.168.7.255	24	255.255.255.0

Apabila diimplementasikan pada topologi yang sudah diberikan, maka akan menghasilkan diagram seperti dibawah ini.



## Assign IP sesuai subnet

Untuk memulai membangun topologi jaringan tersebut, maka hal pertama yang harus dilakukan adalah menginisialisasi komponen yang ada pada topologi tersebut. Di tugas ini, komponen yang dibutuhkan adalah host (PC) dan router. Serta masing-masing host harus terhubung satu sama lain.

```
# Run Mininet
net = Mininet( link=TCLink )

# Add Router
net.addHost("r1")
net.addHost("r2")
net.addHost("r3")
net.addHost("r4")

# Add Host ha, hb
net.addHost("ha")
net.addHost("hb")

MAX_QUEUE_SIZE = 100

# Add Link
net.addLink( net[ 'ha' ], net[ 'r1' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth0', intfName2='r1-eth0',
cls=TCLink, bw=1 ) # NET 1
net.addLink( net[ 'r1' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth1', intfName2='r3-eth1',
cls=TCLink, bw=0.5 ) # NET 2
net.addLink( net[ 'r3' ], net[ 'hb' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r3-eth0', intfName2='hb-eth0',
cls=TCLink, bw=1 ) # NET 3
net.addLink( net[ 'hb' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='hb-eth1', intfName2='r4-eth1',
cls=TCLink, bw=1 ) # NET 4
net.addLink( net[ 'r4' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r4-eth0', intfName2='r2-eth0',
cls=TCLink, bw=0.5 ) # NET 5
net.addLink( net[ 'ha' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth1', intfName2='r2-eth1',
cls=TCLink, bw=1 ) # NET 6
net.addLink( net[ 'r1' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth2', intfName2='r4-eth2',
cls=TCLink, bw=1 ) # NET 7
net.addLink( net[ 'r2' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r2-eth2', intfName2='r3-eth2',
cls=TCLink, bw=1 ) # NET 8

net.build()
```

Untuk memastikan apakah interface yang dikoneksikan sudah sesuai dengan topologi, dapat dicek menggunakan command:

**mininet > net**

```
mininet> net
r1 r1-eth0:ha-eth0 r1-eth1:r3-eth1 r1-eth2:r4-eth2
r2 r2-eth0:r4-eth0 r2-eth1:ha-eth1 r2-eth2:r3-eth2
r3 r3-eth1:r1-eth1 r3-eth0:hb-eth0 r3-eth2:r2-eth2
r4 r4-eth1:hb-eth1 r4-eth0:r2-eth0 r4-eth2:r1-eth2
ha ha-eth0:r1-eth0 ha-eth1:r2-eth1
hb hb-eth0:r3-eth0 hb-eth1:r4-eth1
mininet> 
```

Setelah diinisialisasi dan dikoneksikan, maka masing-masing host harus dilakukan penyetingan IP sesuai dengan subnet yang sudah dibuat.

Setting IP: **HOST A**

```
# config ip into interface
# ha
net['ha'].cmd('ifconfig ha-eth0 0')
net['ha'].cmd('ifconfig ha-eth1 0')
net['ha'].cmd('ifconfig ha-eth0 192.168.0.1 netmask 255.255.255.0')
net['ha'].cmd('ifconfig ha-eth1 192.168.5.1 netmask 255.255.255.0')
```

Pastikan kembali bahwa config IP pada interface di **host A** sudah sesuai

```
mininet> ha ifconfig
ha-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.1 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::68b3:3fff:fe10:c67f prefixlen 64 scopeid 0x20<link>
    ether 6a:b3:3f:10:c6:7f txqueuelen 1000 (Ethernet)
    RX packets 51 bytes 4282 (4.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 52 bytes 4268 (4.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

ha-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.5.1 netmask 255.255.255.0 broadcast 192.168.5.255
    inet6 fe80::98a8:32ff:fe0d:813b prefixlen 64 scopeid 0x20<link>
    ether 9a:a8:32:0d:81:3b txqueuelen 1000 (Ethernet)
    RX packets 19 bytes 1466 (1.4 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
```

Setting IP: **HOST B**

```
# hb
net['hb'].cmd('ifconfig hb-eth0 0')
net['hb'].cmd('ifconfig hb-eth1 0')
net['hb'].cmd('ifconfig hb-eth0 192.168.2.2 netmask 255.255.255.0')
net['hb'].cmd('ifconfig hb-eth1 192.168.3.1 netmask 255.255.255.0')
```

Pastikan kembali bahwa config IP pada interface **host B** sudah sesuai

```
mininet> hb ifconfig
hb-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.2.2 netmask 255.255.255.0 broadcast 192.168.2.255
    inet6 fe80::f0ec:67ff:fe5e:6ef9 prefixlen 64 scopeid 0x20<link>
    ether f2:ec:67:5e:6e:f9 txqueuelen 1000 (Ethernet)
    RX packets 31 bytes 2518 (2.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 31 bytes 2518 (2.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

hb-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.3.1 netmask 255.255.255.0 broadcast 192.168.3.255
    inet6 fe80::90d8:65ff:fe6d:2a81 prefixlen 64 scopeid 0x20<link>
    ether 92:d8:65:6d:2a:81 txqueuelen 1000 (Ethernet)
    RX packets 36 bytes 3036 (3.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 38 bytes 3064 (3.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

## Setting IP: Router 1

```
# r1
net['r1'].cmd('ifconfig r1-eth0 0')
net['r1'].cmd('ifconfig r1-eth1 0')
net['r1'].cmd('ifconfig r1-eth2 0')
net['r1'].cmd('ifconfig r1-eth0 192.168.0.2 netmask 255.255.255.0')
net['r1'].cmd('ifconfig r1-eth1 192.168.1.1 netmask 255.255.255.0')
net['r1'].cmd('ifconfig r1-eth2 192.168.6.1 netmask 255.255.255.0')
```

Pastikan kembali bahwa config IP pada interface **router 1** sudah sesuai

```
mininet> r1 ifconfig
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

r1-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.2 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::2c1b:62ff:fec1:f1c prefixlen 64 scopeid 0x20<link>
    ether 2e:1b:62:c1:0f:1c txqueuelen 1000 (Ethernet)
    RX packets 53 bytes 4338 (4.3 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 52 bytes 4352 (4.3 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r1-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.1.1 netmask 255.255.255.0 broadcast 192.168.1.255
    inet6 fe80::2474:81ff:fed9:df00 prefixlen 64 scopeid 0x20<link>
    ether 26:74:81:d9:df:00 txqueuelen 1000 (Ethernet)
    RX packets 49 bytes 4030 (4.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 47 bytes 3862 (3.8 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r1-eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.6.1 netmask 255.255.255.0 broadcast 192.168.6.255
    inet6 fe80::3c7d:1bff:fecc:ffff prefixlen 64 scopeid 0x20<link>
    ether 3e:7d:1b:cc:ff:ff txqueuelen 1000 (Ethernet)
    RX packets 47 bytes 3818 (3.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 45 bytes 3666 (3.6 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

## Setting IP: Router 2

```
# r2
net['r2'].cmd('ifconfig r2-eth0 0')
net['r2'].cmd('ifconfig r2-eth1 0')
net['r2'].cmd('ifconfig r2-eth2 0')
net['r2'].cmd('ifconfig r2-eth0 192.168.4.2 netmask 255.255.255.0')
net['r2'].cmd('ifconfig r2-eth1 192.168.5.2 netmask 255.255.255.0')
net['r2'].cmd('ifconfig r2-eth2 192.168.7.1 netmask 255.255.255.0')
```

Pastikan kembali bahwa config IP pada interface **router 2** sudah sesuai

```
mininet> r2 ifconfig
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

r2-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.4.2 netmask 255.255.255.0 broadcast 192.168.4.255
    inet6 fe80::f866:dbff:fe38:39b5 prefixlen 64 scopeid 0x20<link>
    ether fa:66:db:38:39:b5 txqueuelen 1000 (Ethernet)
    RX packets 35 bytes 2826 (2.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 34 bytes 2728 (2.7 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r2-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.5.2 netmask 255.255.255.0 broadcast 192.168.5.255
    inet6 fe80::b0eb:4ff:fe0e:b77d prefixlen 64 scopeid 0x20<link>
    ether b2:eb:04:0e:b7:7d txqueuelen 1000 (Ethernet)
    RX packets 19 bytes 1426 (1.4 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 20 bytes 1536 (1.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r2-eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.7.1 netmask 255.255.255.0 broadcast 192.168.7.255
    inet6 fe80::6c57:24ff:fe76:fdea prefixlen 64 scopeid 0x20<link>
    ether 6e:57:24:76:fd:ea txqueuelen 1000 (Ethernet)
    RX packets 36 bytes 2936 (2.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 36 bytes 2924 (2.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```



### Setting IP: Router 3

```
# r3
net['r3'].cmd('ifconfig r3-eth0 0')
net['r3'].cmd('ifconfig r3-eth1 0')
net['r3'].cmd('ifconfig r3-eth2 0')
net['r3'].cmd('ifconfig r3-eth0 192.168.2.1 netmask 255.255.255.0')
net['r3'].cmd('ifconfig r3-eth1 192.168.1.2 netmask 255.255.255.0')
net['r3'].cmd('ifconfig r3-eth2 192.168.7.2 netmask 255.255.255.0')
```

Pastikan kembali bahwa config IP pada interface **router 3** sudah sesuai

```
mininet> r3 ifconfig
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

r3-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.2.1 netmask 255.255.255.0 broadcast 192.168.2.255
    inet6 fe80::68d4:a3ff:fe27:7ae prefixlen 64 scopeid 0x20<link>
    ether 6a:d4:a3:27:07:ae txqueuelen 1000 (Ethernet)
    RX packets 31 bytes 2518 (2.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 32 bytes 2588 (2.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r3-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.1.2 netmask 255.255.255.0 broadcast 192.168.1.255
    inet6 fe80::a8e0:95ff:fe33:ab7 prefixlen 64 scopeid 0x20<link>
    ether aa:e0:95:33:0a:b7 txqueuelen 1000 (Ethernet)
    RX packets 47 bytes 3862 (3.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 49 bytes 4030 (4.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r3-eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.7.2 netmask 255.255.255.0 broadcast 192.168.7.255
    inet6 fe80::3cb2:8fff:fef8:5245 prefixlen 64 scopeid 0x20<link>
    ether 3e:b2:8f:f8:52:45 txqueuelen 1000 (Ethernet)
    RX packets 36 bytes 2924 (2.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 36 bytes 2936 (2.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

## Setting IP: **Router 4**

```
# r4
net['r4'].cmd('ifconfig r4-eth0 0')
net['r4'].cmd('ifconfig r4-eth1 0')
net['r4'].cmd('ifconfig r4-eth2 0')
net['r4'].cmd('ifconfig r4-eth0 192.168.4.1 netmask 255.255.255.0')
net['r4'].cmd('ifconfig r4-eth1 192.168.3.2 netmask 255.255.255.0')
net['r4'].cmd('ifconfig r4-eth2 192.168.6.2 netmask 255.255.255.0')
```

Pastikan kembali bahwa config IP pada interface **router 4** sudah sesuai

```
mininet> r4 ifconfig
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

r4-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.4.1 netmask 255.255.255.0 broadcast 192.168.4.255
    inet6 fe80::f40e:8cff:fe52:b199 prefixlen 64 scopeid 0x20<link>
    ether f6:0e:8c:52:b1:99 txqueuelen 1000 (Ethernet)
    RX packets 34 bytes 2728 (2.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 35 bytes 2826 (2.8 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r4-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.3.2 netmask 255.255.255.0 broadcast 192.168.3.255
    inet6 fe80::ccb7:21ff:fe96:bc41 prefixlen 64 scopeid 0x20<link>
    ether ce:b7:21:fe:bc:41 txqueuelen 1000 (Ethernet)
    RX packets 38 bytes 3064 (3.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 37 bytes 3106 (3.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

r4-eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.6.2 netmask 255.255.255.0 broadcast 192.168.6.255
    inet6 fe80::507e:64ff:fe96:8560 prefixlen 64 scopeid 0x20<link>
    ether 52:7e:64:96:85:60 txqueuelen 1000 (Ethernet)
    RX packets 45 bytes 3666 (3.6 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 47 bytes 3818 (3.8 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Setelah IP di setting, maka router yang terhubung harus diaktifkan fitur ip\_forward

```
# Start IP Forward on Router
net[ 'r1' ].cmd( 'sysctl net.ipv4.ip_forward=1' )
net[ 'r2' ].cmd( 'sysctl net.ipv4.ip_forward=1' )
net[ 'r3' ].cmd( 'sysctl net.ipv4.ip_forward=1' )
net[ 'r4' ].cmd( 'sysctl net.ipv4.ip_forward=1' )
```

## Uji konektivitas dengan ping antara 2 host yang berada dalam 1 network

Ping Network 1:

```
mininet> ha ping r1 -c 1
PING 192.168.0.2 (192.168.0.2) 56(84) bytes of data.
64 bytes from 192.168.0.2: icmp_seq=1 ttl=64 time=0.084 ms

--- 192.168.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.084/0.084/0.084/0.000 ms
mininet> r1 ping ha -c 1
PING 192.168.0.1 (192.168.0.1) 56(84) bytes of data.
64 bytes from 192.168.0.1: icmp_seq=1 ttl=64 time=0.048 ms

--- 192.168.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.048/0.048/0.048/0.000 ms
mininet> 
```

Ping Network 2:

```
mininet> r1 ping r3 -c 1
PING 192.168.1.2 (192.168.1.2) 56(84) bytes of data.
64 bytes from 192.168.1.2: icmp_seq=1 ttl=64 time=0.084 ms

--- 192.168.1.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.084/0.084/0.084/0.000 ms
mininet> r3 ping r1 -c 1
ping: connect: Network is unreachable
mininet> r3 ping 192.168.1.1 -c 1
PING 192.168.1.1 (192.168.1.1) 56(84) bytes of data.
64 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=0.075 ms

--- 192.168.1.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.075/0.075/0.075/0.000 ms
mininet> █
```

Ping Network 3:

```
mininet> hb ping r3 -c 1
ping: connect: Network is unreachable
mininet> hb ping 192.168.2.1 -c 1
PING 192.168.2.1 (192.168.2.1) 56(84) bytes of data.
64 bytes from 192.168.2.1: icmp_seq=1 ttl=64 time=0.102 ms

--- 192.168.2.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.102/0.102/0.102/0.000 ms
mininet> r3 ping hb -c 1
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=0.075 ms

--- 192.168.2.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.075/0.075/0.075/0.000 ms
mininet> █
```

Ping Network 4:

```
mininet> hb ping r4 -c 1
PING 192.168.3.2 (192.168.3.2) 56(84) bytes of data.
64 bytes from 192.168.3.2: icmp_seq=1 ttl=64 time=0.091 ms

--- 192.168.3.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.091/0.091/0.091/0.000 ms
mininet> r4 ping hb -c 1
ping: connect: Network is unreachable
mininet> r4 ping 192.168.3.1 -c 1
PING 192.168.3.1 (192.168.3.1) 56(84) bytes of data.
64 bytes from 192.168.3.1: icmp_seq=1 ttl=64 time=0.084 ms

--- 192.168.3.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.084/0.084/0.084/0.000 ms
mininet> █
```

Ping Network 5:

```
mininet> r4 ping r2 -c 1
PING 192.168.4.2 (192.168.4.2) 56(84) bytes of data.
64 bytes from 192.168.4.2: icmp_seq=1 ttl=64 time=0.071 ms

--- 192.168.4.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.071/0.071/0.071/0.000 ms
mininet> r2 ping r4 -c 1
ping: connect: Network is unreachable
mininet> r2 ping 192.168.4.1 -c 1
PING 192.168.4.1 (192.168.4.1) 56(84) bytes of data.
64 bytes from 192.168.4.1: icmp_seq=1 ttl=64 time=0.062 ms

--- 192.168.4.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.062/0.062/0.062/0.000 ms
mininet> █
```

#### Ping Network 6:

```
mininet> ha ping r2 -c 1
ping: connect: Network is unreachable
mininet> ha ping 192.168.5.2 -c 1
PING 192.168.5.2 (192.168.5.2) 56(84) bytes of data.
64 bytes from 192.168.5.2: icmp_seq=1 ttl=64 time=0.093 ms

--- 192.168.5.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.093/0.093/0.093/0.000 ms
mininet> r2 ping ha -c 1
ping: connect: Network is unreachable
mininet> r2 ping 192.168.5.1 -c 1
PING 192.168.5.1 (192.168.5.1) 56(84) bytes of data.
64 bytes from 192.168.5.1: icmp_seq=1 ttl=64 time=0.075 ms

--- 192.168.5.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.075/0.075/0.075/0.000 ms
mininet> █
```

#### Ping Network 7:

```
mininet> r1 ping r4 -c 1
ping: connect: Network is unreachable
mininet> r1 ping 192.168.6.2 -c 1
PING 192.168.6.2 (192.168.6.2) 56(84) bytes of data.
64 bytes from 192.168.6.2: icmp_seq=1 ttl=64 time=0.096 ms

--- 192.168.6.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.096/0.096/0.096/0.000 ms
mininet> r4 ping r1 -c 1
ping: connect: Network is unreachable
mininet> r4 ping 192.168.6.1 -c 1
PING 192.168.6.1 (192.168.6.1) 56(84) bytes of data.
64 bytes from 192.168.6.1: icmp_seq=1 ttl=64 time=0.096 ms

--- 192.168.6.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.096/0.096/0.096/0.000 ms
mininet> █
```

Ping Network 8:

```
mininet> r2 ping r3 -c 1
ping: connect: Network is unreachable
mininet> r2 ping 192.168.7.2 -c 1
PING 192.168.7.2 (192.168.7.2) 56(84) bytes of data.
64 bytes from 192.168.7.2: icmp_seq=1 ttl=64 time=0.129 ms

--- 192.168.7.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.129/0.129/0.129/0.000 ms
mininet> r3 ping r2 -c 1
ping: connect: Network is unreachable
mininet> r3 ping 192.168.7.1 -c 1
PING 192.168.7.1 (192.168.7.1) 56(84) bytes of data.
64 bytes from 192.168.7.1: icmp_seq=1 ttl=64 time=0.100 ms

--- 192.168.7.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.100/0.100/0.100/0.000 ms
mininet> █
```



## CLO 2

### Membuat tabel routing di semua host, dibuktikan dengan ping antar host

Setelah berhasil melakukan ping antar host di masing-masing network, maka langkah selanjutnya adalah membuat routing. Untuk host, maka dibutuhkan tabel routing untuk mengetahui informasi jalur mana saja yang dapat digunakan untuk pengiriman data pada jaringan.

Tabel routing: **Host A**

```
# ha
net['ha'].cmd('ip rule add from 192.168.0.1 table 1')
net['ha'].cmd('ip rule add from 192.168.5.1 table 2')
net['ha'].cmd('ip route add 192.168.0.0/24 dev ha-eth0 scope link table 1')
net['ha'].cmd('ip route add default via 192.168.0.2 dev ha-eth0 table 1')
net['ha'].cmd('ip route add 192.168.5.0/24 dev ha-eth1 scope link table 2')
net['ha'].cmd('ip route add default via 192.168.5.2 dev ha-eth1 table 2')
net['ha'].cmd('ip route add default scope global nexthop via 192.168.0.2 dev ha-eth0')
```

Pada host A, jalur yang bisa digunakan untuk pengiriman data adalah jalur pada **NET 1 (192.168.0.1 - table 1)** dan **NET 6 (192.168.5.1 - table 2)**. Untuk host A, default scope global nexthop nya melalui **NET 1**.

Tabel routing: **Host B**

```
# hb
net['hb'].cmd('ip rule add from 192.168.2.2 table 1')
net['hb'].cmd('ip rule add from 192.168.3.1 table 2')
net['hb'].cmd('ip route add 192.168.2.0/24 dev hb-eth0 scope link table 1')
net['hb'].cmd('ip route add default via 192.168.2.1 dev hb-eth0 table 1')
net['hb'].cmd('ip route add 192.168.3.0/24 dev hb-eth1 scope link table 2')
net['hb'].cmd('ip route add default via 192.168.3.2 dev hb-eth1 table 2')
net['hb'].cmd('ip route add default scope global nexthop via 192.168.3.2 dev hb-eth1')
```

Pada host B, jalur yang bisa digunakan untuk pengiriman data adalah jalur pada **NET 3 (192.168.2.2 - table 1)** dan **NET 4 (192.168.3.1 - table 2)**. Untuk host A, default scope global nexthop nya melalui **NET 4**.

Selain tabel routing pada host, perlu dilakukan gateway pada router yang ada.



Gateway: **Router 1**

```
# r1
net['r1'].cmd('route add -net 192.168.2.0/24 gw 192.168.1.2')
net['r1'].cmd('route add -net 192.168.3.0/24 gw 192.168.6.2')
net['r1'].cmd('route add -net 192.168.4.0/24 gw 192.168.6.2')
net['r1'].cmd('route add -net 192.168.5.0/24 gw 192.168.6.2')
net['r1'].cmd('route add -net 192.168.7.0/24 gw 192.168.1.2')
```

Gateway: **Router 2**

```
# r2
net['r2'].cmd('route add -net 192.168.0.0/24 gw 192.168.7.2')
net['r2'].cmd('route add -net 192.168.1.0/24 gw 192.168.7.2')
net['r2'].cmd('route add -net 192.168.2.0/24 gw 192.168.7.2')
net['r2'].cmd('route add -net 192.168.3.0/24 gw 192.168.4.1')
net['r2'].cmd('route add -net 192.168.6.0/24 gw 192.168.4.1')
```

Gateway: **Router 3**

```
# r3
net['r3'].cmd('route add -net 192.168.0.0/24 gw 192.168.1.1')
net['r3'].cmd('route add -net 192.168.3.0/24 gw 192.168.7.1')
net['r3'].cmd('route add -net 192.168.4.0/24 gw 192.168.7.1')
net['r3'].cmd('route add -net 192.168.5.0/24 gw 192.168.7.1')
net['r3'].cmd('route add -net 192.168.6.0/24 gw 192.168.1.1')
```

Gateway: **Router 4**

```
# r4
net['r4'].cmd('route add -net 192.168.0.0/24 gw 192.168.6.1')
net['r4'].cmd('route add -net 192.168.1.0/24 gw 192.168.6.1')
net['r4'].cmd('route add -net 192.168.2.0/24 gw 192.168.6.1')
net['r4'].cmd('route add -net 192.168.5.0/24 gw 192.168.4.2')
net['r4'].cmd('route add -net 192.168.7.0/24 gw 192.168.4.2')
```

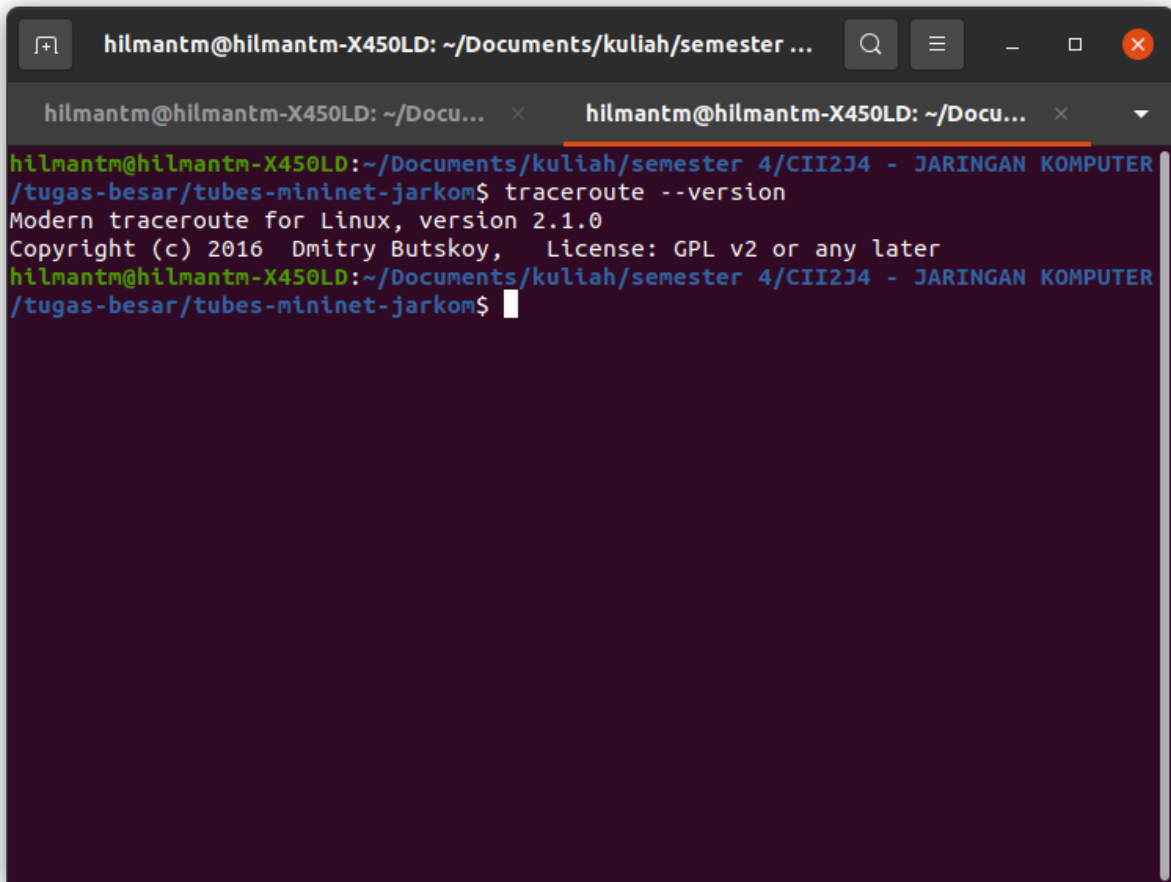
Untuk membuktikan bahwa semua sudah terkoneksi, pastikan ping satu persatu hingga ketika pingall tidak ada lagi "X" atau host yang tidak terkoneksi

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...  
r2 -> r1 r3 r4 ha X  
r3 -> r1 r2 r4 ha X  
r4 -> r1 r2 r3 ha X  
ha -> r1 r2 r3 r4 X  
hb -> r1 r2 r3 r4 ha  
*** Results: 16% dropped (25/30 received)  
mininet> ha ping hb  
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.  
64 bytes from 192.168.2.2: icmp_seq=1 ttl=62 time=0.081 ms  
64 bytes from 192.168.2.2: icmp_seq=2 ttl=62 time=0.080 ms  
64 bytes from 192.168.2.2: icmp_seq=3 ttl=62 time=0.091 ms  
^C  
--- 192.168.2.2 ping statistics ---  
3 packets transmitted, 3 received, 0% packet loss, time 2026ms  
rtt min/avg/max/mdev = 0.080/0.084/0.091/0.005 ms  
mininet>  
mininet>  
mininet>  
mininet> pingall  
*** Ping: testing ping reachability  
r1 -> r2 r3 r4 ha hb  
r2 -> r1 r3 r4 ha hb  
r3 -> r1 r2 r4 ha hb  
r4 -> r1 r2 r3 ha hb  
ha -> r1 r2 r3 r4 hb  
hb -> r1 r2 r3 r4 ha  
*** Results: 0% dropped (30/30 received)  
mininet> 
```

## Menganalisis routing yang digunakan menggunakan traceroute

Traceroute merupakan library yang harus di install pada linux. Untuk cek apakah traceroute sudah terinstall atau belum, ketikkan command:

**traceroute --version**

A screenshot of a terminal window with a dark purple background. The window title bar shows the user 'hilmantm' on a machine named 'hilmantm-X450LD' at the directory '~/Documents/kuliah/semester ...'. The terminal shows the command 'traceroute --version' being executed. The output text is as follows:

```
hilmantm@hilmantm-X450LD:~/Documents/kuliah/semester 4/CII2J4 - JARINGAN KOMPUTER
/tugas-besar/tubes-mininet-jarkom$ traceroute --version
Modern traceroute for Linux, version 2.1.0
Copyright (c) 2016 Dmitry Butskoy, License: GPL v2 or any later
hilmantm@hilmantm-X450LD:~/Documents/kuliah/semester 4/CII2J4 - JARINGAN KOMPUTER
/tugas-besar/tubes-mininet-jarkom$
```

Apabila belum terinstall pada linux anda, maka install menggunakan command:

**sudo apt-get update**

**sudo apt-get install traceroute**

## Traceroute: Host A

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...
*** Results: 100% dropped (0/30 received)

100.0
*** Starting CLI:
mininet> ha traceroute r1
traceroute to 192.168.0.2 (192.168.0.2), 30 hops max, 60 byte packets
 1 192.168.0.2 (192.168.0.2) 0.314 ms 0.256 ms 0.234 ms
mininet> ha traceroute r2
traceroute to 192.168.4.2 (192.168.4.2), 30 hops max, 60 byte packets
 1 192.168.0.2 (192.168.0.2) 0.700 ms 0.631 ms 0.603 ms
 2 192.168.6.2 (192.168.6.2) 0.578 ms 0.509 ms 0.476 ms
 3 192.168.4.2 (192.168.4.2) 0.448 ms 0.355 ms 0.317 ms
mininet> ha traceroute r3
traceroute to 192.168.1.2 (192.168.1.2), 30 hops max, 60 byte packets
 1 192.168.0.2 (192.168.0.2) 0.873 ms 0.742 ms 0.666 ms
 2 192.168.1.2 (192.168.1.2) 0.615 ms 0.532 ms 0.466 ms
mininet> ha traceroute r4
traceroute to 192.168.3.2 (192.168.3.2), 30 hops max, 60 byte packets
 1 192.168.0.2 (192.168.0.2) 0.419 ms 0.361 ms 0.335 ms
 2 192.168.3.2 (192.168.3.2) 0.314 ms 0.278 ms 0.253 ms
mininet> ha traceroute hb
traceroute to 192.168.2.2 (192.168.2.2), 30 hops max, 60 byte packets
 1 192.168.0.2 (192.168.0.2) 0.404 ms 0.335 ms 1.169 ms
 2 192.168.1.2 (192.168.1.2) 1.158 ms 1.146 ms 1.136 ms
 3 192.168.2.2 (192.168.2.2) 1.124 ms 1.112 ms 1.100 ms
mininet>
mininet>
mininet>
```

- **Route untuk mencapai ha → r2**  
ha → r1 → r4 → r2
- **Route untuk mencapai ha → r3**  
ha → r1 → r3
- **Route untuk mencapai ha → r4**  
ha → r1 → r4
- **Route untuk mencapai ha → hb**  
ha → r1 → r3 → hb

## Traceroute: **Host B**

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...
mininet>
mininet>
mininet>
mininet>
mininet> hb traceroute ha
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets
 1 192.168.3.2 (192.168.3.2)  0.639 ms  0.568 ms  0.544 ms
 2 192.168.6.1 (192.168.6.1)  0.522 ms  0.482 ms  0.454 ms
 3 192.168.0.1 (192.168.0.1)  0.425 ms  0.370 ms  0.332 ms
mininet> hb traceroute r1
traceroute to 192.168.0.2 (192.168.0.2), 30 hops max, 60 byte packets
 1 192.168.3.2 (192.168.3.2)  0.497 ms  0.434 ms  0.408 ms
 2 192.168.0.2 (192.168.0.2)  0.386 ms  0.346 ms  0.316 ms
mininet> hb traceroute r2
traceroute to 192.168.4.2 (192.168.4.2), 30 hops max, 60 byte packets
 1 192.168.3.2 (192.168.3.2)  0.553 ms  0.482 ms  0.450 ms
 2 192.168.4.2 (192.168.4.2)  0.424 ms  0.376 ms  0.344 ms
mininet> hb traceroute r3
traceroute to 192.168.1.2 (192.168.1.2), 30 hops max, 60 byte packets
 1 192.168.3.2 (192.168.3.2)  0.511 ms  0.449 ms  0.427 ms
 2 192.168.6.1 (192.168.6.1)  0.408 ms  0.374 ms  0.349 ms
 3 192.168.1.2 (192.168.1.2)  0.327 ms  0.281 ms  0.250 ms
mininet> hb traceroute r4
traceroute to 192.168.3.2 (192.168.3.2), 30 hops max, 60 byte packets
 1 192.168.3.2 (192.168.3.2)  0.354 ms  0.289 ms  0.261 ms
mininet>
mininet>
mininet>
```

- **Route untuk mencapai hb → ha**  
hb → r4 → r1 → ha
- **Route untuk mencapai hb → r1**  
hb → r4 → r1
- **Route untuk mencapai hb → r2**  
hb → r4 → r2
- **Route untuk mencapai hb → r3**  
hb → r4 → r1 → r3
- **Route untuk mencapai hb → r4**  
hb → r4

## Traceroute: Router 1

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...  
2 192.168.1.2 (192.168.1.2) 1.158 ms 1.146 ms 1.136 ms  
3 192.168.2.2 (192.168.2.2) 1.124 ms 1.112 ms 1.100 ms  
mininet>  
mininet>  
mininet>  
mininet>  
mininet> r1 traceroute ha  
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets  
1 192.168.0.1 (192.168.0.1) 0.517 ms 0.433 ms 0.402 ms  
mininet> r1 traceroute r2  
traceroute to 192.168.4.2 (192.168.4.2), 30 hops max, 60 byte packets  
1 192.168.6.2 (192.168.6.2) 0.501 ms 0.428 ms 0.402 ms  
2 192.168.4.2 (192.168.4.2) 0.380 ms 0.339 ms 0.312 ms  
mininet> r1 traceroute r3  
traceroute to 192.168.1.2 (192.168.1.2), 30 hops max, 60 byte packets  
1 192.168.1.2 (192.168.1.2) 0.428 ms 0.366 ms 0.344 ms  
mininet> r1 traceroute r4  
traceroute to 192.168.3.2 (192.168.3.2), 30 hops max, 60 byte packets  
1 192.168.3.2 (192.168.3.2) 0.402 ms 0.339 ms 0.314 ms  
mininet> r1 traceroute hb  
traceroute to 192.168.2.2 (192.168.2.2), 30 hops max, 60 byte packets  
1 192.168.1.2 (192.168.1.2) 0.489 ms 0.425 ms 0.400 ms  
2 192.168.2.2 (192.168.2.2) 0.379 ms 0.336 ms 0.308 ms  
mininet>  
mininet>  
mininet>  
mininet>  
mininet>
```

- **Route untuk mencapai r1 → ha**  
r1 → ha
- **Route untuk mencapai r1 → r2**  
r1 → r4 → r2
- **Route untuk mencapai r1 → r3**  
r1 → r3
- **Route untuk mencapai r1 → r4**  
r1 → r4
- **Route untuk mencapai r1 → hb**  
r1 → r3 → hb

## Traceroute: **Router 2**

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...
mininet>
mininet>
mininet>
mininet>
mininet> r2 traceroute ha
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets
 1  192.168.7.2 (192.168.7.2)  0.484 ms  0.384 ms  0.358 ms
 2  192.168.1.1 (192.168.1.1)  0.338 ms  0.299 ms  0.272 ms
 3  192.168.0.1 (192.168.0.1)  0.247 ms  1.182 ms  1.170 ms
mininet> r2 traceroute r1
traceroute to 192.168.0.2 (192.168.0.2), 30 hops max, 60 byte packets
 1  192.168.7.2 (192.168.7.2)  0.336 ms  0.284 ms  0.268 ms
 2  192.168.0.2 (192.168.0.2)  0.254 ms  0.227 ms  0.207 ms
mininet> r2 traceroute r3
traceroute to 192.168.1.2 (192.168.1.2), 30 hops max, 60 byte packets
 1  192.168.1.2 (192.168.1.2)  0.342 ms  0.286 ms  0.266 ms
mininet> r2 traceroute r4
traceroute to 192.168.3.2 (192.168.3.2), 30 hops max, 60 byte packets
 1  192.168.3.2 (192.168.3.2)  0.340 ms  0.280 ms  0.261 ms
mininet> r2 traceroute hb
traceroute to 192.168.2.2 (192.168.2.2), 30 hops max, 60 byte packets
 1  192.168.7.2 (192.168.7.2)  0.462 ms  0.400 ms  0.375 ms
 2  192.168.2.2 (192.168.2.2)  0.355 ms  0.314 ms  0.288 ms
mininet>
mininet>
mininet>
mininet>
```

- **Route untuk mencapai r2 → ha**  
r2 → r3 → r1 → ha
- **Route untuk mencapai r2 → r1**  
r2 → r3 → r1
- **Route untuk mencapai r2 → r3**  
r2 → r3
- **Route untuk mencapai r2 → r4**  
r2 → r4
- **Route untuk mencapai r2 → hb**  
r2 → r3 → hb

## Traceroute: Router 3

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...
mininet>
mininet>
mininet>
mininet>
mininet> r3 traceroute ha
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets
 1 192.168.1.1 (192.168.1.1) 0.535 ms 0.464 ms 0.440 ms
 2 192.168.0.1 (192.168.0.1) 0.418 ms 0.375 ms 0.346 ms
mininet> r3 traceroute r1
traceroute to 192.168.0.2 (192.168.0.2), 30 hops max, 60 byte packets
 1 192.168.0.2 (192.168.0.2) 0.454 ms 0.392 ms 0.370 ms
mininet> r3 traceroute r2
traceroute to 192.168.4.2 (192.168.4.2), 30 hops max, 60 byte packets
 1 192.168.4.2 (192.168.4.2) 0.423 ms 0.360 ms 0.335 ms
mininet> r3 traceroute r4
traceroute to 192.168.3.2 (192.168.3.2), 30 hops max, 60 byte packets
 1 192.168.7.1 (192.168.7.1) 0.607 ms 0.525 ms *
 2 192.168.3.2 (192.168.3.2) 0.468 ms 0.418 ms 0.383 ms
mininet> r3 traceroute hb
traceroute to 192.168.2.2 (192.168.2.2), 30 hops max, 60 byte packets
 1 192.168.2.2 (192.168.2.2) 0.292 ms 0.237 ms 0.221 ms
mininet>
mininet>
mininet>
mininet>
mininet>
```

- **Route untuk mencapai r3 → ha**  
r3 → r1 → ha
- **Route untuk mencapai r3 → r1**  
r3 → r1
- **Route untuk mencapai r3 → r2**  
r3 → r2
- **Route untuk mencapai r3 → r4**  
r3 → r2 → r4
- **Route untuk mencapai r3 → hb**  
r3 → hb



## Traceroute: **Router 4**

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...
mininet>
mininet>
mininet>
mininet> r4 traceroute ha
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets
 1  192.168.6.1 (192.168.6.1)  0.532 ms  0.461 ms  0.437 ms
 2  192.168.0.1 (192.168.0.1)  0.416 ms  0.373 ms  0.343 ms
mininet> r4 traceroute r1
traceroute to 192.168.0.2 (192.168.0.2), 30 hops max, 60 byte packets
 1  192.168.0.2 (192.168.0.2)  0.560 ms  0.479 ms  0.445 ms
mininet> r4 traceroute r2
traceroute to 192.168.4.2 (192.168.4.2), 30 hops max, 60 byte packets
 1  192.168.4.2 (192.168.4.2)  0.549 ms  0.477 ms  0.447 ms
mininet> r4 traceroute r3
traceroute to 192.168.1.2 (192.168.1.2), 30 hops max, 60 byte packets
 1  192.168.6.1 (192.168.6.1)  0.445 ms  0.370 ms  0.348 ms
 2  192.168.1.2 (192.168.1.2)  0.327 ms  0.291 ms  0.266 ms
mininet> r4 traceroute hb
traceroute to 192.168.2.2 (192.168.2.2), 30 hops max, 60 byte packets
 1  192.168.6.1 (192.168.6.1)  0.445 ms  0.386 ms  *
 2  192.168.1.2 (192.168.1.2)  0.348 ms  0.317 ms  *
 3  192.168.2.2 (192.168.2.2)  0.275 ms  0.237 ms  0.211 ms
mininet>
mininet>
mininet>
mininet>
mininet>
```

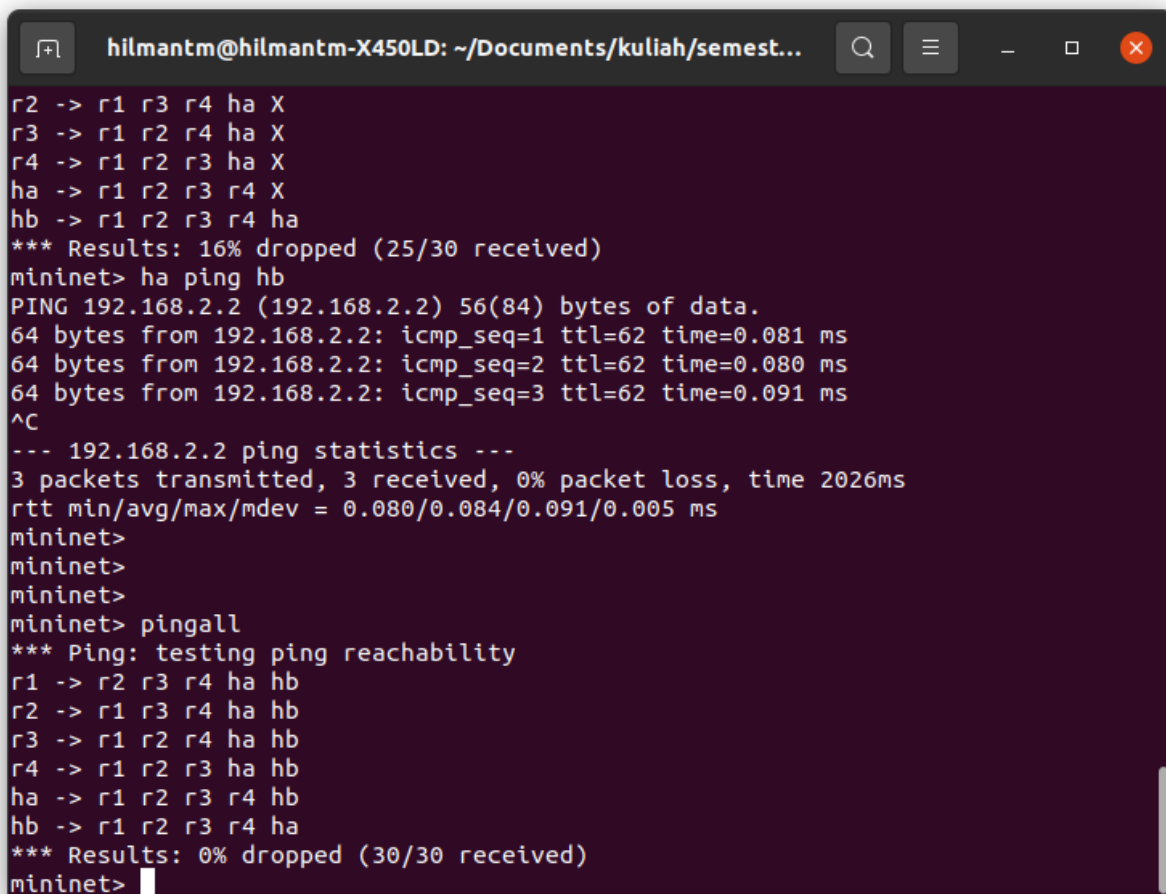
- **Route untuk mencapai r4 → ha**  
r4 → r1 → ha
- **Route untuk mencapai r4 → r1**  
r4 → r1
- **Route untuk mencapai r4 → r2**  
r4 → r2
- **Route untuk mencapai r4 → r3**  
r4 → r1 → r3
- **Route untuk mencapai r4 → hb**  
r4 → r1 → r3 → hb

## CLO 3

### Generate traffic menggunakan iPerf

**Iperf** merupakan open source tools yang digunakan untuk mengukur kecepatan, throughput dan kualitas link jaringan. Tools ini menggunakan protokol TCP dan UDP. TCP digunakan untuk mengukur kecepatan dan throughput link, UDP digunakan untuk mengukur jitter (variasi dari paket ke paket) dan Packet Loss.

Untuk generate traffic menggunakan iPerf, pastikan topologi yang sudah dibangun sudah terkoneksi sempurna (jika pingall, maka tidak ada lagi “X” pada result nya).

A screenshot of a terminal window with a dark background. The window title is 'hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...'. The terminal shows a series of commands and their outputs. First, several 'ping' commands are run from different hosts (r2, r3, r4, ha, hb) to a target 'hb', all showing 'X' for unreachable. Then, a 'pingall' command is run, which shows successful connectivity for all hosts. Finally, an 'iperf' command is run, showing a throughput of approximately 16 MB/s. The terminal text is as follows:

```
r2 -> r1 r3 r4 ha X
r3 -> r1 r2 r4 ha X
r4 -> r1 r2 r3 ha X
ha -> r1 r2 r3 r4 X
hb -> r1 r2 r3 r4 ha
*** Results: 16% dropped (25/30 received)
mininet> ha ping hb
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=62 time=0.081 ms
64 bytes from 192.168.2.2: icmp_seq=2 ttl=62 time=0.080 ms
64 bytes from 192.168.2.2: icmp_seq=3 ttl=62 time=0.091 ms
^C
--- 192.168.2.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2026ms
rtt min/avg/max/mdev = 0.080/0.084/0.091/0.005 ms
mininet>
mininet>
mininet>
mininet> pingall
*** Ping: testing ping reachability
r1 -> r2 r3 r4 ha hb
r2 -> r1 r3 r4 ha hb
r3 -> r1 r2 r4 ha hb
r4 -> r1 r2 r3 ha hb
ha -> r1 r2 r3 r4 hb
hb -> r1 r2 r3 r4 ha
*** Results: 0% dropped (30/30 received)
mininet>
```

Setelah itu, gunakan **xterm** untuk membuka terminal pada salah satu host untuk di test. Gunakan **tcpdump** untuk mengcapture pengiriman data menggunakan protokol TCP dan menulisnya

kedalam file .pcap agar bisa dibaca melalui aplikasi wireshark.

```
"Node: ha"
root@hilmantm-X450LD:/home/hilmantm/Documents/kuliah/semester 4/CII2J4 - JARINGAN KOMPUTER/tugas-besar/tubes-mininet-jarkom# tcpdump -w tcpha.pcap -c 100
tcpdump: listening on ha-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
100 packets captured
160 packets received by filter
0 packets dropped by kernel
root@hilmantm-X450LD:/home/hilmantm/Documents/kuliah/semester 4/CII2J4 - JARINGAN KOMPUTER/tugas-besar/tubes-mininet-jarkom#
```

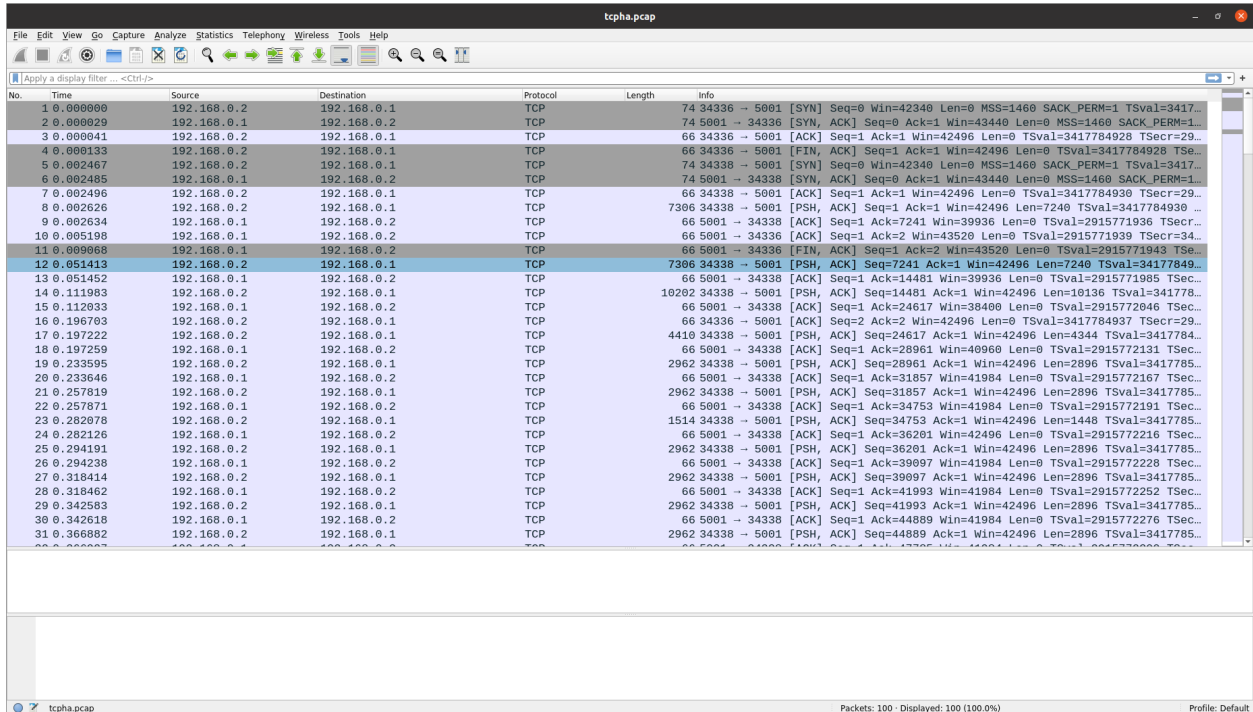
Untuk simulasi pengetesan, iperf akan dilakukan dari **router 1** ke **host A**.

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semest...
hilmantm@hilmantm-X450LD: ~/Doc... x hilmantm@hilmantm-X450LD: ~/Doc... x
--- 192.168.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.062/0.062/0.062/0.000 ms
mininet> r2 ping ha -c 1
PING 192.168.0.1 (192.168.0.1) 56(84) bytes of data:
64 bytes from 192.168.0.1: icmp_seq=1 ttl=62 time=0.117 ms

--- 192.168.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.117/0.117/0.117/0.000 ms
mininet>
mininet>
mininet>
mininet> pingall
*** Ping: testing ping reachability
r1 -> r2 r3 r4 ha hb
r2 -> r1 r3 r4 ha hb
r3 -> r1 r2 r4 ha hb
r4 -> r1 r2 r3 ha hb
ha -> r1 r2 r3 r4 hb
hb -> r1 r2 r3 r4 ha
*** Results: 0% dropped (30/30 received)
mininet> xterm ha
mininet> iperf r1 ha
*** Iperf: testing TCP bandwidth between r1 and ha
*** Results: ['958 Kbits/sec', '1.23 Mbits/sec']
mininet>
```

## Capture traffic menggunakan custom script atau wireshark untuk diinspeksi, dibuktikan dengan traffic di wireshark/tcpdump

Setelah traffic di capture kedalam file .pcap, maka buka file tersebut menggunakan wireshark untuk memvalidasi apakah benar protokol yang digunakan adalah TCP.



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.0.2	192.168.0.1	TCP	74	34336 → 5001 [SYN] Seq=0 Win=42340 Len=0 MSS=1460 SACK_PERM=1 TSval=3417...
2	0.000029	192.168.0.1	192.168.0.2	TCP	74	5001 → 34336 [SYN, ACK] Seq=0 Ack=1 Win=43440 Len=0 MSS=1460 SACK_PERM=1...
3	0.000041	192.168.0.2	192.168.0.1	TCP	66	34336 → 5001 [ACK] Seq=1 Ack=1 Win=42496 Len=0 TSval=3417784928 TSecr=29...
4	0.000133	192.168.0.2	192.168.0.1	TCP	66	34336 → 5001 [FIN, ACK] Seq=1 Ack=1 Win=42496 Len=0 TSval=3417784928 TSecr=29...
5	0.002467	192.168.0.2	192.168.0.1	TCP	74	34336 → 5001 [SYN] Seq=0 Win=42340 Len=0 MSS=1460 SACK_PERM=1 TSval=3417...
6	0.002485	192.168.0.1	192.168.0.2	TCP	74	5001 → 34336 [SYN, ACK] Seq=0 Ack=1 Win=43440 Len=0 MSS=1460 SACK_PERM=1...
7	0.002496	192.168.0.2	192.168.0.1	TCP	66	34336 → 5001 [ACK] Seq=1 Ack=1 Win=42496 Len=0 TSval=3417784930 TSecr=29...
8	0.002626	192.168.0.2	192.168.0.1	TCP	7306	34336 → 5001 [PSH, ACK] Seq=1 Ack=1 Win=42496 Len=7240 TSval=3417784938 ...
9	0.002634	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=7241 Win=39936 Len=0 TSval=2915771936 TSecr=...
10	0.005198	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=2 Win=43520 Len=0 TSval=2915771939 TSecr=34...
11	0.008068	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [FIN, ACK] Seq=1 Ack=2 Win=43520 Len=0 TSval=2915771943 TSecr=...
12	0.051413	192.168.0.2	192.168.0.1	TCP	7306	34336 → 5001 [PSH, ACK] Seq=7241 Ack=1 Win=42496 Len=7240 TSval=34177849...
13	0.051452	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=14481 Win=39936 Len=0 TSval=2915771985 TSecr=...
14	0.111983	192.168.0.2	192.168.0.1	TCP	10202	34336 → 5001 [PSH, ACK] Seq=14481 Ack=1 Win=42496 Len=10136 TSval=341778...
15	0.112033	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=24617 Win=38400 Len=0 TSval=2915772046 TSecr=...
16	0.196793	192.168.0.2	192.168.0.1	TCP	66	34336 → 5001 [ACK] Seq=2 Ack=2 Win=42496 Len=0 TSval=3417784937 TSecr=29...
17	0.197222	192.168.0.2	192.168.0.1	TCP	4410	34336 → 5001 [PSH, ACK] Seq=24617 Ack=1 Win=42496 Len=4344 TSval=3417784...
18	0.197259	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=28961 Win=40960 Len=0 TSval=2915772131 TSecr=...
19	0.233595	192.168.0.2	192.168.0.1	TCP	2962	34336 → 5001 [PSH, ACK] Seq=28961 Ack=1 Win=42496 Len=2896 TSval=3417785...
20	0.233646	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=31857 Win=41984 Len=0 TSval=2915772167 TSecr=...
21	0.257819	192.168.0.2	192.168.0.1	TCP	2962	34336 → 5001 [PSH, ACK] Seq=31857 Ack=1 Win=42496 Len=2896 TSval=3417785...
22	0.257871	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=34753 Win=41984 Len=0 TSval=2915772191 TSecr=...
23	0.282078	192.168.0.2	192.168.0.1	TCP	1514	34336 → 5001 [PSH, ACK] Seq=34753 Ack=1 Win=42496 Len=1448 TSval=3417785...
24	0.282126	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=36201 Win=42496 Len=0 TSval=2915772216 TSecr=...
25	0.294191	192.168.0.2	192.168.0.1	TCP	2962	34336 → 5001 [PSH, ACK] Seq=36201 Ack=1 Win=42496 Len=2896 TSval=3417785...
26	0.294238	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=39097 Win=41984 Len=0 TSval=2915772228 TSecr=...
27	0.318414	192.168.0.2	192.168.0.1	TCP	2962	34336 → 5001 [PSH, ACK] Seq=39097 Ack=1 Win=42496 Len=2896 TSval=3417785...
28	0.318462	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=41993 Win=41984 Len=0 TSval=2915772252 TSecr=...
29	0.342583	192.168.0.2	192.168.0.1	TCP	2962	34336 → 5001 [PSH, ACK] Seq=41993 Ack=1 Win=42496 Len=2896 TSval=3417785...
30	0.342618	192.168.0.1	192.168.0.2	TCP	66	5001 → 34336 [ACK] Seq=1 Ack=44889 Win=41984 Len=0 TSval=2915772276 TSecr=...
31	0.366882	192.168.0.2	192.168.0.1	TCP	2962	34336 → 5001 [PSH, ACK] Seq=44889 Ack=1 Win=42496 Len=2896 TSval=3417785...

Dari hasil diatas, benar bahwa protokol pengetesan iperf menggunakan TCP.

### Lantas, apa perbedaan TCP dan UDP?

TCP memiliki kelebihan yaitu dapat memastikan keakuratan data yang sampai ke penerima. Sedangkan UDP memiliki keunggulan dalam hal kecepatan transfer data. Penerapan kedua protokol tersebut dapat disesuaikan dengan kebutuhan. UDP merupakan jenis protokol yang memiliki karakteristik connectionless atau tidak berbasis koneksi. Sedangkan TCP adalah kebalikannya, yaitu berbasis koneksi.

## CLO 4

Set ukuran buffer pada router : 20, 40, 60 dan 100 dan Capture pengaruh ukuran buffer terhadap delay

Buffer size: 20

```
MAX_QUEUE_SIZE = 20

# Add Link
net.addLink( net[ 'ha' ], net[ 'r1' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth0', intfName2='r1-eth0', cls=TCLink, bw=1 ) # NET 1
net.addLink( net[ 'r1' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth1', intfName2='r3-eth1', cls=TCLink, bw=0.5 ) # NET 2
net.addLink( net[ 'r3' ], net[ 'hb' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r3-eth0', intfName2='hb-eth0', cls=TCLink, bw=1 ) # NET 3
net.addLink( net[ 'hb' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='hb-eth1', intfName2='r4-eth1', cls=TCLink, bw=1 ) # NET 4
net.addLink( net[ 'r4' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r4-eth0', intfName2='r2-eth0', cls=TCLink, bw=0.5 ) # NET 5
net.addLink( net[ 'ha' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth1', intfName2='r2-eth1', cls=TCLink, bw=1 ) # NET 6
net.addLink( net[ 'r1' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth2', intfName2='r4-eth2', cls=TCLink, bw=1 ) # NET 7
net.addLink( net[ 'r2' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r2-eth2', intfName2='r3-eth2', cls=TCLink, bw=1 ) # NET 8
```

```
mininet>
mininet> iperf ha hb
*** Iperf: testing TCP bandwidth between ha and hb
*** Results: ['479 Kbits/sec', '880 Kbits/sec']
mininet> ha ping hb -c 20
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=62 time=0.066 ms
64 bytes from 192.168.2.2: icmp_seq=2 ttl=62 time=0.158 ms
64 bytes from 192.168.2.2: icmp_seq=3 ttl=62 time=0.075 ms
64 bytes from 192.168.2.2: icmp_seq=4 ttl=62 time=0.107 ms
64 bytes from 192.168.2.2: icmp_seq=5 ttl=62 time=0.093 ms
64 bytes from 192.168.2.2: icmp_seq=6 ttl=62 time=0.105 ms
64 bytes from 192.168.2.2: icmp_seq=7 ttl=62 time=0.094 ms
64 bytes from 192.168.2.2: icmp_seq=8 ttl=62 time=0.100 ms
64 bytes from 192.168.2.2: icmp_seq=9 ttl=62 time=0.074 ms
64 bytes from 192.168.2.2: icmp_seq=10 ttl=62 time=0.075 ms
64 bytes from 192.168.2.2: icmp_seq=11 ttl=62 time=0.093 ms
64 bytes from 192.168.2.2: icmp_seq=12 ttl=62 time=0.074 ms
64 bytes from 192.168.2.2: icmp_seq=13 ttl=62 time=0.077 ms
64 bytes from 192.168.2.2: icmp_seq=14 ttl=62 time=0.078 ms
64 bytes from 192.168.2.2: icmp_seq=15 ttl=62 time=0.102 ms
64 bytes from 192.168.2.2: icmp_seq=16 ttl=62 time=0.095 ms
64 bytes from 192.168.2.2: icmp_seq=17 ttl=62 time=0.134 ms
64 bytes from 192.168.2.2: icmp_seq=18 ttl=62 time=0.064 ms
64 bytes from 192.168.2.2: icmp_seq=19 ttl=62 time=0.076 ms
64 bytes from 192.168.2.2: icmp_seq=20 ttl=62 time=0.139 ms

--- 192.168.2.2 ping statistics ---
20 packets transmitted, 20 received, 0% packet loss, time 1943ms
rtt min/avg/max/mdev = 0.064/0.093/0.158/0.024 ms
mininet>
```

Buffer size: 40

```
MAX_QUEUE_SIZE = 40
```

```
# Add Link
net.addLink( net[ 'ha' ], net[ 'r1' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth0', intfName2='r1-eth0', cls=TCLink, bw=1 ) # NET 1
net.addLink( net[ 'r1' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth1', intfName2='r3-eth1', cls=TCLink, bw=0.5 ) # NET 2
net.addLink( net[ 'r3' ], net[ 'hb' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r3-eth0', intfName2='hb-eth0', cls=TCLink, bw=1 ) # NET 3
net.addLink( net[ 'hb' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='hb-eth1', intfName2='r4-eth1', cls=TCLink, bw=1 ) # NET 4
net.addLink( net[ 'r4' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r4-eth0', intfName2='r2-eth0', cls=TCLink, bw=0.5 ) # NET 5
net.addLink( net[ 'ha' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth1', intfName2='r2-eth1', cls=TCLink, bw=1 ) # NET 6
net.addLink( net[ 'r1' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth2', intfName2='r4-eth2', cls=TCLink, bw=1 ) # NET 7
net.addLink( net[ 'r2' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r2-eth2', intfName2='r3-eth2', cls=TCLink, bw=1 ) # NET 8
```

```
mininet>
mininet> iperf ha hb
*** Iperf: testing TCP bandwidth between ha and hb
*** Results: ['417 Kbits/sec', '1.16 Mbits/sec']
mininet> ha ping hb -c 20
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=62 time=0.065 ms
64 bytes from 192.168.2.2: icmp_seq=2 ttl=62 time=0.171 ms
64 bytes from 192.168.2.2: icmp_seq=3 ttl=62 time=0.099 ms
64 bytes from 192.168.2.2: icmp_seq=4 ttl=62 time=0.167 ms
64 bytes from 192.168.2.2: icmp_seq=5 ttl=62 time=0.102 ms
64 bytes from 192.168.2.2: icmp_seq=6 ttl=62 time=0.136 ms
64 bytes from 192.168.2.2: icmp_seq=7 ttl=62 time=0.132 ms
64 bytes from 192.168.2.2: icmp_seq=8 ttl=62 time=0.114 ms
64 bytes from 192.168.2.2: icmp_seq=9 ttl=62 time=0.123 ms
64 bytes from 192.168.2.2: icmp_seq=10 ttl=62 time=0.113 ms
64 bytes from 192.168.2.2: icmp_seq=11 ttl=62 time=0.096 ms
64 bytes from 192.168.2.2: icmp_seq=12 ttl=62 time=0.116 ms
64 bytes from 192.168.2.2: icmp_seq=13 ttl=62 time=0.087 ms
64 bytes from 192.168.2.2: icmp_seq=14 ttl=62 time=0.088 ms
64 bytes from 192.168.2.2: icmp_seq=15 ttl=62 time=0.109 ms
64 bytes from 192.168.2.2: icmp_seq=16 ttl=62 time=0.107 ms
64 bytes from 192.168.2.2: icmp_seq=17 ttl=62 time=0.091 ms
64 bytes from 192.168.2.2: icmp_seq=18 ttl=62 time=0.093 ms
64 bytes from 192.168.2.2: icmp_seq=19 ttl=62 time=0.088 ms
64 bytes from 192.168.2.2: icmp_seq=20 ttl=62 time=0.114 ms

--- 192.168.2.2 ping statistics ---
20 packets transmitted, 20 received, 0% packet loss, time 19460ms
rtt min/avg/max/mdev = 0.065/0.110/0.171/0.025 ms
mininet>
```



Buffer size: 60

```
MAX_QUEUE_SIZE = 60

# Add Link
net.addLink( net[ 'ha' ], net[ 'r1' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth0', intfName2='r1-eth0', cls=TCLink, bw=1 ) # NET 1
net.addLink( net[ 'r1' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth1', intfName2='r3-eth1', cls=TCLink, bw=0.5 ) # NET 2
net.addLink( net[ 'r3' ], net[ 'hb' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r3-eth0', intfName2='hb-eth0', cls=TCLink, bw=1 ) # NET 3
net.addLink( net[ 'hb' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='hb-eth1', intfName2='r4-eth1', cls=TCLink, bw=1 ) # NET 4
net.addLink( net[ 'r4' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r4-eth0', intfName2='r2-eth0', cls=TCLink, bw=0.5 ) # NET 5
net.addLink( net[ 'ha' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth1', intfName2='r2-eth1', cls=TCLink, bw=1 ) # NET 6
net.addLink( net[ 'r1' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth2', intfName2='r4-eth2', cls=TCLink, bw=1 ) # NET 7
net.addLink( net[ 'r2' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r2-eth2', intfName2='r3-eth2', cls=TCLink, bw=1 ) # NET 8
```

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semeste...
mininet>
mininet> iperf ha hb
*** Iperf: testing TCP bandwidth between ha and hb
*** Results: ['479 Kbits/sec', '961 Kbits/sec']
mininet> ha ping hb -c 20
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=62 time=0.071 ms
64 bytes from 192.168.2.2: icmp_seq=2 ttl=62 time=0.116 ms
64 bytes from 192.168.2.2: icmp_seq=3 ttl=62 time=0.138 ms
64 bytes from 192.168.2.2: icmp_seq=4 ttl=62 time=0.134 ms
64 bytes from 192.168.2.2: icmp_seq=5 ttl=62 time=0.111 ms
64 bytes from 192.168.2.2: icmp_seq=6 ttl=62 time=0.121 ms
64 bytes from 192.168.2.2: icmp_seq=7 ttl=62 time=0.107 ms
64 bytes from 192.168.2.2: icmp_seq=8 ttl=62 time=0.104 ms
64 bytes from 192.168.2.2: icmp_seq=9 ttl=62 time=0.127 ms
64 bytes from 192.168.2.2: icmp_seq=10 ttl=62 time=0.130 ms
64 bytes from 192.168.2.2: icmp_seq=11 ttl=62 time=0.123 ms
64 bytes from 192.168.2.2: icmp_seq=12 ttl=62 time=0.088 ms
64 bytes from 192.168.2.2: icmp_seq=13 ttl=62 time=0.091 ms
64 bytes from 192.168.2.2: icmp_seq=14 ttl=62 time=0.069 ms
64 bytes from 192.168.2.2: icmp_seq=15 ttl=62 time=0.103 ms
64 bytes from 192.168.2.2: icmp_seq=16 ttl=62 time=0.088 ms
64 bytes from 192.168.2.2: icmp_seq=17 ttl=62 time=0.110 ms
64 bytes from 192.168.2.2: icmp_seq=18 ttl=62 time=0.144 ms
64 bytes from 192.168.2.2: icmp_seq=19 ttl=62 time=0.097 ms
64 bytes from 192.168.2.2: icmp_seq=20 ttl=62 time=0.071 ms

--- 192.168.2.2 ping statistics ---
20 packets transmitted, 20 received, 0% packet loss, time 19465ms
rtt min/avg/max/mdev = 0.069/0.107/0.144/0.022 ms
mininet>
```

Buffer size: 100

```
MAX_QUEUE_SIZE = 100

# Add Link
net.addLink( net[ 'ha' ], net[ 'r1' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth0', intfName2='r1-eth0', cls=TCLink, bw=1 ) # NET 1
net.addLink( net[ 'r1' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth1', intfName2='r3-eth1', cls=TCLink, bw=0.5 ) # NET 2
net.addLink( net[ 'r3' ], net[ 'hb' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r3-eth0', intfName2='hb-eth0', cls=TCLink, bw=1 ) # NET 3
net.addLink( net[ 'hb' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='hb-eth1', intfName2='r4-eth1', cls=TCLink, bw=1 ) # NET 4
net.addLink( net[ 'r4' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r4-eth0', intfName2='r2-eth0', cls=TCLink, bw=0.5 ) # NET 5
net.addLink( net[ 'ha' ], net[ 'r2' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='ha-eth1', intfName2='r2-eth1', cls=TCLink, bw=1 ) # NET 6
net.addLink( net[ 'r1' ], net[ 'r4' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r1-eth2', intfName2='r4-eth2', cls=TCLink, bw=1 ) # NET 7
net.addLink( net[ 'r2' ], net[ 'r3' ], max_queue_size=MAX_QUEUE_SIZE, intfName1='r2-eth2', intfName2='r3-eth2', cls=TCLink, bw=1 ) # NET 8
```

```
hilmantm@hilmantm-X450LD: ~/Documents/kuliah/semeste...
mininet>
mininet> iperf ha hb
*** Iperf: testing TCP bandwidth between ha and hb
*** Results: ['478 Kbits/sec', '1.16 Mbits/sec']
mininet> ha ping hb -c 20
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=62 time=0.093 ms
64 bytes from 192.168.2.2: icmp_seq=2 ttl=62 time=0.097 ms
64 bytes from 192.168.2.2: icmp_seq=3 ttl=62 time=0.106 ms
64 bytes from 192.168.2.2: icmp_seq=4 ttl=62 time=0.143 ms
64 bytes from 192.168.2.2: icmp_seq=5 ttl=62 time=0.144 ms
64 bytes from 192.168.2.2: icmp_seq=6 ttl=62 time=0.156 ms
64 bytes from 192.168.2.2: icmp_seq=7 ttl=62 time=0.096 ms
64 bytes from 192.168.2.2: icmp_seq=8 ttl=62 time=0.152 ms
64 bytes from 192.168.2.2: icmp_seq=9 ttl=62 time=0.085 ms
64 bytes from 192.168.2.2: icmp_seq=10 ttl=62 time=0.070 ms
64 bytes from 192.168.2.2: icmp_seq=11 ttl=62 time=0.114 ms
64 bytes from 192.168.2.2: icmp_seq=12 ttl=62 time=0.068 ms
64 bytes from 192.168.2.2: icmp_seq=13 ttl=62 time=0.063 ms
64 bytes from 192.168.2.2: icmp_seq=14 ttl=62 time=0.117 ms
64 bytes from 192.168.2.2: icmp_seq=15 ttl=62 time=0.089 ms
64 bytes from 192.168.2.2: icmp_seq=16 ttl=62 time=0.125 ms
64 bytes from 192.168.2.2: icmp_seq=17 ttl=62 time=0.088 ms
64 bytes from 192.168.2.2: icmp_seq=18 ttl=62 time=0.173 ms
64 bytes from 192.168.2.2: icmp_seq=19 ttl=62 time=0.107 ms
64 bytes from 192.168.2.2: icmp_seq=20 ttl=62 time=0.106 ms

--- 192.168.2.2 ping statistics ---
20 packets transmitted, 20 received, 0% packet loss, time 19452ms
rtt min/avg/max/mdev = 0.063/0.109/0.173/0.030 ms
mininet>
```

## Kesimpulan:

Apabila dilihat dari hasil test iPerf, tidak ada ketentuan yang pasti apa pengaruh buffer terhadap iPerf test. Contohnya pada buffer 60 dan 100, waktu result turun.

Apabila dilihat dari hasil test ping, maka ada sedikit perbedaan pada time nya. Semakin besar buffer semakin tinggi time yang diperlukan walaupun tidak naik signifikan.