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POX CONTROLLER

POX controller adalah salah satu controller SDN yang mendukung protokol OpenFlow. POX adalah controller yang berbasis bahasa Python. Tahapannya sebagai berikut.

1. Melakukan POX Controller files pada Mininet

```
mininet@mininet-vm: ~/pox/pox/forwarding
Using username "mininet".
mininet@localhost's password:
Welcome to Ubuntu 14.04.4 LTS (GNU/Linux 4.2.0-27-generic x86_64)

 * Documentation:  https://help.ubuntu.com/
Last login: Tue Apr 17 23:17:03 2018 from 10.0.2.2
mininet@mininet-vm:~$ cd pox
mininet@mininet-vm:~/pox$ cd pox
mininet@mininet-vm:~/pox/pox$ cd misc
mininet@mininet-vm:~/pox/pox/misc$ ll
total 76
drwxrwxr-x  3 mininet mininet  4096 Mar 21  2017 ./
drwxrwxr-x 15 mininet mininet  4096 Mar 21  2017 ../
-rw-rw-r--  1 mininet mininet  1240 Mar 21  2017 cbench.py
-rw-rw-r--  1 mininet mininet  1079 Mar 21  2017 full_payload.py
-rw-rw-r--  1 mininet mininet  5214 Mar 21  2017 gephi_topo.py
-rw-rw-r--  1 mininet mininet   689 Mar 21  2017 __init__.py
-rw-rw-r--  1 mininet mininet 10251 Mar 21  2017 ip_loadbalancer.py
-rw-rw-r--  1 mininet mininet  3794 Mar 21  2017 mac_blocker.py
-rw-rw-r--  1 mininet mininet 14375 Mar 21  2017 nat.py
-rw-rw-r--  1 mininet mininet  4582 Mar 21  2017 of_tutorial.py
-rw-rw-r--  1 mininet mininet  2096 Mar 21  2017 pidfile.py
drwxrwxr-x  2 mininet mininet  4096 Mar 21  2017 telnetd/
mininet@mininet-vm:~/pox/pox/misc$ cd
mininet@mininet-vm:~$ cd pox/pox/forwarding
mininet@mininet-vm:~/pox/pox/forwarding$ ll
total 96
drwxrwxr-x  2 mininet mininet  4096 Mar 21  2017 ./
drwxrwxr-x 15 mininet mininet  4096 Mar 21  2017 ../
-rw-rw-r--  1 mininet mininet  1092 Mar 21  2017 hub.py
-rw-rw-r--  1 mininet mininet   651 Mar 21  2017 __init__.py
-rw-rw-r--  1 mininet mininet  4426 Mar 21  2017 l2_flowvisor.py
-rw-rw-r--  1 mininet mininet  6692 Mar 21  2017 l2_learning.py
-rw-rw-r--  1 mininet mininet 15558 Mar 21  2017 l2_multi.py
-rw-rw-r--  1 mininet mininet  4324 Mar 21  2017 l2_nx.py
-rw-rw-r--  1 mininet mininet  2105 Mar 21  2017 l2_nx_self_learning.py
-rw-rw-r--  1 mininet mininet  2882 Mar 21  2017 l2_pairs.py
-rw-rw-r--  1 mininet mininet 12330 Mar 21  2017 l3_learning.py
-rw-rw-r--  1 mininet mininet 14102 Mar 21  2017 topo_proactive.py
mininet@mininet-vm:~/pox/pox/forwarding$
```

2. Memilih of_tutorial.py pada pox maupun pox dan misc

```
mininet@mininet-vm: ~/pox/pox/misc
# Copyright 2012 James McCauley
#
# Licensed under the Apache License, Version 2.0 (the "License");
# you may not use this file except in compliance with the License.
# You may obtain a copy of the License at:
#
#   http://www.apache.org/licenses/LICENSE-2.0
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# Unless required by applicable law or agreed to in writing, software
# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.
"""
This component is for use with the OpenFlow tutorial.

It acts as a simple hub, but can be modified to act like an L2
learning switch.

It's roughly similar to the one Brandon Heller did for NOX.
"""

from pox.core import core
import pox.openflow.libopenflow_01 as of

log = core.getLogger()

class Tutorial (object):
    """
    A Tutorial object is created for each switch that connects.
    A Connection object for that switch is passed to the __init__ function.
    """
    def __init__(self, connection):
        # Keep track of the connection to the switch so that we can
        # send it messages!
        self.connection = connection

        # This binds our PacketIn event listener
        connection.addListeners(self)

        # Use this table to keep track of which ethernet address is on
        # which switch port (keys are MACs, values are ports).
        self.mac_to_port = {}

    def resend_packet (self, packet_in, out_port):
        """
        Instructs the switch to resend a packet that it had sent to us.
        "packet_in" is the ofp_packet_in object the switch had sent to the

```

3. memulai pox controller dengan './pox.py log.level --DEBUG misc.of_tutorial pada directory pox'. Kemudian mengetikkan lagi perintah `sudo mn --topo single,3 --mac --witch ovsk --controller remote`.

```

mininet@mininet-vm: ~
mininet@mininet-vm:~$ sudo mn -c
*** Removing excess controllers/ofprotocols/ofdatapaths/pings/noxes
killall controller ofprotocol ofdatapath ping nox_core lt-nox_core ovs-openflowd ovs-controller udpbwtest mnexec ixs 2> /dev/null
killall -9 controller ofprotocol ofdatapath ping nox_core lt-nox_core ovs-openflowd ovs-controller udpbwtest mnexec ixs 2> /dev/null
pkill -9 -f "sudo mnexec"
*** Removing junk from /tmp
rm -f /tmp/vconn* /tmp/vlogs* /tmp/*.out /tmp/*.log
*** Removing old X11 tunnels
*** Removing excess kernel datapaths
ps ax | egrep -o 'dp[0-9]+' | sed 's/dp/nl:/'
*** Removing OVS datapaths
ovs-vsctl --timeout=1 list-br
ovs-vsctl --timeout=1 list-br
*** Removing all links of the pattern foo-ethX
ip link show | egrep -o '([_.,:alnum:])+eth[[:digit:]]+)'
ip link show
*** Killing stale mininet node processes
pkill -9 -f mininet;
*** Shutting down stale tunnels
pkill -9 -f Tunnel=Ethernet
pkill -9 -f .ssh/mn
rm -f ~/.ssh/mn/*
*** Cleanup complete.
mininet@mininet-vm:~$ sudo mn --topo single,3 --mac --switch ovsk --controller remote
*** Creating network
*** Adding controller
Unable to contact the remote controller at 127.0.0.1:6653
Unable to contact the remote controller at 127.0.0.1:6633
Setting remote controller to 127.0.0.1:6653
*** Adding hosts:
h1 h2 h3
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1) (h3, s1)
*** Configuring hosts
h1 h2 h3
*** Starting controller
c0
*** Starting 1 switches
^1
Node: h1
root@mininet-vm:~# ping -c1 10.0.0.2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=9.45 ms

--- 10.0.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 9.454/9.454/9.454/0.000 ms
root@mininet-vm:~# []

Node: h2
root@mininet-vm:~# tcpdump -XX -n -i h2-eth0 > h2.txt
No command 'tcpdump' found, did you mean:
Command 'tcpdump' from package 'tcpdump' (main)
tcpdump: command not found
root@mininet-vm:~# tcpdump -XX -n -i h2-eth0 > h2.txt
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h2-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
^C6 packets captured
6 packets received by filter
0 packets dropped by kernel
root@mininet-vm:~# []

Node: h3
root@mininet-vm:~# tcpdump -XX -n -i h3-eth0 > h3.txt
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h3-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
^C6 packets captured
6 packets received by filter
0 packets dropped by kernel
root@mininet-vm:~# []

mininet@mininet-vm: ~/pox
mininet@mininet-vm:~$ git clone http://github.com/noxrepo/pox
fatal: destination path 'pox' already exists and is not an empty directory.
mininet@mininet-vm:~$ git checkout betta
fatal: Not a git repository (or any of the parent directories): .git
mininet@mininet-vm:~$ cd pox
mininet@mininet-vm:~/pox$ git checkout betta
Already on 'betta'
Your branch is up-to-date with 'origin/betta'.
mininet@mininet-vm:~/pox$ ./pox.py log.level --DEBUG misc.of_tutorial
POX 0.1.0 (betta) / Copyright 2011-2013 James McCauley, et al.
DEBUG:core:POX 0.1.0 (betta) going up...
DEBUG:core:Running on CPython (2.7.6/Oct 26 2016 20:30:19)
DEBUG:core:Platform is Linux-4.2.0-27-generic-x86_64-with-Ubuntu-14.04-trusty
INFO:core:POX 0.1.0 (betta) is up.
DEBUG:openflow.of_01:Listening on 0.0.0.0:6633
INFO:openflow.of_01:[None 1] closed
INFO:openflow.of_01:[00-00-00-00-00-01 2] connected
DEBUG:misc.of_tutorial:Controlling [00-00-00-00-00-01 2]
[]

```

- Setelah itu, ketikkan perintah sebagai berikut '`tcpdump -XX -n -i h2-eth0 > h2.txt`' pada terminal node 2, dan '`tcpdump -XX -n -i h3-eth0 > h3.txt`' pada terminal node 3. Lalu lakukan ping pada terminal node 1 dengan perintah '`ping -c1 10.0.0.2`'

T mininet@mininet-vm: ~

mininet@mininet-vm:~\$ cat h2.txt

08:39:34.828743 ARP, Request who-has 10.0.0.2 tell 10.0.0.1, length 28

0x0000: ffff ffff ffff 0000 0000 0001 0806 0001

0x0010: 0800 0604 0001 0000 0000 0001 0a00 0001

0x0020: 0000 0000 0000 0a00 0002

08:39:34.828766 ARP, Reply 10.0.0.2 is-at 00:00:00:00:00:02, length 28

0x0000: 0000 0000 0001 0000 0000 0002 0806 0001

0x0010: 0800 0604 0002 0000 0000 0002 0a00 0002

0x0020: 0000 0000 0001 0a00 0001

08:39:34.831160 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 5099, seq 1, length 64

0x0000: 0000 0000 0002 0000 0000 0001 0800 4500E.

0x0010: 0054 13fb 4000 4001 12ac 0a00 0001 0a00 .T..@.....

0x0020: 0002 0800 69f2 13eb 0001 b666 d75a 0000i.....f.Z..

0x0030: 0000 218d 0c00 0000 0000 1011 1213 1415 ..!.....

0x0040: 1617 1819 1a1b 1c1d 1e1f 2021 2223 2425!""#\$%

0x0050: 2627 2829 2a2b 2c2d 2e2f 3031 3233 3435 &'()*+,-./012345

0x0060: 3637 67

08:39:34.831393 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 5099, seq 1, length 64

0x0000: 0000 0000 0001 0000 0000 0002 0800 4500E.

0x0010: 0054 46d0 0000 4001 1fd7 0a00 0002 0a00 .TF...@.....

0x0020: 0001 0000 71f2 13eb 0001 b666 d75a 0000q.....f.Z..

0x0030: 0000 218d 0c00 0000 0000 1011 1213 1415 ..!.....

0x0040: 1617 1819 1a1b 1c1d 1e1f 2021 2223 2425!""#\$%

0x0050: 2627 2829 2a2b 2c2d 2e2f 3031 3233 3435 &'()*+,-./012345

0x0060: 3637 67

08:39:39.835283 ARP, Request who-has 10.0.0.1 tell 10.0.0.2, length 28

0x0000: 0000 0000 0001 0000 0000 0002 0806 0001

0x0010: 0800 0604 0001 0000 0000 0002 0a00 0002

0x0020: 0000 0000 0000 0a00 0001

08:39:39.883178 ARP, Reply 10.0.0.1 is-at 00:00:00:00:00:01, length 28

0x0000: 0000 0000 0002 0000 0000 0001 0806 0001

0x0010: 0800 0604 0002 0000 0000 0001 0a00 0001

0x0020: 0000 0000 0002 0a00 0002

mininet@mininet-vm:~\$ █

```

mininet@mininet-vm:~$ cat h3.txt
08:39:34.828740 ARP, Request who-has 10.0.0.2 tell 10.0.0.1, length 28
  0x0000:  ffff ffff ffff 0000 0000 0001 0806 0001  .....
  0x0010:  0800 0604 0001 0000 0000 0001 0a00 0001  .....
  0x0020:  0000 0000 0000 0a00 0002                .....
08:39:34.829769 ARP, Reply 10.0.0.2 is-at 00:00:00:00:00:02, length 28
  0x0000:  0000 0000 0001 0000 0000 0002 0806 0001  .....
  0x0010:  0800 0604 0002 0000 0000 0002 0a00 0002  .....
  0x0020:  0000 0000 0001 0a00 0001                .....
08:39:34.831159 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 5099, seq 1, length 64
  0x0000:  0000 0000 0002 0000 0000 0001 0800 4500  .....E.
  0x0010:  0054 13fb 4000 4001 12ac 0a00 0001 0a00  .T..@.....
  0x0020:  0002 0800 69f2 13eb 0001 b666 d75a 0000  ....i.....f.Z..
  0x0030:  0000 218d 0c00 0000 0000 1011 1213 1415  ..!.....
  0x0040:  1617 1819 1a1b 1c1d 1e1f 2021 2223 2425  .....!"#$%
  0x0050:  2627 2829 2a2b 2c2d 2e2f 3031 3233 3435  &'()*+,-./012345
  0x0060:  3637                                     67
08:39:34.832014 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 5099, seq 1, length 64
  0x0000:  0000 0000 0001 0000 0000 0002 0800 4500  .....E.
  0x0010:  0054 46d0 0000 4001 1fd7 0a00 0002 0a00  .TF...@.....
  0x0020:  0001 0000 71f2 13eb 0001 b666 d75a 0000  ....q.....f.Z..
  0x0030:  0000 218d 0c00 0000 0000 1011 1213 1415  ..!.....
  0x0040:  1617 1819 1a1b 1c1d 1e1f 2021 2223 2425  .....!"#$%
  0x0050:  2627 2829 2a2b 2c2d 2e2f 3031 3233 3435  &'()*+,-./012345
  0x0060:  3637                                     67
08:39:39.877184 ARP, Request who-has 10.0.0.1 tell 10.0.0.2, length 28
  0x0000:  0000 0000 0001 0000 0000 0002 0806 0001  .....
  0x0010:  0800 0604 0001 0000 0000 0002 0a00 0002  .....
  0x0020:  0000 0000 0000 0a00 0001                .....
08:39:39.883173 ARP, Reply 10.0.0.1 is-at 00:00:00:00:00:01, length 28
  0x0000:  0000 0000 0002 0000 0000 0001 0806 0001  .....
  0x0010:  0800 0604 0002 0000 0000 0001 0a00 0001  .....
  0x0020:  0000 0000 0002 0a00 0002                .....

mininet@mininet-vm:~$ █

```

5. Mengetikkan kembali perintah untuk merekam aktivitas node lagi pada node 2 dan 3. Untuk lebih jelasnya, kita bisa menyaksikan gambar dibawah ini

```
Node: h2
root@mininet-vm:~# tcpdump -XX -n -i h2-eth0 > h2.txt
No command 'tcpdump' found, did you mean:
Command 'tcpdump' from package 'tcpdump' (main)
tcpdump: command not found
root@mininet-vm:~# tcpdump -XX -n -i h2-eth0 > h2.txt
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h2-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
^C6 packets captured
16 packets received by filter
0 packets dropped by kernel
root@mininet-vm:~# tcpdump -XX -n -i h2-eth0 > h2.txt
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h2-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
^C3 packets captured
13 packets received by filter
0 packets dropped by kernel
root@mininet-vm:~#

Node: h3
root@mininet-vm:~# tcpdump -XX -n -i h3-eth0 > h3.txt
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h3-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
^C6 packets captured
16 packets received by filter
0 packets dropped by kernel
root@mininet-vm:~# tcpdump -XX -n -i h3-eth0 > h3.txt
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h3-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
^C3 packets captured
13 packets received by filter
0 packets dropped by kernel
root@mininet-vm:~#

Node: h1
root@mininet-vm:~# ping -c1 10.0.0.2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=9.45 ms

--- 10.0.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 9.454/9.454/9.454/0.000 ms
root@mininet-vm:~# ping -c1 10.0.0.5
PING 10.0.0.5 (10.0.0.5) 56(84) bytes of data.
From 10.0.0.1 icmp_seq=1 Destination Host Unreachable

--- 10.0.0.5 ping statistics ---
1 packets transmitted, 0 received, +1 errors, 100% packet loss, time 0ms

root@mininet-vm:~#
```

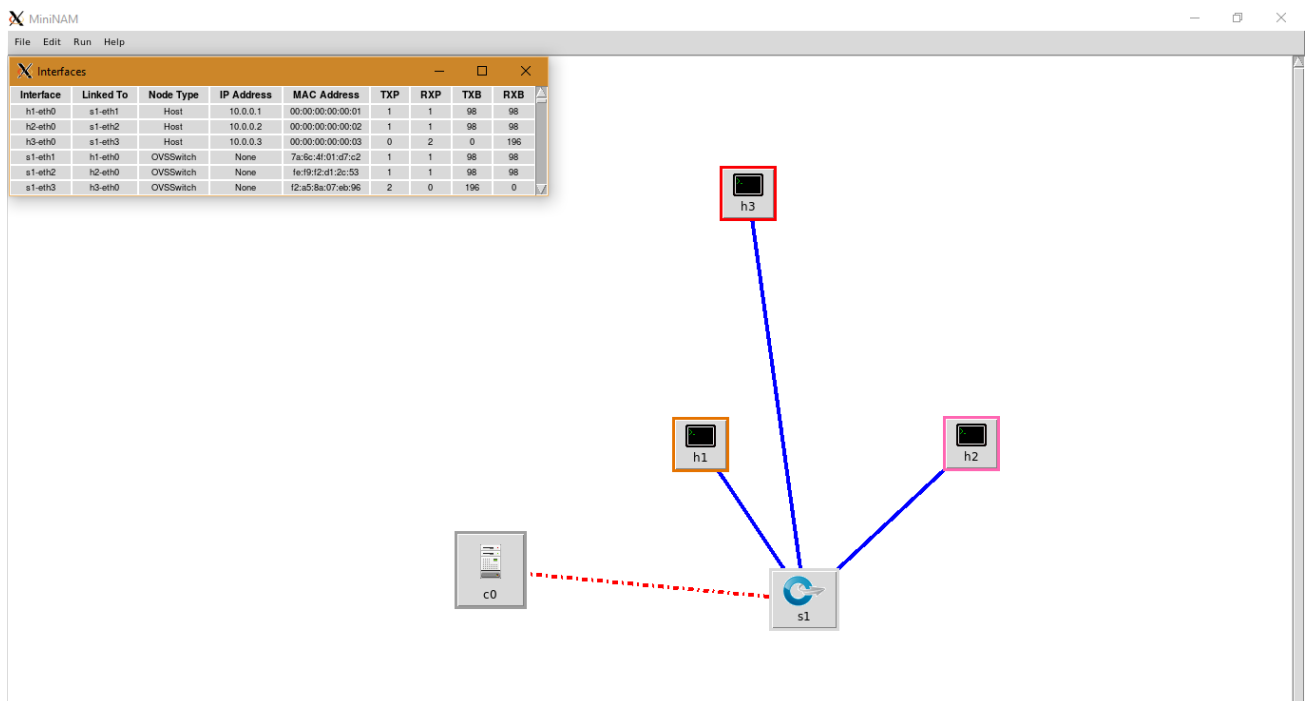
```
mininet@mininet-vm:~$ cat h2.txt
08:49:13.332689 ARP, Request who-has 10.0.0.5 tell 10.0.0.1, length 28
0x0000: ffff ffff ffff 0000 0000 0001 0806 0001 .....
0x0010: 0800 0604 0001 0000 0000 0001 0a00 0001 .....
0x0020: 0000 0000 0000 0a00 0005 .....
08:49:14.331482 ARP, Request who-has 10.0.0.5 tell 10.0.0.1, length 28
0x0000: ffff ffff ffff 0000 0000 0001 0806 0001 .....
0x0010: 0800 0604 0001 0000 0000 0001 0a00 0001 .....
0x0020: 0000 0000 0000 0a00 0005 .....
08:49:15.332863 ARP, Request who-has 10.0.0.5 tell 10.0.0.1, length 28
0x0000: ffff ffff ffff 0000 0000 0001 0806 0001 .....
0x0010: 0800 0604 0001 0000 0000 0001 0a00 0001 .....
0x0020: 0000 0000 0000 0a00 0005 .....
```

```
mininet@mininet-vm:~$
```

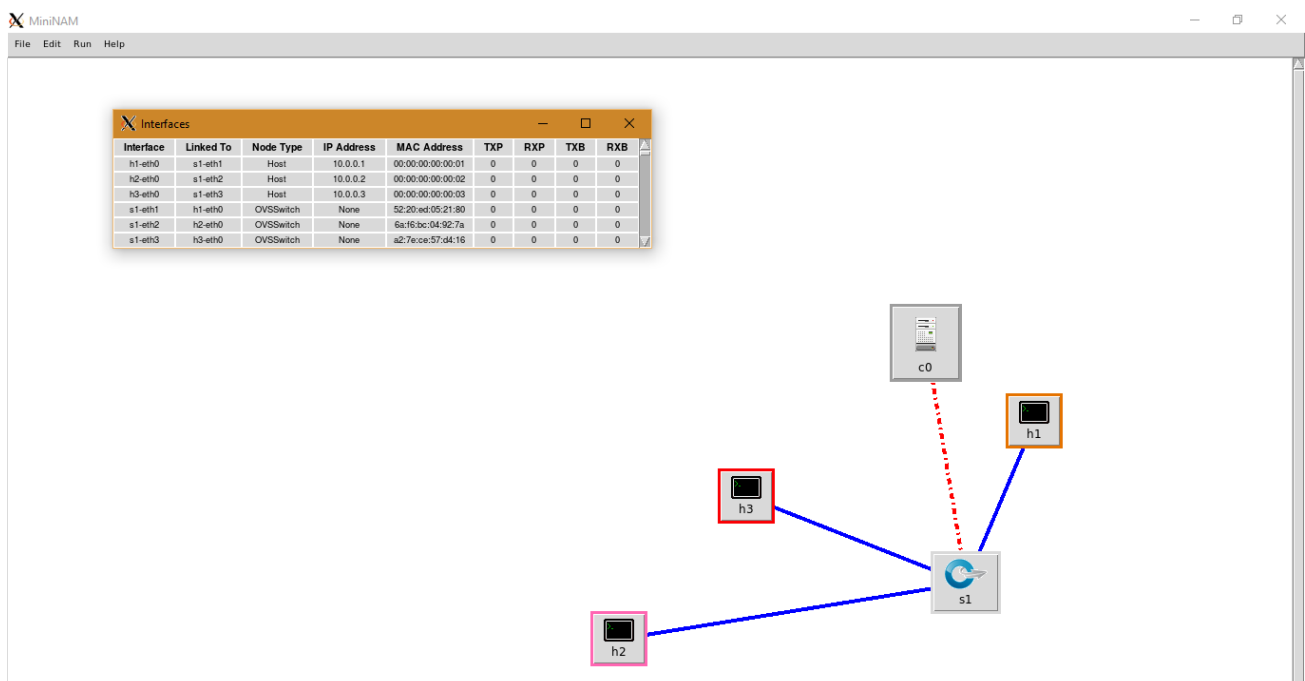
```
mininet@mininet-vm:~$ cat h3.txt
08:49:13.332686 ARP, Request who-has 10.0.0.5 tell 10.0.0.1, length 28
0x0000: ffff ffff ffff 0000 0000 0001 0806 0001 .....
0x0010: 0800 0604 0001 0000 0000 0001 0a00 0001 .....
0x0020: 0000 0000 0000 0a00 0005 .....
08:49:14.331478 ARP, Request who-has 10.0.0.5 tell 10.0.0.1, length 28
0x0000: ffff ffff ffff 0000 0000 0001 0806 0001 .....
0x0010: 0800 0604 0001 0000 0000 0001 0a00 0001 .....
0x0020: 0000 0000 0000 0a00 0005 .....
08:49:15.332860 ARP, Request who-has 10.0.0.5 tell 10.0.0.1, length 28
0x0000: ffff ffff ffff 0000 0000 0001 0806 0001 .....
0x0010: 0800 0604 0001 0000 0000 0001 0a00 0001 .....
0x0020: 0000 0000 0000 0a00 0005 .....
```

```
mininet@mininet-vm:~$
```

6. Tampilan jaringan yg kita buat tadi pada MiniNAM ketika ping dari 10.0.0.1 ke 10.0.0.2. terlihat ada komunikasi antara host 1 dan 2.



7. Tampilan jaringan yg kita buat tadi pada MiniNAM ketika ping dari 10.0.0.1 ke 10.0.0.5. terlihat tidak ada komunikasi antar host.



8. disini kita akan melakukan perbandingan antara kecepatan menggunakan hub dan switch. berikan perintah iperf pada console.

```
mininet> sh ovs-ofctl dump-flows s1
NXST_FLOW reply (xid=0x4):
mininet> pingpair
h1 -> h2
h2 -> h1
*** Results: 0% dropped (2/2 received)
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2 h3
h2 -> h1 h3
h3 -> h1 h2
*** Results: 0% dropped (6/6 received)
mininet> iperf
*** Iperf: testing TCP bandwidth between h1 and h3
*** Results: ['6.61 Mbits/sec', '7.32 Mbits/sec']
mininet>
```

9. sehingga dapat kita simpulkan bahwa switch dapat bekerja lebih cepat daripada hub

