

ADMINISTRASI dan DESAIN JARINGAN
Mininet, MiniNAM, OpenFlow dan PoxController



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Universitas Sumatera Utara
2018

MININET

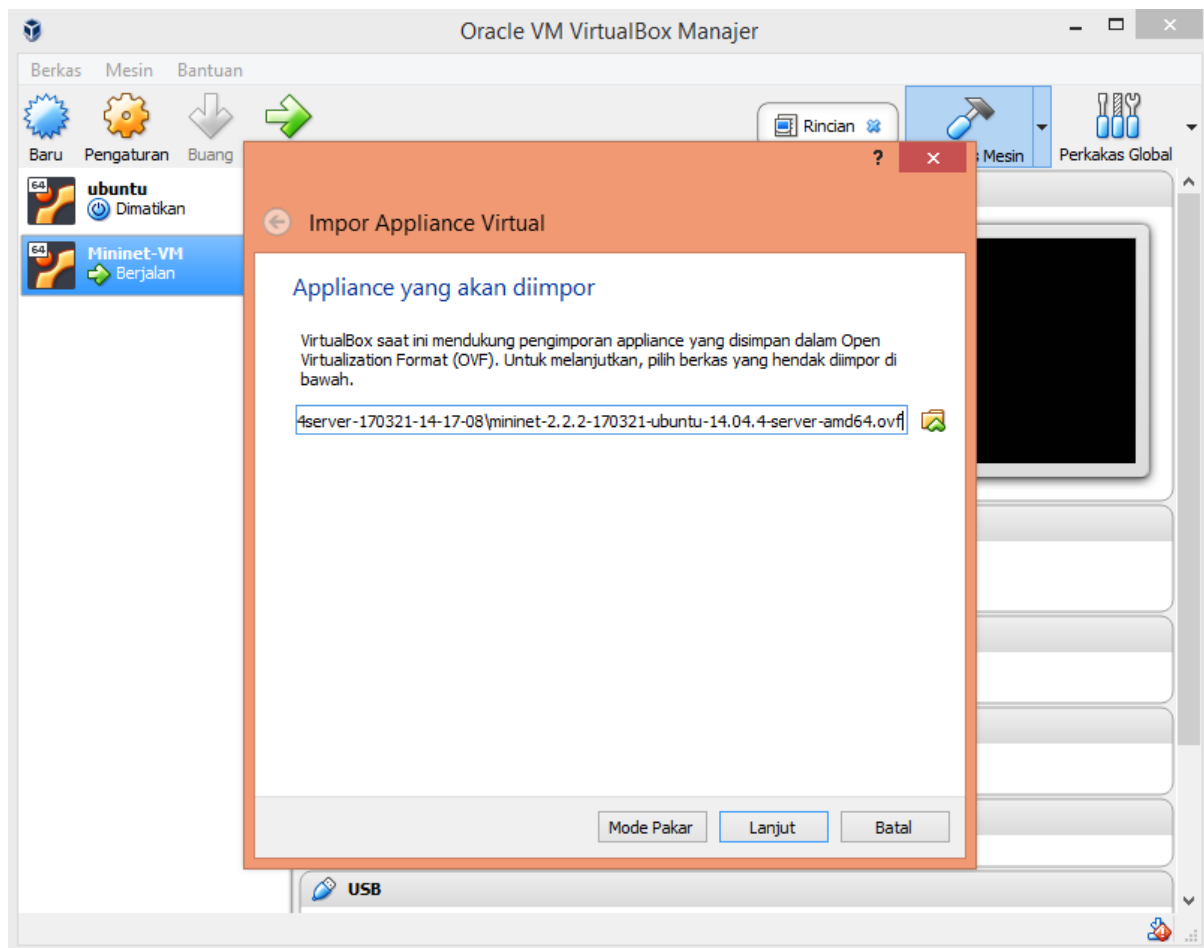
Mininet adalah emulator berbasis CLI yang digunakan untuk membuat sebuah topologi jaringan pada Software Defined Network. Pada Mininet sudah terdapat beberapa topologi bawaan yang dapat langsung digunakan dengan menggunakan perintah (command) tertentu.

Unduh Mininet tersedia di situs

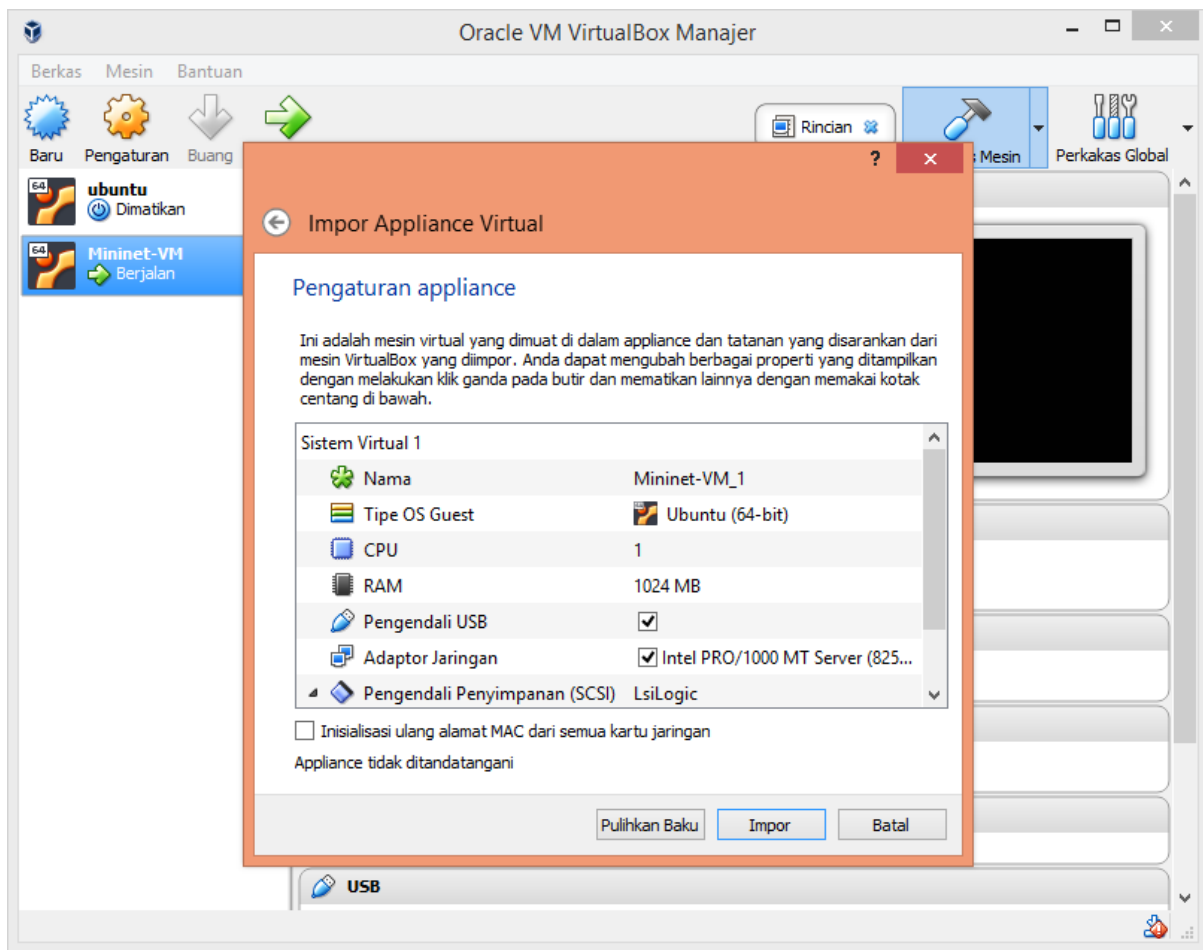
<https://github.com/mininet/mininet/wiki/Mininet-VMImages> .

Setelah itu, ekstrak file Mininetnya sehingga yang digunakan adalah yang berekstensi **.ovf**. Lakukan instalasi Mininet pada Virtual Box. Buka **Virtual Box** lalu klik menu **File > Import Appliance**.

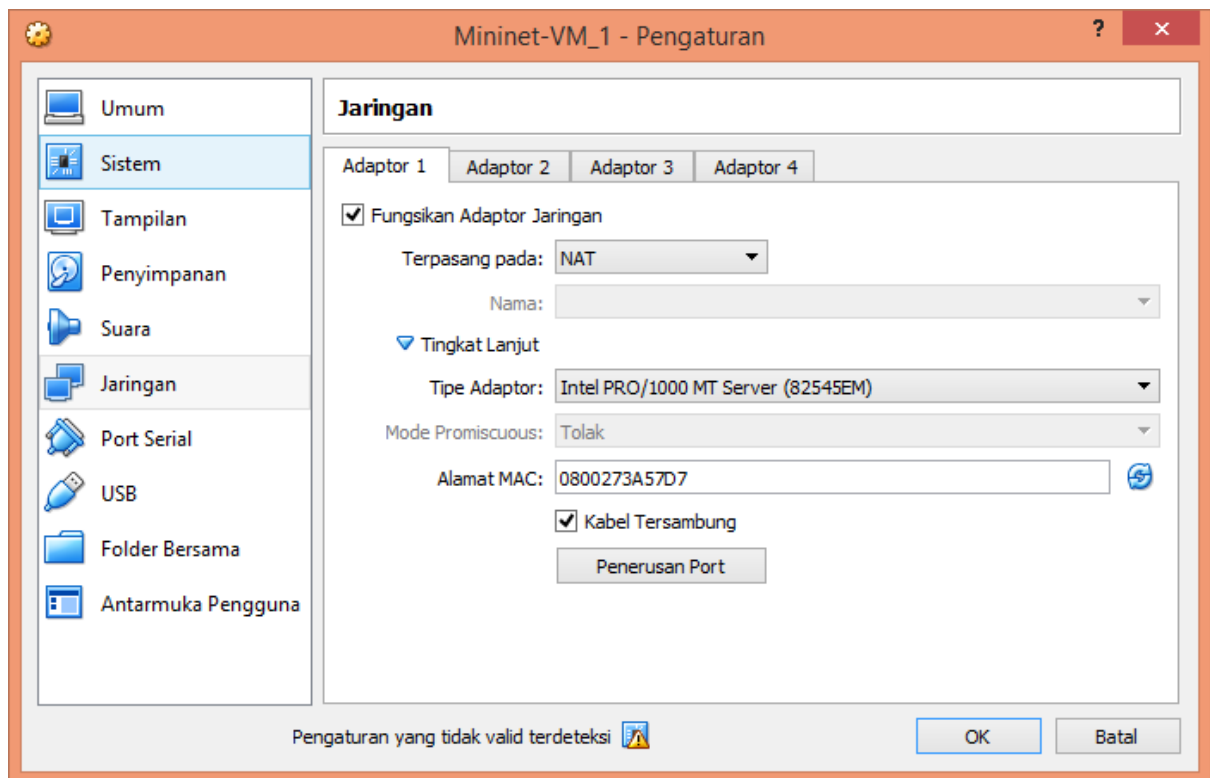
Cari dan masukkan file mininet yang berekstensi **.ovf** tadi dan klik **Lanjut**.



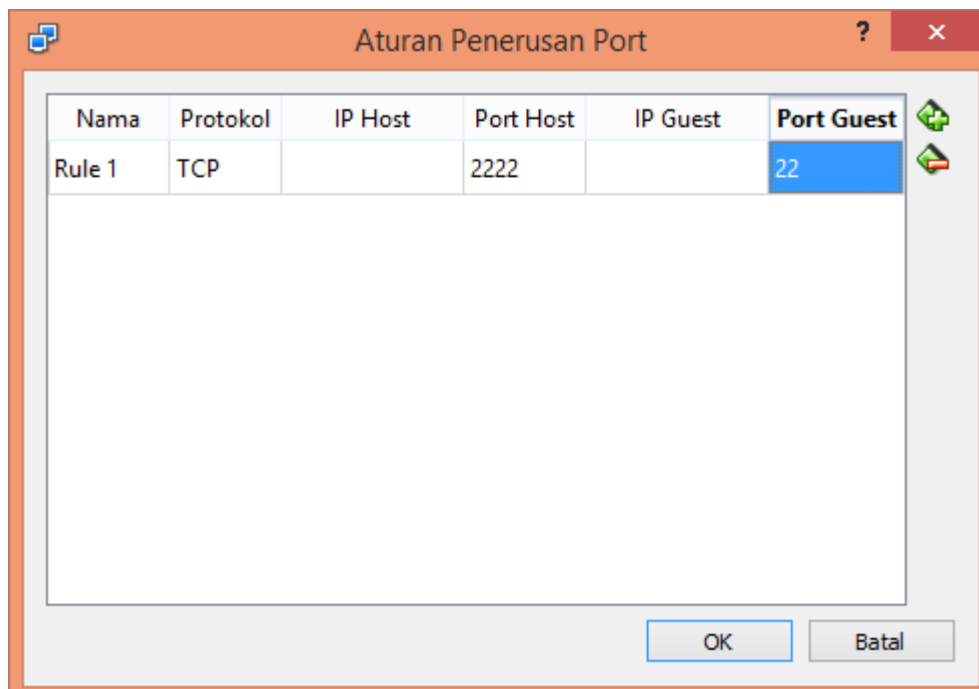
Dilanjutkan dengan klik tombol **Impor**.



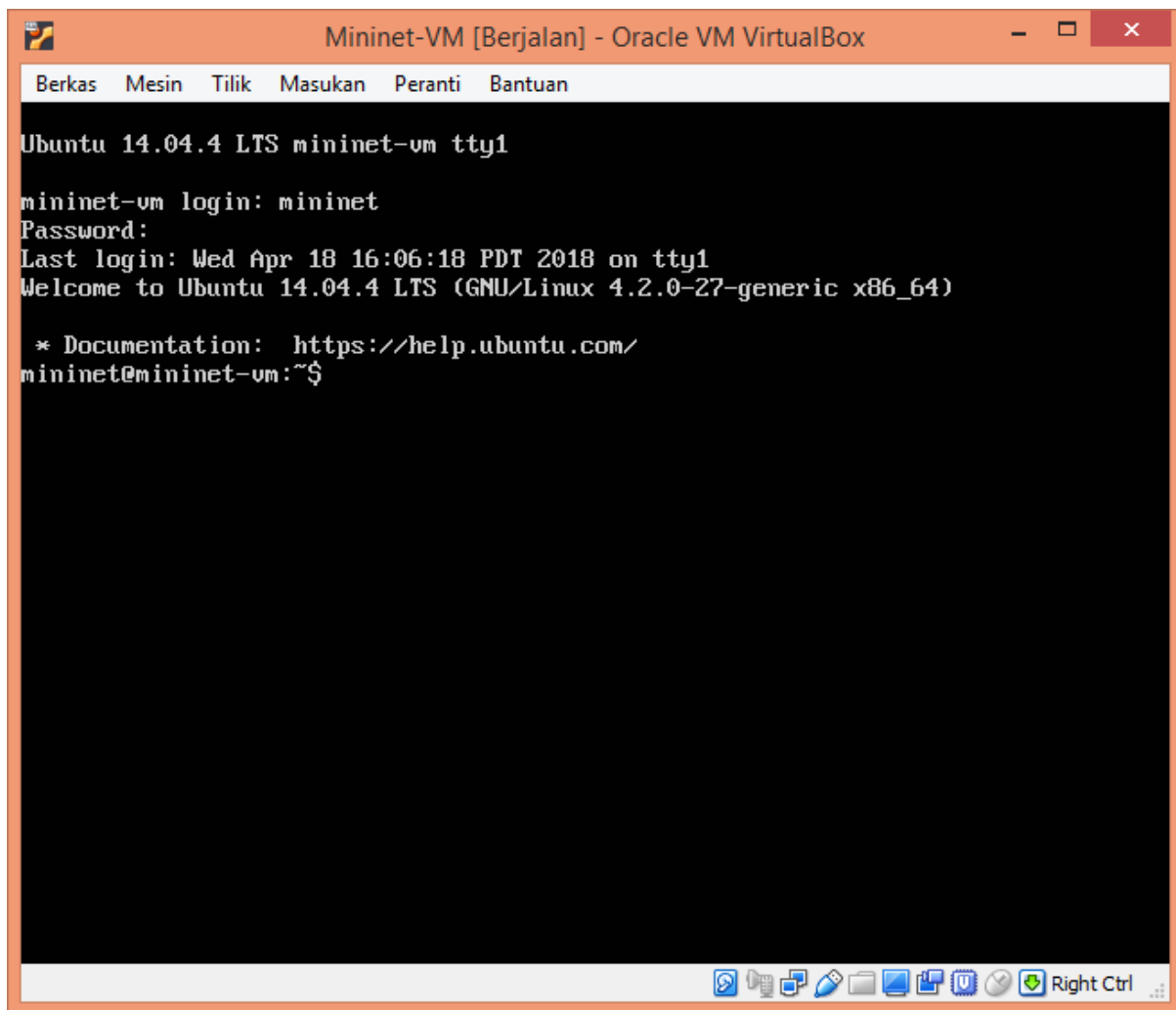
Setelah proses *impor* selesai, lakukan pengaturan untuk mengintegrasikannya dengan RYU. Caranya, dengan pergi ke menu **Pengaturan > Jaringan**. Lakukan langkah pengaturan **Network** Virtual Machine Mininet sama seperti pengaturan pada Virtual Machine Ubuntu Server sebelumnya. Kemudian klik **Penerusan Port**.



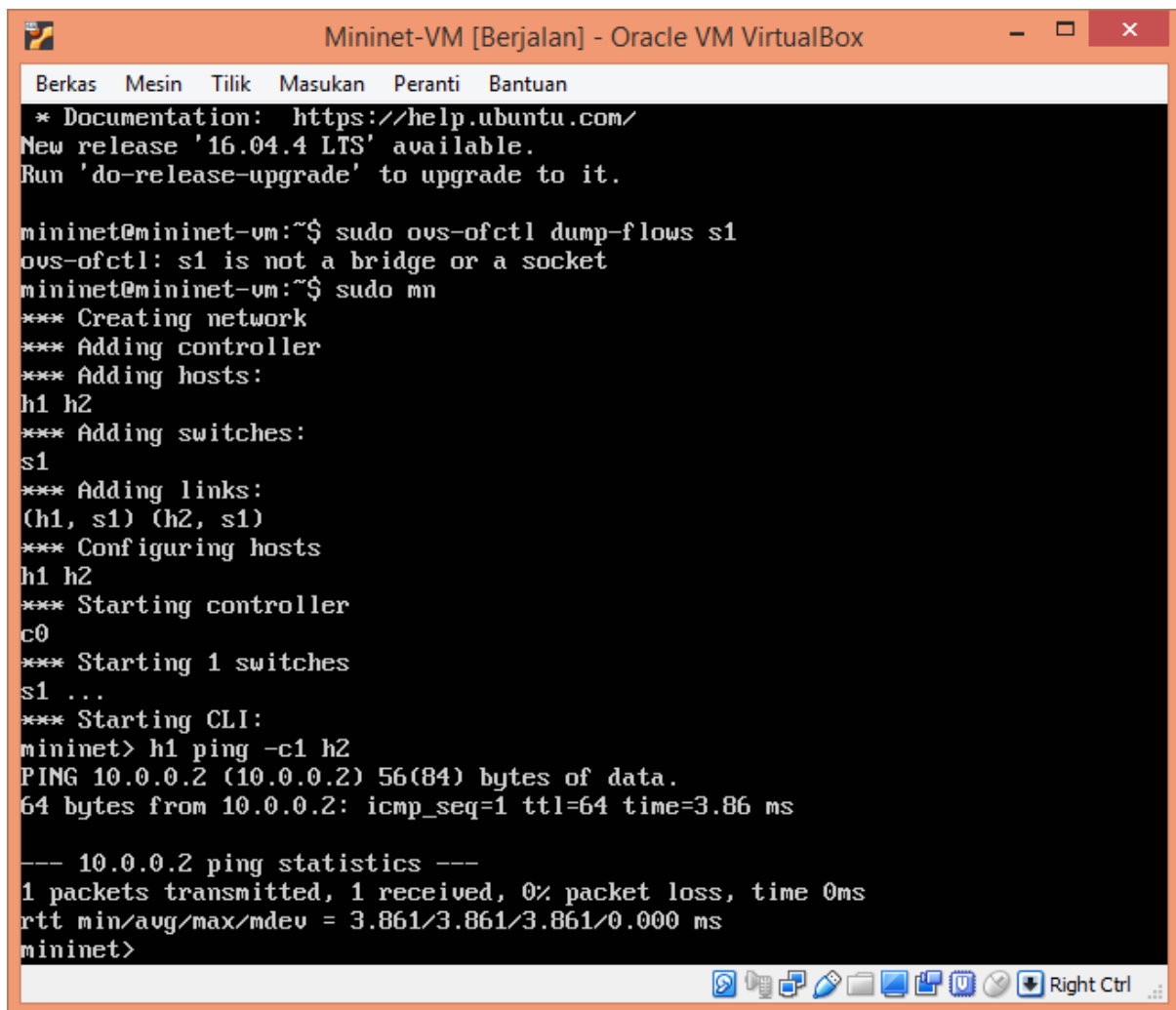
Kemudian isi Rule 1 seperti dibawah ini



Setelah itu, run VM dan masukkan Username dan Password : **mininet**.



Kemudian access via SSH



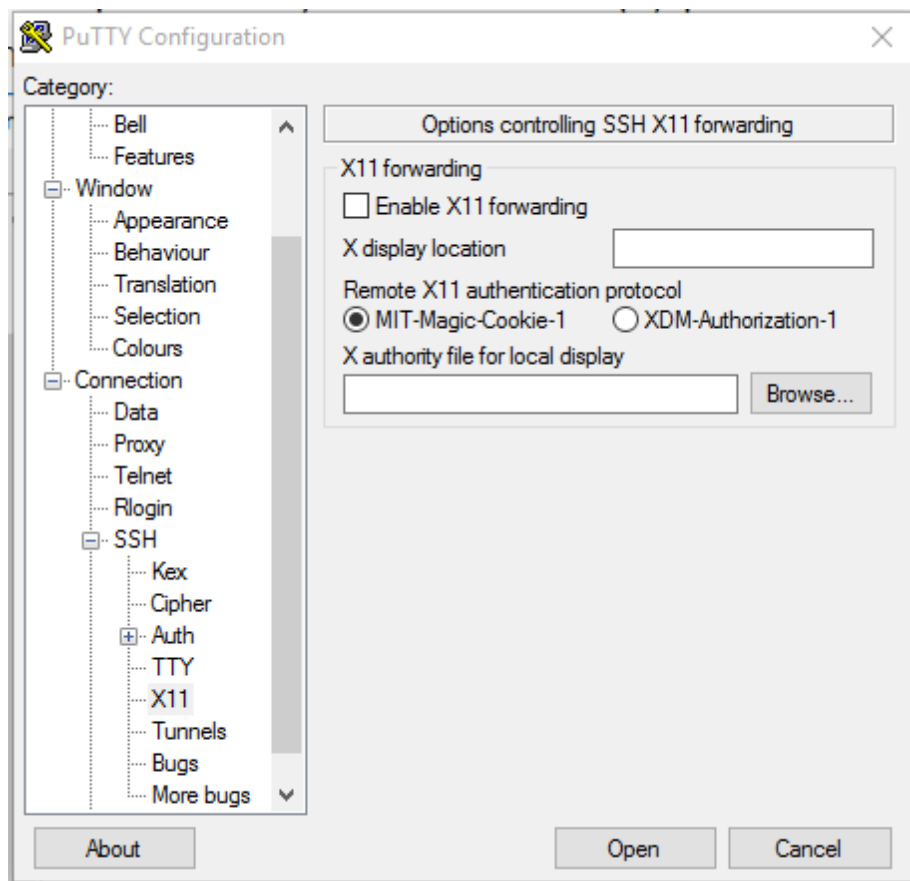
```
Mininet-VM [Berjalan] - Oracle VM VirtualBox
Berkas  Mesin  Tilik  Masukan  Peranti  Bantuan
* Documentation: https://help.ubuntu.com/
New release '16.04.4 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

mininet@mininet-vm:~$ sudo ovs-ofctl dump-flows s1
ovs-ofctl: s1 is not a bridge or a socket
mininet@mininet-vm:~$ sudo mn
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet> h1 ping -c1 h2
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=3.86 ms

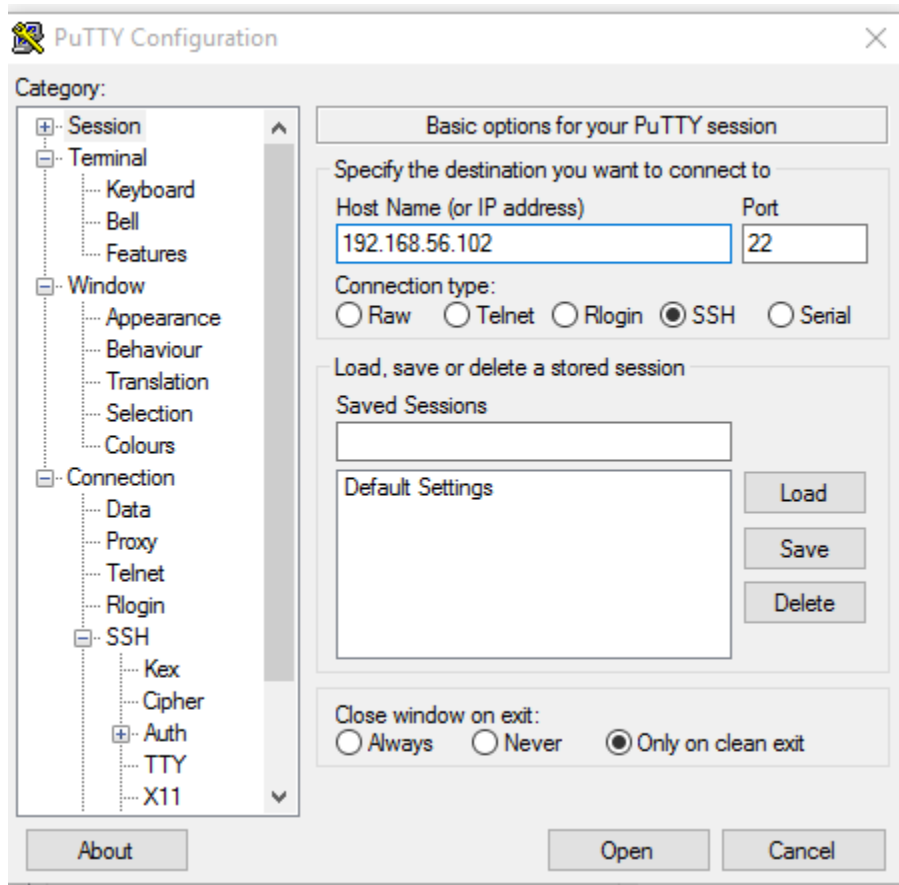
--- 10.0.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 3.861/3.861/3.861/0.000 ms
mininet>
```

Kemudian remote Mininet-VM dengan SSH, jika menggunakan windows, bisa menggunakan Putty.

Terlebih dahulu install dan jalankan dulu X ming X server for Windows. Setelah di install, buka aplikasi Putty.exe – klik icon (+) pada SSH – centang enable X11 Forwarding.



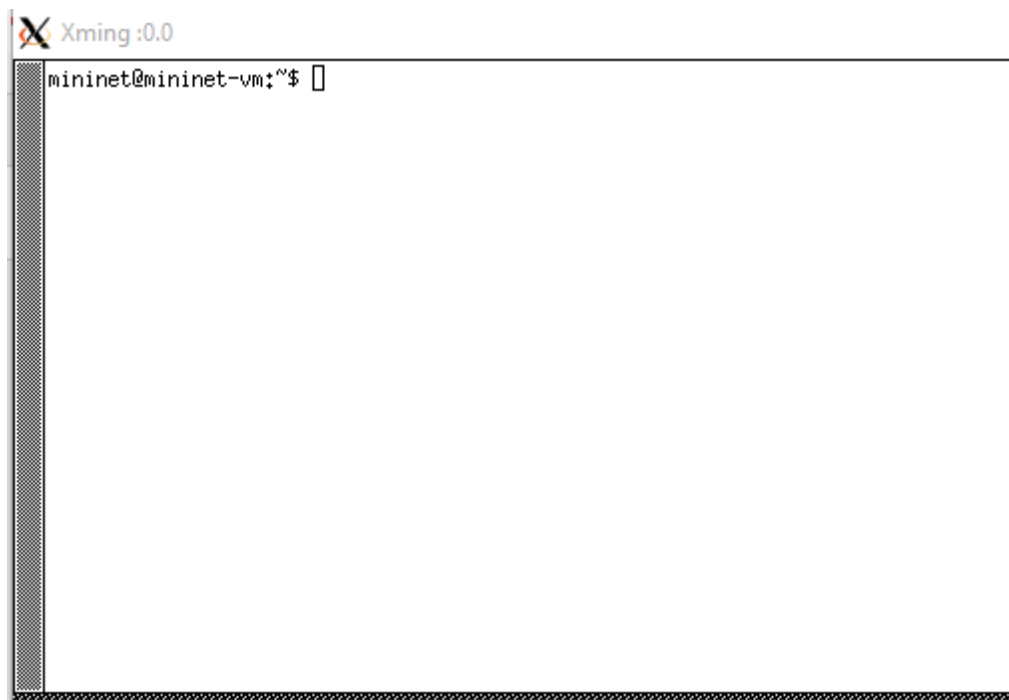
Kemudian , pilih session , dan masukan IP yang kita buat pada VM Image tadi



Lalu ketikkan perintah `xterm -sb &` pada SSH yang tadi :

```
mininet@mininet-vm: ~  
login as: mininet  
mininet@192.168.56.103's password:  
Welcome to Ubuntu 14.04 LTS (GNU/Linux 3.13.0-24-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com/  
Last login: Sat Nov  5 01:02:15 2016  
/usr/bin/xauth:  file /home/mininet/.Xauthority does not exist  
mininet@mininet-vm:~$ xterm -sb &
```


Kemudian akan muncul tampilan seperti ini :

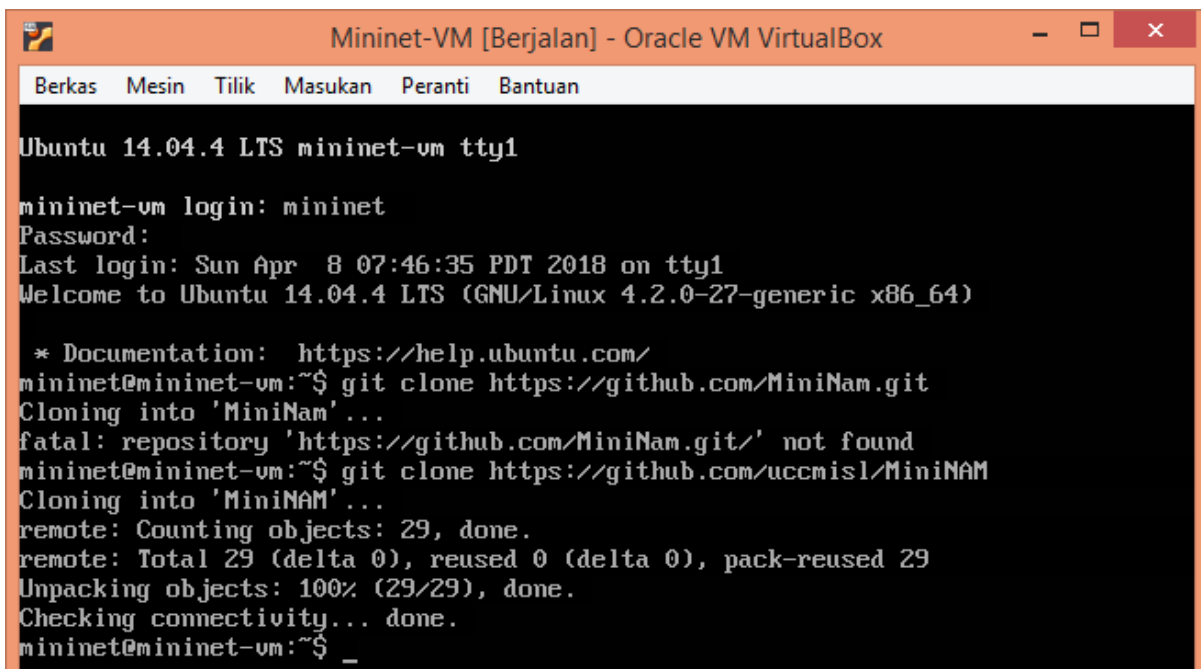


MININAM

MiniNAM memungkinkan modifikasi dinamis preferensi dan filter paket: pengguna dapat melihat arus selektif dengan opsi untuk paket kode warna berdasarkan sumber / node tujuan dan / atau jenis paket.

MiniNAM adalah alat berbasis GUI yang ditulis dengan Python Tkinter. Ini menyediakan animasi real-time dari jaringan apa pun yang dibuat oleh emulator Mininet. MiniNAM mencakup semua komponen yang diperlukan untuk memulai, memvisualisasikan dan memodifikasi aliran jaringan Mininet secara real-time.

Install MiniNAM dengan command “git clone <https://github.com/uccmisl/MiniNam.git>” kemudian akan menampilkan hasil seperti ini



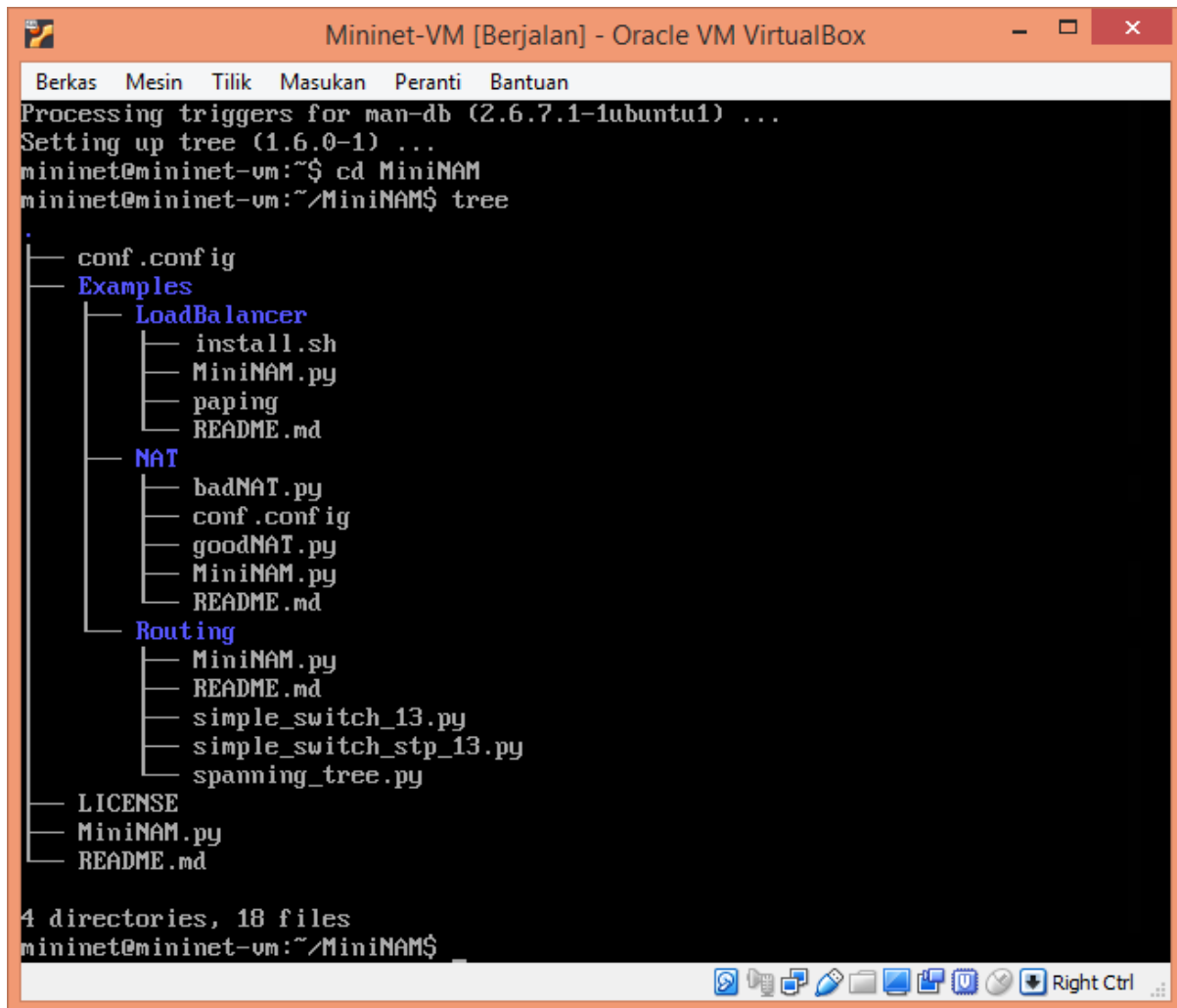
```
Mininet-VM [Berjalan] - Oracle VM VirtualBox
Berkas Mesin Tilik Masukan Peranti Bantuan

Ubuntu 14.04.4 LTS mininet-vm tty1

mininet-vm login: mininet
Password:
Last login: Sun Apr  8 07:46:35 PDT 2018 on tty1
Welcome to Ubuntu 14.04.4 LTS (GNU/Linux 4.2.0-27-generic x86_64)

 * Documentation:  https://help.ubuntu.com/
mininet@mininet-vm:~$ git clone https://github.com/MiniNam.git
Cloning into 'MiniNam'...
fatal: repository 'https://github.com/MiniNam.git/' not found
mininet@mininet-vm:~$ git clone https://github.com/uccmisl/MiniNAM
Cloning into 'MiniNAM'...
remote: Counting objects: 29, done.
remote: Total 29 (delta 0), reused 0 (delta 0), pack-reused 29
Unpacking objects: 100% (29/29), done.
Checking connectivity... done.
mininet@mininet-vm:~$ _
```

Kemudian tampilkan tree MiniNAM dengan mengetik “tree”.



```
Mininet-VM [Berjalan] - Oracle VM VirtualBox
Berkas Mesin Tilik Masukan Peranti Bantuan
Processing triggers for man-db (2.6.7.1-1ubuntu1) ...
Setting up tree (1.6.0-1) ...
mininet@mininet-vm:~$ cd MiniNAM
mininet@mininet-vm:~/MiniNAM$ tree
.
├── conf.config
├── Examples
│   ├── LoadBalancer
│   │   ├── install.sh
│   │   ├── MiniNAM.py
│   │   ├── paping
│   │   └── README.md
│   └── NAT
│       ├── badNAT.py
│       ├── conf.config
│       ├── goodNAT.py
│       ├── MiniNAM.py
│       └── README.md
├── Routing
│   ├── MiniNAM.py
│   ├── README.md
│   ├── simple_switch_13.py
│   ├── simple_switch_stp_13.py
│   └── spanning_tree.py
├── LICENSE
├── MiniNAM.py
└── README.md

4 directories, 18 files
mininet@mininet-vm:~/MiniNAM$
```

Setelah itu MiniNAM install Python Imaging menggunakan perintah “sudo apt-get-install git python-imaging”, akan menampilkan hasil seperti ini

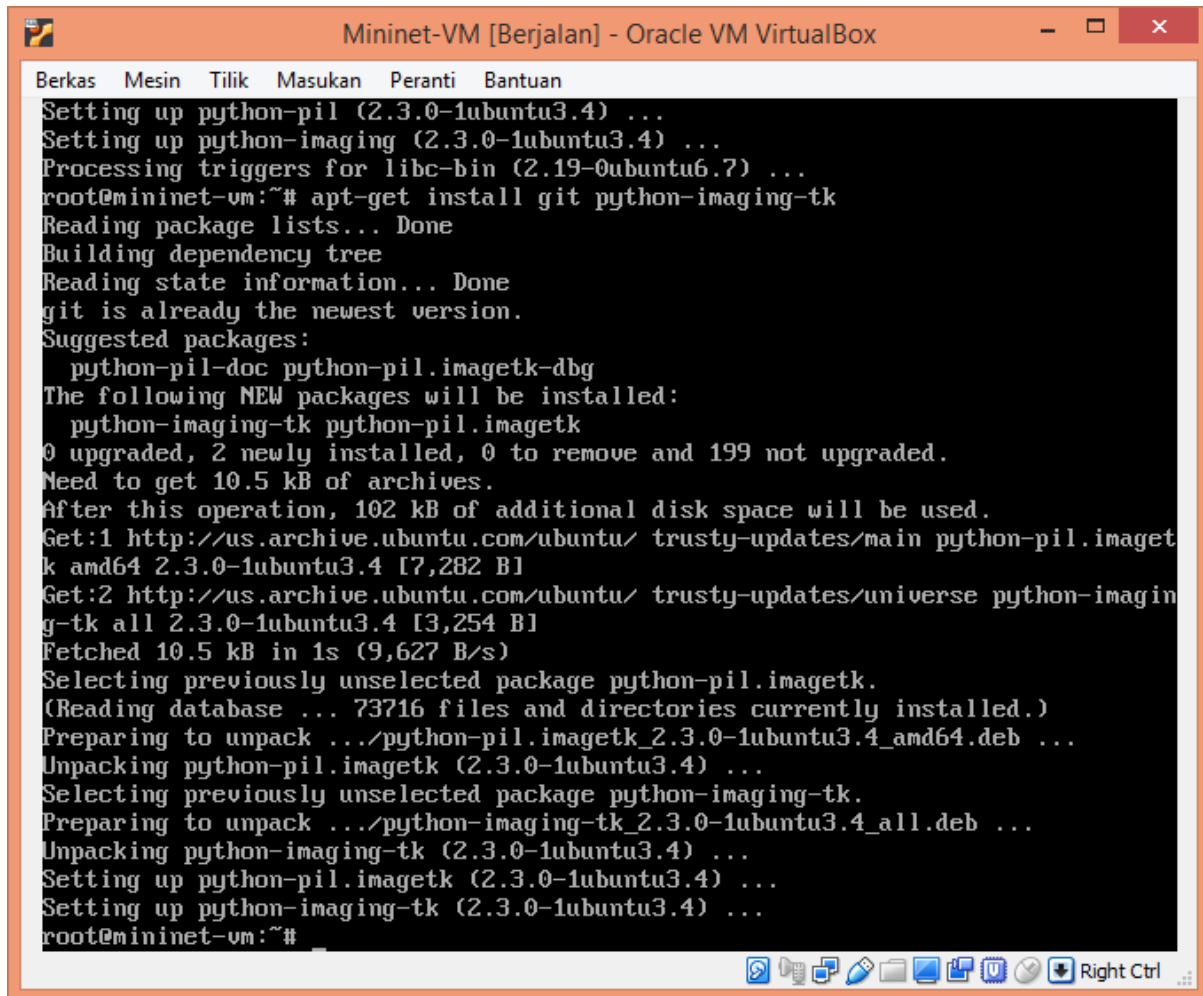
Mininet-VM [Berjalan] - Oracle VM VirtualBox

Berkas Mesin Tilik Masukan Peranti Bantuan

```
Hit http://us.archive.ubuntu.com trusty/restricted i386 Packages
Hit http://us.archive.ubuntu.com trusty/universe i386 Packages
Hit http://us.archive.ubuntu.com trusty/multiverse i386 Packages
Hit http://us.archive.ubuntu.com trusty/main Translation-en
Hit http://us.archive.ubuntu.com trusty/multiverse Translation-en
Hit http://us.archive.ubuntu.com trusty/restricted Translation-en
Hit http://us.archive.ubuntu.com trusty/universe Translation-en
Ign http://us.archive.ubuntu.com trusty/main Translation-en_US
Ign http://us.archive.ubuntu.com trusty/multiverse Translation-en_US
Ign http://us.archive.ubuntu.com trusty/restricted Translation-en_US
Ign http://us.archive.ubuntu.com trusty/universe Translation-en_US
Fetched 106 kB in 25s (4,191 B/s)
Reading package lists... Done
root@mininet-vm:~# apt-get install git python-imaging
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  libwebp5 libwebpmux1 python-pil
Suggested packages:
  git-daemon-run git-daemon-sysvinit git-doc git-el git-email git-gui gitweb
  git-arch git-bzr git-cvs git-mediawiki git-svn python-pil-doc python-pil-dbg
The following NEW packages will be installed:
  libwebp5 libwebpmux1 python-imaging python-pil
The following packages will be upgraded:
  git
1 upgraded, 4 newly installed, 0 to remove and 199 not upgraded.
Need to get 2,697 kB of archives.
After this operation, 1,636 kB of additional disk space will be used.
Do you want to continue? [Y/n]
```

Right Ctrl

Dan “sudo apt-get install git python-imaging”



```
Mininet-VM [Berjalan] - Oracle VM VirtualBox
Berkas  Mesin  Tilik  Masukan  Peranti  Bantuan
Setting up python-pil (2.3.0-1ubuntu3.4) ...
Setting up python-imaging (2.3.0-1ubuntu3.4) ...
Processing triggers for libc-bin (2.19-0ubuntu6.7) ...
root@mininet-vm:~# apt-get install git python-imaging-tk
Reading package lists... Done
Building dependency tree
Reading state information... Done
git is already the newest version.
Suggested packages:
  python-pil-doc python-pil.imagetk-dbg
The following NEW packages will be installed:
  python-imaging-tk python-pil.imagetk
0 upgraded, 2 newly installed, 0 to remove and 199 not upgraded.
Need to get 10.5 kB of archives.
After this operation, 102 kB of additional disk space will be used.
Get:1 http://us.archive.ubuntu.com/ubuntu/ trusty-updates/main python-pil.imagetk amd64 2.3.0-1ubuntu3.4 [7,282 B]
Get:2 http://us.archive.ubuntu.com/ubuntu/ trusty-updates/universe python-imaging-tk all 2.3.0-1ubuntu3.4 [3,254 B]
Fetched 10.5 kB in 1s (9,627 B/s)
Selecting previously unselected package python-pil.imagetk.
(Reading database ... 73716 files and directories currently installed.)
Preparing to unpack .../python-pil.imagetk_2.3.0-1ubuntu3.4_amd64.deb ...
Unpacking python-pil.imagetk (2.3.0-1ubuntu3.4) ...
Selecting previously unselected package python-imaging-tk.
Preparing to unpack .../python-imaging-tk_2.3.0-1ubuntu3.4_all.deb ...
Unpacking python-imaging-tk (2.3.0-1ubuntu3.4) ...
Setting up python-pil.imagetk (2.3.0-1ubuntu3.4) ...
Setting up python-imaging-tk (2.3.0-1ubuntu3.4) ...
root@mininet-vm:~#
```

OPENFLOW

OpenFlow adalah protokol yang digunakan oleh controller SDN untuk berkomunikasi dengan infrastruktur jaringannya. Kemudian berbicara mengenai openflow network/SDN pasti akan menyinggung masalah pemilihan controller. Controller merupakan bagian yang sangat vital pada arsitektur SDN. Karena controller lah yang akan mendefinisikan jaringan, mengatur masalah availability, lajur traffic data, routing dan forwarding dll.

Pertama, buat topologi 3 host 1 switch dan kemudian ping.

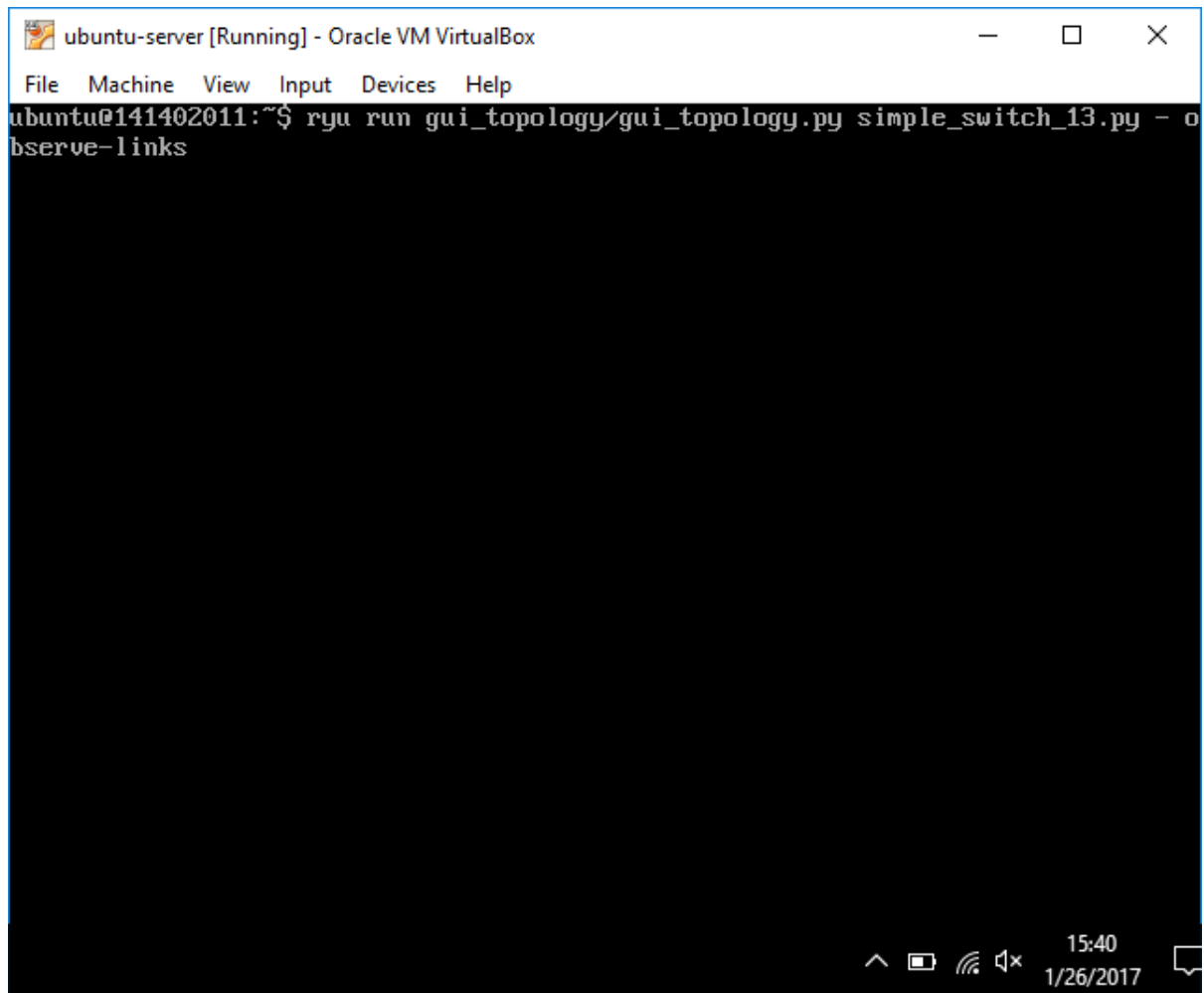
```
mininet> sh ovs-pfctl dump-flows s1
/bin/sh: 1: ovs-pfctl: not found
mininet> sh ovs-pfctl dump-flows s1
/bin/sh: 1: ovs-pfctl: not found
mininet> h1 ping -c3 h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
From 10.0.0.1 icmp_seq=1 Destination Host Unreachable
From 10.0.0.1 icmp_seq=2 Destination Host Unreachable
From 10.0.0.1 icmp_seq=3 Destination Host Unreachable

--- 10.0.0.2 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2014ms
pipe 3
mininet>
```

```
mininet> h1 ping -c3 h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
From 10.0.0.1 icmp_seq=1 Destination Host Unreachable
From 10.0.0.1 icmp_seq=2 Destination Host Unreachable
From 10.0.0.1 icmp_seq=3 Destination Host Unreachable

--- 10.0.0.2 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2016ms
pipe 3
mininet>
```

Integrasikan Mininet Dengan RYU Menggunakan Protokol OpenFlow 1.3, Pastikan Bahwa Telah Berhasil Konektivitas Antara RYU Dengan Mininet. Integrasi Mininet dan RYU dilakukan dengan menggunakan protokol OpenFlow 1.3. Jalankan perintah “ryu run gui_topology/gui_topology.py simple_switch_13.py –observe-links”.

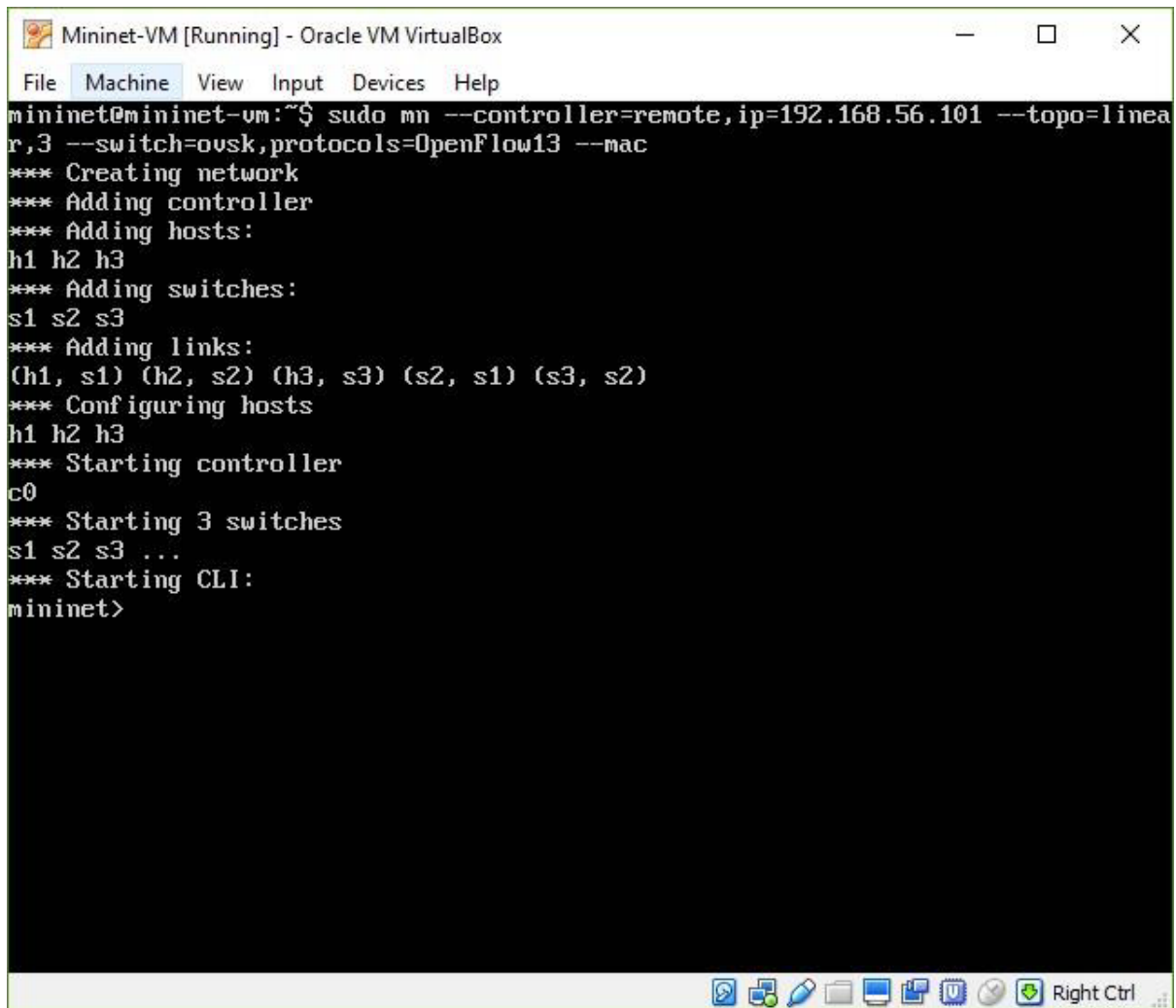


The image shows a terminal window titled "ubuntu-server [Running] - Oracle VM VirtualBox". The window has a menu bar with "File", "Machine", "View", "Input", "Devices", and "Help". The terminal prompt is "ubuntu@141402011:~\$". The command entered is "ryu run gui_topology/gui_topology.py simple_switch_13.py -o bserve-links". The terminal output is currently blank. The bottom status bar shows system icons, the time "15:40", and the date "1/26/2017".

```
ubuntu-server [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
ubuntu@141402011:~$ ryu run gui_topology/gui_topology.py simple_switch_13.py -o
bserve-links
```

IP *address* dapat dilihat dengan perintah **ifconfig** pada Ubuntu Server yaitu inet **eth1**.

Buka Mininet dan jalankan perintah berikut “**sudo mn – controller=remote,ip=192.168.56.101 –topo=linear,3 – switch=ovsk,protocols=OpenFlow13 –mac.**”



```
Mininet-VM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
mininet@mininet-vm:~$ sudo mn --controller=remote,ip=192.168.56.101 --topo=linear,3 --switch=ovsk,protocols=OpenFlow13 --mac
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3
*** Adding switches:
s1 s2 s3
*** Adding links:
(h1, s1) (h2, s2) (h3, s3) (s2, s1) (s3, s2)
*** Configuring hosts
h1 h2 h3
*** Starting controller
c0
*** Starting 3 switches
s1 s2 s3 ...
*** Starting CLI:
mininet>
```

POX CONTROLLER

Pox controller adalah sebuah platform pengembangan open source untuk aplikasi software developed network yang berdasarkan pada bahasa pemrograman Python dan merupakan kontroler OpenFlow.

Melihat pox controller file pada Mininet dengan mengetik “tree -L 1 -d” kemudian masuk ke folder misc, lalu ketik ll. Jika berhasil akan tampil seperti ini :


```
Mininet-VM [Berjalan] - Oracle VM VirtualBox
Berkas Mesin Tilik Masukan Peranti Bantuan
mininet@mininet-vm:~$ tree -L 1 -d
.
├── loxigen
├── MininetM
├── mininet
├── of_lops
├── oftest
├── openflow
└── pox

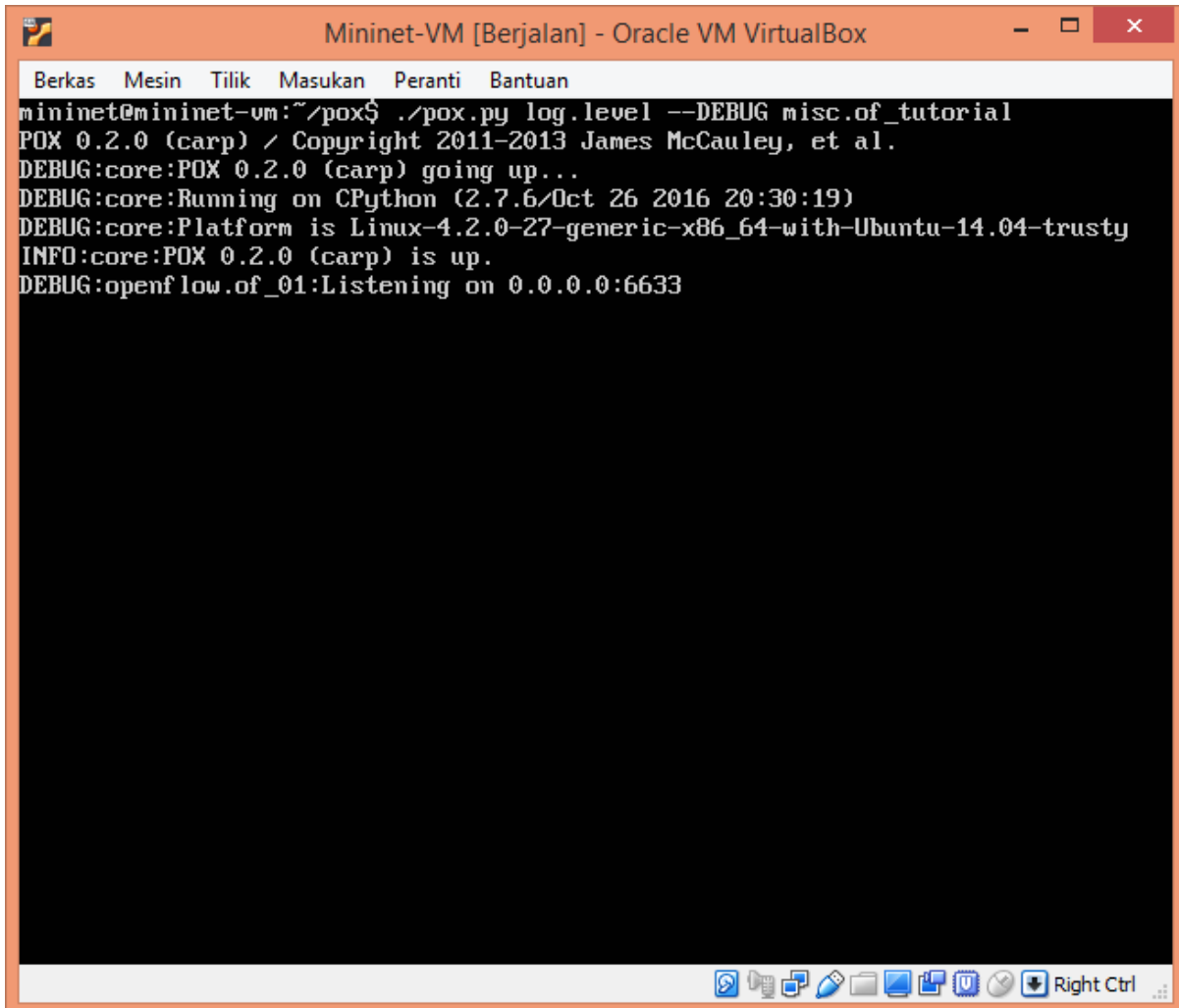
7 directories
mininet@mininet-vm:~$ cd pox
mininet@mininet-vm:~/pox$ cd pox/misc
mininet@mininet-vm:~/pox/pox/misc$ ll
total 76
drwxrwxr-x 3 mininet mininet 4096 Mar 21 2017 ./
drwxrwxr-x 15 mininet mininet 4096 Mar 21 2017 ../
-rw-rw-r-- 1 mininet mininet 1240 Mar 21 2017 cbench.py
-rw-rw-r-- 1 mininet 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$
```

Dan kemudian masuk ke folder forwarding dan ketik “ll”.

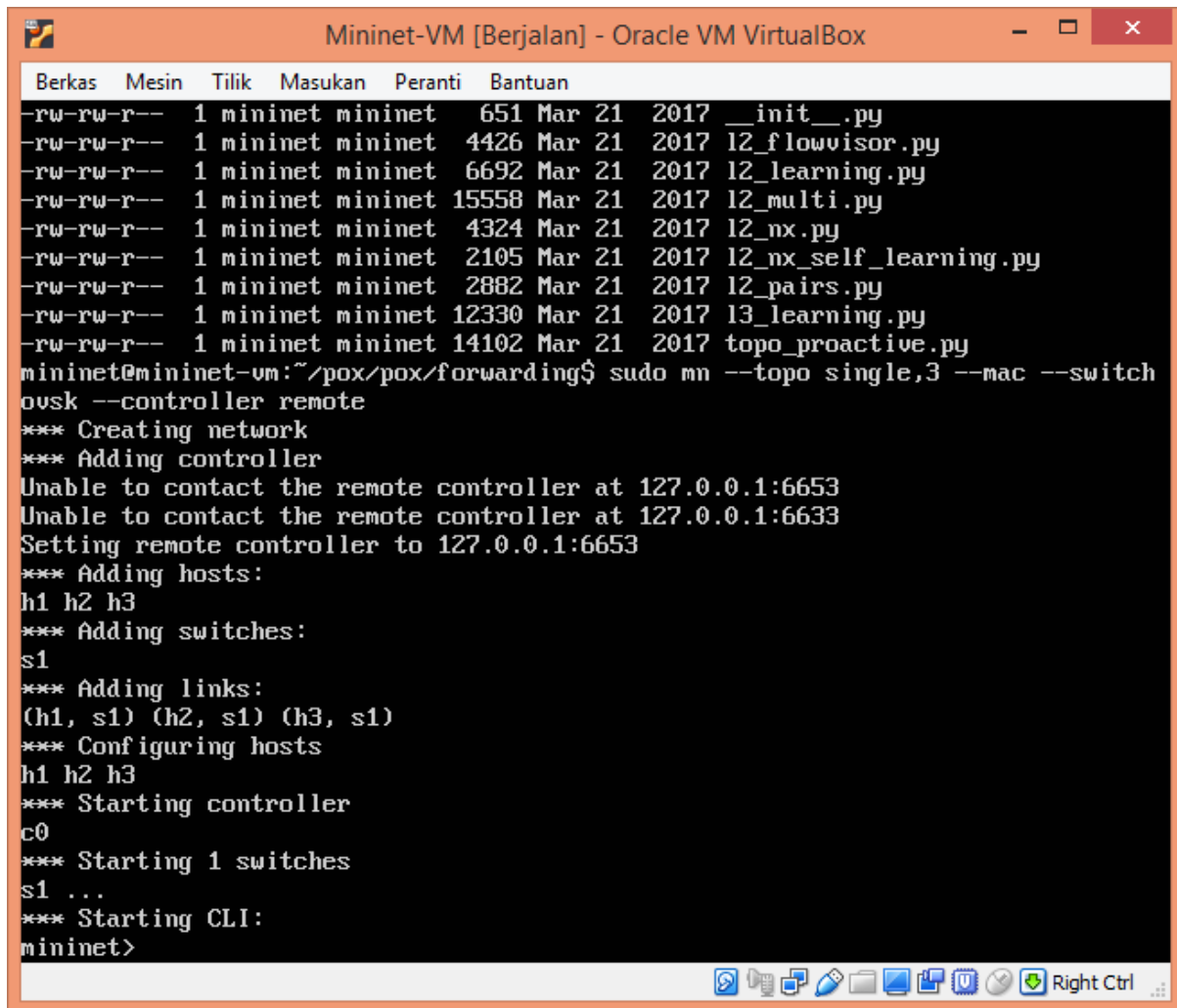
```
Mininet-VM [Berjalan] - Oracle VM VirtualBox
Berkas Mesin Tilik Masukan Peranti Bantuan
total 76
drwxrwxr-x 3 mininet mininet 4096 Mar 21 2017 ./
drwxrwxr-x 15 mininet mininet 4096 Mar 21 2017 ../
-rw-rw-r-- 1 mininet mininet 1240 Mar 21 2017 cbench.py
-rw-rw-r-- 1 mininet mininet 1079 Mar 21 2017 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:~/pox/pox$ cd 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$
```

Setelah itu, mulai pox controller dengan './pox.py log.level --DEBUG misc.of_tutorial pada directory pox'. kita coba membuat network pada terminal

lain dengan mengetik “sudo mn --topo single,3 --mac --witch ovsk --controller remote”.



```
Mininet-VM [Berjalan] - Oracle VM VirtualBox
Berkas  Mesin  Tilik  Masukan  Peranti  Bantuan
mininet@mininet-vm:~/pox$ ./pox.py log.level --DEBUG misc.of_tutorial
POX 0.2.0 (carp) / Copyright 2011-2013 James McCauley, et al.
DEBUG:core:POX 0.2.0 (carp) 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 0.2.0 (carp) is up.
DEBUG:openflow.of_01:Listening on 0.0.0.0:6633
```



```
Berkas  Mesin  Tilik  Masukan  Peranti  Bantuan
-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$ 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
s1 ...
*** Starting CLI:
mininet>
```

Kemudian mulai membuka terminal untuk node 1,2, dan 3 dengan perintah 'xterm h1 h2 h3' pada console jaringan yang akan memunculkan 3 terminal untuk masing-masing node.

Berikan perintah '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, perintah tersebut memerintahkan terminal node untuk merekam aktivitas node dan menyimpannya pada file h2.txt dan h3.txt.