



# Vidyavardhini's College of Engineering and Technology

Department of Artificial Intelligence & Data Science

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Experiment No.10
Simulation of software defined network using mininet
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**Aim:** To simulate a Software Defined Network (SDN) environment using Mininet and observe communication between hosts.

**Objective:**

To understand the concept of Software Defined Networking

To simulate a virtual network topology using Mininet

To configure and test connectivity between hosts using ping command

To integrate a controller (such as POX/OVS) for centralized control of the

**SDN Requirement:**

Ubuntu Linux (or VM with Ubuntu installed)

Mininet installed (mininet.org)

Open vSwitch (default in Mininet)

Python support for running Mininet scripts

**Theory:**

Software Defined Networking (SDN) is a networking paradigm that separates the control plane from the data plane. In SDN, a central controller manages the flow of traffic in the network, while switches and routers only forward packets based on rules defined by the controller.

Mininet is a popular network emulator that can create a realistic virtual network with hosts, switches, and controllers on a single machine. It allows testing of SDN applications quickly and efficiently. Key components:

**Host:** Represents end devices in the network

**Switch:** Open vSwitch used for packet forwarding

**Controller:** Centralized controller (like POX, Ryu, ONOS) that manages the network  
**Link:** Virtual connections between hosts, switches, and controllers

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Procedure:

Step 1: Launch Mininet

Open a terminal in Ubuntu and run:

```
sudo mn --topo single,3 --mac --switch ovsk --controller remote
```

This command creates a simple topology with 1 switch and 3 hosts.

Step 2: Test connectivity

Use the command:

```
pingall
```

This sends ICMP packets between all hosts to verify connectivity.

Step 3: Start Mininet CLI

Run commands inside Mininet CLI:

```
h1 ping h2
```

```
h1 ping h3
```

Step 4: Create custom topology using Python

Create a Python script (topo.py):

```
from mininet.topo import Topo
from mininet.net import Mininet
from mininet.node import RemoteController
from mininet.cli import CLI

class MyTopo(Topo):
    def build(self):
        h1 = self.addHost('h1')
        h2 = self.addHost('h2')
        s1 = self.addSwitch('s1')
        self.addLink(h1, s1)
        self.addLink(h2, s1)

topo = MyTopo()
net = Mininet(topo=topo, controller=RemoteController)
net.start()
CLI(net)
net.stop()
```

Run the script using:

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```
sudo python3 topo.py
```

## Step 5: Attach a controller

Install and run POX controller:

git clone <https://github.com/noxrepo/pox.git>

cd pox

./pox.py forwarding.l2\_learning

## Step 6: Connect Mininet to POX controller

Run Mininet with remote controller option:

sudo mn --controller=remote,ip=127.0.0.1,port=6633

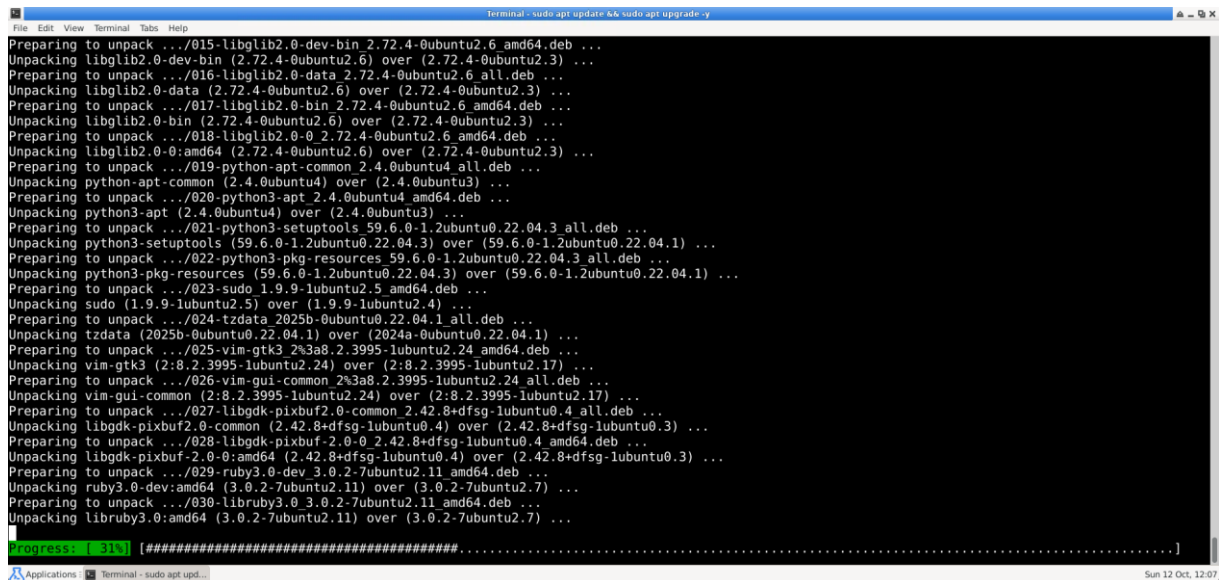
Output:

Pingall shows 100% packet delivery between hosts

Hosts communicate via switch controlled by the SDN controller

Routing and forwarding decisions are handled dynamically by the controller

Output:-



```
terminal - sudo apt update && sudo apt upgrade -y
File Edit View Terminal Tabs Help
Preparing to unpack .../015-libgl1-mesa-dev-bin_2.72.4-0ubuntu2.6_amd64.deb ...
Unpacking libgl1-mesa-dev-bin (2.72.4-0ubuntu2.6) over (2.72.4-0ubuntu2.3) ...
Preparing to unpack .../016-libgl1-mesa-data_2.72.4-0ubuntu2.6_all.deb ...
Unpacking libgl1-mesa-data (2.72.4-0ubuntu2.6) over (2.72.4-0ubuntu2.3) ...
Preparing to unpack .../017-libgl1-mesa-bin_2.72.4-0ubuntu2.6_amd64.deb ...
Unpacking libgl1-mesa-bin (2.72.4-0ubuntu2.6) over (2.72.4-0ubuntu2.3) ...
Preparing to unpack .../018-libgl1-mesa-0_2.72.4-0ubuntu2.6_amd64.deb ...
Unpacking libgl1-mesa-0:amd64 (2.72.4-0ubuntu2.6) over (2.72.4-0ubuntu2.3) ...
Preparing to unpack .../019-python-apt-common_2.4.0ubuntu4_all.deb ...
Unpacking python-apt-common (2.4.0ubuntu4) over (2.4.0ubuntu3) ...
Preparing to unpack .../020-python3-apt_2.4.0ubuntu4_amd64.deb ...
Unpacking python3-apt (2.4.0ubuntu4) over (2.4.0ubuntu3) ...
Preparing to unpack .../021-python3-setuptools_59.6.0-1.2ubuntu0.22.04.3_all.deb ...
Unpacking python3-setuptools (59.6.0-1.2ubuntu0.22.04.3) over (59.6.0-1.2ubuntu0.22.04.1) ...
Preparing to unpack .../022-python3-pkg-resources_59.6.0-1.2ubuntu0.22.04.3_all.deb ...
Unpacking python3-pkg-resources (59.6.0-1.2ubuntu0.22.04.3) over (59.6.0-1.2ubuntu0.22.04.1) ...
Preparing to unpack .../023-sudo_1.9.9-1ubuntu2.5_amd64.deb ...
Unpacking sudo (1.9.9-1ubuntu2.5) over (1.9.9-1ubuntu2.4) ...
Preparing to unpack .../024-tzdata_2025b-0ubuntu0.22.04.1_all.deb ...
Unpacking tzdata (2025b-0ubuntu0.22.04.1) over (2024a-0ubuntu0.22.04.1) ...
Preparing to unpack .../025-vim-gtk3_2%3a8.2.3995-1ubuntu2.24_amd64.deb ...
Unpacking vim-gtk3 (2:8.2.3995-1ubuntu2.24) over (2:8.2.3995-1ubuntu2.17) ...
Preparing to unpack .../026-vim-gui-common_2%3a8.2.3995-1ubuntu2.24_all.deb ...
Unpacking vim-gui-common (2:8.2.3995-1ubuntu2.24) over (2:8.2.3995-1ubuntu2.17) ...
Preparing to unpack .../027-libgdk-pixbuf2.0-common_2.42.8+dfsg-1ubuntu0.4_all.deb ...
Unpacking libgdk-pixbuf2.0-common (2.42.8+dfsg-1ubuntu0.4) over (2.42.8+dfsg-1ubuntu0.3) ...
Preparing to unpack .../028-libgdk-pixbuf2.0_2.42.8+dfsg-1ubuntu0.4_amd64.deb ...
Unpacking libgdk-pixbuf2.0:amd64 (2.42.8+dfsg-1ubuntu0.4) over (2.42.8+dfsg-1ubuntu0.3) ...
Preparing to unpack .../029-ruby3.0-dev_3.0.2-7ubuntu2.11_amd64.deb ...
Unpacking ruby3.0-dev:amd64 (3.0.2-7ubuntu2.11) over (3.0.2-7ubuntu2.7) ...
Preparing to unpack .../030-libruby3.0_3.0.2-7ubuntu2.11_amd64.deb ...
Unpacking libruby3.0:amd64 (3.0.2-7ubuntu2.11) over (3.0.2-7ubuntu2.7) ...
Progress: [ 31%] [#####]
Applications Terminal - sudo apt upd... Sun 12 Oct, 12:07
```

```
Terminal - labex@68eb288d0f92ec70f139cd6b:/  
File Edit View Terminal Tabs Help  
Setting up python3-dev (3.10.6-1~22.04.1) ...  
Setting up python3-pip (22.0.2+dfsg-1ubuntu0.7) ...  
Setting up gfortran-11 (11.4.0-1ubuntu1~22.04.2) ...  
Setting up libwebkit2gtk-4.0-37:amd64 (2.48.7-0ubuntu0.22.04.2) ...  
Setting up openjdk-17-source (17.0.16+8~us1-0ubuntu1~22.04.1) ...  
Setting up libyelp0:amd64 (42.1-1ubuntu0.1) ...  
Setting up apport (2.20.11-0ubuntu82.10) ...  
Installing new version of config file /etc/init.d/apport ...  
invoke-rc.d: could not determine current runlevel  
invoke-rc.d: policy-rc.d denied execution of restart.  
Setting up yelp (42.1-1ubuntu0.1) ...  
Setting up language-pack-zh-hans (1:22.04+20240902) ...  
Setting up language-pack-zh-hans-base (1:22.04+20240902) ...  
Generating locales (this might take a while)...  
Generation complete.  
Setting up language-pack-gnome-zh-hans (1:22.04+20240902) ...  
Setting up language-pack-gnome-zh-hans-base (1:22.04+20240902) ...  
Processing triggers for mailcap (3.70+nmu1ubuntu1) ...  
Processing triggers for desktop-file-utils (0.26-1ubuntu3) ...  
Processing triggers for hicolor-icon-theme (0.17-2) ...  
Processing triggers for libc-bin (2.35-0ubuntu3.11) ...  
Processing triggers for man-db (2.10.2-1) ...  
Processing triggers for plymouth-theme-ubuntu-text (0.9.5+git20211018-1ubuntu3) ...  
Processing triggers for dbus (1.12.20-2ubuntu4.1) ...  
Processing triggers for ca-certificates (20240203~22.04.1) ...  
Updating certificates in /etc/ssl/certs...  
0 added, 0 removed; done.  
Running hooks in /etc/ca-certificates/update.d...  
  
done.  
done.  
labex:// $
```

```
Applications | Terminal - labex@68eb288d0f92ec70f139cd6b: /  
Your First Linux Lab | Quick Start  
https://labex.io/labs/linux-your-first-linux-lab-270253?course=quick-start-with-linux&hideheader=true&hidelabby=true  
File Edit View Terminal Tabs Help  
Selecting previously unselected package openvswitch-switch.  
Preparing to unpack .../11-openvswitch-switch_2.17.9-0ubuntu0.22.04.1_amd64.deb ...  
Unpacking openvswitch-switch (2.17.9-0ubuntu0.22.04.1) ...  
Setting up python3-sortedcontainers (2.1.0-2) ...  
Setting up python3-openvswitch (2.17.9-0ubuntu0.22.04.1) ...  
Setting up kmod (29-1ubuntu1) ...  
Setting up libunbound8:amd64 (1.13.1-1ubuntu5.12) ...  
Setting up iperf (2.1.5+dfsg1-1) ...  
Setting up python3-netifaces:amd64 (0.11.0-1build2) ...  
Setting up uuid-runtime (2.37.2-4ubuntu3.4) ...  
Adding group 'uuuid' (GID 124) ...  
Done.  
Warning: The home dir /run/uuuid you specified can't be accessed: No such file or directory  
Adding system user 'uuuid' (UID 115) ...  
Adding new user 'uuuid' (UID 115) with group 'uuuid' ...  
Not creating home directory '/run/uuuid'.  
invoke-rc.d: could not determine current runlevel  
invoke-rc.d: policy-rc.d denied execution of start.  
Created symlink /etc/systemd/system/sockets.target.wants/uuuid.socket → /lib/systemd/system/uuuid.socket.  
Setting up openvswitch-common (2.17.9-0ubuntu0.22.04.1) ...  
Setting up libcgroupl:amd64 (2.0-2) ...  
Setting up openvswitch-switch (2.17.9-0ubuntu0.22.04.1) ...  
update-alternatives: using /usr/lib/openvswitch-switch/ovs-vswitchd to provide /usr/sbin/ovs-vswitchd (ovs-vswitchd) in auto mode  
Created symlink /etc/systemd/system/multi-user.target.wants/openvswitch-switch.service → /lib/systemd/system/openvswitch-switch.service.  
Created symlink /etc/systemd/system/openvswitch-switch.service.requires/ovs-record-hostname.service → /lib/systemd/system/ovs-record-hostname.service.  
invoke-rc.d: could not determine current runlevel  
invoke-rc.d: policy-rc.d denied execution of start.  
Setting up cgroup-tools (2.0-2) ...  
Setting up mininet (2.3.0-1ubuntu1) ...  
Processing triggers for man-db (2.10.2-1) ...  
Processing triggers for libc-bin (2.35-0ubuntu3.11) ...  
labex:// $  
Sun 12 Oct, 12:10
```

```
terminal - labex@68eb28dd0f9ec70f139cdeb:/
File Edit View Terminal Tabs Help
Setting up python3-netifaces:amd64 (0.11.0-1build2) ...
Setting up uuid-runtime (2.37.2-4ubuntu3.4) ...
Adding group 'uuid' (GID 124) ...
Done.
Warning: The home dir /run/uuid you specified can't be accessed: No such file or directory
Adding system user 'uuid' (UID 115) ...
Adding new user 'uuid' (UID 115) with group 'uuid' ...
Not creating home directory '/run/uuid'.
invoke-rc.d: could not determine current runlevel
invoke-rc.d: policy-rc.d denied execution of start.
Created symlink /etc/systemd/system/sockets.target.wants/uuid.socket → /lib/systemd/system/uuid.socket.
Setting up openvswitch-common (2.17.9-0ubuntu0.22.04.1) ...
Setting up libcgroupl:amd64 (2.0-2) ...
Setting up openvswitch-switch (2.17.9-0ubuntu0.22.04.1) ...
update-alternatives: using /usr/lib/openvswitch-switch/ovs-vswitchd to provide /usr/sbin/ovs-vswitchd (ovs-vswitchd) in auto mode
Created symlink /etc/systemd/system/multi-user.target.wants/openvswitch-switch.service → /lib/systemd/system/openvswitch-switch.service.
Created symlink /etc/systemd/system/openvswitch-switch.service.requires/ovs-record-hostname.service → /lib/systemd/system/ovs-record-hostname.service.
invoke-rc.d: could not determine current runlevel
invoke-rc.d: policy-rc.d denied execution of start.
Setting up cgroup-tools (2.0-2) ...
Setting up mininet (2.3.0-1ubuntu1) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.11) ...
labex:/// $ sudo apt install -y openvswitch-switch
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openvswitch-switch is already the newest version (2.17.9-0ubuntu0.22.04.1).
openvswitch-switch set to manually installed.
The following packages were automatically installed and are no longer required:
  gir1.2-libxfce4util-1.0 gir1.2-xfconf-0 gsfons gsfons-x11 libdbus-glib-1-2 libgdk-pixbuf-xlib-2.0-0 libjpeg-turbo-progs miscfiles xscreensaver-data
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
labex:/// $
```

```
terminal - labex@68eb28dd0f9ec70f139cdeb:/
File Edit View Terminal Tabs Help
invoke-rc.d: could not determine current runlevel
invoke-rc.d: policy-rc.d denied execution of start.
Setting up cgroup-tools (2.0-2) ...
Setting up mininet (2.3.0-1ubuntu1) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.11) ...
labex:/// $ sudo apt install -y openvswitch-switch
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openvswitch-switch is already the newest version (2.17.9-0ubuntu0.22.04.1).
openvswitch-switch set to manually installed.
The following packages were automatically installed and are no longer required:
  gir1.2-libxfce4util-1.0 gir1.2-xfconf-0 gsfons gsfons-x11 libdbus-glib-1-2 libgdk-pixbuf-xlib-2.0-0 libjpeg-turbo-progs miscfiles xscreensaver-data
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
labex:/// $ sudo apt install -y python3 python3-pip git
pip3 install --user mininet
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
git is already the newest version (1:2.34.1-1ubuntu1.15).
python3 is already the newest version (3.10.6-1-22.04.1).
python3-pip is already the newest version (22.0.2+dfsg-1ubuntu0.7).
The following packages were automatically installed and are no longer required:
  gir1.2-libxfce4util-1.0 gir1.2-xfconf-0 gsfons gsfons-x11 libdbus-glib-1-2 libgdk-pixbuf-xlib-2.0-0 libjpeg-turbo-progs miscfiles xscreensaver-data
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
Looking in indexes: http://mirrors.cloud.aliyuncs.com/pypi/simple
Requirement already satisfied: mininet in /usr/lib/python3/dist-packages (2.3.0)

[notice] A new release of pip is available: 24.1.2 -> 25.2
[notice] To update, run: python3 -m pip install --upgrade pip
labex:/// $
```

Conclusion:

Simulation of SDN using Mininet demonstrates how networks can be virtualized and centrally managed using controllers. This experiment shows host-to-host connectivity and highlights the role of the controller in defining packet forwarding behavior