Lab 0

Installation and Initial Test of Mininet

CST 311, Introduction to Computer Networks, Spring 2021

**READ INSTRUCTIONS CAREFULLY BEFORE YOU START THE LAB.**

This lab is due on Sunday, Feb 14, 2021.

This lab is worth 50 points. Part 1 of this lab is to set up Virtualbox and Mininet software on your computer along with two other software tools to help you work with Mininet. Part 3 of this document lists what you need to turn in.

Part 1: Installation of VirtualBox and Mininet

Watch Video Recordings to Setup Mininet

In iLearn, there are links to two video recordings by Prof. McCann. You may find these useful to set up a mininet VM on your machine. These are the videos:

1. Installing Mininet VM and configuring Putty on Windows 10
2. Configure Putty to run GUI programs on Mininet VM

Virtual Box

**Oracle VirtualBox** is a free and open-source hosted hypervisor for x86 virtualization. A **hypervisor** is a process that separates a computer’s operating system and applications from the underlying physical hardware. The **hypervisor** allows the physical host machine to operate multiple virtual machines as guests.

1. Go to downloads and get the appropriate VirtualBox installer suitable for your computer.

<https://www.virtualbox.org/wiki/Downloads>

1. Install the executable you downloaded and click next through the default options to complete installation.

Mininet

**Mininet** is an open source software emulator for prototyping a network on a single virtual machine that runs a Linux OS. With Mininet you can create a network of virtual hosts, switches, controllers, and links. A Mininet virtual machine can also be used to emulate Software-Defined Networking (which we will cover in weeks 5 and 6). The emulated devices that Mininet sets up are virtual nodes (or “containers”). Each host created by Mininet can run real Linux commands. The magic behind Mininet’s illusion is a set of features built into Linux that allow a single system to be split into a bunch of smaller “containers”, each with a fixed share of the processing power, combined with virtual link code that allows links with accurate delays and speeds.

1. Go to Download. Under Option 1: Mininet VM Installation (easy, recommended), click on Mininet VM Image link in step 1. It will take you to the following page:

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

1. Download the image file appropriate for your computer and pick the most recent release.

(Note: The file mininet-2.2.2-170321-ubuntu-14.04.4-server-i386.zip is the 32-bit

version.)

Turn virtualization on in BIOS (if necessary)

You will need to turn virtualization on in BIOS of your computer for VirtualBox to work. You may need to look up on the internet for your machine’s specific instructions to turn virtualization on.

Configure a virtual network adapter on the Virtual Box VM.

As described in Professor McCann’s videos, use the Oracle VM Virtual Box Manager to configure Adapter 1 as a NAT interface. Click on the Advanced Tab: ensure that the Cable Connected box is checked. Click on the Port Forwarding tab and fill out the table to match the video.

Install Terminal and XServer software

When you start up the Mininet VM in VirtualBox, the display window, as it appears on your computer, has limitations. The window is small, it captures the mouse, and it does not allow you to copy and paste. In addition, you cannot run graphical programs on the Mininet VM. What is needed is a terminal program (to run ssh) and an X-Server program for running GUI programs via the terminal. If your host computer is **Linux**, you should already have these programs available. If your host computer is a **Mac**, then you need to download and install **XQuartz**. If your host computer is a **Windows PC**, then you need to download and install two programs: **PuTTY** and **XMing**. XQuartz, PuTTy, and XMing are all open source programs.

Part 2: Initial Lab Testing

1. Start PuTTY. Using the instructions in Prof. McCann’s video, set up PuTTY configuration to login to Mininet.
2. Turn on the Mininet VM and login via PuTTY. (The login name is mininet and the password is mininet.) You are logging into the Linux OS in this VM.
3. At the $ prompt, type in the command to look at the Mininet VM adapter configuration

mininet@mininet-vm:~$ifconfig

You should see two network interfaces listed, one of which is the loopback adapter. Note the other adapter name (e.g. eth0) that matches one of the Ethernet addresses that you discovered in Part 1, Configure. This is the NAT adapter.

1. Notice that the Host-only adapter does not appear. (The third Mininet lab will show you how to activate this interface.)
2. You must have root privileges to activate Mininet. The command *sudo mn* executes the default mininet network topology script with these privileges.

mininet@mininet-vm:~$sudo mn

1. Now the Mininet Command Line Interface (CLI) appears. Explore the network by typing each of the commands *net, links, nodes*, and *dump* at the mininet> prompt. Also test the network with a pingall command.

e.g. mininet>net

Note the IP addresses of h1, h2, and s1.

Take a screenshot of PuTTY window showing that you executed the mininet commands in this task. Note the names of the interfaces on the switches and hosts, and the IP addresses of the hosts.

1. You can execute commands on the hosts by prefacing the command with the host name. Have host h1 ping host h2 with 10 pings. Note that ping measures the round trip time (RTT) for a packet to travel between a source and a destination.

mininet>h1 ping -c 10 h2

Look at the average time and the number of successful pings.

1. Exit Mininet.

mininet>exit 9

1. Now restart the Mininet emulation with different parameters for the link between the hosts and the switch.

mininet@mininet-vm:~$sudo mn --link tc,bw=5,delay=10ms,loss=10

(There are two dashes just before “link”.)

bw is the bandwidth in Mbps, delay is the total delay between the links in milliseconds, and loss is in percentage of packets. (Note that this loss rate is not typical. It is set this high so that you can see the effect on a small number of pings in the next task.)

1. Have h1 ping h2 with 10 packets.

mininet>h1 ping -c 10 h2

Look at the average time and the number of successful pings. There should be a number of lost packets.

Part 3: What to turn in via iLearn

1. Answer the questions on the quiz.
2. Screenshot of PuTTY window showing that you executed the mininet commands in Part 2, task 6 above.

The screenshot file must be in pdf format only. Any other formats will not be accepted. Image should not be blurred and must be clearly readable. The naming convention of the file should be Lab0\_yourlastname.pdf. **Put your name in the document as well.**

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Notes:

1. Adapted from lab by Professor Mike McCann, CSUMB
2. Bob Lantz, Nikhil Handigol, Brandon Heller, and Vimal Jeyakumar, “Introduction to Mininet”, https://github.com/mininet/mininet/wiki/Introduction-to-Mininet