COMP 40660: Advances in Wireless Networking

School of Computer Science, University College Dublin, Ireland

Spring 2023

Assignment 1: Mininet

This assignment is worth 15% of the overall grade.

Mininet Overview

Mininet is one of the most widely used research tools for SDN and OpenFlow, it allows you to emulate virtual networks with switches, hosts, and SDN controllers with a single command. Hence, Mininet is a great way to learn about SDN and OpenFlow with different network configurations. For more about Mininet, please go to http://mininet.org/

Download and Installation

Linux is the recommended platform for this exercise. For instructions on how to download and install Mininet on Linux, check the following link: http://mininet.org/download/ . Instructions are available for the whole process of downloading packages and their installation. There are also some examples for the verification of the installation.

For those who may want to perform these tasks from a Windows/OS X computer, you can download VirtualBox from this link: https://www.virtualbox.org/wiki/Downloads and configure it with Linux. Thereafter it's similar to the Linux installation process.

If you do the Mininet VM installation, you will have all the required packages installed including Mininet VM, OpenFlow tutorials with examples, and Wireshark. Wireshark is a free and open-source packet analyser used for network troubleshooting, analysis, software and communications protocol development, and education. Please follow the link http://mininet.org/walkthrough/ to learn the basic Mininet commands.

You can also explore other methods of installation from the Mininet download page.

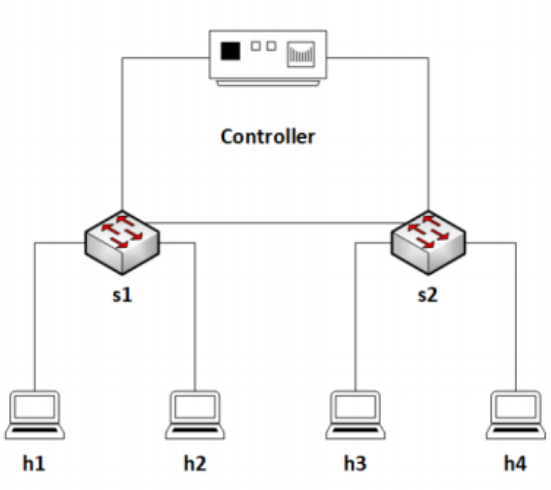
Report writing

A detailed report should be submitted with answers to all the questions in the exercise. For each question, the following must be provided in the answers: a short description of the solution, screenshots of all outputs, screenshots/written code, and figures for the network topologies. Associated files (where suitable, e.g.: MiniEdit) can be added to the appendices.

The report should be submitted as an individual assignment by **12th of March 2023 (11:59 PM)** in .pdf format through the COMP40660 page in Brightspace.

Exercise 1

1. Custom topology creation:



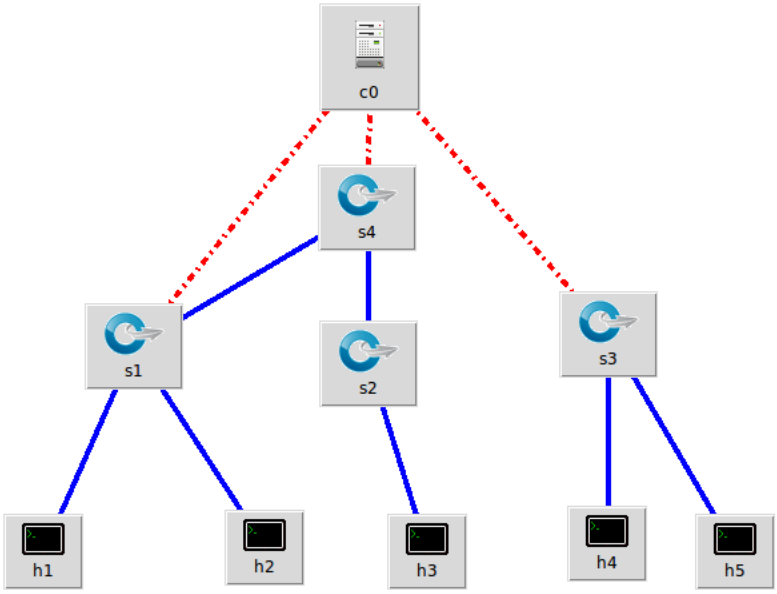
   a. Create the above topology in Mininet.
   b. Test the network.
      i. Dump the connections.
      ii. Test reachability of all the connections
   c. Finally terminate the network
   d. What would be the outcome of the reachability test if there was no link between s1 and s2?
   e. Would there be any difference in the outcome if you replaced the OpenFlow switches with legacy switches? Why? Why not?
2. Custom topology with performance parameters:
   a. Reuse the previous topology and create the hosts and links with the following constraints
      i. Hosts – h2 and h3 gets 50% of system CPU power.
      ii. Link constraints – Bandwidth of 10Mbps, delay of 5ms, loss of 2% and maximum queue size of 1000
   b. Test the connection speeds between the following hosts.
      i. h1 and h2
      ii. h1 and h3
      iii. h2 and h3
      iv. h1 and h4
3. Explain briefly outcomes you got from the speed tests in question 2.b by comparing the corresponding throughputs.
4. What difference would it make in the speed test if the links between all 4 hosts and their corresponding switches were defined using the same parameters? (Show with evidence)

Exercise 2

5. Integrating a remote controller:
   a. Make a simple topology, run the POX controller as a hub. Check the flow tables using `dpctl`.
   b. Now make the controller as a learning switch. Check the flow tables using `dpctl`.
   c. Compare the results of `dpctl` of step a. and b. What is the difference between the two and why?

Exercise 3

6. Graphical use of mininet, MiniEdit (Layer 2 Learning Using Pox Controller). Here the goal is to familiarize students with the Miniedit environment, which is a simple GUI-based application written with Mininet's Python API. Miniedit allows you to drag and drop network component like switches and hosts, wire them up into a network and use a "run" button to initiate the network. Here, you will be using the POX SDN controller to create a simple layer 2 learning switch using SDN switches in a simulated network so every host on the network can forward packets to another host.
    a. Please follow these steps:
        i. Launch the **miniedit** application by running the file `miniedit.py` from the folder */mininet/examples.*
        ii. Create the topology below by dragging and dropping the required components to your workspace and linking them together.



        iii. Rename the `c0` to `POX` and change the controller type to `remote controller`. Leave the IP address as default `(127.0.0.1)` and the port number as `6633`.
        iv. Save the miniedit file as `PoxL2LearningBridge.mn` to your *mininet/examples* directory. Include this file to your submission.
        v. Open a new terminal and search for the POX controller folder from your home or root directory depending on where you unzipped your POX package.
        vi. From the POX directory, run the pox controller with the following command: *./pox.py forwarding.l2_learning*
        vii. You should have an outcome similar to the one in the figure below on your terminal.

```
ext           NOTICE   pox.py  setup.cfg  tools
root@labo-PC2:/home/labo/pox# ./pox.py forwarding.l2_learning
POX 0.2.0 (carp) / Copyright 2011-2013 James McCauley, et al.
INFO:core:POX 0.2.0 (carp) is up.
```

        viii. This indicates that your POX controller is up and running.

ix. On the miniedit application, go to **Edit>>Preferences**, and select the **Start CLI** option, this opens up a command line interface when you run your network, there you can issue other commands like you do on typical mininet terminal. Also ensure that your OpenFlow version is set to 1.0, POX controller may not run with later versions.
x. Now run your network and observe the POX terminal. Briefly explain what you observed.
xi. From the miniedit command line, run the command `pingall` to test the reachability of the different hosts, include a screenshot of the outcome to your report.

Exercise 4

7. Execute the following command: `sudo mn –topo single,3 –mac –switch ovsk –controller remote`
    a. What actions will Mininet take based on this command? (List in similar order as in Exercise 1 default topology example)
    b. Next open the switch terminal and run a simple command to reveal the current flow entries. What do you see in the flow entries? Why are they the way they currently are?
    c. What outcome do you see? What is the expected outcome? Why is it the way it currently is?
    d. Now, go back to the Mininet console and try to ping h2 from h1. Do you get any replies? Why? Why not?
    e. Next task is to manually install the necessary flows to enable packet exchange between all nodes on the network. What commands did you use? (Please include all the commands you used in bullet points)
    f. Run the command to reveal flow entries again. What outcome do you see? Compare this outcome to the initial outcome in Q11, why is it the way it currently is?
    g. Now, go back to the Mininet console and try to ping h2 from h1. Do you get any replies? Why? Why not?

End of the assignment
