CEG5101 Modern Computer Networking
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Laboratory 02
Open Virtual Switch (Open vSwitch)

LEARNING OBJECTIVES

Upon successful completion of this laboratory, the students will be able:

i. To become familiar with Open vSwitch and its basic operation
ii. To implement Open vSwitch flow tables
iii. To Enable traffic forwarding using layer 3

EQUIPMENT

i. *Hardware* – Laptop/Computer with internet access
ii. *Software* – Mininet, Linux OS

DISCUSSION

Task 1: To become familiar with Open vSwitch and its basic operation

1.1 Open vSwitch, abbreviated as OVS, is a virtual multilayer switch.

1.2 In this activity, we will start with building a simple network by connecting two end devices with an Open vSwitch and configuring it in the Mininet GUI.

1.3 Launch MiniEdit on your laptop and start adding devices to the workspace from the device component bar as shown below.

1.4 Note that there are two types of switches in the device components, i.e. switch and legacy switch , and both are OpenFlow switches. Only that legacy switch operates in standalone fail-mode and the other switch operates in secure fail-mode. In this lab, we use open vswitches.

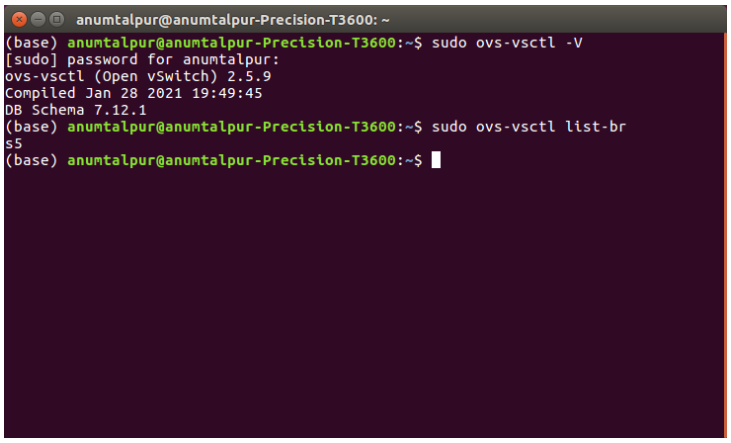
1.5 Next, using the device properties, assign 10.0.0.1/8 and 10.0.0.2/8 to host h1 and h2, respectively. Click “Run” to start network operation.

1.6 The next step is to verify Open vSwitch information on the switches.

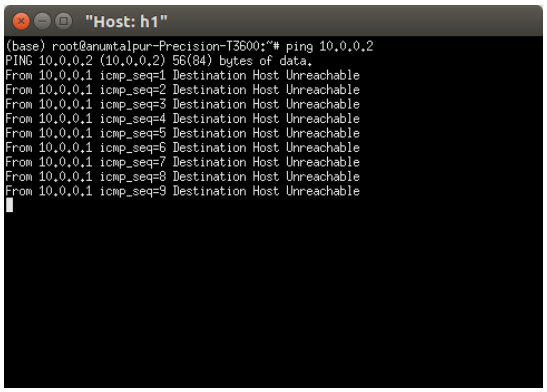
https://www.openvswitch.org
http://mininet.org/walkthrough/

1.7 Launch a new terminal window and issue the command “sudo ovs-vsctl -V” to check the installed version of Open vSwitch. Here, ovs-vsctl is ovs-vswitched management utility that displays available virtual switches and their states.

1.8 Next, we will issue the command “sudo ovs-vsctl list-br” to list all active Open vSwitches. As we can see in the screenshot below, a switch named s5 is an active Open vSwitch in this network.



1.9 Next, to verify connectivity and check whether switches are forwarding packets successfully without the controller, send a ping command from one host to another. As an example, open the host h1 terminal and issue the command “ping 10.0.0.2”. You will notice that host h2 is unreachable from hosth1.



1.10 This is because no flow table rules enabled so far. Therefore, in the next activity, we will implement flow table rules within switches.

Task 2: To implement Open vSwitch flow tables

2.1 In this activity, we will learn Open Flow protocol and implement flow table entries for forwarding packets from one host to another. The packet forwarding in Openflow is performed using packet-matching function.

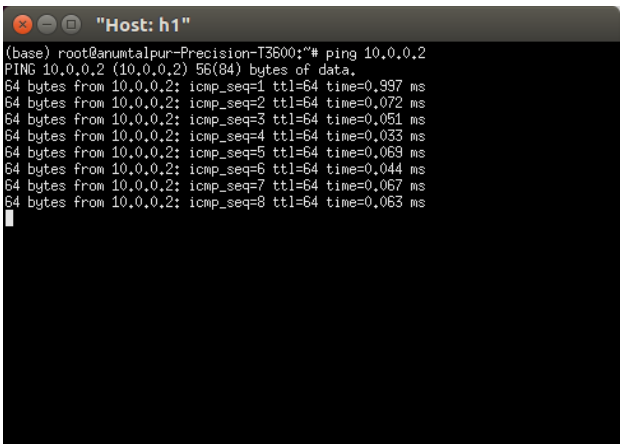
2.2 Continuing with the same network, as created in step 1.3, open a new terminal and type “sudo ovs-ofctl add-flow s5 action=normal” to add a flow in switch s5. Here, ovs-ofctl is the command for monitoring and administering OpenFlow switches.

```
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl add-flow s5 actio
n=normal
(base) anumtalpur@anumtalpur-Precision-T3600:~$
```

2.3 To verify whether the flow implementation is successful or not, we can print entries of the switch by issuing the command “sudo ovs-ofctl dump-flows s5”.

```
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl add-flow s5 actio
n=normal
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl dump-flows s5
NXST_FLOW reply (xid=0x4):
 cookie=0x0, duration=53.601s, table=0, n_packets=0, n_bytes=0, idle_age=53, act
ions=NORMAL
(base) anumtalpur@anumtalpur-Precision-T3600:~$
```

2.4 Once the flows are defined, we can verify the connectivity by sending a ping command from one host to another.



Task 3: To Enable traffic forwarding using layer 3

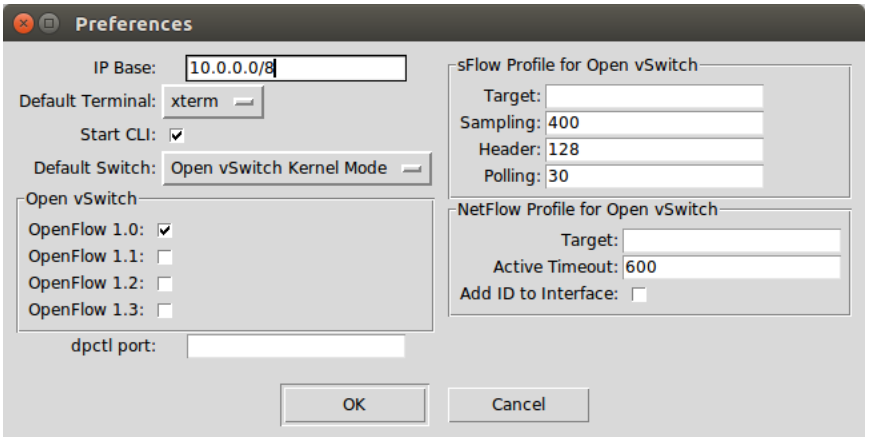
3.1 In this activity, we will learn to delete existing flows and add flows manually using layer 3 information.

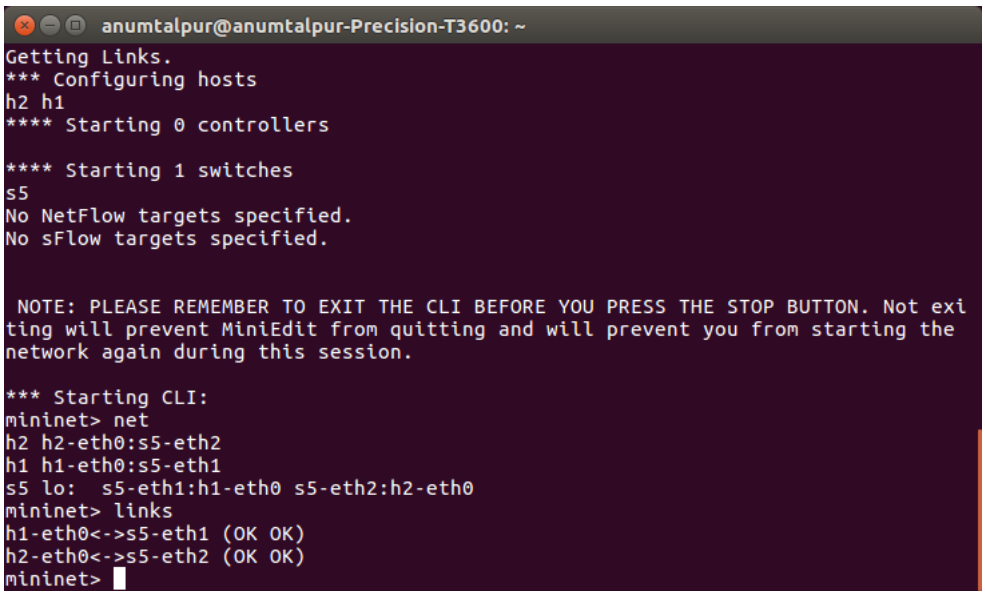
3.2 At first, we will type the following command “sudo ovs-ofctl del-flows s5” to delete existing flows in switch s5. To verify the deletion of flow, we can try printing flows again using step 2.3.

```
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl del-flows s5
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl dump-flows s5
NXST_FLOW reply (xid=0x4):
(base) anumtalpur@anumtalpur-Precision-T3600:~$
```

3.3 To manually enter flow using layer 3 information, we need the information on port connectivity, i.e, which port of the switch is connected to which host. This can be found by issuing the command “net” or “links” on the Mininet terminal.

3.4 To have access to the mininet CLI, before you run the network, go to the edit tab and then select preferences. Make sure that the “start CLI” box is ticked.





3.5 Next, based on the connection information we have, we will issue following commands,

$ sudo ovs-ofctl add-flow s5 ip,nw_dst=10.0.0.1,action=output:1
$ sudo ovs-ofctl add-flow s5 ip,nw_dst=10.0.0.2,action=output:2
$ sudo ovs-ofctl add-flow s5 arp,action=normal

Here, the first two commands specify that the traffic for destination address 10.0.0.1 and 10.0.0.2 must be forwarded to switch port number 1 and 2, respectively. The third command adds a flow to allow ARP requests.

https://www.openvswitch.org
http://mininet.org/walkthrough/

```
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl add-flow s5 ip,nw
_dst=10.0.0.1,action=output:2
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl add-flow s5 ip,nw
_dst=10.0.0.2,action=output:1
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl add-flow s5 arp,a
ction=normal
(base) anumtalpur@anumtalpur-Precision-T3600:~$
```

3.6 NOTE: Here, the correct use of IP addresses and the switch ports to which hosts are connected is important for the success of packet forwarding. The switch will match against the destination IP address and the traffic going to that destination will be forwarded to the specified switch port.

3.7 Next, we can verify the packet forwarding with manually entered flows by sending a ping command from one host to another or by printing the flows with the command “sudo ovs-ofctl dump-flows s5”.

```
(base) anumtalpur@anumtalpur-Precision-T3600:~$ sudo ovs-ofctl dump-flows s5NXST_FLOW reply (xid=0x4):
 cookie=0x0, duration=469.856s, table=0, n_packets=0, n_bytes=0, idle_age=469, ip,nw_dst=10.0.0.1 actions=output:2
 cookie=0x0, duration=446.122s, table=0, n_packets=0, n_bytes=0, idle_age=446, ip,nw_dst=10.0.0.2 actions=output:1
 cookie=0x0, duration=439.559s, table=0, n_packets=0, n_bytes=0, idle_age=439, arp actions=NORMAL
(base) anumtalpur@anumtalpur-Precision-T3600:~$
```