HW3 - COEN 241

Task 1

1. What is the output of “nodes” and “net”

Solution:

Output of “nodes”:

h1 h2 h3 h4 h5 h6 h7 h8 s1 s2 s3 s4 s5 s6 s7

Output of “net”:

h1 h1-eth0:s3-eth2
h2 h2-eth0:s3-eth3
h3 h3-eth0:s4-eth2
h4 h4-eth0:s4-eth3
h5 h5-eth0:s6-eth2
h6 h6-eth0:s6-eth3
h7 h7-eth0:s7-eth2
h8 h8-eth0:s7-eth3
s1 lo: s1-eth1:s2-eth1 s1-eth2:s5-eth1
s2 lo: s2-eth1:s1-eth1 s2-eth2:s3-eth1 s2-eth3:s4-eth1
s3 lo: s3-eth1:s2-eth2 s3-eth2:h1-eth0 s3-eth3:h2-eth0
s4 lo: s4-eth1:s2-eth3 s4-eth2:h3-eth0 s4-eth3:h4-eth0
s5 lo: s5-eth1:s1-eth2 s5-eth2:s6-eth1 s5-eth3:s7-eth1
s6 lo: s6-eth1:s5-eth2 s6-eth2:h5-eth0 s6-eth3:h6-eth0
s7 lo: s7-eth1:s5-eth3 s7-eth2:h7-eth0 s7-eth3:h8-eth0

2. What is the output of “h7 ifconfig”

Solution:

h7-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 10.0.0.7 netmask 255.0.0.0 broadcast 10.255.255.255
inet6 fe80::202d:4ff:fe61:ea78 prefixlen 64 scopeid 0x20<link>
ether 22:2d:04:61:ea:78 txqueuelen 1000 (Ethernet)
RX packets 237 bytes 36730 (36.7 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 11 bytes 886 (886.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
inet 127.0.0.1 netmask 255.0.0.0
inet6 ::1 prefixlen 128 scopeid 0x10<host>
loop txqueuelen 1000 (Local Loopback)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

Task 2

1. Draw the function call graph of this controller. For example, once a packet comes to the controller, which function is the first to be called, which one is the second, and so forth?

Solution:

launch() -> __init__ -> _handle_packetIn(event) -> act_like_hub(packet, packet_in) -> resend_packet() -> send message to port

2. Have h1 ping h2, and h1 ping h8 for 100 times (e.g., h1 ping -c100 p2).

Solution:

h1 ping -c100 h2
--- 10.0.0.2 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99674ms
rtt min/avg/max/mdev = 1.019/1.535/3.519/0.536 ms

h1 ping -c100 h8
--- 10.0.0.8 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 97670ms
rtt min/avg/max/mdev = 4.609/5.673/12.451/1.643 ms

a. How long does it take (on average) to ping for each case?
h1 ping h2 - Average ping is 1.534 ms
h1 ping h8 - Average ping is 5.672 ms

b. What is the minimum and maximum ping you have observed?
h1 ping h2 - Minimum ping observed is 1.020 ms
h1 ping h8 - Minimum ping observed is 4.612 ms

h1 ping h2 - Maximum ping observed is 3.523 ms
h1 ping h8 - Maximum ping observed is 12.454 ms

c. What is the difference, and why?
The ping times are much longer for h1 to h8 than h1 to h2, because h1 only has one switch in between itself and h2, i.e. s3, where as there are several hops between h1 and h8,i.e., s3, s2, s1, s5, s7.

3. Run “iperf h1 h2” and “iperf h1 h8”

Solution:

a. What is “iperf” used for?
Iperf is used to test network by creating TCP and UDP data streams and measures the throughput. It can be used to set parameters required for testing the network and optimizing it.

b. What is the throughput for each case?
mininet> iperf h1 h2
*** Iperf: testing TCP bandwidth between h1 and h2

*** Results: ['11.1 Mbits/sec', '12.6 Mbits/sec']
mininet> iperf h1 h8
*** Iperf: testing TCP bandwidth between h1 and h8
*** Results: ['3.09 Mbits/sec','3.18 Mbits/sec']

c. What is the difference, and explain the reasons for the difference.
The throughput for h1 and h2 is more than h1 and h8 due to network congestion and latency. For h1 and h2, number of hops are less therefore more data is transfered than h1 and h8.

4. Which of the switches observe traffic? Please describe your way for observing such traffic on switches (e.g., adding some functions in the "of_tutorial" controller).

Solution:
We can conclude based on this that log.info is used as all switches observe the traffic, particularly when all of them are overloaded with packets. As the event listener, the _handle PacketIn function is called each time a packet is received.

Task 3

1. Describe how the above code works, such as how the "MAC to Port" map is established. You could use a 'ping' example to describe the establishment process (e.g., h1 ping h2).

Solution:
Operation h1 ping h2 requires that the packet be passed through switch s3. "Mac to Port" checks to see if packet.src is present as that of the key and value whenever a packet p from h1 arrives through one of the input ports and is done via act_like_switch(). The port can now be utilized every time a packet gets sent to a host provided in the key. The packet is forwarded to the designated port if the pair is present, else the switch picks up new information by attaching the key, value pair to the mac address and forwarding the packet to every ports but the input port.

2. (Comment out all prints before doing this experiment) Have h1 ping h2, and h1 ping h8 for 100 times (e.g., h1 ping -c100 p2).

Solution:
h1 ping -c100 h2
--- 10.0.0.2 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99173ms
rtt min/avg/max/mdev = 1.534/1.787/2.544/0.245 ms

h1 ping -c100 h8
--- 10.0.0.8 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99145ms
rtt min/avg/max/mdev = 3.117/4.546/13.623/1.533 ms

a. How long did it take (on average) to ping for each case?
h1 ping h2 - Average ping is 1.780 ms
h1 ping h8 - Average ping is 4.538 ms

b. What is the minimum and maximum ping you have observed?

h1 ping h2 - Minimum ping observed is 1.524 ms
h1 ping h8 - Minimum ping observed is 3.127 ms

h1 ping h2 - Maximum ping observed is 2.552 ms
h1 ping h8 - Maximum ping observed is 13.634 ms

c. Any difference from Task 2 and why do you think there is a change if there is?
Task 3 requires less time as Task 2 for h1 ping h2. However there is a significant variation in ping time between h1 and h8, as further adjustments are necessary. Task 3 is faster or it has a shorter ping time since only a small number of packets are flooded in job 3. When the target MAC address is located in the map, the switches will resubmit the packet, but only to the port that is specified in the "mac to port" mapping. Because there won't be as much network congestion, pings are substantially faster.

3. Q.3 Run “iperf h1 h2” and “iperf h1 h8”.
Solution:
a. What is the throughput for each case?
mininet> iperf h1 h2
*** Iperf: testing TCP bandwidth between h1 and h2
*** Results: ['33.7 Mbits/sec', '35.4 Mbits/sec']

mininet> iperf h1 h8
*** Iperf: testing TCP bandwidth between h1 and h8
*** Results: ['3.95 Mbits/sec', '4.17 Mbits/sec']

b. What is the difference from Task 2 and why do you think there is a change if there is?
Task 3 has a higher throughput than Task 2 due to reduced network congestion. This is due to “Mac to Port” map having learned all the ports, which prevents flooding. The average increase in h1 and h2 throughput for tasks 1 and task 2 is close to three times because there are fewer packet hops, there's no discernible improvement for h1 and h8.