This project is aim to understand how our devices are connected to the wireless internet using a virtual environment that we set up. In our environment, three access points are connected via ethernet and one mobile station will be moving across access points. Two experiments were carried out: First, to monitor what happens to ping requests when a mobile station moves across different access points. Second, monitor how the signal strength changes as a mobile station move to different parameters of the access points.

Mini-net does not have a wifi function installed, so we downloaded an open source emulator to run wifi on mini-net interface. Steps 1- 6, will be guiding you through the installation process before starting the experiments. Note: This is assuming that you have already have mini-net installed.

1. Install Mininet wifi from the following:
   https://github.com/intrig-unicamp/mininet-wifi

Position Experiment

For the first experiment, we are going to monitor how a mobile station (laptops, phones) is able to remain connected to the internet even though it had move from one access point to another.

7. Run the postition.py file. A mininet-wifi graph will appear, indicating the ap1,ap2,ap3, sta1. Sta1 is now located in the parameters of ap1.
   **NOTE: sta1 will start moving in 60 seconds.*
   ```
   Sudo python position.py
   ```

8. Open xterm for h1 and sta1
   ```
   Xterm h1
   Xterm sta1
   ```

9. In xterm of sta1, open wireshark. Wireshark will be used as a form of monitoring the transmission of packet. Select any.
   ```
   Wireshark
   ```

10. In xterm of h1, ping sta1(10.0.0.1)
    ```
    Ping 10.0.0.1
    ```

11. Return to main CLI of mininet-wifi and we will be monitoring sta1 connected access points as it moves. When sta1 is in the parameters of ap1, running the following command will display that the access point is ap1 as can be seen from the SSID.

```
Sta1 iw dev sta1-wlan0 link
```

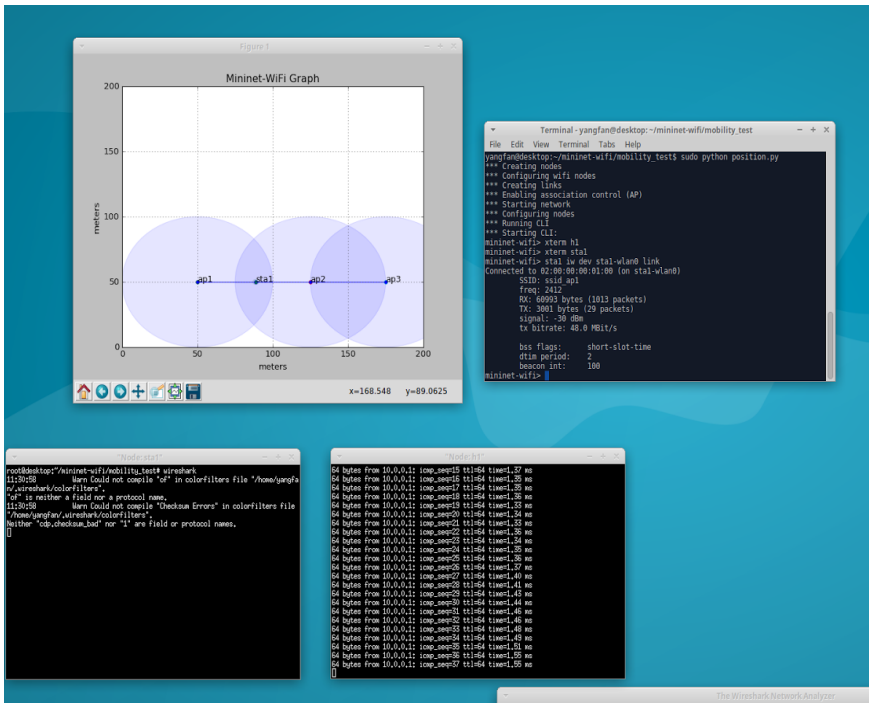

Fig1. sta1 is in the parameter of ap1

12. Observe the mininet-wifi graph. As sta1 moves out of ap1 parameter, the ping from h1 to sta1 would stop.

13. As sta1 enters ap2 parameters, run the following to confirm the access point that sta1 is in now. Check that the displayed information shows that it is SSID of ap2.

```
Sta1 iw dev sta1-wlan0 link
```

Check the wireshark interface and observe that the protocol states ICMPv6 which performs error reporting and diagnostic functions (e.g. ping).

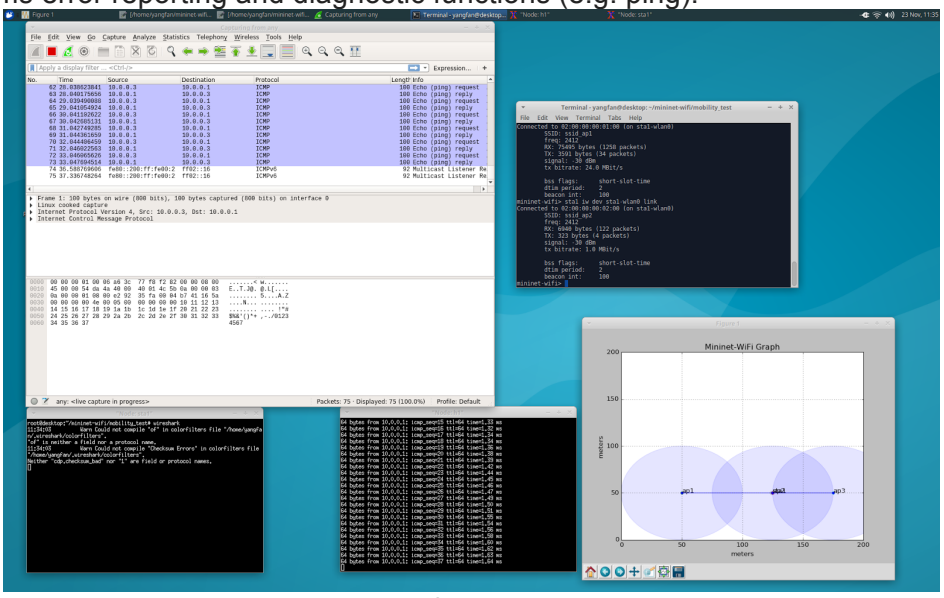

Fig2. sta1 has left ap1 and entered ap2

14. In wireshark, observe that as sta1 enters ap3 at 77 seconds, h1 is asking which access point has sta1, and the response is sta1 reporting its own MAC address.

15. As sta1 enters ap3 parameters, run the following to confirm the access point that sta1 is in now. Check that the displayed information shows that it is SSID of ap3.

```
Sta1 iw dev sta1-wlan0 link
```

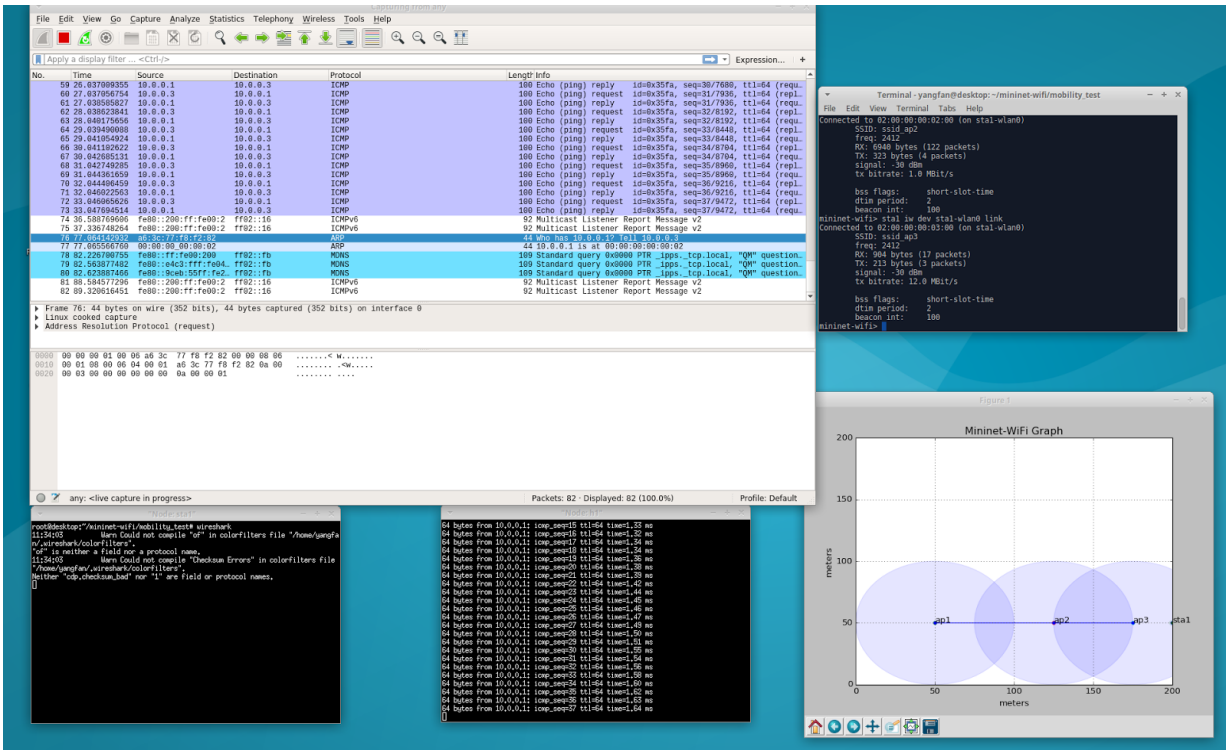

Fig3. sta1 has now entered ap3 parameters,
h1 is still unable to ping to sta1

16. Previously, the ping from h1 to sta1 had stop, monitor the xterm of h1 from previous step. Now, we are going to delete the flows in the access point. In the main CLI of mininet-wifi, run the following command.

```
Dpctl del-flows
```

In reality, an Software Defined Network(SDN) controller will be able to update the CAM table and redirect the flows to the nearest access point. However for this simulation, the controller is unable to manage the mobility of the users because it lacks a CAPWAP (Communication and Provision of Wireless Access Protocol).

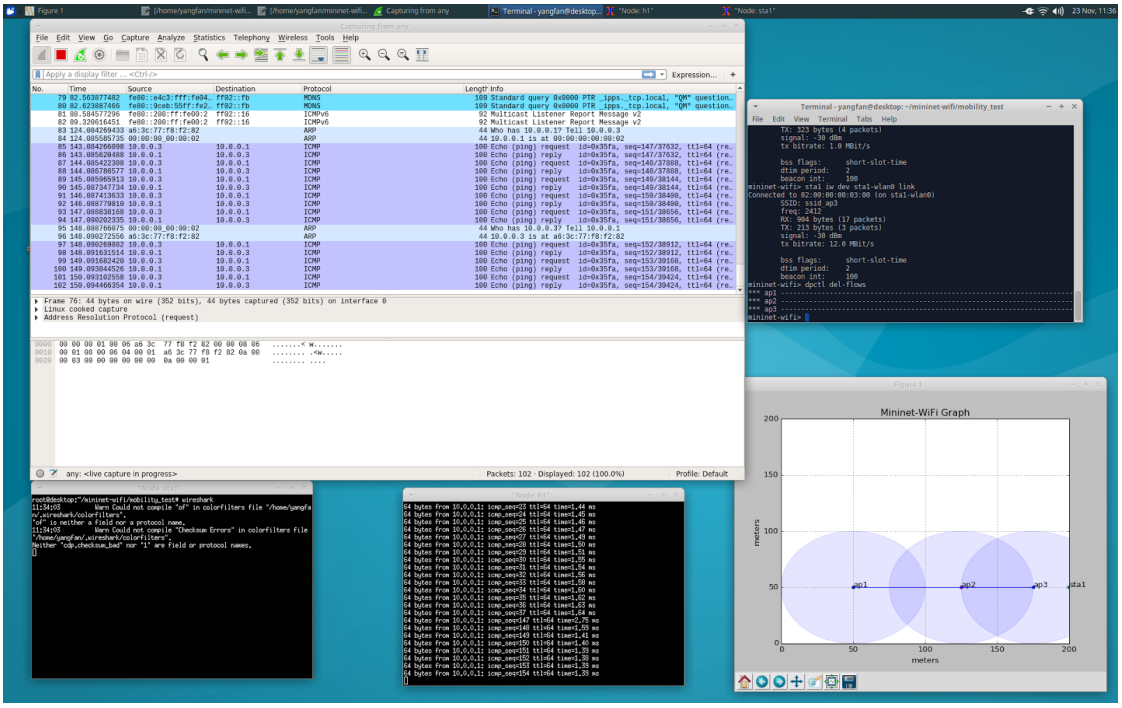

Fig 4. Pings returned to normal after flows are deleted from the CAM table of the controller

17. Once all flows are deleted, controller will set up new flows. Run the following command.

```
Dpctl dump-flows
```

18. Now we can see that the ICMP packets passing down from h1 to sta1 are now traversing all access point.

19. To end the mininet session

```
Exit
Sudo man -n
```

RSSI Experiment

For this experiment, we monitored the signal strength that the mobile station is receiving.

20. Run the rssi.py file. A mininet-wifi graph will appear, indicating the ap1,ap2,ap3, sta1. Sta1 is now located in the parameters of ap1.

```
Sudo python rssi.py
```

21. It is observed that as sta1 is brought nearer to the point of the access point that sends out the signal, the value is larger. This signify a stronger signal strength. However, when at the intersection between the access points, the signal strength decreases as there is interference brought about by the adjacent access points.

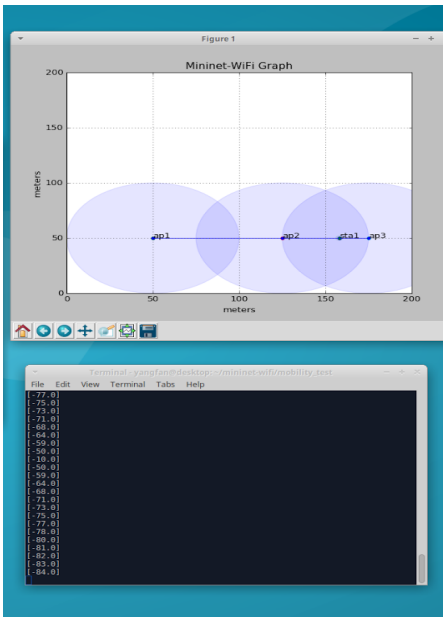

Fig 5 sta1 in the intersection of two access points, the signal strength is low

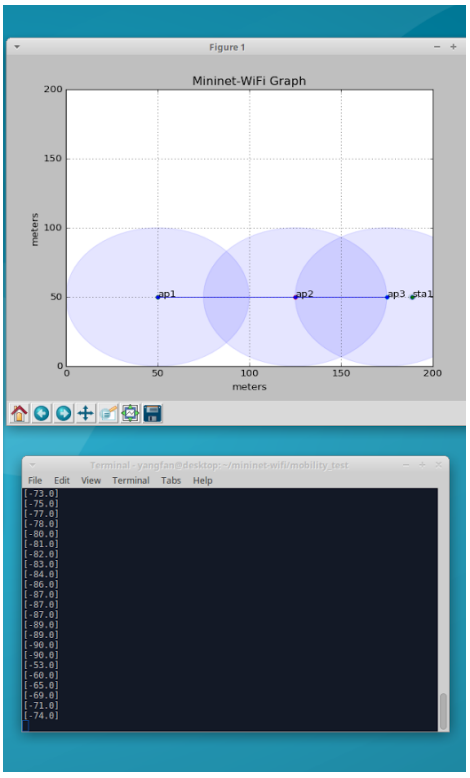

Fig 6. Sta1 leaves the intersection and is closer to ap3, the signal strength increase