Mini Project 2 姓名:郭紘安 學號:109062578

1. What you do :

Step 1:

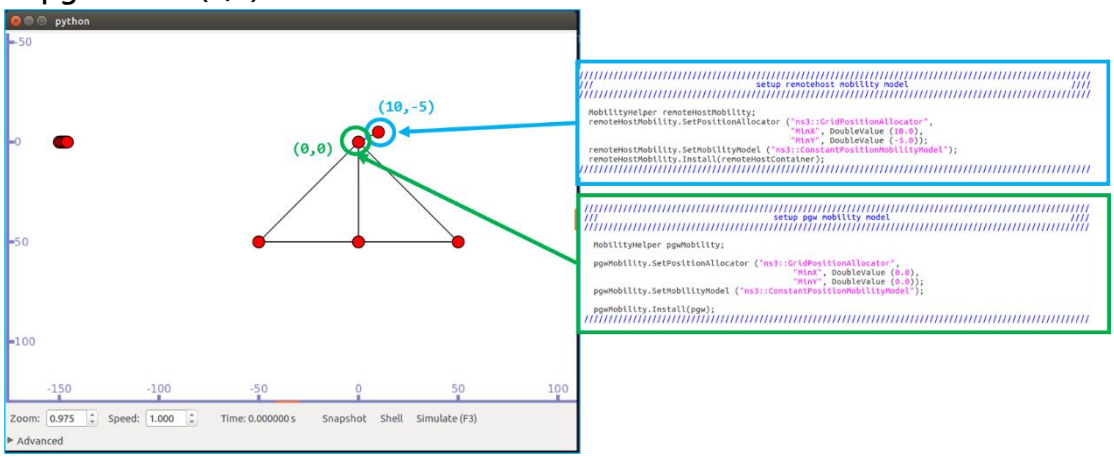
使用 cmd.AddValue 來新增兩個新參數 ue、enb。

```
//////////////////////////////////////////////////////////////////////////////////////////////////////////////////
///                                        Commandline                                                        ////
//////////////////////////////////////////////////////////////////////////////////////////////////////////////////
  CommandLine cmd;
  cmd.AddValue ("simTime", "Total duration of the simulation (in seconds)", simTime);
  cmd.AddValue ("speed", "Speed of the UE (default = 20 m/s)", speed);
  cmd.AddValue ("enbTxPowerDbm", "TX power [dBm] used by HeNBs (defalut = 46.0)", enbTxPowerDbm);

  cmd.AddValue ("ue","Ue (default = 1)",numberOfUes);
  cmd.AddValue ("enb","eNodeB (default = 1)",numberOfEnbs);

  cmd.Parse (argc, argv);
```

```
andy@ubuntu:~/ns-allinone-3.26/ns-3.26$ ./waf --run "scratch/109062578_project2 --enbTxPowerDbm=30 --simTime=1( --ue=5 --enb=3  --visualize
```

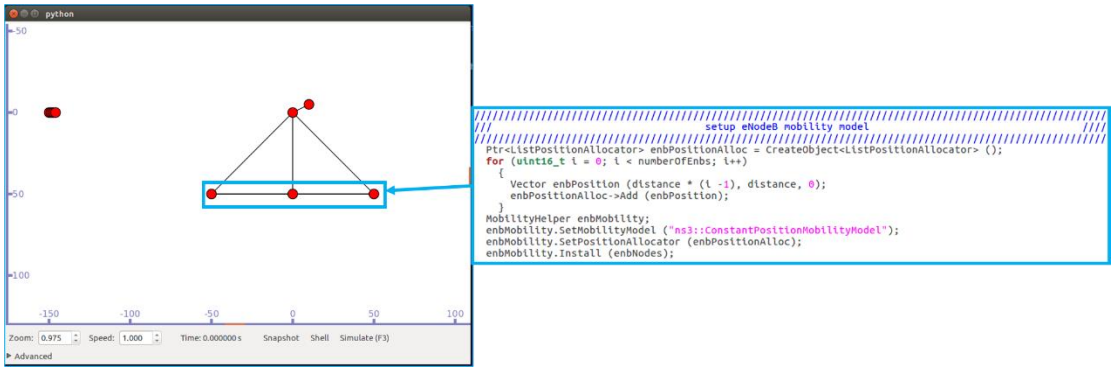
Step 2 :

使用 MobilityHelper 建立 remoteHostMobility 和 pgwMobility，remoteHostMobility 負責設定 remoteHost 的座標(10,-5)，pgwMobility 負責設定 pgw 的座標(0,0)。



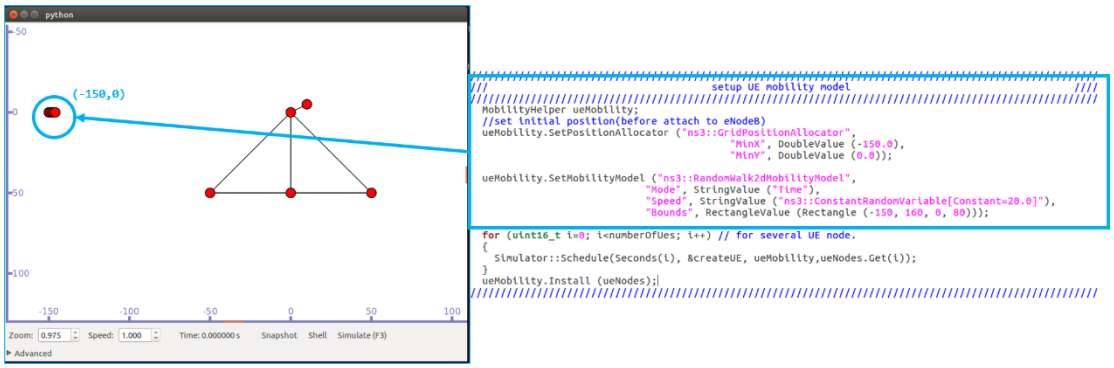
Step 3 :

使用 endPositionAlloc 來設定 eNodeB 的位置。



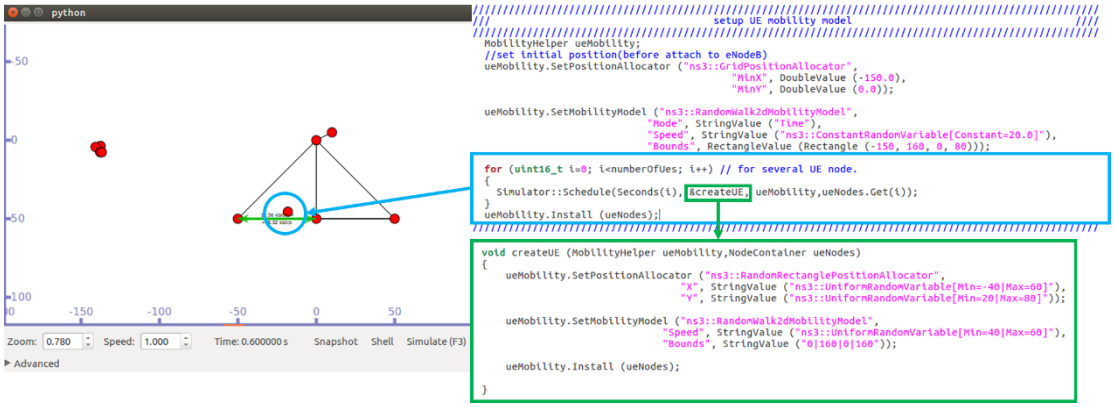
Step 4 :

使用 MobilityHelper 一開始建立所有的 UE node，同時給予他們初始位置(-150,0)以及使用 RandomWalk2MobilityModel 來讓每個 node 能夠 random walk。



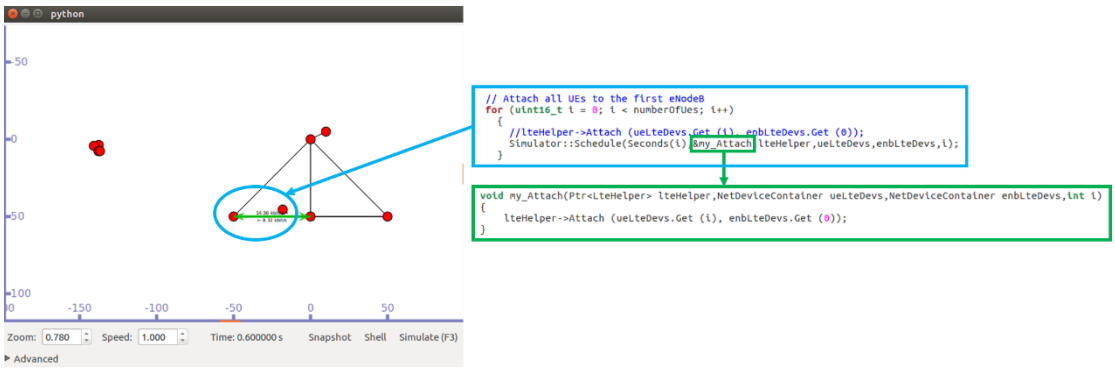
Step 5 :

使用 Simulator::Schedule 來讓 UE node 每隔一秒新增一個 node 到 eNodeB 的附近。



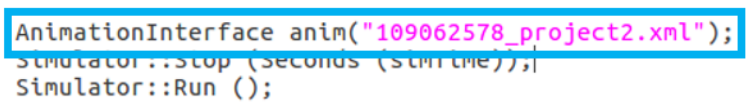
Step 6 :

使用 Simulator::Schedule 來讓 UE node 每隔一秒 attach 到第一個 eNodeB。



Step 7:

使用 AnimationInterface 來生成 xml 檔。



2. Observe the trace file :

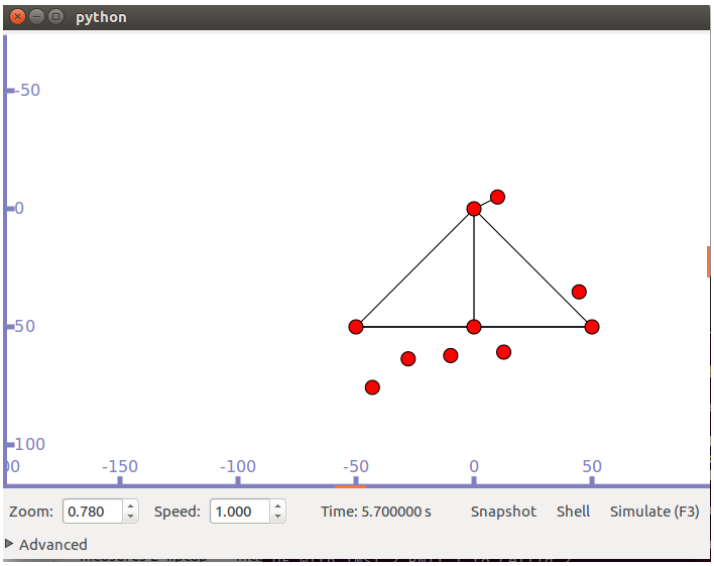
輸入:

./waf --run "scratch/109062578_project2 --enbTxPowerDbm=30 --simTime=10 --ue=5 --enb=3" –visualize

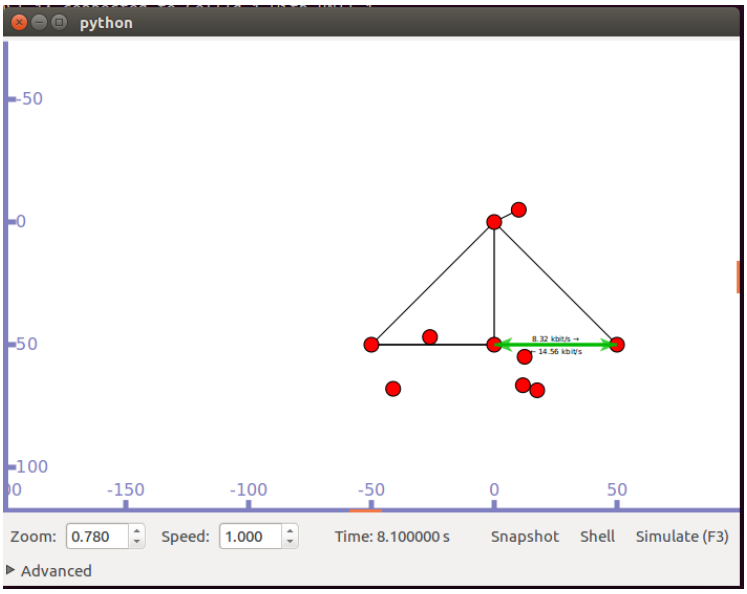
之後按 Simulate 執行。

```
andy@ubuntu:~/ns-allinone-3.26/ns-3.26$ ./waf --run "scratch/109062578_project2 --enbTxPowerDbm=30 --simTime=10 --ue=5 --enb=3" --visualize
Waf: Entering directory `/home/andy/ns-allinone-3.26/ns-3.26/build'
Waf: Leaving directory `/home/andy/ns-allinone-3.26/ns-3.26/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (3.281s)
Could not load icon applets-screenshooter due to missing gnomedesktop Python module
Could not load icon gnome-terminal due to missing gnomedesktop Python module
scanning topology: 10 nodes...
WARNING: no NetDeviceTraits registered for device type 'VirtualNetDevice'; I will assume this is a non-virtual wireless device, but you should edit '/home/andy/ns-allinone-3.26/ns-3.26/src/visualizer/visualizer/base.pyc', variable 'netdevice_traits', to make sure.
scanning topology: calling graphviz layout
scanning topology: all done
/NodeList/3/DeviceList/0/LteUeRrc/ConnectionEstablished UE IMSI 1: connected to CellId 1 with RNTI 1
/NodeList/0/DeviceList/0/LteEnbRrc/ConnectionEstablished eNB CellId 1: successful connection of UE with IMSI 1 RNTI 1
/NodeList/0/DeviceList/0/LteEnbRrc/HandoverStart eNB CellId 1: start handover of UE with IMSI 1 RNTI 1 to CellId 2
/NodeList/3/DeviceList/0/LteUeRrc/HandoverStart UE IMSI 1: previously connected to CellId 1 with RNTI 1, doing handover to CellId 2
/NodeList/3/DeviceList/0/LteUeRrc/HandoverEndOk UE IMSI 1: successful handover to CellId 2 with RNTI 1
/NodeList/1/DeviceList/0/LteEnbRrc/HandoverEndOk eNB CellId 2: completed handover of UE with IMSI 1 RNTI 1
/NodeList/4/DeviceList/0/LteUeRrc/ConnectionEstablished UE IMSI 2: connected to CellId 1 with RNTI 11
/NodeList/0/DeviceList/0/LteEnbRrc/ConnectionEstablished eNB CellId 1: successful connection of UE with IMSI 2 RNTI 11
/NodeList/0/DeviceList/0/LteEnbRrc/HandoverStart eNB CellId 1: start handover of UE with IMSI 2 RNTI 11 to CellId 3
/NodeList/4/DeviceList/0/LteUeRrc/HandoverStart UE IMSI 2: previously connected to CellId 1 with RNTI 11, doing handover to CellId 3
/NodeList/4/DeviceList/0/LteUeRrc/HandoverEndOk UE IMSI 2: successful handover to CellId 3 with RNTI 1
/NodeList/2/DeviceList/0/LteEnbRrc/HandoverEndOk eNB CellId 3: completed handover of UE with IMSI 2 RNTI 1
/NodeList/5/DeviceList/0/LteUeRrc/ConnectionEstablished UE IMSI 3: connected to CellId 1 with RNTI 12
/NodeList/0/DeviceList/0/LteEnbRrc/ConnectionEstablished eNB CellId 1: successful connection of UE with IMSI 3 RNTI 12
/NodeList/1/DeviceList/0/LteEnbRrc/HandoverStart eNB CellId 2: start handover of UE with IMSI 1 RNTI 1 to CellId 1
/NodeList/3/DeviceList/0/LteUeRrc/HandoverStart UE IMSI 1: previously connected to CellId 2 with RNTI 1, doing handover to CellId 1
/NodeList/3/DeviceList/0/LteUeRrc/HandoverEndOk UE IMSI 1: successful handover to CellId 1 with RNTI 13
/NodeList/0/DeviceList/0/LteEnbRrc/HandoverEndOk eNB CellId 1: completed handover of UE with IMSI 1 RNTI 13
/NodeList/6/DeviceList/0/LteUeRrc/ConnectionEstablished UE IMSI 4: connected to CellId 1 with RNTI 15
/NodeList/0/DeviceList/0/LteEnbRrc/ConnectionEstablished eNB CellId 1: successful connection of UE with IMSI 4 RNTI 15
/NodeList/0/DeviceList/0/LteEnbRrc/HandoverStart eNB CellId 1: start handover of UE with IMSI 4 RNTI 15 to CellId 2
/NodeList/6/DeviceList/0/LteUeRrc/HandoverStart UE IMSI 4: previously connected to CellId 1 with RNTI 15, doing handover to CellId 2
/NodeList/6/DeviceList/0/LteUeRrc/HandoverEndOk UE IMSI 4: successful handover to CellId 2 with RNTI 2
/NodeList/1/DeviceList/0/LteEnbRrc/HandoverEndOk eNB CellId 2: completed handover of UE with IMSI 4 RNTI 2
/NodeList/0/DeviceList/0/LteEnbRrc/HandoverStart eNB CellId 1: start handover of UE with IMSI 3 RNTI 12 to CellId 2
/NodeList/5/DeviceList/0/LteUeRrc/HandoverStart UE IMSI 3: previously connected to CellId 1 with RNTI 12, doing handover to CellId 2
/NodeList/5/DeviceList/0/LteUeRrc/HandoverEndOk UE IMSI 3: successful handover to CellId 2 with RNTI 3
/NodeList/1/DeviceList/0/LteEnbRrc/HandoverEndOk eNB CellId 2: completed handover of UE with IMSI 3 RNTI 3
/NodeList/7/DeviceList/0/LteUeRrc/ConnectionEstablished UE IMSI 5: connected to CellId 1 with RNTI 30
/NodeList/0/DeviceList/0/LteEnbRrc/ConnectionEstablished eNB CellId 1: successful connection of UE with IMSI 5 RNTI 30
/NodeList/0/DeviceList/0/LteEnbRrc/HandoverStart eNB CellId 1: start handover of UE with IMSI 5 RNTI 30 to CellId 3
/NodeList/7/DeviceList/0/LteUeRrc/HandoverStart UE IMSI 5: previously connected to CellId 1 with RNTI 30, doing handover to CellId 3
/NodeList/7/DeviceList/0/LteUeRrc/HandoverEndOk UE IMSI 5: successful handover to CellId 3 with RNTI 2
/NodeList/2/DeviceList/0/LteEnbRrc/HandoverEndOk eNB CellId 3: completed handover of UE with IMSI 5 RNTI 2
/NodeList/2/DeviceList/0/LteEnbRrc/HandoverStart eNB CellId 3: start handover of UE with IMSI 2 RNTI 1 to CellId 2
/NodeList/4/DeviceList/0/LteUeRrc/HandoverStart UE IMSI 2: previously connected to CellId 3 with RNTI 1, doing handover to CellId 2
/NodeList/4/DeviceList/0/LteUeRrc/HandoverEndOk UE IMSI 2: successful handover to CellId 2 with RNTI 4
/NodeList/1/DeviceList/0/LteEnbRrc/HandoverEndOk eNB CellId 2: completed handover of UE with IMSI 2 RNTI 4
```

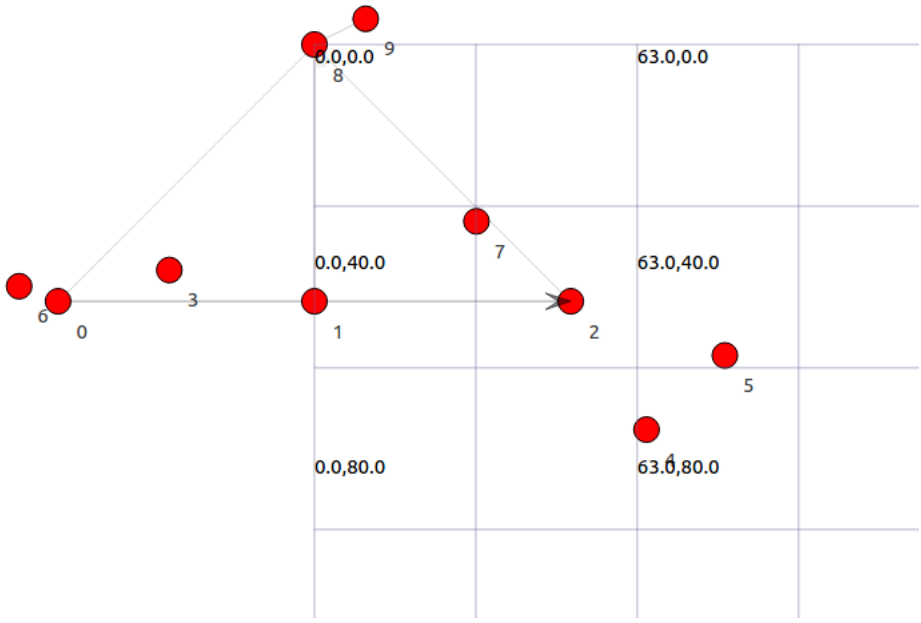
可以從 log 中發現但 UE node 會先 attach 到 eNodeB，才開始進行 handover 開始進行 handover 時會先 previously attach 下個要連的 eNodeB 才進行 handover，從第一個 eNodeB handover 到 第二個 eNodeB。



可以從 Topology 中發現但 UE node 會先 attach 到 eNodeB，但是因為沒有進行 handover，所以不會有綠色的傳輸箭頭。



可以從 Topology 中發現進行 handover 時，會有綠色的傳輸箭頭。



可以從 Animation 中發現沒有 handover 時不會有綠色傳輸箭頭，進行 handover 時，則會有綠色的傳輸箭頭。

3. Results :

UE node 一開始回先 attach 到 eNodeB 之後，才會進行 handover 的動作，在進行 handover 之前會先 previously attach 下個要連的 eNodeB ，成功連上之後，才會進行 handover。

4. What you learn :

學習到如何使用 mobility 來讓 node 能夠隨機產生以及讓他們能夠 random walk，以及如何使用 schedule 來控制何時新增新的 node 或是何時進行 attach。
在使用 random walk 的時候因為 bound 的範圍不對所以一直在執行的時候死當，後來範圍對了之後就可以順利執行。