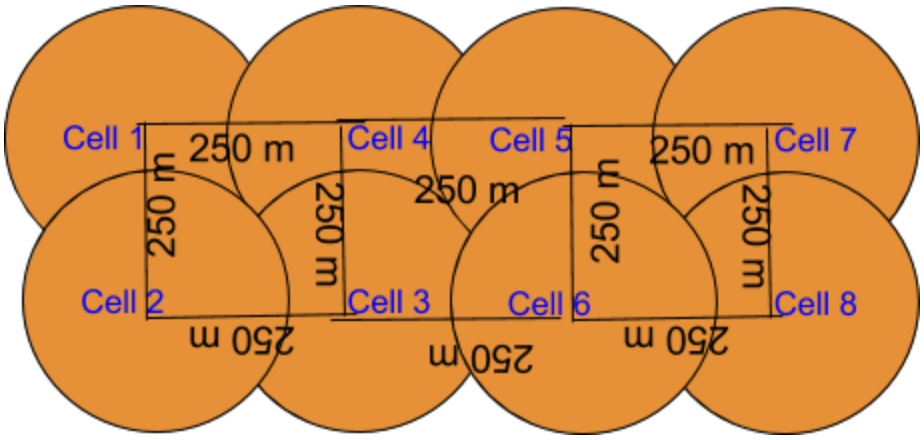
Group Assignment 2

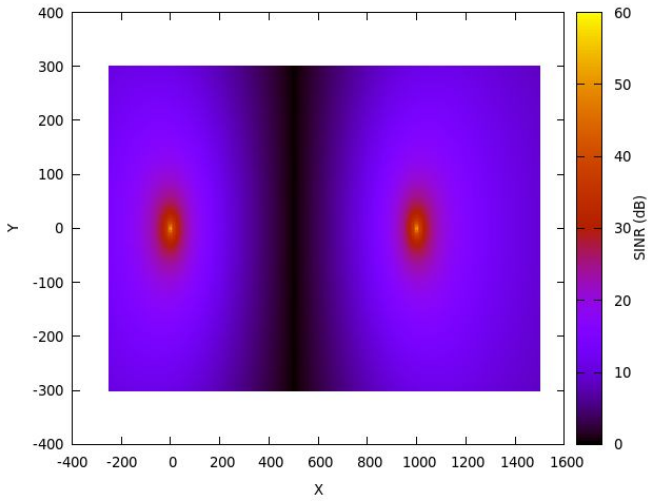
Group size: 2

Due date: March 29, 2016 on GC

The objective of this assignment is to evaluate and compare performance of different handover algorithms in NS-3.

Create a topology as shown in below figure without any coverage holes. Add P-GW and Remote Host to this topology and connect them with point-to-point link of 1 Gbps





A Sample REM plot with two eNB

Configure eNBs and their UEs with the parameters as given in below Table:

Simulation Parameter	**Value**
Number of UEs	3 per eNB; 1 Downlink UDP Flow per UE from the Remote Host
Number of eNBs	8
Inter distance between eNBs	250 Meters
eNB Tx Power (i.e., small cells)	20 dBm (0.1W)
Application Type	UDP
UDP Traffic	1500 bytes per every **10ms** by UDP; Each UE is configured with 1 DL UDP flow of 1.2 Mbps
UE mobility speeds	10m/s, 50m/s, 100 m/s; where in a given expt all UEs are configured with one of these speeds (set mobility bounds such that UE mobility should be within range of 8 cells)
UE mobility model	RandomWalk2d Mobility
UEs initial placement in a Cell	Random disc placement within 100m radius of eNB
# of RBs	50 in DL and 50 in UL (LTE FDD)
UE attachment to eNB	Automatic to one of eNBs based on received signal strength, so X2 handovers may take place during mobility
Scheduler	PF
Total simulation time	10 seconds
Number of seeds per experiment	5; RngRun1 = "Last TWO DIGITS of one of your ROLL NUMBERS" RngRun5 = RngRun1+4

Compare **A2-A4-RSRQ handover algorithm** and **Strongest cell handover algorithm (A3RsrpHandoverAlgorithm)** available in NS-3 LENA LTE module by creating a 8-cell LTE network as shown above with the simulation parameters given in the table. **Your main script (e.g., asg2.cc) should take handover algo, speed, and RngRun as inputs.** Refer here to know more about these handover algorithms. References section contains all necessary reading material to complete the assignment. If you still have any doubts, post your queries in Group Asg 2 Discussion thread on GC to get help from TAs/me/other groups.

Modify lena-X2-handover script to get asg2.cc for studying various handover algorithms.

You need to turn in the following graphs:

Graph 1: SINR Radio Environment Map (REM) of 8-cell topology given above.

Graph 2: Identify a UE (say UEx) which has experienced HIGHEST no. of handovers in your experiment for a SEED by using **A3RsrpHandoverAlgorithm.** Then **Plot RSRP traces for UEx** for 10m/s, 50m/s, 100m/s for that one SEED. X-axis: Time (secs/10's of ms) and Y-axis: RSRP curves in dBm for 10m/s, 50m/s, 100m/s. **From the plot, mark time instant(s) at which handovers took place.**

Graph 3: Plot instantaneous throughput trace for the same UEx considered in plotting Graph 2
X-axis: time (secs) and Y-axis: Instantaneous throughput curves in Mbps for 10m/s, 50m/s, 100m/s cases.

Graph 4: Consider A3 RSRP handover Algorithm and study the effect of Hysteresis on no. of handovers. Plot bar graph:
X-axis: Hysteresis (1 ,3 ,6) dB Y-axis: Avg. No. of Handovers for 10m/s, 50m/s, 100m/s cases. Note that here you need to take avg. of no. of handovers overs 5 seeds. Does increase in Hysteresis lead to any handover failures? What could you set as a good value for Hysteresis?

Graph 5: Consider A2-A4-RSRQ handover algorithm and study the effect of Neighbour Cell Offset on number of handovers. Plot bar graph:
X-axis: Neighbour Cell Offset (1 ,2 ,5) RSRQ Y-axis: Avg. Number of Handovers for 10m/s, 50m/s, 100m/s cases. Note that here you need to take avg. of no. of handovers overs 5 seeds. Does increase in Offset lead to any handover failures? What could you set as a good value for Offset?

Graph 6: Plot Aggregate System Throughputs for different Handover Algorithms
X-axis: Speed (10, 50, 100) m/s; Y-axis: (Average of Aggregate System throughput) with bars for No-Op handover, A3-RSRP handover, A2-A4 RSRQ handover algorithms by setting Hysteresis and Neighbour

Cell Offset with the best values found in Graphs 4 and 5. Get sum of throughputs of all 8 cells (i.e., all 24 UEs flows) in different runs by varying seed values and then get the average of that for plotting.

For each of the graphs, provide analysis of the trends observed and quantify improvements for the scheduling algorithms studied.

Deliverables

The following items are supposed to be included in a tar.gz file and uploaded on GC.

1. Assignment Report having all graphs and their detailed analysis of trends
2. The ns-3 scripts involved in creating the testing scenarios described above with appropriate names.
    a. main script (e.g., GroupID-Asg2.cc)
    b. other supporting (modified) scripts of NS-3, if any
3. All stats collected and any other outside scripts (shell, python, perl, gnuplot etc) for collection of results and plotting of data.
4. README file should contain how to run your simulations and generate graphs.

NOTEs:

- *Use Stats generated by NS-3 to collect results (dl-rlc stat, dl-rsrp stat)*
- *Running simulation, Stats collections and generating Gnuplots should be automated.*
- *Each of the above deliverables carries marks so you need to upload all valid docs, code, and scripts.*
- *While changing existing code, better make your own copies and rename them with your algorithm names. You can add your new programs (.cc and .h file names) in **wscript** file of lte module. So that other source files dependencies may not exist.*

Late Policy:

7 slip days overall

10% cut in marks for each day beyond slip dates.

References

1. https://www.nsnam.org/docs/models/html/lte-design.html#sec-handover-algorithm
2. https://www.nsnam.org/docs/models/html/lte-design.html#mac
3. https://www.nsnam.org/doxygen/lena-x2-handover_8cc_source.html
4. https://www.nsnam.org/docs/models/html/lte-user.html#radio-environment-maps
5. https://www.nsnam.org/docs/models/html/lte-user.html
6. http://code.nsnam.org/ns-3-dev/file/028452e3b558/src/lte/examples/lena-rem.cc
7. http://code.nsnam.org/ns-3-dev/file/028452e3b558/src/lte/examples/lena-intercell-interference.c