UNIVERSITY OF BUEA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER ENGINEERING

CEF356: MOBILE COMMUNICATIONS AND PROTOCOLS

LAB MANUAL

By

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LAB 1: RADIO NETWORK PLANNING OF A 4G NETWORK

OBJECTIVE:

The objective of this section of the Mobile and Wireless Communications laboratory session is to perform coverage planning of a newly deployed LTE network in Atoll, a radio network planning software package. The case study here is the Douala area where it is required to install 30 BTS sites and analyze the coverage to determine if 30 sites will be enough to take care of coverage requirement of the Douala area.

AIM:

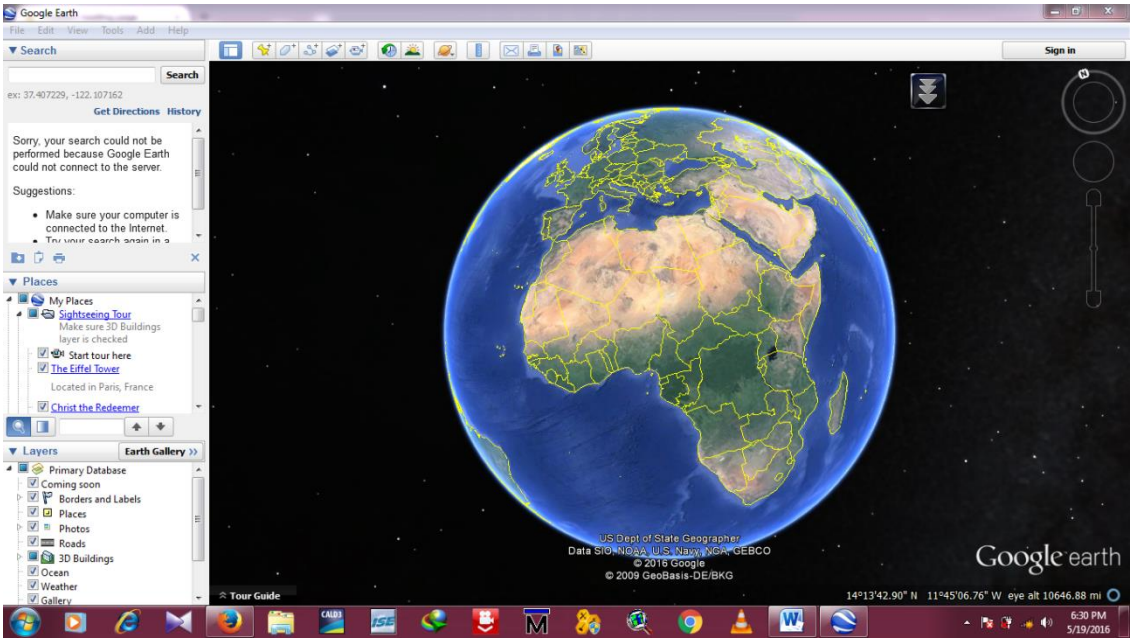
Coverage planning of LTE network in Atoll, case study Douala area.

HARDWARE AND SOFTWARE REQUIREMENTS:

- Personal computer (PC).
- Atoll and Google Earth.

PROCEDURE:

In order to plan and forecast our network in a particular environment, we need up to date geospatial information about the region. Now because of GIS, we were able to sit within the comforts of our classroom and obtain live feeds from Bonaberi and Douala using GOOGLE EARTH. To do this, GOOGLE EARTH on a PC is started with an internet connection available. The following window appears



On the search panel on the top left of the screen, Douala is typed and searched for. The following figure is obtained

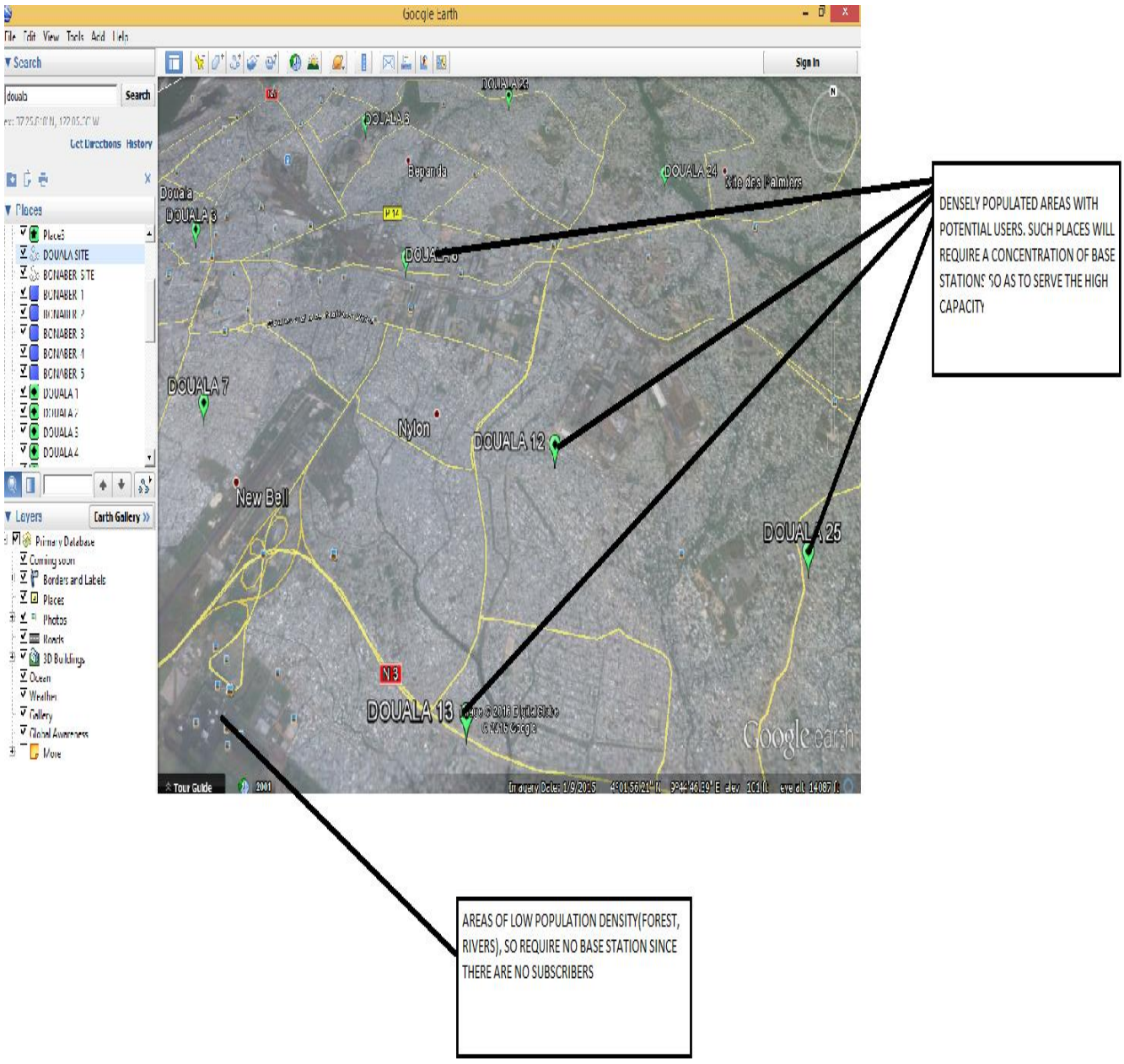
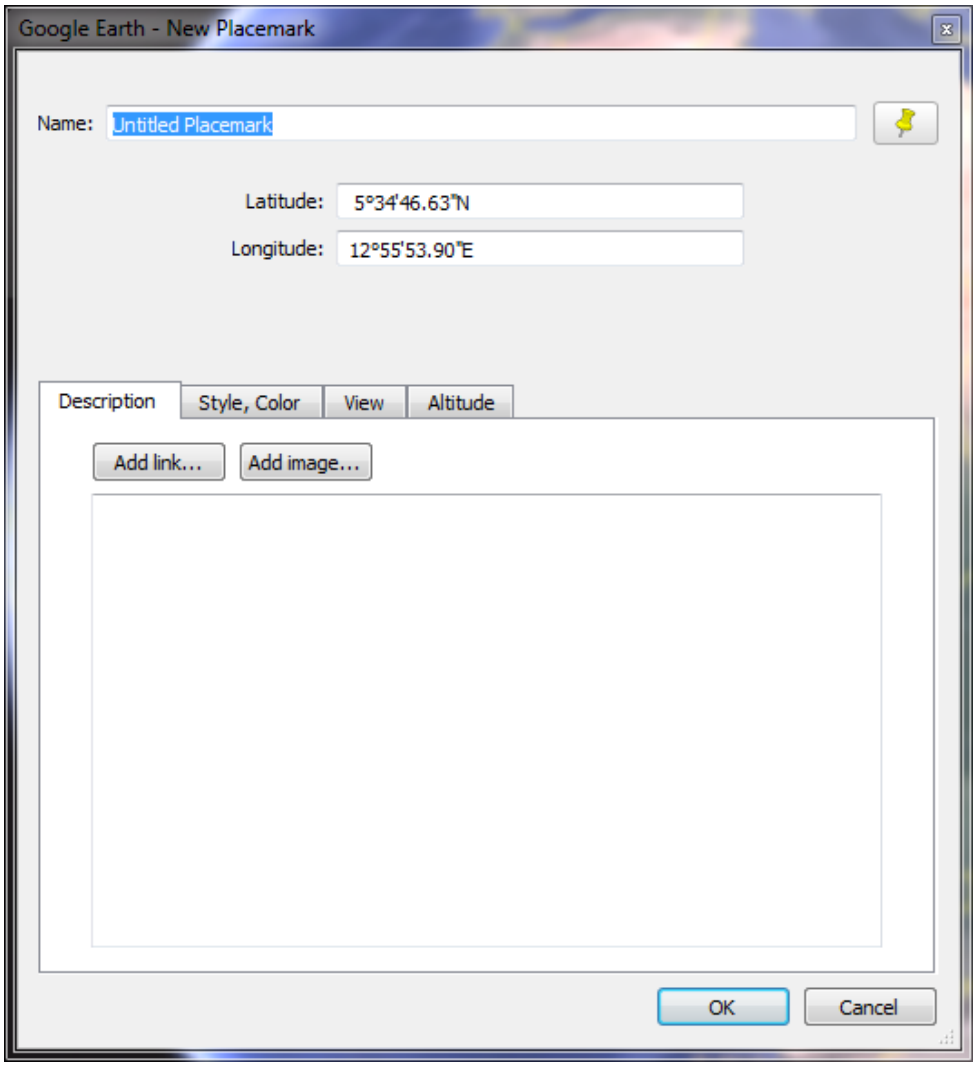


Figure 5: relationship between BTS placement and population density

Telecommunications resources and hardware are very expensive, so we want to be sure of proper and efficient use of these resources in terms of profits and consumer satisfaction when deploying our network. In order to do so therefore we need to simulate and test our network solutions before implementing them. This is made possible again by GIS (GOOGLE EARTH). In this case, we were planning the installation of 30 new BTSs. To do this on GOOGLE EARTH, the add

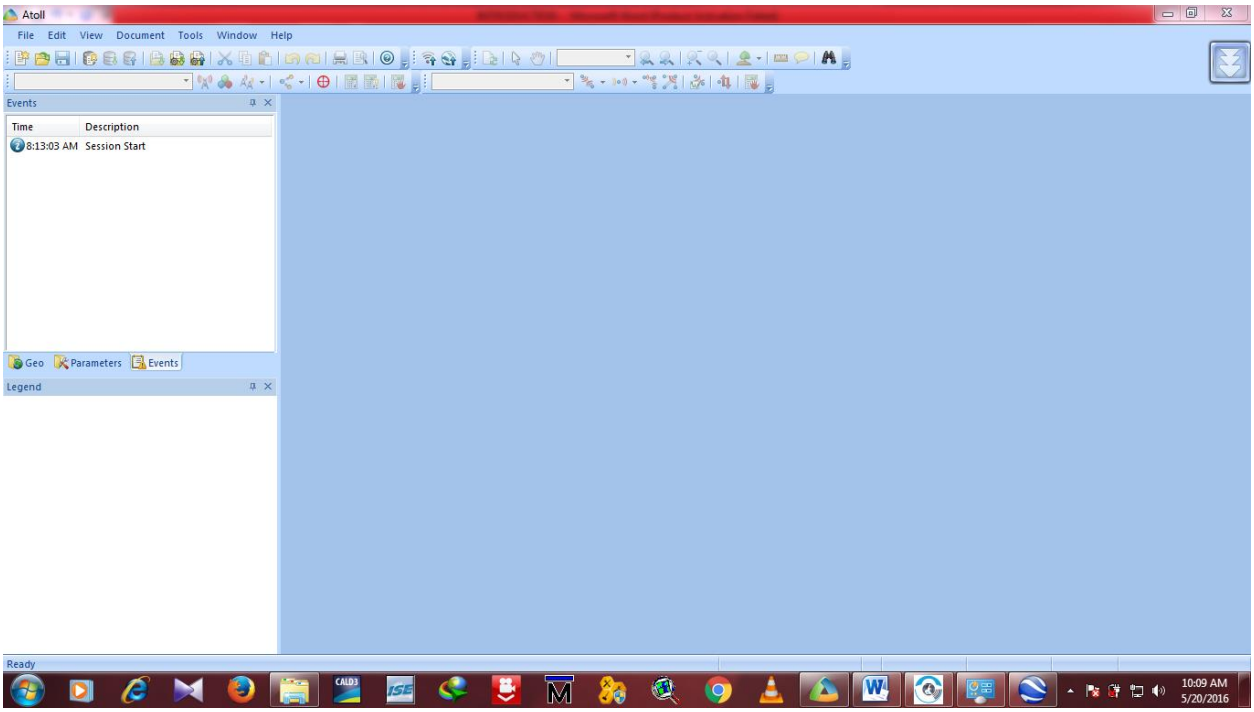
placemarker icon is clicked and the 30 BTSs are arbitrarily placed on Bonaberi (5BTSs) and Douala (25BTSs). The placemarkers representing the 30 BTSs in GOOGLE EARTH are named BONA1 to BONA5 and DLA1 to DLA25 by double clicking on each placemarker and writing the name in the ensuing window.



The colour and style of each placemarker can be varied by clicking on the appropriate tab from the window above. But what we are now interested in is the geographic coordinates of each BTS. Again from the above window these information are gotten by reading from the appropriate panels as shown.

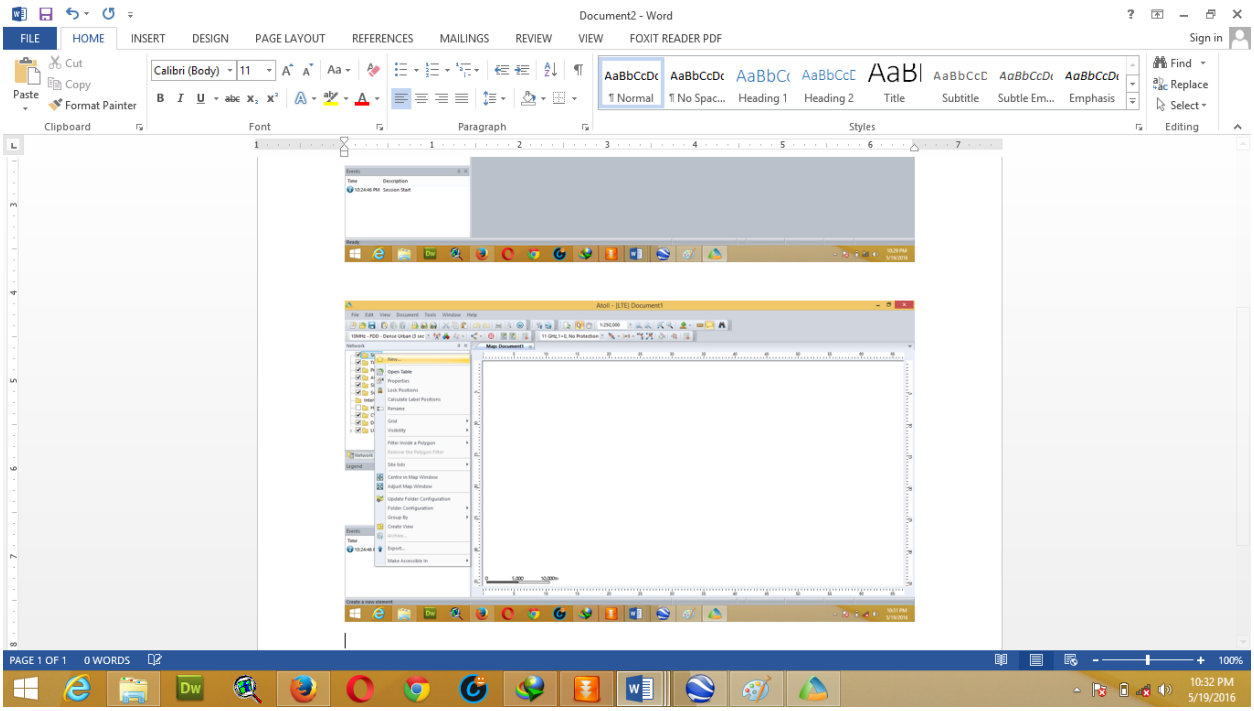
These BTSs and their coordinates are tabulated on excel for documentation purposes to be later invoked in ATOLL.

So far we have used GOOGLE EARTH to get all the basic information required to plan our network. Now we move to the planning proper and this is the area where ATOLL is employed. Now diving to the nitty-gritty of the matter, ATOLL is run and the following window is seen

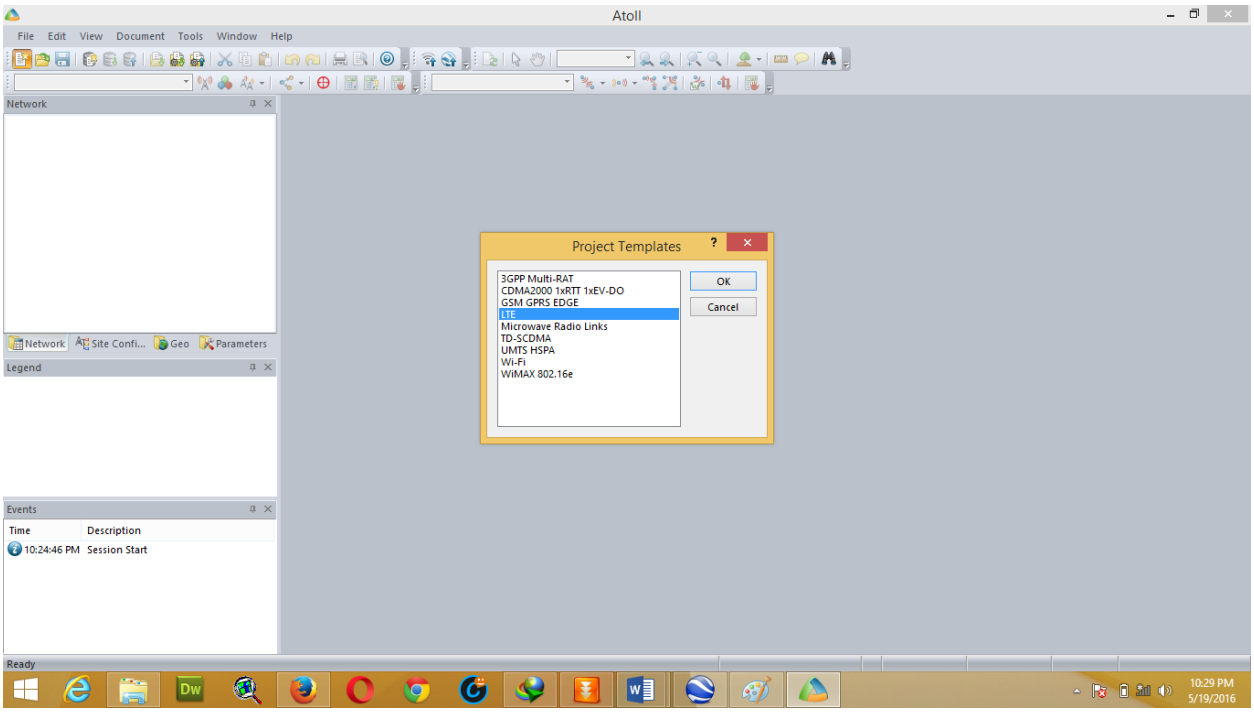


Now we click on **view** and a drop-down menu appears from which **event viewer** is selected. This will help us view actions carried out on the software. To get the legend of our work again we go under **view** and select **legend window**

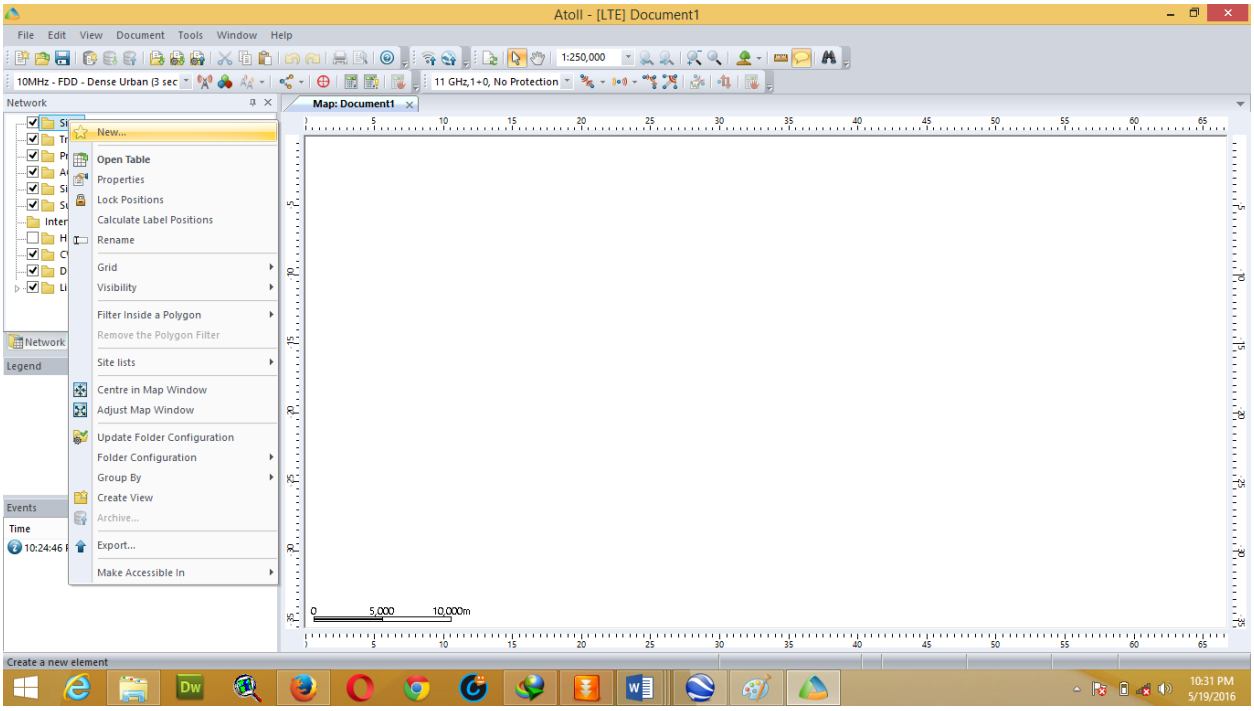
We are now set to start our project so the next thing to do is to go to file>new project and the following window appears.



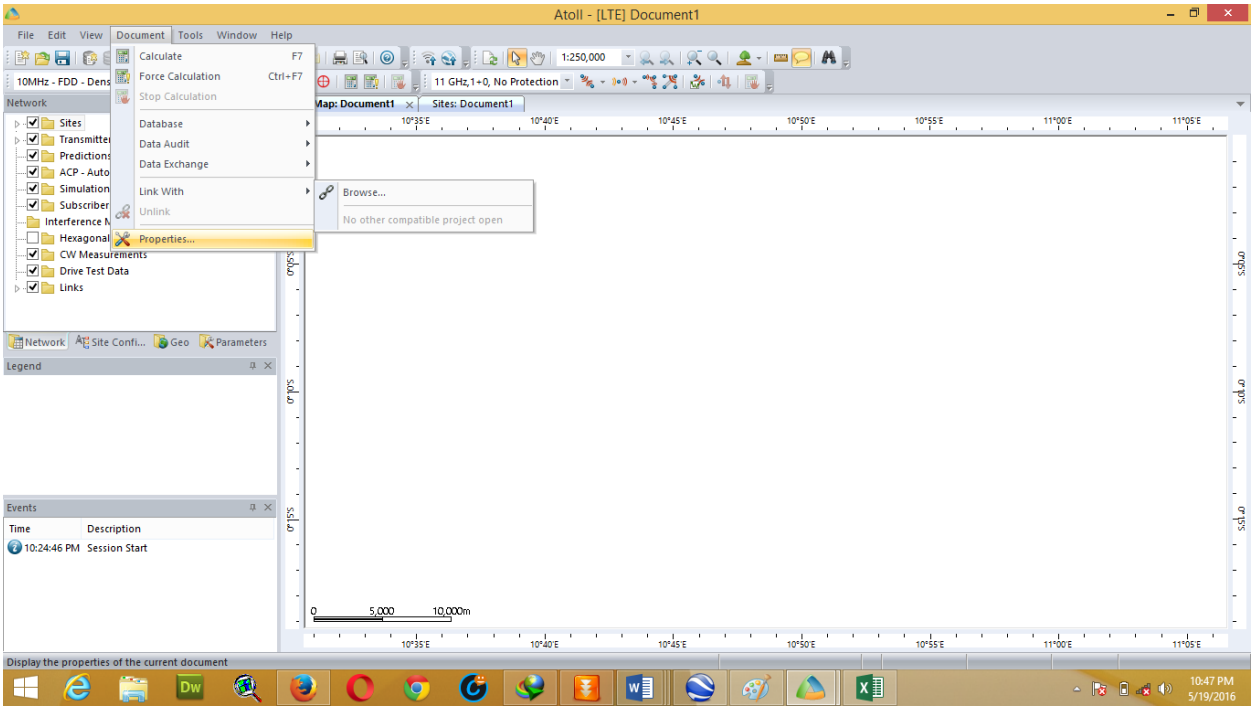
Since we are interested in 4G LTE network planning, we select LTE and click ok.



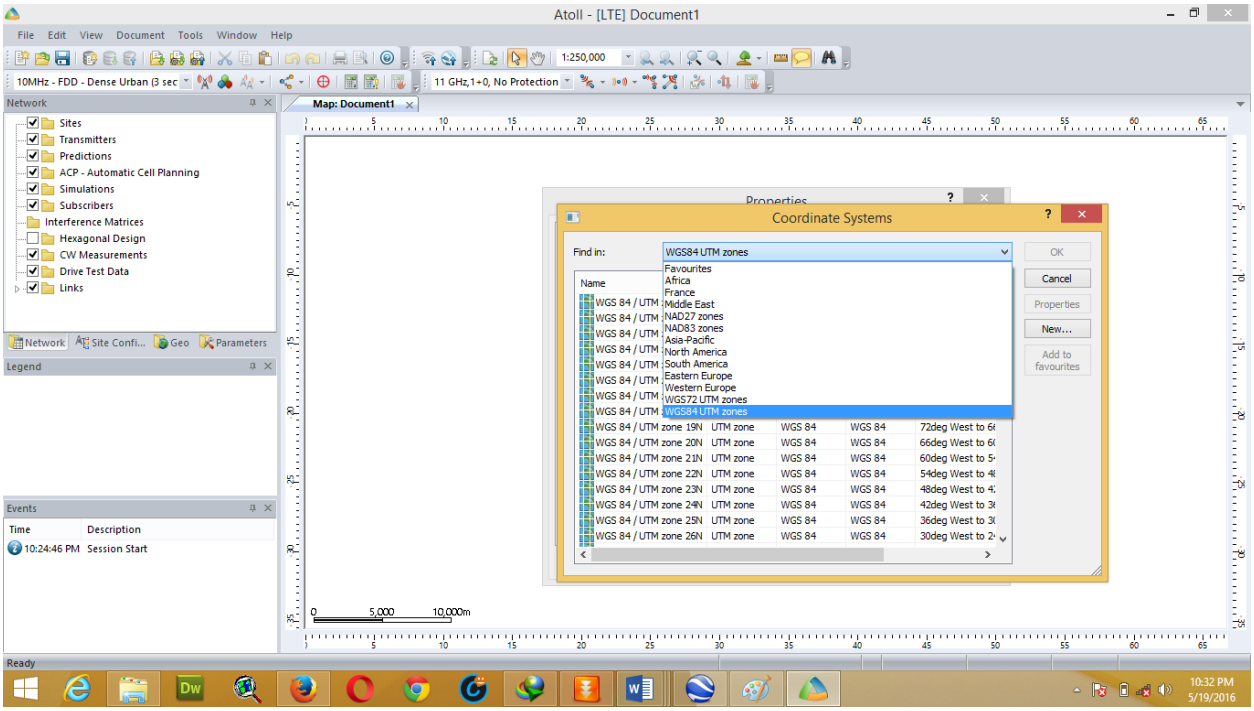
Notice the windows on the left-hand screen for they are the windows we selected to give more information about our work.



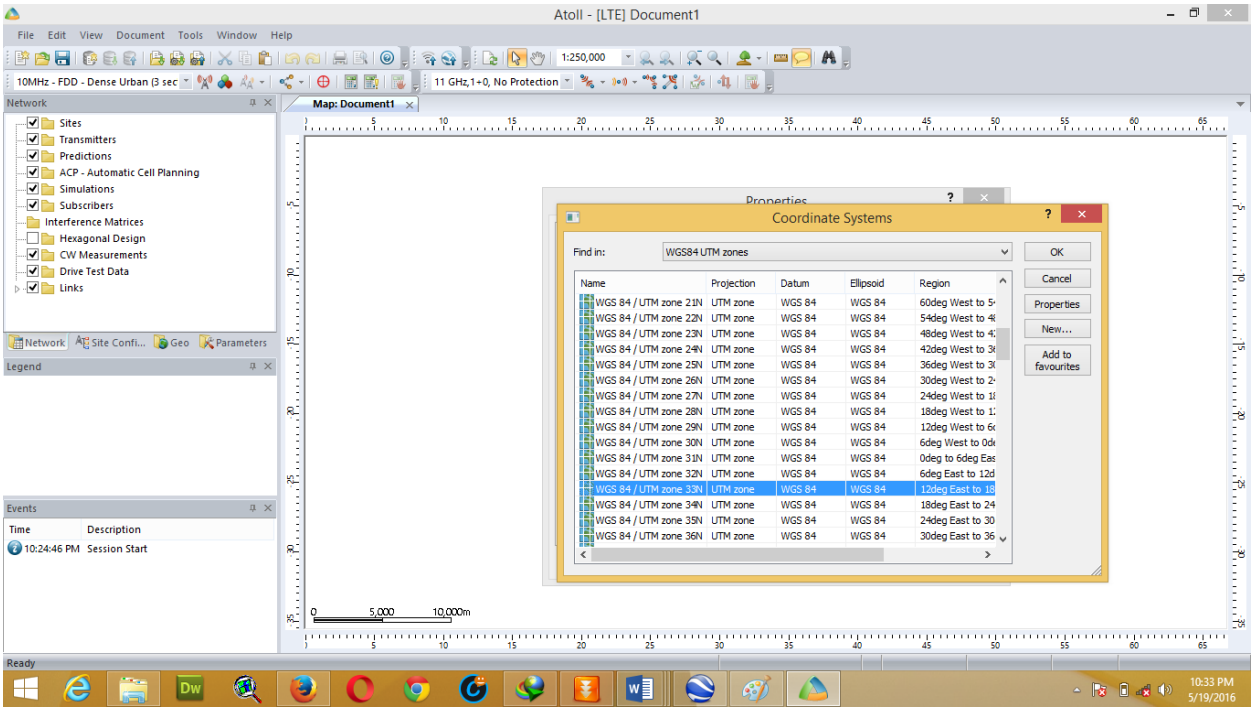
To change the coordinate system of our map, the following is done. Go to documents>properties



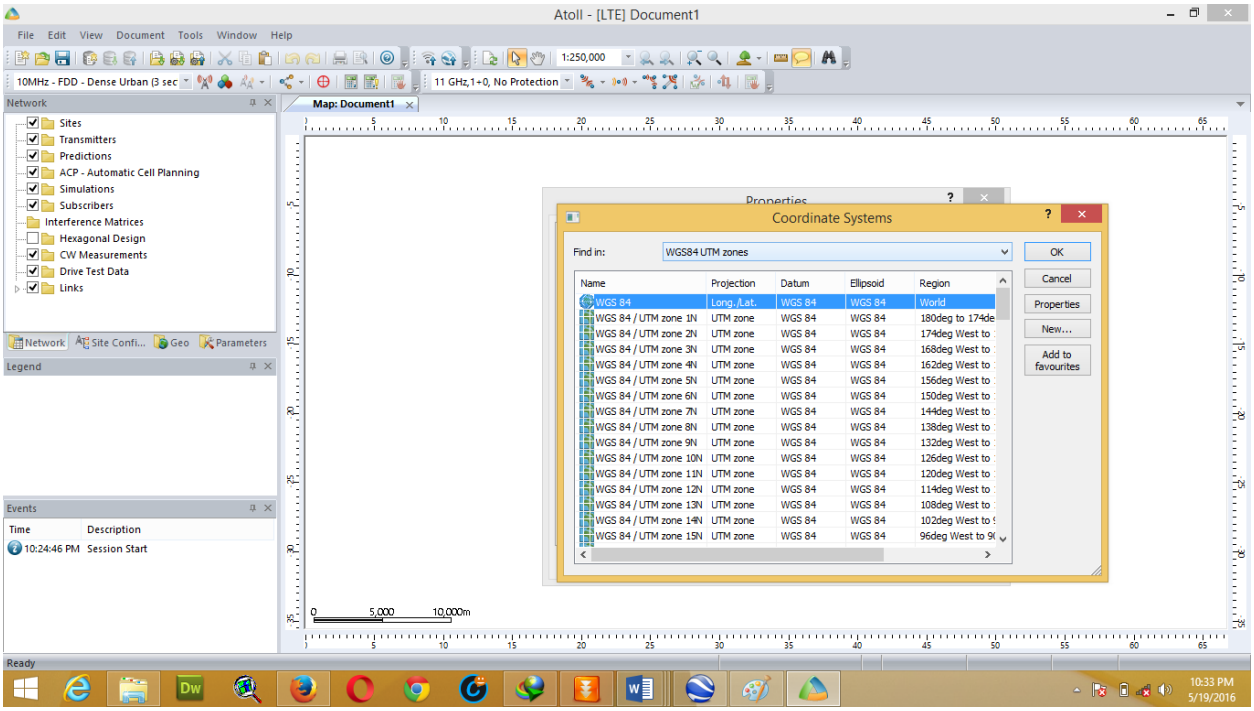
Browse **projections** and select the following.



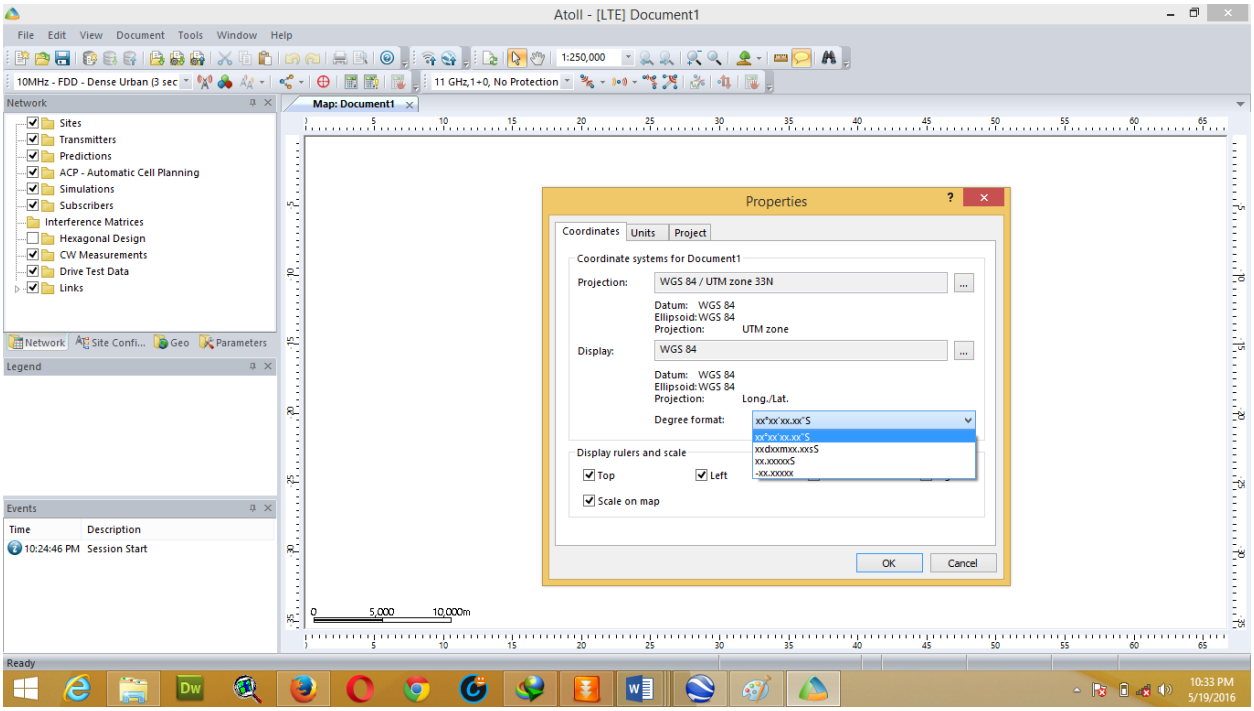
Then select the 33N option as seen below



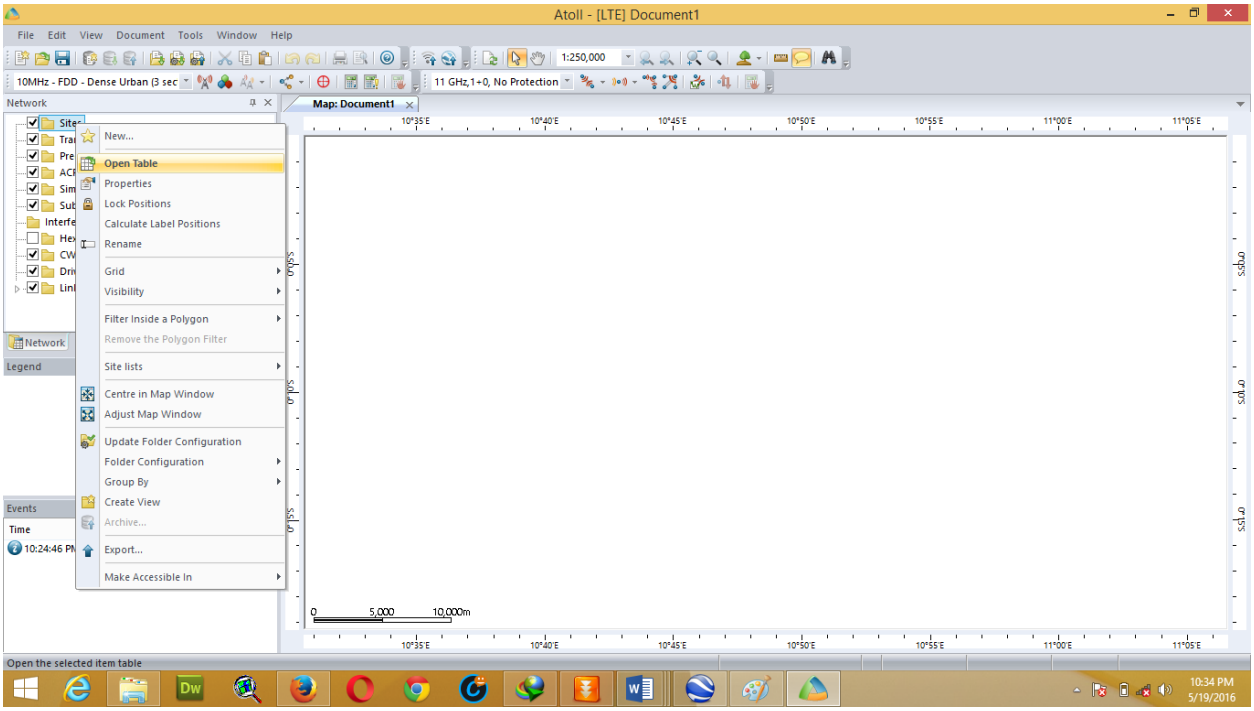
Then browse **Display** and select the following



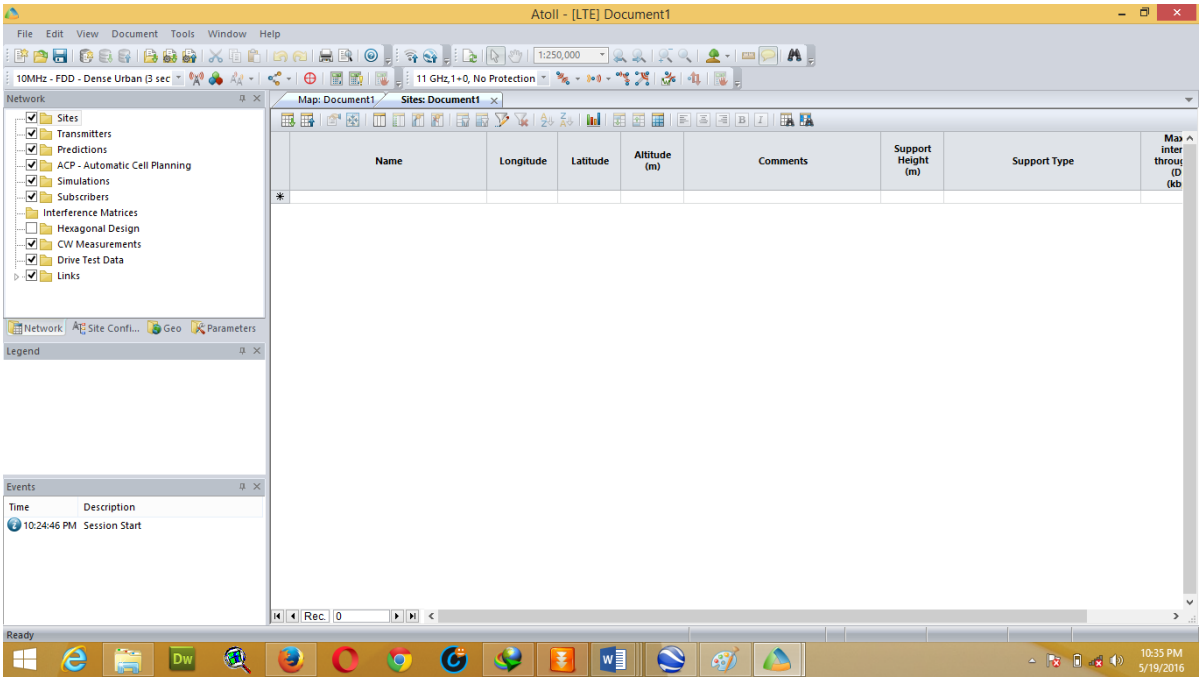
Now under degree format select the following



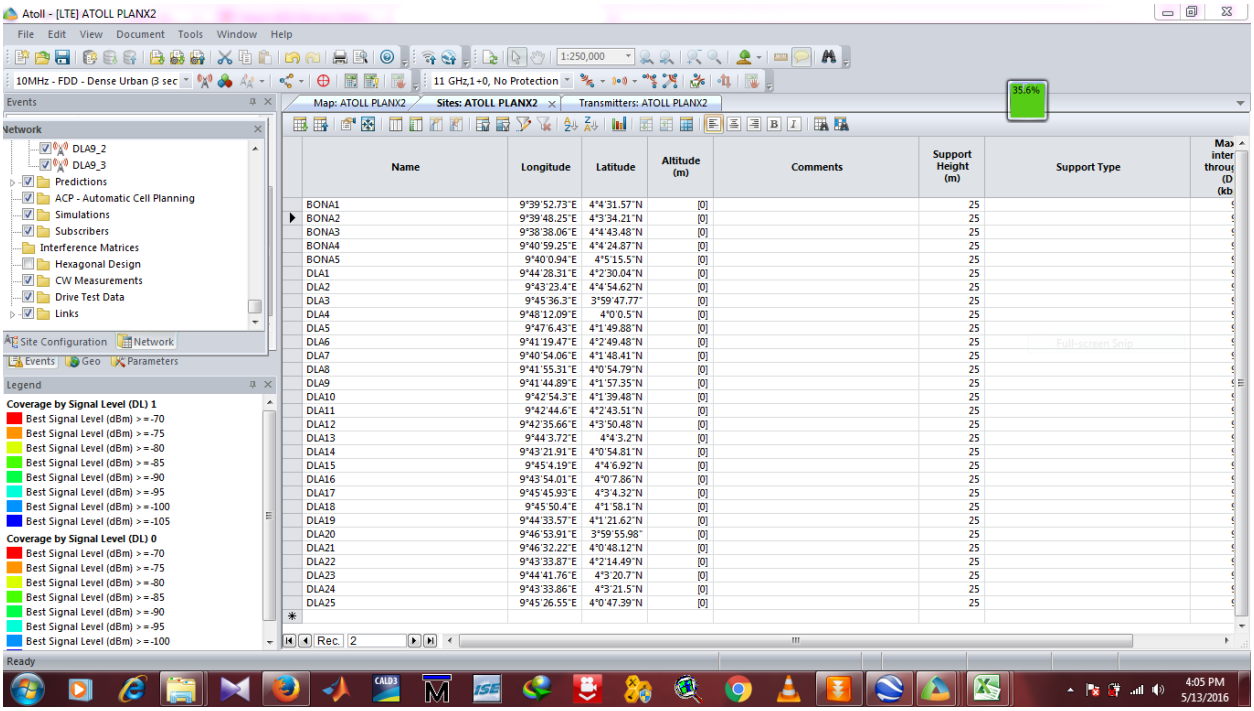
When this is successfully done the coordinate system of the map changes to degree minutes seconds. Go sites under network panel, right click and select open table as seen below



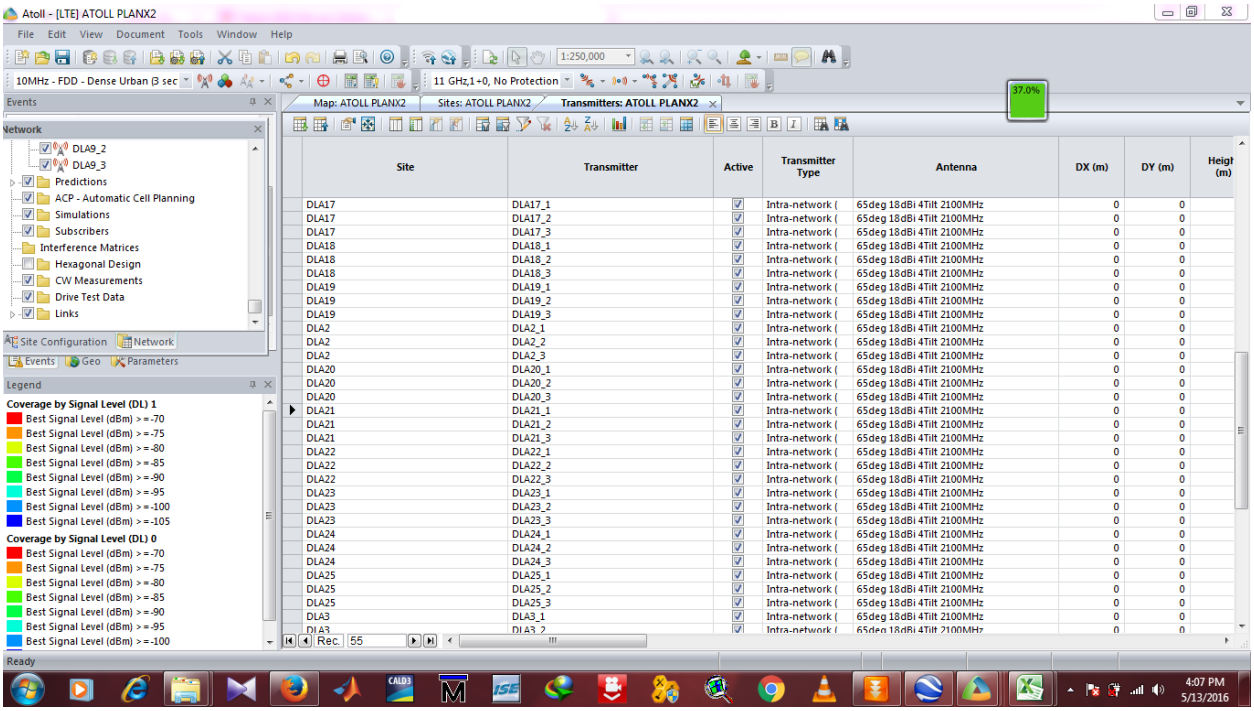
The following table will then appear as shown below



Remember that we had documented our coordinates gotten from GOOGLE EARTH on excel. So now we simply go to that excel document copy the whole document and paste it on the ATOLL table as shown below

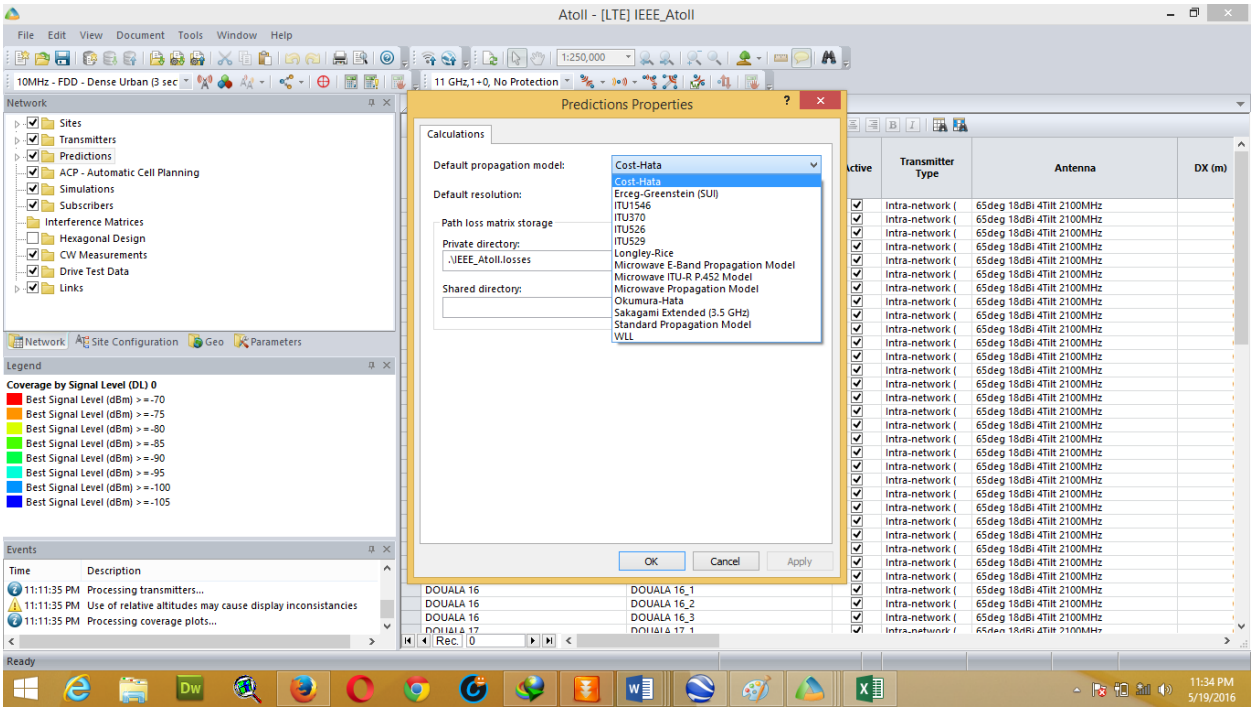


Under sites, our 30BTSs will appear. Since Capacity is of prime importance to our work, we right click on each and add 3 transmitters for each BTS to give a total now of 90 Transmitters. To view and make adjustments to our attennas, we go to Transmiters under the network panel, right click and add table.

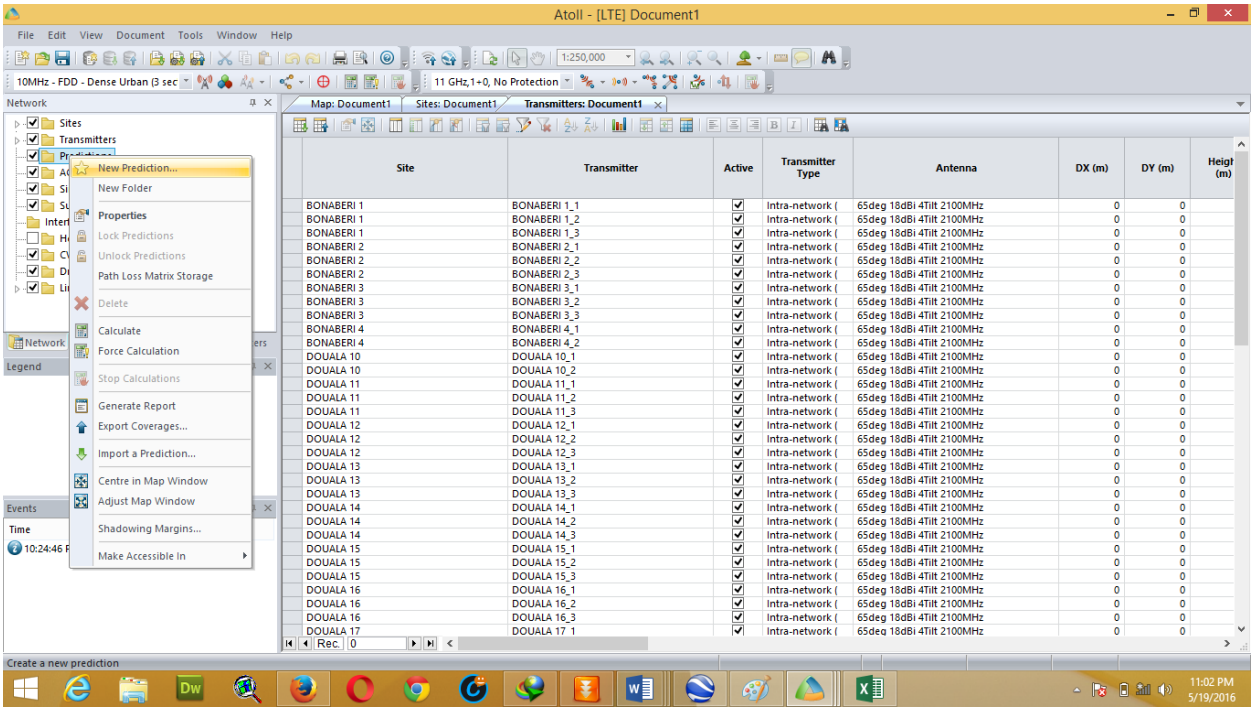


In this table, antenna heights are put to 25. The purpose of adding 3 transmitters to each BTS was to employ the idea of SECTORIZATION which is a key technology used to improve capacity of a network. In this practical we are employing 3 sector (3 Transmitters) BTS. Each transmitter is given an azimuth of 0, 120 and 240 degrees respectively to the 3 transmitters of each BTS.

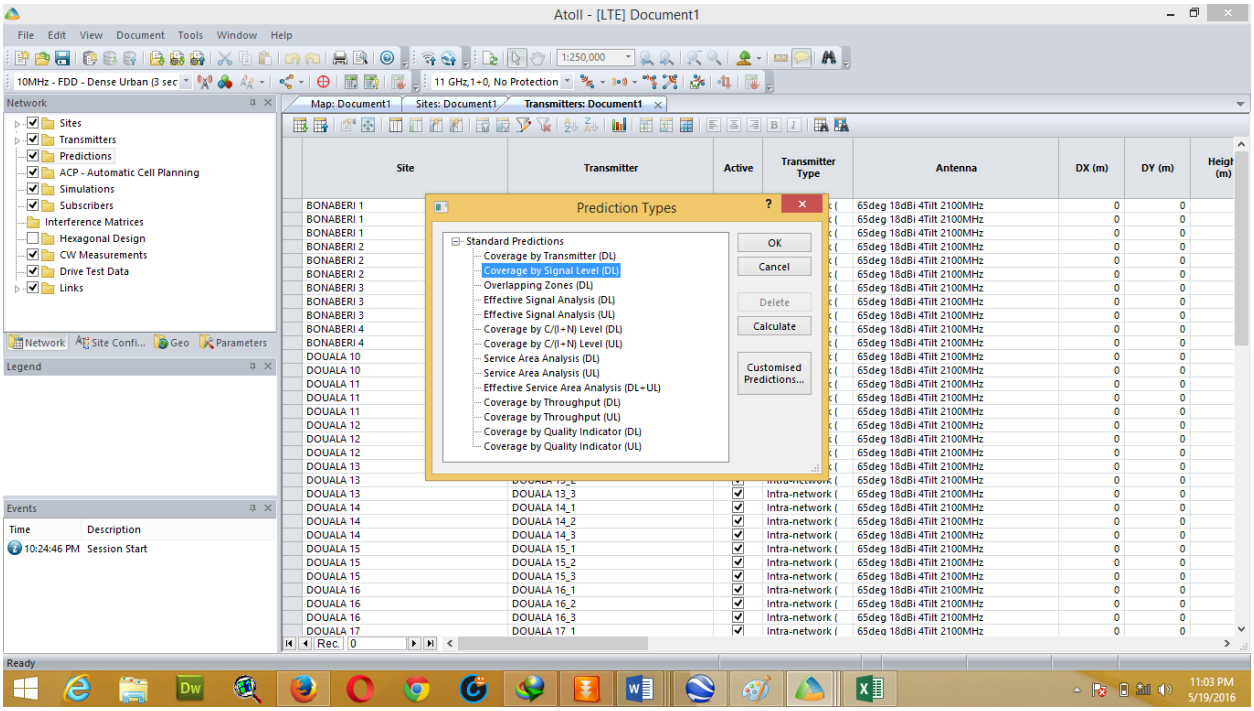
We now need a propagation model for a town like Douala and from theory learned in Telecommunications, the suitable model is COST231-HATA model. So again under network panel, right click on predictions>properties and select the model as shown



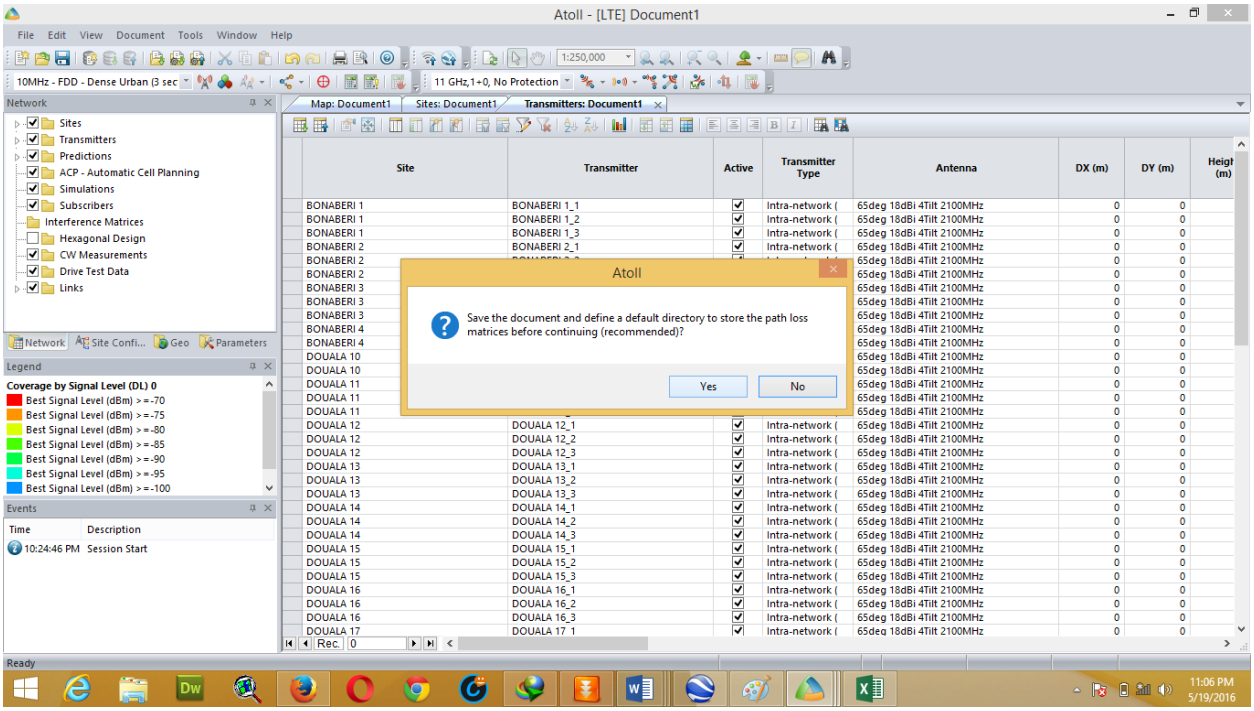
Now it is important to save the work done so far on ATOLL. Next, we go prediction>new prediction as shown



Then select the second option and click ok



Then click yes from the ensuing window below



All that is left for us to do now is to export our work to GOOGLE EARTH. This is so because our ATOLL version is not a full pack. If it were, then there will be no need to export our ATOLL work to GOOGLE EARTH because ATOLL has its own embedded GIS. After exporting to GOOGLE EARTH, we have the following figure

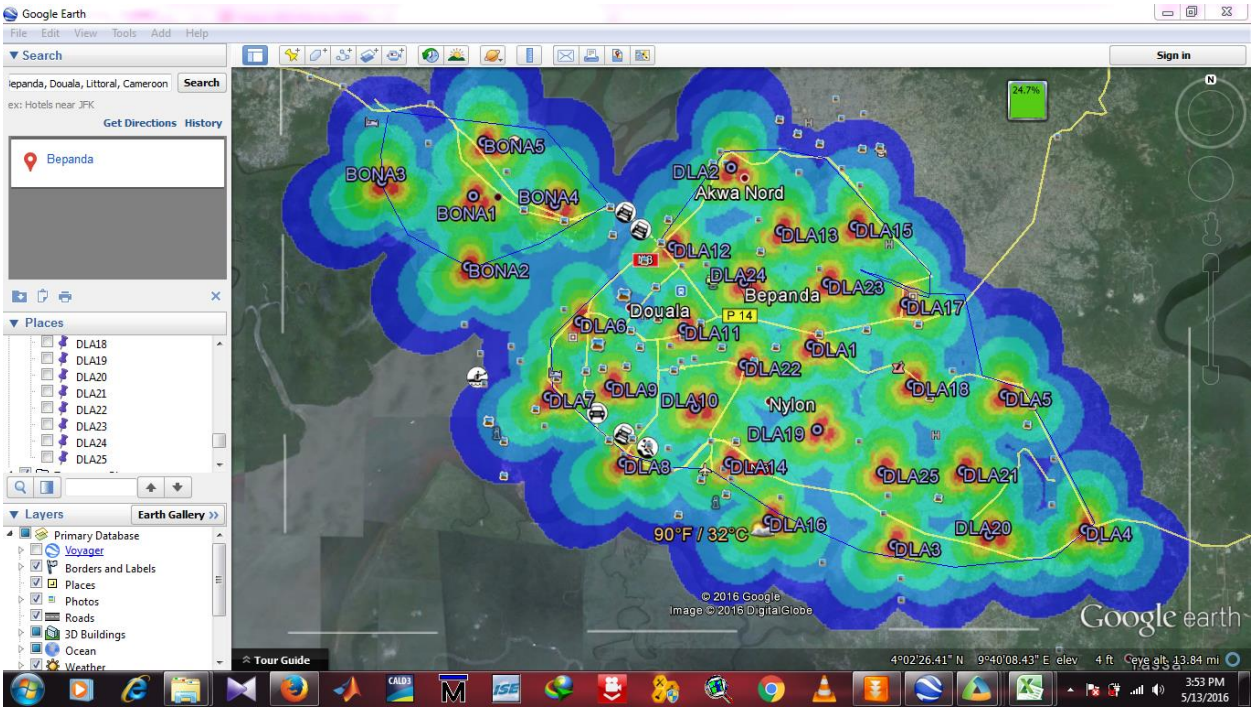


Figure of Planned network

Notice the legend window of ATOLL which describes our signal levels. The coverage plan indicates shadow areas (areas where the signal strength is very low) within the intended coverage area. This indicates that further tuning and addition of more sites is required to effectively cover the Douala area (eliminate the dead zones or shadow areas). This is all about our network planning and forecasting simulation. If this is approved by company superiors then we proceed to the actual locations and do some surveys.

However, in doing these surveys we may find that a BTS point is say on a feeble roof top, some pond, near tall trees, near a forest bed or say on a street road. If this be the case, we will need to change our location to within 10m of the actual location. This will have no effect on our network. After field survey is completed and approved network implementation will commence.

EXERCISE:

- Perform the coverage plan of a 4G network to be deployed in the city of Buea. Discuss your results
- Write a report of the activity carried out alongside with your results and recommendations.

LAB 2: BUILDING A BASIC WLAN

OBJECTIVE:

The objective of this section of the Mobile Communications laboratory session is to perform configuration of a Wireless Local Area Network (WLAN) in eNSP software.

AIM:

Configuration of WLAN services for a campus network in eNSP.

HARDWARE AND SOFTWARE REQUIREMENTS:

- Personal computer (PC).
- eNSP.

SPECIFICATIONS

- Applicable ACs: AC6605 and AC6005
- Applicable APs: all APs
- Applicable software version: V200R005C00

NETWORKING REQUIREMENTS

1. The S2 switch supports the WLAN-AC function. If the switch does not support the WLAN-AC function, use a common AC to replace the switch. The AC in the following content is an S2 switch.

2. The AC is deployed in an out-of-path mode and is on the same Layer 2 network as the APs.

3. The AC functions as a DHCP server to assign IP addresses to APs, S1 functions as a DHCP server to assign IP addresses to stations (STAs).

4. Service data is directly forwarded.

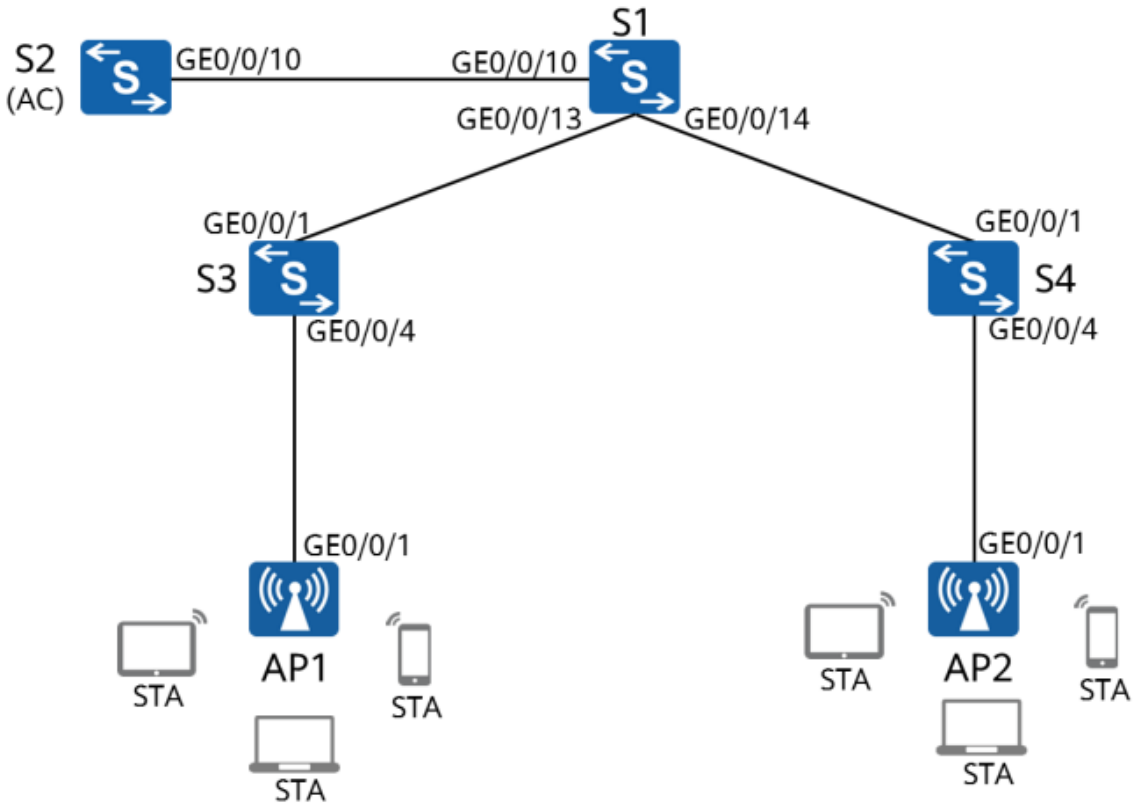


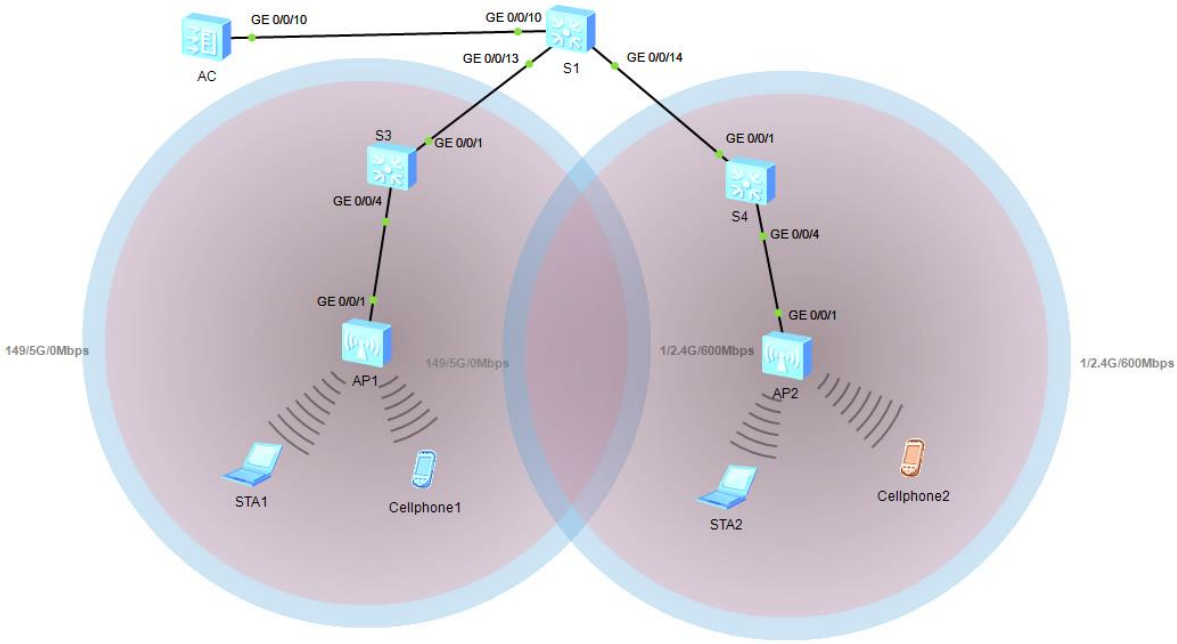
Figure 1. WLAN topology

Configuration Roadmap

The configuration roadmap is as provided in a separate document titled “CEF356 Lab 2 – WLAN Configuration”.

RESULTS

Your result should be similar to what is displayed on Figure 2 below. To test, use a ping and make sure it is possible to reach any STA from another STA.



EXERCISE:

- Perform the configuration of WLAN services for the FET Building. Discuss your results
- Write a report of the activity carried out alongside with your results and recommendations