REPUBLIQUE DU CAMEROUN

Paix-Travail-Patrie

MINISTRE DE L'ENSEINEMENT

SECONDAIRE

 FACULTE DE L'ENGINERIE

ET TECHNOLOGIE

REPUBLIC   OF CAMEROON

Peace-Work-Fatherland

MINISTER OF HIGHER EDUCATION

FACULTY OF ENGINNERING

 AND TECHNOLOGY

UNIVERSITY OF BUEA

DEPARTMENT OF COMPUTER ENGINEERING

COURSE: SOFTWARE DEVELOPMENT TOOLS

COURSE CODE: CEF 345

BUILDING A WIRELESS LAN TO CONNECT FET BUILDING AND TECHNO BUILDING AND PERFORMING A RADIO NETWORK PLANNING IN BUEA

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PART1:

Perform the Radio Network Planning of a 4G LTE Network for the Buea area in Cameroon

OBJECTIVES:

The objective of this Mobile and Wireless Communications project 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 Buea area where it is required to a certain number of BTS sites and analyse the coverage to determine if that number of sites will be enough to take care of coverage requirement of the Buea area.
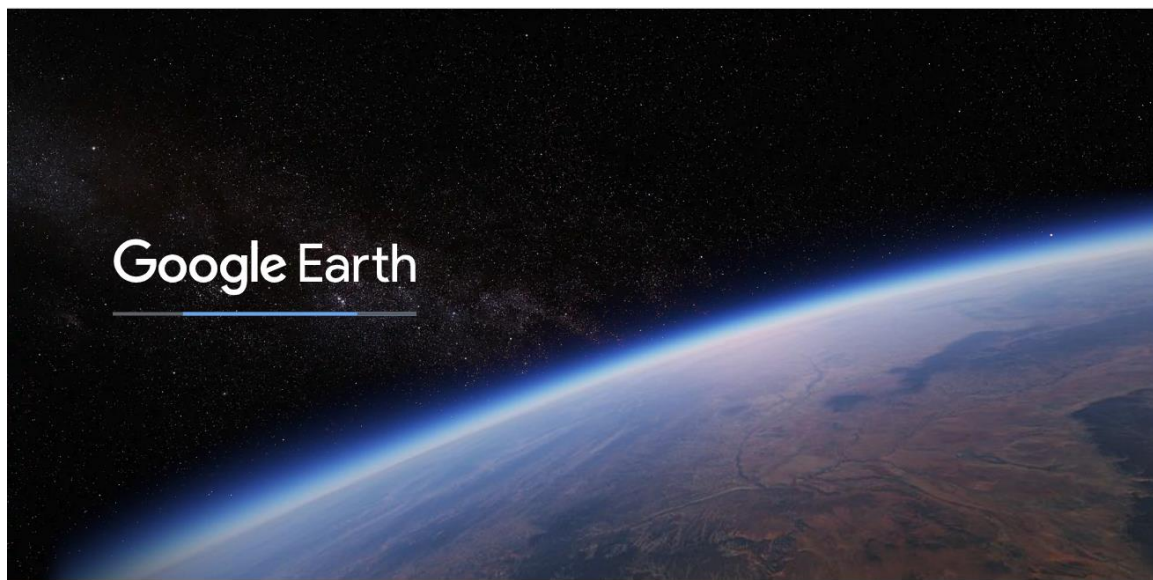
AIM:

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

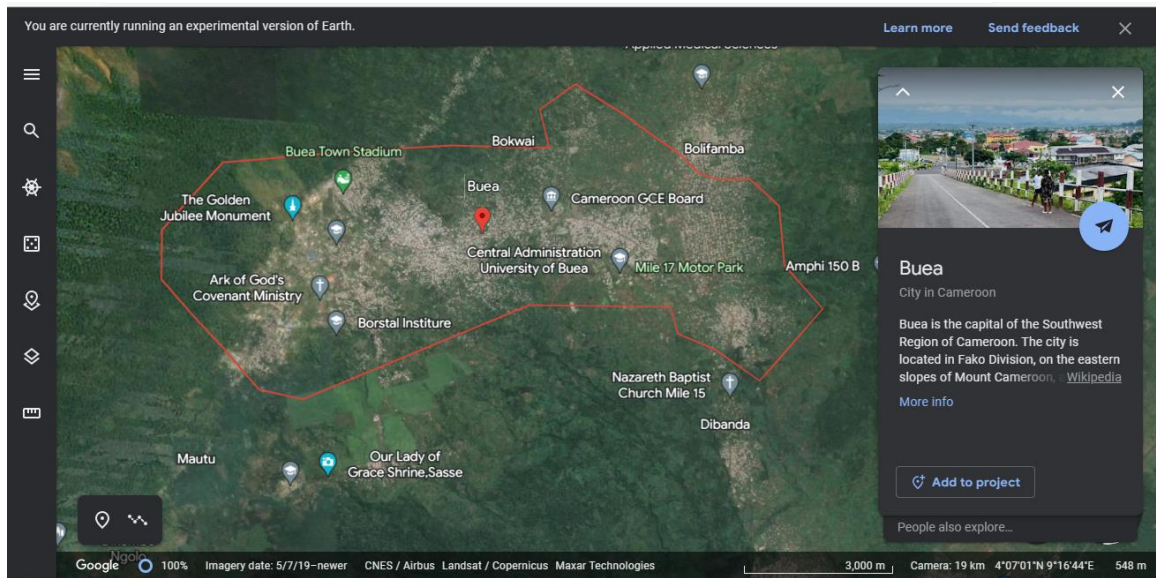## HARDWARE AND SOFTWARE REQUIREMENTS:

- Personal computer (PC)
- Atoll
- Google Earth Pro.
- Google Maps
- CEF 356 LAB MANUAL

Main Procedures:

We used Google earth to find the Buea Area. With a total surface area of 870km^2.

Then from Google Earth, we could successfully see the borders of Buea, excluding Mt. Cameroon

We then obtained a total coverage area of 45.98km^2.

From there, we assumed a hexagonal cell radius of 2.25km which helped us find the Surface area of a cell.

Area of a Cell:

$$S_{cell} = \frac{3\sqrt{3}\,R^2}{2}$$

$$= \frac{3\sqrt{3}\,(2.25)^2}{2}$$

$$= 13.15\ km^2$$

Using this value, we easily came out with the number of cells needed for Buea.

If 1 cell = $13.15\ km^2$

x cells = $45.98\ km^2$

$\Rightarrow x = \dfrac{45.98}{13.15} = 3.49\ cells$

$\approx 4\ cells$

We proceeded by getting the total number of clusters that it will give, in case we do 2 cell frequency reuse.

$$S_{cluster} = N \times S_{cell}$$

$$= 2 \times 93.75$$

$$= 26.3 \, km^{\sim}$$

$$\therefore \# \, of \, Clusters = \frac{S_{Total}}{S_{cluster}}$$
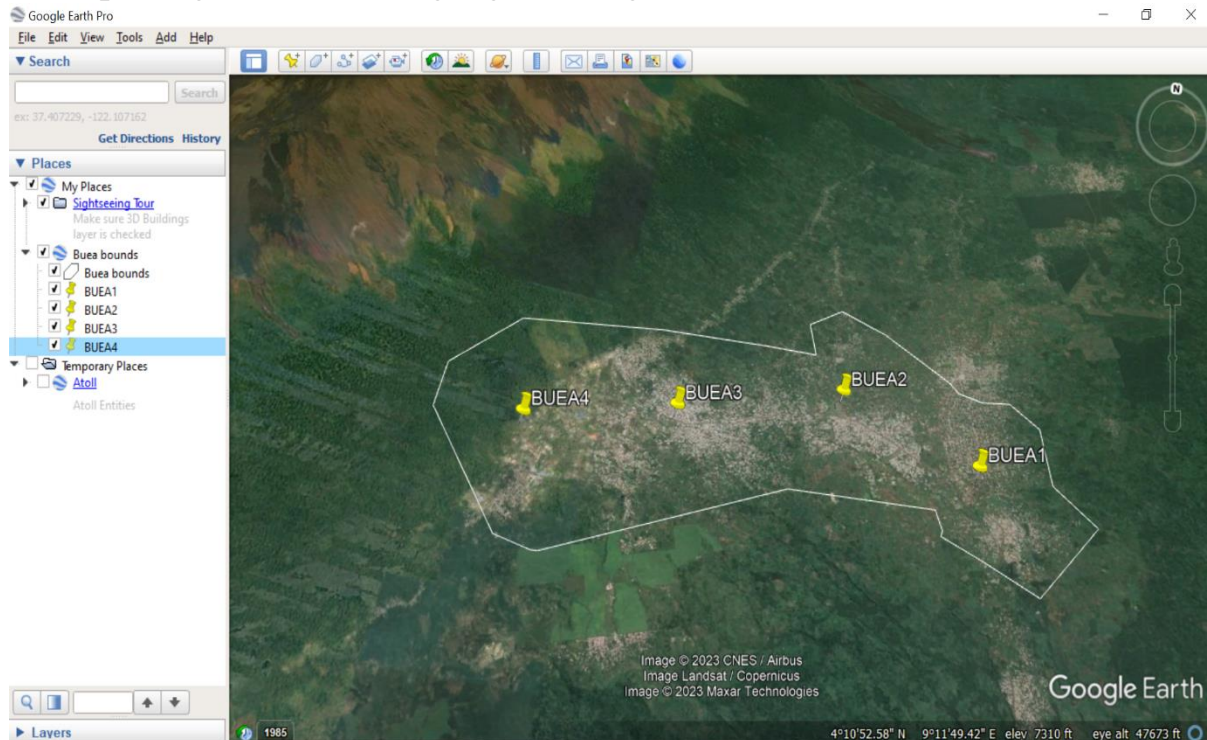
$$= 1.75$$

$$\simeq 2 \, Clusters$$

Diagrammatically, we had this;
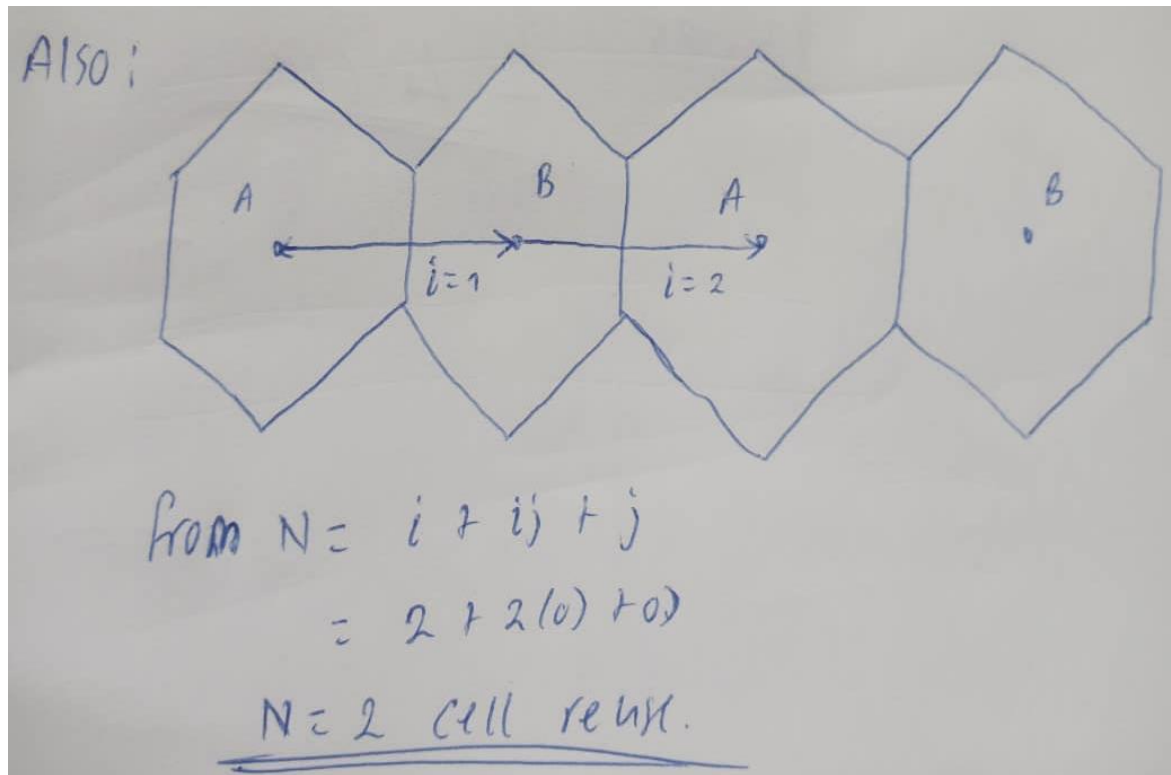
Now, placing these BTS on google earth gives

We exported the following sites on Atoll

| Name	Longitude	Latitude	Altitude (m)	Comments	Support Height (m)	Support Type	Max S1 interface throughput (DL) (kbps)	Max S1 interface throughput (UL) (kbps)
BUEA1	9°18'15.76"E	4°8'59.82"N	[0]		50		950,000	950,000
BUEA2	9°16'48.02"E	4°9'42.99"N	[0]		50		950,000	950,000
BUEA3	9°15'0.22"E	4°9'15.79"N	[0]		50		950,000	950,000
BUEA4	9°13'24.29"E	4°8'54.61"N	[0]		50		950,000	950,000
*								

As you can see, the BTS where named BUEA1, BUEA2, BUEA3, BUEA4 respectively.

Adjusting some the transceivers parameters, gave to our cells a coverage shape similar to the form of a 3 petal flower

Site	Transmitter	Active	Transmitter Type	Antenna	DX (m)	DY (m)	Height (m)	Azimuth (°)	Mechanical Downtilt (°)	Additional Electrical Downtilt (°)
BUEA1	BUEA1_1	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	0	0	
BUEA1	BUEA1_2	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	120	0	
BUEA1	BUEA1_3	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	240	0	
BUEA2	BUEA2_1	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	0	0	
BUEA2	BUEA2_2	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	120	0	
BUEA2	BUEA2_3	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	240	0	
BUEA3	BUEA3_1	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	0	0	
BUEA3	BUEA3_2	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	120	0	
BUEA3	BUEA3_3	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	240	0	
BUEA4	BUEA4_1	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	0	0	
BUEA4	BUEA4_2	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	120	0	
BUEA4	BUEA4_3	☑	Intra-network (Se	65deg 18dBi 4Tilt 2100MHz	0	0	30	240	0	
*		☐								

Below is what we finally obtain when we export these modifications on Google earth pro.
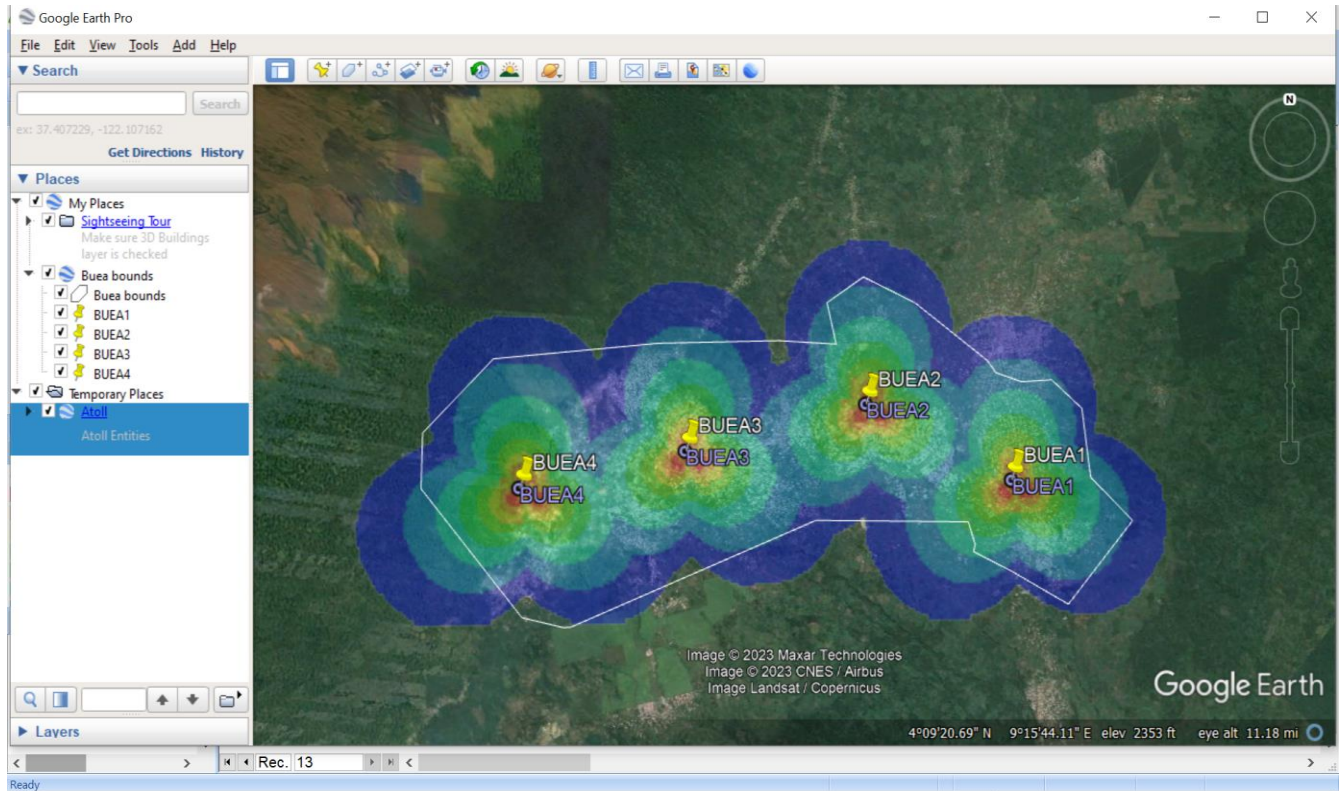
OBSERVATIONS:

Using a number of BTS lesser than 4 will not be able to cover the entire Buea area, and using a number BTS greater than this will be cost, resource and time expensive.

CONCLUSION:

We came to realize that, if a new network is to be deployed in Buea, it will only require 4 BTS,

PART2:

Building a wireless Lan to connect FET building and Techno building

🞣 INTRODUCTION

Wired LANs are expensive and lack mobility, thus, The increasing demand for portability and mobility requires Wireless LAN (WLAN) technologies. WLAN is now the most cost-efficient and convenient network access mode. It allows users to move within the covered area.

🞣 AIM

The aim of this experiment is to configure a WLAN service for a FET building and TECHNO building in eNSP software.

🞣 REQUIREMENT

❖ Software such as
  ✓ eNSP
  ✓ Virtual box 5.2.44 (ORACLE)
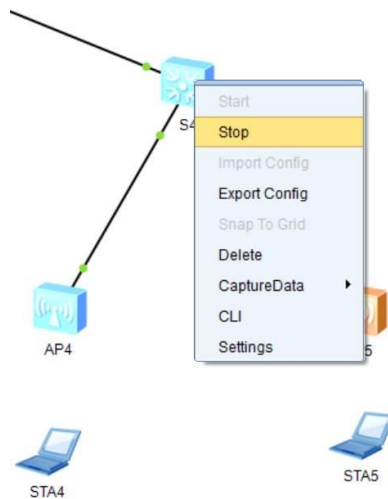 ✓ Wireshark
  ✓ Winpcap
❖ Personal Computer

🞣 PROCEDURE

❖ **DATA PLANING**

The Virtual LAN VLAN protocol so as to eliminate large broadcast storms. Also, it also provides stability and ease management of the network devices.

❖ **CONFIGURATION**
  ➢ CONFIGURATION OF THE WIRED NETWORK CONNECTIVITY
    • First start all devices individually as shown below

- Then, the Command Line Interface (CLI) is used to configure the

  1. Name the device
     Configuration sample:
       [S3]interface GigabitEthernet 0/0/4 [S3-GigabitEthernet0/0/4]poe enable
  2. VLANs
     Configuration sample:
       [S1]vlan batch 100 101
       [S1-GigabitEthernet0/0/13]port link-type -trunk
       [S1-GigabitEthernet0/0/13]port trunk allow-pass vlan 100 --101
       [S1-GigabitEthernet0/0/13]quit
       [S1]interface GigabitEthernet -0/0/14
       [S1GigabitEthernet0/0/14]port link-type trunk
       [S1-GigabitEthernet0/0/14]port trunk allow-pass vlan 100 101
       [S1-GigabitEthernet0/0/14]

  3. interface IP addresses
     Configuration sample:
       [S1]interface Vlanif 101
       [S1-Vlanif101]ip address 192.168.101.254 24
  4. DHCP
     Configuration sample:
       [S1]dhcp enable
  5. Create an AP group and name it ap-group1
     configuration sample:

[AC]wlan

[AC-wlan-view]ap-group name ap-group1

6. Create a regulatory domain profile, and set the AC country code in the profile

Configuration sample:

[AC]wlan

[AC-wlan-view]regulatory-domain-profile namedefault

7. Bind the regulatory domain profile to an AP group.

[AC]wlan

[AC-wlan-view]ap-group name ap-group1

[AC-wlan-ap-group-ap-group1]regulatory-domain-profile default

Below are some codes

```
<Huawei>system
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]disp sys
[Huawei]disp system-information
System Information
==================================================
Serial Number          : 210235448310073l7476
System Time            : 2023-06-01 15:44:11
System Up time         : 33min 26sec
System Name            : Huawei
Country Code           : US
MAC Address            : 00:e0:fc:d4:50:e0
Radio 0 MAC Address    : 00:00:00:00:00:00
Radio 1 MAC Address    : 00:00:00:00:00:10
IP Address             : 192.168.100.217
Subnet Mask            : 255.255.255.0
Default Gateway        : 192.168.100.254
IPv6 IP Address        :
IPv6 Default Gateway   :
Management VLAN ID(AP) :
IP MODE                : dhcp
Slot Status            : Dual band(802.11b/g/n;802.11a/n/ac)
AP Type                : AP2050DN
Board Type             : AP2050DN
Board Serial Number    : 210235448310073l7476
Board Bom Version      : 0
Boot Rom Version       : -
Software Version       : V200R007C10SPC300

===== CAPWAP LINK IS UP!!! =====
|
```

```
<AC6005>
<AC6005>

  Please check whether system data has been changed, and save data in time

  Configuration console time out, please press any key to log on

<AC6005>system-view
Enter system view, return user view with Ctrl+Z.
[AC6005]sysname AC
[AC]vlan batch 100 101
Info: This operation may take a few seconds. Please wait for a moment...done.
[AC]inter
[AC]interface g
[AC]interface GigabitEthernet 0/0/1
[AC-GigabitEthernet0/0/1]port link-type trunk
[AC-GigabitEthernet0/0/1]port trunk allow-pass vlan 100 101
[AC-GigabitEthernet0/0/1]quit
[AC]

  Please check whether system data has been changed, and save data in time

  Configuration console time out, please press any key to log on

<AC>
<AC>system
<AC>system-view
Enter system view, return user view with Ctrl+Z.
[AC]interface Vlanif 100
[AC-Vlanif100]ip address 192.168.100.254 24
[AC-Vlanif100]quit
[AC]dhcp enable
Info: The operation may take a few seconds. Please wait for a moment.done.
[AC]ip pool ap
Info: It is successful to create an IP address pool.
[AC-ip-pool-ap]network 192.168.100.254 mask 24
[AC-ip-pool-ap]gateway-list 192.168.100.254
[AC-ip-pool-ap]quit
[AC]interface Vlanif 100
[AC-Vlanif100]dhcp select global
[AC-Vlanif100]quit
[AC]wlan
[AC-wlan-view]ap-group name ap-group1
Info: This operation may take a few seconds. Please wait for a moment.done.
```

```
<Huawei>system
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]disp sys
[Huawei]disp system-information
System Information
===============================================
Serial Number            : 21023544831007317476
System Time              : 2023-06-01 15:44:11
System Up time           : 33min 26sec
System Name              : Huawei
Country Code             : US
MAC Address              : 00:e0:fc:d4:50:e0
Radio 0 MAC Address      : 00:00:00:00:00:00
Radio 1 MAC Address      : 00:00:00:00:00:10
IP Address               : 192.168.100.217
Subnet Mask              : 255.255.255.0
Default Gateway          : 192.168.100.254
IPv6 IP Address          :
IPv6 Default Gateway     :
Management VLAN ID(AP)    :
IP MODE                  : dhcp
Slot Status              : Dual band(802.11b/g/n;802.11a/n/ac)
AP Type                  : AP2050DN
Board Type               : AP2050DN
Board Serial Number      : 21023544831007317476
Board Bom Version        : 0
Boot Rom Version         : -
Software Version         : V200R007C10SPC300

===== CAPWAP LINK IS UP!!! =====
```

```
[AC-wlan-ap-group-ap-group1]regulatory-domain-profile default
Warning: Modifying the country code will clear channel, power and antenna gain c
onfigurations of the radio and reset the AP. Continue?[Y/N]:y
[AC-wlan-ap-group-ap-group1]quit
[AC-wlan-view]quit
[AC]capwap source interface Vlanif 100
[AC]wlan
[AC-wlan-view]ap-auth mode mac-auth
                 ^
Error: Unrecognized command found at '^' position.
[AC-wlan-view]ap auth-mode mac-auth
[AC-wlan-view]ap-id 0 ap-mac 00e0-fcd4-50e0
[AC-wlan-ap-0]ap-name ap1
[AC-wlan-ap-0]ap-group ap-group1
Warning: This operation may cause AP reset. If the country code changes, it will
 clear channel, power and antenna gain configurations of the radio, Whether to c
ontinue? [Y/N]:y
Info: This operation may take a few seconds. Please wait for a moment.. done.
[AC-wlan-ap-0]quit
[AC-wlan-view]ap-id 1 ap-mac 00e0-fc27-5440
[AC-wlan-ap-1]ap-name ap2
[AC-wlan-ap-1]ap-group ap-group1
Warning: This operation may cause AP reset. If the country code changes, it will
 clear channel, power and antenna gain configurations of the radio, Whether to c
ontinue? [Y/N]:y
Info: This operation may take a few seconds. Please wait for a moment.. done.
[AC-wlan-ap-1]quit
[AC-wlan-view]ap-id 2 ap-mac 00e0-fc74-0e50
[AC-wlan-ap-2]ap-name ap3
[AC-wlan-ap-2]ap-group ap-group1
Warning: This operation may cause AP reset. If the country code changes, it will
 clear channel, power and antenna gain configurations of the radio, Whether to c
ontinue? [Y/N]:y
Info: This operation may take a few seconds. Please wait for a moment.. done.
[AC-wlan-ap-2]quit
[AC-wlan-view]ap-id 3
Error: The AP does not exist.
[AC-wlan-view]ap-id 3 ap-mac 00e0-fc2c-1c30
[AC-wlan-ap-3]ap-name ap4
[AC-wlan-ap-3]ap-group ap-group1
Warning: This operation may cause AP reset. If the country code changes, it will
 clear channel, power and antenna gain configurations of the radio, Whether to c
ontinue? [Y/N]:y
Info: This operation may take a few seconds. Please wait for a moment.. done.
```

```
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname S3
[S3]*
Jun  1 2023 11:07:53-08:00 S3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 4, the ch
ange loop count is 0, and the maximum number of records is 4095.vlan
      ^
Error: Unrecognized command found at '^' position.
[S3]vlan batch 100 101
Info: This operation may take a few seconds. Please wait for a moment...done.
[S3]inter
Jun  1 2023 11:08:13-08:00 S3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 5, the ch
ange loop count is 0, and the maximum number of records is 4095.
[S3]interface g
[S3]interface GigabitEthernet 0/0/1
[S3-GigabitEthernet0/0/1]port link-type trunk
[S3-GigabitEthernet0/0/1]port trunk allow-pass vlan 10
Jun  1 2023 11:08:43-08:00 S3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 6, the ch
ange loop count is 0, and the maximum number of records is 4095.
[S3-GigabitEthernet0/0/1]port trunk allow-p
Jun  1 2023 11:08:53-08:00 S3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 7, the ch
ange loop count is 0, and the maximum number of records is 4095.ass
                                                          ^
Error:Incomplete command found at '^' position.
[S3-GigabitEthernet0/0/1]port trunk allow-pass vlan 100 101
[S3-GigabitEthernet0/0/1]quit
[S3]
Jun  1 2023 11:09:13-08:00 S3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 8, the ch
ange loop count is 0, and the maximum number of records is 4095.
[S3]inter
[S3]interface g
[S3]interface GigabitEthernet 0/0/2
[S3-GigabitEthernet0/0/2]port link-type trunk
[S3-GigabitEthernet0/0/2]port pvid
Jun  1 2023 11:09:53-08:00 S3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
191.3.1 configurations have been changed. The current change number is 9, the ch
ange loop count is 0, and the maximum number of records is 4095.
[S3-port-group-pvid]port trunk pvid vlan 100
Jun  1 2023 11:10:03-08:00 S3 DS/4/DATASYNC_CFGCHANGE:OID 1.3.6.1.4.1.2011.5.25.
```

```
<AC6005>
<AC6005>

  Please check whether system data has been changed, and save data in time

  Configuration console time out, please press any key to log on

<AC6005>system-view
Enter system view, return user view with Ctrl+Z.
[AC6005]sysname AC
[AC]vlan batch 100 101
Info: This operation may take a few seconds. Please wait for a moment...done.
[AC]inter
[AC]interface g
[AC]interface GigabitEthernet 0/0/1
[AC-GigabitEthernet0/0/1]port link-type trunk
[AC-GigabitEthernet0/0/1]port trunk allow-pass vlan 100 101
[AC-GigabitEthernet0/0/1]quit
[AC]

  Please check whether system data has been changed, and save data in time

  Configuration console time out, please press any key to log on

<AC>
<AC>system
<AC>system-view
Enter system view, return user view with Ctrl+Z.
[AC]interface Vlanif 100
[AC-Vlanif100]ip address 192.168.100.254 24
[AC-Vlanif100]quit
[AC]dhcp enable
Info: The operation may take a few seconds. Please wait for a moment.done.
[AC]ip pool ap
Info: It is successful to create an IP address pool.
[AC-ip-pool-ap]network 192.168.100.254 mask 24
[AC-ip-pool-ap]gateway-list 192.168.100.254
[AC-ip-pool-ap]quit
[AC]interface Vlanif 100
[AC-Vlanif100]dhcp select global
[AC-Vlanif100]quit
[AC]wlan
[AC-wlan-view]ap-group name ap-group1
Info: This operation may take a few seconds. Please wait for a moment.done.
```
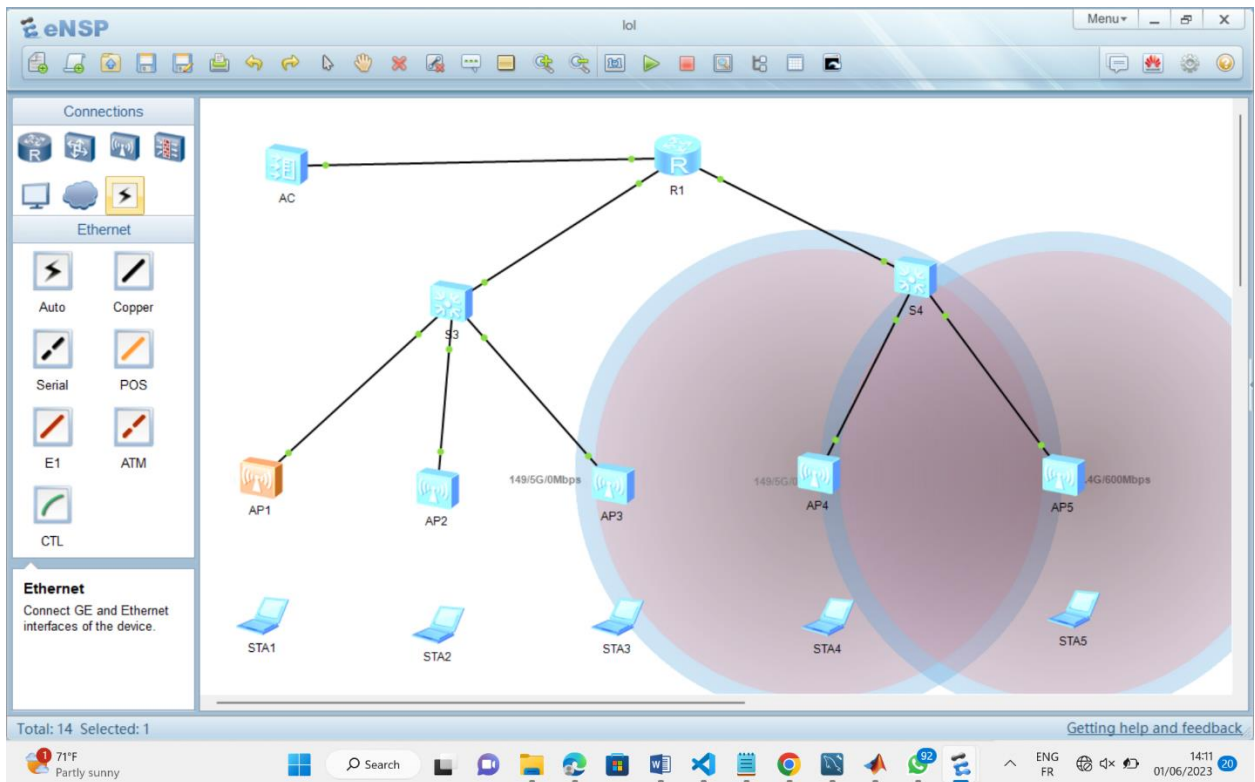
🔸 **RESULTS**

Including wireless connection to terminal devices