**Documentation**

You can follow the Open5GS official documentation for specific installation step for different versions of Ubuntu/Debian (<https://open5gs.org/open5gs/docs/guide/01-quickstart>). I will be showing the installation step of Open5GS and UERANSIM using Ubuntu 22.04.5 (Ubuntu Jammy).

**Open5GS**

1. First, install gnupg, wget, curl toolkit as it will be used later the installation of Open5GS using this command:

**sudo apt-get update**

**sudo apt-get install -y gnupg wget curl**

2. Then install MongoDB, this will be used for recording the subscriber’s database. You can install it using this command:

**wget -qO - https://www.mongodb.org/static/pgp/server-6.0.asc | sudo apt-key add -**

**echo "deb [ arch=amd64,arm64 ] https://repo.mongodb.org/apt/ubuntu focal/mongodb-org/6.0 multiverse" | sudo tee /etc/apt/sources.list.d/mongodb-org-6.0.lis**

3. Since Ubuntu 22.04 has upgraded libssl to 3 and does not propose libssl1.1, we can force the installation of libssl1.1 by adding Ubuntu 20.04 source using this command:

**echo "deb [ arch=amd64,arm64 ] https://repo.mongodb.org/apt/ubuntu focal/mongodb-org/6.0 multiverse" | sudo tee /etc/apt/sources.list.d/mongodb-org-6.0.lis**

**sudo apt-get update && sudo apt-get install libssl1.1**

4. After the installation is complete, you will need to remove the focal-security list file created to download MongoDB, you can do that by following the steps below:

**sudo rm /etc/apt/sources.list.d/focal-security.list**

**sudo apt install -y mongodb-org mongodb-org-database**

5. After the installation of MongoDB is done, start it and enable it so MongoDB will start itself every new session occurs:

**sudo systemctl start mongod**

**sudo systemctl enable mongod**

**sudo systemctl status mongod** (to check if the service is up)

6. After we are done with the installation of MongoDB, we will need to install NodeJS, this is necessary if we want to use the WebUi of Open5GS:

**curl -fsSL https://deb.nodesource.com/setup\_18.x | sudo -E bash -**

**sudo apt install nodejs**

7. Now let start with installation of Open5GS services, we can do that by using the following command:

**sudo add-apt-repository ppa:open5gs/latest**

**sudo apt-get install -y software-properties-common**

**sudo apt-get -y update**

**sudo apt install -y open5gs**

8. After the installation of Open5GS is completed, you can check the services status using this, all of them should be active by default:

**sudo service open5gs-\* status / sudo systemctl status open5gs-\***

9. Now we will be installing net-tools to use ifconfig command to verify the new connection coming from Open5GS, the new network should be named as ogstun:

**sudo apt-get install net-tools**

**ifconfig**

Note: If unable to install the net-tools, try reconnecting the network of the VM on the top-right corner by turning it off and on.

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10. Lastly for Open5GS, you can install the webui extension for easier management of subscriber using this line:

**curl -fsSL https://open5gs.org/open5gs/assets/webui/install | sudo -E bash -**

You should also see default administration account [Username:admin Password:1423] then you can access to the webui using localhost:3000 (localhost:9999 🡨 use this if it didn’t work) and enter the username and password you should be able to login successfully. Here is the sample interface you should see.

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**UERANSIM**

1. Like Open5GS, we will also need to download various toolkit first before installing UERANSIM, here are the command for installing the tool required:

**sudo apt install make gcc g++ libsctp-dev lksctp-tools iproute2 git**

**sudo snap install cmake –classic**

2. After all these kits are installed, we will need to install UERANSIM by cloning its content from github using this command (Please ensure you are on the home directory, you can access it using **cd ~**):

**git clone https://github.com/aligungr/UERANSIM**

3. After cloning the github file, you will need to go inside the file and make the file so UERANSIM will be successfully installed:

**cd ~/UERANSIM**

**make**

4. To verify that Open5GS and UERANSIM are installed correctly, run this command to confirm:

**cd config/**

**../build/nr-gnb -c open5gs-gnb.yaml**

Note: If you see the message line “[info] NG setup procedure is successful” then it mean both Open5GS and UERANSIM are successfully installed.

**Configuration Step**

1. Generally, you don’t need to configure Open5GS services if you are running in a loopback address (Single VM), you will only need to configure the gNB and UE file from UERANSIM, you can do that by typing this command:

**cd ~/UERANSIM/config/**

**cp open5gs-gnb.yaml gnb1.yaml**

**cp open5gs-ue.yaml ue1.yaml**

Note: the use of cp(copy) is optional, but it is a good practice to do as you will still be able to access the original file if you messed up in configuration.

2. We will start with configuration of gnb1.yaml, I will give example of various thing that you can change, this is what you be expected to see on your gnb1.yaml. I am using gedit to make change to the file, you can access it using this:

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AI-generated content may be incorrect.gedit gnb1.yaml &**

Note: the use of & is optional, it is only used so that when you exit the command from terminal using Ctrl+C, the editing page will still hover on the sidebar.

Thing you can change is mcc and mnc, but if you want to do so you will also need to change stuff on your ue1.yaml, I will further explain about these 2 later when I explain ue1.yaml.

For linkIp, ngapIp, gtpIp you could change them to any loopback address you pleased, as long all 3 of them share the same ip, you may also change to your VM IP if you wanted to, but that is only used when you split your Open5GS core and your UERANSIM.

For amfConfigs, you will leave it as default address, 127.0.0.5, you will only need to make change on this address when you also make change on your amf.yaml in /etc/open5gs

3. After you are done with gnb.yaml configuration of gnb1.yaml, we will move to ue1.yaml, use the same command as used previously to access the file editor. Here are the sample of UE configuration file.

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Like mentioned previously, you can make change on mcc and mnc inside the file, but you need to ensure that both files have matching mcc and mnc, beside you will also need to make change on supi, so the first 5 or 6 digit show its mcc and mnc. Here is the formation of the imsi.

imsi-999700000000001

mcc mnc UE

Note: inside mnc the default is 70, but remember 70 and 070 are not the same thing.

The key and op can also be changed for security purposes, otherwise just keep it at default.

The most important thing to keep track is the gnbSearchList, if you recently have make change on linkIp, your gnbSearchList ip will also need to sync with it.

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Lastly, you can change between apn or dnn, if you are using loopback address then just keep with default (apn), you will only switch to dnn when your UE is on another device as your RAN.

4. After done with the configuration, you will need to add new subscriber inside your Open5GS webui. You can access to it by using firefox and go to localhost:3333 (localhost:9999 if 3333 doesn’t work) and type in the default administration account credentials.

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Click the “+” button on the bottom-right corner, then a new interface will show up, you will need to fill up the IMSI, which can be found in ue1.yaml, fill in the 15 digit inside it and press “Save” on the bottom-left of the pop-up interface then subscriber details will be created.

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5. After done with all the configuration we can proceed on the connectivity test.

**Connectivity Test**

1. To visualize the packets, we will be using wireshark to help with that, to install it, follow these steps:

**sudo apt update**

**sudo apt install wireshark**

2. Depend on your preference, if you selected “Yes” then you will need to add user into wireshark group to allow them use wireshark, you can add them to the wireshark user group by typing this command:

**sudo usermod -aG wireshark <username>**

3. After the installation, you can verify the version of wireshark to ensure that it is the latest version, the latest version currently available is Wireshark 3.6.2:

**wireshark --version**

4. You will need to download a wireshark plugin extension from github source for UERANSIM, here is the command needed for installing wireshark extension, ensure that you are in home directory when you are cloning this github source for easier access.

**git clone** [**https://github.com/nextmn/RLS-wireshark-dissector.git**](https://github.com/nextmn/RLS-wireshark-dissector.git)

5. Then open your wireshark using terminal by typing “wireshark” or open it on the bottom-right corner, then inside wireshark, go to “help” tab -> “About wireshark” -> “Plugins”, find where is the plugin saved in wireshark, by default it should be in “/usr/lib/x86\_84-linux-gnu/wireshark/plugins”. You will need to save the downloaded plugin into there. For convenience, here is the commands:

**cd /usr/lib/x86\_84-linux-gnu/wireshark/plugins**

**sudo cp -R ~/RLS-wireshark-dissector/ RLS-wireshark-dissector**

6. To visualize the connection, open wireshark, then go to Loopback: lo, on the top you can filter what you want to observe, for example if we want to observe the amf we will be typing ip.addr == 127.0.0.5

7. Now that we are done with setting up wireshark, let start with connectivity test, first it will be setting up our gNB. You can set up gNB using these commands:

**cd ~/UERANSIM/build/**

**./nr-gnb -c ../config/gnb1.yaml**

When connectivity success, you should be able to observe SCTP and NGAP protocol showing up on the wireshark, or you can verify it using either one of the commands:

**sudo service open5gs-amfd status / sudo systemctl status open5gs-amfd**

or

**sudo tail -f /var/log/open5gs/amf.log**

8. Now for checking on UE select “any” on wireshark and apply filter NR-RRC then start the connection to the gNB using these commands:

**Cd ~/UERANSIM/build/**

**sudo ./nr-ue -c ../config/ue1.yaml**

When connectivity success, you should be able to see NR-RRC connection between gNB and UE

9. Another way of testing is by using ping, when establish the connection, you can see inside the UE log that show this line of message “Connection setup for PDU session[1] is successful, TUN interface[uesimtun0, 10.45.0.X] is up.” You can ping the uesimtun0 ip to verify there is connectivity.