

# 5G using free5gc

**Install Dependencies:** Install the necessary tools and libraries:

```
bash
```

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```
sudo apt install -y git curl wget unzip make gcc g++ cmake autoconf automake libtool p  
sudo apt install -y mongodb build-essential linux-headers-$(uname -r) iproute2
```

```
ubuntu@ubuntu:~/Documents/5G$ sudo apt install -y git curl wget unzip make gcc g++ cmake autoconf automake libtool pkg-config libmnl-dev libyaml-dev  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
autoconf is already the newest version (2.71-2).  
autoconf set to manually installed.  
automake is already the newest version (1:1.16.5-1.3).  
automake set to manually installed.  
g++ is already the newest version (4:11.2.0-1ubuntu1).  
gcc is already the newest version (4:11.2.0-1ubuntu1).  
libtool is already the newest version (2.4.6-15build2).  
libtool set to manually installed.  
make is already the newest version (4.3-4.1build1).  
curl is already the newest version (7.81.0-1ubuntu1.19).  
git is already the newest version (1:2.34.1-1ubuntu1.11).  
unzip is already the newest version (6.0-26ubuntu3.2).  
unzip set to manually installed.  
wget is already the newest version (1.21.2-2ubuntu1.1).  
wget set to manually installed.  
The following packages were automatically installed and are no longer required:  
  libwpe-1.0-1 libwpebackend-fdo-1.0-1  
Use 'sudo apt autoremove' to remove them.  
The following additional packages will be installed:  
  cmake-data dh-elpa-helper libjsoncpp25 librhash0  
Suggested packages:  
  cmake-doc ninja-build cmake-format libyaml-doc  
The following NEW packages will be installed:  
  cmake cmake-data dh-elpa-helper libjsoncpp25 libmnl-dev librhash0 libyaml-dev pkg-config  
0 upgraded, 8 newly installed, 0 to remove and 0 not upgraded.  
Need to get 7,251 kB of archives.  
After this operation, 32.3 MB of additional disk space will be used.  
Get:1 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 libjsoncpp25 amd64 1.9.5-3 [80.0 kB]  
Get:2 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 librhash0 amd64 1.4.2-1ubuntu1 [125 kB]  
Get:3 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 dh-elpa-helper all 2.0.9ubuntu1 [7,610 B]  
Get:4 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 cmake-data all 3.22.1-1ubuntu1.22.04.2 [1,913 kB]  
Get:5 http://in.archive.ubuntu.com/ubuntu jammy-updates/main amd64 cmake amd64 3.22.1-1ubuntu1.22.04.2 [5,010 kB]  
Get:6 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 pkg-config amd64 0.29.2-1ubuntu3 [48.2 kB]  
Get:7 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 libmnl-dev amd64 1.0.4-3build2 [4,882 B]  
Get:8 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 libyaml-dev amd64 0.2.2-1build2 [62.8 kB]  
Fetched 7,251 kB in 25s (294 kB/s)
```

```
ubuntu@ubuntu:~/Documents/5G$ sudo apt install -y build-essential linux-headers-$(ubuntu -r) iproute2  
ubuntu: command not found  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
Virtual packages like 'linux-headers' can't be removed  
build-essential is already the newest version (12.9ubuntu3).  
iproute2 is already the newest version (5.15.0-1ubuntu2).  
The following packages were automatically installed and are no longer required:  
  libwpe-1.0-1 libwpebackend-fdo-1.0-1  
Use 'sudo apt autoremove' to remove them.  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

```
ubuntu@ubuntu:~/Documents/5G$ mongo --version  
MongoDB shell version v5.0.30  
Build Info: {  
    "version": "5.0.30",  
    "gitVersion": "966efda23d779a86c76c34e1b13e561d68f2bb37",  
    "openSSLVersion": "OpenSSL 1.1.1f  31 Mar 2020",  
    "modules": [],  
    "allocator": "tcmalloc",  
    "environment": {  
        "distmod": "ubuntu2004",  
        "distarch": "x86_64",  
        "target_arch": "x86_64"  
    }  
}
```

## Clone Free5GC Repository:

bash

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```
git clone --recursive https://github.com/free5gc/free5gc.git  
cd free5gc
```

```
ubuntu@ubuntu:~/Documents/5G$ git clone --recursive https://github.com/free5gc/free5gc.git  
Cloning into 'free5gc'...  
remote: Enumerating objects: 3058, done.  
remote: Counting objects: 100% (831/831), done.  
remote: Compressing objects: 100% (346/346), done.  
remote: Total 3058 (delta 564), reused 704 (delta 480), pack-reused 2227 (from 1)  
Receiving objects: 100% (3058/3058), 1004.92 KiB | 32.00 KiB/s, done.  
Resolving deltas: 100% (1813/1813), done.  
Submodule 'amf' (https://github.com/free5gc/amf.git) registered for path 'NFs/amf'  
Submodule 'ausf' (https://github.com/free5gc/ausf.git) registered for path 'NFs/ausf'  
Submodule 'chf' (https://github.com/free5gc/chf.git) registered for path 'NFs/chf'  
Submodule 'n3iwf' (https://github.com/free5gc/n3iwf.git) registered for path 'NFs/n3iwf'  
Submodule 'NFs/nef' (https://github.com/free5gc/nef.git) registered for path 'NFs/nef'  
Submodule 'nrf' (https://github.com/free5gc/nrf.git) registered for path 'NFs/nrf'  
Submodule 'nssf' (https://github.com/free5gc/nssf.git) registered for path 'NFs/nssf'  
Submodule 'pcf' (https://github.com/free5gc/pcf.git) registered for path 'NFs/pcf'  
Submodule 'smf' (https://github.com/free5gc/smf.git) registered for path 'NFs/smf'  
Submodule 'tngf' (https://github.com/free5gc/tngf.git) registered for path 'NFs/tngf'  
Submodule 'udm' (https://github.com/free5gc/udm.git) registered for path 'NFs/udm'  
Submodule 'udr' (https://github.com/free5gc/udr.git) registered for path 'NFs/udr'  
Submodule 'upf' (https://github.com/free5gc/go-upf.git) registered for path 'NFs/upf'  
Submodule 'webconsole' (https://github.com/free5gc/webconsole.git) registered for path 'webconsole'  
Cloning into '/home/ubuntu/Documents/5G/free5gc/NFs/amf'...
```

```
Receiving objects: 100% (1353/1353), 12.34 MiB | 608.00 KiB/s, done.  
Resolving deltas: 100% (926/926), done.  
Submodule path 'NFs/amf': checked out 'ce90b7bda0e40478842f983a2dbc03e299b3564'  
Submodule path 'NFs/ausf': checked out '842217c4784b193f48e92a218fce2ac903d944f'  
Submodule path 'NFs/chf': checked out '10fb184010c6cbe02b0e62bb244b9c1eec7fd728'  
Submodule path 'NFs/n3iwf': checked out 'e9097bf533799a3b6aedb87fbf6886521097cf88'  
Submodule path 'NFs/nef': checked out '6e29dc5f112264f2c576e6f90e74192c698227d7'  
Submodule path 'NFs/nrf': checked out '0d3f45183ef3ebd9fc694e450825228acf2e1dba'  
Submodule path 'NFs/nssf': checked out 'a73f10ff6d7176d5bae7315ad5f23136b56a143'  
Submodule path 'NFs/pcf': checked out 'a904a1bbfd9b8d2d89742308bdf90e2503835f0c'  
Submodule path 'NFs/smf': checked out '74e1550847d2499f6d834fac2d5e6d75b98cc142'  
Submodule path 'NFs/tngf': checked out '890944b89cc7f8ccf99cfddd7dc2e26b8c7536fe'  
Submodule path 'NFs/udm': checked out 'd7e6f704543f6f8d42e30d453087a6d9600b684e'  
Submodule path 'NFs/udr': checked out 'ee6e0c866c4ebc0ff5050c94cf6843ac41a49205'  
Submodule path 'NFs/upf': checked out '3b73a2bc43f01fc412bac34f221776684f652623'  
Submodule path 'webconsole': checked out '2253502d46712e0d200b188830985c3e94b31bd9'  
Submodule path 'NFs/chf': checked out '10fb184010c6cbe02b0e62bb244b9c1eec7fd728'  
Submodule path 'NFs/smf': checked out '74e1550847d2499f6d834fac2d5e6d75b98cc142'  
Submodule path 'NFs/udr': checked out 'ee6e0c866c4ebc0ff5050c94cf6843ac41a49205'  
ubuntu@ubuntu:~/Documents/5G$ cd free5gc
```

**Install Go:** Free5GC requires Go. Install the compatible version:

bash

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```
wget https://go.dev/dl/go1.17.13.linux-amd64.tar.gz
sudo tar -C /usr/local -xzf go1.17.13.linux-amd64.tar.gz
echo "export PATH=\$PATH:/usr/local/go/bin" >> ~/.bashrc
source ~/.bashrc
```

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ wget https://go.dev/dl/go1.21.5.linux-amd64.tar.gz
--2024-12-01 16:20:23-- https://go.dev/dl/go1.21.5.linux-amd64.tar.gz
Resolving go.dev (go.dev)... 216.239.38.21, 216.239.36.21, 216.239.32.21, ...
Connecting to go.dev (go.dev)|216.239.38.21|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://dl.google.com/go/go1.21.5.linux-amd64.tar.gz [following]
--2024-12-01 16:20:24-- https://dl.google.com/go/go1.21.5.linux-amd64.tar.gz
Resolving dl.google.com (dl.google.com)... 216.58.203.46, 2404:6800:4009:805::200e
Connecting to dl.google.com (dl.google.com)|216.58.203.46|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 66618285 (64M) [application/x-gzip]
Saving to: 'go1.21.5.linux-amd64.tar.gz'

go1.21.5.linux-amd64.tar.gz          100%[=====] 63.53M  1.14MB/s   in 35s

2024-12-01 16:20:59 (1.83 MB/s) - 'go1.21.5.linux-amd64.tar.gz' saved [66618285/66618285]

ubuntu@ubuntu:~/Documents/5G/free5gc$ sudo tar -C /usr/local -xzf go1.21.5.linux-amd64.tar.gz
ubuntu@ubuntu:~/Documents/5G/free5gc$ echo "export PATH=\$PATH:/usr/local/go/bin" >> ~/.bashrc
source ~/.bashrc
ubuntu@ubuntu:~/Documents/5G/free5gc$ go version
go version go1.21.5 linux/amd64
```

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ wget https://go.dev/dl/go1.21.5.linux-amd64.tar.gz
--2024-12-01 16:20:23-- https://go.dev/dl/go1.21.5.linux-amd64.tar.gz
Resolving go.dev (go.dev)... 216.239.38.21, 216.239.36.21, 216.239.32.21, ...
Connecting to go.dev (go.dev)|216.239.38.21|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://dl.google.com/go/go1.21.5.linux-amd64.tar.gz [following]
--2024-12-01 16:20:24-- https://dl.google.com/go/go1.21.5.linux-amd64.tar.gz
Resolving dl.google.com (dl.google.com)... 216.58.203.46, 2404:6800:4009:805::200e
Connecting to dl.google.com (dl.google.com)|216.58.203.46|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 66618285 (64M) [application/x-gzip]
Saving to: 'go1.21.5.linux-amd64.tar.gz'

go1.21.5.linux-amd64.tar.gz          100%[=====] 63.53M  1.14MB/s   in 35s

2024-12-01 16:20:59 (1.83 MB/s) - 'go1.21.5.linux-amd64.tar.gz' saved [66618285/66618285]

ubuntu@ubuntu:~/Documents/5G/free5gc$ sudo tar -C /usr/local -xzf go1.21.5.linux-amd64.tar.gz
ubuntu@ubuntu:~/Documents/5G/free5gc$ echo "export PATH=\$PATH:/usr/local/go/bin" >> ~/.bashrc
source ~/.bashrc
ubuntu@ubuntu:~/Documents/5G/free5gc$ go version
go version go1.21.5 linux/amd64
```

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ make all
Start building amf...
cd NFs/amf/cmd && \
CGO_ENABLED=0 go build -gcflags "" -ldflags "-X github.com/free5gc/util/version.VERSION=v3.4.4 -X github.com/free5gc/util/version.90b7bd -X github.com/free5gc/util/version.COMMIT_TIME=2024-10-11T03:39:55Z" -o /home/ubuntu/Documents/5G/free5gc/bin/amf main.go
Start building ausf...
cd NFs/ausf/cmd && \
CGO_ENABLED=0 go build -gcflags "" -ldflags "-X github.com/free5gc/util/version.VERSION=v3.4.4 -X github.com/free5gc/util/version.2217c4 -X github.com/free5gc/util/version.COMMIT_TIME=2024-06-28T05:50:14Z" -o /home/ubuntu/Documents/5G/free5gc/bin/ausf main.go
go: downloading github.com/urfave/cli v1.22.5
go: downloading github.com/sirupsen/logrus v1.8.1
go: downloading github.com/asaskevich/govalidator v0.0.0-20210307081110-f21760c49a0d
go: downloading github.com/freesgc/openapi v1.0.8
go: downloading github.com/google/uuid v1.3.0
go: downloading github.com/bronzelman/radius v0.0.0-20190516032554-afdb8baec892d
go: downloading github.com/google/gopacket v1.1.19
go: downloading golang.org/x/sys v0.18.0
go: downloading github.com/matttn/go-isatty v0.0.19
go: downloading golang.org/x/net v0.23.0
go: downloading github.com/cpuguy83/go-md2man/v2 v2.0.0-20190314233015-f79a8a8ca69d
go: downloading github.com/golang-jwt/jwt v3.2.1+incompatible
go: downloading golang.org/x/oauth2 v0.0.0-20210810183815-faf39c7919d5
go: downloading github.com/go-playground/validator/v10 v10.14.0
go: downloading github.com/pelletier/go-toml/v2 v2.0.8
go: downloading github.com/ugorji/go/codec v1.2.11
go: downloading github.com/russross/blackfriday/v2 v2.0.1
go: downloading github.com/gabriel-vastle/mimetype v1.4.2
go: downloading github.com/leodido/go-urn v1.2.4
go: downloading golang.org/x/crypto v0.21.0
go: downloading github.com/shurcooL/sanitized_anchor_name v1.0.0
Start building nrf...
cd NFs/nrf/cmd && \
CGO_ENABLED=0 go build -gcflags "" -ldflags "-X github.com/free5gc/util/version.VERSION=v3.4.4 -X github.com/free5gc/util/version.90b7bd -X github.com/free5gc/util/version.COMMIT_TIME=2024-10-11T03:39:55Z" -o /home/ubuntu/Documents/5G/free5gc/bin/nrf main.go
```

## Setting up the certification for the configuration made in Free5GC:

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ cd ~/Documents/5G/free5gc/support/free5gc-ca
bash: cd: /home/ubuntu/Documents/5G/free5gc/support/free5gc-ca: No such file or directory
ubuntu@ubuntu:~/Documents/5G/free5gc$ cd ~/Documents/5G/free5gc
ubuntu@ubuntu:~/Documents/5G/free5gc$ mkdir -p support/free5gc-ca/cert
ubuntu@ubuntu:~/Documents/5G/free5gc$ cd support/free5gc-ca
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out ca.key 2048
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl req -x509 -new -nodes -key ca.key -sha256 -days 3650 -out ca.pem -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=NRF"
openssl req -new -key nrf.key -out nrf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=NRF"
openssl x509 -req -in nrf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out nrf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = NRF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out amf.key 2048
openssl req -new -key amf.key -out amf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=AMF"
openssl x509 -req -in amf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out amf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = AMF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out smf.key 2048
openssl req -new -key smf.key -out smf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=SMF"
openssl x509 -req -in smf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out smf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = SMF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out udm.key 2048
openssl req -new -key udm.key -out udm.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=UDM"
openssl x509 -req -in udm.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out udm.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = UDM
```

```
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out smf.key 2048
openssl req -new -key smf.key -out smf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=SMF"
openssl x509 -req -in smf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out smf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = SMF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out udm.key 2048
openssl req -new -key udm.key -out udm.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=UDM"
openssl x509 -req -in udm.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out udm.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = UDM
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out ausf.key 2048
openssl req -new -key ausf.key -out ausf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=AUSF"
openssl x509 -req -in ausf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out ausf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = AUSF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out pcf.key 2048
openssl req -new -key pcf.key -out pcf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=PCF"
openssl x509 -req -in pcf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out pcf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = PCF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out upf.key 2048
openssl req -new -key upf.key -out upf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=UPF"
openssl x509 -req -in upf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out upf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = UPF
```

```
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out pcf.key 2048
openssl req -new -key pcf.key -out pcf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=PCF"
openssl x509 -req -in pcf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out pcf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = PCF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out upf.key 2048
openssl req -new -key upf.key -out upf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=UPF"
openssl x509 -req -in upf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out upf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = UPF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out nssf.key 2048
openssl req -new -key nssf.key -out nssf.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=NSSF"
openssl x509 -req -in nssf.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out nssf.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = NSSF
ubuntu@ubuntu:~/Documents/5G/free5gc/support/free5gc-ca$ openssl genrsa -out udr.key 2048
openssl req -new -key udr.key -out udr.csr -subj "/C=US/ST=California/L=San Francisco/O=Free5GC/OU=Core/CN=UDR"
openssl x509 -req -in udr.csr -CA ca.pem -CAkey ca.key -CAcreateserial -out udr.pem -days 3650 -sha256
Certificate request self-signature ok
subject=C = US, ST = California, L = San Francisco, O = Free5GC, OU = Core, CN = UDR
```

## Install UERANSIM and build it:

```
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ sudo apt install libscpt-dev
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  libscpt-dev
0 upgraded, 1 newly installed, 0 to remove and 239 not upgraded.
Need to get 51.1 kB of archives.
After this operation, 220 kB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu jammy/main amd64 libscpt-dev amd64 1.0.19+dfsg-1build1 [51.1 kB]
Fetched 51.1 kB in (60.9 kB/s)
Selecting previously unselected package libscpt-dev:amd64.
(Reading database ... 212085 files and directories currently installed.)
Preparing to unpack .../libscpt-dev_1.0.19+dfsg-1build1_amd64.deb ...
Unpacking libscpt-dev:amd64 (1.0.19+dfsg-1build1) ...
Setting up libscpt-dev:amd64 (1.0.19+dfsg-1build1) ...
Processing triggers for man-db (2.10.2-1) ...
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ make clean
make: *** No rule to make target 'clean'. Stop.
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ make clean
make: *** No rule to make target 'clean'. Stop.
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ rm -rf cmake-build-release
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ mkdir cmake-build-release
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ cd cmake-build-release
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ cmake ..
-- The C Compiler identification is GNU 11.4.0
-- The CXX Compiler identification is GNU 11.4.0
-- Detecting C Compiler ABI info
-- Detecting C Compiler ABI info - done
-- Check for working C compiler: /usr/bin/cc - skipped
-- Detecting C compile features
-- Detecting C compile features - done
-- Detecting CXX Compiler ABI info
-- Detecting CXX Compiler ABI info - done
-- Check for working CXX compiler: /usr/bin/c++ - skipped
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Configuring done
-- Generating done
-- Build files have been written to: /home/sathvika/Documents/5g/UERANSIM/cmake-build-release
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ make
[ 0%] Building C object src/asn/asn1/CMakeFiles/asn-asnic.dir/ASN.c.o
[ 0%] Building C object src/asn/asn1/CMakeFiles/asn-asnic.dir/BIT_STRING.c.o
[ 0%] Building C object src/asn/asn1/CMakeFiles/asn-asnic.dir/BOOLEAN.c.o
[ 0%] Building C object src/asn/asn1/CMakeFiles/asn-asnic.dir/INTEGER.c.o
[ 98%] Building CXX object src/ue/CMakeFiles/ue.dir/nas/usim/sqn_mng.cpp.o
[ 98%] Building CXX object src/ue/CMakeFiles/ue.dir/nas/usim/usim.cpp.o
[ 98%] Building CXX object src/ue/CMakeFiles/ue.dir/nts.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rlls/ctl_task.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rlls/task.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rlls/udp_task.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/access.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/cells.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/channel.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/connection.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/failures.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/handler.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/idle.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/nas.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/sap.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/state.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/sysinfo.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/rrc/task.cpp.o
[ 99%] Building CXX object src/ue/CMakeFiles/ue.dir/timer.cpp.o
[100%] Building CXX object src/ue/CMakeFiles/ue.dir/tun/config.cpp.o
[100%] Building CXX object src/ue/CMakeFiles/ue.dir/tun/task.cpp.o
[100%] Building CXX object src/ue/CMakeFiles/ue.dir/tun/tun.cpp.o
[100%] Building CXX object src/ue/CMakeFiles/ue.dir/types.cpp.o
[100%] Building CXX object src/ue/CMakeFiles/ue.dir/ue.cpp.o
[100%] Linking CXX static library libue.a
[100%] Built target ue
[100%] Building CXX object CMakeFiles/nr-ue.dir/src/ue.cpp.o
[100%] Linking CXX executable nr-ue
[100%] Built target nr-ue
[100%] Building CXX object CMakeFiles/devbnd.dir/src/binder.cpp.o
[100%] Linking CXX shared library libdevbnd.so
[100%] Built target devbnd
[100%] Building CXX object CMakeFiles/nr-cll.dir/src/cll.cpp.o
[100%] Linking CXX executable nr-cll
[100%] Built target nr-cll
sathvikasathvika-virtual-machine:~/Documents/5g/UERANSIM$ ls -l
total 21852
-rw-rw-r-- 1 sathvika sathvika 13865 Nov 27 23:07 CMakeCache.txt
drwxrwxr-x 8 sathvika sathvika 4096 Nov 27 23:11 CMakeFiles
-rw-rw-r-- 1 sathvika sathvika 3222 Nov 27 23:07 cmake_install.cmake
-rwxrwxr-x 1 sathvika sathvika 15248 Nov 27 23:11 libdevbnd.so
-rw-rw-r-- 1 sathvika sathvika 12242 Nov 27 23:07 Makefile
-rwxrwxr-x 1 sathvika sathvika 1032128 Nov 27 23:11 nr-cll
-rwxrwxr-x 1 sathvika sathvika 10644888 Nov 27 23:10 nr-gnb
-rwxrwxr-x 1 sathvika sathvika 10640720 Nov 27 23:11 nr-ue
drwxrwxr-x 8 sathvika sathvika 4096 Nov 27 23:07 src
```

## Mongo Status:

```
ubuntu@ubuntu: ~ $ mongo
MongoDB shell version v5.0.30
connecting to: mongodb://127.0.0.1:27017/?compressors=disabled&gssapiServiceName=mongodb
Error: couldn't connect to server 127.0.0.1:27017, connection attempt failed: SocketException: Error connecting to 127.0.0.1:27017 :: caused by :: Connection refused :
connect@src/mongo/shell/mongo.js:372:17
{connect}()@2:6
exception: connect failed
Exiting with code 1
ubuntu@ubuntu: ~ $ sudo systemctl start mongo
[sudo] password for ubuntu:
Failed to start mongo.service: Unit mongo.service not found.
ubuntu@ubuntu: ~ $ sudo systemctl enable mongo
Failed to enable unit: Unit file mongo.service does not exist.
ubuntu@ubuntu: ~ $ sudo systemctl start mongod
ubuntu@ubuntu: ~ $ sudo systemctl enable mongod
ubuntu@ubuntu: ~ $ sudo systemctl status mongod
● mongod.service - MongoDB Database Server
   Loaded: loaded (/lib/systemd/system/mongod.service; enabled; vendor preset: enabled)
   Active: active (running) since Fri 2024-12-06 01:08:08 IST; 43s ago
     Docs: https://docs.mongodb.org/manual
 Main PID: 2741 (mongod)
    Memory: 236.9M
      CPU: 1.830s
       CGroub: /system.slice/mongod.service
             └─2741 /usr/bin/mongod --config /etc/mongod.conf

Dec 06 01:08:08 ubuntu systemd[1]: Started MongoDB Database Server.
dec 06 01:08:09 ubuntu mongod[2741]: { "t": "{$date": "2024-12-05T19:38:09.521Z"}, "c": "initandlisten", "s": "conn", "m": "Accepted connection from 127.0.0.1:54006 (pid: 2741)", "l": "info" }
lines 1-12/12 (END)
ubuntu@ubuntu: ~ $ mongo
MongoDB shell version v5.0.30
connecting to: mongodb://127.0.0.1:27017/?compressors=disabled&gssapiServiceName=mongodb
Implicit session: session { "id" : UUID("a9a8359d-3a5f-47fc-b1c9-f80aa70a191c") }
MongoDB server version: 5.0.30
=====
Warning: the "mongo" shell has been superseded by "mongosh",
which delivers improved usability and compatibility.The "mongo" shell has been deprecated and will be removed in
an upcoming release.
For installation instructions, see
https://docs.mongodb.com/mongodb-shell/install/
=====
---
The server generated these startup warnings when booting:
2024-12-06T01:08:09.742+05:30: Using the XFS filesystem is strongly recommended with the WiredTiger storage engine. See http://dochub.mongodb.org/core/prodnotes-filesystem
2024-12-06T01:08:10.808+05:30: Access control is not enabled for the database. Read and write access to data and configuration is unrestricted
```

**Data stored under free5g in Mongo can be accessed command by**

1: mongo

## 2: use free5

```
> db.subscribers.find().pretty()
{
    "_id" : ObjectId("6751f7bdf1371b520a0dd82"),
    "inst" : "4049800000000001",
    "key" : "465B5CE8B199B49FAA5F0A2EE238A6BC",
    "opc" : "E8ED289DEBA952E4283B54E88E6183CA",
    "amf" : "8000",
    "plmnID" : {
        "mcc" : "404",
        "mnc" : "10"
    },
    "slices" : [
        {
            "sst" : 1,
            "sd" : "010203"
        }
    ],
    "accessAndMobilitySubscriptionData" : {
        "roamingRestricted" : false,
        "subscribedUeNb" : {
            "uplink" : "1000 Kbps",
            "downlink" : "1000 Kbps"
        },
        "nssai" : [
            "defaultSingleNssais" : [
                {
                    "sst" : 1,
                    "sd" : "010203"
                }
            ]
        }
    },
    "amPolicyData" : {
        "subscCats" : [
            "free5gc"
        ]
    },
    "authenticationSubscription" : {
        "permanentKey" : {
            "permanentKeyValue" : "465B5CE8B199B49FAA5F0A2EE238A6BC"
        },
        "opc" : {
            "opcValue" : "E8ED289DEBA952E4283B54E88E6183CA"
        }
    }
}
```

```
    "authenticationSubscription" : {
        "permanentKey" : {
            "permanentKeyValue" : "465B5CEBB199B49FAA5F0A2EE238A6BC"
        },
        "opc" : {
            "opcValue" : "E8ED289DEBA952E4283B54E88E6183CA"
        },
        "authenticationManagementField" : "8000"
    },
    "smPolicyData" : {
        "smPolicySnsaiData" : {
            "01010203" : {
                "smPolicyDnnData" : {
                    "internet" : {
                        "dnn" : "internet"
                    }
                }
            }
        }
    },
    "smfSelectionSubscriptionData" : {
        "subscribedSnsaiInfos" : {
            "01010203" : {
                "dnnInfos" : [
                    {
                        "dnn" : "internet"
                    }
                ]
            }
        }
    }
}
>|
```

## Configure nrf, arm, smf, upf, udm, pcf, ausf

You can get this file on Github under 5G using free5gc

### Run Free5GC Components: Start all components individually:

- Before running this we need to go under folder free5gc (basically the folder where you install free5gc)

#### Command: `./bin/nrf`

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ ./bin/nrf
2024-12-07T09:44:55.851735003+05:30 [INFO][NRF][Main] NRF version:
    free5GC version: v3.4.4
    build time: 2024-12-01T10:53:33Z
    commit hash: 0d3f4518
    commit time: 2024-10-18T02:32:20Z
    go version: go1.21.5 linux/amd64
2024-12-07T09:44:55.852291210+05:30 [INFO][NRF][CFG] Read config from ./config/nrfcfg.yaml
2024-12-07T09:44:55.852627351+05:30 [INFO][NRF][Main] Log enable is set to [true]
2024-12-07T09:44:55.852658680+05:30 [INFO][NRF][Main] Log level is set to [info]
2024-12-07T09:44:55.852671583+05:30 [INFO][NRF][Main] Report Caller is set to [false]
2024-12-07T09:44:55.852679140+05:30 [INFO][NRF][Init] nrfconfig Info: Version[1.0.2] Description[NRF initial local configuration]
2024-12-07T09:44:55.853169242+05:30 [INFO][NRF][Init] generate new NRF cert
[GIN-debug] [WARNING] Running in "debug" mode. Switch to "release" mode in production.
- using env: export GIN_MODE=release
- using code: gin.SetMode(gin.ReleaseMode)

2024-12-07T09:44:55.854784811+05:30 [INFO][NRF][SBI] Binding addr: [127.0.0.10:8000]
[GIN-debug] GET      /          --> github.com/free5gc/nrf/internal/sbi.(*Server).applyService.(*Server).getAccessokenRoutes.func3 (3 handlers)
[GIN-debug] POST     /oauth2/token   --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPAccessTokenRequest-fm (3 handlers)
[GIN-debug] GET      /nrrf-disc/v1/   --> github.com/free5gc/nrf/internal/sbi.(*Server).applyService.(*Server).getNfDiscoveryRoutes.func4 (4 handlers)
[GIN-debug] GET      /nrrf-disc/v1/nf-instances --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPSearchNFInstances-fm (4 handlers)
[GIN-debug] PUT     /nrrf-nfm/v1/nf-instances/:nfInstanceId --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPUpdateNFInstance-fm (3 handlers)
[GIN-debug] GET      /nrrf-nfm/v1/   --> github.com/free5gc/nrf/internal/sbi.(*Server).getNfManagementRoute.func1 (4 handlers)
[GIN-debug] DELETE   /nrrf-nfm/v1/nf-instances/:nfInstanceId --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPDeregisterNFInstance-fm (4 handlers)
[GIN-debug] GET      /nrrf-nfm/v1/nf-instances/:nfInstanceId --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPGetNFInstance-fm (4 handlers)
[GIN-debug] PATCH   /nrrf-nfm/v1/nf-instances/:nfInstanceId --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPUpdateNFInstance-fm (4 handlers)
[GIN-debug] GET      /nrrf-nfm/v1/nf-instances --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPGetNFInstances-fm (4 handlers)
[GIN-debug] DELETE   /nrrf-nfm/v1/subscriptions/:subscriptionID --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPRemoveSubscription-fm (4 handlers)
[GIN-debug] PATCH   /nrrf-nfm/v1/subscriptions/:subscriptionID --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPUpdateSubscription-fm (4 handlers)
[GIN-debug] POST     /nrrf-nfm/v1/subscriptions --> github.com/free5gc/nrf/internal/sbi.(*Server).HTTPCreateSubscription-fm (4 handlers)
2024-12-07T09:44:55.854976722+05:30 [INFO][NRF][Init] Server starting
2024-12-07T09:44:55.855424522+05:30 [INFO][NRF][SBI] SBI server started
2024-12-07T09:45:05.861525164+05:30 [INFO][NRF][NFM] Handle NFRegisterRequest
2024-12-07T09:45:05.882385336+05:30 [INFO][NRF][NFM] urllist update
2024-12-07T09:45:05.895844174+05:30 [INFO][NRF][NFM] Create NF Profile: 16da0a01-94fc-408e-80f6-8c5515730a5d
2024-12-07T09:45:05.897946480+05:30 [INFO][NRF][NFM] Use NF certPath: cert/amf.pem
2024-12-07T09:45:05.901188599+05:30 [INFO][NRF][GIM] | 201 | 127.0.0.1 | PUT | /nnrf-nfm/v1/nf-instances/16da0a01-94fc-408e-80f6-8c5515730a5d |
2024-12-07T09:45:14.960463420+05:30 [INFO][NRF][NFM] Handle NFRegisterRequest
2024-12-07T09:45:14.962301180+05:30 [INFO][NRF][NFM] urllist update
2024-12-07T09:45:14.963322180+05:30 [INFO][NRF][NFM] Create NF Profile: eca66eab-a9b1-4cdf-9566-1c81f06a48a0
2024-12-07T09:45:14.965655524+05:30 [INFO][NRF][NFM] Use NF certPath: cert/smf.pem
2024-12-07T09:45:14.969614519+05:30 [INFO][NRF][GIM] | 201 | 127.0.0.1 | PUT | /nnrf-nfm/v1/nf-instances/eca66eab-a9b1-4cdf-9566-1c81f06a48a0 |
```

## Command: ./bin/amf

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ ./bin/amf
2024-12-07T09:45:05.830883335+05:30 [INFO][AMF][Main] AMF version:
    free5GC version: v3.4.4
    build time: 2024-12-01T10:52:15Z
    commit hash: ce90b7bd
    commit time: 2024-10-11T03:39:55Z
    go version: go1.21.5 linux/amd64
2024-12-07T09:45:05.833174105+05:30 [INFO][AMF][CFG] Read config from [./config/amfcfg.yaml]
2024-12-07T09:45:05.836480314+05:30 [INFO][AMF][Main] Log enable is set to [true]
2024-12-07T09:45:05.836521009+05:30 [INFO][AMF][Main] Log level is set to [info]
2024-12-07T09:45:05.836530943+05:30 [INFO][AMF][Main] Report Caller is set to [false]
[GIN-debug] [WARNING] Running in "debug" mode. Switch to "release" mode in production.
- using env: export GIN_MODE=release
- using code: gin.SetMode(gin.ReleaseMode)

[GIN-debug] GET    /namf-callback/v1/          --> github.com/free5gc/amf/internal/sbi.newRouter.(*Server).getHttp
[GIN-debug] POST   /namf-callback/v1/am-policy/polAssoId/update --> github.com/free5gc/amf/internal/sbi.(*Server).amPolicyUpdateNotification-fm
[GIN-debug] POST   /namf-callback/v1/am-policy/polAssoId/terminate --> github.com/free5gc/amf/internal/sbi.(*Server).amPolicyControlTerminationRequestNotification-fm
[GIN-debug] POST   /namf-callback/v1/n1-message-notify --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPN1MessageNotify-fm
[GIN-debug] POST   /namf-callback/v1/deregistration/uuid --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPDeregistration-fm
[GIN-debug] GET    /namf-comm/v1/           --> github.com/free5gc/amf/internal/sbi.(*Server).getCommunication
[GIN-debug] PUT    /namf-comm/v1/subscriptions/:subscriptionId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPSubscriptionCreate-fm
[GIN-debug] DELETE /namf-comm/v1/subscriptions/:subscriptionId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPSubscriptionDelete-fm
[GIN-debug] PUT    /namf-comm/v1/ue-contexts/:ueContextId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextCreate-fm
[GIN-debug] POST   /namf-comm/v1/ue-contexts/:ueContextId/assign-ebi --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextAssignEbi-fm
[GIN-debug] POST   /namf-comm/v1/ue-contexts/:ueContextId/transfer-update --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextTransferUpdate-fm
[GIN-debug] POST   /namf-comm/v1/ue-contexts/:ueContextId/release --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextRelease-fm
[GIN-debug] POST   /namf-comm/v1/ue-contexts/:ueContextId/transfer --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextTransfer-fm
[GIN-debug] DELETE /namf-comm/v1/ue-contexts/:ueContextId/n1-n2-messages/subscriptions/:subscriptionId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextN1N2MessageSubscriptionDelete-fm
[GIN-debug] POST   /namf-comm/v1/ue-contexts/:ueContextId/n1-n2-messages --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextN1N2Message-fm
[GIN-debug] GET    /namf-comm/v1/ue-contexts/:ueContextId/n1-n2-messages/:n1N2MessageId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextN1N2MessageGet-fm
[GIN-debug] POST   /namf-comm/v1/ue-contexts/:ueContextId/n1-n2-messages/subscriptions --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextN1N2MessageSubscriptionCreate-fm
[GIN-debug] DELETE /namf-comm/v1/non-ue-n2-messages/subscriptions/:n2NotifySubscriptionId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextN2NotifySubscriptionDelete-fm
[GIN-debug] POST   /namf-comm/v1/non-ue-n2-messages/transfer --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextN2Transfer-fm
[GIN-debug] POST   /namf-comm/v1/non-ue-n2-messages/subscriptions --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPUEContextN2MessageSubscriptionCreate-fm
[GIN-debug] POST   /namf-comm/v1/subscriptions --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPPAMFStatusCreate-fm
[GIN-debug] GET    /namf-evts/v1/           --> github.com/free5gc/amf/internal/sbi.newRouter.(*Server).getEvent
[GIN-debug] DELETE /namf-evts/v1/subscriptions/:subscriptionId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPEventDelete-fm
[GIN-debug] PATCH  /namf-evts/v1/subscriptions/:subscriptionId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPEventUpdate-fm
[GIN-debug] POST   /namf-evts/v1/subscriptions --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPCreateSubscription-fm
[GIN-debug] GET    /namf-mt/v1/           --> github.com/free5gc/amf/internal/sbi.newRouter.(*Server).getMTR
[GIN-debug] GET    /namf-mt/v1/ue-contexts/:ueContextId --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPPP
[GIN-debug] POST   /namf-mt/v1/ue-contexts/:ueContextId/ue-reachind --> github.com/free5gc/amf/internal/sbi.(*Server).HTTPPP
```

## Command: ./bin/smf

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ ./bin/smf
2024-12-07T09:45:14.943539481+05:30 [INFO][SMF][Main] SMF version:
    free5GC version: v3.4.4
    build time: 2024-12-01T10:54:03Z
    commit hash: 74e15508
    commit time: 2024-11-05T08:49:10Z
    go version: go1.21.5 linux/amd64
2024-12-07T09:45:14.946107522+05:30 [INFO][SMF][CFG] Read config from [./config/smfcfg.yaml]
2024-12-07T09:45:14.948710849+05:30 [INFO][SMF][CFG] Read config from [./config/uerouting.yaml]
2024-12-07T09:45:14.949051492+05:30 [INFO][SMF][Main] Log enable is set to [true]
2024-12-07T09:45:14.949062620+05:30 [INFO][SMF][Main] Log level is set to [info]
2024-12-07T09:45:14.949069422+05:30 [INFO][SMF][Main] Report Caller is set to [false]
2024-12-07T09:45:14.949080484+05:30 [INFO][SMF][CTX] smfconfig Info: Version[1.0.7] Description[SMF initial local configuration]
2024-12-07T09:45:14.949103584+05:30 [INFO][SMF][CTX] Endpoints: [127.0.0.8]
[GIN-debug] [WARNING] Running in "debug" mode. Switch to "release" mode in production.
- using env: export GIN_MODE=release
- using code: gin.SetMode(gin.ReleaseMode)

[GIN-debug] POST   /nsmf-callback/sm-policies/:smContextRef/update --> github.com/free5gc/smf/internal/sbi.(*Server).HTTPSPolicyUpdateNotification-fm (3 handlers)
[GIN-debug] POST   /nsmf-callback/sm-policies/:smContextRef/terminate --> github.com/free5gc/smf/internal/sbi.(*Server).SmPolicyControlTerminationRequestNotification-fm
[GIN-debug] POST   /nsmf-callback/notifyUri --> github.com/free5gc/smf/internal/sbi.(*Server).HTTPChargingNotification-fm (3 handlers)
[GIN-debug] GET    /upl/v1/ --> github.com/free5gc/smf/internal/sbi.newRouter.(*Server).GetUPIRoutes.func4 (3 handlers)
[GIN-debug] GET    /upl/v1/upNodesLinks --> github.com/free5gc/smf/internal/sbi.(*Server).GetUpNodesLinks-fm (3 handlers)
[GIN-debug] POST   /upl/v1/upNodesLinks --> github.com/free5gc/smf/internal/sbi.(*Server).PostUpNodesLinks-fm (3 handlers)
[GIN-debug] DELETE /upl/v1/upNodesLinks/:upNodeRef --> github.com/free5gc/smf/internal/sbi.(*Server).DeletedUpNodeLink-fm (3 handlers)
[GIN-debug] GET    /nsmf-pduSession/v1/ --> github.com/free5gc/smf/internal/sbi.(*Server).getPDUSESSIONRoutes.func1 (4 handlers)
[GIN-debug] POST   /nsmf-pduSession/v1/pdu-sessions/:pduSessionRef/release --> github.com/free5gc/smf/internal/sbi.(*Server).ReleasePduSession-fm (4 handlers)
[GIN-debug] POST   /nsmf-pduSession/v1/pdu-sessions/:pduSessionRef/modify --> github.com/free5gc/smf/internal/sbi.(*Server).UpdatePduSession-fm (4 handlers)
[GIN-debug] POST   /nsmf-pduSession/v1/sm-contexts/:smContextRef/release --> github.com/free5gc/smf/internal/sbi.(*Server).HTTPReleaseSMContext-fm (4 handlers)
[GIN-debug] POST   /nsmf-pduSession/v1/sm-contexts/:smContextRef/retrieve --> github.com/free5gc/smf/internal/sbi.(*Server).RetrieveSMContext-fm (4 handlers)
[GIN-debug] POST   /nsmf-pduSession/v1/sm-contexts/:smContextRef/modifry --> github.com/free5gc/smf/internal/sbi.(*Server).HTTPUpdatesMContext-fm (4 handlers)
[GIN-debug] PATCH  /nsmf-pduSession/v1/pdu-sessions --> github.com/free5gc/smf/internal/sbi.(*Server).PostPduSessions-fm (4 handlers)
[GIN-debug] POST   /nsmf-pduSession/v1/sm-contexts --> github.com/free5gc/smf/internal/sbi.(*Server).HTTPPDMSContexts-fm (4 handlers)
[GIN-debug] GET    /nsmf-event-exposure/v1/ --> github.com/free5gc/smf/internal/sbi.newRouter.(*Server).getEventExposureRoutes.func5 (4 handlers)
[GIN-debug] POST   /nsmf-event-exposure/v1/subscriptions --> github.com/free5gc/smf/internal/sbi.(*Server).SubscriptionsPost-fm (4 handlers)
[GIN-debug] DELETE /nsmf-event-exposure/v1/subscriptions/:subid --> github.com/free5gc/smf/internal/sbi.(*Server).SubscriptionsSubidDelete-fm (4 handlers)
[GIN-debug] GET    /nsmf-event-exposure/v1/subscriptions/:subid --> github.com/free5gc/smf/internal/sbi.(*Server).SubscriptionsSubidGet-fm (4 handlers)
[GIN-debug] PUT    /nsmf-event-exposure/v1/subscriptions/:subid --> github.com/free5gc/smf/internal/sbi.(*Server).SubscriptionsSubidPut-fm (4 handlers)
[GIN-debug] GET    /nsmf-oam/v1/ --> github.com/free5gc/smf/internal/sbi.newRouter.(*Server).getOARoutes.func6 (4 handlers)
[GIN-debug] GET    /nsmf-oam/v1/ue-pdu-session-info/:smContextRef --> github.com/free5gc/smf/internal/sbi.HTTPGetUEPDUSESSIONInfo-fm (4 handlers)
[GIN-debug] GET    /nsmf-oam/v1/user-plane-info/ --> github.com/free5gc/smf/internal/sbi.(*Server).HTTPGetMFUserPlaneInfo-fm (4 handlers)
2024-12-07T09:45:14.950185700+05:30 [INFO][SMF][Init] Server started
2024-12-07T09:45:14.977208973+05:30 [INFO][SMF][Main] OAuth2 setting receive from NRF: true
```

## Command: sudo ./bin/upf (upf need root previlage)

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ sudo ./bin/upf
[sudo] password for ubuntu:
2024-12-07T09:45:35.717879024+05:30 [INFO][UPF][Main] UPF version:
    free5GC version: v3.4.4
    build time: 2024-12-01T10:54:36Z
    commit hash: 3b73a2bc
    commit time: 2024-11-04T09:39:18Z
    go version: go1.21.5 linux/amd64
2024-12-07T09:45:35.717947971+05:30 [INFO][UPF][CFG] Read config from [.config/upfcfg.yaml]
2024-12-07T09:45:35.718179242+05:30 [INFO][UPF][CFG] =====
2024-12-07T09:45:35.718185066+05:30 [INFO][UPF][CFG] (*factory.Config)(0xc0000b35e0)({
    Version: (string) "1.0.3",
    Description: (string) "UPF initial local configuration",
    Pfcpc: (*factory.Pfcpc)(0xc0000b17a0)({
        Addr: (string) (len=9) "127.0.0.8",
        NodeID: (string) (len=9) "127.0.0.8",
        RetransTimeout: (time.Duration) 1s,
        MaxRetrans: (uint8) 3
    }),
    Gtpu: (*factory.Gtpu)(0xc0000b1950)({
        Forwarder: (string) (len=5) "gtp5g",
        IfList: ([]factory.IfInfo) (len=1 cap=1) {
            (factory.IfInfo) {
                Addr: (string) (len=9) "127.0.0.8",
                Type: (string) (len=2) "N3",
                Name: (string) "",
                IfName: (string) "",
                MTU: (uint32) 0
            }
        }
    }),
    DnnList: ([]factory.DnnList) (len=2 cap=2) {
        (factory.DnnList) {
            Dnn: (string) (len=8) "internet",
            Cidr: (string) (len=12) "10.60.0.0/16",
            NatIfName: (string) ""
        },
        (factory.DnnList) {
            Dnn: (string) (len=8) "internet",
            Cidr: (string) (len=12) "10.61.0.0/16",
            NatIfName: (string) ""
        }
    }
},
```

## Command: ./bin/udm

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ ./bin/udm
2024-12-07T09:45:45.737832792+05:30 [INFO][UDM][Main] UDM version:
    free5GC version: v3.4.4
    build time: 2024-12-01T10:54:12Z
    commit hash: d7e6f704
    commit time: 2024-11-08T02:50:24Z
    go version: go1.21.5 linux/amd64
2024-12-07T09:45:45.741148657+05:30 [INFO][UDM][CFG] Read config from [.config/udmcfg.yaml]
2024-12-07T09:45:45.743708112+05:30 [INFO][UDM][Main] Log enable is set to [true]
2024-12-07T09:45:45.743735732+05:30 [INFO][UDM][Main] Log level is set to [info]
2024-12-07T09:45:45.743740309+05:30 [INFO][UDM][Main] Report Caller is set to [false]
2024-12-07T09:45:45.743748718+05:30 [INFO][UDM][Util] udmconfig Info: Version[1.0.3] Description[UDM initial local configuration]
[GIN-debug] [WARNING] Running in "debug" mode. Switch to "release" mode in production.
- using env: export GIN_MODE=release
- using code: gin.SetMode(gin.ReleaseMode)

2024-12-07T09:45:45.743820322+05:30 [INFO][UDM][SBI] Binding addr: [127.0.0.3:8000]
2024-12-07T09:45:45.745311716+05:30 [INFO][UDM][Init] Server started
2024-12-07T09:45:45.745344512+05:30 [INFO][UDM][SBI] Starting server...
2024-12-07T09:45:45.772032445+05:30 [INFO][UDM][Main] OAuth2 setting receive from NRF: true
2024-12-07T09:45:45.772093459+05:30 [INFO][UDM][SBI] Start SBI server (listen on 127.0.0.3:8000)
[GIN-debug] [WARNING] Running in "debug" mode. Switch to "release" mode in production.
- using env: export GIN_MODE=release
- using code: gin.SetMode(gin.ReleaseMode)

[GIN-debug] GET    /nudm-ee/v1/          --> github.com/free5gc/udm/internal/sbi.(*Server).HandleIndex-fm (4 handlers)
[GIN-debug] POST   /nudm-ee/v1/:ueIdentity/ee-subscriptions --> github.com/free5gc/udm/internal/sbi.(*Server).HandleCreateEeSubscr...
[GIN-debug] DELETE  /nudm-ee/v1/:ueIdentity/ee-subscriptions/:subscriptionId --> github.com/free5gc/udm/internal/sbi.(*Server).HandleDeleteEeSubscr...
[GIN-debug] PATCH   /nudm-ee/v1/:ueIdentity/ee-subscriptions/:subscriptionId --> github.com/free5gc/udm/internal/sbi.(*Server).HandleUpdateEeSubscr...
[GIN-debug] GET    /          --> github.com/free5gc/udm/internal/sbi.(*Server).HandleIndex-fm (3 handlers)
[GIN-debug] POST   /sdm-subscriptions      --> github.com/free5gc/udm/internal/sbi.(*Server).HandleDataChangeNotificationToNF-f...
[GIN-debug] GET    /nudm-ueau/v1/          --> github.com/free5gc/udm/internal/sbi.(*Server).HandleIndex-fm (4 handlers)
[GIN-debug] POST   /nudm-ueau/v1/:supi/auth-events --> github.com/free5gc/udm/internal/sbi.(*Server).HandleConfirmAuth-fm (4 handl...
[GIN-debug] GET    /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleGenerateAuthData...
[GIN-debug] POST   /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleGenerateAuthData...
[GIN-debug] PUT    /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleUpdateAuthData...
[GIN-debug] PATCH  /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleUpdateAuthData...
[GIN-debug] HEAD   /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleGetAuthData...
[GIN-debug] OPTIONS /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleOptionsAuthData...
[GIN-debug] DELETE  /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleDeleteAuthData...
[GIN-debug] CONNECT /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleConnectAuthData...
[GIN-debug] TRACE   /nudm-ueau/v1/:supi/security-information/generate-auth-data --> github.com/free5gc/udm/internal/sbi.(*Server).HandleTraceAuthData...
[GIN-debug] GET    /nudm-uecm/v1/          --> github.com/free5gc/udm/internal/sbi.(*Server).HandleIndex-fm (4 handlers)
```

## Command: ./bin/pcf

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ ./bin/pcf
2024-12-07T09:46:04.457927398+05:30 [INFO][PCF][Main] pcf
2024-12-07T09:46:04.458008100+05:30 [INFO][PCF][Main] PCF version:
    free5GC version: v3.4.4
    build time: 2024-12-01T10:53:58Z
    commit hash: a904a1bb
    commit time: 2024-10-18T03:47:58Z
    go version: go1.21.5 linux/amd64
2024-12-07T09:46:04.459446636+05:30 [INFO][PCF][CFG] Read config from [./config/pcfcfg.yaml]
2024-12-07T09:46:04.466664222+05:30 [INFO][PCF][Main] Log enable is set to [true]
2024-12-07T09:46:04.466702439+05:30 [INFO][PCF][Main] Log level is set to [info]
2024-12-07T09:46:04.466707403+05:30 [INFO][PCF][Main] Report Caller is set to [false]
2024-12-07T09:46:04.466745148+05:30 [INFO][PCF][Util] pcfconfig Info: Version[1.0.2] Description[PCF initial local configuration]
[GIN-debug] [WARNING] Running in "debug" mode. Switch to "release" mode in production.
- using env: export GIN_MODE=release
- using code: gin.SetMode(gin.ReleaseMode)

[GIN-debug] POST /npcf-smpolicycontrol/v1/sm-policies --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPSMpoliciesPost-fm (3 handlers)
[GIN-debug] POST /npcf-smpolicycontrol/v1/sm-policies/:smPolicyId/delete --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPSMpoliciesDelete-fm
[GIN-debug] GET /npcf-smpolicycontrol/v1/sm-policies/:smPolicyId --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPSMpoliciesGet-fm
[GIN-debug] POST /npcf-smpolicycontrol/v1/sm-policies/:smPolicyId/update --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPSMpoliciesUpdate-fm
[GIN-debug] GET /npcf-am-policy-control/v1/policies/:polAssoId --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPPPoliciesPost-fm
[GIN-debug] DELETE /npcf-am-policy-control/v1/policies/:polAssoId --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPPPoliciesDelete-fm
[GIN-debug] POST /npcf-am-policy-control/v1/policies/:polAssoId/update --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPPPoliciesUpdate-fm
[GIN-debug] POST /npcf-am-policy-control/v1/policies --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPPPoliciesPost-fm (4 handlers)
[GIN-debug] POST /npcf-bdtpolicycontrol/v1/bdtPolices --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPCreateBDTPolicy-fm
[GIN-debug] GET /npcf-bdtpolicycontrol/v1/bdtPolices/:bdtPolicyId --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPGetBDTPolicy-fm
[GIN-debug] PATCH /npcf-bdtpolicycontrol/v1/bdtPolices/:bdtPolicyId --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPUpdateBDTPolicy-fm
[GIN-debug] POST /npcf-callback/v1/nudr-notify/policy-data/:supi --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPNudrPolicyData-fm
[GIN-debug] POST /npcf-callback/v1/nudr-notify/influence-data/:supi --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPInfluenceData-fm
[GIN-debug] POST /npcf-callback/v1/amstatus --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPAmfStatusChangeNotify-fm (3 handlers)
[GIN-debug] GET /npcf-oam/v1/am-policy/:supi --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPOAMGetAmPolicy-fm (4 handlers)
[GIN-debug] POST /npcf-policyauthorization/v1/app-sessions --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPPostAppSessions-fm
[GIN-debug] DELETE /npcf-policyauthorization/v1/app-sessions/:appSessionId/events-subscription --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPDeleteAppSessionEvents-fm
[GIN-debug] PUT /npcf-policyauthorization/v1/app-sessions/:appSessionId/events-subscription --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPPutAppSessionEvents-fm
[GIN-debug] POST /npcf-policyauthorization/v1/app-sessions/:appSessionId/delete --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPDeleteAppSession-fm
[GIN-debug] GET /npcf-policyauthorization/v1/app-sessions/:appSessionId --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPGetAppSession-fm
[GIN-debug] PATCH /npcf-policyauthorization/v1/app-sessions/:appSessionId --> github.com/free5gc/pcf/internal/sbi.(*Server).HTTPPutAppSession-fm
[GIN-debug] DELETE /npcf-ue-policy-control/v1/policies/{polAssoId} --> github.com/free5gc/pcf/internal/sbi.(*Server).PoliciesPolAsDelete-fm
[GIN-debug] GET /npcf-ue-policy-control/v1/policies/{polAssoId} --> github.com/free5gc/pcf/internal/sbi.(*Server).PoliciesPolAsGet-fm
[GIN-debug] POST /npcf-ue-policy-control/v1/policies/{polAssoId}/update --> github.com/free5gc/pcf/internal/sbi.(*Server).PoliciesPolAsUpdate-fm
[GIN-debug] POST /npcf-ue-policy-control/v1/policies --> github.com/free5gc/pcf/internal/sbi.(*Server).PoliciesPost-fm (3 handlers)
2024-12-07T09:46:04.472629266+05:30 [INFO][PCF][SBI] Binding addr: [127.0.0.7:8000]
```

## Command: ./bin/ausf

```
ubuntu@ubuntu:~/Documents/5G/free5gc$ ./bin/ausf
2024-12-07T09:46:13.842575960+05:30 [INFO][AUSF][Main] AUSF version:
    free5GC version: V3.4.4
    build time: 2024-12-01T10:52:31Z
    commit hash: 842217c4
    commit time: 2024-06-28T05:50:14Z
    go version: go1.21.5 linux/amd64
2024-12-07T09:46:13.845021973+05:30 [INFO][AUSF][CFG] Read config from [./config/ausfcfg.yaml]
2024-12-07T09:46:13.851334407+05:30 [INFO][AUSF][Main] Log enable is set to [true]
2024-12-07T09:46:13.851390742+05:30 [INFO][AUSF][Main] Log level is set to [info]
2024-12-07T09:46:13.851403080+05:30 [INFO][AUSF][Main] Report Caller is set to [false]
2024-12-07T09:46:13.8520260280+05:30 [INFO][AUSF][Init] ausfconfig Info: Version[1.0.3] Description[AUSF initial local configuration]
ausf context = &{{{{0 0} {[[] {} <nil>] map[]} 0} {[0 0} {[[] {} <nil>} map[]} 0} b9ae42a0-ca8c-45bd-8260-69241241aef0 ausfGroup001 8000 1
.pem.map[nausf-auth:{b9ae42a0-ca8c-45bd-8260-69241241aef0 nausf-auth 0xc000010210 [] <nil> [] [] <nil>
[GIN-debug] [WARNING] Running in "debug" mode. Switch to "release" mode in production.
- using env: export GIN_MODE=release
- using code: gin.SetMode(gin.ReleaseMode)

[GIN-debug] GET /nausf-auth/v1/ --> github.com/free5gc/ausf/internal/sbi.Index (4 handlers)
[GIN-debug] POST /nausf-auth/v1/ue-authentications/:authCtxId/eap-session --> github.com/free5gc/ausf/internal/sbi.(*Server).EapAuth-fm
[GIN-debug] POST /nausf-auth/v1/ue-authentications --> github.com/free5gc/ausf/internal/sbi.(*Server).UeAuthenticationsPost-fm (4 handlers)
[GIN-debug] PUT /nausf-auth/v1/ue-authentications/:authCtxId/5g-aka-confirmation --> github.com/free5gc/ausf/internal/sbi.(*Server).UeAuthenticationsPut-fm
2024-12-07T09:46:13.853462170+05:30 [INFO][AUSF][SBI] Binding addr: [127.0.0.9:8000]
2024-12-07T09:46:13.85511415+05:30 [INFO][AUSF][Init] Server started
2024-12-07T09:46:13.870034835+05:30 [INFO][AUSF][Main] OAuth2 setting receive from NRF: true
2024-12-07T09:46:13.870182167+05:30 [INFO][AUSF][SBI] Start SBI server (listen on 127.0.0.9:8000)
```

## Update UERANSIM Configurations:

- Update the **amfIp** in **ueransim-gnb.yaml** to match Free5GC's AMF IP.
- Use the same **mcc**, **mnc**, **sst**, and **sd** across Free5GC and UERANSIM.

## Run UERANSIM: Start the gNB and UE:

Command: `./nr-gnb -c ../config/ueransim-gnb.yaml`

```
ubuntu@ubuntu:~/Documents/5G/UERANSIM/build$ ./nr-gnb -c ../config/ueransim-gnb.yaml
UERANSIM v3.2.6
[2024-12-07 09:55:42.568] [sctp] [info] Trying to establish SCTP connection... (127.0.0.5:38412)
[2024-12-07 09:55:42.569] [sctp] [info] SCTP connection established (127.0.0.5:38412)
[2024-12-07 09:55:42.570] [sctp] [debug] SCTP association setup ascId[30]
[2024-12-07 09:55:42.570] [ngap] [debug] Sending NG Setup Request
[2024-12-07 09:55:42.588] [ngap] [debug] NG Setup Response received
[2024-12-07 09:55:42.588] [ngap] [info] NG Setup procedure is successful
```

Command: `./nr-ue -c ../config/ueransim-ue.yaml`

Error 1:

```
ubuntu@ubuntu:~/Documents/5G/UERANSIM/build$ ./nr-ue -c ../config/ueransim-ue.yaml
UERANSIM v3.2.6
[2024-12-02 00:21:13.875] [nas] [info] UE switches to state [MM-Deregistered/PLMN-Search]
[2024-12-02 00:21:13.876] [rrc] [debug] New signal detected for cell[1], total [1] cells in coverage
[2024-12-02 00:21:13.876] [nas] [info] Selected plmn[404/98]
[2024-12-02 00:21:13.876] [rrc] [info] Selected cell plmn[404/98] tac[1] category[Suitable]
[2024-12-02 00:21:13.876] [nas] [info] UE switches to state [MM-Deregistered/PS]
[2024-12-02 00:21:13.876] [nas] [info] UE switches to state [MM-Deregistered/Normal-Service]
[2024-12-02 00:21:13.876] [nas] [debug] Initial registration required due to [MM-Dereg-Normal-Service]
[2024-12-02 00:21:13.876] [nas] [debug] UAC access attempt is allowed for identity[0], category[MO_sig]
[2024-12-02 00:21:13.876] [nas] [debug] Sending Initial Registration
[2024-12-02 00:21:13.876] [nas] [info] UE switches to state [MM-Register-Initiated]
[2024-12-02 00:21:13.877] [rrc] [debug] Sending RRC Setup Request
[2024-12-02 00:21:13.877] [rrc] [info] RRC connection established
[2024-12-02 00:21:13.877] [rrc] [info] UE switches to state [RRC-Connected]
[2024-12-02 00:21:13.878] [nas] [info] UE switches to state [CM-Connected]
[2024-12-02 00:21:13.885] [nas] [error] Initial Registration failed [Congestion]
[2024-12-02 00:21:13.885] [nas] [debug] Handling Registration Reject abnormal case
[2024-12-02 00:21:13.885] [nas] [info] UE switches to state [MM-Deregistered/Attempting-Registration]
[2024-12-02 00:21:13.989] [nas] [warning] Registration Reject ignored since the MM state is not MM_REGISTERED_INITIATED
[2024-12-02 00:21:13.989] [nas] [warning] Sending MM Status with cause [MESSAGE_NOT_COMPATIBLE_WITH_PROTOCOL_STATE]
[2024-12-02 00:21:23.885] [nas] [debug] NAS timer[3511] expired [1]
[2024-12-02 00:21:23.885] [nas] [debug] Initial registration required due to [T3511-Expiry-In-Att-Reg]
[2024-12-02 00:21:23.885] [nas] [debug] Sending Initial Registration
[2024-12-02 00:21:23.885] [nas] [info] UE switches to state [MM-Register-Initiated]
[2024-12-02 00:21:23.890] [nas] [error] Initial Registration failed [Congestion]
[2024-12-02 00:21:23.890] [nas] [debug] Handling Registration Reject abnormal case
[2024-12-02 00:21:23.890] [nas] [info] UE switches to state [MM-Deregistered/Attempting-Registration]
[2024-12-02 00:21:23.997] [nas] [warning] Registration Reject ignored since the MM state is not MM_REGISTERED_INITIATED
[2024-12-02 00:21:23.997] [nas] [warning] Sending MM Status with cause [MESSAGE_NOT_COMPATIBLE_WITH_PROTOCOL_STATE]
[2024-12-02 00:21:33.895] [nas] [debug] NAS timer[3511] expired [1]
[2024-12-02 00:21:33.895] [nas] [debug] Initial registration required due to [T3511-Expiry-In-Att-Reg]
[2024-12-02 00:21:33.895] [nas] [debug] Sending Initial Registration
[2024-12-02 00:21:33.895] [nas] [info] UE switches to state [MM-Register-Initiated]
[2024-12-02 00:21:33.909] [nas] [error] Initial Registration failed [Congestion]
[2024-12-02 00:21:33.909] [nas] [debug] Handling Registration Reject abnormal case
[2024-12-02 00:21:33.909] [nas] [info] UE switches to state [MM-Deregistered/Attempting-Registration]
[2024-12-02 00:21:34.012] [nas] [warning] Registration Reject ignored since the MM state is not MM_REGISTERED_INITIATED
[2024-12-02 00:21:34.012] [nas] [warning] Sending MM Status with cause [MESSAGE_NOT_COMPATIBLE_WITH_PROTOCOL_STATE]
[2024-12-02 00:21:44.906] [nas] [debug] NAS timer[3511] expired [1]
[2024-12-02 00:21:44.906] [nas] [debug] Initial registration required due to [T3511-Expiry-In-Att-Reg]
[2024-12-02 00:21:44.906] [nas] [debug] Sending Initial Registration
[2024-12-02 00:21:44.906] [nas] [info] UE switches to state [MM-Register-Initiated]
```

Error 2:

```
ubuntu@ubuntu:~/Documents/5G/UERANSIM/build$ ./nr-ue -c ../config/ueransim-ue.yaml
UERANSIM v3.2.6
[2024-12-07 09:56:37.361] [nas] [info] UE switches to state [MM-Deregistered/PLMN-Search]
[2024-12-07 09:56:37.362] [rrc] [debug] New signal detected for cell[1], total [1] cells in coverage
[2024-12-07 09:56:39.561] [nas] [error] No PLMN could be selected among [1] PLMNs
[2024-12-07 09:56:41.763] [nas] [error] No PLMN could be selected among [1] PLMNs
[2024-12-07 09:56:42.361] [rrc] [info] Selected cell plmn[404/10] tac[1] category[Acceptable]
[2024-12-07 09:56:42.361] [nas] [info] UE switches to state [MM-Deregistered/PS]
[2024-12-07 09:56:42.361] [nas] [info] UE switches to state [MM-Deregistered/Limited-Service]
```

Here we are facing some errors like congestion errors, roaming errors, and no PLMN