

Open Air Interface & FlexRIC Installation

ECE 5984: 5G-Advanced, O-RAN & 6G
Virginia Tech

Helpful Commands

- Changing directory (cd)
 - Enter a directory: `cd <directory name/path>`
 - Exit a directory: `cd ..`
 - Exit multiple directories: `cd ../../../../../`
- List all files in current directory: `ls`
- Open a file: `vim <filename/path>`
 - Edit a file: Press `i`
 - Stop editing a file: `<Esc>`
 - Save a file: stop editing `<Esc>` and type `:w`
 - Exit a file: Stop editing `<Esc>` and type `:q`
 - Save and exit: Stop editing `<Esc>` and type `:wq`

Install Dependencies

```
sudo apt-get update  
sudo apt-get install git net-tools unzip  
git clone https://gitlab.eurecom.fr/oai/openairinterface5g.git ~/openairinterface5g  
cd ~/openairinterface5g/cmake_targets  
../build_oai -l  
cd
```



A terminal window showing the output of a dependency resolution command. The output lists many header files and their corresponding paths, such as 'simde/x86/avx512/setr4.h' and '/usr/include/simde/x86/avx512/setr4.h'. At the bottom of the terminal, the text 'BUILD SHOULD BE SUCCESSFUL' is displayed in green.

```
pratheek@Pratheek: ~/oai/cn  x  +  v  
'../simde/x86/avx512/setr4.h' -> '/usr/include/simde/x86/avx512/setr4.h'  
'../simde/x86/avx512/setzero.h' -> '/usr/include/simde/x86/avx512/setzero.h'  
'../simde/x86/avx512/shldv.h' -> '/usr/include/simde/x86/avx512/shldv.h'  
'../simde/x86/avx512/sll.h' -> '/usr/include/simde/x86/avx512/sll.h'  
'../simde/x86/avx512/sllv.h' -> '/usr/include/simde/x86/avx512/sllv.h'  
'../simde/x86/avx512/sqrt.h' -> '/usr/include/simde/x86/avx512/sqrt.h'  
'../simde/x86/avx512/sra.h' -> '/usr/include/simde/x86/avx512/sra.h'  
'../simde/x86/avx512/srai.h' -> '/usr/include/simde/x86/avx512/srai.h'  
'../simde/x86/avx512/srav.h' -> '/usr/include/simde/x86/avx512/srav.h'  
'../simde/x86/avx512/srl.h' -> '/usr/include/simde/x86/avx512/srl.h'  
'../simde/x86/avx512/srlv.h' -> '/usr/include/simde/x86/avx512/srlv.h'  
'../simde/x86/avx512/store.h' -> '/usr/include/simde/x86/avx512/store.h'  
'../simde/x86/avx512/subs.h' -> '/usr/include/simde/x86/avx512/subs.h'  
'../simde/x86/avx512/ternarylogic.h' -> '/usr/include/simde/x86/avx512/ternarylogic.h'  
'../simde/x86/avx512/test.h' -> '/usr/include/simde/x86/avx512/test.h'  
'../simde/x86/avx512/testn.h' -> '/usr/include/simde/x86/avx512/testn.h'  
'../simde/x86/avx512/unpackhi.h' -> '/usr/include/simde/x86/avx512/unpackhi.h'  
'../simde/x86/avx512/unpacklo.h' -> '/usr/include/simde/x86/avx512/unpacklo.h'  
'../simde/x86/avx512/xor.h' -> '/usr/include/simde/x86/avx512/xor.h'  
'../simde/x86/gfni.h' -> '/usr/include/simde/x86/gfni.h'  
BUILD SHOULD BE SUCCESSFUL
```

Install Dependencies (cont'd)

Check GCC Version

```
gcc --version
```

```
pratheek@Pratheek:~/oai/cmake_targets$ gcc --version
gcc (Ubuntu 13.3.0-6ubuntu2~24.04) 13.3.0
Copyright (C) 2023 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

You should see GCC 12/13. If you see GCC 11, it's not compatible.

Run only if you see GCC 11

```
sudo apt -y install gcc-10 g++-10
sudo update-alternatives --install /usr/bin/gcc gcc /usr/bin/gcc-10 10
sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-10 10
```

```
pratheek@ubuntu22:~$ sudo update-alternatives --install /usr/bin/gcc gcc /usr/bin/gcc-10 10
sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-10 10
update-alternatives: using /usr/bin/gcc-10 to provide /usr/bin/gcc (gcc) in auto mode
update-alternatives: using /usr/bin/g++-10 to provide /usr/bin/g++ (g++) in auto mode
pratheek@ubuntu22:~$
```

Install OAI CN 5G

- Reference: https://gitlab.eurecom.fr/oai/openairinterface5g/-/blob/develop/doc/NR_SA_Tutorial_OAI_CN5G.md?ref_type=heads
- Install Docker

```
sudo apt update

sudo install -m 0755 -d /etc/apt/keyrings

curl -fsSL https://download.docker.com/linux/ubuntu/gpg -o /etc/apt/keyrings/docker.asc

sudo chmod a+r /etc/apt/keyrings/docker.asc

echo "deb [arch=$(dpkg --print-architecture) signed-by=/etc/apt/keyrings/docker.asc] https://download.docker.com/linux/ubuntu "$(./etc/os-release && echo "$VERSION_CODENAME")" stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null

sudo apt update

sudo apt install -y docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin

sudo usermod -a -G docker $(whoami)

sudo reboot
```

Note: Sometimes, when executing commands, you might encounter an error message similar to “command not found” or “unrecognized option”. This can be due to font inconsistencies between Windows (on which this ppt has been designed) and Linux. To resolve this, wherever there is a hyphen (“-”), delete it and retype it again manually.

OAI CN 5G Configuration files

```
wget -O ~/oai-cn5g.zip https://gitlab.eurecom.fr/oai/openairinterface5g/-/archive/develop/openairinterface5g-develop.zip?path=doc/tutorial_resources/oai-cn5g  
unzip ~/oai-cn5g.zip  
mv ~/openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g ~/oai-cn5g  
rm -r ~/openairinterface5g-develop-doc-tutorial_resources-oai-cn5g ~/oai-cn5g.zip  
cd ~/oai-cn5g  
sudo docker compose pull
```

Start OAI CN 5G

```
cd ~/oai-cn5g  
docker compose up -d
```

Stop OAI CN 5G

```
cd ~/oai-cn5g  
docker compose down
```

Note: Sometimes, when executing commands, you might encounter an error message similar to "command not found" or "unrecognized option". This can be due to font inconsistencies between Windows (on which this ppt has been designed) and Linux. To resolve this, wherever there is a hyphen ("-"), delete it and retype it again manually.

```
pratheek@Pratheek:~/oai-cn5g$ unzip ~/oai-cn5g.zip
Archive: /home/pratheek/oai-cn5g.zip
55a56002de51b0e5269ebc4d2b5f3425d5b67fc6
  creating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/
  creating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/
  creating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/
  creating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/
  creating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/conf/
inflating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/conf/config.yaml
inflating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/conf/sip.conf
inflating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/conf/users.conf
  creating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/database/
inflating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/database/oai_db.sql
inflating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/docker-compose.yaml
  creating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/healthscripts/
inflating: openairinterface5g-develop-doc-tutorial_resources-oai-cn5g/doc/tutorial_resources/oai-cn5g/healthscripts/mysql-healthcheck.sh
```

```
pratheek@Pratheek:~/oai-cn5g$ sudo docker compose pull
[+] Pulling 82/82
✓ oai-ext-dn Pulled                                         15.2s
✓ oai-smf Pulled                                         18.7s
✓ oai-nrf Pulled                                         16.5s
✓ oai-ausf Pulled                                         48.5s
✓ oai-udm Pulled                                         11.8s
✓ oai-upf Pulled                                         48.6s
✓ oai-amf Pulled                                         53.2s
✓ ims Pulled                                              55.2s
✓ oai-udr Pulled                                         12.1s
✓ mysql Pulled                                           95.6s
```

Install OAI RAN

- Reference: https://gitlab.eurecom.fr/oai/openairinterface5g/-/tree/oran_jpn/openair2/E2AP?ref_type=heads

```
cd ~/openairinterface5g/cmake_targets  
./build_oai -w SIMU --gNB --nrUE --build-e2 --ninja
```

```
-- AVX2 instructions are ON  
-- Found Git: /usr/bin/git (found version "2.25.1")  
-- E2AP submodule not detected, therefore $git submodule init && git submodule update --init --remote.  
Submodule 'openair2/E2AP/flexric' (https://gitlab.eurecom.fr/mosaic5g/flexric.git) registered for path '.../.../openair2/E2AP/flexric'  
Cloning into '/home/advcell/oai/openair2/E2AP/flexric'...  
Submodule path '.../.../openair2/E2AP/flexric': checked out 'aad1ed2f2146cd2f080058c788aad018355a6cb'  
-- Selected LIBRARY TYPE: STATIC  
-- Selected E2AP_ENCODING: ASN  
-- Selected KPM_SM_ENCODING: ASN  
-- Selected RC_SM_ENCODING: ASN  
-- Selected MAC_SM_ENCODING: PLAIN  
-- Selected RLC_SM_ENCODING: PLAIN  
-- Selected PDCP_SM_ENCODING: PLAIN  
-- Selected SLICE_SM_ENCODING: PLAIN  
-- Selected GTP_SM_ENCODING: PLAIN  
-- Selected SM_ENCODING: PLAIN  
  
gcc -Wall -g -c -o genids.o genids.c  
gcc -Wall -g -o genids genids.o  
.genids T_messages.txt T_IDs.h  
xxd -i T_messages.txt T_messages.txt.h  
gcc -Wall -I.../.../.../openair2/COMMON -Itracer -o _check_vcd check_vcd.c tracer/database.c tracer/utils.c -lm -pthread  
./_check_vcd || (rm -f ./_check_vcd ./T_IDs.h ./T_messages.txt.h && false)  
rm -f ./_check_vcd  
-- No Doxygen documentation requested  
-- Configuring done  
-- Generating done  
-- Build files have been written to: /home/advcell/oai/cmake_targets/ran_build/build  
Compiling nr-softmodem nr-cuup nr-uesoftmodem params_libconfig coding rfsimulator...  
Log file for compilation is being written to: /home/advcell/oai/cmake_targets/log/all.txt  
WARNING: 23 warnings. See /home/advcell/oai/cmake_targets/log/all.txt  
nr-softmodem nr-cuup nr-uesoftmodem params_libconfig coding rfsimulator compiled  
liboai_device.so is not linked to any device library  
Building transport protocol libraries  
Log file for compilation is being written to: /home/advcell/oai/cmake_targets/log/oai_eth_transpro.txt  
oai_eth_transpro compiled  
liboai_transpro.so is linked to ETHERNET transport  
BUILD SHOULD BE SUCCESSFUL.
```

You should see ASN encoding for E2AP, KPM SM & RC SM

```
advcell@ubuntu20:~/oai/cmake_targets$ ./build_oai -I -w SIMU --gNB --nrUE --build-e2 --ninja  
Will install external packages  
Setting hardware to: OAI_SIMU  
Will compile gNB  
Will compile NR UE  
RF HW set to OAI_SIMU  
OPENAIR_DIR = /home/advcell/oai  
Installing packages
```

Build should be successful

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Install OAI RAN (cont'd)

- Run the following commands if
 - You do not see the output in the red box outlined in the previous slide.
 - The “**flexric**” directory in **~/oai/openair2/E2AP/flexric** is empty.

```
cd ~/openairinterface5g/openair2/E2AP/  
git submodule init  
git submodule update  
  
cd ~/openairinterface5g/cmake_targets/  
.build_oai -w SIMU --gNB --nrUE --build-e2 --ninja
```

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