教育部「5G行動寬頻人才培育跨校教學聯盟計畫」 5G行動網路協定與核網技術聯盟中心 課程:4G/5G行動寬頻協同網路



5G Emulator仿真模擬實驗

副教授: 吳俊興 助教:林原進、吳振宇 國立高雄大學 資訊工程學系

Outline

- 實驗目的及實驗內容
- •5G Emulator-nukxDC(ee) 實驗環境
 - srsLTE Small Cell 架構
 - 軟硬體環境
- •5G Emulator-nukxDC(ee) 網路實驗平台建置
 - 安裝基礎 SISLTE 網路環境
 - 設定srsLTE EPC
 - 設定srsLTE eNB
 - 設定srsLTE UE
- 執行程式暨測試
- 總結

實驗目的

- 建置兩個小基站以模擬EN-DC的協同運作,讓 學生熟悉NSA的5G協同網路架構
- 透過SrSLTE網路環境了解到UE傳送封包後
 - 觀察封包如何在整體環境裡傳遞
 - 同時測量實驗環境的效率與協定

實驗內容

- 在三台主機上安裝和配置 UE 和 EPC 以及 eNB
- 設置 UE 和 eNB
- 執行 EPC 和 UE 以及 eNB
- 開啟 Wireshark
- 從 Wireshark 觀察各個主機間的封包訊息流向

EN-DC with the EPC

- E-UTRAN supports MR-DC via E-UTRA-NR Dual Connectivity (EN-DC), in which a UE is connected to one eNB that acts as a MN and one en-gNB that acts as a SN
- The eNB is connected to the EPC via the S1 interface and to the en-gNB via the X2 interface
- The en-gNB might also be connected to the EPC via the S1-U interface and other en-gNBs via the X2-U interface



Dual Connectivity Architecture (User Plane)



Dual Connectivity (User Plane)



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| 名稱 | 規格 | 數量 | 目的 |
|----------|-------------------------------------|----|---|
| EPC+eNB1 | 電腦型號 : ASUS VivoMini UN65H | 1 | 啟動MME, S-GW, P-GW |
| | Ethernet Network Cards | 2 | 一張連接內部網路 (PCI-E : Realtek RTL8111/8168) 一張連接外部網路 (USB : TP-LINK UE300) |
| | USRP B210 | 1 | 啟動srsLTE eNB |
| eNB2 | 電腦規格 : CPU : i7-6700 , RAM : 32G | 1 | 模擬第二個基地站 |
| | USRP B210 | 1 | 啟動srsLTE eNB |
| UE | 電腦型號 : ASUS NB M580V | 1 | 模擬 UE |
| | USRP B210 | 1 | 啟動srsLTE UE |
| Hub | 型號 : TP-LINK WR1043ND | 1 | 分配內部網路 |

軟硬體環境-軟體

| 名稱 | 軟體 | 版本 |
|-----|----------------|---|
| EPC | OS : Ubuntu | Ubuntu 16.04 |
| | | Kernel: 4.15.0-041500-lowlatatency |
| | srsLTE EPC | srsLTE 18.06.1 470953bf9c5875646e4d5049c8f213d202fa84fd |
| eNB | OS : Ubuntu | Ubuntu 16.04 |
| | | Kernel: 4.15.0-041500-lowlatatency |
| | srsLTE eNB | srsLTE 18.06.1 470953bf9c5875646e4d5049c8f213d202fa84fd |
| UE | OS : Ubuntu | Ubuntu 16.04 |
| | | Kernel: 4.15.0-041500-lowlatatency |
| | srsLTE UE | srsLTE 18.06.1 470953bf9c5875646e4d5049c8f213d202fa84fd |

srsLTE/nukxDC實驗架構



下載及安裝Kernel

- 開啟一個終端機,並且依序輸入
- wget -P ~/Downloads/kernel https://kernel.ubuntu.com/~kernelppa/mainline/v4.4.15/linux-headers-4.4.15-040415_4.4.15-040415.201607111333_all.deb
- wget -P ~/Downloads/kernel https://kernel.ubuntu.com/~kernelppa/mainline/v4.4.15/linux-headers-4.4.15-040415lowlatency_4.4.15-040415.201607111333_amd64.deb
- wget -P ~/Downloads/kernel https://kernel.ubuntu.com/~kernelppa/mainline/v4.4.15/linux-image-4.4.15-040415lowlatency_4.4.15-040415.201607111333_amd64.deb

安裝過程

😑 🗊 asus-medium@asusmedium-UN65H: ~

asus-medium@asusmedium-UN65H:~\$ wget -P ~/Downloads/kernel https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-headers-4.4.15-040415 4 .4.15-040415.201607111333 all.deb --2019-07-12 10:23:21-- https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-headers-4.4.15-040415 4.4.15-040415.201607111333 all.deb Resolving kernel.ubuntu.com (kernel.ubuntu.com)... 91.189.94.216 Connecting to kernel.ubuntu.com (kernel.ubuntu.com)|91.189.94.216|:443... connected. HTTP request sent, awaiting response... 200 OK Length: 9755644 (9.3M) [application/x-debian-package] Saving to: '/home/asus-medium/Downloads/kernel/linux-headers-4.4.15-040415 4.4.15-040415.201607111333 all.deb' in 7.2s 2019-07-12 10:23:29 (1.30 MB/s) - '/home/asus-medium/Downloads/kernel/linux-headers-4.4.15-040415_4.4.15-040415.201607111333_all.deb' saved [97 55644/9755644] asus-medium@asusmedium-UN65H:~\$ wget -P ~/Downloads/kernel https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-headers-4.4.15-040415-l owlatency 4.4.15-040415.201607111333 amd64.deb --2019-07-12 10:23:29-- https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-headers-4.4.15-040415-lowlatency 4.4.15-040415.2016071113 33 amd64.deb Resolving kernel.ubuntu.com (kernel.ubuntu.com)... 91.189.94.216 Connecting to kernel.ubuntu.com (kernel.ubuntu.com)|91.189.94.216|:443... connected. HTTP request sent, awaiting response... 200 OK Length: 748090 (731K) [application/x-debian-package] Saving to: '/home/asus-medium/Downloads/kernel/linux-headers-4.4.15-040415-lowlatency 4.4.15-040415.201607111333 amd64.deb' in 1.4s 2019-07-12 10:23:32 (505 KB/s) - '/home/asus-medium/Downloads/kernel/linux-headers-4.4.15-040415-lowlatency 4.4.15-040415.201607111333 amd64.de b' saved [748090/748090] asus-medium@asusmedium-UN65H:~\$ wget -P ~/Downloads/kernel https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-image-4.4.15-040415-low

latency 4.4.15-040415.201607111333 amd64.deb

修改開機選單和設定

- 開啟終端機輸入以下指令
- sudo gedit /etc/default/grub
- 找到下列文字 GRUB_HIDDEN_TIMEOUT=0 GRUB_HIDDEN_TIMEOUT_QUIET=true
- 改成 #GRUB_HIDDEN_TIMEOUT=0 #GRUB_HIDDEN_TIMEOUT_QUIET=true



更新grub設定

- 在終端機輸入以下指令
- sudo update-grub2
- 接著輸入以下指令,重新啟動電腦
- sudo reboot
- 然後在開機選單選擇剛才安裝的lowlatency

😰 🗖 🔲 asus-medium@asusmedium-UN65H: ~ asus-medium@asusmedium-UN65H:~\$ sudo update-grub2 [sudo] password for asus-medium: Generating grub configuration file ... Found linux image: /boot/vmlinuz-4.15.0-041500-lowlatency Found initrd image: /boot/initrd.img-4.15.0-041500-lowlatency Found linux image: /boot/vmlinuz-4.15.0-041500-lowlatency Found initrd image: /boot/initrd.img-4.15.0-041500-lowlatency Found linux image: /boot/vmlinuz-4.15.0-47-generic Found initrd image: /boot/initrd.img-4.15.0-47-generic Found linux image: /boot/vmlinuz-4.15.0-46-generic Found initrd image: /boot/initrd.img-4.15.0-46-generic Found linux image: /boot/vmlinuz-4.15.0-30-lowlatency Found initrd image: /boot/initrd.img-4.15.0-30-lowlatency Adding boot menu entry for EFI firmware configuration done asus-medium@asusmedium-UN65H:~\$



- 重新開機後在終端機輸入指令,確認版本
- unamr -r

asus-medium@asusmedium-UN65H:~
asus-medium@asusmedium-UN65H:~\$ uname -r
4.15.0-041500-lowlatency
asus-medium@asusmedium-UN65H:~\$

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Install Packages

 sudo apt-get install cmake libfftw3-dev libboost-all-dev libconfig++-dev libsctp-dev

Install mbed TLS

- wget https://tls.mbed.org/download/start/mbedtls-2.16.0apache.tgz
- tar zxvf mbedtls-2.16.0-apache.tgz
- sudo mv /path/to/mbedtls-2.16.0 /usr/local
- cd /usr/local/mbedtls-2.16.0
- cmake.
- make
- make test
- cmake -DENABLE_TESTING=Off.
- cmake -DUSE_SHARED_MBEDTLS_LIBRARY=On .
- sudo make install library

ref : https://tls.mbed.org/kb/compiling-and-building/how-do-i-build-compile-mbedtls

Install UHD

- sudo add-apt-repository ppa:ettusresearch/uhd
- sudo apt-get update
- sudo apt-get install libuhd-dev libuhd003 uhd-host
- sudo ./usr/lib/uhd/utils/uhd_images_downloader.py

Download and Build srsGUI

- sudo apt-get install libboost-system-dev libboost-testdev libboost-thread-dev libqwt-dev libqt4-dev
- git clone https://github.com/srsLTE/srsGUI.git
- cd srsgui
- mkdir build
- cd build
- cmake ../
- make
- make test

Download and Build srsLTE

- git clone https://github.com/nukcsie2066/nukxDC.git
- cd srsLTE
- mkdir build
- cd build
- cmake ../
- make
- make test
- sudo make install

编譯前注意事項

- 三台電腦皆需要編譯,請注意充當的角色不同, 路徑也不相同,以下用 /path/to/ 取代。
 - e.g. epc&enb1 : ~/nukxDC/epc_enb1/
 - e.g. enb2 : ~/nukxDc/enb2/
 - e.g. ue : ~/nukxDC/ue/

- cd /path/to/srsLTE
- mkdir build
- cd build
- cmake ../

asus-medium@asusmedium-UN65H: ~/Desktop/enb/build asus-medium@asusmedium-UN65H:~\$ cd Desktop/enb/ asus-medium@asusmedium-UN65H:~/Desktop/enb\$ mkdir build asus-medium@asusmedium-UN65H:~/Desktop/enb\$ cd build asus-medium@asusmedium-UN65H:~/Desktop/enb/build\$ cmake .../

make

😑 💷 🛛 asus-medium@asusmedium-UN65H: ~/Desktop/enb/build - CMAKE CXX FLAGS is -march=native -Wall -Wno-comment -Wno-reorder -Wno-unused-but-set-variable -Wno-unused-variable -Wformat -Wmissing-field-initiali zers -Wtype-limits -std=c++03 -mfpmath=sse -mavx2 -DLV HAVE AVX2 -DLV HAVE AVX -DLV HAVE SSE -O3 -DBUILD TYPE RELEASE -- Using install prefix: /usr/local -- Building for version: 18.6.1 - SRSGUI LIBRARIES SRSGUI LIBRARIES-NOTFOUND - SRSGUI INCLUDE DIRS SRSGUI INCLUDE DIRS-NOTFOUND -- Could NOT find SRSGUI (missing: SRSGUI LIBRARIES SRSGUI INCLUDE DIRS) - SRSGUI LIBRARIES SRSGUI LIBRARIES-NOTFOUND SRSGUI INCLUDE DIRS SRSGUI INCLUDE DIRS-NOTFOUND - Could NOT find SRSGUI (missing: SRSGUI_LIBRARIES SRSGUI_INCLUDE_DIRS) examples will be installed. - No post-build command defined Building with srsUE - No post-build-UE command defined -- No post-build command defined Building with srsENB -- Found LibConfig++: /usr/lib/x86_64-linux-gnu/libconfig++.so -- static LibConfig++ path: /usr/lib/x86_64-linux-gnu/libconfig++.a -- Found LibConfig: /usr/lib/x86 64-linux-gnu/libconfig.so -- static LibConfig path: /usr/lib/x86 64-linux-gnu/libconfig.a Checking for module 'sctp' No package 'sctp' found -- SCTP LIBRARIES: /usr/lib/x86 64-linux-gnu/libsctp.so -- SCTP INCLUDE DIRS: /usr/include -- Found SCTP: /usr/lib/x86 64-linux-gnu/libsctp.so -- No post-build-ENB command defined - Building with srsEPC - Found LibConfig++: /usr/lib/x86 64-linux-gnu/libconfig++.so -- static LibConfig++ path: /usr/lib/x86 64-linux-gnu/libconfig++.a Found LibConfig: /usr/lib/x86 64-linux-gnu/libconfig.so -- static LibConfig path: /usr/lib/x86_64-linux-gnu/libconfig.a Checking for module 'sctp' No package 'sctp' found -- SCTP LIBRARIES: /usr/lib/x86_64-linux-gnu/libsctp.so -- SCTP INCLUDE DIRS: /usr/include -- No post-build-EPC command defined -- Configuring done -- Generating done -- Build files have been written to: /home/asus-medium/Desktop/enb/build asus-medium@asusmedium-UN65H:~/Desktop/enb/build\$ make

make test

🔵 💿 🛛 asus-medium@asusmedium-UN65H: ~/Desktop/enb/build 94%] Built target cell search Scanning dependencies of target usrp_capture_sync 95%] Building C object lib/examples/CMakeFiles/usrp_capture_sync.dir/usrp_capture_sync.c.o 95%] Linking C executable usrp capture 95%] Linking C executable usrp_capture_sync 95%] Built target usrp capture Scanning dependencies of target srsue 95%] Building CXX object srsue/src/CMakeFiles/srsue.dir/main.cc.o 95%] Built target usrp capture sync Scanning dependencies of target mac_test 95%] Building CXX object srsue/test/mac/CMakeFiles/mac test.dir/mac test.cc.o 96%] Linking CXX executable mac test 97%] Linking CXX executable srsmbms 97%] Built target mac test Scanning dependencies of target srsenb 97%] Built target srsmbms **97%**] Building CXX object srsue/src/CMakeFiles/srsue.dir/ue_base.cc.o 97%] Building CXX object srsenb/src/CMakeFiles/srsenb.dir/main.cc.o 97%] Linking CXX executable srsepc 97%] Built target srsepc Scanning dependencies of target ip_test_enb 97%] Building CXX object srsenb/test/upper/CMakeFiles/ip test enb.dir/ip test.cc.o 98%] Building CXX object srsue/src/CMakeFiles/srsue.dir/ue.cc.o 99%] Linking CXX executable ip test enb 99%] Built target ip test enb Scanning dependencies of target benchmark_radio 99%] Building CXX object lib/src/radio/test/CMakeFiles/benchmark_radio.dir/benchmark_radio.cc.o 99%] Linking CXX executable benchmark radio 99%] Built target benchmark radio 99%] Building CXX object srsenb/src/CMakeFiles/srsenb.dir/enb.cc.o 99%] Building CXX object srsue/src/CMakeFiles/srsue.dir/metrics stdout.cc.o 99%] Building CXX object srsue/src/CMakeFiles/srsue.dir/metrics_csv.cc.o [100%] Building CXX object srsenb/src/CMakeFiles/srsenb.dir/parser.cc.o [100%] Linking CXX executable srsue [100%] Building CXX object srsenb/src/CMakeFiles/srsenb.dir/enb cfg parser.cc.o [100%] Built target srsue [100%] Building CXX object srsenb/src/CMakeFiles/srsenb.dir/metrics stdout.cc.o [100%] Linking CXX executable srsenb [100%] Built target srsenb asus-medium@asusmedium-UN65H:~/Desktop/enb/build\$ make test

sudo make install

| 8 🗖 🗖 | asus-medium@asusmedium-UN65H: ~/Desktop/enb/build | | | |
|--|--|--------|----------|--|
| 439/456 | Test #439: logger_test Start 440: msg gueue test | Passed | 0.01 sec | |
| 440/456 | Test #440: msg_queue_test Start 441: test eea1 | Passed | 1.06 sec | |
| 441/456 | Test #441: test_eea1 Start 442: test_eea2 | Passed | 0.00 sec | |
| 442/456 | Test #442: test_eea2 Start 443: test f12345 | Passed | 0.00 sec | |
| 443/456 | Test #443: test_f12345 Start 444: phy_dl_test | Passed | 0.00 sec | |
| 444/456 | Test #444: phy_dl_test Start 445: rlc_am_data_test | Passed | 0.40 sec | |
| 445/456 | Test #445: rlc_am_data_test Start 446: rlc_am_control_test | Passed | 0.00 sec | |
| 446/456 | Test #446: rlc_am_control_test Start 447: rlc_am_test | Passed | 0.00 sec | |
| 447/456 | Test #447: rlc_am_test Start 448: rlc_am_stress_test | Passed | 0.20 sec | |
| 448/456 | Test #448: rlc_am_stress_test Start 449: rlc_um_stress_test | Passed | 5.08 sec | |
| 449/456 | Test #449: rlc_um_stress_test Start 450: rlc_tm_stress_test | Passed | 5.05 sec | |
| 450/456 | Test #450: rlc_tm_stress_test Start 451: rlc_um_data_test | Passed | 5.05 sec | |
| 451/456 | Test #451: rlc_um_data_test Start 452: rlc_um_test | Passed | 0.00 sec | |
| 452/456 | Test #452: rlc_um_test Start 453: metrics_test | Passed | 0.03 sec | |
| 453/456 | Test #453: metrics_test Start 454: usim_test | Passed | 2.00 sec | |
| 454/456 | Test #454: usim_test Start 455: rrc_reconfig_test | Passed | 0.00 sec | |
| 455/456 | Test #455: rrc_reconfig_testStart 456: nas_test | Passed | 0.00 sec | |
| 456/456 | Test #456: nas_test | Passed | 0.02 sec | |
| 100% tests passed, 0 tests failed out of 456 | | | | |
| Total Test time (real) = 98.16 sec asus-medium@asusmedium-UN65H:~/Desktop/enb/build\$ sudo make install | | | | |
| | | | | |

sudo Idconfig

😕 😑 🗉 🛛 ue@ue-X580VD: ~/Desktop/srsLTE/build

ue@ue-X580VD:~/Desktop/srsLTE/build\$ sudo ldconfig

•#完成編譯過程

| 😣 🖻 💿 asus-medium@asusmedium-UN65H: ~/Desktop/enb/build |
|---|
| Up-to-date: /usr/local/include/srslte/common/trace.h |
| Installing: /usr/local/lib/libsrsite_asn1.a |
| Installing: /usr/local/lib/libsrslte_common.a |
| Installing: /usr/local/lb/lbsrslte_pny.a |
| Instatting: /usi/local/tu/tub/siste_i.so |
| - Tostalling /us//us//tostal/to/itostate adio a |
| - Installing, /us//usa//tb/tbs/stte_noter a |
| - Installing: /usr/local/include/srslte/version.h |
| - Up-to-date: /usr/local/share/srsite/ue.conf.example |
| Installing: /usr/local/bin/srsue |
| Set runtime path of "/usr/local/bin/srsue" to "" |
| Up-to-date: /usr/local/bin/srsue |
| Installing: /usr/local/lib/libsrsue_phy.a |
| Installing: /usr/local/lib/libsrsue_mac.a |
| Installing: /usr/local/lib/libsrsue_upper.a |
| Up-to-date: /usr/local/share/srslte/enb.conf.example |
| Up-to-date: /usr/local/share/srsite/drp.conf.example |
| Up-to-date: /usr/local/share/srsite/rr.conf.example |
| up-to-date: /us//tocal/share/sistle/sto.com.example |
| Set runtime path of "/usc/local/bin/scsenb" to "" |
| - In-to-date: /usr/local/bin/srsenb |
| - Installing: /usr/local/ib/libsrsenb_phy.a |
| Installing: /usr/local/lib/libsrsenb mac.a |
| Installing: /usr/local/lib/libsrsenb_upper.a |
| Up-to-date: /usr/local/share/srslte/epc.conf.example |
| Up-to-date: /usr/local/share/srslte/mbms.conf.example |
| Up-to-date: /usr/local/share/srslte/user_db.csv.example |
| Up-to-date: /usr/local/bin/srsepc_if_masq.sh |
| Installing: /usr/local/bin/srsepc |
| Set runtime path of "/usr/local/bin/srsepc" to "" |
| Installing: /usr/local/bin/srsmbms |
| Set functive path of /usi/total/bit/sistems to |
| - Tostalling, Just Jocal/ib/lib/seer me a |
| - Installing: /us/local/ib/libsrsec.bs.a |
| Installing: /usr/local/lib/libsrspc_sgw.a |
| Installing: /usr/local/lib/libsrsepc_mbms_gw.a |
| asus-medium@asusmedium-UN65H:~/Desktop/enb/build\$ |
| |

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gedit /path/to/srsepc/epc.conf

😣 亘 💷 🛛 asus-medium@asusmedium-UN65H: ~

asus-medium@asusmedium-UN65H:~\$ gedit Desktop/enb/srsepc/epc.conf

修改 mme_bind_addr



修改 gtpu_bind_addr



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修改 eNB conf 檔

| **** | *####### | ######## | *######## | *######## | ##### |
|---|------------|----------|--------------|-----------|--------|
| [enb] | | | | | |
| enb_id = 0x19B | | | | | |
| cell_id = 0x01 | | | | | |
| phy_cell_id = 1 | | | | | |
| tac = 0x0007 | 收注二 | 個addr | 邦 铅 为 | 197 0 0 | 1 |
| мсс = 001 | 府坦二 | Mauui | 即政网 | 121.0.0 | · 1 |
| mnc = 01 | | | | | |
| mme_addr = 127.0.0. | 1 | | | | |
| gtp_bind_addr = 127 | 7.0.0.1 | | | | |
| s1c_bind_addr = 127 | 7.0.0.1 | | | | |
| n_prb = 25 | | | | | |
| #tm = 4 | | | | | |
| #nof_ports = 2 | | | | | |
| | | | | | |
| ####################################### | ***** | ######## | *######## | *######## | ###### |
修改 x2_addr

• #enb1及enb2皆需要更改

| ####################################### | **** |
|---|---------------|
| [expert] | |
| <pre>#pdsch_max_its = 4</pre> | |
| <pre>#nof_phy_threads = 2</pre> | |
| <pre>#pregenerate_signals = false</pre> | |
| <pre>#tx_amplitude = 0.6</pre> | x2 bind addr |
| <pre>#link_failure_nof_err = 50</pre> | |
| <pre>rrc_inactivity_timer = 6000000</pre> | 议局日口内病的加加 |
| <pre>#max_prach_offset_us = 30</pre> | |
| #enable_mbsfn <u>= false</u> | |
| x2_bind_addr = 192.168.128.101 | x2_senb_addr |
| $x2_senb_addr = 192.168.128.100$ | 設為另一個eNB內網的網址 |
| | |

編輯 lwaap_entity.h 檔案

gedit /path/to/srsLTE/lib/include/srslte/upper/lwaap_entity.h



Outline

- 實驗目的及實驗內容
- •5G Emulator-nukxDC(ee) 實驗環境
 - srsLTE Small Cell 架構
 - 軟硬體環境
- •5G Emulator-nukxDC(ee) 網路實驗平台建置
 - 安裝基礎 srsLTE網路環境
 - 設定srsLTE EPC
 - 設定srsLTE eNB
 - 設定srsLTE UE
- 執行程式暨測試
- 總結

編輯 lwaap.h 檔案

gedit /path/to/srsue/hdr/upper/lwaap.h

| <pre>#define WIFI_IF "enp2s0" #define ENB_MAC0 0x54 #define ENB_MAC1 0xa0 #define ENB_MAC2 0x50 #define ENB_MAC3 0xd6 #define ENB_MAC4 0x77 #define ENB_MAC5 0x3f</pre> | WLAN_IF 設為 UE 內網 網卡名稱 ENB_MAC 設為 eNB1 內網 網卡MAC_addr |
|---|--|
|---|--|

完成编譯

- 將上述檔案修改完成後,依序輸入下列指令
- cd /path/to/srsLTE/build/
- make
- sudo make install
- sudo Idconfig

asus-medium@asusmedium-UN65H: ~/Desktop/srsLTE/build asus-medium@asusmedium-UN65H:~\$ cd Desktop/srsLTE/build/ asus-medium@asusmedium-UN65H:~/Desktop/srsLTE/build\$ make ; sudo make install ; sudo ldconfig

Outline

- 實驗目的及實驗內容
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程式執行

- 順序: epc>enb1>enb2>ue
- EPC + eNB1
 - cd /path/to/srsLTE/srsepc
 - sudo srsepc_if_masq.sh dongle #請改成對外網卡名 稱
 - sudo srsepc epc.conf
 - sudo ifconfig srs_spgw_sgi mtu 1460
 - cd /path/to/srsLTE/srsenb
 - sudo srsenb enb1.conf #enb1

EPC+eNB1 - Step 1

- cd /path/to/srsLTE/srsepc
- sudo srsepc_if_masq.sh dongle #請改成對外網卡名稱
- sudo srsepc epc.conf

```
asus-medium@asusmedium-UN65H: ~/Desktop/enb/srsepc
asus-medium@asusmedium-UN65H: ~/Desktop/enb/srsepc$ sudo srsepc_if_masq.sh dongle
[sudo] password for asus-medium:
Masquerading Interface dongle
asus-medium@asusmedium-UN65H: ~/Desktop/enb/srsepc$ sudo srsepc epc.conf
--- Software Radio Systems EPC ---
Reading configuration file epc.conf...
HSS Initialized.
MME GTP-C Initialized
MME Initialized.
SP-GW Initialized.
```

查看介面

- •#當 EPC 啟動完成後,會產生一個 srs_spgw_sgi 的網卡介面
- 在終端機輸入 if config

EPC+eNB1 - Step 2

- •#開啟新的 terminal
- sudo ifconfig srs_spgw_sgi mtu 1460

asus-medium@asusmedium-UN65H: ~
asus-medium@asusmedium-UN65H:~\$ sudo ifconfig srs_spgw_sgi mtu 1460
[sudo] password for asus-medium:
asus-medium@asusmedium-UN65H:~\$

EPC+eNB1 - Step 3

- •#開啟新的 terminal
- cd /path/to/srsLTE/srsenb

• sudo srsenb enb.conf

😣 😑 💷 🛛 asus-medium@asusmedium-UN65H: ~/Desktop/enb/srsenb asus-medium@asusmedium-UN65H:~/Desktop/enb/srsenb\$ sudo srsenb enb1.conf [sudo] password for asus-medium: --- Software Radio Systems LTE eNodeB ---Reading configuration file enb1.conf... [INFO] [UHD] linux; GNU C++ version 5.4.0 20160609; Boost_105800; UHD_3.14.0.0-release Opening USRP with args: type=b200,master clock rate=30.72e6 [INF0] [B200] Detected Device: B210 [INFO] [B200] Operating over USB 3. [INFO] [B200] Initialize CODEC control... [INFO] [B200] Initialize Radio control... [INF0] [B200] Performing register loopback test... [INF0] [B200] Register loopback test passed [INF0] [B200] Performing register loopback test... [INFO] [B200] Register loopback test passed [INFO] [B200] Asking for clock rate 30.720000 MHz... [INF0] [B200] Actually got clock rate 30.720000 MHz. Setting frequency: DL=2160.0 Mhz, UL=1970.0 MHz [INF0] [B200] Asking for clock rate 23.040000 MHz... [INF0] [B200] Actually got clock rate 23.040000 MHz. Setting Sampling frequency 5.76 MHz ==== eNodeB started === Type <t> to view trace

eNB2

- cd /path/to/srsLTE/srsenb
- sudo srsenb enb.conf

😣 🕒 🗊 jin@jin-D620MT-D620SF-BM3CF: ~/Desktop/enb2/srsenb jin@jin-D620MT-D620SF-BM3CF:~/Desktop/enb2/srsenb\$ sudo srsenb enb2.conf [sudo] password for jin: --- Software Radio Systems LTE eNodeB ---Reading configuration file enb2.conf... [INF0] [UHD] linux; GNU C++ version 5.4.0 20160609; Boost 105800; UHD 3.14.0.0-r elease Opening USRP with args: type=b200,master_clock_rate=30.72e6 [INF0] [B200] Detected Device: B210 [INFO] [B200] Operating over USB 3. [INFO] [B200] Initialize CODEC control... [INFO] [B200] Initialize Radio control... [INF0] [B200] Performing register loopback test... [INFO] [B200] Register loopback test passed [INF0] [B200] Performing register loopback test... [INF0] [B200] Register loopback test passed [INFO] [B200] Asking for clock rate 30.720000 MHz... [INFO] [B200] Actually got clock rate 30.720000 MHz. Setting frequency: DL=2685.0 Mhz, UL=2565.0 MHz [INFO] [B200] Asking for clock rate 23.040000 MHz... [INF0] [B200] Actually got clock rate 23.040000 MHz. Setting Sampling frequency 5.76 MHz ==== eNodeB started === Type <t> to view trace

程式執行

- UE
 - cd /path/to/srsLTE/srsue
 - sudo srsue ue.conf
 - •#開啟新的 terminal
 - sudo route del default
 - sudo route add default gw 172.16.0.2 tun_srsue #EPC 分配給 UE 的 IP_addr

UE - Step 1

- cd /path/to/srsLTE/srs ue
- sudo srsue ue.conf

ue@ue-X580VD: ~/Desktop/ue_lwaap/srsue ue@ue-X580VD:~/Desktop/ue_lwaap/srsue\$ sudo srsue ue.conf [sudo] password for ue: Reading configuration file ue.conf... Built in Release mode using commit 0a69e56 on branch develop_ue. Buffer capacity 10240 Buffer capacity 40960 --- Software Radio Systems LTE UE ---Opening RF device with 1 RX antennas... [INFO] [UHD] linux; GNU C++ version 5.4.0 20160609; Boost_105800; UHD_3.14.0.0-r elease Opening USRP with args: type=b200,master_clock_rate=30.72e6 [INFO] [B200] Detected Device: B210 [INFO] [B200] Operating over USB 3. [INF0] [B200] Initialize CODEC control... [INFO] [B200] Initialize Radio control... [INFO] [B200] Performing register loopback test... [INFO] [B200] Register loopback test passed [INF0] [B200] Performing register loopback test... [INF0] [B200] Register loopback test passed [B200] Asking for clock rate 30.720000 MHz... [INFO] [INF0] [B200] Actually got clock rate 30.720000 MHz. LWAAP MAC 10:7b:44:23:7:ba Waiting PHY to initialize... Attaching UE... Searching cell in DL EARFCN=500, f_dl=2160.0 MHz, f_ul=1970.0 MHz Found Cell: PCI=1, PRB=25, Ports=1, CFO=1.1 KHz [INFO] [B200] Asking for clock rate 23.040000 MHz... [INF0] [B200] Actually got clock rate 23.040000 MHz. Found PLMN: Id=00101, TAC=7 Random Access Transmission: seq=0, ra-rnti=0x2 RRC Connected Random Access Complete. 這是EPC分配給 Network attach successful. IP: 172.16.0.2 Software Radio Systems LTE UE的 IP addr

UE - Step 2

- •#開啟新的 terminal
- sudo route del default
- sudo route add default gw 172.16.0.2 tun_srsue #EPC 分配給 UE 的 IP_addr

we@ue-X580VD:~
ue@ue-X580VD:~
sudo route del default
[sudo] password for ue:
ue@ue-X580VD:~\$ sudo route add default gw 172.16.0.2 tun_srsue
ue@ue-X580VD:~\$

Outline

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Ping 指令測試

- #UE 利用 USRP 傳送 ICMP 封包給 eNB1
- ping 172.16.0.1 –c 10

😣 🗐 🔲 🛛 ue@ue-X580VD: ~

```
ue@ue-X580VD:~$ sudo route del default
[sudo] password for ue:
ue@ue-X580VD:~$ sudo route add default gw 172.16.0.2 tun srsue
ue@ue-X580VD:~$ ping 172.16.0.1 -c 10
PING 172.16.0.1 (172.16.0.1) 56(84) bytes of data.
64 bytes from 172.16.0.1: icmp seq=1 ttl=64 time=1.02 ms
64 bytes from 172.16.0.1: icmp seq=2 ttl=64 time=0.813 ms
64 bytes from 172.16.0.1: icmp seq=3 ttl=64 time=1.03 ms
64 bytes from 172.16.0.1: icmp seq=4 ttl=64 time=1.30 ms
64 bytes from 172.16.0.1: icmp seq=5 ttl=64 time=0.858 ms
64 bytes from 172.16.0.1: icmp seq=6 ttl=64 time=0.996 ms
64 bytes from 172.16.0.1: icmp seq=7 ttl=64 time=1.04 ms
64 bytes from 172.16.0.1: icmp seq=8 ttl=64 time=0.844 ms
64 bytes from 172.16.0.1: icmp_seq=9 ttl=64 time=0.784 ms
64 bytes from 172.16.0.1: icmp seg=10 ttl=64 time=1.45 ms
--- 172.16.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9050ms
rtt min/avg/max/mdev = 0.784/1.015/1.457/0.208 ms
ue@ue-X580VD:~$
```

Wireshark 查看

UE Wireshark

| repping a cooping more . | | | | | | | T T Evo | ression |
|--|---|---|---|------------------|----------------|-------------|-------------|----------|
| | | | | | | | tand . Expi | ession |
| r. Time | Source | Destination | Protocol | Length Info | | | | |
| 1 0.0000000 | 0 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo (| ping) request | id=0x4a56, | seq=1/256, | ttl=64 (|
| 20.00102234 | 7 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo (| ping) reply | 1d=0x4a56, | seq=1/256, | tt1=64 (|
| 3 1.00035102 | 7 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo (| ping) request | 1d=0x4a56, | seq=2/512, | tt1=64 (|
| 4 1.00115398 | 9 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo (| ping) reply | 1d=0x4a56, | seq=2/512, | tt1=64 (|
| 5 1.31521071 | 4 1/2.16.0.2 | 8.8.8.8 | DNS | 62 Standa | rd query exter | 4 A daisy.u | buntu.com | |
| 6 2.01100624 | 9 1/2.16.0.2 | 1/2.16.0.1 | ICMP | 84 Echo (| ping) request | 1d=0x4a56, | seq=3/768, | tt1=04 (|
| 72.01200757 | 8 1/2.16.0.1 | 172.16.0.2 | ICMP | 84 Echo (| ping) reply | 1d=0x4a56, | seq=3/768, | tt1=64 (|
| 8 3.01229403 | 0 1/2.10.0.2 | 1/2.10.0.1 | ICMP | 84 Echo (| ping) request | 10-0x4a56, | seq=4/1024, | LL1=04 |
| 9 3.0135/105 | 1 1/2.16.0.1 | 172.10.0.2 | TCMP | 84 Echo (| ping) reply | 10=0x4a56, | seq=4/1024, | tt1=64 |
| 10 4.01363302 | 2 172.10.0.2 | 1/2.10.0.1 | ICMP | 84 ECNO (| ping) request | 1d=0x4a56, | seq=5/1280, | tt1=64 |
| 11 4.0144/9// | 5 1/2.16.0.1 | 172.16.0.2 | ICMP | 84 Echo (| ping) reply | 1d=0x4a56, | seq=5/1280, | tt1=64 |
| 12 5.01455313 | 4 1/2.10.0.2 | 1/2.10.0.1 | TCMP | 84 Echo (| ping) request | 10=0x4a56, | seq=0/1530, | tt1=04 |
| 13 5.01553/72 | 1 1/2.16.0.1 | 172.10.0.2 | ICMP | 84 ECho (| ping) reply | 10=0x4a56, | seq=6/1536, | tt1=64 |
| 14 6.01612538 | 2 1/2.16.0.2 | 172.16.0.1 | ICMP | 84 Echo (| ping) request | 1d=0x4a56, | seq=//1/92, | tt1=64 |
| 15 0.01/14288 | 8 172.10.0.1 | 172.10.0.2 | TOMP | 84 ECHO (| ping) repry | 10-0x4850, | seq=//1/92, | 111-04 |
| 16 7.01725019 | 5 1/2.10.0.2 | 172.10.0.1 | TCMP | 84 Echo (| ping) request | 10=0x4a56, | seq=8/2048, | tt1=64 |
| 17 7.01808228 | 4 1/2.10.0.1 | 172.10.0.2 | TCMP | 84 Echo (| ping) reply | 10=0x4a56, | seq=8/2048, | 111=04 |
| 18 8.02698602 | 4 1/2.16.0.2 | 172.10.0.1 | ICMP | 84 Echo (| ping) request | 10=0x4a56, | seq=9/2304, | 111=64 |
| 19 0.02775040 | 4 172.10.0.1 | 172.10.0.2 | TOMP | 84 Echo (| ping) reply | 10-0x4a50, | seq-9/2304, | LL1-04 |
| 20 9.05098406 | 6 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo (| ping) request | 1d=0x4a56, | seq=10/2566 | , tt1=64 |
| Frame 1: 84 bytes Raw packet data Internet Protocol Internet Control | on wire (672 bit Version 4, Src: Message Protocol | ts), 84 bytes capture 172.16.0.2, Dst: 172 | d (672 bits) on : 2.16.0.1 | interface 0 | | | | |
| 45 60 60 54 10 ac 10 00 01 20 00 00 00 00 30 14 15 16 17 340 24 25 26 27 | 4a b4 40 00 40 0 98 00 66 ab 4a 5 e0 c6 03 00 00 0 18 19 1a 1b 1c 1 28 29 2a 2b 2c 2 | 1 97 d1 ac 10 00 02 6 00 01 8f 06 15 5d 0 00 00 10 11 12 13 d 1e 1f 20 21 22 23 d 2e 2f 30 31 32 33 | ETJ.@. @ f. JV \$%&'()*+ ,/01 | · 1 "# 23 | | | | |
| Internet Control 000 45 00 00 54 010 ac 10 00 01 020 00 00 00 00 030 14 15 16 17 040 24 25 26 27 050 34 35 36 37 | Message Protocol 4a b4 40 00 40 0 88 60 66 ab 4a 5 e0 c6 03 00 00 0 18 19 1a 1b 1c 1 28 29 2a 2b 2c 2 | 1 97 d1 ac 10 00 02 6 00 01 8f 06 15 5d 0 00 00 10 11 12 13 d 1e 1f 20 21 22 23 d 2e 2f 30 31 32 33 | ETJ.@.@ f.JV \$%&'()*+ ,/01 4567 | ·] · . 23 | | | | |

eNB1 Wireshark

| Apply a display filter < | |
|---|-----|
| Apply a display filter <ctrl-></ctrl-> Expression No. Time Source Destination Protocol Length Info 1 0.600 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xFbf4 3 14.01 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xFbf4 4 23.01 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xFbf4 | |
| No. Time Source Destination Protocol Length Info 1 0.000172.16.0.2 8.8.8.8 DNS 62 Standard query 0xb7b4 2 9.008172.16.0.2 140.127.139.9 DNS 62 Standard query 0xb7b4 3 14.01172.16.0.2 8.8.8.8 DNS 62 Standard query 0xb7b4 4 23.01172.16.0.2 140.127.139.9 DNS 62 Standard query 0xb7b4 | + |
| 1 0.000 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xbe79 2 9.008 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xfbf4 3 14.01 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xfbf4 3 14.01 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xfbf4 4 23.01 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xfbf4 | F |
| 2 9.008 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xfbf4 3 14.01 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xfbf4 4 23.01 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xfbf4 | Α |
| 3 14.01 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xfbf4 4 23.01 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xfbf4 | Α |
| 4 23.01 172.16.0.2 140.127.198.9 DNS 62 Standard guery 0xfbf4 | Α |
| | Α |
| 5 26.70 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 6 26.70 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 7 27.70 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 8 27.70 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 9 28.01 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xfbf4 | Α |
| 10 28.71 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 11 28.71 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 12 29.71 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 13 29.71 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 14 30.71 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 15 30.71 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 16 31.71 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 17 31.71 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 18 32.71 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 19 32.71 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 20 33.72 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 21 33.72 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 22 34.73 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 23 34.73 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 24 35.75 172.16.0.2 172.16.0.1 ICMP 84 Echo (ping) request | .d= |
| 25 35.75 172.16.0.1 172.16.0.2 ICMP 84 Echo (ping) reply | .d= |
| 26 37.03 172.16.0.2 140.127.198.9 DNS 62 Standard query 0xb4b4 | Α |
| 27 42.03 172.16.0.2 8.8.8.8 DNS 62 Standard query 0xb4b4 | Α |
| ▶ Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits) on interface 0 Raw packet data ▶ Internet Protocol Version 4, Src: 172.16.0.2, Dst: 8.8.8.8 ▶ User Datagram Protocol Src Port: 4/287, Dst Port: 53 | |

srs_spgw_sgi: <live capture in progress>

Domain Name System (query)

Packets: 31 · Displayed: 31 (100.0%) Profile: Default

iPerf3 測試

- iperf3 –s #eNB1
- iperf3 -c 172.16.0.1 -b 100B -w 1k #UE

| u | e@ue· | -X580VD:~\$ ipe | rf3 - | c 172.16.0.1 | -b 100b -w 1k | | |
|---|-------|-----------------|-------|---------------|------------------|--------|-------------|
| С | onneo | cting to host : | 172.1 | 6.0.1, port 5 | 201 | | |
| Γ | 4] | local 172.16. | 0.2 p | ort 49278 con | nected to 172.16 | .0.1 p | ort 5201 |
| Ī | ID] | Interval | | Transfer | Bandwidth | Retr | Cwnd |
| Ē | 4] | 0.00-1.00 | sec | 3.94 KBytes | 32.3 Kbits/sec | 0 | 5.62 KBytes |
| Ē | 4] | 1.00-2.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | 0 | 5.62 KBytes |
| Ī | 4] | 2.00-3.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | 0 | 5.62 KBytes |
| Ē | 4] | 3.00-4.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | 0 | 5.62 KBytes |
| Γ | 4] | 4.00-5.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | Θ | 5.62 KBytes |
| Ē | 4] | 5.00-6.00 | sec | 2.25 KBytes | 18.4 Kbits/sec | 0 | 5.62 KBytes |
| Γ | 4] | 6.00-7.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | 0 | 5.62 KBytes |
| Ī | 4] | 7.00-8.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | 0 | 5.62 KBytes |
| Ē | 4] | 8.00-9.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | 0 | 5.62 KBytes |
| E | 4] | 9.00-10.00 | sec | 2.25 KBytes | 18.4 Kbits/sec | 0 | 5.62 KBytes |
| - | | | | | | | |
| Γ | ID] | Interval | | Transfer | Bandwidth | Retr | |
| Γ | 4] | 0.00-10.00 | sec | 28.1 KBytes | 23.0 Kbits/sec | Θ | sender |
| I | 4] | 0.00-10.00 | sec | 27.0 KBytes | 22.1 Kbits/sec | | receiver |

| 1 | × 🔿 | 🗊 asus-medium@ | þasusn | nedium-UN65H: | | |
|---|-------------------|----------------|--------|---------------|----------------------|------------|
| ā | isus-i | medium@asusmed | ium-U | N65H:~\$ iper | f3 -s | |
| | | | | | | |
| 1 | Serve | r listening on | 5201 | | | |
| | | | | | | |
| ŀ | <pre>\cceb.</pre> | ted connection | from | 172.16.0.2, | port 49276 | |
| L | 5] | local 172.16. | 0.1 p | ort 5201 con | nected to 172.16.0.2 | port 49278 |
| I | [ID] | Interval | | Transfer | Bandwidth | |
| I | 5] | 0.00-1.00 | sec | 2.25 KBytes | 18.4 Kbits/sec | |
| I | 5] | 1.00-2.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | |
| I | 5] | 2.00-3.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | |
| I | 5] | 3.00-4.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | |
| I | 5] | 4.00-5.00 | sec | 2.25 KBytes | 18.4 Kbits/sec | |
| I | 5] | 5.00-6.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | |
| I | 5] | 6.00-7.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | |
| I | 5] | 7.00-8.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | |
| I | 5] | 8.00-9.00 | sec | 2.81 KBytes | 23.0 Kbits/sec | |
| I | 5] | 9.00-10.00 | sec | 2.25 KBytes | 18.4 Kbits/sec | |
| I | 5] | 10.00-10.04 | sec | 576 Bytes | 121 Kbits/sec | |
| | | | | | | |
| I | ID] | Interval | | Transfer | Bandwidth | |
| I | 5] | 0.00-10.04 | sec | 0.00 Bytes | 0.00 bits/sec | sender |
| | 5] | 0.00-10.04 | sec | 27.0 KBytes | 22.0 Kbits/sec | receiver |
| | | | | | | |

UE iperf3

eNB1 iperf3

調配封包傳送比例

#在eNB1 的 terminal 輸入 "r"並按下" enter"
 #接著輸入11
 #比例僅能輸入整數

asus-medium@asusmedium-UN65H: ~/Desktop/enb/srsenb 💿 🕒 [INFO] [B200] Initialize CODEC control... [INFO] [B200] Initialize Radio control... [INF0] [B200] Performing register loopback test... [INFO] [B200] Register loopback test passed [INF0] [B200] Performing register loopback test... [INFO] [B200] Register loopback test passed [INFO] [B200] Asking for clock rate 30.720000 MHz... [INFO] [B200] Actually got clock rate 30.720000 MHz. Setting frequency: DL=2160.0 Mhz, UL=1970.0 MHz [INFO] [B200] Asking for clock rate 23.040000 MHz... [INF0] [B200] Actually got clock rate 23.040000 MHz. Setting Sampling frequency 5.76 MHz ==== eNodeB started === Type <t> to view trace RACH: tti=6101, preamble=0, offset=0, temp crnti=0x46 Data LCID 3 Data LCID ----- 3 LWAAP TX MAC 78:24:af:4:55:3 LWAAP add user rnti=0x46 User 0x46 connected Enter lwa ratio:1 1

Ping 指令測試

- #UE 利用 USRP 傳送 ICMP 封包給 eNB1
- ping 172.16.0.1 –c 10

😣 🗏 🔲 🛛 ue@ue-X580VD: ~

```
ue@ue-X580VD:~$ ping 172.16.0.1 -c 10
PING 172.16.0.1 (172.16.0.1) 56(84) bytes of data.
64 bytes from 172.16.0.1: icmp_seq=1 ttl=64 time=6.51 ms
64 bytes from 172.16.0.1: icmp seg=2 ttl=64 time=1.76 ms
64 bytes from 172.16.0.1: icmp seq=3 ttl=64 time=1.28 ms
64 bytes from 172.16.0.1: icmp seq=4 ttl=64 time=0.721 ms
64 bytes from 172.16.0.1: icmp seq=5 ttl=64 time=1.73 ms
64 bytes from 172.16.0.1: icmp seq=6 ttl=64 time=1.40 ms
64 bytes from 172.16.0.1: icmp seq=7 ttl=64 time=2.22 ms
64 bytes from 172.16.0.1: icmp seq=8 ttl=64 time=1.46 ms
64 bytes from 172.16.0.1: icmp seq=9 ttl=64 time=1.76 ms
64 bytes from 172.16.0.1: icmp seq=10 ttl=64 time=1.94 ms
--- 172.16.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9030ms
rtt min/avg/max/mdev = 0.721/2.081/6.518/1.529 ms
ue@ue-X580VD:~$
```

Wireshark 查看

UE Wireshark

| | <ceri-></ceri-> | | | | | | Exp | ression |
|--|--|---|--|------------------|----------------|------------|-------------|-----------|
| Time | Source | Destination | Protocol | Length Info | | | | |
| 10.00000000 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seg=1/256, | ttl=64 (|
| 2 0.006510806 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=1/256, | ttl=64 () |
| 3 1.001561301 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=2/512, | ttl=64 (|
| 4 1.003317077 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=2/512, | ttl=64 () |
| 5 2.003400158 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=3/768, | ttl=64 (|
| 6 2.004660939 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=3/768, | ttl=64 () |
| 7 3.004741225 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=4/1024, | , ttl=64 |
| 8 3.005452262 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=4/1024, | , ttl=64 |
| 9 4.022341708 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=5/1280, | , ttl=64 |
| 10 4.024044875 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=5/1280, | , ttl=64 |
| 11 5.024160584 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=6/1536, | , ttl=64 |
| 12 5.025555250 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=6/1536, | , ttl=64 |
| 13 6.025682477 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=7/1792, | , ttl=64 |
| 14 6.027898089 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | 1d=0x4a90, | seq=7/1792, | ttl=64 |
| 15 7.027016439 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=8/2048, | , ttl=64 |
| 16 7.028465698 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=8/2048, | , ttl=64 |
| 17 8.028583339 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | 1d=0x4a90, | seq=9/2304, | tt1=64 |
| 18 8.030332587 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | 1d=0x4a90, | seq=9/2304, | tt1=64 |
| 19 9.030425657 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x4a90, | seq=10/2566 |), ttl=64 |
| 20 9.032352766 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x4a90, | seq=10/2566 | a, ttl=64 |
| aw packet data nternet Protocol nternet Control M | Version 4, Src: 17 Message Protocol | 2.16.0.2, Dst: 172.10 | 3.0.1 | Interrace o | | | | |
| 0 45 00 00 54 a 0 ac 10 00 01 0 0 00 00 00 00 0 14 15 16 17 1 24 25 26 27 2 34 55 36 37 | 9 b1 40 00 40 01 3 8 00 7c b5 4a 90 0 c 82 02 00 90 00 0 8 19 1a 1b 1c 1d 1 8 29 2a 2b 2c 2d 2 | H8 d4 ac 10 00 02 E H8 01 1e 07 15 5d - H8 00 10 11 12 13 - H8 00 10 11 12 13 - H8 1f 20 21 22 23 - H8 2f 30 31 32 33 S | T (0) (0.8 J %&'()*+ ,/0: 567 | -] "# 123 | | | | |

eNB1 Wireshark

| 8 🔿 🤇 | Capturing | g from srs_spgw_sgi | | | | | |
|--------------|---------------------------------------|---|-------------------|-------------------|------------------|--------------------|---------|
| | 1 🖉 💿 | | <>> > + | - | | | |
| App | ly a display fi | ilter <ctrl-></ctrl-> | | | | Expression | on + |
| No. | Time | Source | Destination | Protocol | Length Info | | |
| | 1 0.000 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x |
| 4 | 2 0.000 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x |
| | 3 1.002 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x… |
| | 4 1.002 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x |
| | 5 2.003 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x |
| | 6 2.003 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | 1d=0x |
| | 7 3.004 | 1/2.16.0.2 | 1/2.16.0.1 | ICMP | 84 Echo | (ping) request | 1d=0x |
| | 8 3.004 | 172.16.0.2 | 172.10.0.2 | TCMP | 84 Echo | (ping) reply | id=0x |
| | 94.022 | 172.10.0.2 | 172.10.0.1 | TCMP | 84 Echo | (ping) request | 10=0x |
| | 11 5 024 | 172.10.0.1 | 172.10.0.2 | TCMP | 84 Echo | (ping) request | id=0x |
| | 12 5 024 | 172.16.0.1 | 172.10.0.1 | TCMP | 84 Echo | (ping) request | id=0x |
| | 13 6 026 | 172 16 0 2 | 172 16 0 1 | TCMP | 84 Echo | (ping) request | id=0x |
| | 14 6.026 | 172.16.0.1 | 172.16.0.2 | TCMP | 84 Echo | (ning) renly | id=0x |
| | 15 7.027 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x |
| | 16 7.027 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x |
| | 17 8.029 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x |
| | 18 8.029 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x |
| | 19 9.030 | 172.16.0.2 | 172.16.0.1 | ICMP | 84 Echo | (ping) request | id=0x |
| L | 20 9.031 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo | (ping) reply | id=0x |
| ▶ Fra Raw | me 1: 84 b packet da ernet Prot | bytes on wire (672 bits) Ita Jacol Version 4. Src: 13 | 7, 84 bytes captu | red (672 bits) on | interface G | 9 | |
| ▶ Int | ernet Cont | rol Message Protocol | 2.10.0.2, 031. 1 | | | | |
| 0 7 | srs_spgw_s | gi: <live capture="" in="" progress=""></live> | | Packets: 20 · | Displayed: 20 (1 | 100.0%) Profile: [| Default |

Wireshark 查看

eNB2 Wireshark 收封包情況

eNB2 Wireshark 送封包情況

| 8 🗇 🕫 Capturing from eth0 | 😢 🗇 🗊 Capturing from eth0 | |
|---|---|--|
| 📶 🗖 🖉 🗎 🖺 🖄 🗳 🔍 🗸 💙 🐎 🛏 🚍 📃 🖄 🖉 🖬 🔛 | 📶 🔳 🖉 🐵 🖆 🎦 🏹 🗳 🖌 🔸 🦊 🐥 👘 🗮 🕘 🖉 🖽 🏢 | |
| 🛙 gtp 🛛 🗠 🔹 Expression 🕴 + | 📕 eth.addr == 10:7b:44:23:07:ba 🛛 🖉 📼 🔹 Expression + | |
| No. Time Source Destination Protocol Length Info | No. Time Source Destination Protocol Length Info | |
| 165 166 3526222. 192.168 128.108 GTF <0x807c> 136 PFP Unknown (0x807c) 167 162.3559822. 192.168 182.181 192.168 128.101 GTF <0x807c> 136 PFP Unknown (0x807c) 170 164.3755283. 192.168 128.101 192.168 128.100 GTF <0x8080c> 136 PFP Unknown (0x8080) 173 166.3793961. 192.168 128.101 192.168 128.100 GTF <0x8082> 136 PFP Unknown (0x8080) 173 166.3793961. 192.168 128.100 GTF<<0x8082> 136 PFP Unknown (0x8082) 176 168 3819434. 192.108 128.100 GTF<<0x8084> 136 PFP Unknown (0x8084) | 12 4.526631389 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9865 101 Ethernet II 14 6.52481117 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9865 101 Ethernet II 17 8.544238927 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9865 101 Ethernet II 20 10.54890329 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9865 101 Ethernet II 20 10.54890329 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9865 101 Ethernet II 21 11.778640171 192.168 124.0.0.251 MDNS 168 Ethernet II 23 12.559589248 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9865 101 Ethernet II | |
| <pre>> Frame 165: 136 bytes on wire (1088 bits), 136 bytes captured (1088 bits) on interface 0 > Ethernet II, Src: AssustekC 04:55:03 (78:24:af:04:55:03), Dst: AssustekC cb:12:fb (d0:17:c2:cb:12:fb) > Internet Protocol Version 4, Src: 192.168.128.01, Dst: 192.168.128.100 > User Datagram Protocol, Src Port: 2152, Dst Port: 2152 > GPRS Tunneling Protocol > Point-to-Point Protocol > Data (84 bytes)</pre> | ▶ Frame 12: 101 bytes on wire (808 bits), 101 bytes captured (808 bits) on interface 0 ▶ Ethernet II, Src: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb), Dst: AsustekC_23:07:ba (10:7b:44:23:07:ba) ▶ Data (87 bytes) | |
| 00000 d0 17 02 60 10 <td< td=""><td>0000 19.7b 44.23 07 ball 17.2 ch 12.7b 16.7b 17.7b 18.7b 17.7b 18.7b 17.7b 18.7b <th 18.7b<="" <="" td=""></th></td></td<> | 0000 19.7b 44.23 07 ball 17.2 ch 12.7b 16.7b 17.7b 18.7b 17.7b 18.7b 17.7b 18.7b 18.7b <th 18.7b<="" <="" td=""></th> | |

iPerf3 測試

- iperf3 –s #eNB1
- iperf3 -c 172.16.0.1 -b 100B -w 1k #UE

| ue@ue-X580VD:-\$ iperf3 -c 172.16.0.1 - Connecting to host 172.16.0.1, port 520 [4] local 172.16.0.2 port 49282 conno [ID] Interval Transfer [4] 0.00-1.00 sec 3.94 KBytes [4] 1.00-2.00 sec 2.81 KBytes [4] 2.00-3.00 sec 2.81 KBytes [4] 3.00-4.00 sec 2.81 KBytes [4] 3.00-5.00 sec 2.81 KBytes [4] 5.00-6.00 sec 2.25 KBytes [4] 5.00-6.00 sec 2.81 KBytes [4] 7.00-8.00 sec 2.81 KBytes [4] 8.00-9.00 sec 2.81 KBytes | b 100b -w 1k 01 ected to 172.16.0.1 port 5201 Bandwidth Retr Cwnd 32.3 Kbits/sec 0 5.62 KBytes 23.0 Kbits/sec 0 5.62 KBytes 23.0 Kbits/sec 0 5.62 KBytes 23.0 Kbits/sec 0 5.62 KBytes 18.4 Kbits/sec 0 5.62 KBytes 23.0 Kbits/sec 0 5.62 KBytes | Server listening on 5201 Accepted connection from 172.16.0.2, port 49280 [5] local 172.16.0.1 port 5201 connected to 172.16.0.2 port 49282 [ID] Interval Transfer Transfer Bandwidth [5] 1.00-2.00 sec 2.25 KBytes 18.4 Kbits/sec [5] 2.00-3.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 3.00-4.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 4.00-5.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 5.00-6.00 sec 2.25 KBytes 18.4 Kbits/sec [5] 5.00-6.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 6.00-7.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 6.00-7.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 7.00-8.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 7.00-9.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 7.00-9.00 sec 2.81 KBytes 23.0 Kbits/sec [5] 8.00-9.00 sec 2.81 KBytes 23.0 Kbits/sec |
|---|--|---|
| [4] 9.00-10.00 sec 2.81 KBytes 2 | 23.0 Kbits/sec 0 5.62 KBytes | [5] 9.00-10.00 sec 2.25 KBytes 18.4 Kbits/sec [5] 10.00-10.04 sec 576 Bytes 118 Kbits/sec |
| [ID] Interval Transfer [[4] 0.00-10.00 sec 28.7 KBytes 2 [4] 0.00-10.00 sec 27.0 KBytes 2 | Bandwidth Retr 23.5 Kbits/sec 0 sender 22.1 Kbits/sec receiver | [ID] Interval Transfer Bandwidth [5] 0.00-10.04 sec 0.00 bits/sec sender [5] 0.00-10.04 sec 27.0 KBytes 22.0 Kbits/sec receive |



eNB1 iperf3

Wireshark 查看

UE Wireshark

eNB1 Wireshark

| 8 🔿 🖸 | Capturing from tu | In_srsue | | | | | |
|--------|-----------------------|------------------------|--------------------|-------------------------|-------------------------------------|-------------------------------------|------------|
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| App | ly a display filter < | Ctrl-/> | | | | 📼 👻 Expre | ssion + |
| No. | Time | Source | Destination | Protocol | ength Info | | 6 |
| - | 1 0.000000000 | 172.16.0.2 | 172.16.0.1 | TCP | 60 49280 → 5201 | [SYN] Seg=0 Win=29200 Len=0 MSS | =1460 S |
| | 2 0.001159631 | 172.16.0.1 | 172.16.0.2 | TCP | 60 5201 → 49280 | [SYN, ACK] Seg=0 Ack=1 Win=2896 | 9 Len=0 |
| | 3 0.001187893 | 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 5201 | [ACK] Seg=1 Ack=1 Win=29696 Len | =0 TSva |
| | 4 0.001220858 | 172.16.0.2 | 172.16.0.1 | TCP | 89 49280 → 5201 | [PSH, ACK] Seq=1 Ack=1 Win=2969 | 5 Len=3 |
| | 5 0.002179330 | 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49280 | [ACK] Seq=1 Ack=38 Win=29696 Let | n=0 TSv |
| | 6 0.002577125 | 172.16.0.1 | 172.16.0.2 | TCP | 53 5201 → 49280 | [PSH, ACK] Seq=1 Ack=38 Win=296 | 96 Len= |
| | 7 0.002580274 | 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 520 1 | [ACK] Seq=38 Ack=2 Win=29696 Let | n=0 TSv |
| | 8 0.002626162 | 172.16.0.2 | 172.16.0.1 | TCP | 56 49280 → 5201 | [PSH, ACK] Seq=38 Ack=2 Win=296 | 96 Len= |
| | 9 0.046130571 | 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49280 | [ACK] Seq=2 Ack=42 Win=29696 Le | n=0 TSv |
| | 10 0.046142609 | 172.16.0.2 | 172.16.0.1 | TCP | 164 49280 → 5201 | [PSH, ACK] Seq=42 Ack=2 Win=296 | 36 Len= |
| | 11 0.047245753 | 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49280 | [ACK] Seq=2 ACK=154 W1n=29696 L | en=⊎ TS |
| | 12 0.047252709 | 172.10.0.1 | 172.10.0.2 | TCP | 53 5201 - 49280 60 40383 - 5301 | [PSH, ACK] SEQ-2 ACK-154 WIN-29 | 1460 CA |
| | 14 0 049127520 | 172.10.0.2 | 172.10.0.1 | TCP | 60 5201 - 49282 | [STN] Seq=0 Will=1152 Lell=0 M35=. | Len=0 |
| | 15 0 048134616 | 172.16.0.2 | 172.16.0.1 | TCP | 52 49282 - 5201 | [ACK] Seg=1 Ack=1 Win=1152 Len= | A TSval |
| | 16 0.048188765 | 172.16.0.2 | 172.16.0.1 | TCP | 89 49282 → 5201 | [PSH, ACK] Seg=1 Ack=1 Win=1152 | Len=37 |
| | 17 0.048842744 | 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 | [ACK] Seg=1 Ack=38 Win=1115 Len | =0 TSva |
| | 18 0.090452241 | 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 5201 | [ACK] Seg=154 Ack=3 Win=29696 L | en=0 TS |
| | 19 0.091407141 | 172.16.0.1 | 172.16.0.2 | TCP | 54 5201 → 49280 | [PSH, ACK] Seg=3 Ack=154 Win=29 | 696 Len |
| | 20 0.091412820 | 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 5201 | [ACK] Seq=154 Ack=5 Win=29696 L | en=0 TS |
| | 21 0.298496502 | 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 | [PSH, ACK] Seq=38 Ack=1 Win=115 | 2 Len=5 |
| | 22 0.299634002 | 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 | [ACK] Seq=1 Ack=614 Win=539 Len: | =0 TSva |
| | 23 0.299945633 | 172.16.0.1 | 172.16.0.2 | TCP | 52 [TCP Window L | Jpdate] 5201 → 49282 [ACK] Seq=1 | Ack=61 |
| | 24 0.506474861 | 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 | [PSH, ACK] Seq=614 Ack=1 Win=11 | 52 Len= |
| | 25 0.508174739 | 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 | [ACK] Seq=1 Ack=1190 Win=1152 L | an=0 TS |
| | 26 0.714724939 | 172.16.0.2 | 1/2.16.0.1 | TCP | 628 49282 → 5201 | [PSH, ACK] Seq=1190 ACK=1 Win=1 | 152 Len |
| | 27 0.710257104 | 172.10.0.1 | 172.10.0.2 | TCP | 52 5201 → 49282 639 40393 → 5301 | [ACK] Seq=1 ACK=1706 W1R=1152 L | 3n=0 TS |
| | 20 0.922354900 | 172.10.0.2 | 172.10.0.1 | TCP | 52 5201 - 49282 | [ACK] Seg=1 Ack=2342 Win=1152 L | en=0 TS |
| h Eror | ne 1: 60 bytes o | n wire (480 hits) 60 | bytes centured (/ | 180 hits) on i | nterface @ | TACKT OCU-1 ACK-2042 WIN-1102 E | |
| Raw | nacket data | 11 WITE (400 DICS), 00 | bytes captured (* | +00 01(5) 011 1 | incernace o | | |
| ▶ Inte | ernet Protocol Ve | ersion 4, Src: 172,16 | .0.2. Dst: 172.16. | .0.1 | | | |
| ▶ Trar | nsmission Control | 1 Protocol, Src Port: | 49280, Dst Port: | 5201, Seq: 0, | Len: 0 | | |
| | | | | | | | |
| | | | | | | | |
| 0000 | 45 00 00 3c 00 | 90 40 00 40 06 e2 08 | ac 10 00 02 E | ·<··@· @··· | | | |
| | ac 10 00 01 c0 | 80 14 51 3c 33 6f 8c | 00 00 00 00 | ····Q <30···· | | | |
| | a0 02 72 10 80 | 03 00 00 02 04 05 04 | 1 04 02 08 0a ·· | F · C · · · · · · · · · | | | |
| 0030 | 00 35 63 17 00 | 00 00 00 01 03 03 00 | · · · · · | | | | |
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| | | | | | | | |
| 0 7 | Bytes 12-15: Source | (ip.src) | | | Packets: 13 | 7 · Displayed: 137 (100.0%) Profile | e: Default |

| App | ly a display filter <ctrl-></ctrl-> | | | Expression |
|-----|-------------------------------------|-------------|----------|-----------------------------|
| | Time Source | Destination | Protocol | Length Info |
| | 1 0.000 172.16.0.2 | 172.16.0.1 | TCP | 60 49280 → 5201 [SYN] Seq= |
| | 2 0.000 172.16.0.1 | 172.16.0.2 | TCP | 60 5201 → 49280 [SYN, ACK] |
| | 3 0.001 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 5201 [ACK] Seq= |
| | 4 0.001 172.16.0.2 | 172.16.0.1 | TCP | 89 49280 → 5201 [PSH, ACK] |
| | 5 0.001 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49280 [ACK] Seq= |
| | 6 0.001 172.16.0.1 | 172.16.0.2 | TCP | 53 5201 → 49280 [PSH, ACK] |
| | 7 0.002 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 5201 [ACK] Seq= |
| | 8 0.002 172.16.0.2 | 172.16.0.1 | TCP | 56 49280 → 5201 [PSH, ACK] |
| | 9 0.045 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49280 [ACK] Seq= |
| | 10 0.046 172.16.0.2 | 172.16.0.1 | TCP | 164 49280 → 5201 [PSH, ACK] |
| | 11 0.046 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49280 [ACK] Seq |
| | 12 0.046 172.16.0.1 | 172.16.0.2 | TCP | 53 5201 → 49280 [PSH, ACK] |
| | 13 0.047 172.16.0.2 | 172.16.0.1 | TCP | 60 49282 → 5201 [SYN] Seq= |
| | 14 0.047 172.16.0.1 | 172.16.0.2 | TCP | 60 5201 → 49282 [SYN, ACK] |
| | 15 0.047 172.16.0.2 | 172.16.0.1 | TCP | 52 49282 → 5201 [ACK] Seq= |
| | 16 0.048 172.16.0.2 | 172.16.0.1 | TCP | 89 49282 → 5201 [PSH, ACK] |
| | 17 0.048 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seq= |
| | 18 0.090 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 5201 [ACK] Seq= |
| | 19 0.090 172.16.0.1 | 172.16.0.2 | TCP | 54 5201 → 49280 [PSH, ACK] |
| | 20 0.091 172.16.0.2 | 172.16.0.1 | TCP | 52 49280 → 5201 [ACK] Seq |
| | 21 0.298 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 22 0.298 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 23 0.298 172.16.0.1 | 172.16.0.2 | TCP | 52 [TCP Window Update] 526 |
| | 24 0.506 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 25 0.507 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 26 0.714 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 27 0.715 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 28 0.922 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 29 0.922 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 30 1.130 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 31 1.130. 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 32 1.338 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 33 1.338 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 34 1.546 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 35 1.546 172.16.0.1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 36 1.754 172.16.0.2 | 172.16.0.1 | TCP | 628 49282 → 5201 [PSH, ACK] |
| | 37 1 754 172 16 0 1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 38 1.962 172.16.0 2 | 172.16.0 1 | TCP | 628 49282 → 5201 [PSH ACK] |
| | 39 1.962 172.16.0 1 | 172.16.0.2 | TCP | 52 5201 → 49282 [ACK] Seg |
| | 40 2 170 172 16 0 2 | 172 16 0 1 | TCP | 628 49282 - 5201 [PSH ACK] |

Transmission Control Protocol, Src Port: 49280, Dst Port: 5201, Seq: 0, Len: 0

Srs_spgw_sgi: <live capture in progress>
 Packets: 137 · Displayed: 137 (100.0%) Profile: Default

Wireshark 查看

Capturing from eth

eNB2 Wireshark 收封包情況

| 0 0 0 | capturing from e | 1110 | | | |
|--------------|---------------------|-----------------------|---------------------|---|---------------------------------|
| | 0 🗋 | 🗎 🕅 🏹 🌾 | > 🗲 🛏 🦨 | | |
| 📕 gtp | | | | | Expression + |
| No. | Time | Source | Destination | Protocol Length Info | 8 |
| | 23 5.838488323 | 192.168.128.101 | 192.168.128.100 | GTP <0x8096> 104 PPP | Unknown (0x8096) |
| | 25 6.254447287 | 192.168.128.101 | 192.168.128.100 | GTP <0x8098> 104 PPP | Unknown (0x8098) |
| | 27 6.670459665 | 192.168.128.101 | 192.168.128.100 | GTP <0x809a> 104 PPP | Unknown (0x809a) |
| | 29 7.086869429 | 192.168.128.101 | 192.168.128.100 | GTP <0x809c> 104 PPP | Unknown (0x809c) |
| | 31 7.503186998 | 192.108.128.101 | 192.108.128.100 | GTP <0X809e> 104 PPP | Unknown (0x809e) |
| | 36 8.335646233 | 192.168.128.101 | 192.168.128.100 | GTP <0x80a2> 104 PPP | Unknown (0x80a2) |
| | 38 8,751092726 | 192,168,128,101 | 192.168.128.100 | GTP <0x80a4> 104 PPP | Unknown (0x80a4) |
| | 40 9.166891569 | 192.168.128.101 | 192.168.128.100 | GTP <0x80a6> 104 PPP | Unknown (0x80a6) |
| | 44 9.582870889 | 192.168.128.101 | 192.168.128.100 | GTP <0x80a8> 104 PPP | Unknown (0x80a8) |
| | 46 9.999215686 | 192.168.128.101 | 192.168.128.100 | GTP <0x80aa> 104 PPP | Unknown (0x80aa) |
| | 48 10.415837934 | 192.168.128.101 | 192.168.128.100 | GTP <0x80ac> 104 PPP | Unknown (0x80ac) |
| | 50 10.83005/91/ | 192.168.128.101 | 192.108.128.100 | GTP <0x80ae> 104 PPP | Unknown (0x80ae) |
| | 55 11 663151544 | 192.100.120.101 | 192.108.128.100 | GTP <0X80002 104 PPP | Unknown (0x80b0) |
| | 57 12.079068232 | 192.168.128.101 | 192.168.128.100 | GTP <0x80b4> 104 PPP | Unknown (0x80b2) |
| | 59 12.495957731 | 192.168.128.101 | 192.168.128.100 | GTP <0x80b6> 104 PPP | Unknown (0x80b6) |
| | 61 12.910734875 | 192.168.128.101 | 192.168.128.100 | GTP <0x80b8> 104 PPP | Unknown (0x80b8) |
| | 63 13.327063160 | 192.168.128.101 | 192.168.128.100 | GTP <0x80ba> 104 PPP | Unknown (0x80ba) |
| | 65 13.742965265 | 192.168.128.101 | 192.168.128.100 | GTP <0x80bc> 104 PPP | Unknown (0x80bc) |
| | 68 14.159481085 | 192.168.128.101 | 192.168.128.100 | GTP <0x80be> 104 PPP | Unknown (0x80be) |
| | 70 14.384053100 | 192.168.128.101 | 192.168.128.100 | GTP <0X80C0> 104 PPP | Unknown (0x80c0) |
| | 72 14.425420540 | 192.100.120.101 | 192.100.120.100 | GTP <0X80C2> 104 PPP GTP <0X80C4> 108 PPP | |
| | 76 14.471141819 | 192.168.128.101 | 192.168.128.100 | GTP <0x80c6> 104 PPP | Unknown (0x80c6) |
| L | 78 14.590559802 | 192.168.128.101 | 192.168.128.100 | GTP <0x80c8> 92 PPP | Unknown (0x80c8) |
| ▶ Fran | ne 31: 104 bytes | on wire (832 bits), | 104 bytes captured | l (832 bits) on interface | 0 |
| ► Ethe | ernet II, Src: A | sustekC_04:55:03 (78 | :24:af:04:55:03), [| ost: AsustekC_cb:12:fb (d0 | :17:c2:cb:12:fb) |
| ▶ Inte | ernet Protocol V | /ersion 4, Src: 192.1 | 68.128.101, Dst: 19 | 02.168.128.100 | |
| ▶ User | Datagram Proto | col, Src Port: 2152, | Dst Port: 2152 | | |
| ► GPR: | s Tunneling Prot | 0001 | | | |
| POIL | (52 hytes) | .0001 | | | |
| P Duce | (02 by:03) | | | | |
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| | | | | | |
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| | | | | | |
| | | | | | |
| | d0 17 c2 cb 12 | fb 78 24 af 04 55 | 03 08 00 45 00 ··· | · · · · x\$ · · U · · · E · | |
| | 00 5a 41 13 40 | 00 40 11 77 65 c0 | a8 80 65 c0 a8 Z | A·@·@· we···e·· | |
| | 80 64 08 68 08 | 68 00 46 12 a5 30 | Ff 00 36 00 46 ·d | $h \cdot h \cdot F \rightarrow 0 \cdot 6 \cdot F$ | |
| | 00 03 80 9e 45 | 00 00 34 5f a0 40 | 00 40 06 83 00 | ··E··4@·@··· | |
| | ac 10 00 01 ac | 10 00 02 14 51 00 | 02 54 89 45 49 ··· | Q. I.EI | |
| | 3d 2d c4 d5 86 | 5b f6 01 | =- | [| |
| | | | | | |
| 07 | eth0: clive capture | in progress> | | Packets: 122 . Display | ed: 34 (27.9%) Profile: Default |

eNB2 Wireshark 送封包情況

| No. Time Source Destination Protocol Length Info 17 5.43244338 AsustekC_D:12:Th AsustekC_23:07:ba Sve665 77 Ethernet II 19 5.433065035 AsustekC_D:12:Th AsustekC_23:07:ba Sve665 70 Ethernet II 21 5.473465044 AsustekC_23:07:ba Sve665 77 Ethernet II 23 5.27345064 AsustekC_23:07:ba AsustekC Sve665 71 Ethernet II 25 5.273450604 AsustekC_23:07:ba AsustekC Sve665 60 Ethernet II 26 5.73450604 AsustekC_23:07:ba Sve665 60 Ethernet II 36 7.34647250 AsustekC_23:07:ba Sve665 60 Ethernet II 36 7.34647250 AsustekC_23:07:ba Sve665 60 Ethernet II 48 6.6073704 AsustekC_23:07:ba Sve665 60 Ethernet II 49 8.6137264 AsustekC_23:07:ba Sve665 60 Ethernet II | o. 17 19 21 23 25 | Time 5.432443938 | | | | | as as contraction |
|--|----------------------------------|----------------------------|---------------------|----------------------|-------------|---------------------|-------------------|
| 17 5.43244393 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 77 Ethernet II 21 5.478515642 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 70 Ethernet II 23 5.47469354 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 77 Ethernet II 23 5.47469345 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 77 Ethernet II 27 5.73245822 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 77 Ethernet II 30 6.14756851 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 70 Ethernet II 33 6.14756851 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 34 6.0270274 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 34 6.02707479 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 44 0.4343097 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 44 9.662173704 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 44 9.662173794 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 44 9.662173794 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 49 9.68173704 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 49 9.68173704 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 49 9.68173704 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 10.37075158 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 19.37075158 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 19.37705158 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 10.37705158 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 10.37705158 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 10.37720519 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 10.37720519 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 51 1.38720819 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 64 12.38722091 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 64 12.38722919 AsustekC_b12:fb AsustekC_3107:ba 0x9e55 69 Ethernet II 6 | 17 19 21 23 25 | 5.432443938 | Source | Destination | Protocol | Length Info | |
| 195.43366563 Asustekc_b12:fb Asustekc_23:07:ba Asustekc_23:07:ba Asustekc_23:07:ba Asustekc_b12:fb Asustekc_b1 | 19 21 23 25 | | AsustekC_cb:12:fb | AsustekC_23:07:ba | 0x9e65 | 77 Ethernet | II |
| 215.470516042 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 255.470570554 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 71 Ethernet II 275.7325429325 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 71 Ethernet II 366.14756051 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 376.732507553 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 367.394637250 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 367.394637250 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 486.027027879 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 498.027027879 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 498.027027879 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 498.027027879 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 499.060173704 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 499.060173704 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 499.051770515 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 499.051770515 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5110.397075158 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5110.397075158 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5110.39705158 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5111.350590051 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5511.3520324383 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5511.3520324383 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5511.3520304383 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5511.3520304383 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 5511.3520304383 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 511.55590401 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 511.555904534 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 611.97081637 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 612.08032848 Asustekc_cb:217b Asustekc_23:07:ba 0x4065 69 Ethernet II 712.14.05603284 Asustekc_cb:217b Asustekc_23:07: | 21 23 25 | 5.433865635 | AsustekC_cb:12:fb | AsustekC_23:07:ba | 0x9e65 | 70 Ethernet | 11 |
| 225.4.79409345 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 77 /Ethernet II 275.731258927 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 71 /Ethernet II 275.731258927 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 76 Ethernet II 326.6x50258211 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 69 Ethernet II 337.39457552 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 69 Ethernet II 337.39457259 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 69 Ethernet II 488.6x3343097 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 69 Ethernet II 488.6x3343097 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 69 Ethernet II 488.6x3343097 Asu5teKc_0:12:7b Asu5teKc_2:397:ba 0x8e65 69 Ethernet II 479.475798444 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 479.6x77864 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 479.6x77864 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 479.6x77864 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 511.6x97076153 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 511.6x970761531 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 511.5x989601 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 611.9x97081537 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 611.9x3228086 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 611.9x3228081 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 611.9x3228086 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 771.4x65080234 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e65 69 Ethernet II 712.4x65080234 Asu5teKc_0:12:7b Asu5teKc_2:307:ba 0x8e6 | 23 | 5.478515642 | AsustekC_cb:12:fb | AsustekC_23:07:ba | 0x9e65 | 69 Ethernet | 11 |
| 25 5:32207389 AsUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 A LETMENTE II 27 5:73128925 AsUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 38 6:147268631 AsUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 36 7:394637268 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 37 7:81964391 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 48 0:82727879 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 49 0:82727879 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 49 0:82727879 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 49 0:80277876 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 49 0:80277896 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 49 0:80277859 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 49 0:80277859 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G EtHernet II 51 10:3077615B ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 51 10:3077615B ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 51 10:3077615B ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 51 10:3078715B ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 51 11.350380861 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 51 11.350380861 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 51 11.350380861 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 64 12:38722091 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 64 12:38722091 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 64 12:38722091 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 64 11.38722081 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 64 12:38722091 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 77 14:3680823468 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 77 14:3680823468 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 77 14:3680823468 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 77 14:3680823468 ASUSTERC D:12:7D ASUSTERC 23:07:8A 0X8665 G 9 EtHernet II 77 14:46808234 ASUSTERC D | 25 | 5.479469345 | ASUSTEKC_CD:12:TD | AsustekC_23:07:ba | 0x9e65 | 77 Ethernet | 11 |
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| 47 9.475798484 AsustekC_ch12:fb AsustekC_23:67:ha 0x9e55 69 Ethernet II 49 8.80172859 AsustekC_ch12:fb AsustekC_23:67:ha 0x9e55 69 Ethernet II 51 10.307076158 AsustekC_ch12:fb AsustekC_23:67:ha 0x9e55 69 Ethernet II 55 10.720204583 AsustekC_ch12:fb AsustekC_23:67:ha 0x9e55 69 Ethernet II 57 11.13042743 AsustekC_ch12:fb AsustekC_23:67:ha 0x9e55 69 Ethernet II 59 11.55909011 AsustekC_23:67:ha 0x9e55 69 Ethernet II 61 1.4720916371 61 11.970816371 AsustekC_23:67:ha 0x9e55 69 Ethernet II 61 2.48328868 AsustekC_23:67:ha 0x9e55 69 Ethernet II 61 12.48328868 AsustekC_23:67:ha 0x9e55 69 Ethernet II 61 3.4822283 AsustekC_23:67:ha 0x9e55 69 Ethernet II 71 13.683188234 AsustekC_21:2:7b AsustekC_23:67:ha 0x9e55 69 Ethernet II 71 13.683188234 AsustekC_21:2:7b AsustekC_23:67:ha 0x9e55 69 Ethernet II 72 14.05688591 AsustekC_21:2:7b AsustekC_23:67:ha 0x9e55 69 Ethernet II 72 14.05688591 | 42 | 9 060173704 | AsustekC_cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | TT |
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| 59 11.555999011 AsustekC_cb12:fb AsustekC_23:07:ba exee5 69 Ethernet II 61 11.976916371 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e5 69 Ethernet II 64 12.987220919 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e5 69 Ethernet II 66 12.98328066 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e5 69 Ethernet II 70 13.680180234 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e5 69 Ethernet II 71 13.680180234 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e55 69 Ethernet II 72 13.680180234 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e55 69 Ethernet II 72 13.68085801 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e55 69 Ethernet II 72 14.050805801 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e55 69 Ethernet II 72 14.050805801 AsustekC_cb12:fb AsustekC_23:07:ba 0x9e55 69 Ethernet II 77ame 27: 69 bytes on surf (552 bits), 0 69 bytes on surf (552 bits), 0 0s interface 6 Ethernet II, Src: AsustekC_cb12:fb (d0:17:c2:cb:12:fb), Dst: AsustekC_23:07:ba 01:07:44:23:07:ba) Data (55 bytes) 0ptes) 0ptes) 0ptes) | 57 | 11.139432743 | AsustekC_cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | ĨĨ |
| 61 11.970816371 AsustekC_23:07:ba exterior exterior 69 Ethernet II 64 12.38720919 AsustekC_23:07:ba exterior 69 Ethernet II 66 12.08328868 AsustekC_23:07:ba exterior 69 Ethernet II 66 13.08328868 AsustekC_23:07:ba exterior 69 Ethernet II 70 13.685180234 AsustekC_23:07:ba exterior 69 Ethernet II 71 13.685180234 AsustekC_23:07:ba exterior 69 Ethernet II 72 14.05688591 AsustekC_23:07:ba exterior 69 Ethernet II 72 74.0568591 AsustekC_23:07:ba exterior 69 Ethernet II 72 74.0568591 AsustekC_23:07:ba exterior 69 Ethernet II 72 74.0568591 AsustekC_251:2:1b AsustekC_23:07:ba 0x965 69 Ethernet II 72 74.0568591 AsustekC_251:2:1b AsustekC_251:2:1b 167 Ethernet II 77 Ethernet II 72 74.0568591 AsustekC_251:2:1b (61:17:c2:cb:12:fb), Dist: AsustekC_23:07:ba 10:7b:44:23:07:ba 74 74 7568 AsustekC_251:2:1b (61:17:c2:cb:12:fb), Dist: AsustekC_23:07:ba 10:7b:44:23:07:ba | 59 | 11.555990011 | AsustekC cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | ŤŤ |
| 64 12.387220919 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 66 12.803328868 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 68 13.21222938 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 70 13.636108234 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 71 4.696885981 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 72 14.696885981 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 72 14.996885981 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 70 12 12 12 12 12 12 12 12 12 14 12 12 12 12 12 12 12 12 12 12 12 12 12 | 61 | 11.970816371 | AsustekC_cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | TT |
| 66 12.083328888 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e5 69 Ethernet II 76 13.7122238 AsustekC_23:07:ba 0x9e5 69 Ethernet II 76 13.035108234 AsustekC_23:07:ba 0x9e5 69 Ethernet II 72 14.050805991 AsustekC_23:07:ba 0x9e5 69 Ethernet II 72 14.050805991 AsustekC_23:07:ba 0x9e5 69 Ethernet II Frame 27: 69 bytes on wire (552 bits), 69 bytes captured (552 bits) on interface 0 Ethernet II, 5rc: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb), Dst: AsustekC_23:07:ba (10:7b:44:23:07:ba) Data (55 bytes) yes) Data (55 bytes) 50 Ethernet II | 64 | 12.387220919 | AsustekC cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | II |
| 68 13.219222938 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 70 13.636108234 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II 72 14.696885691 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e65 69 Ethernet II Frame 27: 69 bytes on wire (552 bits), 69 bytes captured (552 bits) on interface 0 Ethernet II, 5rc: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb), Dst: AsustekC_23:07:ba (10:7b:44:23:07:ba) Data (55 bytes) Ves) | 66 | 12.803328868 | AsustekC cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | II |
| 70 13.035108234 AsustekC_cb12:rb AsustekC_23:07:ba 0x9e55 69 Ethernet II 72 14.050805591 AsustekC_cb12:rb AsustekC_23:07:ba 0x9e55 69 Ethernet II Frame 27: 60 bytes on wire (552 bits), 60 bytes captured (552 bits) on interface 0 Ethernet II, Src: AsustekC_cb12:rb (d0:17:c2:cb:12:rb), Dst: AsustekC_23:07:ba (10:7b:44:23:07:ba) Data (55 bytes) | 68 | 13.219222938 | AsustekC_cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | TT |
| 72 14.650865591 AsustekC_cb:12:fb AsustekC_23:07:ba 0x9e05 69 Ethernet II Frame 27: 69 bytes on wire (552 bits), 69 bytes captured (552 bits) on interface 0 Ethernet II, Src: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb), Dst: AsustekC_23:07:ba (10:7b:44:23:07:ba) Data (55 bytes) | 70 | 13.636108234 | AsustekC cb:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | TT |
| Frame 27: 60 bytes on wire (552 bits), 60 bytes captured (552 bits) on interface 0 Ethernet II, Src: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb), Dst: AsustekC_23:07:ba (10:7b:44:23:07:ba) Data (55 bytes) | 72 | 14.050885891 | AsustekC_ch:12:fb | AsustekC 23:07:ba | 0x9e65 | 69 Ethernet | TT |
| | Etherne Data (S | et II, Src: A 55 bytes) | sustekC_cb:12:fb(dd | 0:17:c2:cb:12:fb), D | st: Asustek | C_23:07:ba (10:7b:4 | 4:23:07:ba) |

nukxDC(ee)設定及流量測試

- UE 預設開啟elwa模式
- eNB預設wifi和eth比率為1:1
- 在EPC開啟新的終端機並輸入 iperf3 --s
- 在UE開啟新的終端機並輸入 iperf3 -- c 172.16.0.1 -- M 100B

iperf3 測試結果

| 8 | 🔳 ue@ue-X580\ | VD: ~ | | | | | |
|-------|------------------|--------|----------------|------------------|--------|--------|----------|
| ue@ue | -X580VD:~\$ ipe | erf3 - | c 172.16.0.1 | -M 100B | | | |
| Conne | ecting to host | 172.1 | .6.0.1, port 5 | 201 | | | |
| [4] | local 172.16. | 0.2 p | ort 58362 con | nected to 172.16 | .0.1 p | ort 52 | 201 |
| [ID | Interval | | Transfer | Bandwidth | Retr | Cwnd | |
| 4 | 0.00-1.00 | sec | 1.78 MBytes | 14.9 Mbits/sec | 36 | 9.54 | KBytes |
| 4 | 1.00-2.00 | sec | 1.69 MBytes | 14.2 Mbits/sec | 14 | 14.2 | KBvtes |
| 4 | 2.00-3.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 40 | 14.3 | KBvtes |
| 4 | 3.00-4.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 36 | 13.8 | KBytes |
| 4 | 4.00-5.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 19 | 14.1 | KBytes |
| 4 | 5.00-6.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 9 | 18.0 | KBytes |
| [4 | 6.00-7.00 | sec | 1.54 MBytes | 12.9 Mbits/sec | 21 | 11.2 | KBytes |
| [4 | 7.00-8.00 | sec | 1.47 MBytes | 12.3 Mbits/sec | 1 | 15.9 | KBytes |
| 4 | 8.00-9.00 | sec | 1.47 MBytes | 12.3 Mbits/sec | 36 | 16.1 | KBytes |
| [4] | 9.00-10.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 20 | 10.8 | KBytes |
| | | | | | | | |
| [ID] |] Interval | | Transfer | Bandwidth | Retr | | |
| [4 | 0.00-10.00 | sec | 15.5 MBytes | 13.0 Mbits/sec | 232 | | sender |
| [4] | 0.00-10.00 | sec | 14.9 MBytes | 12.5 Mbits/sec | | | receiver |
| | | | | | | | |
| ipert | f Done. | | | | | | |
| ue@ue | e-X580VD:~\$ ipe | erf3 - | c 172.16.0.1 | -M 100B | | | |
| Conne | ecting to host | 172.1 | .6.0.1, port 5 | 201 | | | |
| [4] |] local 172.16. | 0.2 p | ort 58366 con | nected to 172.16 | .0.1 p | ort 52 | 201 |
| [ID] |] Interval | | Transfer | Bandwidth | Retr | Cwnd | |
| [4] | 0.00-1.00 | sec | 1.76 MBytes | 14.8 Mbits/sec | 28 | 9.28 | KBytes |
| [4] | 1.00-2.00 | sec | 1.57 MBytes | 13.2 Mbits/sec | 22 | 13.1 | KBytes |
| [4] | 2.00-3.00 | sec | 1.65 MBytes | 13.9 Mbits/sec | 2 | 12.6 | KBytes |
| [4] | 3.00-4.00 | sec | 1.47 MBytes | 12.3 Mbits/sec | 5 | 13.0 | KBytes |
| [4] | 4.00-5.00 | sec | 1.47 MBytes | 12.3 Mbits/sec | 33 | 13.1 | KBytes |
| [4] | 5.00-6.00 | sec | 1.47 MBytes | 12.3 Mbits/sec | 28 | 9.20 | KBytes |
| [4] | 6.00-7.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 0 | 15.1 | KBytes |
| [4] | 7.00-8.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 36 | 13.7 | KBytes |
| [4] | 8.00-9.00 | sec | 1.47 MBytes | 12.3 Mbits/sec | 36 | 13.1 | KBytes |
| [4] | 9.00-10.00 | sec | 1.50 MBytes | 12.6 Mbits/sec | 5 | 14.2 | KBytes |
| | | | | | | | |
| [ID] |] Interval | | Transfer | Bandwidth | Retr | | |
| [4] | 0.00-10.00 | sec | 15.4 MBytes | 12.9 Mbits/sec | 195 | | sender |
| [4] | 0.00-10.00 | sec | 14.9 MBytes | 12.5 Mbits/sec | | | receiver |
| | | | | | | | |
| iper | f Done. | | | | | | |
| le@ue | -X580VD:~S | | | | | | |

Wireshark 監看-UE端

| × • • • | tun_srsue | | | | | | | | | | | | |
|---|--|-------------------|------------------------|-------------|---------------|-------------|--|--|--|--|--|--|--|
| | 2 💿 📔 | 🗎 🖹 🎑 🔍 | < > 🗲 🛏 🛛 | | - 1 | | | | | | | | |
| Apply a display filter < Ctrl-/> Expression | | | | | | | | | | | | | |
| No. | Time | Source | Destination | Protocol Le | ength Info | 8 | | | | | | | |
| ↓ 40 | 19.367486314 | 172.16.0.1 | 172.16.0.2 | ICMP | 84 Echo (ping | g) reply … | | | | | | | |
| | | | | | | | | | | | | | |
| ▶ Frame | ▶ Frame 40: 84 bytes on wire (672 bits), 84 bytes captured (672 bits) on interface 0 | | | | | | | | | | | | |
| Raw pa | cket data | | | | | | | | | | | | |
| ▼ Intern | et Protocol Ve | ersion 4, Src: 17 | 2.16.0.1, Dst: 172.16. | 0.2 | | | | | | | | | |
| 0100 |) = Versio | on: 4 | | | | | | | | | | | |
| | 0101 = Header | Length: 20 byte | s (5) | | | | | | | | | | |
| ▶ Diff | erentiated Ser | vices Field: 0x0 | 0 (DSCP: CS0, ECN: Not | t-ECT) | | | | | | | | | |
| Tota | l Length: 84 | | | | | Ξ | | | | | | | |
| Iden | tification: 0x | (07ed (2029) | | | | | | | | | | | |
| ▶ Flag | s: 0x0000 | | | | | | | | | | | | |
| Time | e to live: 64 | | | | | | | | | | | | |

| 800 | *enp4s0 | | | | | | |
|----------|-----------------|---------------------|--------------|--------------|--------------|------------------------|----------------|
| | 1 🔘 🗎 | 🖹 🖹 🎑 🤇 | (| (| | - 1 | |
| eth.typ | e == 0x9e65 | | | | | \times \rightarrow | • Expression + |
| No. | Time | Source | Destinati | on | Protocol Ler | ngth Info | Ê |
| 1(| 6 4.636323122 | AsustekC_23:07:ba | Asustek | C_04:55:03 | 0x9e65 | 101 Ethernet II | |
| ▶ Frame | 16: 101 bytes | on wire (808 bits) |), 101 bytes | captured (80 | 08 bits) on | interface 0 | |
| ▼ Etheri | net II, Src: As | sustekC_23:07:ba (1 | L0:7b:44:23: | 07:ba), Dst: | AsustekC_04 | 1:55:03 (78:24: | af:04:55:03) |
| ▶ Des | tination: Asust | tekC_04:55:03 (78:2 | 24:af:04:55 | :03) | | | |
| ▶ Sou | rce: AsustekC_2 | 23:07:ba (10:7b:44 | :23:07:ba) | | | | |
| Тур | e: Unknown (0x9 | 9e65) | | | | | |
| ▶ Data | (87 bvtes) | | | | | | |

Wireshark 監看-eNB1端

| × • • • | srs_spgv | v_sgi | | | | | | | | | | | |
|-------------------|---|-----------------------|-------|---------|-------|---|----------|--|--------|------|--------|------------|---|
| | | | X 🚺 🔍 | < X | • • | F | - | | Ð | - 1 | | | |
| 📕 Apply a | display fi | ilter <ctrl-></ctrl-> | | | | | | | | | | Expression | + |
| No. | Time | Source | | Destina | ation | | Protocol | | Length | Info | | | - |
| ₄ ∟ 40 | 19.36 | 172.16.0.1 | | 172.10 | ô.0.2 | | ICMP | | 84 | Echo | (ping) | reply … | Y |
| ▶ Frame Raw pa | Frame 40: 84 bytes on wire (672 bits), 84 bytes captured (672 bits) on interface 0 Raw packet data | | | | | | | | | | | | |
| ▶ Intern | Internet Protocol Version 4, Src: 172.16.0.1, Dst: 172.16.0.2 Internet Control Message Protocol | | | | | | | | | | | | |

Wireshark 監看-eNB1端

| 80. | eth0 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|---------------------------------------|-----------------------------------|--------------------------------|---------------------------|--------------------------------|-----------------------------|-------------------------------|-------------------------|------------------|----------------|------------------|------------------|----------------|---------------|------------------------|--------------|--------|------|---------|----|---|
| | 6 | | 0101 0310 0111 | × | 6 | Q | ٢ | ۶ | Þ | Þ | | | | Þ | | 1 | • | | | | | | |
| eth.type | e == 0x9e | e65 gtp |) | | | | | | | | | | | | | | | ĺ | × → | • Ex | pressio | on | + |
| No. 20 | Time 4.095 | Source | ekC_2 | 3:07 | ':ba | | Dest Asus | inatio | on C_04 | :55: | 03 | | Pro 0x9 | e65 | | Leng | <mark>th</mark> 101 | Info Ethe | rnet 3 | II | | | Â |
| Frame Ethern Dest Sour Type | 20: 101 et II, ination ce: Asu e: Unkno | 1 bytes Src: A n: Asus ustekC_ own (0x | on v sust tekC 23:0 (9e65 | wire ekC_ _04: 7:ba) | (808 23:07 55:03 (10: | bit :ba (78 7b:4 | s), : (10: 3:24: 4:23 | 101 7b:4 af:0 :07: | byte 4:23 04:55 (ba) | es ca 3:07: 5:03) | aptu ba)) | red (, Dst | 808 bi : Asus | its) (stekC_ | on in _04:5 | terfa 5:03 | ace (78 | 0 8:24: | af:04 | :55 | :03) | | |
| ⊳ Data (| 87 byte | es) | | | | | | | | | | | | | | | | | | | | | |

| 😣 🚍 🗉 *eth0 | | | | | | | | | | | |
|--|---|--|---------------------------|--|--|--|--|--|--|--|--|
| 🖉 🔳 🖉 🕥 📔 🛅 🖉 🔍 | < > 🕻 🕨 📲 🧱 | | | | | | | | | | |
| eth.type == 0x9e65 gtp | | | Expression + | | | | | | | | |
| No. Time Source 21 4.096 192.168.128.101 | Destination 192.168.128.100 | Protocol Length Inf GTP <0x80a6> 136 PP | fo 'P Unknown (0x80a6) | | | | | | | | |
| Frame 21: 136 bytes on wire (1088 bits), 136 bytes captured (1088 bits) on interface 0 Ethernet II, Src: AsustekC_04:55:03 (78:24:af:04:55:03), Dst: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb) Destination: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb) Source: AsustekC_04:55:03 (78:24:af:04:55:03) Type: IPv4 (0x0800) | | | | | | | | | | | |
| Internet Protocol Version 4, Src: 19 User Datagram Protocol, Src Port: 21 GPRS Tunneling Protocol Point-to-Point Protocol Data (84 bytes) | 2.168.128.101, Dst: 192.1 52, Dst Port: 2152 | 68.128.100 | | | | | | | | | |

Wireshark 監看-eNB2端

| | *eth0 | | | | | | | | |
|---------------------|----------------------------------|------------------------------|--------------------------|--------------------|-------------------------------|---------------------------------|--------------------|---------------------|--------------|
| | 1 0 | 1 | Q 🔇 | > 2 | - - | | - 1 | 3 8 | |
| l eth.typ | e == 0x9e65 | | | | | | | | Expression + |
| No. | Time | Source | | Destinatio | on | Protocol | Length | Info | |
| 117 | 68.103512385 | AsustekC_c | b:12:fb | Asustek | C_23:07:ba | 0x9e65 | 101 | Ethernet | II |
| ▶ Frame ▼ Ethern | 117: 101 bytes et II, Src: As | s on wire (8 sustekC_cb:1 | 308 bits), L2:fb (d0: | 101 by 17:c2:cl | tes captured b:12:fb), Dsi | (808 bits) or t: AsustekC_23 | n inter 3:07:ba | face 0 (10:7b:44 | 4:23:07:ba) |
| ▶ Dest | ination: Asus | tekC_23:07: | ba (10:7b | :44:23:0 | 7:ba) | | | | |
| ▶ Sour | ce: AsustekC_ | cb:12:fb (d | 0:17:c2:c | b:12:fb) | | | | | |
| Туре | e: Unknown (0x | 9e65) | | | | | | | |
| ▶ Data (| 87 bytes) | | | | | | | | |

nukxDC(ee)設定及流量測試

• 在enb1的終端機輸入"r",然後按下"Enter" 接著輸入比率10

※注意須為整數,兩數中間為空格

😣 🗖 🔲 asus-medium@asusmedium-UN65H: ~/Desktop/dc_enb1/srsenb [INF0] [UHD] linux; GNU C++ version 5.4.0 20160609; Boost 105800; UHD 3.14.0.0-r elease Opening USRP with args: type=b200,master clock rate=30.72e6 [INF0] [B200] Detected Device: B210 [INFO] [B200] Operating over USB 3. [INF0] [B200] Initialize CODEC control... [INF0] [B200] Initialize Radio control... [INF0] [B200] Performing register loopback test... [INF0] [B200] Register loopback test passed [INF0] [B200] Performing register loopback test... [INFO] [B200] Register loopback test passed [INFO] [B200] Asking for clock rate 30.720000 MHz... [INF0] [B200] Actually got clock rate 30.720000 MHz. Setting frequency: DL=2160.0 Mhz, UL=1970.0 MHz [INFO] [B200] Asking for clock rate 23.040000 MHz... Failed to bind on address 192.168.128.101, port 2152 [INFO] [B200] Actually got clock rate 23.040000 MHz. Setting Sampling frequency 5.76 MHz ==== eNodeB started === Type <t> to view trace гU Enter lwa ratio:1 0

nukxDC(ee)設定及流量測試

- 在EPC端開啟新的終端機並輸入指令 iperf3 -s
- 在UE端開啟新的終端機並輸入指令 iperf3 c 172.16.0.1 M 100B

iperf3 測試結果

| 80 | 🗉 ue@ue-X580\ | VD: ~ | | | | |
|---------------------------|--|------------|--|---|-------------|--------------------|
| [4] | 0.00-1.00 | sec | 2.24 MBytes | 18.8 Mbits/sec | 26 | 10.3 KBytes |
| [4] | 1.00-2.00 | sec | 2.17 MBytes | 18.2 Mbits/sec | 7 | 16.1 KBytes |
| [4] | 2.00-3.00 | sec | 2.03 MBytes | 17.0 Mbits/sec | 54 | 11.1 KBytes |
| [4] | 3.00-4.00 | sec | 1.99 MBytes | 16.7 Mbits/sec | 35 | 12.2 KBytes |
| [4] | 4.00-5.00 | sec | 2.03 MBytes | 17.0 Mbits/sec | 7 | 14.2 KBytes |
| [4] | 5.00-6.00 | sec | 1.99 MBytes | 16.7 Mbits/sec | 21 | 13.8 KBytes |
| [4] | 6.00-7.00 | sec | 2.07 MBytes | 17.4 Mbits/sec | 14 | 14.3 KBytes |
| [4] | 7.00-8.00 | sec | 1.99 MBytes | 16.7 Mbits/sec | 4 | 17.6 KBytes |
| [4] | 8.00-9.00 | sec | 2.03 MBytes | 17.0 Mbits/sec | 5 | 15.6 KBytes |
| [4] | 9.00-10.00 | sec | 1.96 MBytes | 16.4 Mbits/sec | 35 | 11.9 KBytes |
| [ID] | Interval | | Transfer | Bandwidth | Retr | |
| i 41 | 0.00-10.00 | sec | 20.5 MBvtes | 17.2 Mbits/sec | 208 | sender |
| [4] | 0.00-10.00 | sec | 20.0 MBytes | 16.7 Mbits/sec | | receiver |
| | - | | | | | |
| lpert | Done. | 60 | 170 110 0 1 | | | |
| ue@ue | -X580VD:~\$ lpe | IT3 - | c 172.16.0.1 | -M 100B | | |
| Conne | cting to host | 172.1 | 6.0.1, port 5 | | | + 5004 |
| 4] | local 1/2.10. | 0.2 p | ort 58472 con | nected to 1/2.16 | .0.1 p | ort 5201 |
| | Interval | | a an Abutaa | Bandwidth | Retr | |
| [4] | 0.00-1.00 | sec | 2.20 MBytes | 18.5 MDILS/Sec | 29 | 11.1 KBytes |
| [4] | 1.00-2.00 | sec | 2.13 MBytes | 17.9 MDITS/Sec | 10 | 10.0 KBytes |
| [4] | 2.00-3.00 | sec | 1.99 MBytes | 16.7 MDITS/Sec | 12 | 15.6 KBytes |
| | 3.00-4.00 | sec | 1.92 MBytes | 16.1 MDLts/sec | 45 | 16.1 KBytes |
| [4] | 4.00-5.00 | sec | 1.96 MBytes | 10.4 MDITS/Sec | 05 | 11.9 KBytes |
| [4] | 5.00-6.00 | sec | 1.92 MBytes | 16.1 MDLts/sec | 23 | 13.7 KBytes |
| [4] | 6.00-7.00 | sec | 1.96 MBytes | 16.4 Mbits/sec | 13 | 15.6 KBytes |
| [4] | 7.00-8.00 | sec | 1.92 MBytes | 16.1 Mbits/sec | 55 | 14.8 KBytes |
| [4] | 8.00-9.00 | sec | 1.92 MBytes | 16.1 Mbits/sec | 47 | 15.0 KBytes |
| [4] | | 606 | 1.96 MRvtes | 16.4 Mbits/sec | 1 | 19.9 KBytes |
| | 9.00-10.00 | | <u></u> | · | | |
| [ID] | 9.00-10.00 Interval | | Transfer | Bandwidth | <u>Retr</u> | |
| [ID] [4 <u>]</u> | 9.00-10.00 Interval 0.00-10 <u>.00</u> | sec sec | Transfer 19.9 MBytes | Bandwidth 16.7 Mbits/ <u>sec</u> | Retr 300 | sende <u>r</u> |
| [ID] [4] [4] | 9.00-10.00 Interval 0.00-10.00 0.00-10.00 | sec sec | Transfer 19.9 MBytes 19.3 MBytes | Bandwidth 16.7 Mbits/sec 16.2 Mbits/sec | Retr 300 | sender receiver |

ue@ue-X580VD:~S

Wireshark 監看-UE端

| 8 | Capturing from en | np4s0 | | | |
|-----------|--|------------------------|-----------------------|---------------------------|----------------|
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| 📕 Apply a | display filter <c< th=""><th>Ctrl-/></th><th></th><th>•</th><th>• Expression +</th></c<> | Ctrl-/> | | • | • Expression + |
| No. | Time | Source | Destination | Protocol Length Info | - |
| 160 | 64.454223970 | AsustekC_23:07:ba | AsustekC_04:55:03 | 0x9e65 30 Ethernet I | I |
| ▶ Frame | 160: 30 bytes | on wire (240 bits), 3 | 0 bytes captured (240 | bits) on interface 0 | |
| Etherr | net II, Src: As | sustekC_23:07:ba (10:7 | b:44:23:07:ba), Dst: | AsustekC_04:55:03 (78:24) | :af:04:55:03) |
| ▶ Dest | tination: Asust | tekC_04:55:03 (78:24:a | af:04:55:03) | | |
| ▶ Sour | rce: AsustekC_2 | 23:07:ba (10:7b:44:23: | :07:ba) | | |
| Туре | e: Unknown (0x9 | 9e65) | | | |
| ▶ Data (| 16 bytes) | | | | |

| 80. | tun_srsue | | | | | | | | | | | | |
|-------------------|--|------------------|--------|--------|--------|-----------------|--------------|-----------|------------------|------------------------|--------|------------|---|
| | a 💿 📔 | | 6 | Q (| > | ð | Þ | - | ÷ | - 1 | | | |
| 📕 Apply a | display filter <c< td=""><td>trl-/></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Expression</td><td>+</td></c<> | trl-/> | | | | | | | | | | Expression | + |
| No. → 39 | Time 19.084708821 | Source 172.16 | .0.2 | | D 1 | estina 72.16 | tion .0.1 | | Protocol ICMP | Lenath Info 84 Echo | (ping) | request | - |
| ₄ ∟ 40 | 19.085255726 | 172.16 | .0.1 | | 1 | 72.16 | .0.2 | | ICMP | 84 Echo | (ping) | reply … | Ľ |
| ▶ Frame Raw pa | 40: 84 bytes o cket data | n wire | (672 k | oits), | 84 b | ytes | capt | ured (672 | bits) on | interface | Θ | | Â |
| ▼ Intern | et Protocol Ve | rsion 4 | , Src: | 172.3 | 16.0. | 1, Ds | st: 1 | 72.16.0.2 | | | | | |
Wireshark 監看-eNB1端

| 😣 🖨 🗉 *eth0 | | | | | |
|---|---|--|-------------------------|--|--|
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| Apply a display filter <ctrl-></ctrl-> | | | Expression + | | |
| No. Time Source 147 24.19 192.168.128.101 | Destination 192.168.128.100 | Protocol Length Inf GTP <0x8096> 136 PP | o P Unknown (0x8096) | | |
| Frame 147: 136 bytes on wire (1088 bits), 136 bytes captured (1088 bits) on interface 0 Ethernet II, Src: AsustekC_04:55:03 (78:24:af:04:55:03), Dst: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb) Destination: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb) Source: AsustekC_04:55:03 (78:24:af:04:55:03) Type: IPv4 (0x0800) | | | | | |
| Internet Protocol Version 4, Src: 19 User Datagram Protocol, Src Port: 21 GPRS Tunneling Protocol Point-to-Point Protocol Data (84 bytes) | 2.168.128.101, Dst: 192.: 52, Dst Port: 2152 | L68.128.100 | | | |

| ession + |
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| 3 |

Wireshark 監看-eNB1端

| 😣 🗖 💷 *srs_spgw_sgi | | | | |
|--|---------------------------|------------------------------|-------------------------------|------------------|
| | 2 < > 🤉 🕨 | • 🔺 📃 📗 | 1 🎹 | |
| Apply a display filter <ctrl-></ctrl-> | | | | Expression + |
| No. Time Source ↓ 40 19.08 172.16.0.1 | Destination 172.16.0.2 | Protocol ICMP | Length Info 84 Echo (ping) | reply |
| Frame 40: 84 bytes on wire (672 bi Raw packet data Internet Protocol Version 4, Src: Internet Control Message Protocol | ts), 84 bytes cap | otured (672 bi 172.16.0.2 | ts) on interface O | |
| wireshark_srs_spgw12439_bnoJi9.p | capne Packets: 40 · D |)isplayed: 40 (100.0 | 0%) · Dropped: 0 (0.0%) | Profile: Default |

Wireshark 監看-eNB2端

| | eth0 | | | | | | |
|--|--------------|-------------------|-------------------|----------|--------|----------|----|
| | 1 0 | 🗎 🖹 🧯 🔍 🔇 |) 🅽 🏲 🚽 📃 | | - 1 | 11 | |
| eth.type == 0x9e65 Expression + | | | | | | | |
| No. | Time | Source | Destination | Protocol | Length | Info | |
| 39 | 20.497977377 | AsustekC_cb:12:fb | AsustekC_23:07:ba | 0x9e65 | 101 | Ethernet | II |
| ▶ Frame 39: 101 bytes on wire (808 bits), 101 bytes captured (808 bits) on interface 0 ▼ Ethernet II, Src: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb), Dst: AsustekC_23:07:ba (10:7b:44:23:07:ba) | | | | | | | |
| Destination: AsustekC_23:07:ba (10:7b:44:23:07:ba) Source: AsustekC_cb:12:fb (d0:17:c2:cb:12:fb) Type: Unknown (0x9e65) | | | | | | | |
| ▶ Data (| 87 bytes) | 7 | | | | | |

nukxDC(ee)設定及流量測試

- 在UE的終端機上輸入"e"並按下"Enter"
- 畫面會顯示 Disable elwa.

```
😣 🗐 🔲 ue@ue-X580VD: ~/Desktop/dc_ue/srsue
[INF0] [B200] Performing register loopback test...
[INF0] [B200] Register loopback test passed
[INFO] [B200] Asking for clock rate 30.720000 MHz...
[INFO] [B200] Actually got clock rate 30.720000 MHz.
LWAAP MAC f4:96:34:3:6a:a6
LWAAP IP packet receiver thread run enable
Waiting PHY to initialize...
Attaching UE...
Searching cell in DL EARFCN=500, f_dl=2160.0 MHz, f_ul=1970.0 MHz
Found Cell: PCI=1, PRB=25, Ports=1, CFO=0.7 KHz
[INFO] [B200] Asking for clock rate 23.040000 MHz...
[INFO] [B200] Actually got clock rate 23.040000 MHz.
Found PLMN: Id=00101, TAC=7
Random Access Transmission: seq=6, ra-rnti=0x2
Random Access Transmission: seq=42, ra-rnti=0x2
RRC Connected
Random Access Complete. c-rnti=0x47, ta=0
Network attach successful. IP: 172.16.0.2
Software Radio Systems LTE (srsLTE)
Disable elwa.
```

Outline

- 實驗目的及實驗內容
- •5G Emulator-nukxDC(ee) 實驗環境
 - srsLTE Small Cell 架構
 - 軟硬體環境
- •5G Emulator-nukxDC(ee) 網路實驗平台建置
 - 安裝基礎 srsLTE網路環境
 - 設定srsLTE EPC
 - 設定srsLTE eNB
 - 設定srsLTE UE
- 執行程式暨測試
- 總結

總結

- •讓學生熟悉及建置 srsLTE 的實驗環境
- 在三台主機上安裝 srsLTE UE 和 EPC 和 eNB
 - 了解各個裝置的參數設定
 - 透過終端機訊息了解執行過程
 - •利用 Wireshark 觀測封包的內容及流向
- 透過設定 srsLTE 與網路配置 增進了解 5G 新的網路架構

問題

- 1. 當 eNB1 改變調配比例時, 觀察 UE 傳輸速率的影響
- 2. 當 UE 使用 UDP 傳送封包時,比較 TCP 在相同比例 下的差異
- 3. 當UE是否開啟elwa模式時,傳輸速率的差異