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示範課程

4G/5G 行動寬頻協同網路

實驗四 5G Emulator 仿真模擬實驗

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一、 平台架構

1. 實驗架構

本實驗架構如圖所示,共使用三台電腦,分別開啟 EPC 和 MeNB、SeNB、UE, 三台電腦皆連至 HUB 供內網傳輸,另外 EPC 額外增加外接網卡,供對外連線使 用,MeNB 和 UE 則是透過 USRP 和 SMA 線連接。



2. 實驗環境



二、 軟硬體需求

1. 硬體

名稱	規格	數量	目的
EPC+eNB1	電腦型號:	1	啟動
	ASUS VivoMini UN65H		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:	1	模擬第二個基地站
	CPU: i7-6700, RAM: 32G		
	USRP B210	1	啟動 srsLTE eNB
UE	電腦型號:	1	模擬 UE
	ASUS NB M580V		
	USRP B210	1	啟動 srsLTE UE
Hub	型號:	1	分配內部網路
	TP-LINK WR1043ND		

2. 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 16.04
	Ubuntu	Kernel : 4.15.0-041500-lowlatatency
	srsLTE eNB	srsLTE 18.06.1
		470953bf9c5875646e4d5049c8f213d202fa84fd

UE	OS :	Ubuntu 16.04
	Ubuntu	Kernel : 4.15.0-041500-lowlatatency
	srsLTE UE	srsLTE 18.06.1
		470953bf9c5875646e4d5049c8f213d202fa84fd

三、 環境安裝

1. Linux Kernel 安裝

1.1. 安裝 Kernel

開啟一個終端機(Terminal),並且依序輸入

wget -P ~/Downloads/kernel

https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-headers-4.4.15-04 0415_4.4.15-040415.201607111333_all.deb

wget -P ~/Downloads/kernel

https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-headers-4.4.15-04 0415-lowlatency_4.4.15-040415.201607111333_amd64.deb

wget -P ~/Downloads/kernel

https://kernel.ubuntu.com/~kernel-ppa/mainline/v4.4.15/linux-image-4.4.15-040 415-lowlatency_4.4.15-040415.201607111333_amd64.deb

sudo dpkg -i ~/Downloads/kernel/*.deb

1.2. 安裝過程

※請先確認是否連接網路正常



1.3. 修改開機選單和設定

開啟終端機(Terminal)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 储存後離開



1.4. 更新 grub 設定

開啟終端機並輸入以下指令

sudo update-grub2

😣 🖨 💷 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:~\$

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

1.5. 檢查 Kernel 版本

重新開機後在終端機輸入指令,確認版本

uname -r

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

2. 安裝相關套件

2.1. 一般套件

開啟終端機並輸入

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

2.2. RF Front-end Driver

開啟終端機並依序輸入

sudo add-apt-repository ppa:ettusresearch/uhd
sudo apt-get update
sudo apt-get install libuhd-dev libuhd003 uhd-host
python3 /lib/uhd/utils/uhd_images_downloader.py

2.3. mbed TLS

開啟終端機並依序輸入

wget https://tls.mbed.org/download/start/mbedtls-2.6.0-apache.tgz

tar zxvf mbedtls-2.6.0-apache.tgz

sudo mv ~/Donwload/mbedtls-2.6.0 /usr/local

cd cd /usr/local/mbedtls-2.6.0

cmake.

make

make test

 $cmake \ \textbf{-DENABLE_TESTING=Off} \ .$

 $cmake \ -DUSE_SHARED_MBEDTLS_LIBRARY=On \ .$

sudo make install library

2.4. srsGUI

開啟終端機並依序輸入

sudo apt-get install libboost-system-dev libboost-test-dev 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

2.5. srsLTE

開啟終端機並依序輸入

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

```
🔵 🔲 ue@ue-X580VD: ~/Desktop/srsLTE/build

    ue@ue-XS80VD: ~/Desktop/srsLTE/build

ue@ue-XS80VD: ~$ cd ~/Desktop/srsLTE/
ue@ue-XS80VD: ~/Desktop/srsLTE$ mkdir build
ue@ue-XS80VD: ~/Desktop/srsLTE$ cd build/
ue@ue-XS80VD: ~/Desktop/srsLTE/build$ cmake ../
-- The C compiler identification is GNU 5.4.0
-- The CXX compiler identification is GNU 5.4.0
-- Check for working C compiler: /usr/bin/cc
-- Check for working C compiler: /usr/bin/cc
-- Detecting C compiler ABI info
-- Detecting C compile features
-- Detecting C compile features
-- Deteck for working CXX compiler: /usr/bin/c++
-- Check for working CXX compiler: /usr/bin/c++
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler: /usr/bin/c++
-- Works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler: /usr/bin/c++
-- Works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler: /usr/bin/c++
-- Works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info
-- Check for working CXX compiler: /usr/bin/c++
-- Works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler: /usr/bin/c++
-- Works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler: /usr/bin/c++
-- Works
-- Detecting CXX compiler: /usr/b
          Detecting CXX compiler ABI info
Detecting CXX compiler ABI info
Detecting CXX compile features
Detecting CXX compile features - done
                                                                                                                                      - done
   -- Detecting CXX compile features - done

-- CMAKE_SYSTEM: Linux-4.15.0-51-generic

-- CMAKE_SYSTEM_PROCESSOR: x86_64

-- CMAKE_CXX_COMPILER: /usr/bin/c++

-- Build type not specified: defaulting to Release.
   -- Looking for pthread.h
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
       🕽 😑 🗉 🛛 ue@ue-X580VD: ~/Desktop/srsLTE/build
ue@ue-X580VD:~$ cd ~/Desktop/srsLTE/build
ue@ue-X580VD:~/Desktop/srsLTE$ mkdir build
ue@ue-X580VD:~/Desktop/srsLTE$ cd build/
ue@ue-X580VD:~/Desktop/srsLTE/build$ cmake ../
-- The C compiler identification is GNU 5.4.0
-- The CXX compiler identification is GNU 5.4.0
-- Check for working C compiler: /usr/bin/cc
-- Check for working C compiler: /usr/bin/cc -- works
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info
           Detecting C compile features
Detecting C compile features
                                                                                                                                  done
            Check for working CXX compiler: /usr/bin/c++
Check for working CXX compiler: /usr/bin/c++ -- works
   -- CHECK FOR WORKING CAA COMPETER, 703776

-- Detecting CXX compiler ABI info

-- Detecting CXX compile ABI info - done

-- Detecting CXX compile features - done

-- CMAKE_SYSTEM: Linux-4.15.0-51-generic

-- CMAKE_SYSTEM PROCESSOR: x86 64

    CMAKE_SYSTEM: Linux-4.15.0-51-generic
    CMAKE_SYSTEM: PROCESSOR: x86_64
    CMAKE_CXX_COMPILER: /usr/bin/c++
    Build type not specified: defaulting to Release.
    Looking for pthread.h
    Looking for pthread.h - found
    Looking for pthread_create
    Looking for pthread_create - not found

          😑 🗉 ue@ue-X580VD: ~/Desktop/srsLTE/build
  ue@ue-X580VD:~/Desktop/srsLTE/build$ sudo make install
  [sudo] password for ue:
         1%] Built target rrc_asn1
2%] Built target srslte_asn1
Generating build_info.h
            2%] Built target gen_build_info
7%] Built target srslte_common
                           Built target arch_select
            8%]
                           Built target srslte_enb
            9%]
                           Built target srslte_agc
Built target srslte_ch_estimation
         10%]
         11%1
                            Built target srslte_phy_common
         12%]
         17%]
                            Built target srslte_fec
                            Built target srslte_mimo
          17%]
                            Built target srslte_phch
         22%1
         24%]
                           Built target srslte_sync
                           Built target srslte_utils
Built target srslte_channel
         27%]
         28%]
                            Built target srslte dft
         29%]
         30%]
                           Built target srslte_io
                            Built target srslte modem
          32%]
                            Built target srslte_resampling
         33%1
                           Built target srslte_scrambling
         34%]
        35%]
                           Built target srslte_ue
                           Built target srslte_phy
         35%]
                           Built target refsignal_ul_test_all
          35%]
```

四、 設定 srsLTE

1. 設定 EPC

在 EPC 開一個新的終端機輸入指令

cd ~/path/to/srsLTE/srsepc

gedit epc.conf

😣 🗖 💷 asus-medium@asusmedium-UN65H: ~
asus-medium@asusmedium-UN65H:~\$ gedit Desktop/enb/srsepc/epc.conf
[mme_code = 0x1a {tac, mcc, mnc}注意eNB需要跟EPC的参数設定一致
mme_group = 0x0001
tac = 0x0007 mcc = 001
mnc = 01
mme_bind_addr = 127.0.0.1 mme bind addr 請設為
apn = srsapn dps = addr = 8, 8, 8, 8, 8, 127, 0, 0, 1

#######################################
gtpu bind addr 請設為 #對外網址
[spgw]
atou bind addr-10 1 208 123
gcpd_bcnd_add1=10.1.200.125
sgi_if_addr=172.16.0.1
#######################################
2. 設定 eNB

2.1. 修改 conf 檔

在 MeNB 和 SeNB 開啟一個新的終端機輸入指令

gedit /path/to/srsLTE/srsenb/enb.conf



2.2. 修改 lwaap_entity.h 檔案

開啟終端機輸入指令



3. 設定 UE

在 UE 開啟終端機並輸入指令

gedit /path/to/srsue/hdr/upper/l	waap.h	
#define WIFI_IF #define ENB_MAC0 #define ENB_MAC1 #define ENB_MAC2 #define ENB_MAC3 #define ENB_MAC4 #define ENB_MAC5	"enp2s0" 0x54 0xa0 0x50 0xd6 0x77 0x3f	WLAN_IF 設為 UE 內網 網卡名稱 ENB_MAC 設為 eNB1 內網 網卡MAC_addr

4. 重新編譯

在 EPC、MeNB、SeNB、UE 開啟終端機輸入指令

cd /path/to/srsLTE/build
make
sudo make install
sudo ldconfig

五、 執行 srsLTE

1. 執行 EPC

在 EPC 開一個新的終端機輸入指令

cd ~/path/to/srsLTE/srsepc

./srsepc_if_masq.sh enp4s0 #enp4s0 是本例使用的對外網卡名稱

sudo srsepc epc.conf

asus-medium@asusmedium-UN65H: ~/Desktop/lwa_enb/srsepc asus-medium@asusmedium-UN65H:~\$ cd ~/Desktop/lwa_enb/srsepc/ asus-medium@asusmedium-UN65H:~/Desktop/lwa_enb/srsepc\$./srsepc_if_masq.sh wlp3s0 [sudo] password for asus-medium: Masquerading Interface wlp3s0 asus-medium@asusmedium-UN65H:~/Desktop/lwa_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.

在 EPC 開一個新的終端機輸入指令

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:~\$

2. 執行 eNB

在 eNB 再開一個新的終端機輸入

cd ~/path/to/srsLTE/srsenb

sudo srsenb enb.conf

```
🗧 🔲 🔹 asus-medium@asusmedium-UN65H: ~/Desktop/lwa_enb/srsenb
asus-medium@asusmedium-UN65H:~$ cd ~/Desktop/lwa_enb/srsenb/
asus-medium@asusmedium-UN65H:~/Desktop/lwa_enb/srsenb$ sudo srsenb enb.conf
[sudo] password for asus-medium:
       Software Radio Systems LTE eNodeB ---
Reading configuration file enb.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...
[INFO] [B200] Performing register loopback test...
[INFO] [B200] Register loopback test passed
[INFO] [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...
[INFO] [B200] Actually got clock rate 23.040000 MHz.
Setting Sampling frequency 5.76 MHz
==== eNodeB started ===
Type <t> to view trace
```

3. 執行 UE

在 UE 開一個新的終端機輸入

cd ~/path/to/srsLTE/srsue

sudo srsue ue.conf

sudo route del default

sudo route add default gw 172.16.0.2 tun_srsue

```
🔊 🗇 💿 🛛 ue@ue-X580VD: ~/Desktop/lwaap_ue/srsue
ue@ue-X580VD:~$ cd ~/Desktop/lwaap_ue/srsue/
ue@ue-X580VD:~/Desktop/lwaap_ue/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...
[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
[INFO] [B200] Detected Device: B210
[INFO] [B200] Operating over USB 3.
[INFO] [B200] Initialize CODEC control...
[INFO] [B200] Initialize Radio control...
[INFO] [B200] Performing register loopback test...
[INFO] [B200] Register loopback test passed
[INFO] [B200] Performing register loopback test...
[INFO] [B200] Register loopback test passed
[INFO] [B200] Asking for clock rate 30 720000 MHz
[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=0.5 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=9, ra-rnti=0x2
Random Access Transmission: seq=42, ra-rnti=0x2
Random Access Transmission: seq=9, ra-rnti=0x2
RRC Connected
Random Access Complete. c-rnti=0x48, ta=0
Network attach successful. IP: 172.16.0.2
Software Radio Systems LTE (srsLTE)
  😕 🗐 🔲 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:~$
```

六、 測試

1. 互通測試

根據 EPC 設定, EPC 預設 ip 為 172.16.0.1 UE 在終端機輸入

ping 172.16.0.1 -c 10

若是有收到回覆,則代表平台建置成功。

```
😣 📄 🔲 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=179 ms
64 bytes from 172.16.0.1: icmp_seq=2 ttl=64 time=16.0 ms
64 bytes from 172.16.0.1: icmp_seq=3 ttl=64 time=14.0 ms
64 bytes from 172.16.0.1: icmp_seq=4 ttl=64 time=11.8 ms
64 bytes from 172.16.0.1: icmp_seq=5 ttl=64 time=18.0 ms
64 bytes from 172.16.0.1: icmp_seq=6 ttl=64 time=15.8 ms
64 bytes from 172.16.0.1: icmp_seq=7 ttl=64 time=12.8 ms
64 bytes from 172.16.0.1: icmp_seq=8 ttl=64 time=9.98 ms
64 bytes from 172.16.0.1: icmp seq=9 ttl=64 time=16.9 ms
64 bytes from 172.16.0.1: icmp seq=10 ttl=64 time=13.8 ms
--- 172.16.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9012ms
rtt min/avg/max/<u>m</u>dev = 9.983/30.951/179.973/49.728 ms
ue@ue-X580VD:~$
```

2. 調配封包傳送比例

在 MeNB 執行 enb.conf 的終端機輸入"t"並按下"enter",可以調整比例

3. Wireshark 介面查看

接著利用 Wireshark 軟體觀看封包傳遞流程。 UE 端:

🙆 💿 💿 Capturing from tun_srsue					_	
🖉 📕 🙋 🕥 🚔 🗂 🗙 🍳	< > > 1= == =	0001				
Apply a display filter <ctrl-></ctrl->					Expres	sion +
No. Time Source	Destination	Protocol Length Info				
* 10.00000000 172.16.0.2	172.16.0.1	ICMP 84 Echo ICMP 84 Echo	(ping) request in (ping) reply in	1=0x4a90, s	eq=1/256, tt	1=64 (r_
3 1.001561301 172.16.0.2	172.16.0.1	ICMP 84 Echo	(ping) request in	=0x4a90, s	eq=2/512, tt	1=64 (r_
4 1.003317077 172.16.0.1	172.16.0.2	ICMP 84 Echo ICMP 84 Echo	(ping) reply in (ping) request in	=0x4a90, s	eq=2/512, tt	1=64 (r_
6 2.004660939 172.16.0.1	172.16.0.2	ICMP 84 Echo	(ping) reply ic	=0x4a90, s	eq=3/768, tt	1=64 (r_
7 3.004741225 172.16.0.2	172.16.0.1	ICMP 84 Echo ICMP 84 Echo	(ping) request in	1=0x4a90, s	eq=4/1024, t	ttl=64 (
9 4.022341708 172.16.0.2	172.16.0.1	ICMP 84 Echo	(ping) request in	=0x4a90, s	eq=5/1280, t	ttl=64 (_
10 4.024044875 172.16.0.1	172.16.0.2	ICMP 84 Echo	(ping) reply in	=0x4a90, s	eq=5/1280, t	ttl=64 (
12 5.025555250 172.16.0.1	172.16.0.2	ICMP 84 Echo	(ping) reply in	1=0x4a90, s	eq=6/1536, t	ttl=64 (_
13 6.025682477 172.16.0.2	172.16.0.1	ICMP 84 Echo ICMP 84 Echo	(ping) request in	=0x4a90, s	eq=7/1792, t	ttl=64 (
15 7.027016439 172.16.0.2	172.16.0.1	ICMP 84 Echo	(ping) request in	=0x4a90, s	eq=8/2048, t	ttl=64 (_
16 7.028465698 172.16.0.1 17 8.028583339 172.16.0.2	172.16.0.2	ICMP 84 Echo ICMP 84 Echo	(ping) reply in (ping) request in	1=0x4a90, s	eq=8/2048, t eq=9/2304 t	ttl=64 (
18 8.030332587 172.16.0.1	172.16.0.2	ICMP 84 Echo	(ping) reply in	=0x4a90, s	eq=9/2304, t	ttl=64 (_
19 9.030425657 172.16.0.2 20 9.032352766 172.16.0.1	172.16.0.1	ICMP 84 Echo ICMP 84 Echo	(ping) request in (ping) reply in	=0x4a90, s	eq=10/2560, eq=10/2560.	tt1=64 _
▶ Frame 1: 84 bytes on wire (672 bits)	84 bytes captured (672	hits) on interface 0				
Raw packet data	or ofter outer or (or	sato, on anterrate a				
 Internet Protocol Version 4, Src: 172 Internet Control Message Protocol 	2.16.0.2, Dst: 172.16.0.1					
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0810 ac 18 00 01 08 00 7c h5 4a 90 0	8 01 1e 87 15 5d	· [· · · · · · 1				
0030 14 15 16 17 18 19 1a 1b 1c 1d 1	e 1f 20 21 22 23					
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C Z Eramo (framo) 94 hutor		- 1	ackate: 20 Dicalauad: 2	0 (100.0%)	Drofile	DeFault
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SeNB 端收封包:

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📕 gtp		Expression +					
No. Time	Source Destination	Protocol Length Info					
 165 160.3526222 167 162.3559822 170 164.3755283 173 166.3793961 176 168.3819434 	192.168.128.101 192.168.128.109 192.168.128.101 192.168.128.100 192.168.128.101 192.168.128.100 192.168.128.101 192.168.128.100 192.168.128.101 192.168.128.100 192.168.128.101 192.168.128.100	GTP <a href="https://www.com/doc/state-state</td>					
 Frame 165: 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) Internet Protocol Version 4, Src: 192.161.28:161, Dst: 192.168.128.100 User Datagram Protocol, Src Port: 2152, Dst Port: 2152 GPRS Tunneling Protocol Point-to-Point Protocol Data (84 bytes) 							
0000 d0 17 c2 cb 12 0010 00 7a fe 54 40 0020 80 64 08 68 08 0030 00 03 80 7c 45 Image: Construction of the second sec	fb 78 24 af 04 55 03 08 00 10 00	····x\$ ··U·· 2. T⊕ ⊕ ····e·· d·h·h·f ··0··V·F ··[E·-T···ê··· E Packets: 198 · Displayed: 5 (2.5%) E Profile: Default					

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Expression									
No.	Time	Source	Destination	Protocol	Length Info				
	12 4.526631389	AsustekC_cb:12:fb	AsustekC_23:07:ba	0x9e65	101 Ethernet	II			
	14 6.524811177	AsustekC cb:12:fb	AsustekC 23:07:ba	0x9e65	101 Ethernet	II			
	17 8,544230927	AsustekC cb:12:fb	AsustekC 23:07:ba	0x9e65	101 Ethernet	11			
	20 10.548090329	AsustekC cb:12:fb	AsustekC 23:07:ba	0x9e65	101 Ethernet	II			
	21 11 778640171	192 168 128 102	224 0 0 251	MDNS	160 Standard	query 0x0000 PTR ftn			
	23 12 550589248	AsustekC ch:12:fb	AsustekC 23:07:ba	0x9e65	101 Ethernet	TT T			
▶ Frame 12: 101 bytes on wire (808 bits), 101 bytes captured (808 bits) on interface 0									
Ethernet II, Src: AsystekC cb:12:fb (d0:17:c2:cb:12:fb), Dst: AsystekC 23:07:ba (10:7b:44:23:07:ba)									
Data (87 bytes)									
	. (
	10 31 11 00 03								
	10 /0 44 23 07	Da d⊎ 17 C2 Cb 12 1	b 96 65 03 80 {D	#e					
	7C 45 00 00 54	14 TA 00 00 40 01 0	00 8C aC 10 00 E-						
	01 ac 10 00 02	00 00 84 b5 4a 90 0	00 01 1e 07 15	· · · · · · · J · · · · ·					
0030	5d 00 00 00 00	3c 82 02 00 00 00 0	$00 00 10 11 12] \cdots$	<					
U deth0: eth0: eth									