

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

Mobile Edge Computing: 行動邊緣計算

實驗單元-01：開源碼 LTE 實驗平台與網頁伺服器之建置

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國立高雄科技大學 電腦與通訊工程系

Outline

- 實驗目的及實驗內容
- OAI安裝
 - 實驗環境
 - 架設OAI的EPC軟體
 - 架設OAI的eNB軟體
 - 測試OAI運行
 - UE註冊與註銷
- Web Server安裝
 - 實驗環境
 - 架設Web Server
 - UE影片瀏覽軟體安裝

實驗目的

- 了解LTE架構
- 建置核心網路(EPC)與基地台(eNB)
- 了解UE透過USRP連接EPC，與EPC做註冊
- 了解Web Server的用途

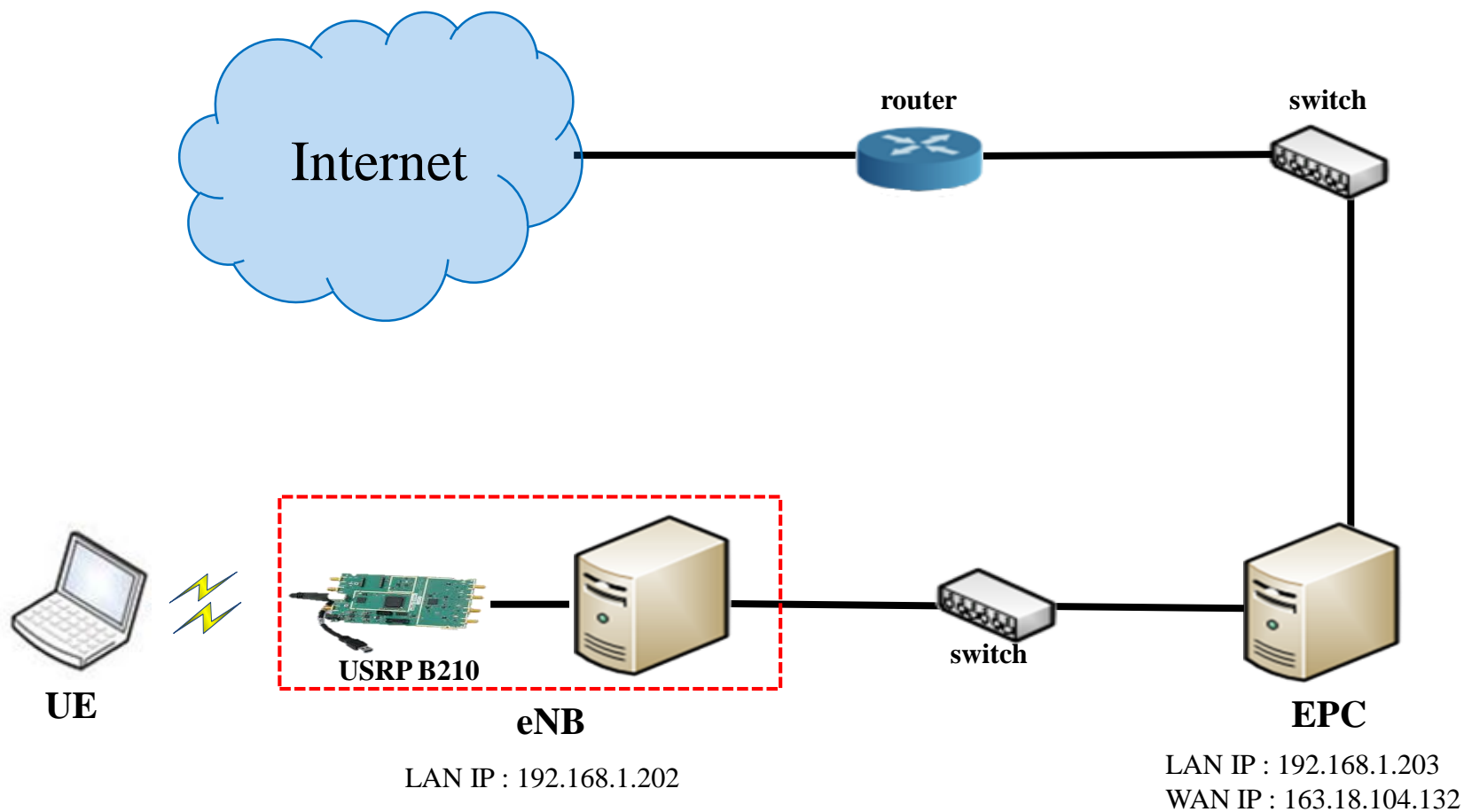
實驗內容

- 使用Linux平台架設OAI-EPC
- 使用Linux平台架設OAI-eNB
- 使用UE以USRP連線至EPC，進行註冊
- 使用Windows 10平台架設Web Server
- 使用Windows 10安裝UE的影片瀏覽軟體

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實驗架構

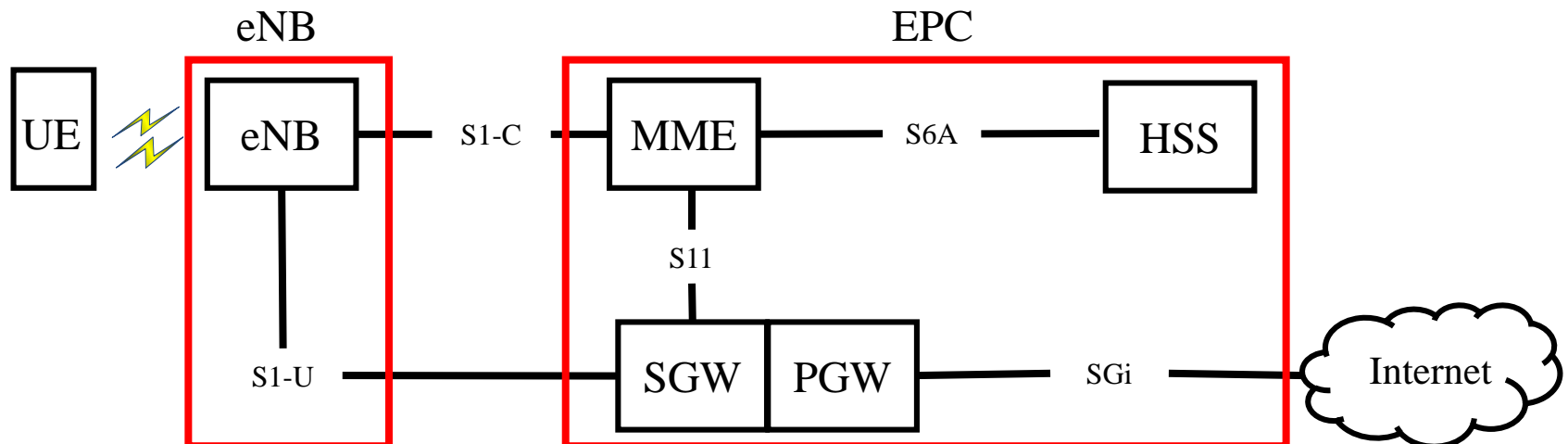


系統架構

EPC

- Mobility Management Entity(MME)
- Serving Gateway(SGW)
- PDN Gateway(PGW)
- Home Subscriber Server(HSS)

E-UTRAN Node B (eNB)



實驗設備-硬體(1/2)

名稱	硬體	數量	目的
EPC	CPU: i7-8559U RAM: 32 GB SSD: 1 TB	1 台	EPC核心網路
	Ethernet Network PCIE Card	1 個	連接WAN (for Internet)
	RJ45外接網卡 (USB)	1 個	連接LAN (for eNB)
eNB	CPU: i7-8559U RAM: 32 GB SSD: 1 TB	1 台	eNodeB 基地台
	Ethernet Network PCIE Card (embedded)	1 個	連接EPC的LAN
	USRP B210	1 片	接收 eNB 封包資料 LTE 訊號收發
	VERT2450 Antenna	2 支	收發 LTE Band 7 (2600 MHz) 訊號
	USB 3.0 cable	1 條	連接 eNB 與 USRP B210

實驗設備-硬體(2/2)

名稱	硬體	數量	目的
UE	CPU: i5-6200U RAM: 4 GB HDD: 500 GB	1 台	連接eNB
	4G Dongle	1 個	提供電腦使用行動網路
	LTE SIM卡	1 張	提供UE使用，註冊EPC
Switch	4-port switch (legacy)	1 台	LAN互相連接
RJ45雙絞線	RJ45雙邊接頭的CAT 5e網路線	5 條	Edge*2條、eNB*1條 Cloud*1條、Web Server*1條

實驗設備-軟體

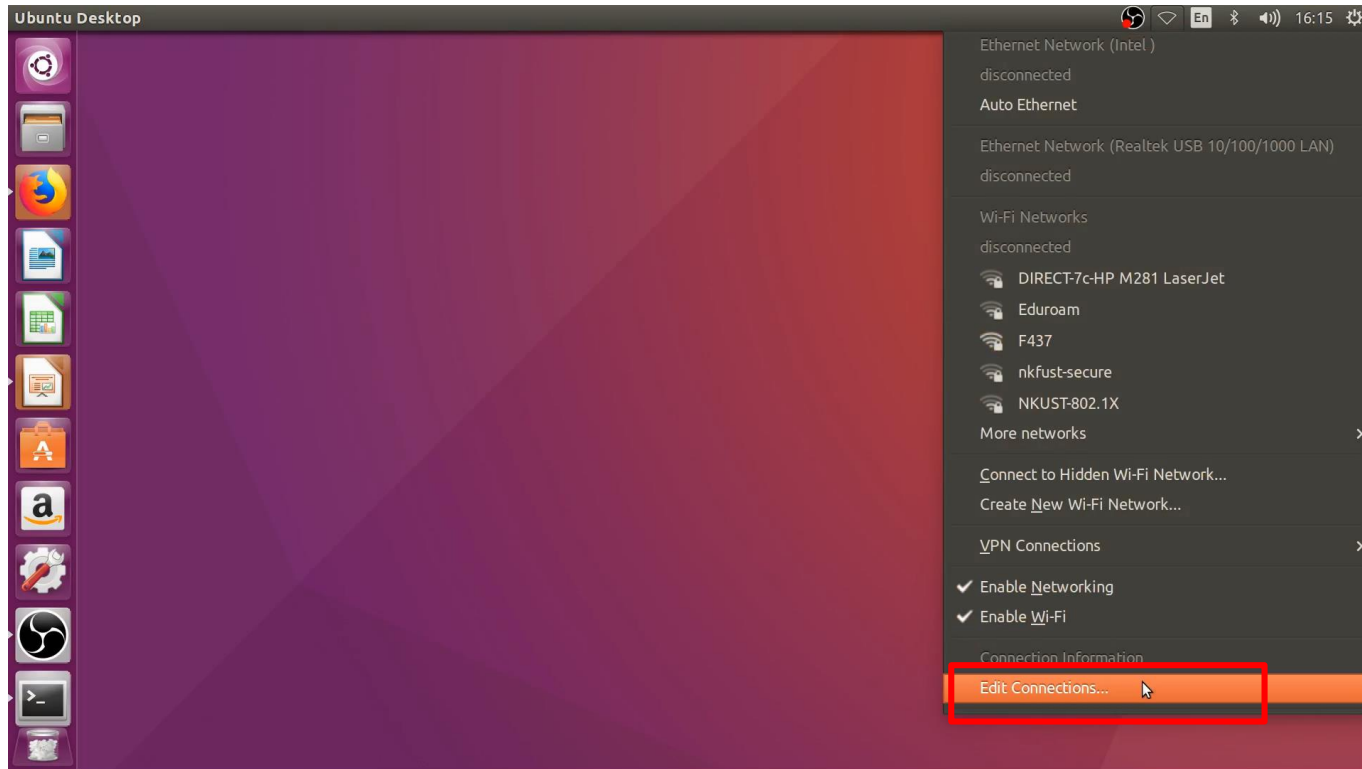
EPC	OS : Ubuntu	16.04 LTS
	openair-cn	發布日期:2017/3/31 https://gitlab.eurecom.fr/oai/openair-cn.git
	xtables-addons-oai	發布日期:2015/9/30 https://gitlab.eurecom.fr/oai/xtables-addons-oai.git
eNB	OS : Ubuntu	16.04 LTS
	openairinterface5g	發布日期:2015/8/8 https://gitlab.eurecom.fr/oai/openairinterface5g/tree/17b9a9e917ce2a3a8c7004c7b9a221c350ddfe17

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 - 實驗環境
 - 架設Web Server
 - UE影片瀏覽軟體安裝

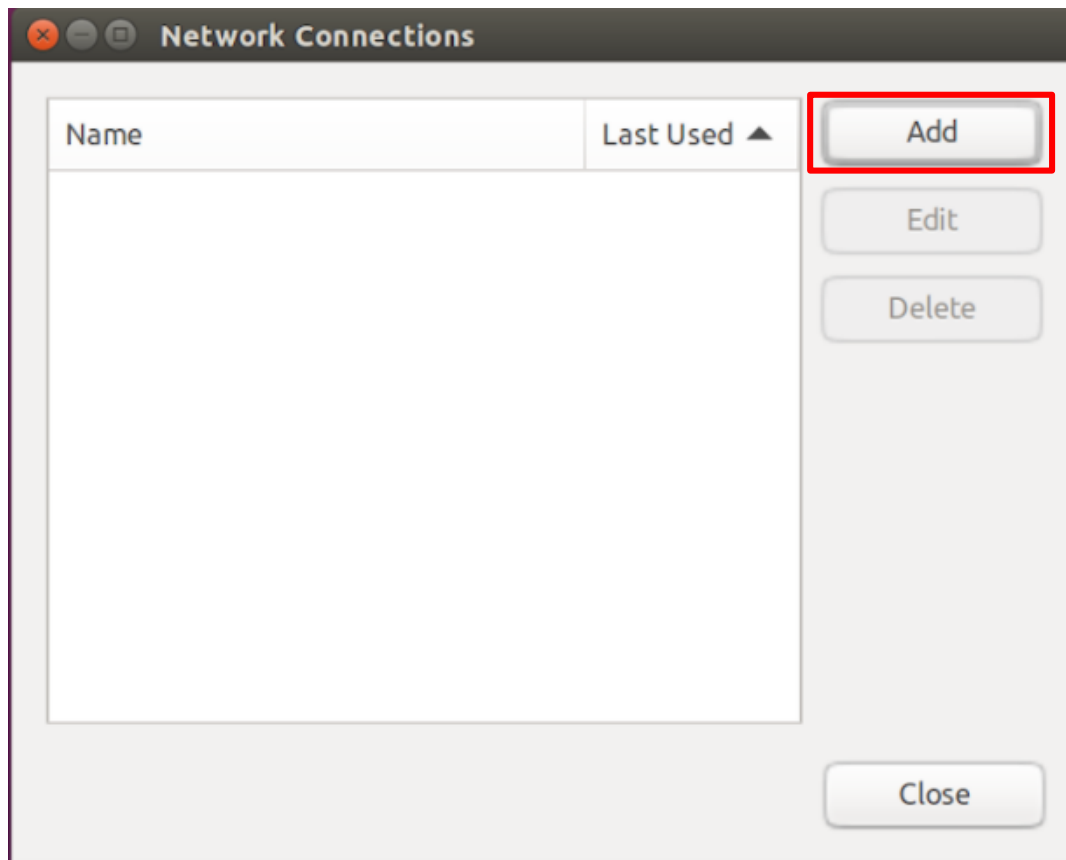
EPC安裝(新增外網-1)

新增外網，連接至Internet
點選右上角Edit Connections



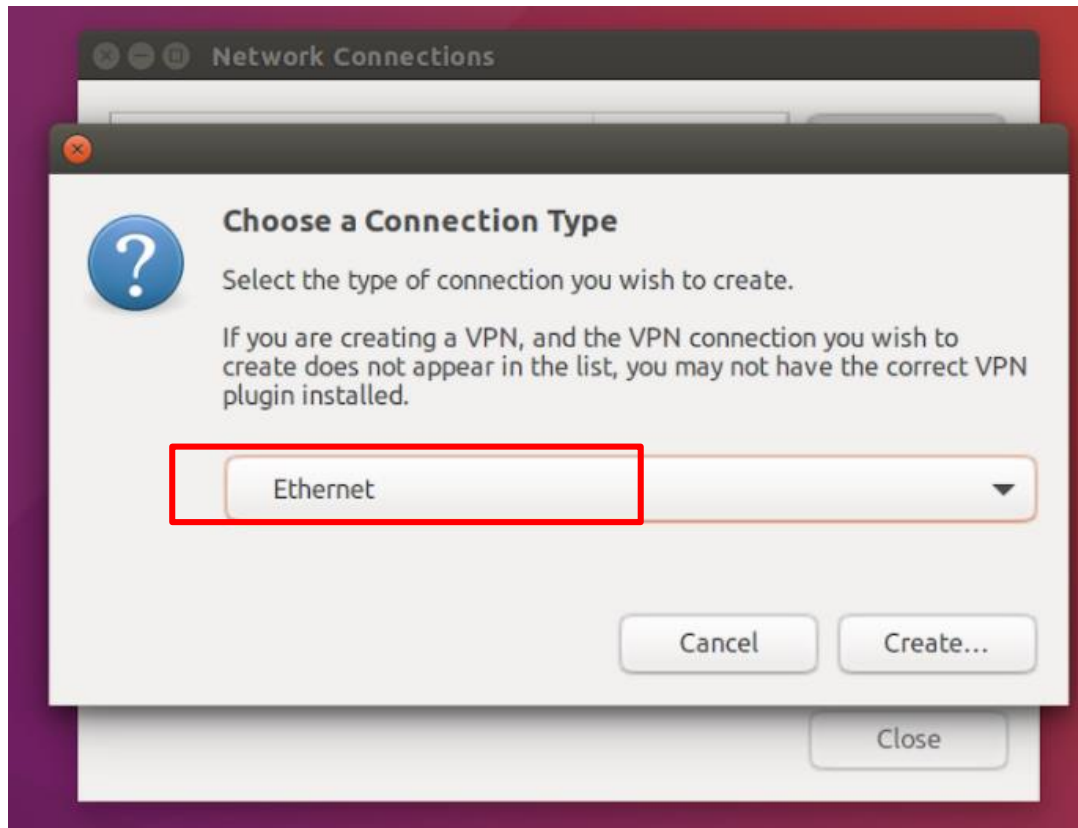
EPC安裝(新增外網-2)

點選Add新增外網



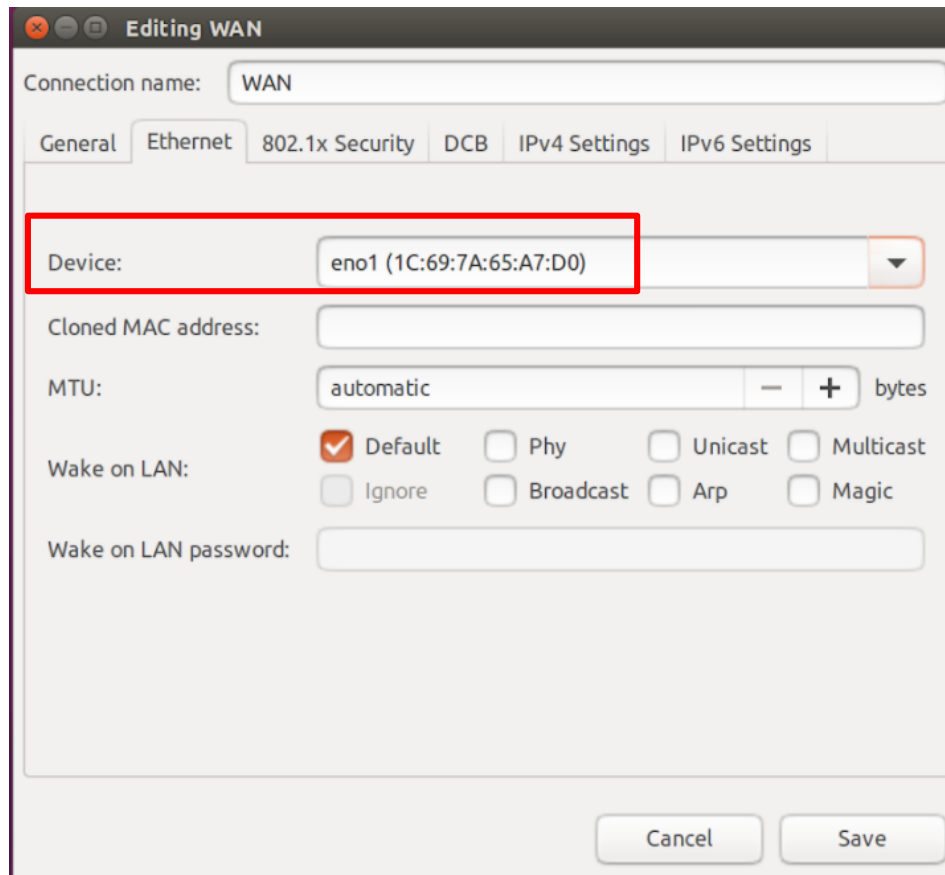
EPC安裝(新增外網-3)

模式選擇Ethernet



EPC安裝(新增外網-4)

點選Ethernet -> device 選擇對應網卡



EPC安裝(新增外網-5)

點選IPv4 Settings -> Method 選擇 Manual

新增 Addresses (參照自己的IP設定)

The screenshot shows the 'Editing WAN' window with the 'IPv4 Settings' tab selected. The 'Method' is set to 'Manual'. Below this, there is a table of addresses with the following data:

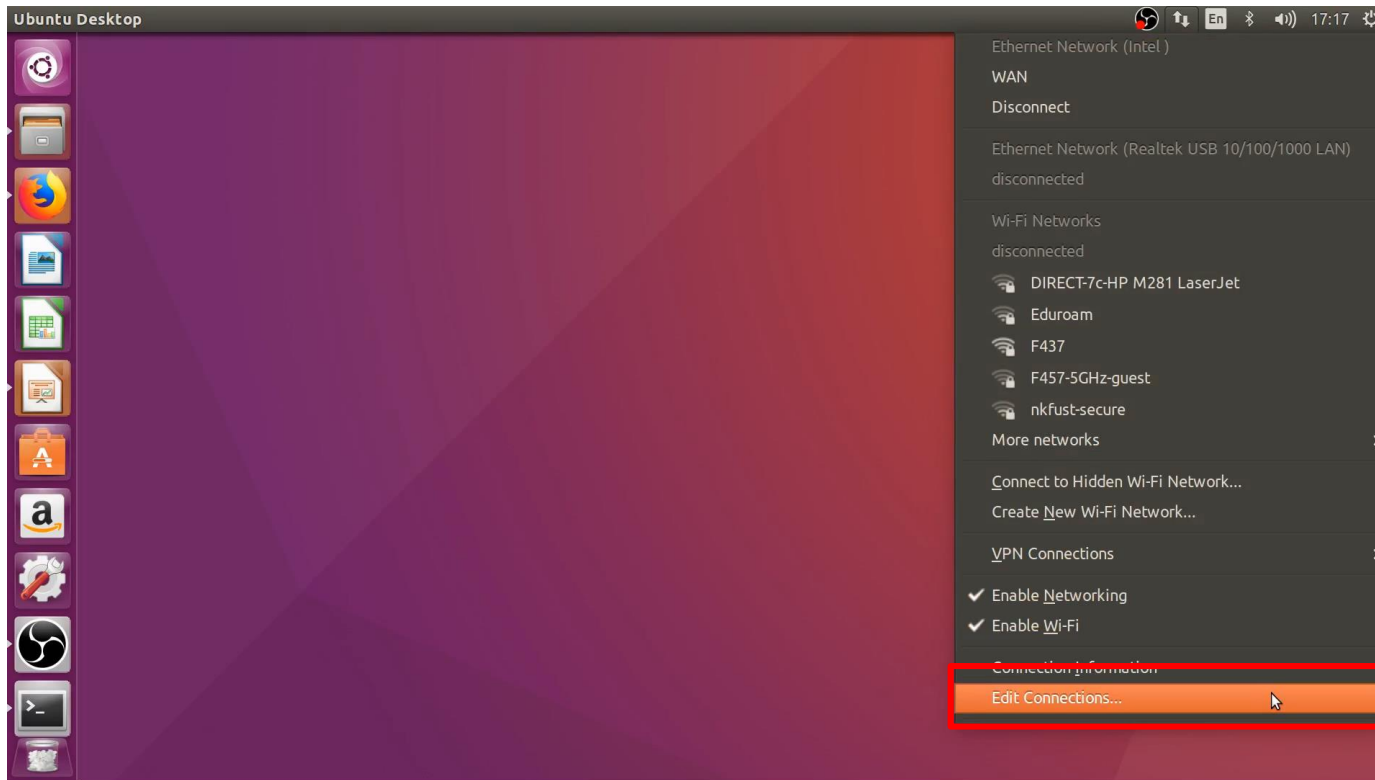
Address	Netmask	Gateway
163.18.104.145	24	163.18.104.254

Below the table, the 'DNS servers' field is set to '163.18.1.7'. There are also fields for 'Search domains' and 'DHCP client ID', and a checkbox for 'Require IPv4 addressing for this connection to complete'. At the bottom, there are 'Cancel' and 'Save' buttons.

EPC安裝(新增內網-1)

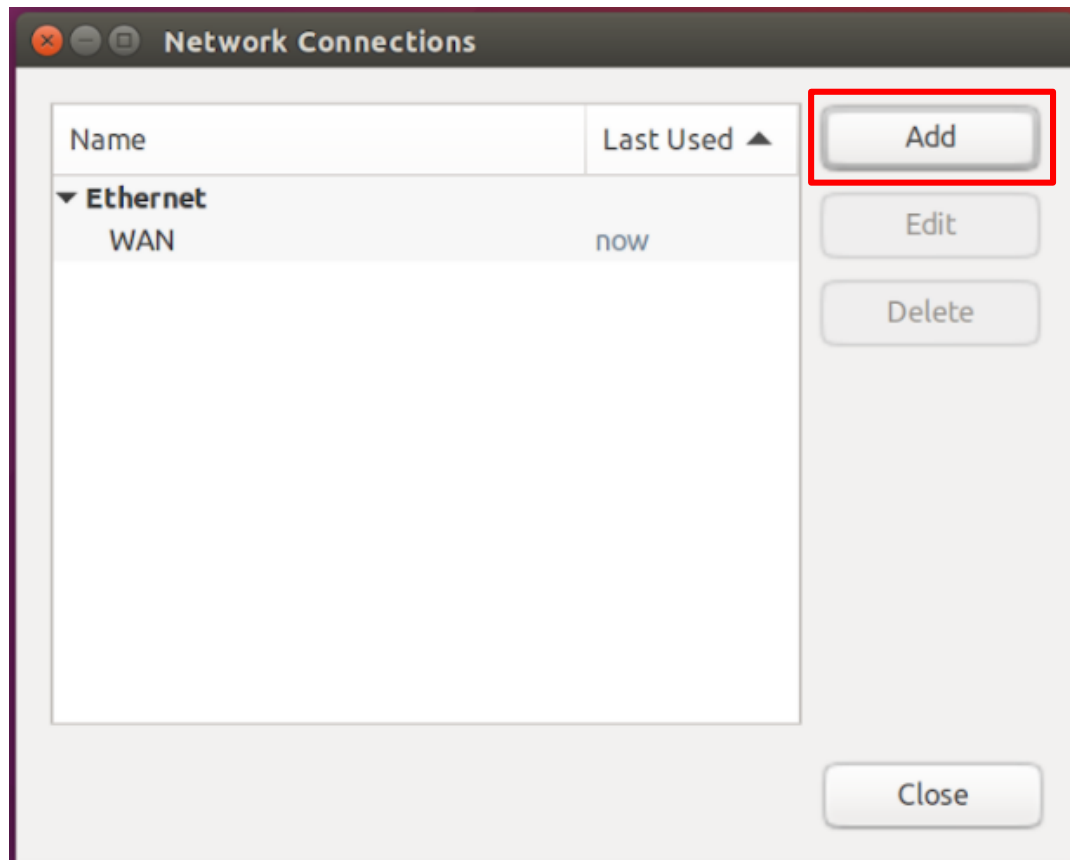
新增內網，連接至eNB

點選右上角Edit Connections



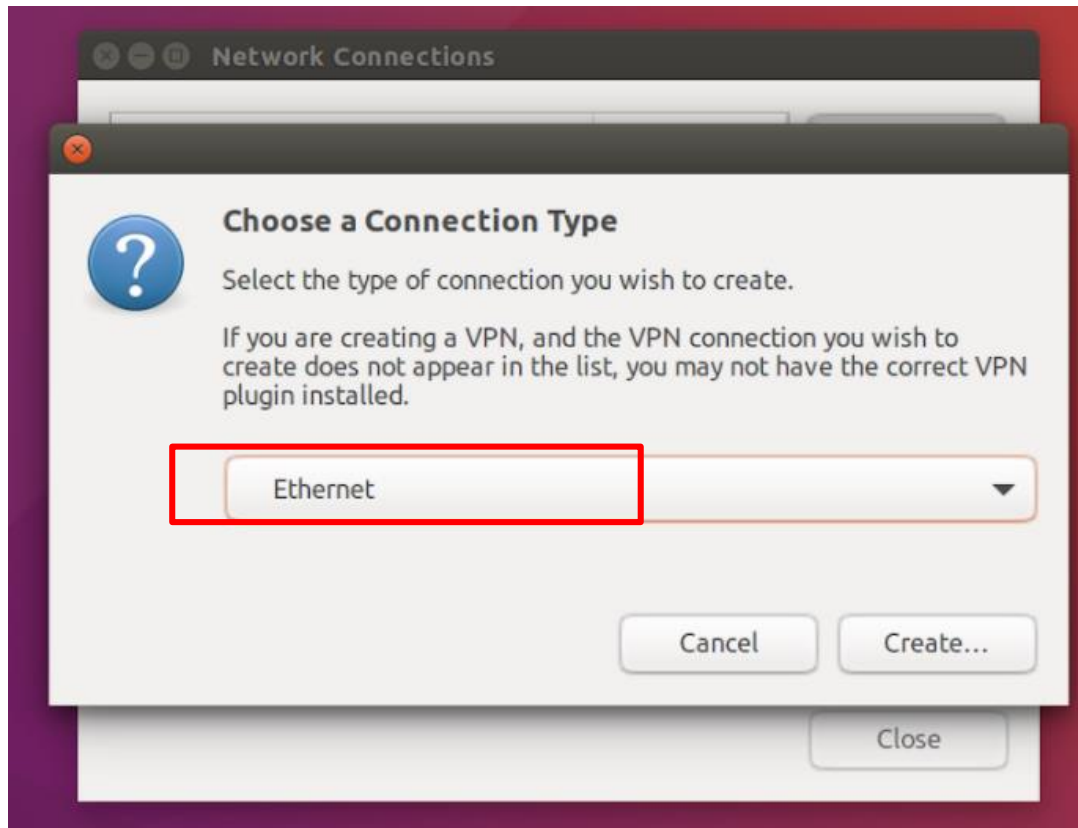
EPC安裝(新增內網-2)

點選Add新增內網



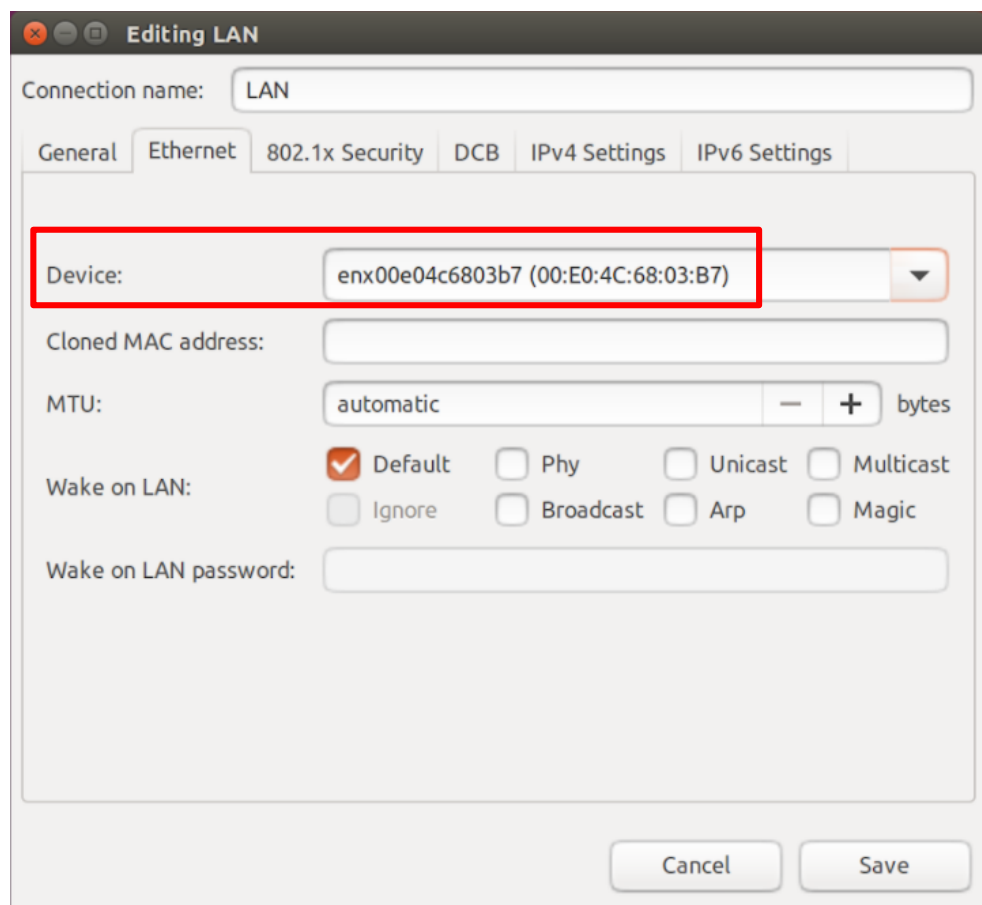
EPC安裝(新增內網-3)

模式選擇Ethernet



EPC安裝(新增內網-4)

點選Ethernet -> device 選擇對應網卡



EPC安裝(新增內網-5)

點選IPv4 Settings -> Method 選擇 Manual

新增 Addresses (設定內網 IP)

Editing LAN

Connection name: LAN

General Ethernet 802.1x Security DCB IPv4 Settings IPv6 Settings

Method: Manual

Addresses

Address	Netmask	Gateway
192.168.1.203	24	192.168.1.254

Add

Delete

DNS servers:

Search domains:

DHCP client ID:

☐ Require IPv4 addressing for this connection to complete

Routes...

Cancel Save

EPC安裝(更改預設閘道-1)

在終端機輸入

- \$ route -n
- 查看外網的Gateway

```
f437epc@f437epc: ~  
f437epc@f437epc:~$ route -n  
Kernel IP routing table  
Destination      Gateway          Genmask         Flags Metric Ref    Use Iface  
0.0.0.0          163.18.104.254  0.0.0.0         UG      100    0      0    eno1  
163.18.104.0     0.0.0.0         255.255.255.0   U        100    0      0    eno1  
169.254.0.0      0.0.0.0         255.255.0.0     U       1000    0      0    eno1  
f437epc@f437epc:~$
```

EPC安裝(更改預設閘道-2)

在終端機輸入

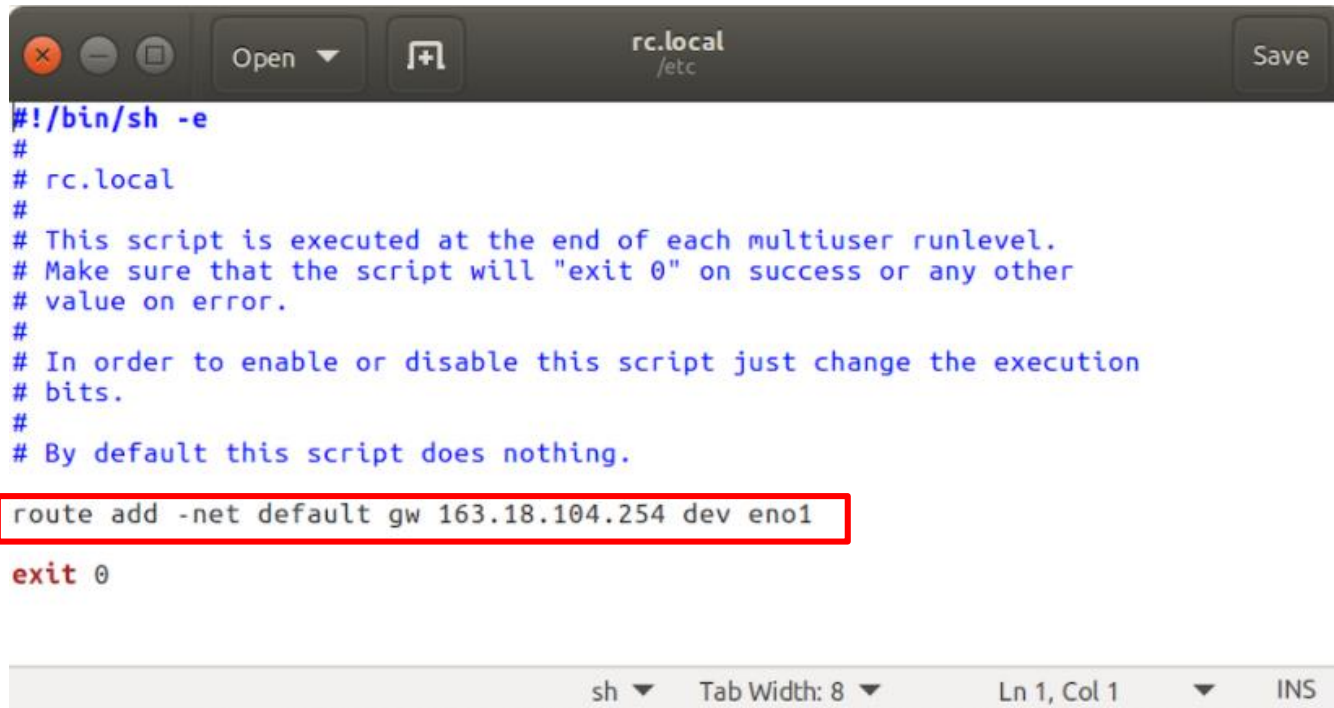
- `$ sudo route add -net default gw 163.18.104.254 dev eno1`
- 更改成外網的預設閘道

```
f437epc@f437epc: ~  
f437epc@f437epc:~$ route -n  
Kernel IP routing table  
Destination      Gateway          Genmask         Flags Metric Ref    Use Iface  
0.0.0.0          163.18.104.254  0.0.0.0         UG    100    0      0 eno1  
163.18.104.0     0.0.0.0         255.255.255.0   U     100    0      0 eno1  
169.254.0.0      0.0.0.0         255.255.0.0     U     1000   0      0 eno1  
f437epc@f437epc:~$  
f437epc@f437epc:~$  
f437epc@f437epc:~$ sudo route add -net default gw 163.18.104.254 dev eno1  
[sudo] password for f437epc:  
f437epc@f437epc:~$
```

EPC安裝(更改預設閘道-3)

在終端機輸入

- \$ sudo gedit /etc/rc.local
- 將更改預設閘道指令，輸入至開機自動生效處



```
#!/bin/sh -e
#
# rc.local
#
# This script is executed at the end of each multiuser runlevel.
# Make sure that the script will "exit 0" on success or any other
# value on error.
#
# In order to enable or disable this script just change the execution
# bits.
#
# By default this script does nothing.

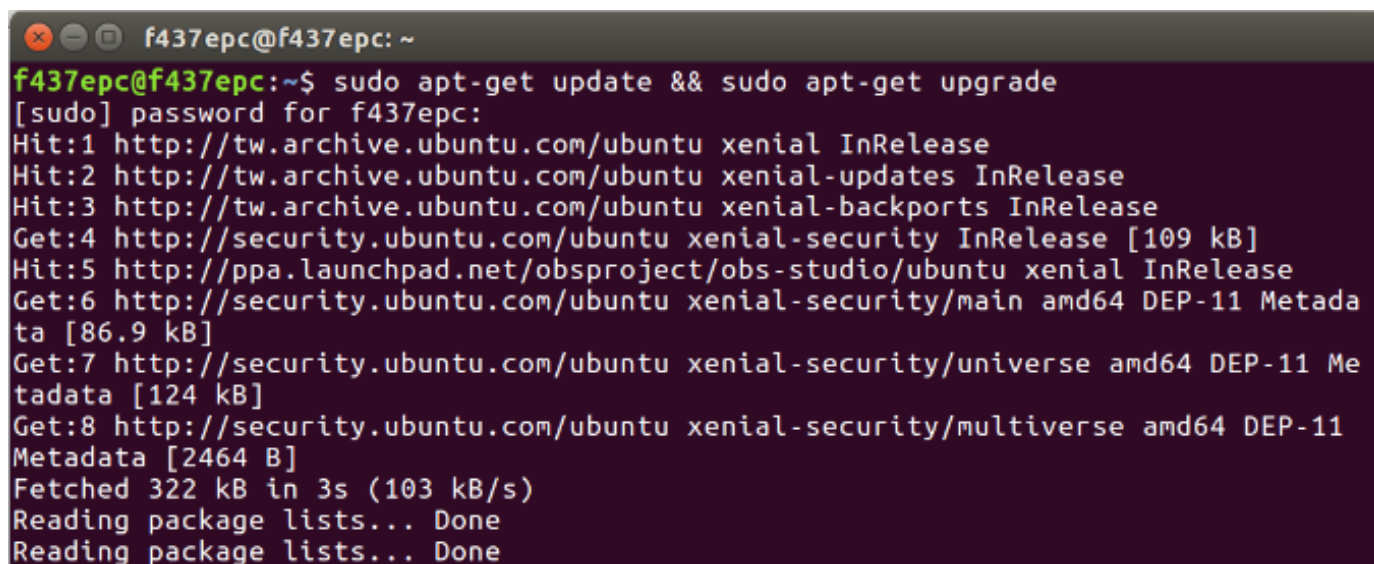
route add -net default gw 163.18.104.254 dev eno1

exit 0
```


EPC安裝(更新系統軟體)

在終端機輸入

- `$ sudo apt-get update && sudo apt-get upgrade`
- 更新系統軟體

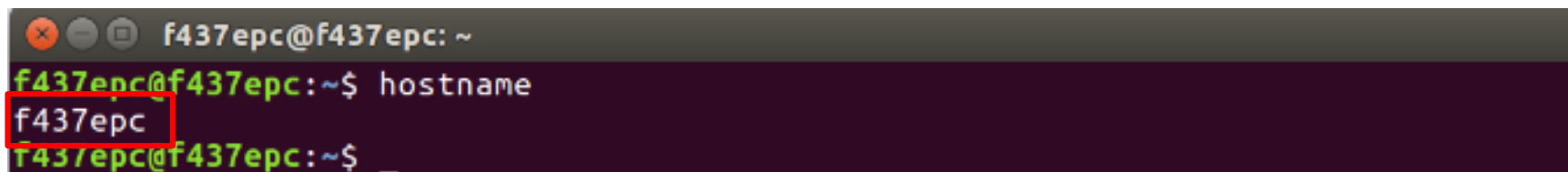


```
f437epc@f437epc: ~  
f437epc@f437epc:~$ sudo apt-get update && sudo apt-get upgrade  
[sudo] password for f437epc:  
Hit:1 http://tw.archive.ubuntu.com/ubuntu xenial InRelease  
Hit:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates InRelease  
Hit:3 http://tw.archive.ubuntu.com/ubuntu xenial-backports InRelease  
Get:4 http://security.ubuntu.com/ubuntu xenial-security InRelease [109 kB]  
Hit:5 http://ppa.launchpad.net/obsproject/obs-studio/ubuntu xenial InRelease  
Get:6 http://security.ubuntu.com/ubuntu xenial-security/main amd64 DEP-11 Metadata [86.9 kB]  
Get:7 http://security.ubuntu.com/ubuntu xenial-security/universe amd64 DEP-11 Metadata [124 kB]  
Get:8 http://security.ubuntu.com/ubuntu xenial-security/multiverse amd64 DEP-11 Metadata [2464 B]  
Fetched 322 kB in 3s (103 kB/s)  
Reading package lists... Done  
Reading package lists... Done
```

EPC安裝(查詢hostname)

在終端機輸入

- \$ hostname
- 查詢主機名稱

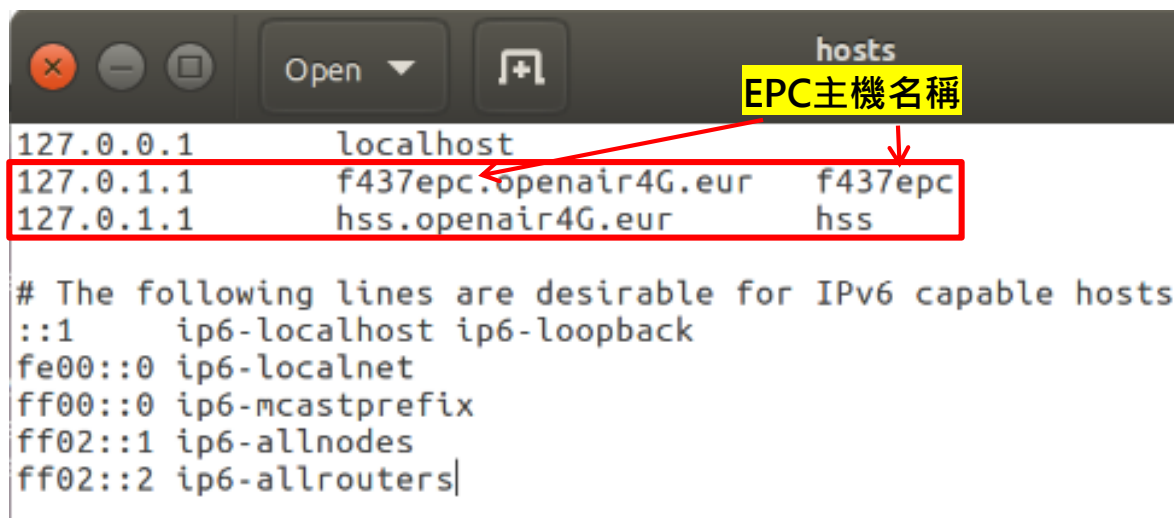


```
f437epc@f437epc: ~  
f437epc@f437epc:~$ hostname  
f437epc  
f437epc@f437epc:~$
```

EPC安裝(設定FQDN)

在終端機輸入

- `$ sudo gedit /etc/hosts`
- 設定Fully Qualified Domain Name，新增下面兩行



```
hosts
EPC主機名稱
127.0.0.1    localhost
127.0.1.1    f437epc.openair4G.eur    f437epc
127.0.1.1    hss.openair4G.eur       hss

# The following lines are desirable for IPv6 capable hosts
::1          ip6-localhost ip6-loopback
fe00::0      ip6-localnet
ff00::0      ip6-mcastprefix
ff02::1      ip6-allnodes
ff02::2      ip6-allrouters
```

EPC安裝(安裝git套件)

在終端機輸入

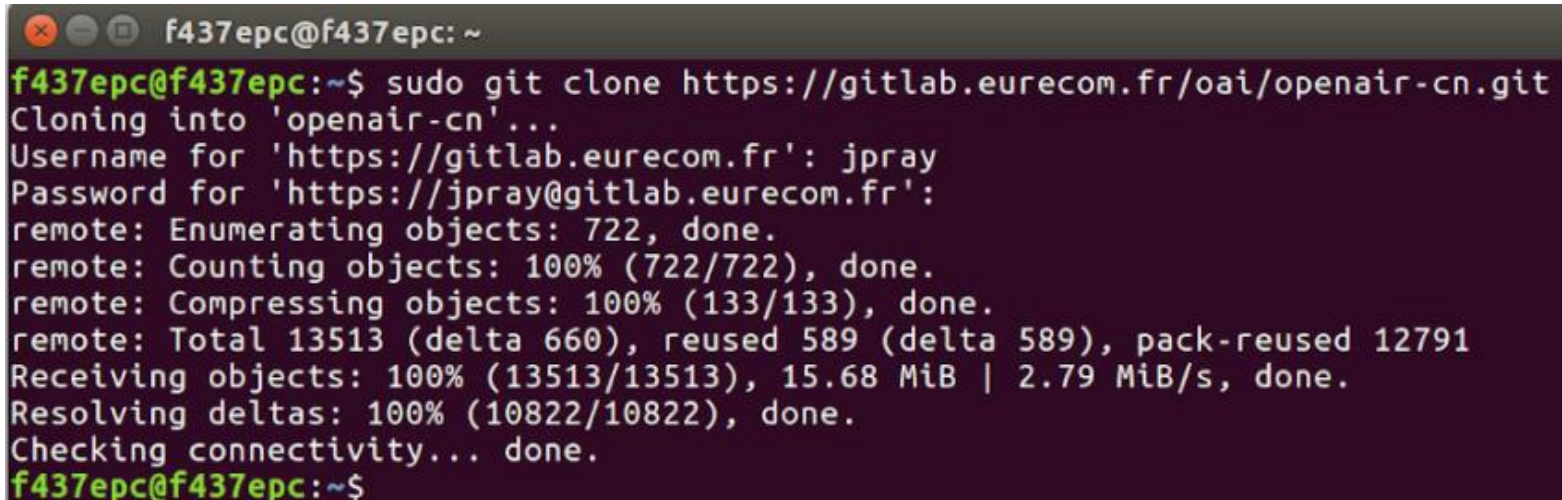
- `$ sudo apt-get install subversion git`

```
f437epc@f437epc: ~  
f437epc@f437epc:~$ sudo apt-get install subversion git  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following package was automatically installed and is no longer required:  
  snapd-login-service  
Use 'sudo apt autoremove' to remove it.  
The following additional packages will be installed:  
  git-man libapr1 libaprutil1 liberror-perl libserf-1-1 libsvn1  
Suggested packages:  
  git-daemon-run | git-daemon-sysvinit git-doc git-el git-email git-gui gitk  
  gitweb git-arch git-cvs git-mediawiki git-svn db5.3-util subversion-tools  
The following NEW packages will be installed:  
  git git-man libapr1 libaprutil1 liberror-perl libserf-1-1 libsvn1 subversion
```

EPC安裝(下載原始碼)

在終端機輸入

- `sudo git clone https://gitlab.eurecom.fr/oai/openair-cn.git`
- 下載openair-cn原始碼
- 輸入 gitlab-eurecom帳號與密碼

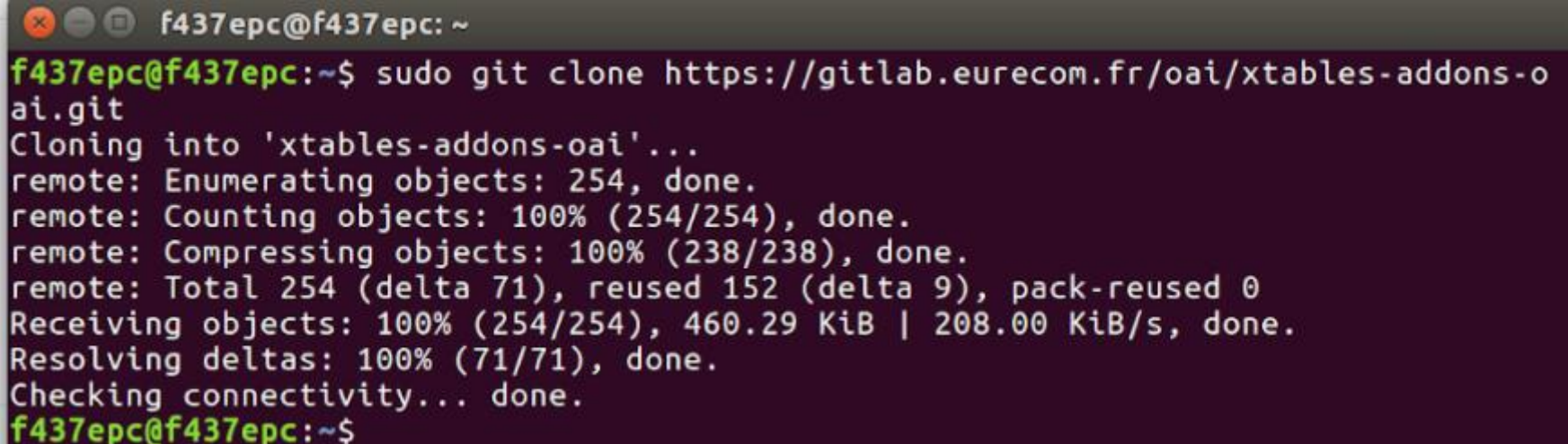


```
f437epc@f437epc: ~  
f437epc@f437epc:~$ sudo git clone https://gitlab.eurecom.fr/oai/openair-cn.git  
Cloning into 'openair-cn'...  
Username for 'https://gitlab.eurecom.fr': jpray  
Password for 'https://jpray@gitlab.eurecom.fr':  
remote: Enumerating objects: 722, done.  
remote: Counting objects: 100% (722/722), done.  
remote: Compressing objects: 100% (133/133), done.  
remote: Total 13513 (delta 660), reused 589 (delta 589), pack-reused 12791  
Receiving objects: 100% (13513/13513), 15.68 MiB | 2.79 MiB/s, done.  
Resolving deltas: 100% (10822/10822), done.  
Checking connectivity... done.  
f437epc@f437epc:~$
```

EPC安裝(下載原始碼)

在終端機輸入

- `sudo git clone https://gitlab.eurecom.fr/oai/xtables-addons-oai.git`
- 下載openair-cn原始碼
- 輸入 gitlab-eurecom帳號與密碼

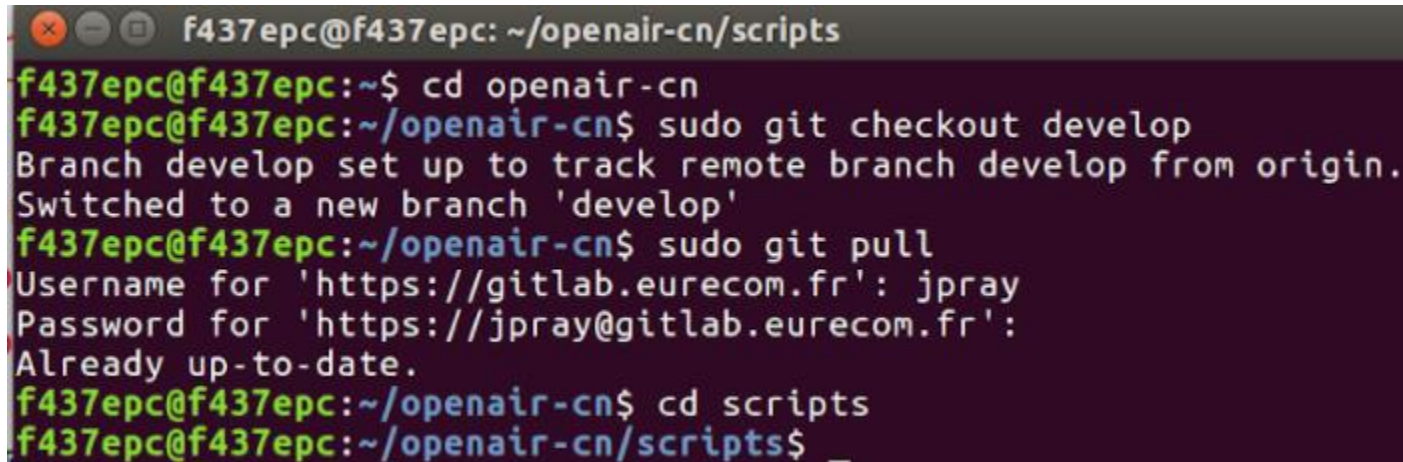


```
f437epc@f437epc: ~  
f437epc@f437epc:~$ sudo git clone https://gitlab.eurecom.fr/oai/xtables-addons-oai.git  
Cloning into 'xtables-addons-oai'...  
remote: Enumerating objects: 254, done.  
remote: Counting objects: 100% (254/254), done.  
remote: Compressing objects: 100% (238/238), done.  
remote: Total 254 (delta 71), reused 152 (delta 9), pack-reused 0  
Receiving objects: 100% (254/254), 460.29 KiB | 208.00 KiB/s, done.  
Resolving deltas: 100% (71/71), done.  
Checking connectivity... done.  
f437epc@f437epc:~$
```


EPC安裝(更新原始碼)

在終端機輸入

- `$ cd openair-cn`
- `$ sudo git checkout develop`
- `$ sudo git pull` (輸入 gitlab-eurecom帳號與密碼)
- `$ cd scripts`



```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~$ cd openair-cn
f437epc@f437epc:~/openair-cn$ sudo git checkout develop
Branch develop set up to track remote branch develop from origin.
Switched to a new branch 'develop'
f437epc@f437epc:~/openair-cn$ sudo git pull
Username for 'https://gitlab.eurecom.fr': jpray
Password for 'https://jpray@gitlab.eurecom.fr':
Already up-to-date.
f437epc@f437epc:~/openair-cn$ cd scripts
f437epc@f437epc:~/openair-cn/scripts$
```

EPC安裝(建置HSS)

在終端機輸入

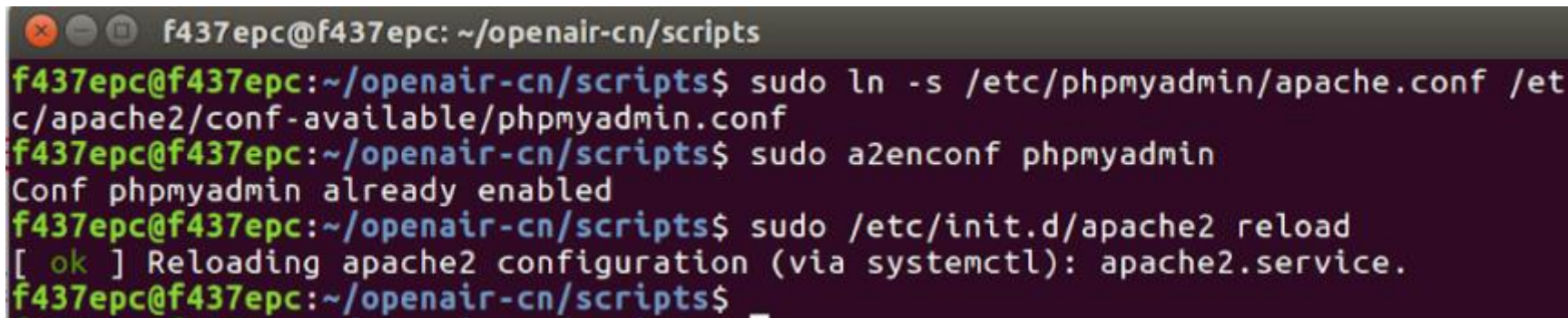
- `$ sudo ./build_hss -i`
- 安裝中出現帳密設定時，一律設定root，網頁伺服器選擇apache2

```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./build_hss -i
Check installed software packages necessary to build and run HSS (support Ubuntu
 14.04/16.04, CentOS 7, RHEL 7):
Hit:1 http://tw.archive.ubuntu.com/ubuntu xenial InRelease
Hit:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates InRelease
Hit:3 http://tw.archive.ubuntu.com/ubuntu xenial-backports InRelease
Get:4 http://security.ubuntu.com/ubuntu xenial-security InRelease [109 kB]
Hit:5 http://ppa.launchpad.net/obsproject/obs-studio/ubuntu xenial InRelease
Fetched 109 kB in 1s (60.1 kB/s)
Reading package lists... Done
Reading package lists... Done
```


EPC安裝 (phpmyadmin設定)

在終端機輸入

- `$ sudo ln -s /etc/phpmyadmin/apache.conf /etc/apache2/conf-available/phpmyadmin.conf`
- `$ sudo a2enconf phpmyadmin`
- `$ sudo /etc/init.d/apache2 reload`

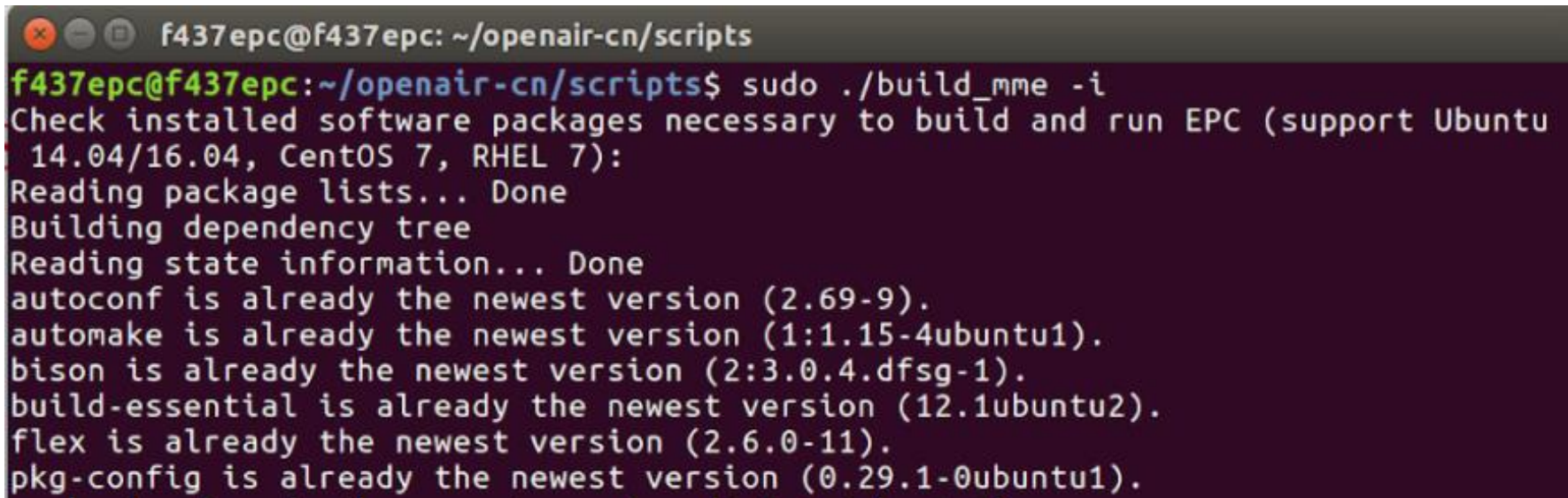


```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ln -s /etc/phpmyadmin/apache.conf /etc/apache2/conf-available/phpmyadmin.conf
f437epc@f437epc:~/openair-cn/scripts$ sudo a2enconf phpmyadmin
Conf phpmyadmin already enabled
f437epc@f437epc:~/openair-cn/scripts$ sudo /etc/init.d/apache2 reload
[ ok ] Reloading apache2 configuration (via systemctl): apache2.service.
f437epc@f437epc:~/openair-cn/scripts$
```

EPC安裝(建置MME)

在終端機輸入

- `$ sudo ./build_mme -i`

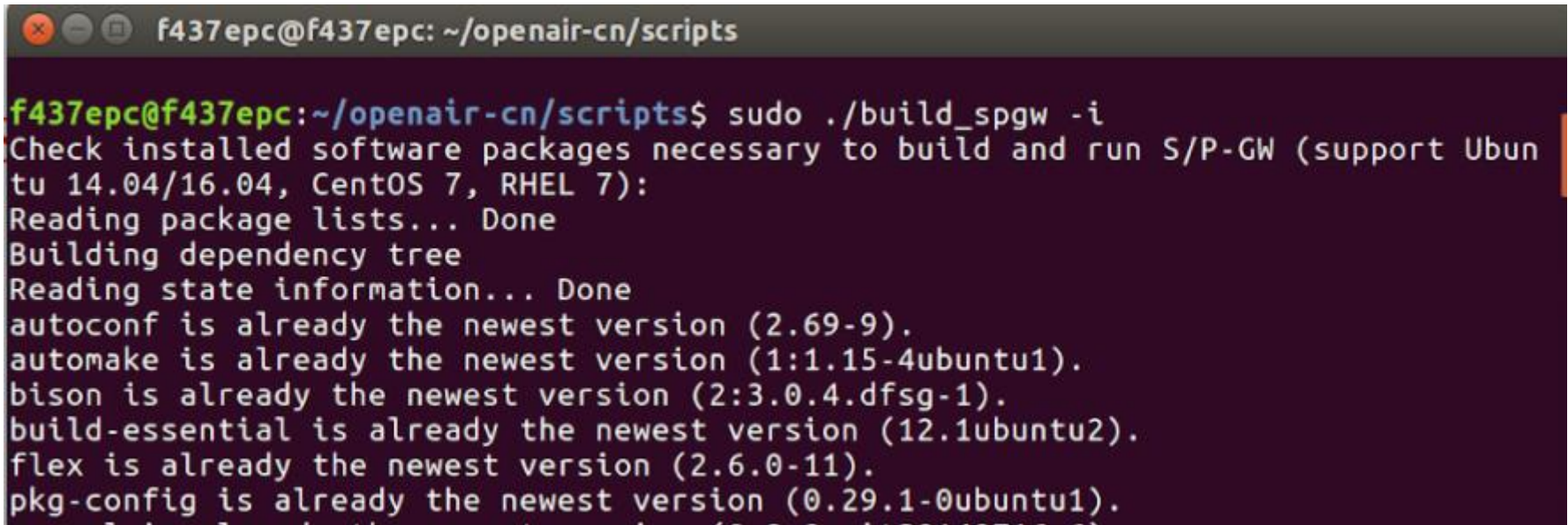
A terminal window with a dark background and light text. The window title is 'f437epc@f437epc: ~/openair-cn/scripts'. The prompt is 'f437epc@f437epc:~/openair-cn/scripts\$'. The command entered is 'sudo ./build_mme -i'. The output shows a check for installed software packages, reading package lists, building a dependency tree, and reading state information. It then lists several packages that are already the newest versions: autoconf, automake, bison, build-essential, flex, and pkg-config.

```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./build_mme -i
Check installed software packages necessary to build and run EPC (support Ubuntu
14.04/16.04, CentOS 7, RHEL 7):
Reading package lists... Done
Building dependency tree
Reading state information... Done
autoconf is already the newest version (2.69-9).
automake is already the newest version (1:1.15-4ubuntu1).
bison is already the newest version (2:3.0.4.dfsg-1).
build-essential is already the newest version (12.1ubuntu2).
flex is already the newest version (2.6.0-11).
pkg-config is already the newest version (0.29.1-0ubuntu1).
```

EPC安裝(建置SPGW)

在終端機輸入

- `$ sudo ./build_spgw -i`

A terminal window with a dark background and light-colored text. The window title bar shows the user 'f437epc' and the directory '~/openair-cn/scripts'. The terminal content shows the command 'sudo ./build_spgw -i' being executed. The script outputs a list of installed software packages and their versions, confirming they are the newest available for the system (Ubuntu 14.04/16.04, CentOS 7, RHEL 7). The packages listed are autoconf, automake, bison, build-essential, flex, and pkg-config, all with their respective version numbers.

```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./build_spgw -i
Check installed software packages necessary to build and run S/P-GW (support Ubuntu 14.04/16.04, CentOS 7, RHEL 7):
Reading package lists... Done
Building dependency tree
Reading state information... Done
autoconf is already the newest version (2.69-9).
automake is already the newest version (1:1.15-4ubuntu1).
bison is already the newest version (2:3.0.4.dfsg-1).
build-essential is already the newest version (12.1ubuntu2).
flex is already the newest version (2.6.0-11).
pkg-config is already the newest version (0.29.1-0ubuntu1).
```

EPC安裝(建立EPC設定檔)

在終端機輸入

- `$ sudo mkdir -p /usr/local/etc/oai/freeDiameter`
- `$ sudo cp ~/openair-cn/etc/mme.conf /usr/local/etc/oai`
- `$ sudo cp ~/openair-cn/etc/hss.conf /usr/local/etc/oai`
- `$ sudo cp ~/openair-cn/etc/spgw.conf /usr/local/etc/oai`
- `$ sudo cp ~/openair-cn/etc/acl.conf /usr/local/etc/oai/freeDiameter`
- `$ sudo cp ~/openair-cn/etc/mme_fd.conf /usr/local/etc/oai/freeDiameter`
- `$ sudo cp ~/openair-cn/etc/hss_fd.conf /usr/local/etc/oai/freeDiameter`

EPC安裝(修改HSS設定檔)

在終端機輸入

- \$ sudo gedit /usr/local/etc/oai/hss.conf
- 修改MYSQL_user、MYSQL_pass、OPERATOR_key

```
HSS :  
{  
## MySQL mandatory options  
MYSQL_server = "127.0.0.1";      # HSS S6a bind address  
MYSQL_user    = "root";          # Database server login  
MYSQL_pass    = "root";          # Database server password  
MYSQL_db      = "oai_db";        # Your database name  
  
## HSS options  
#OPERATOR_key = "1006020f0a478bf6b699f15c062e42b3"; # OP key matching your database  
OPERATOR_key  = "11111111111111111111111111111111"; # OP key matching your database
```


EPC安裝(修改MME設定檔-1)

在終端機輸入

- \$ sudo gedit /usr/local/etc/oai/mme.conf
- MCC、MNC、TAC對應SIM卡的資訊

```
GUMMEI_LIST = (  
    {MCC="208" ; MNC="93" ; MME_GID="4" ; MME_CODE="1" ; }  
);  
  
# ----- MME served TAIs  
# TA (mcc.mnc:tracking area code) DEFAULT = 208.34:1  
# max values = 999.999:65535  
# maximum of 16 TAIs, comma separated  
# !!! Actually use only one PLMN  
TAI_LIST = (  
    {MCC="208" ; MNC="93" ; TAC = "1" ; }  
);
```

EPC安裝(修改MME設定檔-2)

- 修改MME對內網卡名稱與IP

```
NETWORK_INTERFACES :  
{  
    # MME binded interface for S1-C or S1-MME communication (S1AP), c  
    lon't advise wireless interfaces  
    MME_INTERFACE_NAME_FOR_S1_MME           = "enx00e04c6803b7";  
    MME_IPV4_ADDRESS_FOR_S1_MME             = "192.168.1.203/24";  
  
    # MME binded interface for S11 communication (GTPV2-C)  
    MME_INTERFACE_NAME_FOR_S11_MME          = "lo";  
    MME_IPV4_ADDRESS_FOR_S11_MME            = "127.0.11.1/8";  
    MME_PORT_FOR_S11_MME                    = 2123;  
};
```

EPC內網的網卡名稱與IP位址

EPC安裝(修改SPGW設定檔-1)

在終端機輸入

- \$ sudo gedit /usr/local/etc/oai/spgw.conf
- 修改S-GW對內網卡名稱與IP

```
S-GW :
{
    NETWORK_INTERFACES :
    {
        # S-GW binded interface for S11 communication (GTPV2-C), if none selected the IT
        SGW_INTERFACE_NAME_FOR_S11                = "lo";                        # STRING
        HERE
        SGW_IPV4_ADDRESS_FOR_S11                    = "127.0.11.2/8";            # STRING

        # S-GW binded interface for S1-U communication (GTPV1-U) can be ethernet interfa
        advise wireless interfaces
        SGW_INTERFACE_NAME_FOR_S1U_S12_S4_UP        = "enx00e04c6803b7";
        NETWORK CONFIG HERE, USE "lo" if S-GW run on eNB host
        SGW_IPV4_ADDRESS_FOR_S1U_S12_S4_UP          = "192.168.1.203/24";        # STRING
        SGW_IPV4_PORT_FOR_S1U_S12_S4_UP             = 2152;                    # INTEGE
        YOU KNOW WHAT YOU ARE DOING
    }
}
```

EPC內網的網卡名稱與IP位址

EPC安裝(修改SPGW設定檔-2)

- 修改P-GW對外網卡名稱
- 開啟NET功能

```
P-GW =
{
    NETWORK_INTERFACES :
    {
        # P-GW binded interface for S5 or S8 communication, not implemented, so leave it to none
        PGW_INTERFACE_NAME_FOR_S5_S8      = "none";                # STRING, interface name
        IMPLEMENTED YET)

        # P-GW binded interface for SGI (egress/ingress internet traffic)
        PGW_INTERFACE_NAME_FOR_SGI         = "eno1";              # STRING, YOUR NETWORK CARD NAME
        PGW_MASQUERADE_SGI                  = "yes";              # STRING, {"yes", "no"}
        HERE, will do NAT for you if you put "yes".
        UE_TCP_MSS_CLAMPING                 = "no";                # STRING, {"yes", "no"}.
    };
};
```

EPC外網的網卡名稱

開啟NET功能

EPC安裝(修改SPGW設定檔-3)

- 設定DNS IP與MTU

```
IP_ADDRESS_POOL :
{
    IPV4_LIST = (
        "172.16.0.0/12"
    );
};

# DNS address communicated to UEs
DEFAULT_DNS_IPV4_ADDRESS = "163.18.1.7";
DEFAULT_DNS_SEC_IPV4_ADDRESS = "8.8.8.8";

# Non standard feature, normally should be set to "no", b
a PDN address through NAS signalling
FORCE_PUSH_PROTOCOL_CONFIGURATION_OPTIONS = "no";
UE_MTU = 1280;
```

設定DNS IP

UE為手機時，設定yes

EPC安裝(修改mme_fd設定檔)

在終端機輸入

- \$ sudo gedit /usr/local/etc/oai/freeDiameter/mme_fd.conf
- 修改Identity

```
# ----- Local -----  
  
# Uncomment if the framework cannot resolve it.  
Identity = "f437epc.openair4G.eur";  
Realm = "openair4G.eur";  
  
# TLS configuration (see previous section)  
TLS_Cred = "/usr/local/etc/oai/freeDiameter/mme.cert.pem",  
          "/usr/local/etc/oai/freeDiameter/mme.key.pem";  
TLS_CA   = "/usr/local/etc/oai/freeDiameter/mme.cacert.pem";  
  
# Disable use of TCP protocol (only listen and connect in SCTP)  
# Default : TCP enabled  
No SCTP.
```

EPC主機名稱

EPC安裝(OAI認證-1)

在終端機輸入

- `$ cd ~/openair-cn/scripts`
- `$ sudo ./check_hss_s6a_certificate /usr/local/etc/oai/freeDiameter/hss.openair4G.eur`

```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ cd ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./check_hss_s6a_certificate /usr/local/etc/oai/freeDiameter/hss.openair4G.eur
HSS S6A: Did not find valid certificate in /usr/local/etc/oai/freeDiameter/
HSS S6A: generating new certificate in /usr/local/etc/oai/freeDiameter/...
Creating HSS certificate for user 'hss.openair4G.eur'
Generating a 1024 bit RSA private key
.....++++++
.....++++++
writing new private key to 'hss.cakey.pem'
-----
Generating RSA private key, 1024 bit long modulus
.....++++++
.....++++++
e is 65537 (0x10001)
Using configuration from /usr/lib/ssl/openssl.cnf
```

EPC安裝(OAI認證-2)

在終端機輸入

- `$ cd ~/openair-cn/scripts`
- `$ sudo ./check_mme_s6a_certificate /usr/local/etc/oai/freeDiameter/
f437epc.openair4G.eur`

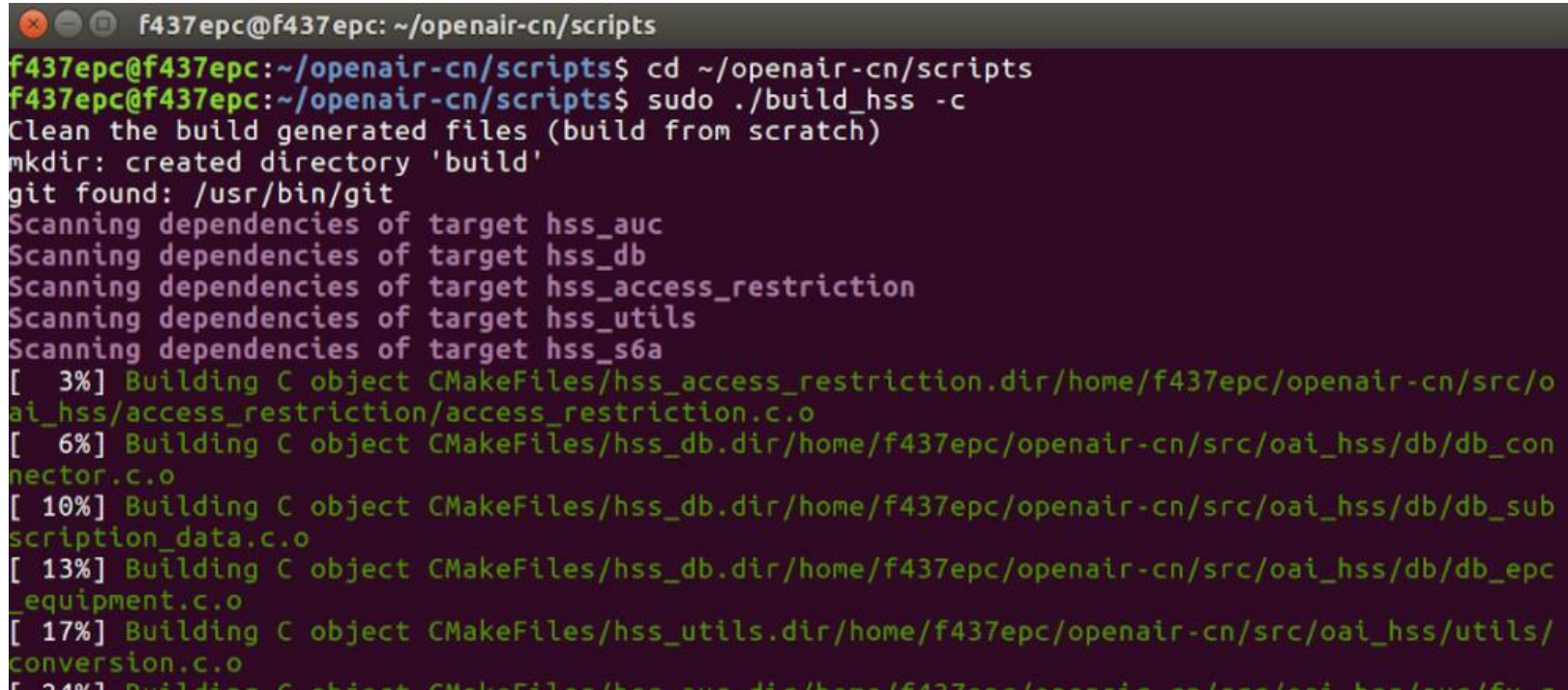
EPC主機名稱

```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ cd ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./check_mme_s6a_certificate /usr/local/etc/oai/freeDiameter/ f437epc.openair4G.eur
File /usr/local/etc/oai/freeDiameter//mme.cert.pem not found
MME S6A: Did not find valid certificate in /usr/local/etc/oai/freeDiameter/
MME S6A: generating new certificate in /usr/local/etc/oai/freeDiameter/...
Creating MME certificate for user 'f437epc.openair4G.eur'
Generating a 1024 bit RSA private key
.....+++++
.....+++++
writing new private key to 'mme.cakey.pem'
-----
Generating RSA private key, 1024 bit long modulus
.....+++++
.....+++++
e is 65537 (0x10001)
Using configuration from /usr/lib/ssl/openssl.cnf
Check that the request matches the signature
```


EPC安裝(編譯HSS)

在終端機輸入

- `$ cd ~/openair-cn/scripts`
- `sudo ./build_hss -c`



```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ cd ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./build_hss -c
Clean the build generated files (build from scratch)
mkdir: created directory 'build'
git found: /usr/bin/git
Scanning dependencies of target hss_auc
Scanning dependencies of target hss_db
Scanning dependencies of target hss_access_restriction
Scanning dependencies of target hss_utils
Scanning dependencies of target hss_s6a
[ 3%] Building C object CMakeFiles/hss_access_restriction.dir/home/f437epc/openair-cn/src/oai_hss/access_restriction/access_restriction.c.o
[ 6%] Building C object CMakeFiles/hss_db.dir/home/f437epc/openair-cn/src/oai_hss/db/db_connector.c.o
[ 10%] Building C object CMakeFiles/hss_db.dir/home/f437epc/openair-cn/src/oai_hss/db/db_subscription_data.c.o
[ 13%] Building C object CMakeFiles/hss_db.dir/home/f437epc/openair-cn/src/oai_hss/db/db_epc_equipment.c.o
[ 17%] Building C object CMakeFiles/hss_utils.dir/home/f437epc/openair-cn/src/oai_hss/utils/conversion.c.o
[ 24%] Building C object CMakeFiles/hss_auc.dir/home/f437epc/openair-cn/src/oai_hss/au...
```

EPC安裝(編譯MME)

在終端機輸入

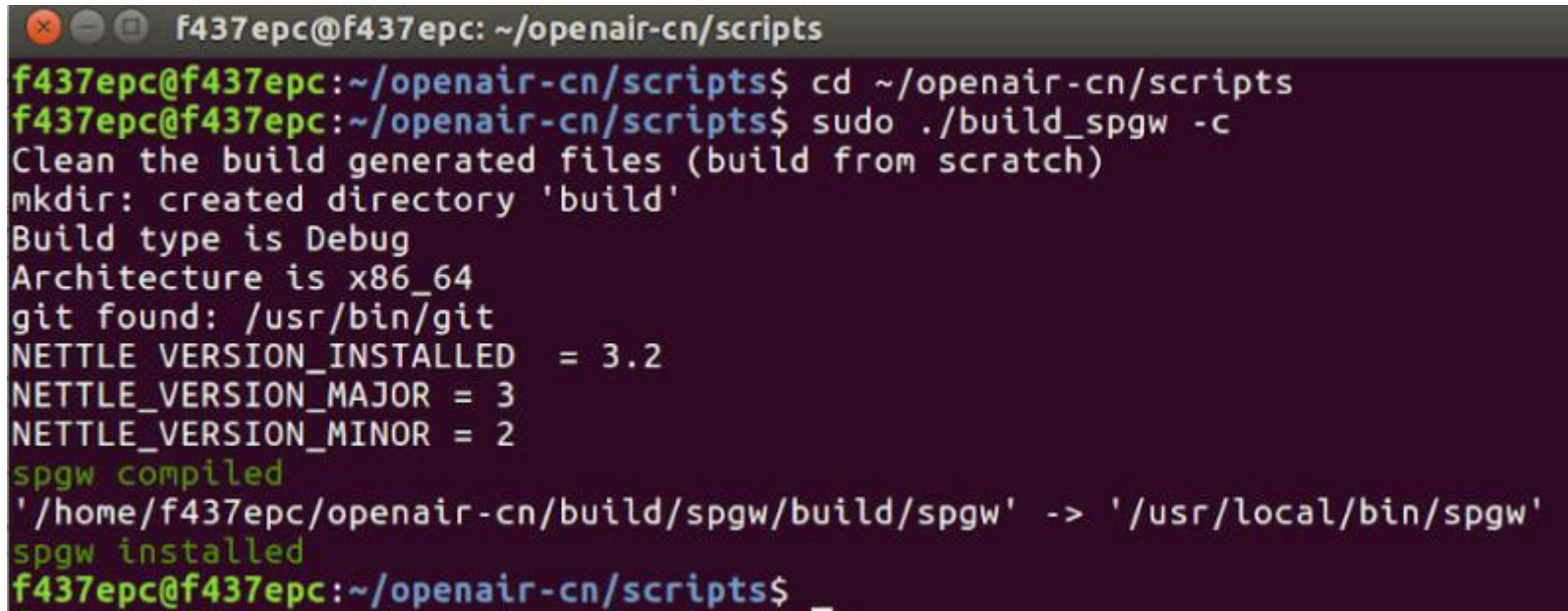
- `$ cd ~/openair-cn/scripts`
- `sudo ./build_mme -c`

```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ cd ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./build_mme -c
Clean the build generated files (build from scratch)
mkdir: created directory 'build'
Build type is Debug
Architecture is x86_64
git found: /usr/bin/git
NETTLE_VERSION_INSTALLED = 3.2
NETTLE_VERSION_MAJOR = 3
NETTLE_VERSION_MINOR = 2
mme compiled
'/home/f437epc/openair-cn/build/mme/build/mme' -> '/usr/local/bin/mme'
mme installed
auth_request compiled
'/home/f437epc/openair-cn/build/mme/build/auth_request' -> '/usr/local/bin/auth_request'
auth_request installed
f437epc@f437epc:~/openair-cn/scripts$
```

EPC安裝(編譯SPGW)

在終端機輸入

- `$ cd ~/openair-cn/scripts`
- `sudo ./build_spgw -c`

A terminal window with a dark background and light-colored text. The window title bar shows 'f437epc@f437epc: ~/openair-cn/scripts'. The terminal content shows the user navigating to the scripts directory and running 'sudo ./build_spgw -c'. The output indicates that build files are cleaned, a 'build' directory is created, and the build type is 'Debug' for 'x86_64' architecture. It also shows the location of 'git' and the version of 'NETTLE' (3.2). The final output states 'spgw compiled' and shows the installation path from the build directory to '/usr/local/bin/spgw'.

```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ cd ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./build_spgw -c
Clean the build generated files (build from scratch)
mkdir: created directory 'build'
Build type is Debug
Architecture is x86_64
git found: /usr/bin/git
NETTLE VERSION_INSTALLED  = 3.2
NETTLE_VERSION_MAJOR     = 3
NETTLE_VERSION_MINOR     = 2
spgw compiled
'/home/f437epc/openair-cn/build/spgw/build/spgw' -> '/usr/local/bin/spgw'
spgw installed
f437epc@f437epc:~/openair-cn/scripts$
```


EPC安裝(oai_db匯入資料庫)

在終端機輸入

- `$ sudo ./run_hss -i ~/openair-cn/src/oai_hss/db/oai_db.sql`
(匯入完成後，按 ctrl + c)

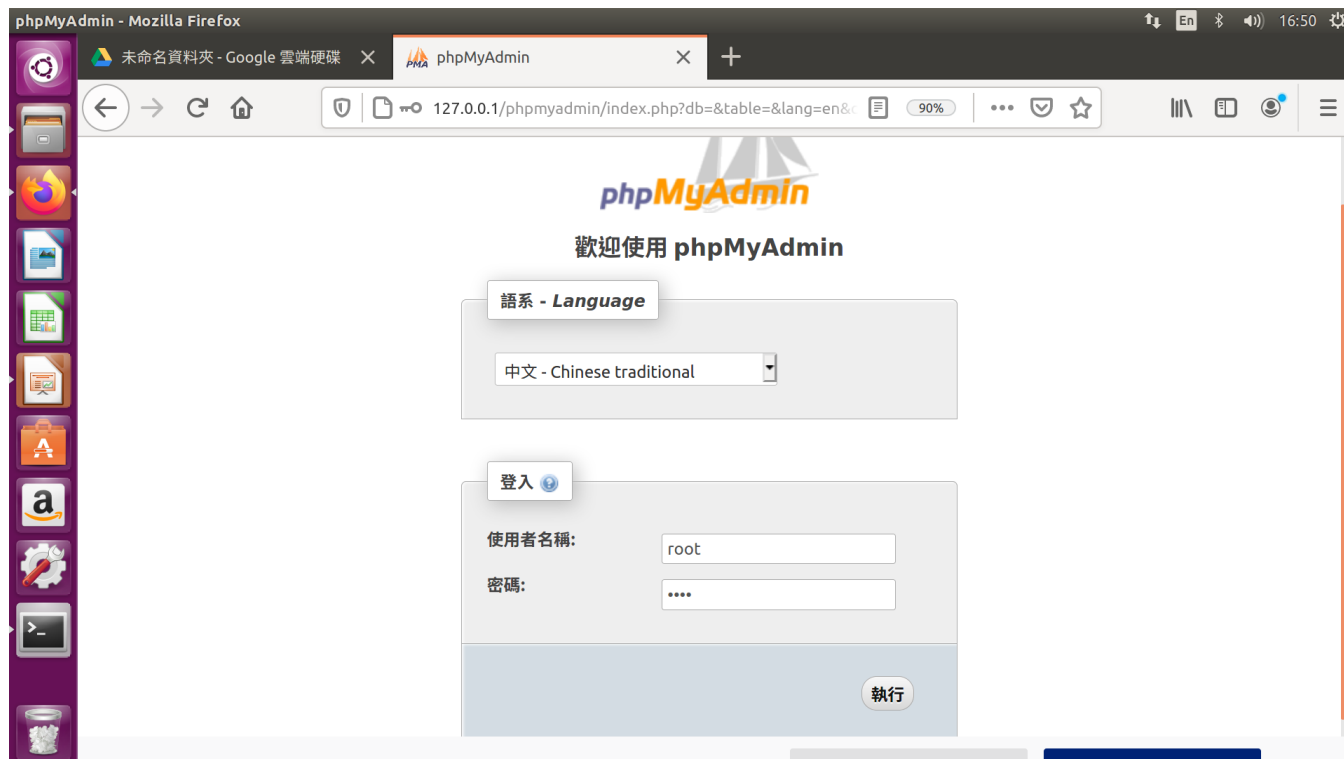
```
f437epc@f437epc: ~/openair-cn/scripts
f437epc@f437epc:~/openair-cn/scripts$ sudo ./run_hss -i ~/openair-cn/src/oai_hss/db/oai_db.sql
setting import DB flag to: 1
OPENAIRCN_DIR    = /home/f437epc/openair-cn
mysqladmin: [Warning] Using a password on the command line interface can be insecure.
mysqladmin: DROP DATABASE oai_db failed;
error: 'Can't drop database 'oai_db'; database doesn't exist'
mysql: [Warning] Using a password on the command line interface can be insecure.
HSS: oai_db creation succeeded
mysql: [Warning] Using a password on the command line interface can be insecure.
HSS: oai_db import succeeded
==== EURECOM OPENAIR-HSS vBranch: develop Abrev. Hash: 724542d Date: Thu Jun 22 16:17:12 2017
+0200 ====
Please report any bug to: openaircn-user@lists.eurecom.fr

Parsing configuration file: /usr/local/etc/oai/hss.conf
Configuration
```

EPC安裝(進入資料庫)

開啟瀏覽器 輸入網址：127.0.0.1/phpmyadmin

- 輸入帳號：root
- 輸入密碼：root

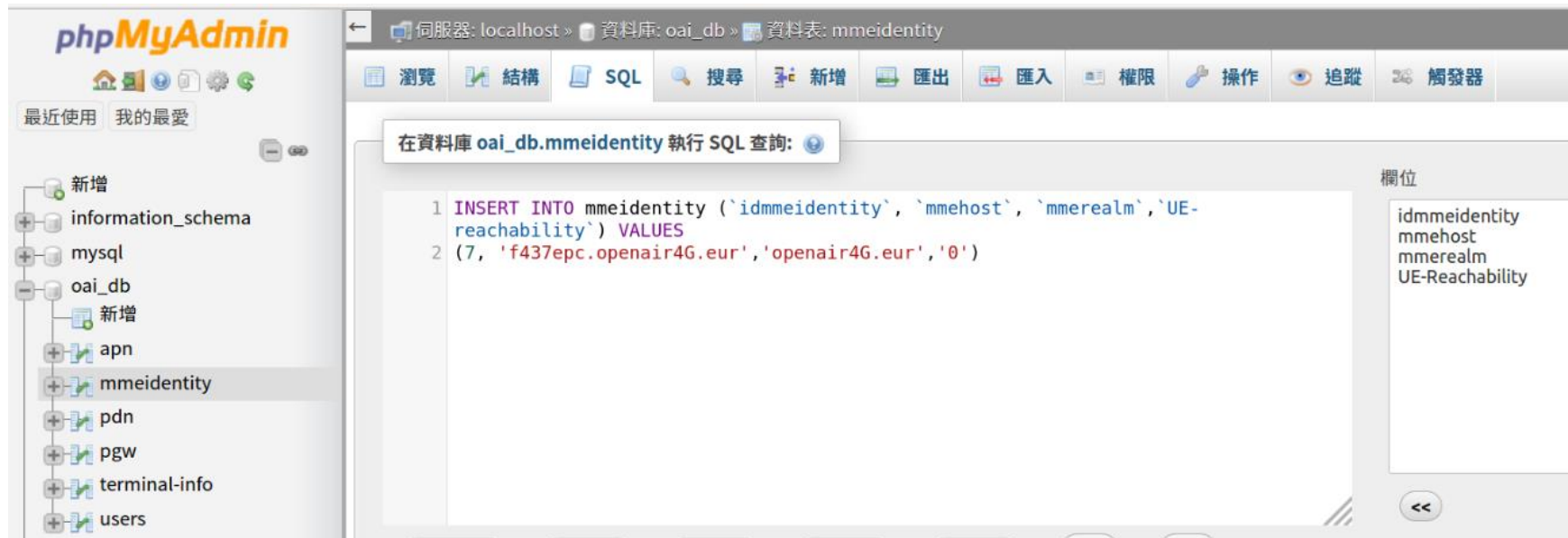


EPC安裝(新增mmeidentity資料)

進入oai_db->mmeidentity->SQL，輸入指令新增資料

- INSERT INTO mmeidentity (`idmmeidentity`, `mmehost`, `mmerealm`, `UE-reachability`) VALUES (7, 'f437epc.openair4G.eur', 'openair4G.eur', '0')

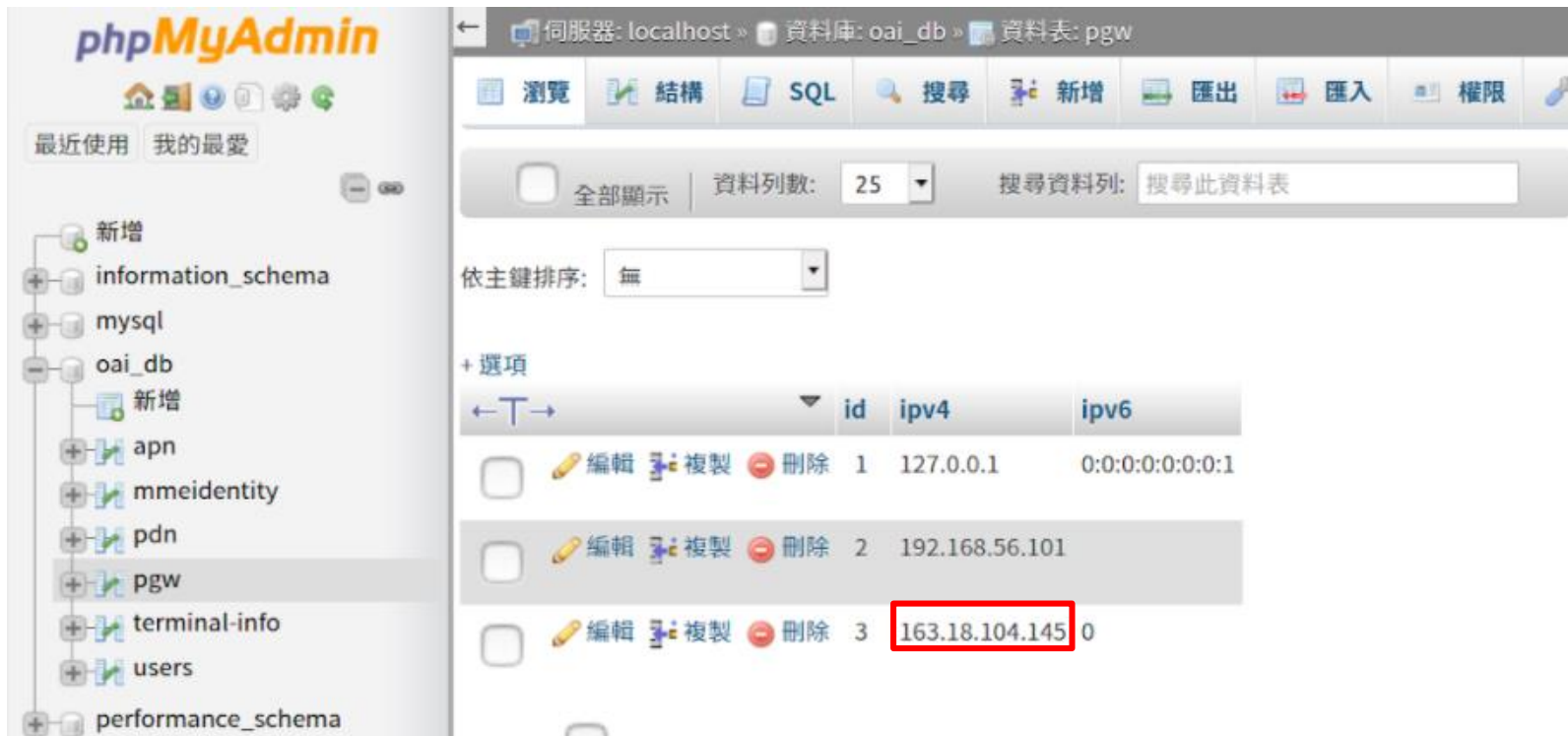
EPC主機名稱



EPC安裝(修改pgw資料表)

進入oai_db->pgw修改新增資料

- 修改id 3的ipv4，對應外網IP



The screenshot shows the phpMyAdmin interface. On the left, the database structure is visible, with 'oai_db' selected and 'pgw' highlighted. The main area displays the 'pgw' table with the following data:

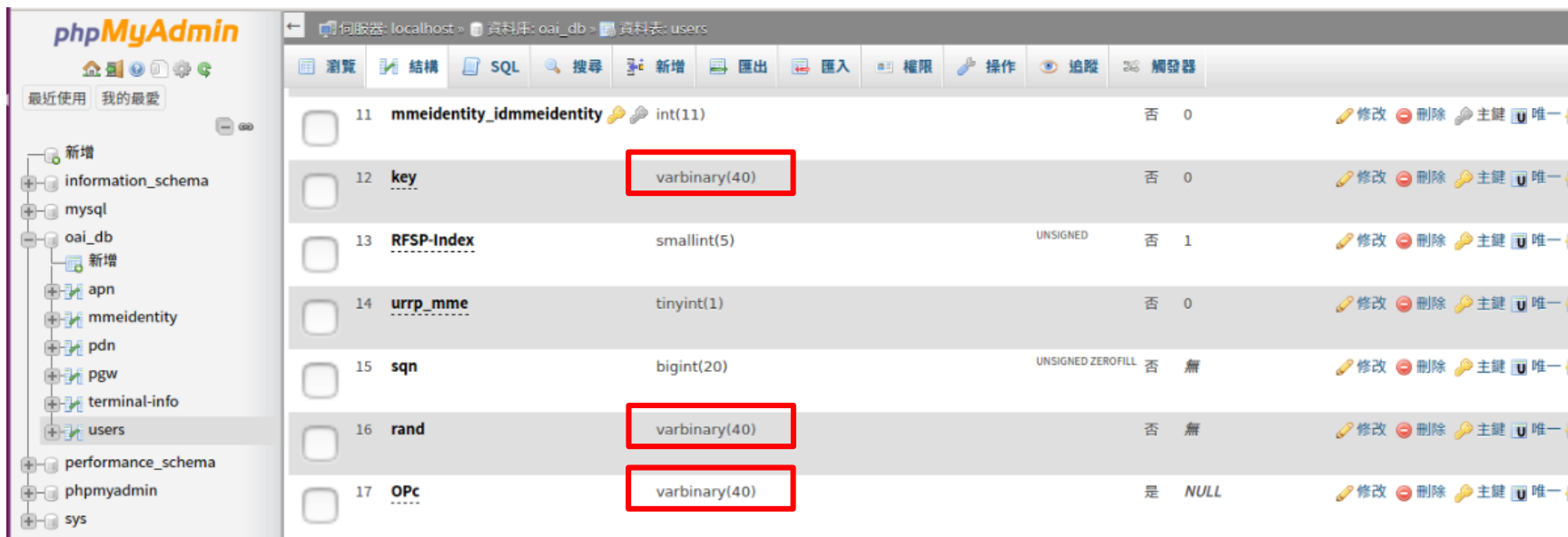
id	ipv4	ipv6
1	127.0.0.1	0:0:0:0:0:0:1
2	192.168.56.101	
3	163.18.104.145	0

The value '163.18.104.145' in the ipv4 column for id 3 is highlighted with a red box.

EPC安裝(修改users結構長度)

進入oai_db-> users->結構

- 修改key、rand、OPc的長度值為40



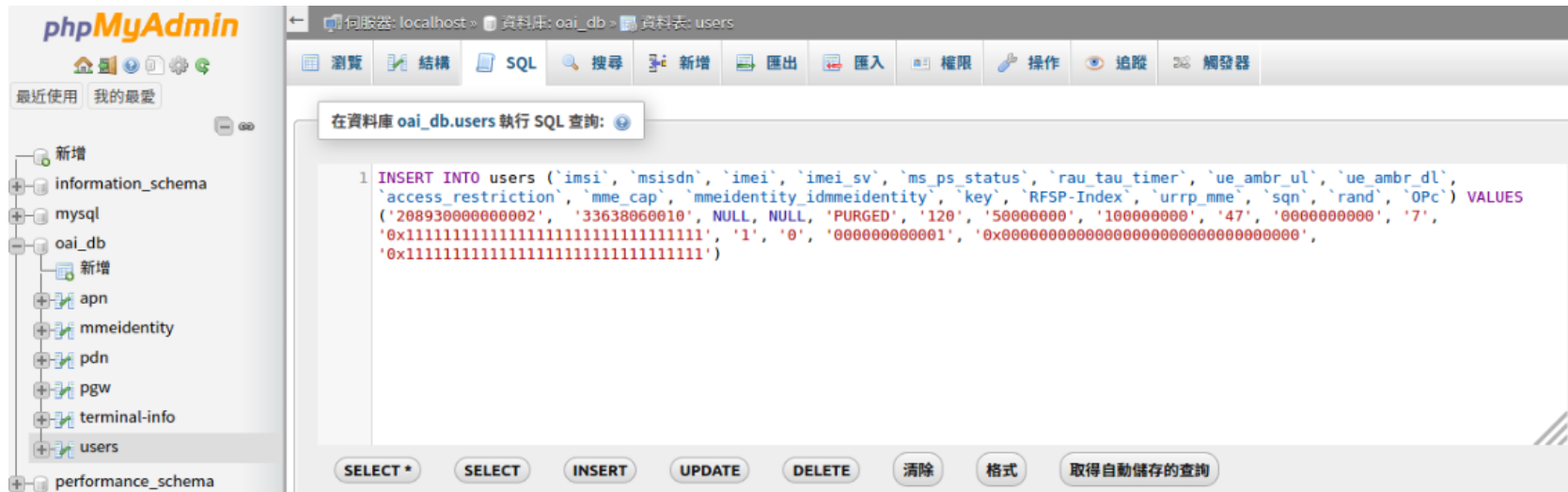
The screenshot shows the phpMyAdmin interface. On the left, the database structure is listed, with 'oai_db' selected. The 'users' table is highlighted. The main panel shows the structure of the 'users' table. The table has 17 columns. Three columns are highlighted with red boxes: 'key' (varbinary(40)), 'rand' (varbinary(40)), and 'OPc' (varbinary(40)).

Column	Type	Unsigned	Zerofill	Primary	Unique	
11 mmeidentity_idmmeidentity	int(11)	否	0	主鍵	唯一	
12 key	varbinary(40)	否	0	主鍵	唯一	
13 RFSP-Index	smallint(5)	UNSIGNED	否	1	主鍵	唯一
14 urrp_mme	tinyint(1)	否	0	主鍵	唯一	
15 sqn	bigint(20)	UNSIGNED ZEROFILL	否	無	主鍵	唯一
16 rand	varbinary(40)	否	無	主鍵	唯一	
17 OPc	varbinary(40)	是	NULL	主鍵	唯一	

EPC安裝(新增users資料)

進入oai_db-> users->SQL

- 將SIM卡資訊，寫入進去
- ```
INSERT INTO users (`imsi`, `msisdn`, `imei`, `imei_sv`, `ms_ps_status`, `rau_tau_timer`,
`ue_ambr_ul`, `ue_ambr_dl`, `access_restriction`, `mme_cap`, `mmeidentity_idmmeidentity`,
`key`, `RFSP-Index`, `urrrp_mme`, `sqn`, `rand`, `OPc`) VALUES ('2089300000000002',
'33638060010', NULL, NULL, 'PURGED', '120', '50000000', '100000000', '47', '0000000000',
'7', '0x11111111111111111111111111111111', '1', '0', '000000000001',
'0x00000000000000000000000000000000', '0x11111111111111111111111111111111')
```

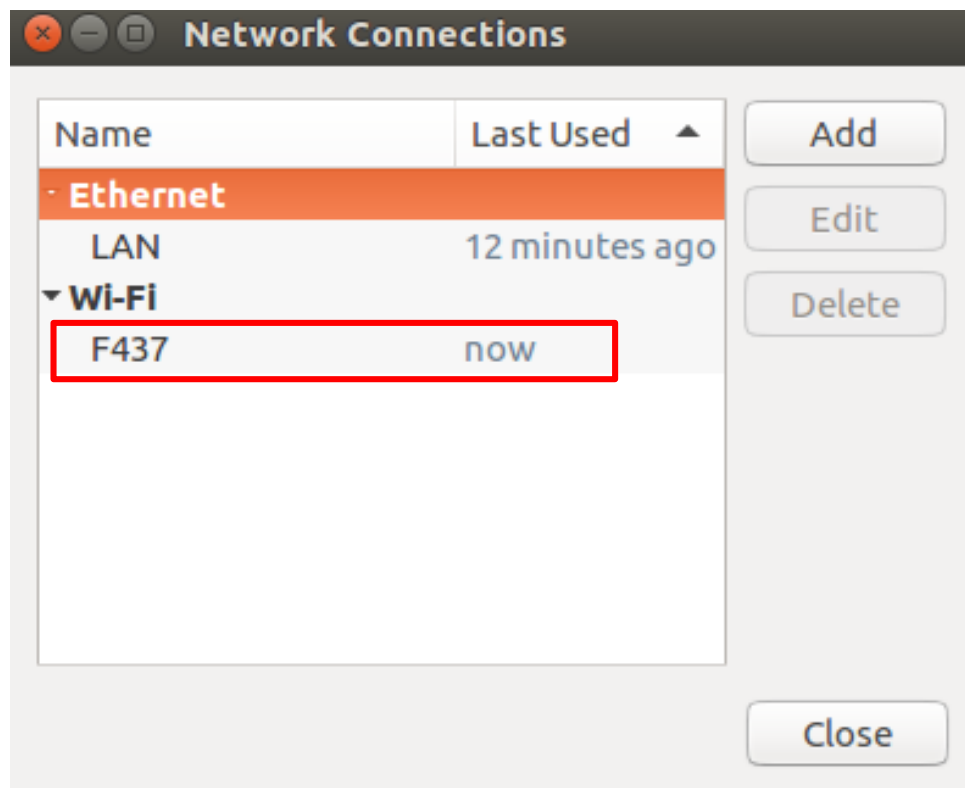


# Outline

- 實驗目的及實驗內容
- OAI安裝
  - 實驗環境
  - 架設OAI的EPC軟體
  - 架設OAI的eNB軟體
  - 測試OAI運行
  - UE註冊與註銷
- Web Server安裝
  - 實驗環境
  - 架設Web Server
  - UE影片瀏覽軟體安裝

# eNB安裝(新增外網)

- 新增外網，連接至Internet，為了下載軟體





# eNB安裝(更新系統軟體)

## 在終端機輸入

- \$ sudo apt-get update && sudo apt-get upgrade
- 更新系統軟體

```
f437enb@f437enb: ~
f437enb@f437enb:~$ sudo apt-get update && sudo apt-get upgrade
[sudo] password for f437enb:
Hit:1 http://tw.archive.ubuntu.com/ubuntu xenial InRelease
Hit:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates InRelease
Hit:3 http://tw.archive.ubuntu.com/ubuntu xenial-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu xenial-security InRelease
Reading package lists... Done
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following packages have been kept back:
 linux-generic-hwe-16.04 linux-headers-generic-hwe-16.04
 linux-image-generic-hwe-16.04
The following packages will be upgraded:
 base-files bind9-host dnsutils firefox firefox-locale-en ghostscript
 ghostscript-x grub-common grub-efi-amd64 grub-efi-amd64-bin
 grub-efi-amd64-signed grub2-common libbind9-140 libcurl3 libcurl3-gnutls
 libdns-export162 libdns162 libgs9 libgs9-common libisc-export160 libisc160
```

# eNB安裝(安裝kernel)

在終端機輸入

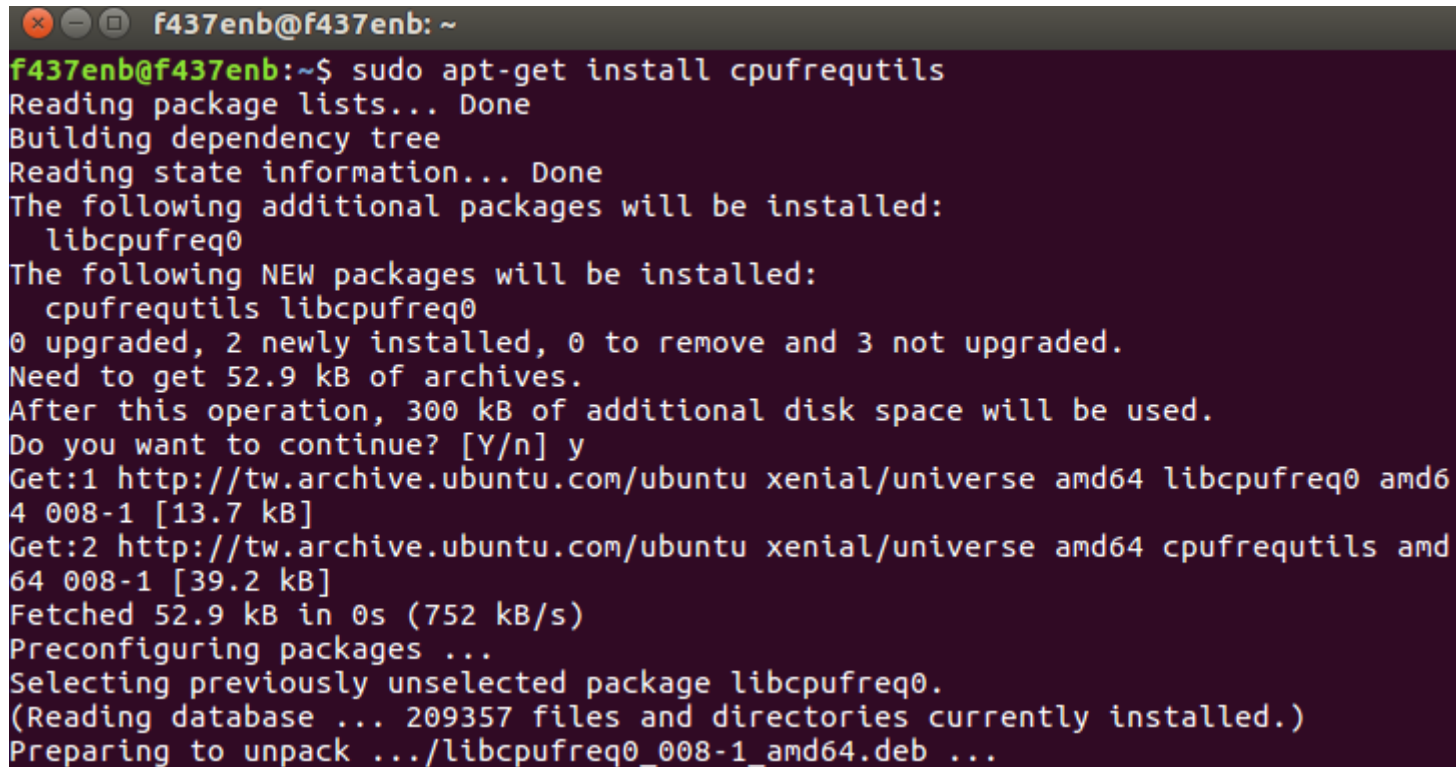
- `$ sudo apt-get install linux-image-4.4.0-59-lowlatency linux-headers-4.4.0-59-lowlatency`
- 安裝kernel 4.4.0-59-lowlatency

```
f437enb@f437enb: ~
f437enb@f437enb:~$ sudo apt-get install linux-image-4.4.0-59-lowlatency linux-headers-4.4.0-59-lowlatency
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
 linux-headers-4.4.0-59
Suggested packages:
 fdutils linux-doc-4.4.0 | linux-source-4.4.0 linux-tools
The following NEW packages will be installed:
 linux-headers-4.4.0-59 linux-headers-4.4.0-59-lowlatency
 linux-image-4.4.0-59-lowlatency
0 upgraded, 3 newly installed, 0 to remove and 3 not upgraded.
Need to get 68.7 MB of archives.
After this operation, 296 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 linux-headers-4.4.0-59 all 4.4.0-59.80 [9971 kB]
Get:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 linux-headers-4.4.0-59-lowlatency amd64 4.4.0-59.80 [774 kB]
```

# eNB安裝(安裝cpufrequtils)

在終端機輸入

- `$ sudo apt-get install cpufrequtils`

A terminal window with a dark background and light text. The window title is 'f437enb@f437enb: ~'. The user has entered the command 'sudo apt-get install cpufrequtils'. The terminal output shows the package lists being read, the dependency tree being built, and the state information being read. It lists additional packages to be installed (libcpufreq0) and new packages to be installed (cpufrequtils, libcpufreq0). It shows that 0 packages are upgraded, 2 are newly installed, and 0 are to be removed. The total disk space needed is 52.9 kB. The user confirms the installation by typing 'y'. The terminal then shows the download progress for two packages from the Ubuntu Xenial universe repository. Finally, it shows the packages being preconfigured and unpacked.

```
f437enb@f437enb:~$ sudo apt-get install cpufrequtils
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
 libcpufreq0
The following NEW packages will be installed:
 cpufrequtils libcpufreq0
0 upgraded, 2 newly installed, 0 to remove and 3 not upgraded.
Need to get 52.9 kB of archives.
After this operation, 300 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://tw.archive.ubuntu.com/ubuntu xenial/universe amd64 libcpufreq0 amd64 008-1 [13.7 kB]
Get:2 http://tw.archive.ubuntu.com/ubuntu xenial/universe amd64 cpufrequtils amd64 008-1 [39.2 kB]
Fetched 52.9 kB in 0s (752 kB/s)
Preconfiguring packages ...
Selecting previously unselected package libcpufreq0.
(Reading database ... 209357 files and directories currently installed.)
Preparing to unpack .../libcpufreq0_008-1_amd64.deb ...
```

# eNB安裝(安裝i7z)

在終端機輸入

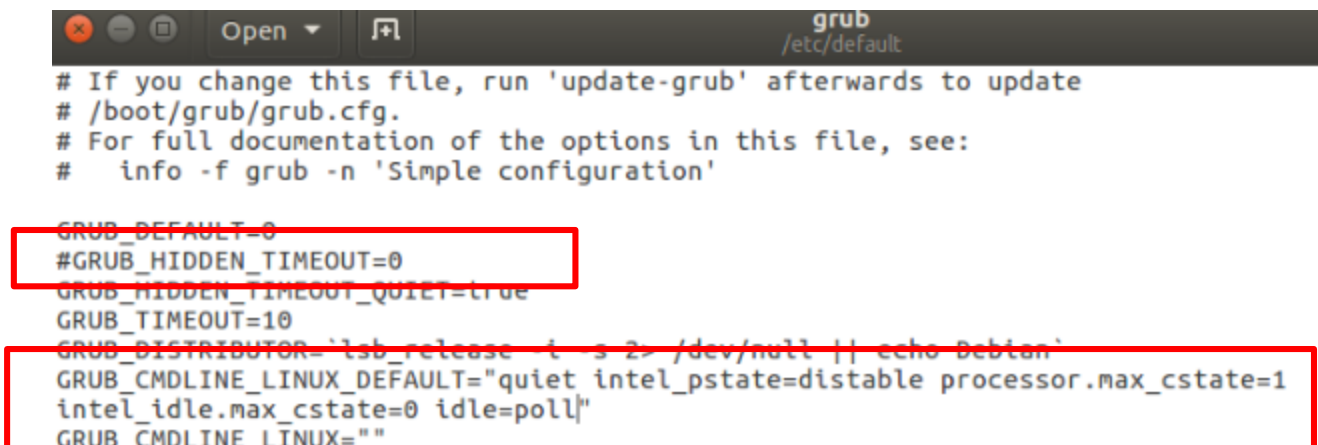
- `$ sudo apt-get install i7z`

```
f437enb@f437enb: ~
f437enb@f437enb:~$ sudo apt-get install i7z
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
 fonts-lato javascript-common libjs-jquery libruby2.3 msr-tools rake ruby
 ruby-did-you-mean ruby-minitest ruby-net-telnet ruby-power-assert
 ruby-test-unit ruby2.3 rubygems-integration
Suggested packages:
 apache2 | lighttpd | httpd ri ruby-dev bundler
The following NEW packages will be installed:
 fonts-lato i7z javascript-common libjs-jquery libruby2.3 msr-tools rake ruby
 ruby-did-you-mean ruby-minitest ruby-net-telnet ruby-power-assert
 ruby-test-unit ruby2.3 rubygems-integration
0 upgraded, 15 newly installed, 0 to remove and 3 not upgraded.
Need to get 6082 kB of archives.
After this operation, 27.6 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://tw.archive.ubuntu.com/ubuntu xenial/main amd64 fonts-lato all 2.0-1
```

# eNB安裝(修改開機選單)

在終端機輸入

- `$ sudo gedit /etc/default/grub`
- 在`GRUB_HIDDEN_TIMEOUT=0`前面加上`#`
- 把`GRUB_CMDLINE_LINUX_DEFAULT="quiet splash"`修改成：  
`GRUB_CMDLINE_LINUX_DEFAULT="quiet intel_pstate=distable  
processor.max_cstate=1 intel_idle.max_cstate=0 idle=poll"`



```
grub
/etc/default

If you change this file, run 'update-grub' afterwards to update
/boot/grub/grub.cfg.
For full documentation of the options in this file, see:
info -f grub -n 'Simple configuration'

GRUB_DEFAULT=0
#GRUB_HIDDEN_TIMEOUT=0
GRUB_HIDDEN_TIMEOUT_QUIET=true
GRUB_TIMEOUT=10
GRUB_DISTRIBUTOR=`lsb_release -t -s 2> /dev/null || echo Debian`
GRUB_CMDLINE_LINUX_DEFAULT="quiet intel_pstate=distable processor.max_cstate=1
intel_idle.max_cstate=0 idle=poll"
GRUB_CMDLINE_LINUX=""
```

# eNB安裝(修改CPU模式-1)

在終端機輸入

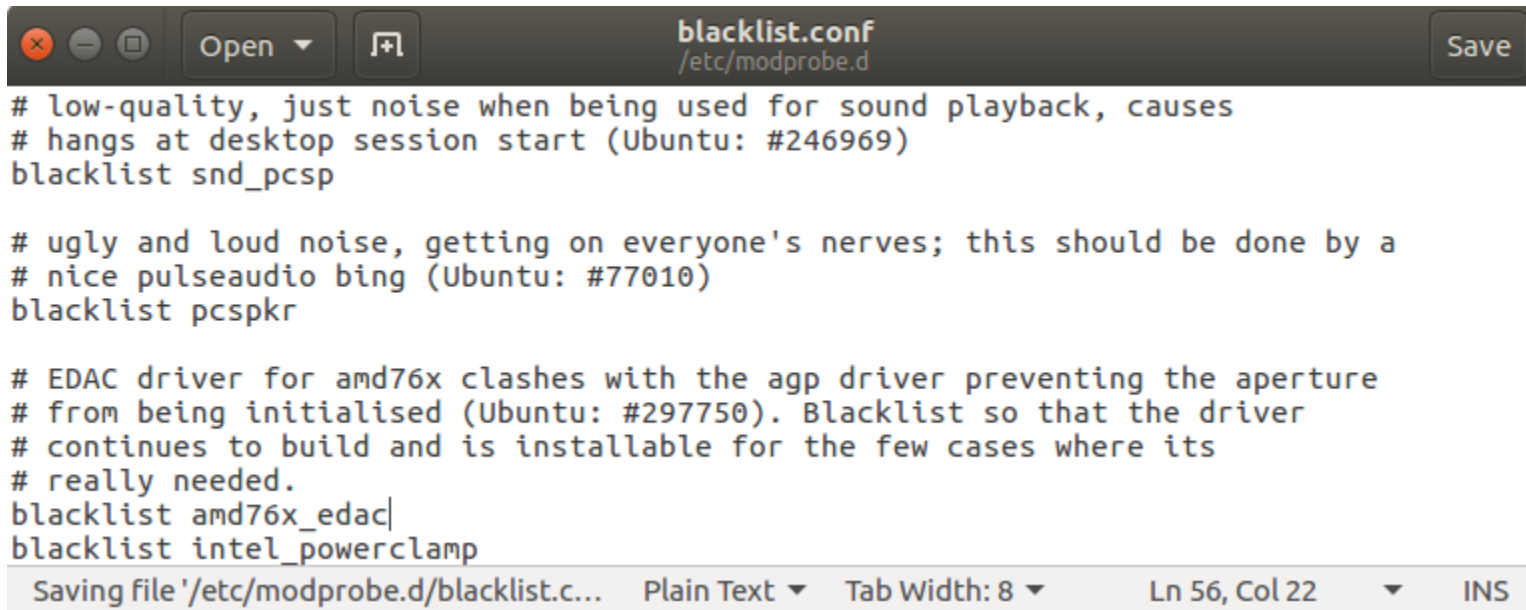
- `$ sudo gedit /etc/default/cpufrequtils`
- 加入`GOVERNOR="performance"`



# eNB安裝(修改CPU模式-2)

在終端機輸入

- `$ sudo gedit /etc/modprobe.d/blacklist.conf`
- 底下加入 `blacklist intel_powerclamp`



```
low-quality, just noise when being used for sound playback, causes
hangs at desktop session start (Ubuntu: #246969)
blacklist snd_pcsp

ugly and loud noise, getting on everyone's nerves; this should be done by a
nice pulseaudio bing (Ubuntu: #77010)
blacklist pcspkr

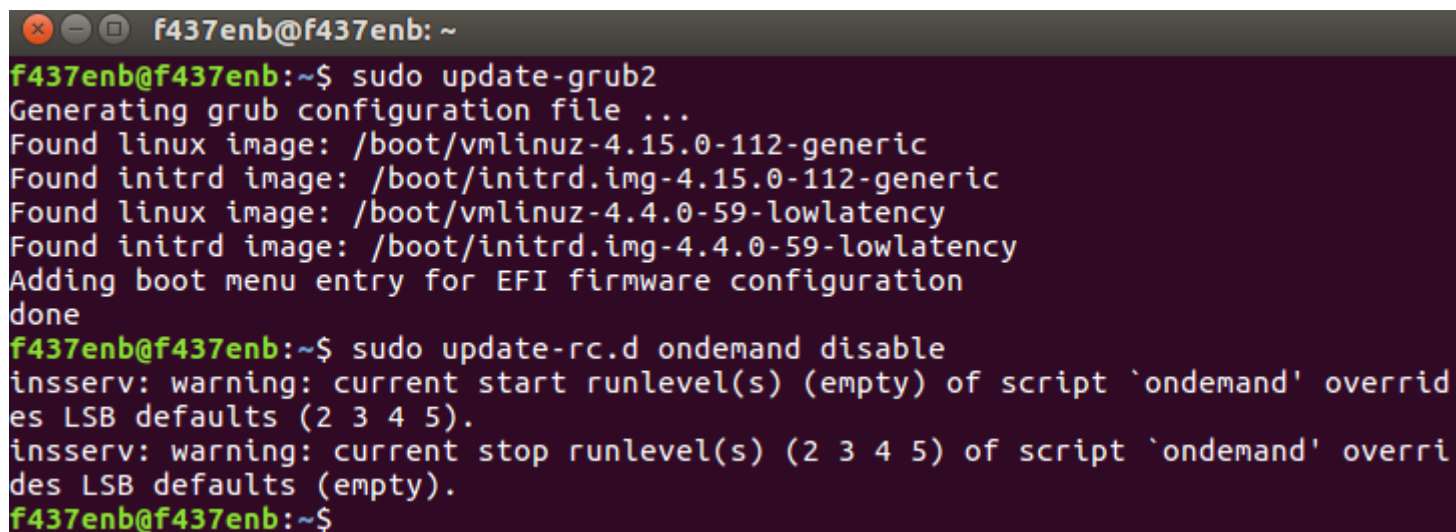
EDAC driver for amd76x clashes with the agp driver preventing the aperture
from being initialised (Ubuntu: #297750). Blacklist so that the driver
continues to build and is installable for the few cases where its
really needed.
blacklist amd76x_edac
blacklist intel_powerclamp
```

Saving file '/etc/modprobe.d/blacklist.c... Plain Text ▾ Tab Width: 8 ▾ Ln 56, Col 22 ▾ INS

# eNB安裝(更新開機選單)

在終端機輸入

- \$ sudo update-grub2
- \$ sudo update-rc.d ondemand disable



```
f437enb@f437enb: ~
f437enb@f437enb:~$ sudo update-grub2
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-4.15.0-112-generic
Found initrd image: /boot/initrd.img-4.15.0-112-generic
Found linux image: /boot/vmlinuz-4.4.0-59-lowlatency
Found initrd image: /boot/initrd.img-4.4.0-59-lowlatency
Adding boot menu entry for EFI firmware configuration
done
f437enb@f437enb:~$ sudo update-rc.d ondemand disable
insserv: warning: current start runlevel(s) (empty) of script `ondemand' overrides LSB defaults (2 3 4 5).
insserv: warning: current stop runlevel(s) (2 3 4 5) of script `ondemand' overrides LSB defaults (empty).
f437enb@f437enb:~$
```



# eNB安裝(選擇kernel開機)

將電腦重新開機

選擇kernel 4.4.0-59-lowlatency啟動

```
GNU GRUB version 2.02~beta2-36ubuntu3.27

Ubuntu, with Linux 4.15.0-112-generic
Ubuntu, with Linux 4.15.0-112-generic (upstart)
Ubuntu, with Linux 4.15.0-112-generic (recovery mode)
*Ubuntu, with Linux 4.4.0-59-lowlatency
Ubuntu, with Linux 4.4.0-59-lowlatency (upstart)
Ubuntu, with Linux 4.4.0-59-lowlatency (recovery mode)

Use the ↑ and ↓ keys to select which entry is highlighted.
Press enter to boot the selected OS, `e' to edit the commands
before booting or `c' for a command-line. ESC to return previous
menu.
```

# eNB安裝(檢查CPU效能-1)

在終端機輸入

- \$ sudo i7z
- 確認CPU頻率，CPU各核心頻率變化不多於1~2Hz

```
f437enb@f437enb: ~
Cpu speed from cpufreq 2712.00MHz
cpufreq might be wrong if cpufreq is enabled. To guess correctly try estimating
Linux's inbuilt cpu_khz code emulated now
True Frequency (without accounting Turbo) 2712 MHz
CPU Multiplier 27x || Bus clock frequency (BCLK) 100.44 MHz

Socket [0] - [physical cores=4, logical cores=8, max online cores ever=4]
TURBO ENABLED on 4 Cores, Hyper Threading ON
Max Frequency without considering Turbo 2812.44 MHz (100.44 x [28])
Max TURBO Multiplier (if Enabled) with 1/2/3/4 Cores is 45x/45x/42x/41x
Real Current Frequency 4090.17 MHz [100.44 x 40.72] (Max of below)
Core [core-id] :Actual Freq (Mult.) C0% Halt(C1)% C3 % C6 %
Core 1 [0]: 4090.17 (40.72x) 100 0 0 0
Core 2 [1]: 4090.17 (40.72x) 100 0 0 0
Core 3 [2]: 4090.17 (40.72x) 100 0 0 0
Core 4 [3]: 4090.16 (40.72x) 100 0 0 0

C0 = Processor running without halting
```

# eNB安裝(檢查CPU效能-2)

在終端機輸入

- \$ sudo cpufreq-info
- 確認CPU為Performance模式

```
f437enb@f437enb: ~
f437enb@f437enb:~$ sudo cpufreq-info
cpufrequtils 008: cpufreq-info (C) Dominik Brodowski 2004-2009
Report errors and bugs to cpufreq@vger.kernel.org, please.
analyzing CPU 0:
 driver: acpi-cpufreq
 CPUs which run at the same hardware frequency: 0
 CPUs which need to have their frequency coordinated by software: 0
 maximum transition latency: 10.0 us.
 hardware limits: 400 MHz - 2.60 GHz
 available frequency steps: 2.60 GHz, 2.60 GHz, 2.50 GHz, 2.40 GHz, 2.20 GHz, 1
.90 GHz, 1.80 GHz, 1.70 GHz, 1.50 GHz, 1.40 GHz, 1.20 GHz, 1.10 GHz, 900 MHz, 70
0 MHz, 600 MHz, 400 MHz
 available cpufreq governors: conservative, ondemand, userspace, powersave, per
formance
 current policy: frequency should be within 400 MHz and 2.60 GHz.
 The governor "performance" may decide which speed to use
 within this range.
 current CPU frequency is 2.60 GHz (asserted by call to hardware).
 cpufreq stats: 2.60 GHz:99.69%, 2.60 GHz:0.31%, 2.50 GHz:0.00%, 2.40 GHz:0.00%
, 2.20 GHz:0.00%, 1.90 GHz:0.00%, 1.80 GHz:0.00%, 1.70 GHz:0.00%, 1.50 GHz:0.00%
```

# eNB安裝(確認Kernel)

在終端機輸入

- \$ sudo uname -a
- 確認Kernel版本為4.4.0-59-lowlatency

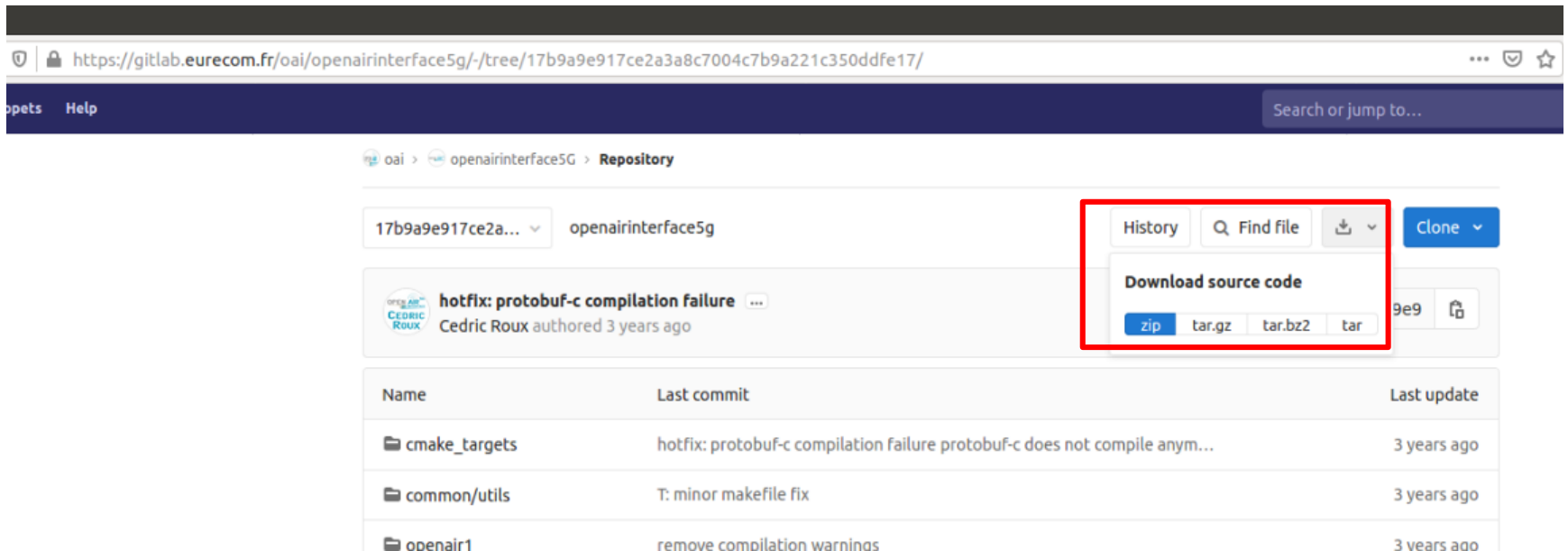
```
f437enb@f437enb: ~
f437enb@f437enb:~$ sudo uname -a
Linux f437enb 4.4.0-59-lowlatency #80-Ubuntu SMP PREEMPT Fri Jan 6 21:04:05 UTC
2017 x86_64 x86_64 x86_64 GNU/Linux
f437enb@f437enb:~$
```

# eNB安裝(下載原始碼)

下載Openairinterface5G原始碼

網址：

<https://gitlab.eurecom.fr/oai/openairinterface5g/tree/17b9a9e917ce2a3a8c7004c7b9a221c350ddfe17>



17b9a9e917ce2a... openairinterface5g

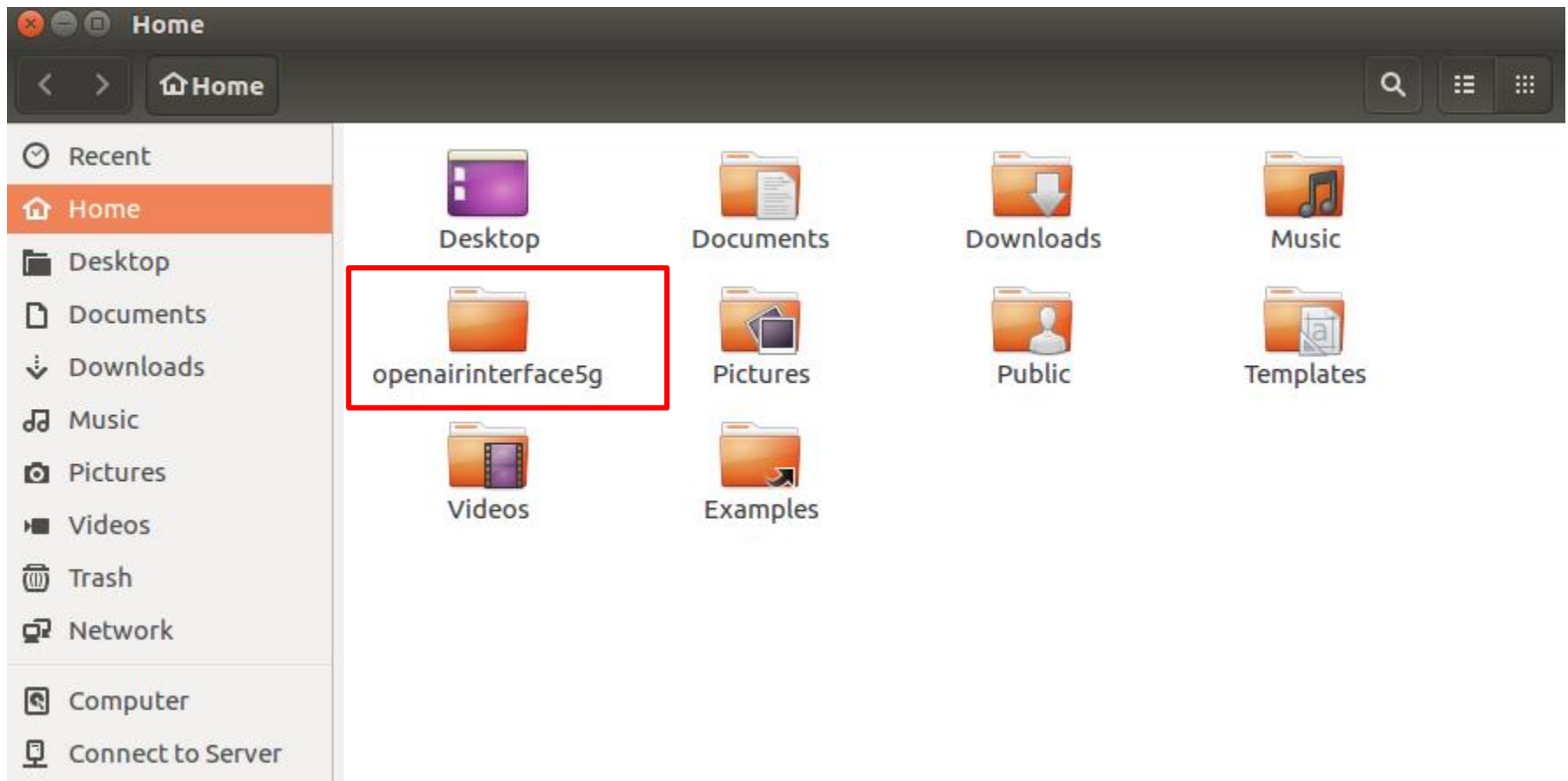
History Find file Download source code

zip tar.gz tar.bz2 tar

| Name          | Last commit                                                                | Last update |
|---------------|----------------------------------------------------------------------------|-------------|
| cmake_targets | hotfix: protobuf-c compilation failure protobuf-c does not compile anym... | 3 years ago |
| common/utlis  | T: minor makefile fix                                                      | 3 years ago |
| openair1      | remove compilation warnings                                                | 3 years ago |

# eNB安裝(解壓縮)

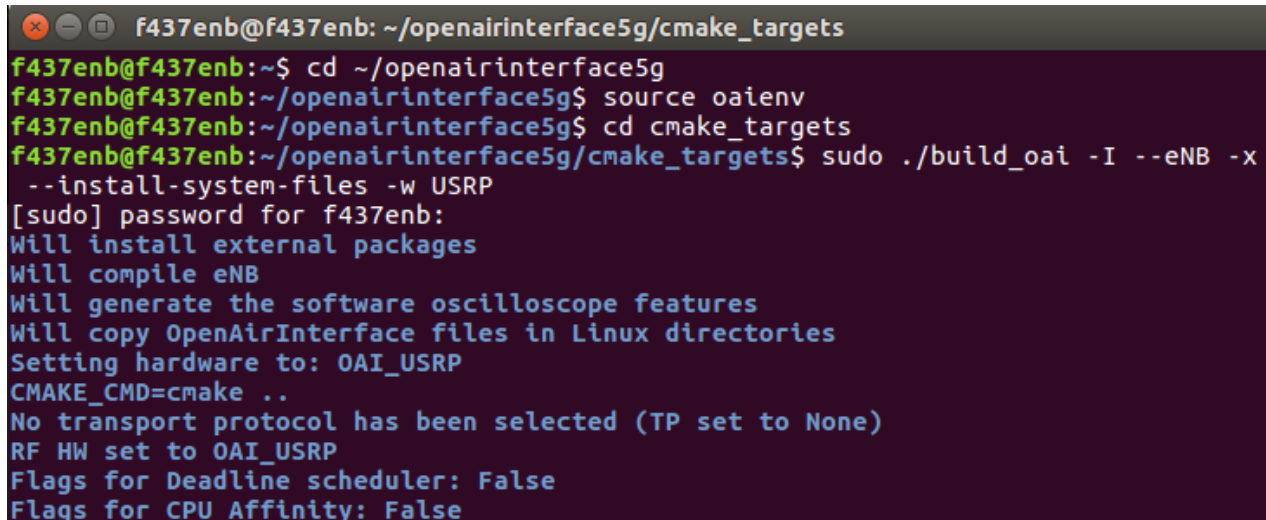
解壓縮Openairinterface5G到Home目錄下



# eNB安裝(安裝eNB軟體)

在終端機輸入

- `$ cd ~/openairinterface5g`
- `$ source oaienv`
- `$ cd cmake_targets`
- `$ sudo ./build_oai -I --eNB -x --install-system-files -w USRP`

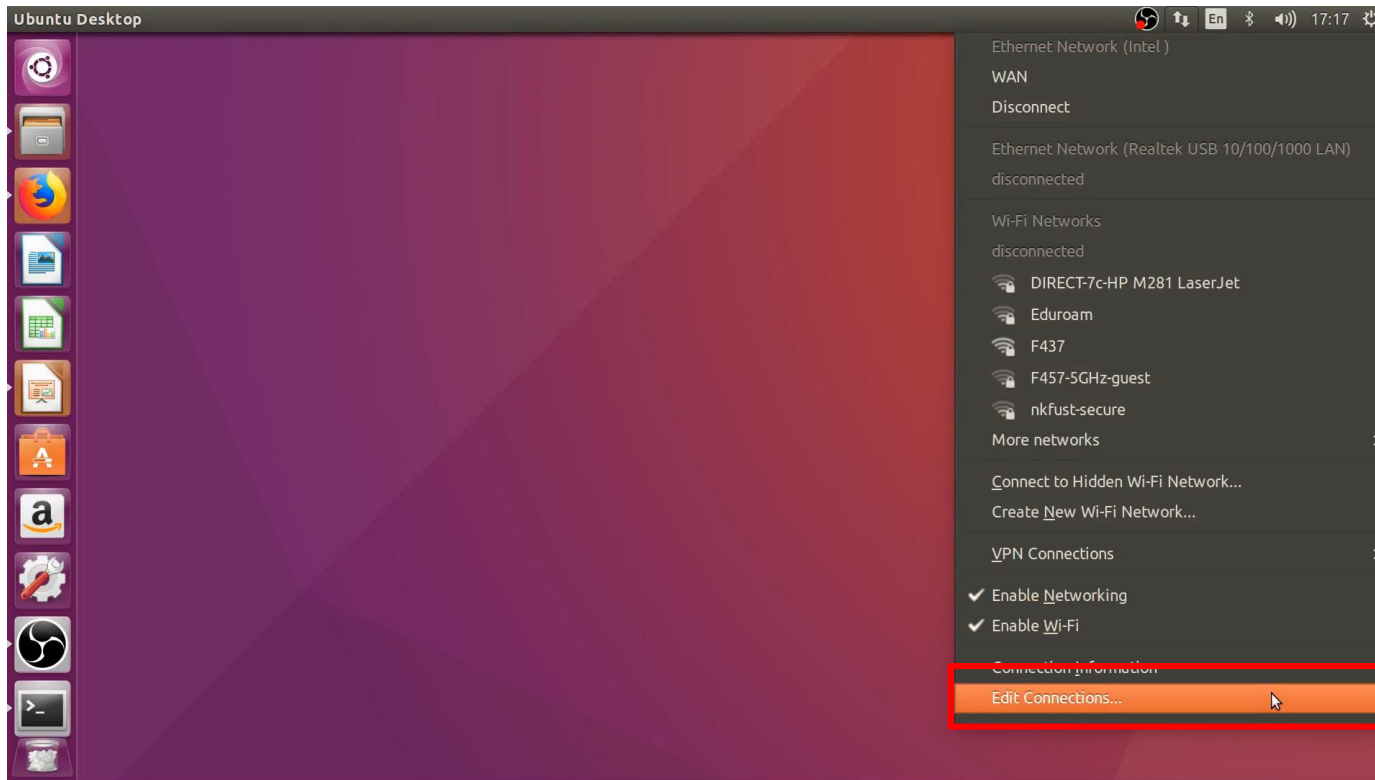


```
f437enb@f437enb: ~/openairinterface5g/cmake_targets
f437enb@f437enb:~$ cd ~/openairinterface5g
f437enb@f437enb:~/openairinterface5g$ source oaienv
f437enb@f437enb:~/openairinterface5g$ cd cmake_targets
f437enb@f437enb:~/openairinterface5g/cmake_targets$ sudo ./build_oai -I --eNB -x
--install-system-files -w USRP
[sudo] password for f437enb:
Will install external packages
Will compile eNB
Will generate the software oscilloscope features
Will copy OpenAirInterface files in Linux directories
Setting hardware to: OAI_USRP
CMAKE_CMD=cmake ..
No transport protocol has been selected (TP set to None)
RF HW set to OAI_USRP
Flags for Deadline scheduler: False
Flags for CPU Affinity: False
```

# eNB安裝(新增內網-1)

新增內網，連接至EPC

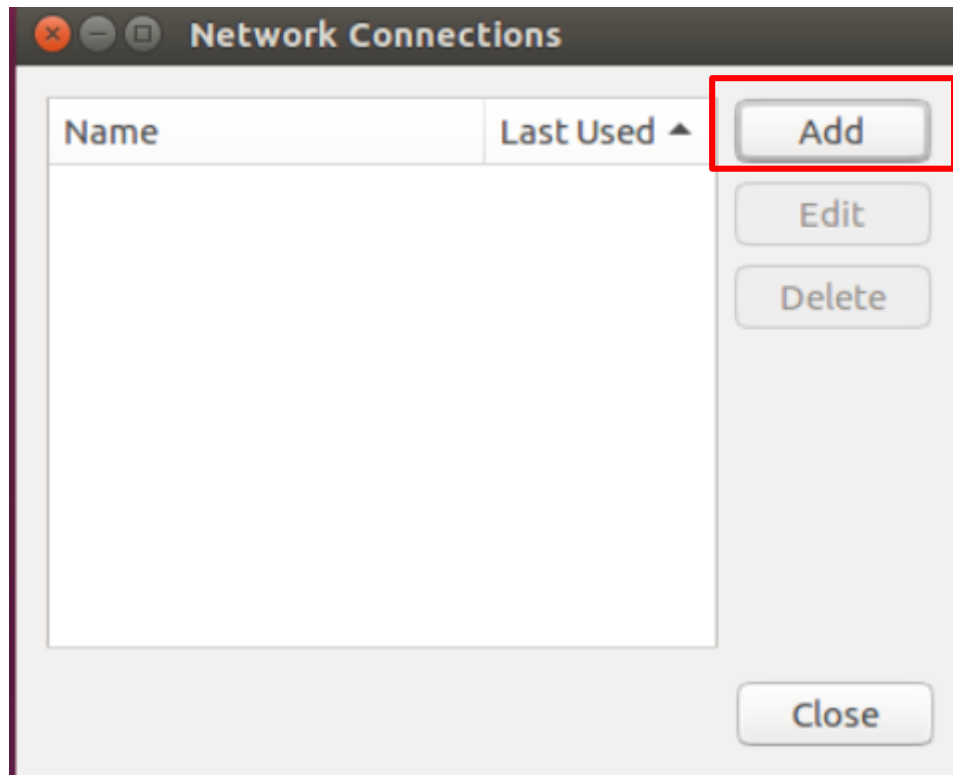
點選右上角Edit Connections





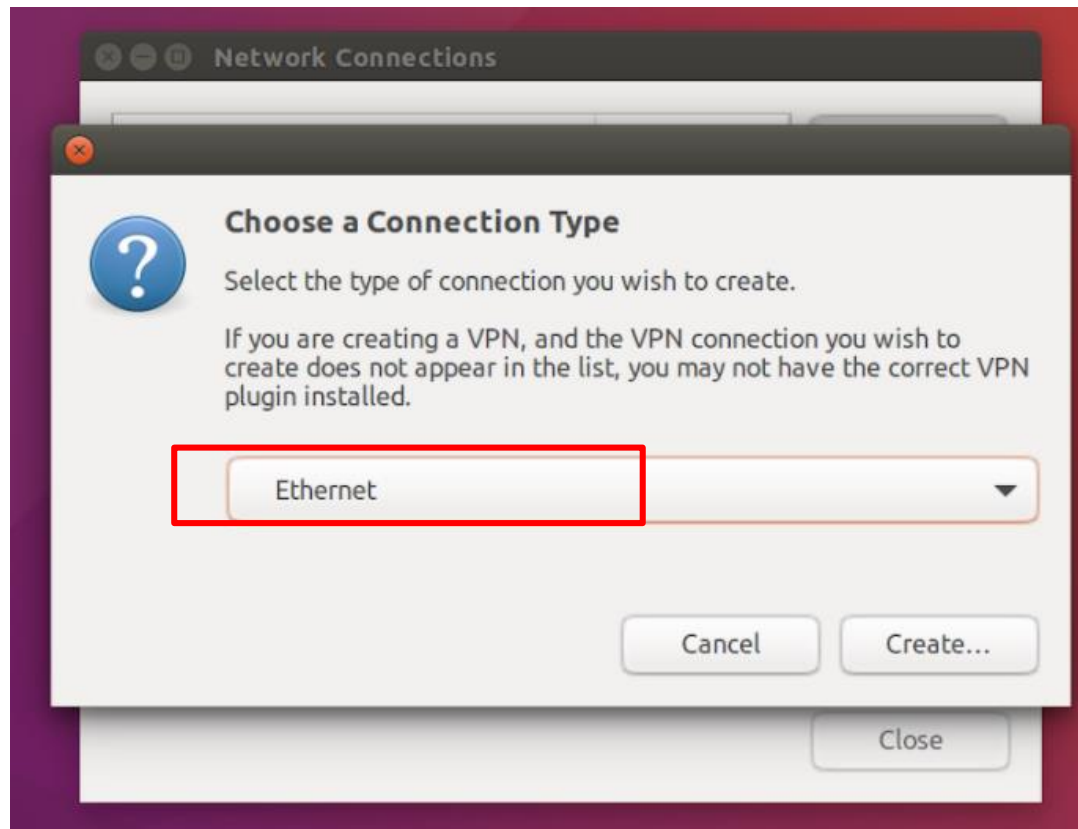
# eNB安裝(新增內網-2)

點選Add新增內網



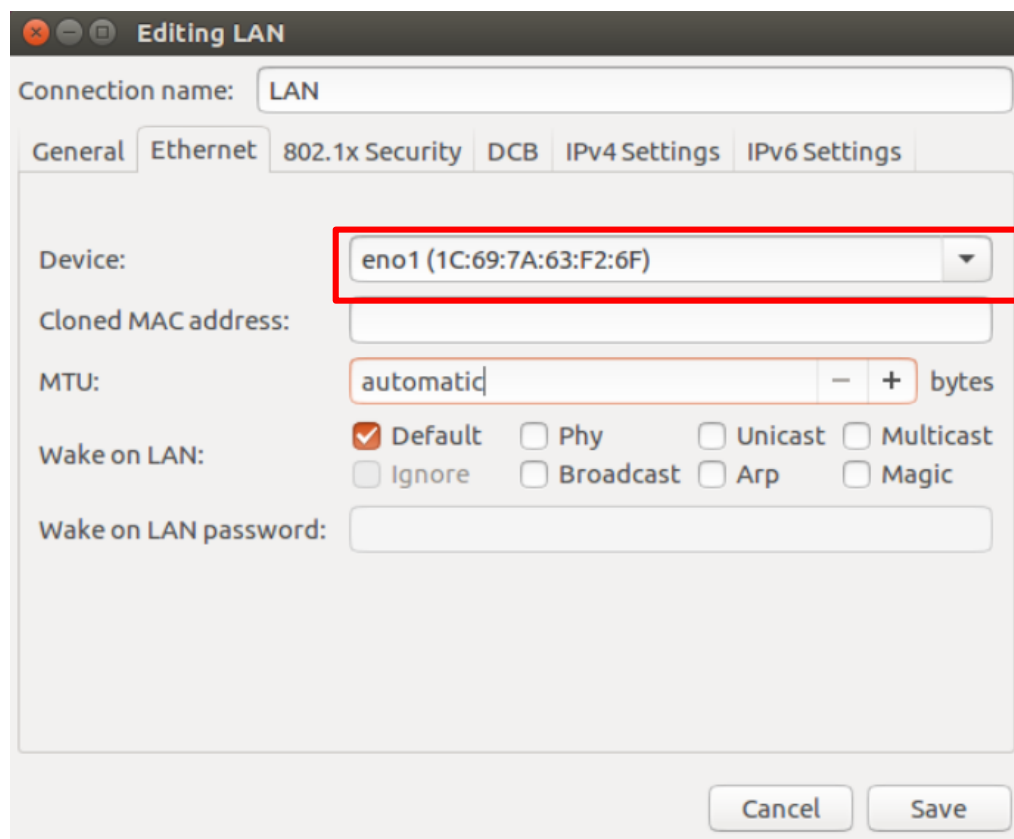
# eNB安裝(新增內網-3)

模式選擇Ethernet



# eNB安裝(新增內網-4)

點選Ethernet -> device 選擇對應網卡



# eNB安裝(新增內網-5)

點選IPv4 Settings -> Method 選擇 Manual

新增 Addresses (設定內網 IP)

Editing LAN

Connection name: LAN

General Ethernet 802.1x Security DCB IPv4 Settings IPv6 Settings

Method: Manual

**Addresses**

| Address       | Netmask | Gateway       |
|---------------|---------|---------------|
| 192.168.1.202 | 24      | 192.168.1.254 |

Add Delete

DNS servers:

Search domains:

DHCP client ID:

☐ Require IPv4 addressing for this connection to complete

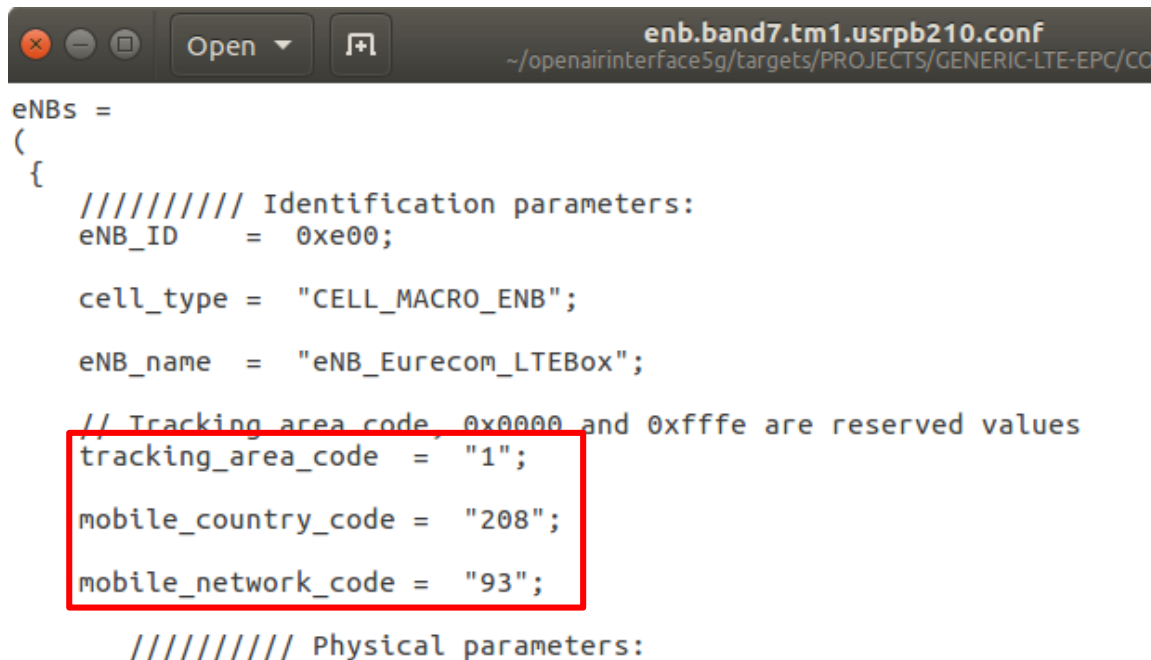
Routes...

Cancel Save

# eNB安裝(更改參數-1)

在終端機輸入

- `$ sudo gedit ~/openairinterface5g/targets/PROJECTS/GENERIC-LTE-EPC/CONF/enb.band7.tm1.usrpb210.conf`
- 修改tracking\_area\_code、mobile\_country\_code、mobile\_network\_code



```
enBs =
(
{
////////// Identification parameters:
eNB_ID = 0xe00;

cell_type = "CELL_MACRO_ENB";

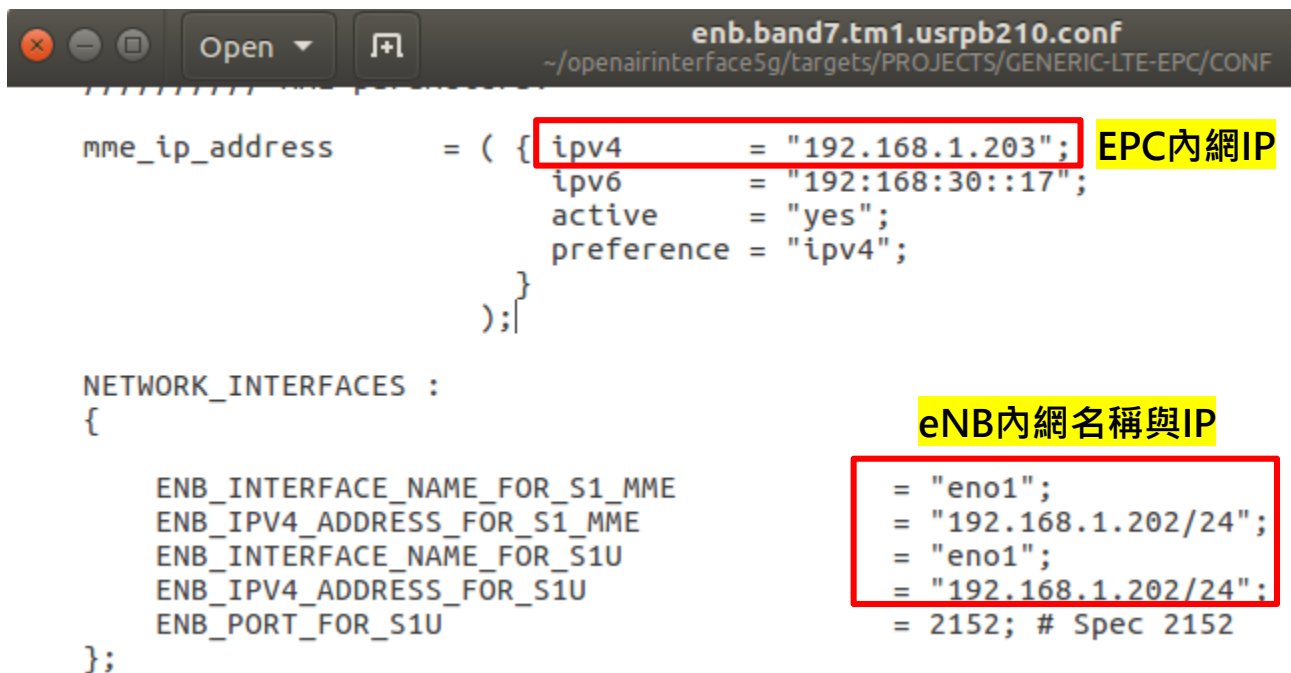
eNB_name = "eNB_Eurecom_LTEBox";

// Tracking area code, 0x0000 and 0xffff are reserved values
tracking_area_code = "1";
mobile_country_code = "208";
mobile_network_code = "93";

////////// Physical parameters:
```

# eNB安裝(更改參數-2)

- 修改mme\_ip\_address
- 修改NETWORK\_INTERFACES



```
enb.band7.tm1.usrb210.conf
~/openairinterface5g/targets/PROJECTS/GENERIC-LTE-EPC/CONF

mme_ip_address = ({ ipv4 = "192.168.1.203"; EPC內網IP
 ipv6 = "192:168:30::17";
 active = "yes";
 preference = "ipv4";
 });

NETWORK_INTERFACES :
{
 ENB_INTERFACE_NAME_FOR_S1_MME
 ENB_IPV4_ADDRESS_FOR_S1_MME
 ENB_INTERFACE_NAME_FOR_S1U
 ENB_IPV4_ADDRESS_FOR_S1U
 ENB_PORT_FOR_S1U
};
```

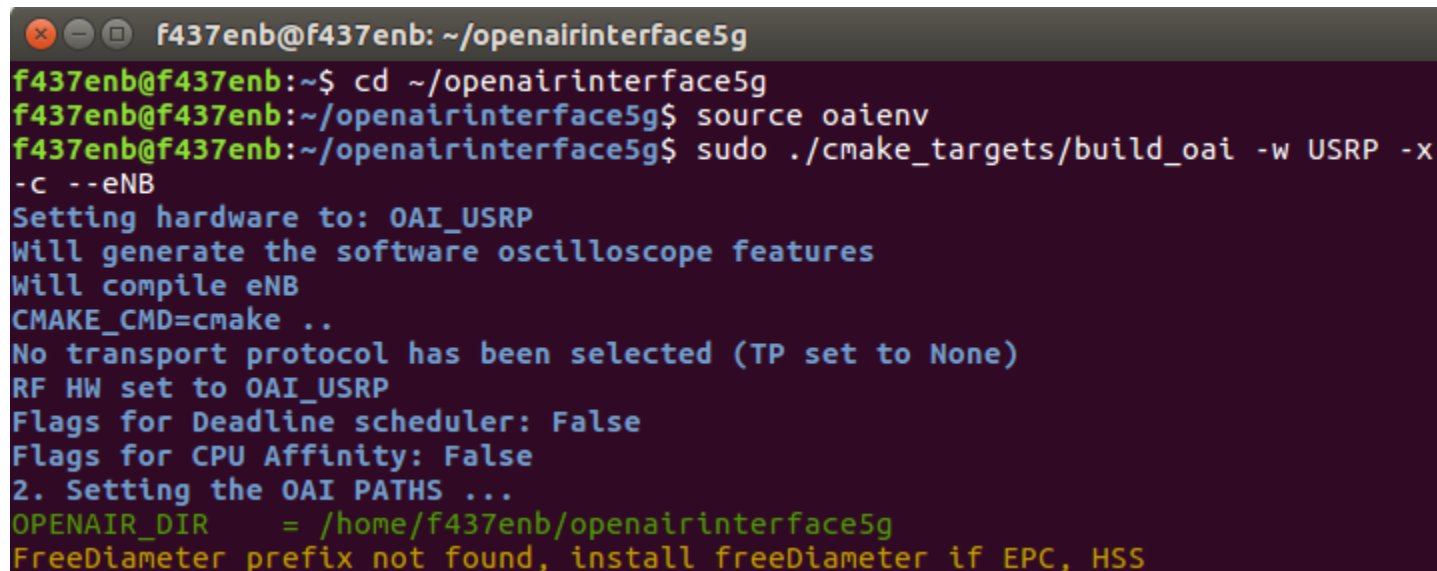
# eNB安裝(編譯eNB)

在終端機輸入

```
$ cd ~/openairinterface5g
```

```
$ source oaienv
```

```
$ sudo ./cmake_targets/build_oai -w USRP -x -c --eNB
```



```
f437enb@f437enb: ~/openairinterface5g
f437enb@f437enb:~$ cd ~/openairinterface5g
f437enb@f437enb:~/openairinterface5g$ source oaienv
f437enb@f437enb:~/openairinterface5g$ sudo ./cmake_targets/build_oai -w USRP -x
-c --eNB
Setting hardware to: OAI_USRP
Will generate the software oscilloscope features
Will compile eNB
CMAKE_CMD=cmake ..
No transport protocol has been selected (TP set to None)
RF HW set to OAI_USRP
Flags for Deadline scheduler: False
Flags for CPU Affinity: False
2. Setting the OAI PATHS ...
OPENAIR_DIR = /home/f437enb/openairinterface5g
FreeDiameter prefix not found, install freeDiameter if EPC, HSS
```

# Outline

- 實驗目的及實驗內容
- OAI安裝
  - 實驗環境
  - 架設OAI的EPC軟體
  - 架設OAI的eNB軟體
  - 測試OAI運行
  - UE註冊與註銷
- Web Server安裝
  - 實驗環境
  - 架設Web Server
  - UE影片瀏覽軟體安裝



# OAI運行(啟動EPC程式)

在終端機輸入

- `cd ~/openair-cn/scripts`
- `./run_hss`

開啟一個新的終端機，並且輸入

- `cd ~/openair-cn/scripts`
- `./run_mme`

開啟一個新的終端機，並且輸入

- `cd ~/openair-cn/scripts`
- `./run_spgw`

# OAI運行(啟動eNB程式)

到eNB的電腦上，在終端機輸入

- `$ cd ~/openairinterface5g/cmake_targets/lte_build_oai/build`
- `$ sudo -E ./lte-softmodem -O ~/openairinterface5g/targets/PROJECTS/GENERIC-LTE-EPC/CONF/enb.band7.tm1.usrpb210.conf -d`

# OAI運行(HSS顯示訊息)

## EPC上的HSS顯示訊息

```
f437epc@f437epc: ~/openair-cn/scripts
0)
09/21/20,16:15:58.445637 NOTI AVP: 'Product-Name'(269) l=20 f=- val="freeDiameter"
09/21/20,16:15:58.445639 NOTI AVP: 'Firmware-Revision'(267) l=12 f=- val=10200 (0x27d8)
09/21/20,16:15:58.445641 NOTI AVP: 'Inband-Security-Id'(299) l=12 f=-M val='NO_INBAND_SECURITY' (0 (0x0))
09/21/20,16:15:58.445644 NOTI AVP: 'Vendor-Specific-Application-Id'(260) l=32 f=-M val=(grouped)
09/21/20,16:15:58.445647 NOTI AVP: 'Auth-Application-Id'(258) l=12 f=-M val=16777251 (0x1000023)
09/21/20,16:15:58.445651 NOTI AVP: 'Vendor-Id'(266) l=12 f=-M val=10415 (0x28af)
09/21/20,16:15:58.445654 NOTI AVP: 'Supported-Vendor-Id'(265) l=12 f=-M val=10415 (0x28af)
09/21/20,16:15:58.445669 DBG SENT to 'f437epc.openair4G.eur': 'Capabilities-Exchange-Answer'0/257 f:---- src:'(nil)' len:216 {C:268/l:12,C:264/l:25,C:296/l:21,C:278/l:12,C:257/l:14,C:257/l:14,C:266/l:12,C:269/l:20,C:267/l:12,C:260/l:32,C:265/l:12}
09/21/20,16:15:58.445693 NOTI No TLS protection negotiated with peer 'f437epc.openair4G.eur'.
09/21/20,16:15:58.445713 NOTI 'STATE_CLOSED' -> 'STATE_OPEN' 'f437epc.openair4G.eur'
```

# OAI運行(MME顯示訊息)

## EPC上的MME顯示訊息

```
f437epc@f437epc: ~/openair-cn/scripts
()
000302 00078:135820 7F850E7FC700 TRACE S1AP -cn/src/s1ap/s1ap_mme_handlers.c:0493 Leaving s1ap_generate_s1_setup_response(
) (rc=0)
000303 00078:135827 7F850E7FC700 TRACE S1AP -cn/src/s1ap/s1ap_mme_handlers.c:0397 Leaving s1ap_mme_handle_s1_setup_request(
(rc=0)
000304 00078:135879 7F850FFFF700 DEBUG SCTP rc/sctp/sctp_primitives_server.c:0277 [40][1] Sending buffer 0x7f84f80011e0 of 2
7 bytes on stream 0 with ppid 18
000305 00078:135968 7F850FFFF700 DEBUG SCTP rc/sctp/sctp_primitives_server.c:0288 Successfully sent 27 bytes on stream 0
000306 00080:428766 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0033 ===== ST
ATISTICS =====

000307 00080:428782 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0034
since last display| Removed since last display |
000308 00080:428787 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0036
1 | 0 |
000309 00080:428792 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0038
0 | 0 |
000310 00080:428797 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0040
0 | 0 |
000311 00080:428801 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0042
0 | 0 |
000312 00080:428805 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0044
0 | 0 |

000313 00080:428809 7F850DFFB700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0045
ATISTICS =====
```

|                 | Current Status | Added s |
|-----------------|----------------|---------|
| Connected eNBs  | 1              |         |
| Attached UEs    | 0              |         |
| Connected UEs   | 0              |         |
| Default Bearers | 0              |         |
| S1-U Bearers    | 0              |         |

# OAI運行(SPGW顯示訊息)

## EPC上的SPGW顯示訊息

```
f437epc@f437epc: ~/openair-cn/scripts
000135 00001:341673 7FC7ED9D2700 DEBUG S11 epc/openair-cn/src/s11/s11_sgw.c:0
301 Initializing S11 interface: DONE
000136 00001:341679 7FC7ED9D2700 DEBUG SPGW-A pc/openair-cn/src/sgw/sgw_task.c:0
148 Initializing SPGW-APP task interface
000137 00001:341685 7FC7ED9D2700 DEBUG GTPv1- air-cn/src/gtpv1-u/gtpv1u_task.c:0
096 Initializing GTPV1U interface
000138 00001:342760 7FC7E9AA5700 DEBUG UDP /src/udp/udp_primitives_server.c:0
126 Creating new listen socket on address 127.0.11.2 and port 2123
000139 00001:342823 7FC7E9AA5700 DEBUG UDP /src/udp/udp_primitives_server.c:0
171 Inserting new descriptor for task 6, sd 31
000140 00001:342852 7FC7E9AA5700 DEBUG UDP /src/udp/udp_primitives_server.c:0
187 Received 1 events
rmmod: ERROR: Module gtp is not currently loaded
000141 00001:358275 7FC7ED9D2700 NOTIC GTPv1- -cn/src/gtpv1-u/gtp_mod_kernel.c:0
081 Using the GTP kernel mode (genl ID is 29)
000142 00001:373910 7FC7ED9D2700 DEBUG GTPv1- -cn/src/gtpv1-u/gtp_mod_kernel.c:0
104 Setting route to reach UE net 172.16.0.0 via gtp0
000143 00001:374472 7FC7ED9D2700 NOTIC GTPv1- -cn/src/gtpv1-u/gtp_mod_kernel.c:0
111 GTP kernel configured
000144 00001:376692 7FC7ED9D2700 DEBUG GTPv1- air-cn/src/gtpv1-u/gtpv1u_task.c:0
124 Initializing GTPV1U interface: DONE
000145 00001:420702 7FC7ED9D2700 DEBUG SPGW-A pc/openair-cn/src/sgw/sgw_task.c:0
208 Initializing SPGW-APP task interface: DONE
```

# OAI運行(eNB顯示訊息)

## eNB上顯示訊息

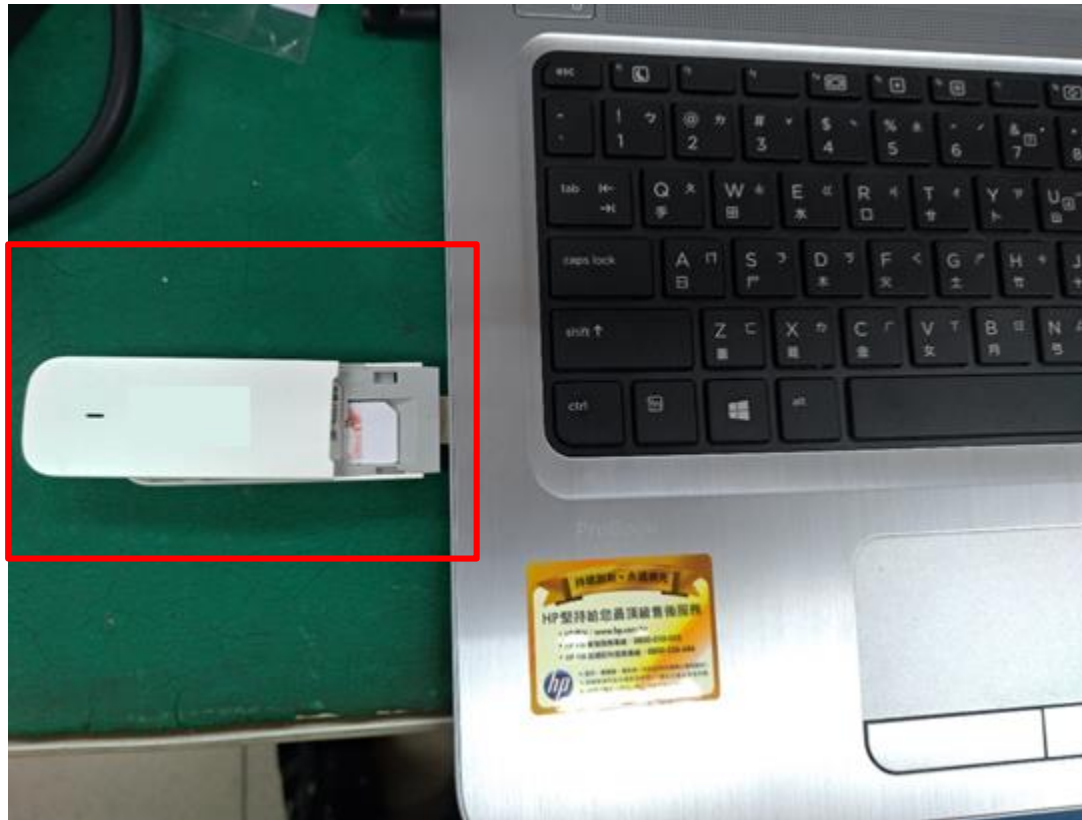
```
f437enb@f437enb: ~/openairinterface5g/cmake_targets/lte_build_oai/build
[PHY][I] Actual TX antenna: TX/RX...
[PHY][I] Device timestamp: 0.000209...
[RRH] has loaded USRP B200 device.
setup_eNB_buffers: frame_parms = 0x7f4da2435788
[PHY][I] Initializing eNB 0 CC_id 0 (eNodeB_3GPP,synch_to_ext_device),
[HW][I][SCHED][eNB] eNB_thread_single started on CPU 4 TID 2364, sched_policy =
SCHED_FIFO , priority = 99, CPU Affinity= CPU_0 CPU_1 CPU_2 CPU_3 CPU_4 CPU_5 CP
U_6 CPU_7
waiting for sync (eNB_thread_single)
Creating te_thread
[PHY][I] thread te created id=2367[HW][I][SCHED][eNB] eNB_thread_prach started on
CPU 1 TID 2368, sched_policy = SCHED_FIFO , priority = 99, CPU Affinity= CPU_0
CPU_1 CPU_2 CPU_3 CPU_4 CPU_5 CPU_6 CPU_7
[HW][I][SCHED][eNB] eNB_thread_synch started on CPU 4 TID 2369, sched_policy = S
CHED_FIFO , priority = 99, CPU Affinity= CPU_0 CPU_1 CPU_2 CPU_3 CPU_4 CPU_5 CPU
_6 CPU_7
waiting for sync (eNB_thread_synch)
Setting eNB buffer to all-RX
Sending sync to all threads
TYPE <CTRL-C> TO TERMINATE
Entering ITTI signals handler
got sync (eNB_thread_single)
got sync (eNB_thread_synch)
```

# Outline

- 實驗目的及實驗內容
- OAI安裝
  - 實驗環境
  - 架設OAI的EPC軟體
  - 架設OAI的eNB軟體
  - 測試OAI運行
  - UE註冊與註銷
- Web Server安裝
  - 實驗環境
  - 架設Web Server
  - UE影片瀏覽軟體安裝

# UE註冊-1

將SIM卡插入Dongle裡，並接上電腦的USB





# UE註冊-2

到網頁上輸入192.168.8.1，並開啟LTE網路



# UE註冊(MME顯示訊息)

UE註冊成功後，EPC上的MME顯示訊息

```
f437epc@f437epc: ~/openair-cn/scripts
001262 00037:891316 7FF0E48D8700 DEBUG S11 penair-cn/src/s11/s11_mme_task.c:0072 Received triggered response indicati
on
001263 00037:891326 7FF0E48D8700 DEBUG GTPv2- v2c-0.11/src/NwGtpv2cMsgParser.c:0203 Received IE 2 of length 2!
001264 00037:891331 7FF0E48D8700 DEBUG S11 ir-cn/src/s11/s11_ie_formatter.c:0441 - Cause 16
001265 00037:891342 7FF0E48D8700 DEBUG GTPv2- /nwgtpv2c-0.11/src/NwGtpv2cMsg.c:0146 Purging message 7ff0c8000900!
001266 00037:891353 7FF0E48D8700 TRACE GTPv2- 2-c/nwgtpv2c-0.11/src/NwGtpv2c.c:0778 Leaving nwGtpv2cSendTriggeredRspIndToU
p() (rc=0)
001267 00037:891357 7FF0E48D8700 TRACE GTPv2- 2-c/nwgtpv2c-0.11/src/NwGtpv2c.c:1187 Leaving nwGtpv2cProcessUdpReq() (rc=0)
001268 00040:463438 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0033 =====
STATISTICS =====
001269 00040:463448 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0034 d since last display| Removed since last display |
001270 00040:463451 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0036 0 | 0
001271 00040:463455 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0038 1 | 0
001272 00040:463458 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0040 1 | 0
001273 00040:463461 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0042 1 | 0
001274 00040:463464 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0044 1 | 0
001275 00040:463467 7FF0CF7FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0045 =====
STATISTICS =====
```

|                 | Current Status | Adde |
|-----------------|----------------|------|
| Connected eNBs  | 1              |      |
| Attached UEs    | 1              |      |
| Connected UEs   | 1              |      |
| Default Bearers | 1              |      |
| S1-U Bearers    | 1              |      |

# UE註冊(eNB顯示訊息)

UE註冊成功後，eNB上顯示訊息

```
f437enb@f437enb: ~/openairinterface5g/cmake_targets/lte_build_oai/build
[RLC][I][FRAME 00000][eNB][MOD 00][RNTI 2eaf][SRB AM 02][CONFIGURE] max_retx_threshold 32 po
ll_pdu 8 poll_byte 16960 t_poll_retransmit 15 t_reordering 35 t_status_prohibit 10
[RLC][I][FRAME 00000][eNB][MOD 00][RNTI 2eaf] [DRB 1] rrc_rlc_add_rlc DRB
[RRC][I][eNB 0] Frame 0 CC 0 : SRB2 is now active
[RRC][I][eNB 0] Frame 0 : Logical Channel UL-DCCH, Received RRCConnectionReconfigurationCom
plete from UE rnti 2eaf, reconfiguring DRB 1/LCID 3
[RRC][I][eNB 0] Frame 0 : Logical Channel UL-DCCH, Received RRCConnectionReconfigurationCom
plete from UE 0, reconfiguring DRB 1/LCID 3
[MAC][I][rrc_mac_config_req] [CONFIG][eNB 0/0] Configuring MAC/PHY for UE 0 (2eaf)
[PHY][I]phy_config_dedicated_eNB: physicalConfigDedicated=0x7fab4c003290
[PHY][I]Transmission Mode (phy_config_dedicated_eNB) 1
[SIAP][I][siap_eNB_initial_ctxt_resp] initial_ctxt_resp_p: e_rab ID 5, enb_addr 192.168.1.20
2, SIZE 4
[SCTP][I][sctp_send_data] Successfully sent 40 bytes on stream 1 for assoc_id 2
[PHY][I][eNB 0] Sent physicalConfigDedicated=0x7fab4c003290 for UE 0
[RRC][N][eNB 0] Frame 384: received a DCCH 2 message on SRB 2 with Size 16 from UE 2eaf
[RRC][I][FRAME 00000][eNB][MOD 00][RNTI 2eaf] Received on DCCH 2 RRC_DCCH_DATA_IND
[MAC][I][schedule_ue_spec] [eNB 0], Frame 385, DCCH1->DLSCH, CC_id 0, Requesting 185 bytes f
rom RLC (RRC message)
[SCTP][I][sctp_send_data] Successfully sent 61 bytes on stream 1 for assoc_id 2
[SCTP][I][sctp_eNB_flush_sockets] Found data for descriptor 43
[SCTP][I][sctp_eNB_read_from_socket] Received notification for sd 43, type 32777
[PHY][I]UE 0 : rnti 2eaf
[MAC][I][eNB_dlsch_ulsch_scheduler] UE rnti 2eaf : in synch, PHR 40 dB CQI 15
[RRC][I]UE rnti 2eaf failure timer 0/20000
[PHY][I]UE 0 : rnti 2eaf
[MAC][I][eNB_dlsch_ulsch_scheduler] UE rnti 2eaf : in synch, PHR 40 dB CQI 15
[RRC][I]UE rnti 2eaf failure timer 0/20000
```

# UE註銷

到網頁上輸入192.168.8.1，並關閉LTE網路



# UE註銷(MME顯示訊息)

UE註銷成功後，EPC上的MME顯示訊息

```
f437epc@f437epc: ~/openair-cn/scripts
001533 00078:864333 7F8B077FE700 TRACE MME-AP cn/src/mme_app/mme_app_context.c:0662
()
001534 00078:864338 7F8B077FE700 TRACE MME-AP cn/src/mme_app/mme_app_context.c:0667
)
001535 00078:864341 7F8B077FE700 DEBUG MME-AP cn/src/mme_app/mme_app_context.c:0988
or mme_ue_s1ap_id 0x00000001
001536 00078:864345 7F8B077FE700 TRACE MME-AP cn/src/mme_app/mme_app_context.c:0677
001537 00078:864352 7F8B077FE700 TRACE MME-AP cn/src/mme_app/mme_app_context.c:0721
001538 00078:864356 7F8B077FE700 TRACE MME-AP cn/src/mme_app/mme_app_context.c:1003
lease_complete()
001539 00080:371885 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0033
TATISTICS ===== S
001540 00080:371904 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0034
since last display| Removed since last display |
001541 00080:371909 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0036
0 | 0
001542 00080:371914 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0038
0 | 1
001543 00080:371918 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0040
0 | 1
001544 00080:371923 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0042
0 | 1
001545 00080:371927 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0044
0 | 1
001546 00080:371931 7F8B077FE700 DEBUG MME-AP src/mme_app/mme_app_statistics.c:0045
TATISTICS ===== S
```

|                 | Current Status | Added |
|-----------------|----------------|-------|
| Connected eNBs  | 1              |       |
| Attached UEs    | 0              |       |
| Connected UEs   | 0              |       |
| Default Bearers | 0              |       |
| S1-U Bearers    | 0              |       |

# UE註銷(eNB顯示訊息)

UE註銷成功後，eNB上顯示訊息

```
f437enb@f437enb: ~/openairinterface5g/cmake_targets/lte_build_oai/build
UE 1 (mcs 10, first rb 1, nb_rb 6, rb_table_index 5, TBS 129, harq_pid 0)
[MAC][I][schedule_ulsch_rnti] [eNB 0][PUSCH 0/8d79] CC_id 0 Frame 397 subframeP 2 Scheduled
UE 1 (mcs 10, first rb 1, nb_rb 6, rb_table_index 5, TBS 129, harq_pid 0)
[MAC][I][schedule_ulsch_rnti] [eNB 0][PUSCH 0/8d79] CC_id 0 Frame 400 subframeP 4 Scheduled
UE 1 (mcs 10, first rb 1, nb_rb 6, rb_table_index 5, TBS 129, harq_pid 0)
[MAC][I][SR_indication] [eNB 0][SR 8d79] Frame 401 subframeP 5 Signaling SR for UE 1 on CC_id 0
[MAC][I][schedule_ulsch_rnti] [eNB 0][PUSCH 7/8d79] CC_id 0 Frame 401 subframeP 9 Scheduled
UE 1 (mcs 10, first rb 1, nb_rb 6, rb_table_index 5, TBS 129, harq_pid 7)
[MAC][I][SR_indication] [eNB 0][SR 8d79] Frame 402 subframeP 5 Signaling SR for UE 1 on CC_id 0
[MAC][I][schedule_ulsch_rnti] [eNB 0][PUSCH 1/8d79] CC_id 0 Frame 402 subframeP 9 Scheduled
UE 1 (mcs 10, first rb 1, nb_rb 6, rb_table_index 5, TBS 129, harq_pid 1)
[PHY][W][eNB 0, CC 0] frame 403, subframe 6, UE 1: ULSCH consecutive error count reached 20,
triggering UL Failure
[MAC][I][UL_failure_indication] [eNB 0][UE 1/8d79] Frame 403 subframeP 6 Signaling UL Failure
for UE 1 on CC_id 0 (timer 0)
[PHY][E]ERROR: Format 1A: rb_alloc (1ff) > RIV_max (144)
[PHY][E]ERROR: Format 1A: rb_alloc (1ff) > RIV_max (144)
[PHY][E]ERROR: Format 1A: rb_alloc (1ff) > RIV_max (144)
[PHY][E]ERROR: Format 1A: rb_alloc (1ff) > RIV_max (144)
[PHY][E]ERROR: Format 1A: rb_alloc (1ff) > RIV_max (144)
[MAC][I][eNB_dlsch_ulsch_scheduler] UE 1 rnti 8d79: UL Failure after repeated PDCCH orders:
Triggering RRC
[RRC][W]Frame 423, Subframe 5: UL failure: UE 8d79 unknown
MAC: remove UE 1 rnti 8d79
[MAC][I][rrc_mac_remove_ue] Removing UE 1 from Primary CC_id 0 (rnti 8d79)
[PHY][I]rx_rf: rfdevice timing drift of -1 samples (ts_off 31235683)
```

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  - UE註冊與註銷
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  - 架設Web Server
  - UE影片瀏覽軟體安裝

# 實驗設備-硬體

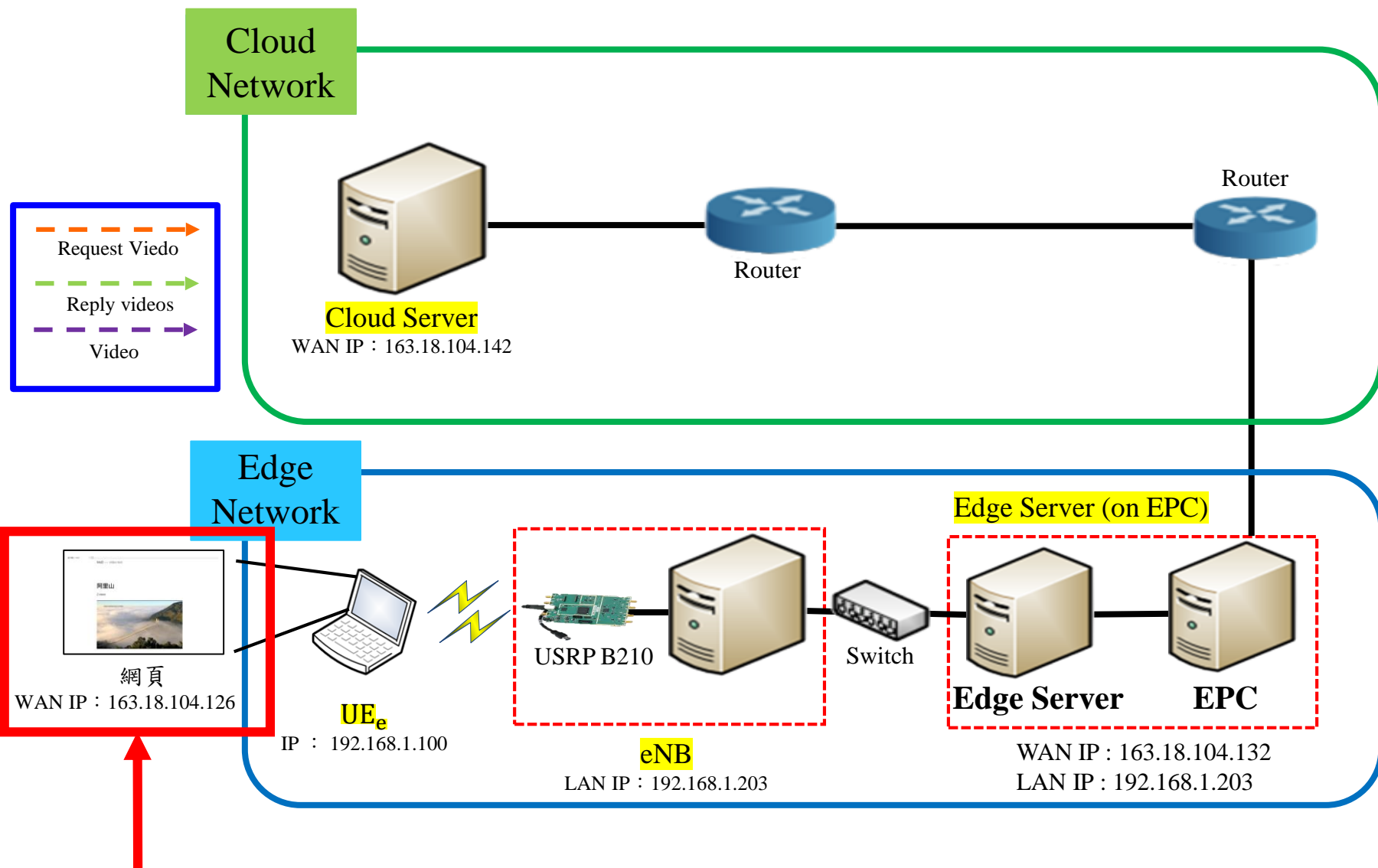
| 名稱         | 硬體                                           | 數量  | 目的                                    |
|------------|----------------------------------------------|-----|---------------------------------------|
| Web Server | CPU : i5-3470 RAM : 8 GB<br>HDD : 500 GB     | 1 台 | 提供UE到網站上觀看Cloud Server與Edge Server的影片 |
|            | Ethernet Network PCIE Card                   | 1 個 | 連接WAN (for Internet)                  |
| UE         | CPU : i7-9750H<br>RAM : 8 GB<br>SSD : 256 GB | 1 台 | 使用UE觀看影片                              |
| RJ45雙絞線    | RJ45雙邊接頭的CAT 5e網路線                           | 1 條 | Web Server*1條                         |



# 實驗設備-軟體

|               |                 |       |
|---------------|-----------------|-------|
| Web<br>Server | OS : Windows 10 | 1909  |
|               | WampServer      | 3.2.0 |
|               | WordPress       | 5.4.2 |
| UE            | OS : Windows 10 | 1909  |
|               | VLC             | 2.2.4 |

# 實驗架構



# Web Server架設須知


- Web Server實驗三-VoD Streaming資料串流實驗時會使用到
- 需先知道Edge Server和Cloud Server的IP

# Outline

- 實驗目的及實驗內容
- OAI安裝
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  - 架設OAI的EPC軟體
  - 架設OAI的eNB軟體
  - 測試OAI運行
  - UE註冊與註銷
- Web Server安裝
  - 實驗環境
  - 架設Web Server
  - UE影片瀏覽軟體安裝

# Wamp Server 下載

- 下載wamp server
- 網址：<https://www.wampserver.com/en/>



The image shows the 'DOWNLOADS' section of the WampServer website. It features a blue arrow icon pointing down into a server-like base. The text 'DOWNLOADS' is prominently displayed in white. Below it, a paragraph explains that WampServer is free under the GPL license and available in 32 and 64 bit versions, noting compatibility issues with older Windows versions. Two yellow buttons are shown: 'WAMP SERVER 64 BITS (X64) 3.2.0' (highlighted with a red border) and 'WAMP SERVER 32 BITS (X86) 3.2.0'. Below each button is a list of included software versions and a link to the changelog.

**DOWNLOADS**

WampServer is available for free (under GPL license) in two distinct versions : 32 and 64 bits. Wampserver 2.5 is not compatible with Windows XP, neither with SP3, nor Windows Server 2003. Older WampServer versions are available on [SourceForge](#).

**WAMP SERVER**

**WAMP SERVER 64 BITS (X64) 3.2.0**

– Wampserver 3.2.0 64 bit x64 – Apache 2.4.41 – PHP 5.6.40, 7.3.12, 7.4.0 – MariaDB 10.4.10|10.3.20 – PhpMyAdmin 4.9.2 – Adminer 4.7.5 – PhpSysInfo 3.3.1. En option : PHP 7.0.33/7.1.33/7.2.25 – MySQL 5.7.28|8.0.18 [changelog](#)

**WAMP SERVER 32 BITS (X86) 3.2.0**

– Wampserver 3.2.0 32 bit x86 – Apache 2.4.41 – PHP 5.6.40, 7.3.12, 7.4.0 – MariaDB 10.4.10|10.3.20 – PhpMyAdmin 4.9.2 – Adminer 4.7.5 – PhpSysInfo 3.3.1. En option : PHP 7.0.33/7.1.33/7.2.25 – MySQL 5.7.28 [changelog](#)

# 安裝Microsoft Visual C++

- 安裝Microsoft Visual C++ 2012、2013、2015
- Wamp Server才能安裝成功



Microsoft Visual C++ 2012 Redistributable (x64) -... 20.5 MB  
2020/9/16



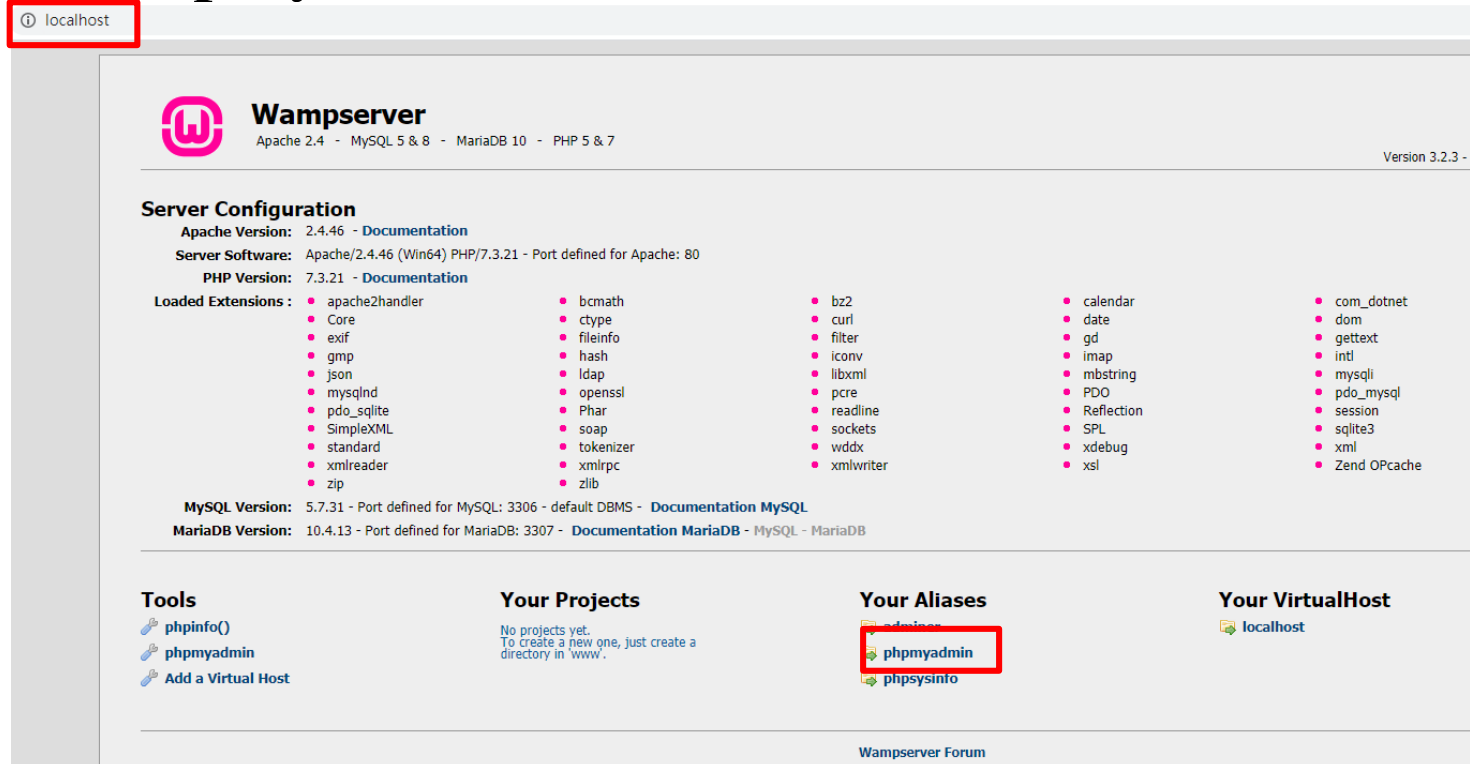
Microsoft Visual C++ 2013 Redistributable (x64) -... 20.6 MB  
2020/9/16



Microsoft Visual C++ 2015 Redistributable (x64) -... 22.4 MB  
2020/9/16

# 開啟phpMyAdmin

- 在瀏覽器上輸入localhost
- 開啟phpmyadmin



The screenshot shows the Wampserver dashboard. At the top, there's a search bar with 'localhost' entered. The main content area displays 'Server Configuration' with details for Apache, PHP, and MySQL. Below this, there's a 'Loaded Extensions' section listing various PHP extensions. At the bottom, there are four sections: 'Tools' (with links to phpinfo(), phpmyadmin, and Add a Virtual Host), 'Your Projects' (with a note to create a new project), 'Your Aliases' (with links to phpmyadmin and phpsysinfo, where 'phpmyadmin' is highlighted with a red box), and 'Your VirtualHost' (with a link to localhost). The footer mentions 'Wampserver Forum'.

localhost

**Wampserver**  
Apache 2.4 - MySQL 5 & 8 - MariaDB 10 - PHP 5 & 7

Version 3.2.3 -

**Server Configuration**  
Apache Version: 2.4.46 - [Documentation](#)  
Server Software: Apache/2.4.46 (Win64) PHP/7.3.21 - Port defined for Apache: 80  
PHP Version: 7.3.21 - [Documentation](#)

**Loaded Extensions :**

- apache2handler
- Core
- exif
- gmp
- json
- mysqlnd
- pdo\_sqlite
- SimpleXML
- standard
- xmlreader
- zip
- bcmath
- ctype
- fileinfo
- hash
- ldap
- openssl
- Phar
- soap
- tokenizer
- xmlrpc
- zlib
- bz2
- curl
- filter
- iconv
- libxml
- pcre
- readline
- sockets
- wddx
- xmlwriter
- calendar
- date
- gd
- imap
- mbstring
- PDO
- Reflection
- SPL
- xdebug
- xsl
- com\_dotnet
- dom
- gettext
- intl
- mysqli
- pdo\_mysql
- session
- sqlite3
- xml
- Zend OPcache

**MySQL Version:** 5.7.31 - Port defined for MySQL: 3306 - default DBMS - [Documentation MySQL](#)  
**MariaDB Version:** 10.4.13 - Port defined for MariaDB: 3307 - [Documentation MariaDB](#) - [MySQL](#) - [MariaDB](#)

**Tools**  
[phpinfo\(\)](#)  
[phpmyadmin](#)  
[Add a Virtual Host](#)

**Your Projects**  
No projects yet.  
To create a new one, just create a directory in 'www'.

**Your Aliases**  
[phpmyadmin](#)  
[phpsysinfo](#)

**Your VirtualHost**  
[localhost](#)

Wampserver Forum

# 登入phpMyAdmin

登入

- 使用者名稱：root
- 密碼：(空白)



The image shows the phpMyAdmin login interface. At the top, there is a logo with a sailboat and the text "phpMyAdmin" in blue and orange, followed by "歡迎使用 phpMyAdmin" in black. Below this, there is a section for language selection with a dropdown menu currently set to "中文 - Chinese traditional". Further down, there is a login section with a tab labeled "登入" and a help icon. It contains three input fields: "使用者名稱：" with the value "root", "密碼：" which is empty, and "選擇伺服器：" with a dropdown menu set to "MySQL". At the bottom right of the login section is a button labeled "執行".

語言 - Language

中文 - Chinese traditional

登入 ?

使用者名稱： root

密碼：

選擇伺服器： MySQL

執行



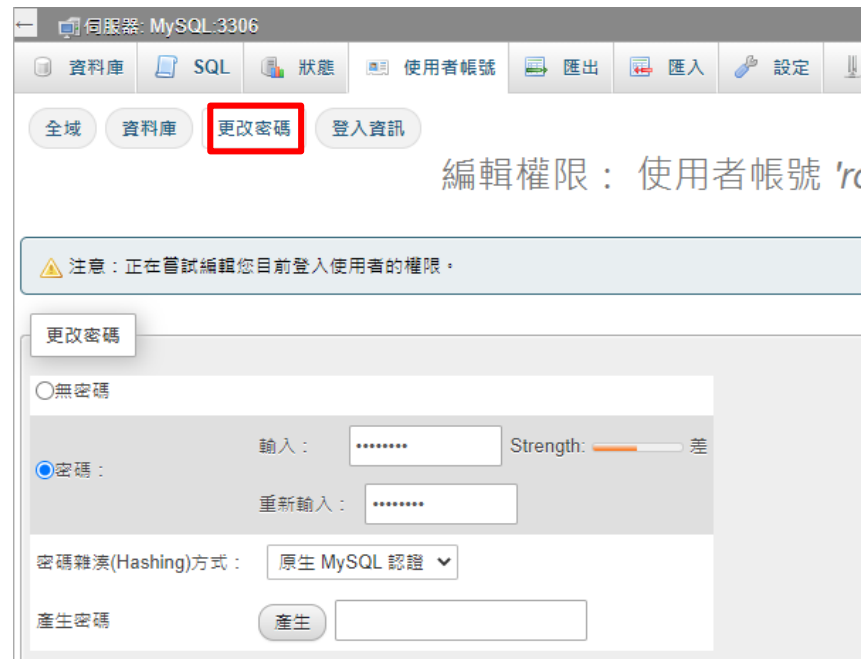
# 更改phpMyAdmin密碼 (1)

- 點選使用者帳號
- 點選編輯權限



# 更改phpMyAdmin密碼 (2)

- 點選更改密碼
- 並輸入自己密碼
- 範例使用：rootf437



伺服器: MySQL 3306

資料庫 SQL 狀態 使用者帳號 匯出 匯入 設定

全域 資料庫 **更改密碼** 登入資訊

編輯權限：使用者帳號 'root'

注意：正在嘗試編輯您目前登入使用者的權限。

更改密碼

☐ 無密碼

☒ 密碼：

輸入：  Strength:  差

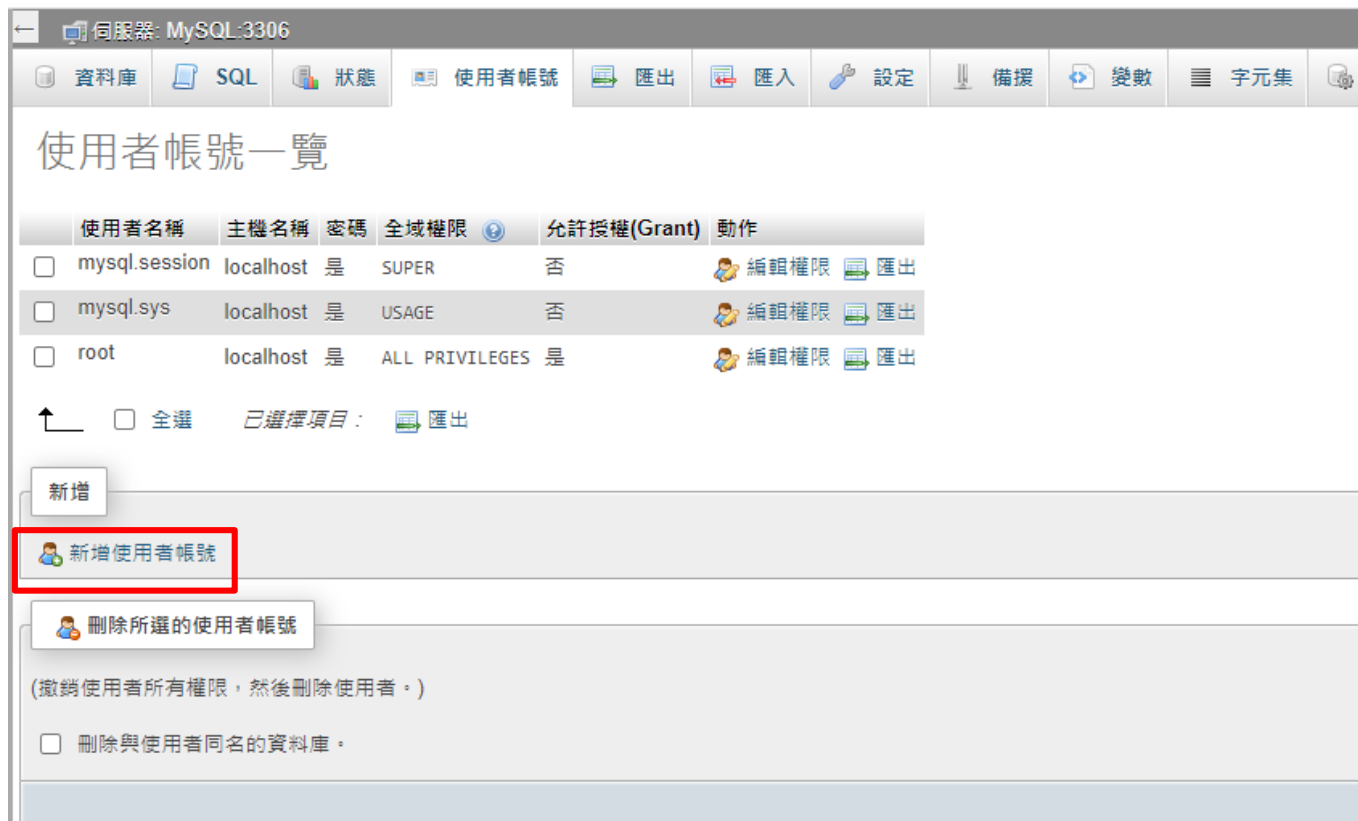
重新輸入：

密碼雜湊(Hashing)方式： 原生 MySQL 認證

產生密碼

# 新增使用者帳號 (1)

- 點選新增使用者帳號



# 新增使用者帳號 (2)

- 使用者名稱：wp
- 主機名稱：163.18.104.126
- 密碼：rootf437

WebServer IP

伺服器: MySQL:3306

資料庫 SQL 狀態 使用者帳號 匯出 匯入 設定 備援

### 新增使用者帳號

登入資訊

使用者名稱： 使用文字方塊: wp

主機名稱： 使用文字欄位: 163.18.104.126

密碼： 使用文字方塊: ..... Strength: 差

重新輸入： .....

認證外掛程式 原生 MySQL 認證

產生密碼: 產生

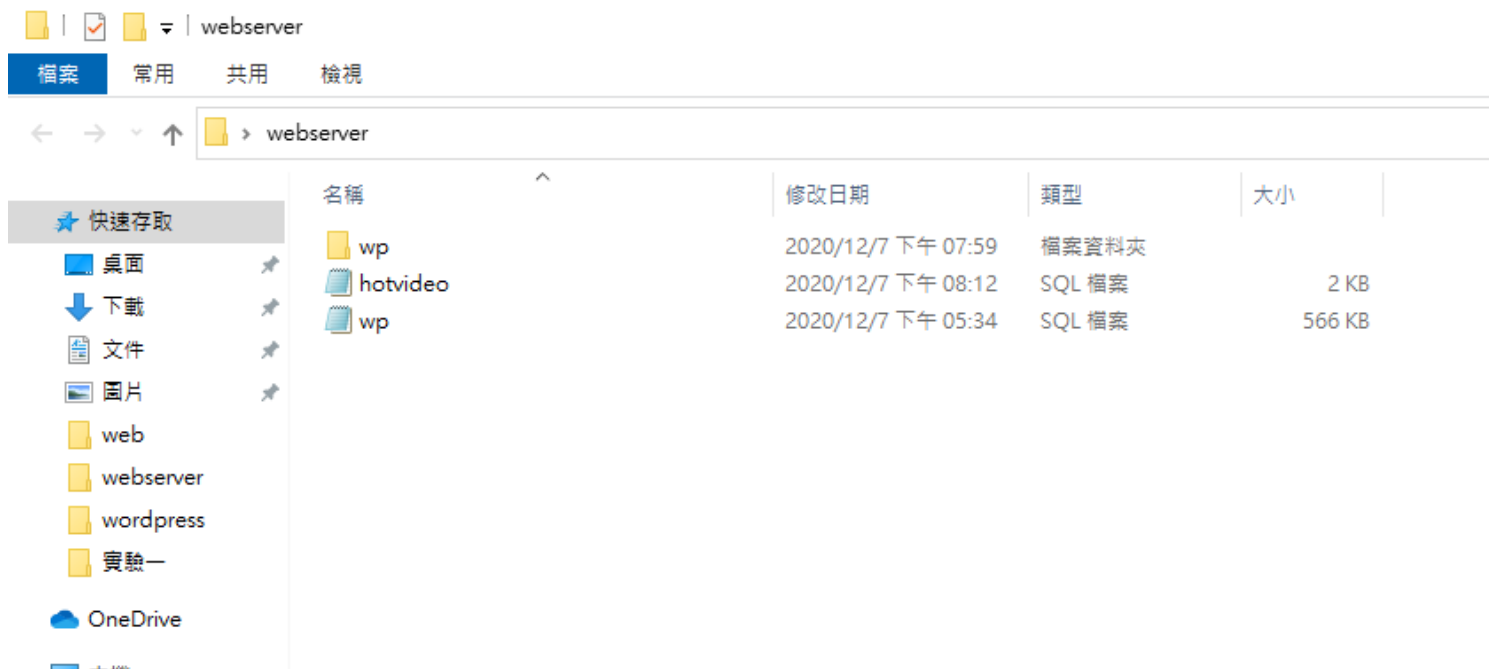
使用者帳號的資料庫

- ☒ 建立與使用者同名的資料庫，並授予所有權限。
- ☒ 給以 帳號\_ 開頭的資料庫 (username\\_%) 授予所有權限。

# 下載修改的wordpress

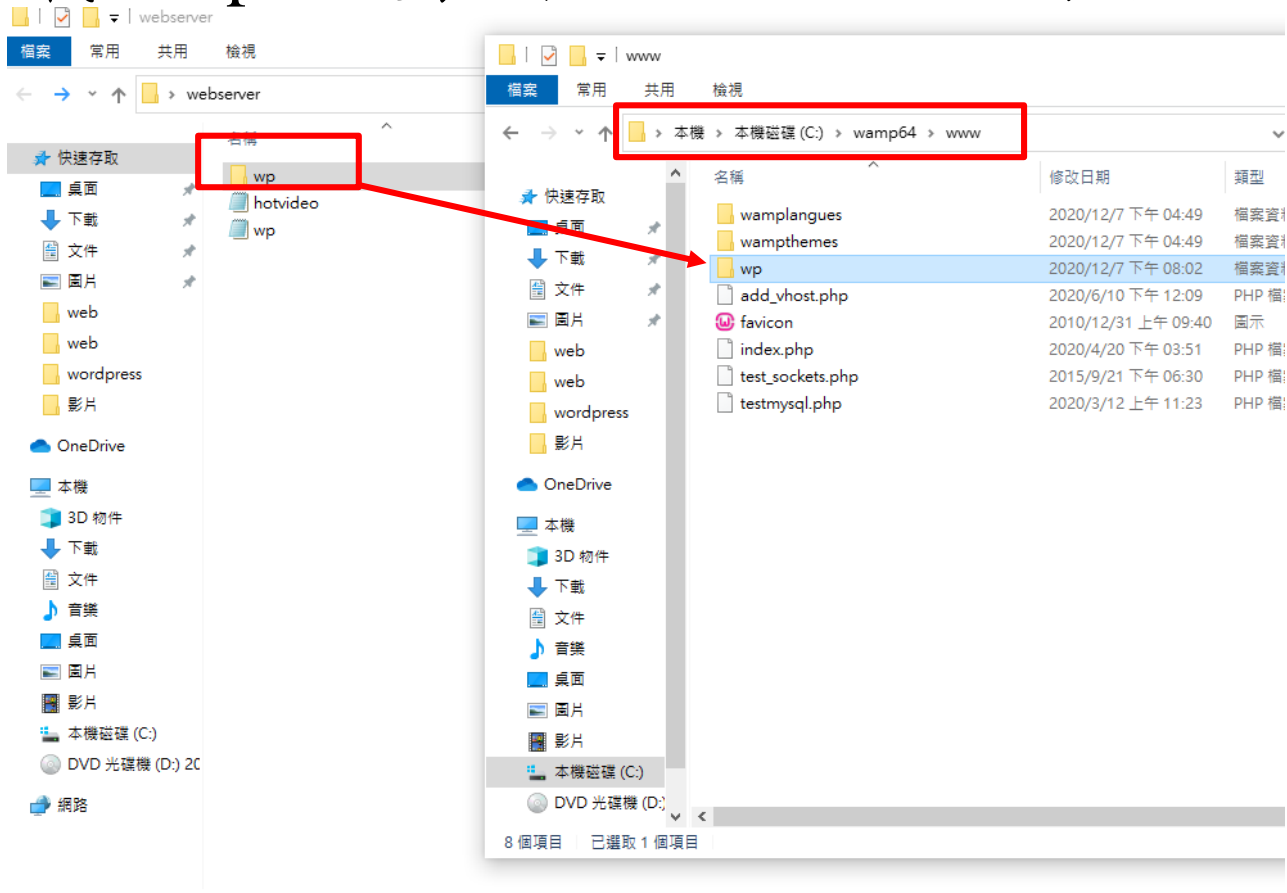
下載webserver.zip並解壓縮，

網址：<https://drive.google.com/drive/folders/1RJ7cxJgYCAKW158kR-qxVLkhW8TsXNiM?usp=sharing>



# 建立wordpress (1)

- 將下載的wp，複製到網站的www目錄下：



# 建立wordpress (2)

- 前往wordpress管理頁面：
- 網址：<http://163.18.104.126/wp/wp-admin/setup-config.php>

**WebServer IP**



# 建立wordpress (3)

- 輸入資料庫連結

安裝人員應於下方輸入資料庫連線詳細資料。如果不清楚以下欄位代表的意義，請洽詢網站主機服務商。

|         |                                                                 |                                             |
|---------|-----------------------------------------------------------------|---------------------------------------------|
| 資料庫名稱   | <input type="text" value="wp"/>                                 | 使用於 WordPress 的網站資料庫名稱。                     |
| 使用者名稱   | <input type="text" value="wp"/>                                 | WordPress 網站資料庫的使用者名稱。                      |
| 密碼      | <input type="text" value="rootf437"/>                           | WordPress 網站資料庫的密碼。                         |
| 資料庫主機位址 | <input type="text" value="163.18.104.126"/> <b>WebServer IP</b> | 如果因故無法使用 localhost 進行連線，請要求網站主機服務商提供正確對應資訊。 |
| 資料表前置詞  | <input type="text" value="wp_"/>                                | 如需在同一個資料庫中安裝多個 WordPress，請修改這個欄位中的預設設定。     |



# 建立wordpress (4)

- 辦理帳號密碼

## 安裝網站所需資訊

請提供下列資訊，不必擔心，這些設定均可於安裝完成後進行變更。

網站標題

wp

使用者名稱

root

使用者名稱只能使用數字、英文字母、空白、底線、連字號、句號及 @ 符號。

密碼

rootf437

隱藏

低

重要提示: 這是安裝完成後用於登入網站的密碼，請將它儲存在安全的位置。

確認密碼

☒ 確認使用安全強度較弱的密碼

電子郵件地址

F109110105@nkust.edu.tw

自己的信箱

繼續操作前，請再次確認填寫的電子郵件地址。

搜尋引擎可見度

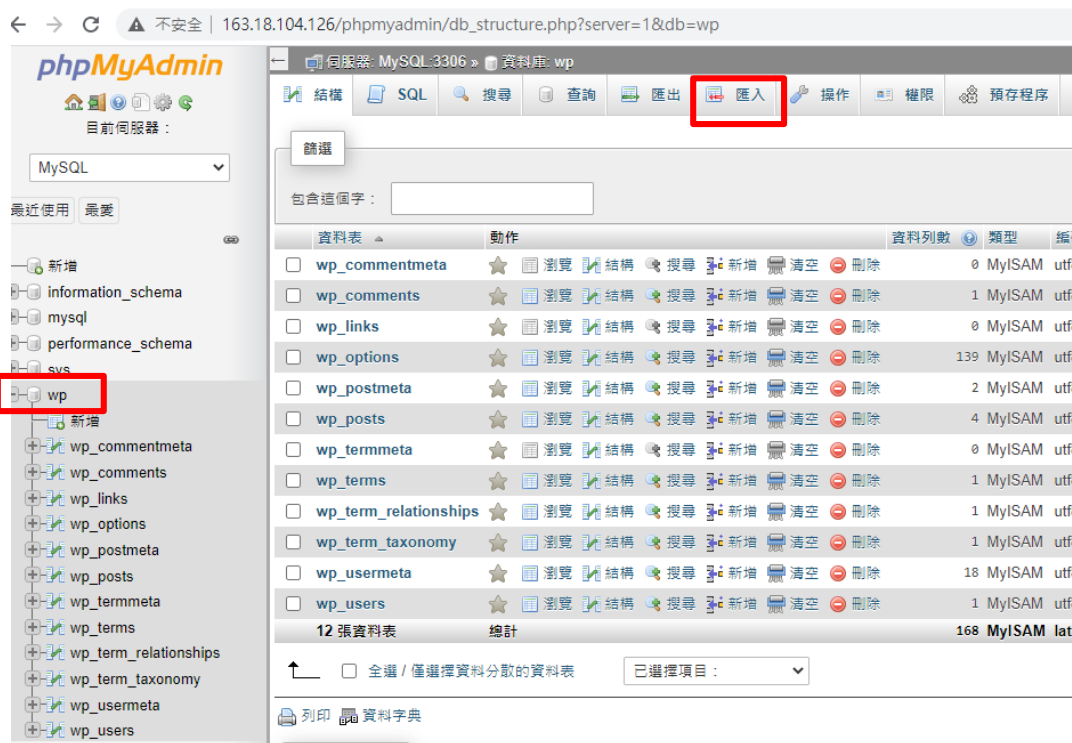
☐ 阻擋搜尋引擎索引這個網站

這項設定的效力並非絕對，完全取決於搜尋引擎是否遵守這項設定的要求。

安裝 WordPress

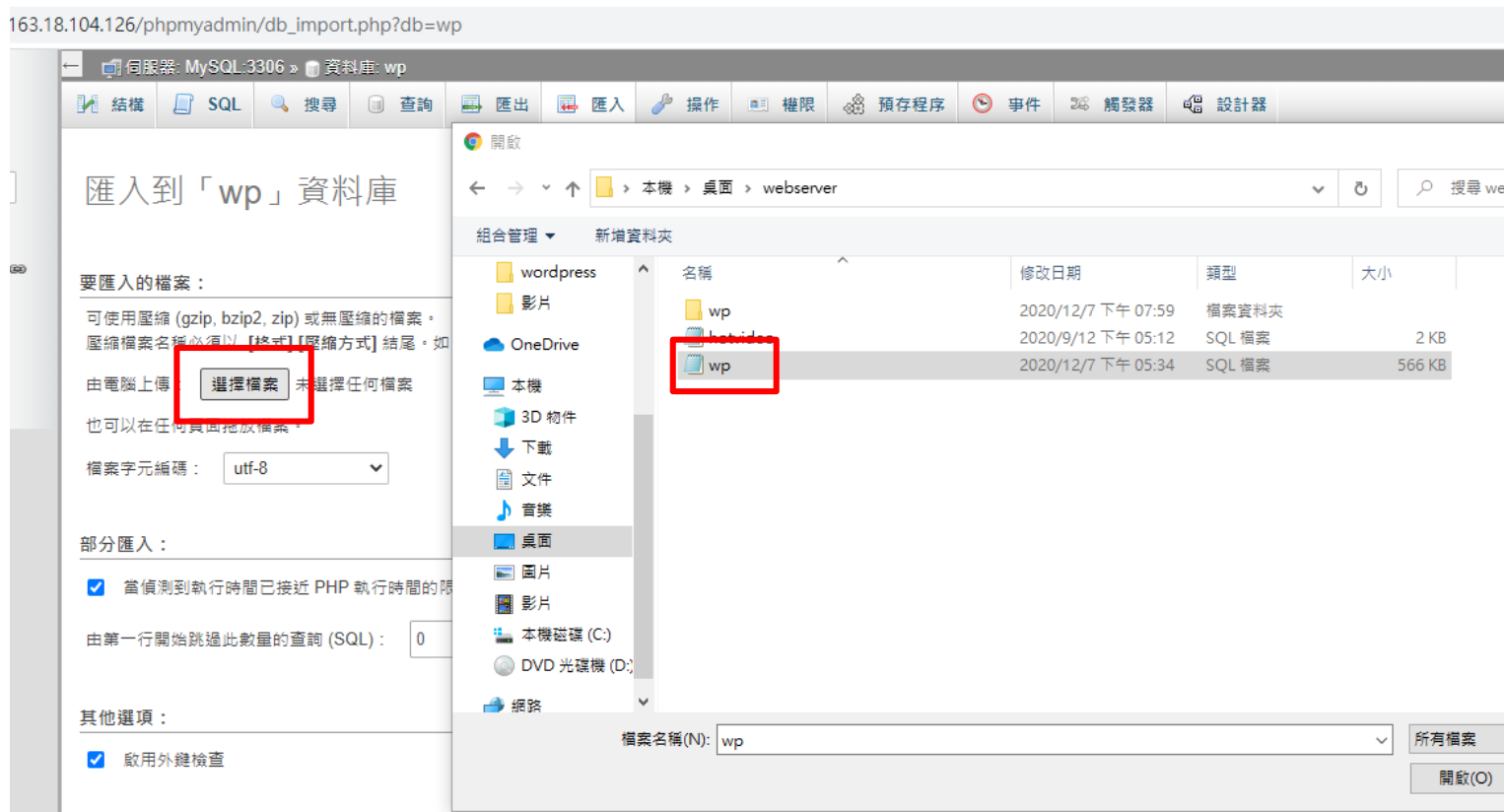
# 匯入資料庫 (1)

- 進入phpMyAdmin，並進入wp
- 點擊匯入



# 匯入資料庫 (2)

- 選擇wp.sql匯入



# 更改wp\_options

- 更改wp\_options

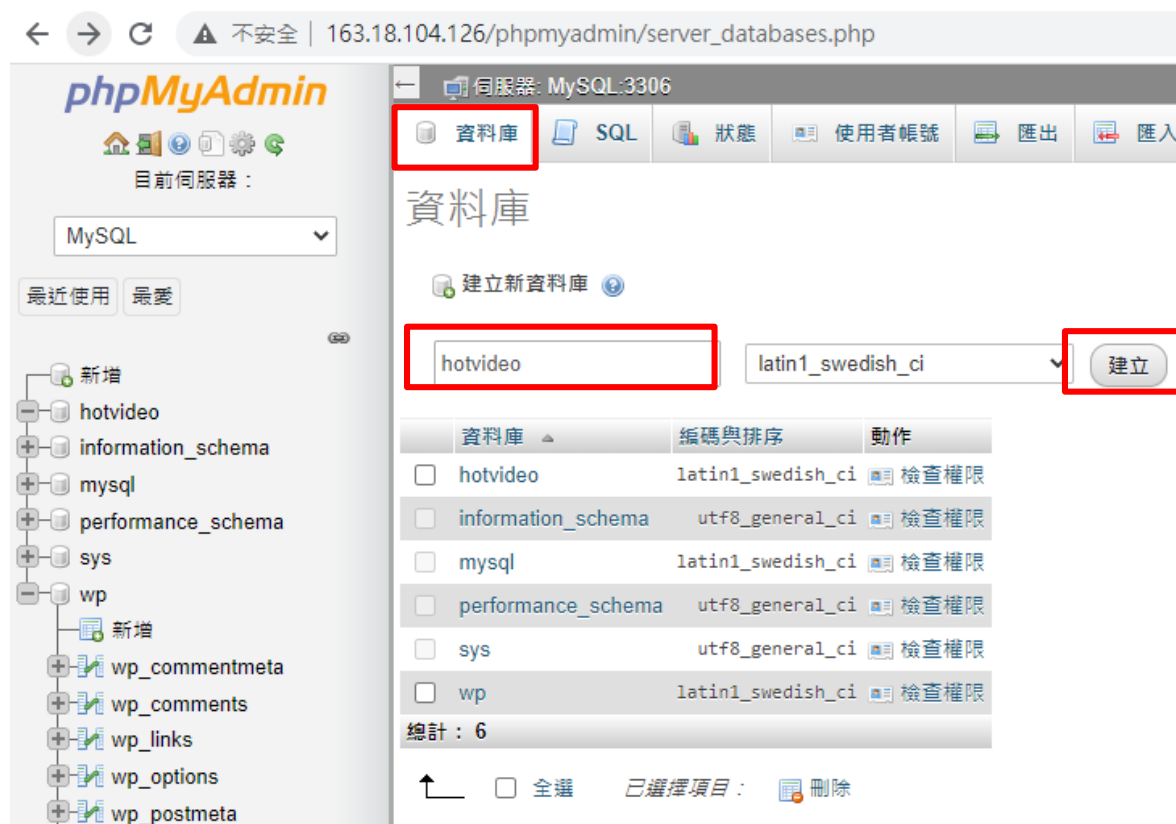
UPDATE `wp\_options` SET `option\_value` = 'http://163.18.104.126/wp' WHERE `wp\_options`.`option\_id` = 2;

1 > >> ☐ 全部顯示 | 資料列數: 25 篩選資料列: 搜尋此資料表

|                          |          | option_id | option_name        | option_value             | autoload |
|--------------------------|----------|-----------|--------------------|--------------------------|----------|
| <input type="checkbox"/> | 編輯 複製 刪除 | 1         | siteurl            | http://163.18.104.126/wp | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 2         | home               | http://163.18.104.126/wp | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 3         | blogname           | wp                       | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 4         | blogdescription    | videotest                | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 5         | users_can_register | 0                        | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 6         | admin_email        | f109110105@nkust.edu.tw  | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 7         | start_of_week      | 1                        | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 8         | use_balanceTags    | 0                        | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 9         | use_smilies        | 1                        | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 10        | require_name_email | 1                        | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 11        | comments_notify    | 1                        | yes      |
| <input type="checkbox"/> | 編輯 複製 刪除 | 12        | posts_per_rss      | 10                       | yes      |

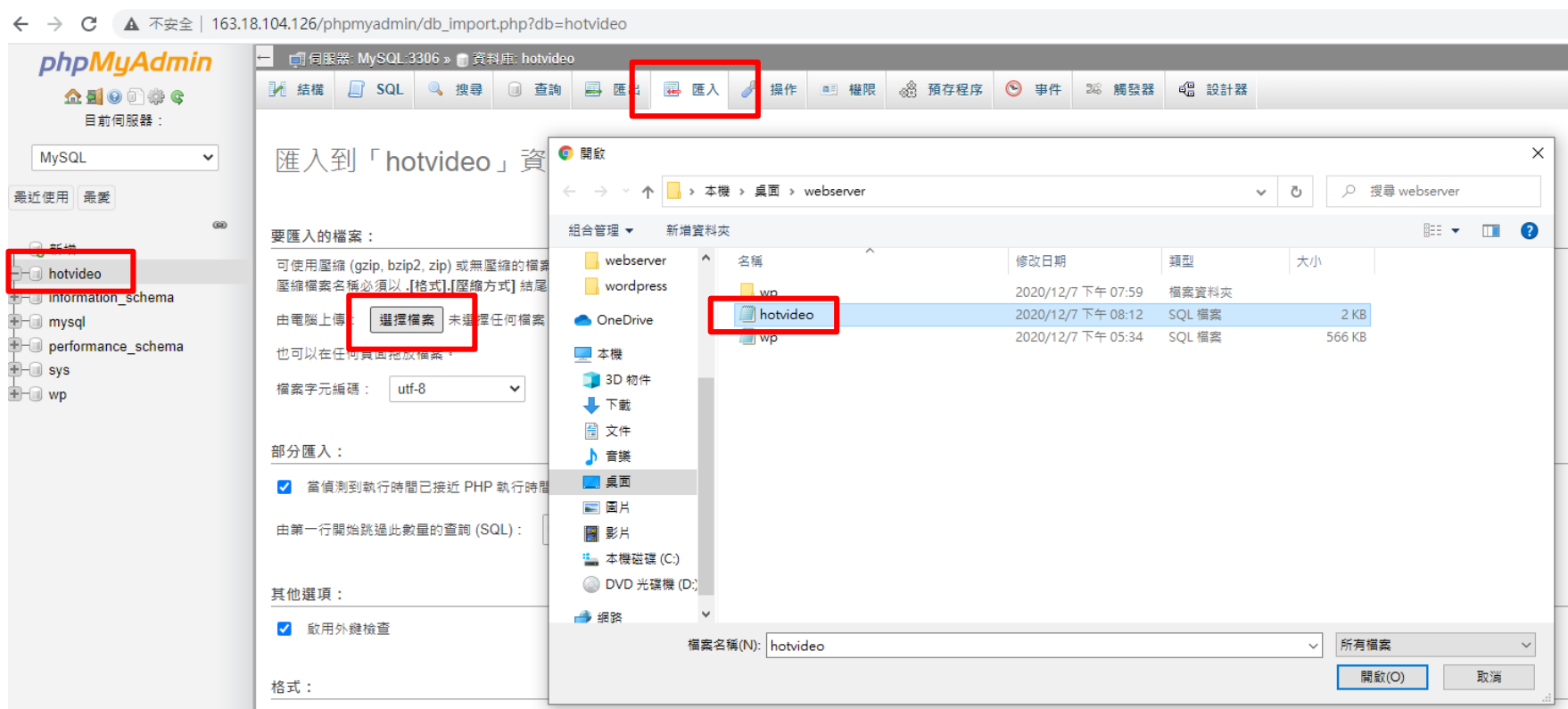
# 新增資料庫

- 到phpMyAdmin的資料庫，建立資料庫



# 匯入資料庫

- 到hotvideo裡，匯入hotvideo.sql



# 進入到網頁設定

- 輸入網址：163.18.104.126/wp/wp-admin
- 使用者名稱：ccnlab WebServer IP
- 密碼：rootf437



The image shows the WordPress login interface. At the top is the WordPress logo. Below it is a white box containing the login form. The form has two input fields: the first is labeled '使用者名稱或電子郵件地址' (Username or email address) and contains the text 'ccnlab'; the second is labeled '密碼' (Password) and contains a series of dots, with an eye icon to its right. Below the password field is a checkbox labeled '保持登入' (Remember me) which is checked. To the right of the checkbox is a blue button labeled '登入' (Login). At the bottom of the form box, there is a link '忘記密碼?' (Forgot password?) and a link '← 返回 <wp>' (Return to WP).

# 網站設定頁面

The screenshot displays the WordPress admin interface. At the top, the browser tab shows '控制台 < wp — WordPress' and the address bar indicates '163.18.104.126/wp/wp-admin/'. The sidebar on the left contains navigation links: 控制台 (Control Panel), 首頁 (Home), 更新 (Updates) with a count of 5, 文章 (Posts), 媒體 (Media), 頁面 (Pages), 留言 (Comments), 外觀 (Appearance), 外掛 (Plugins) with a count of 2, 使用者 (Users), 工具 (Tools), 設定 (Settings), and 收合選單 (Collapse Menu). The main content area is titled '控制台' and features a welcome message: '歡迎使用 WordPress! 這個區塊提供了一些能夠協助使用者入門的連結。' Below this, there are two columns of links. The left column, '開始使用' (Get Started), includes a button '自訂網站外觀' (Customize Site Appearance) and a link '或更換為另一個佈景主題' (or switch to another theme). The right column, '下一步' (Next Steps), includes links for '撰寫第一篇文章' (Write your first post), '新增〈關於〉頁面' (Add an 'About' page), '設定這個網站的首頁' (Set this site's homepage), and '檢視這個網站' (View this site). At the bottom, there are two panels. The '網站狀態' (Site Health) panel shows a yellow circle icon and the text '需要改進' (Needs Improvement), with a message stating that there are major issues that need to be resolved to improve site performance and security, and a link to view 9 items in the '網站狀態' (Site Health) page. The '網站概況' (Site Overview) panel shows '1 篇文章' (1 post) and '16 個頁面' (16 pages). On the right side of the bottom section, there is a '快速草稿' (Quick Draft) panel with fields for '標題' (Title) and '內容' (Content), and a '儲存草稿' (Save Draft) button.



# 更改WordPress密碼

- 點選使用者->ccnlab->新密碼
- 可更改成自己WordPress的密碼

如果變更了這項設定，系統會傳送一封電子郵件至新地址進行確認。在完成確認前，無法使用新的電子郵件地址。

**使用者**

全部使用者  
新增使用者  
個人資料

**工具**

設定  
收合選單

個人網站網址

自我介紹

自傳資訊

請在個人資料中分享簡略的自傳資訊。請注意，依據不同佈景主題的相關設定及版面配置設計，有可能會公開。

**帳號管理**

新密碼

rootf437

隱藏 取消

低

確認密碼

☐ 確認使用安全強度較弱的密碼

登入工作階段

從除了這台裝置之外的全部裝置登出

是否遺失手機或曾在公用電腦上進行登入？執行這項操作便可從全部裝置登出，只保留這台裝置的登入階段。

# 資料庫遠端設定 (1)

- 開啟命令提示字元
- 找到MySQL執行檔的位置:

```
cd C:\wamp64\bin\mysql\mysql5.7.31\bin
```

命令提示字元

```
Microsoft Windows [版本 10.0.18363.1198]
(c) 2019 Microsoft Corporation. 著作權所有，並保留一切權利。
C:\Users\f437>cd C:\wamp64\bin\mysql\mysql5.7.31\bin
C:\wamp64\bin\mysql\mysql5.7.31\bin>
```

- 參考網站：<https://pclevinblog.pixnet.net/blog/post/314562604-%5Bmysql%5Dmysql-%E8%A8%AD%E5%AE%9A%E9%81%A0%E7%AB%AF%E7%99%BB%E5%85%A5--windows>

# 資料庫遠端設定 (2)

- 登入mysql：mysql -u root -prootf437

命令提示字元 - mysql -u root -prootf437

```
Microsoft Windows [版本 10.0.18363.1198]
(c) 2019 Microsoft Corporation. 著作權所有，並保留一切權利。

C:\Users\f437>cd C:\wamp64\bin\mysql\mysql5.7.31\bin

C:\wamp64\bin\mysql\mysql5.7.31\bin>mysql -u root -prootf437
mysql: [Warning] Using a password on the command line interface can be insecure.
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 15
Server version: 5.7.31 MySQL Community Server (GPL)

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Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
```

# 資料庫遠端設定 (3)

- 允許IP存取，允許Edge和Cloud的IP
- GRANT ALL PRIVILEGES ON \*.\* TO root@163.18.104.132 IDENTIFIED BY 'rootf437';  
**Edge IP**
- GRANT ALL PRIVILEGES ON \*.\* TO root@163.18.104.142 IDENTIFIED BY 'rootf437';  
**Cloud IP**
- GRANT ALL PRIVILEGES ON \*.\* TO root@163.18.104.126 IDENTIFIED BY 'rootf437';  
**Web IP**

```
mysql> GRANT ALL PRIVILEGES ON *.* TO root@163.18.104.132 IDENTIFIED BY 'rootf437';
Query OK, 0 rows affected, 1 warning (0.05 sec)

mysql> GRANT ALL PRIVILEGES ON *.* TO root@163.18.104.142 IDENTIFIED BY 'rootf437';
Query OK, 0 rows affected, 1 warning (0.00 sec)

mysql> GRANT ALL PRIVILEGES ON *.* TO root@163.18.104.126 IDENTIFIED BY 'rootf437';
Query OK, 0 rows affected, 1 warning (0.00 sec)
```

# 資料庫遠端設定 (4)

- 最後將權限flush，後離開
- FLUSH PRIVILEGES;
- exit;

```
mysql> GRANT ALL PRIVILEGES ON *.* TO root@163.18.1
Query OK, 0 rows affected, 1 warning (0.03 sec)

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.03 sec)

mysql> exit;
Bye

C:\wamp64\bin\mysql\mysql5.7.31\bin>
```

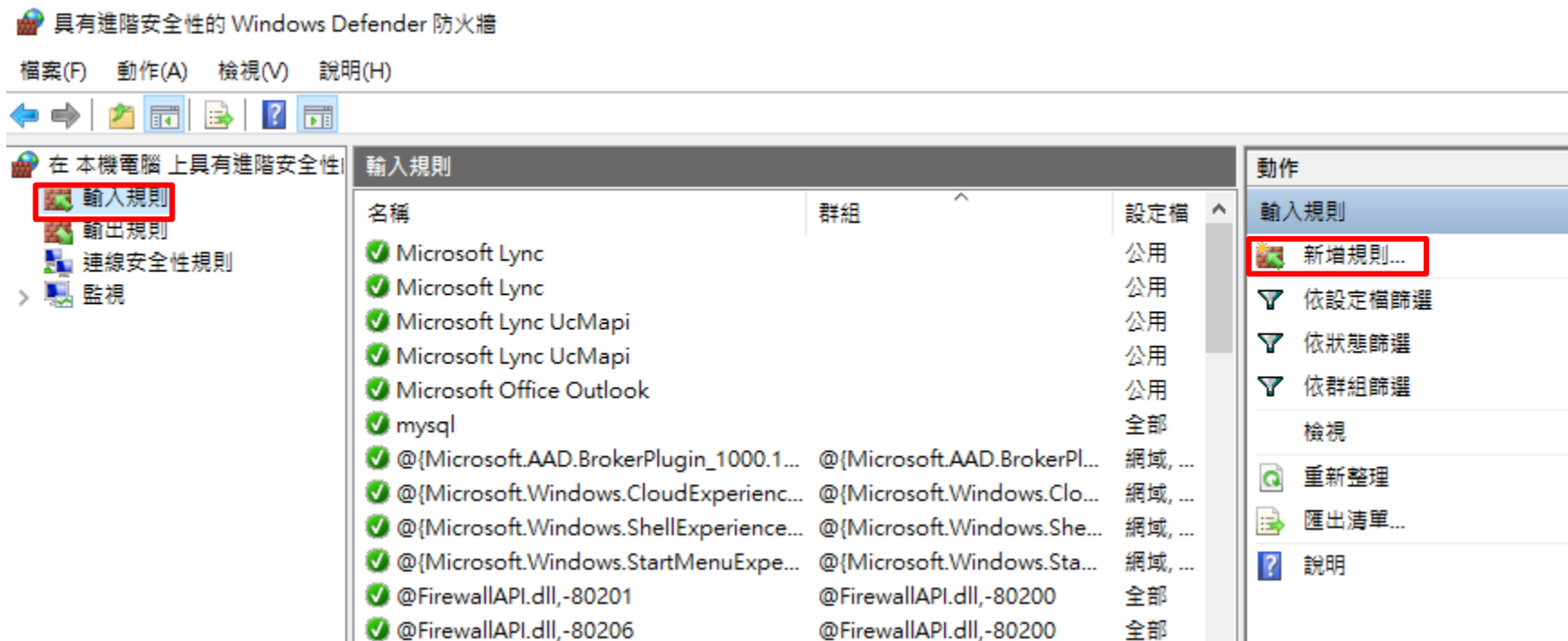
# 開啟防火牆設定 (1)

- 到防火牆，點擊進階設定



# 開啟防火牆設定 (2)

- 進入輸入規則後，點擊新增規則



# 開啟防火牆設定 (3)

- 選擇連接埠

新增輸入規則精靈

規則類型

選取要建立的防火牆規則類型。

步驟:

- 規則類型
- 通訊協定及連接埠
- 動作
- 設定檔
- 名稱

想要建立何種類型的規則？

☐ 程式(P)  
控制程式之連線的規則。

☒ 連接埠(O)  
控制 TCP 或 UDP 連接埠之連線的規則。

☐ 預先定義的(E):  
@FirewallAPI.dll-80200  
控制 Windows 體驗之連線的規則。

☐ 自訂(C)  
自訂規則。

< 上一步(B)   下一步(N) >   取消



# 開啟防火牆設定 (4)

- 選擇所有本機連接埠

新增輸入規則精靈

通訊協定及連接埠

指定套用這個規則的通訊協定與連接埠。

步驟:

- 規則類型
- 通訊協定及連接埠
- 動作
- 設定檔
- 名稱

此規則會套用於 TCP 或 UDP?

☒ TCP(T)  
☐ UDP(U)

這個規則套用於所有本機連接埠或特定本機連接埠?

☒ 所有本機連接埠(A)  
☐ 特定本機連接埠(S):

範例: 80, 443, 5000-5010

< 上一步(B)   下一步(N) >   取消

# 開啟防火牆設定 (5)

- 選擇允許連線

新增輸入規則精靈

## 動作

指定要在連線符合規則中指定的條件時採取的動作。

### 步驟:

- 規則類型
- 通訊協定及連接埠
- 動作
- 設定檔
- 名稱

當連線符合指定的條件時，應採取哪些動作？

☒ **允許連線(A)**

這包含使用 IPsec 保護的連線，以及未使用 IPsec 保護的連線。

☐ **僅允許安全連線(C)**

這只包含已使用 IPsec 驗證的連線。會使用 [連線安全性規則] 節點中的 IPsec 內容和規則設定，來確保連線的安全。

自訂(Z)...

☐ **封鎖連線(K)**

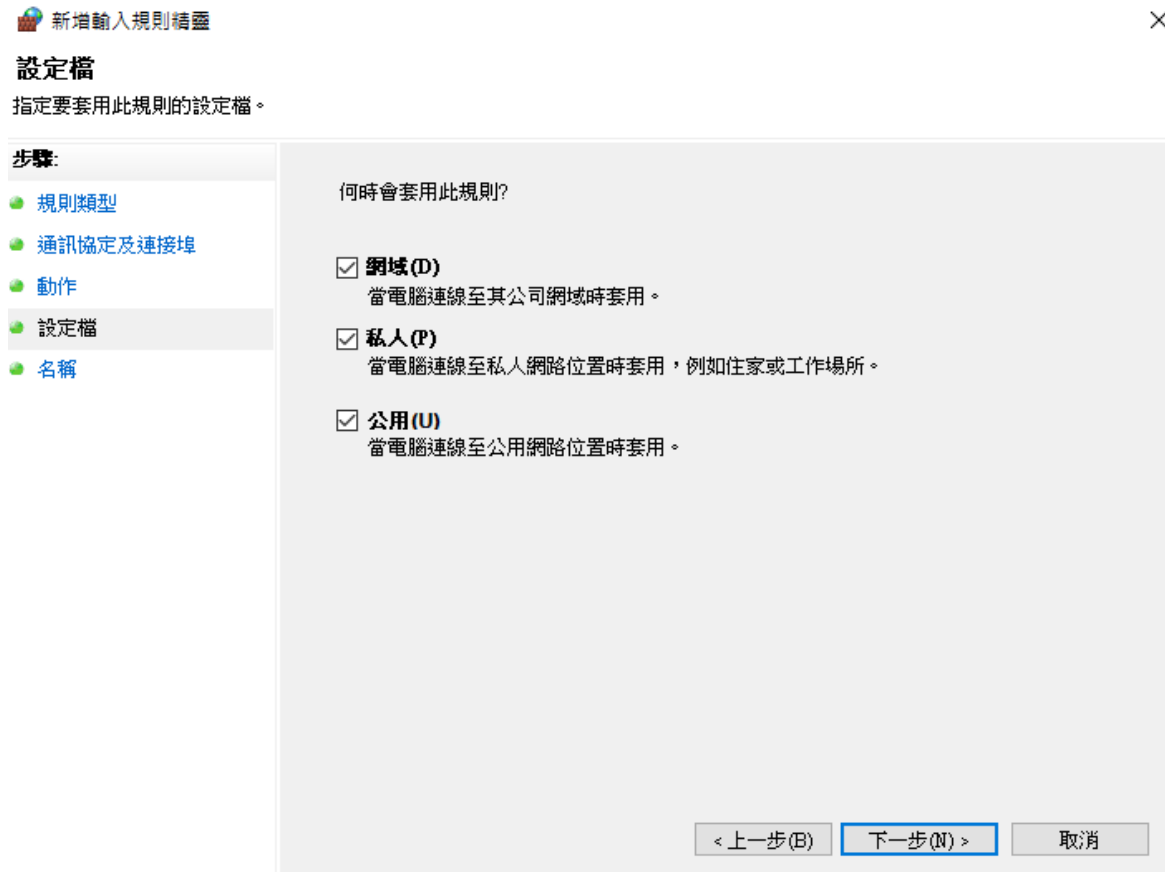
< 上一步(B)

下一步(N) >

取消

# 開啟防火牆設定 (6)

- 勾選全部



新增輸入規則精靈

設定檔  
指定要套用此規則的設定檔。

步驟:

- 規則類型
- 通訊協定及連接埠
- 動作
- 設定檔
- 名稱

何時會套用此規則?

☒ 網域 (D)  
當電腦連線至其公司網域時套用。

☒ 私人 (P)  
當電腦連線至私人網路位置時套用，例如住家或工作場所。

☒ 公用 (U)  
當電腦連線至公用網路位置時套用。

< 上一步(B)    下一步(N) >    取消

# 開啟防火牆設定 (7)

- 取名：MEC

新增輸入規則精靈

**名稱**  
指定此規則的名稱與描述。

**步驟:**

- 規則類型
- 通訊協定及連接埠
- 動作
- 設定檔
- 名稱**

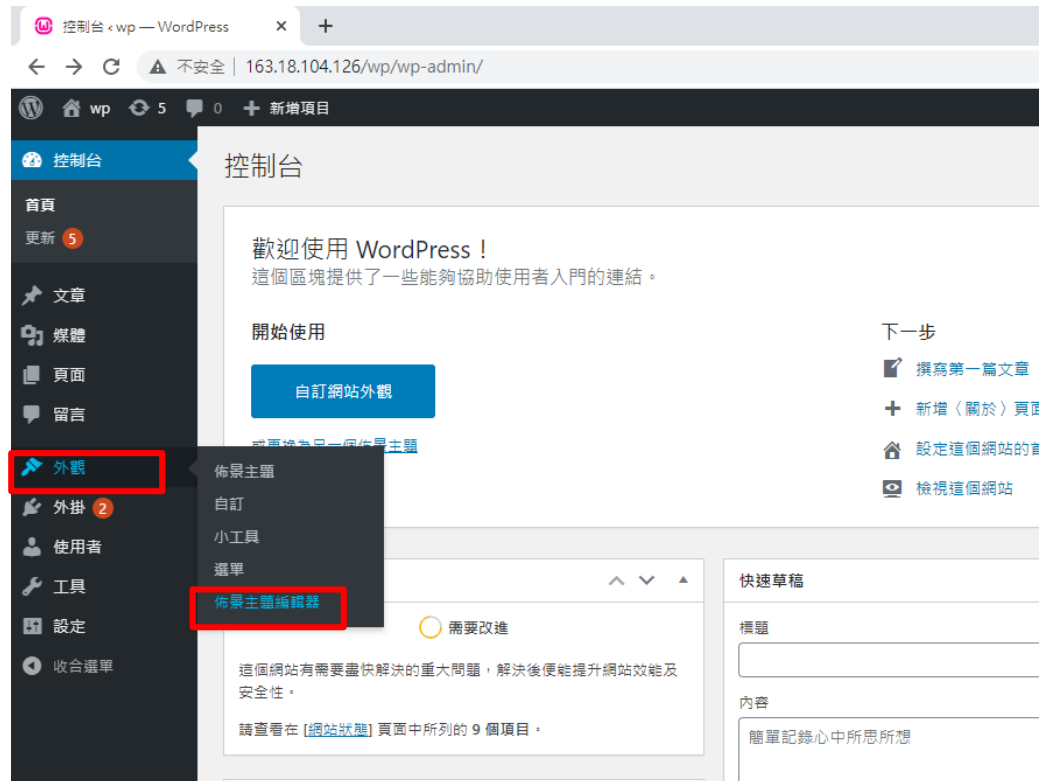
名稱(N):

描述(可省略)(D):

< 上一步(B)    **完成(F)**    取消

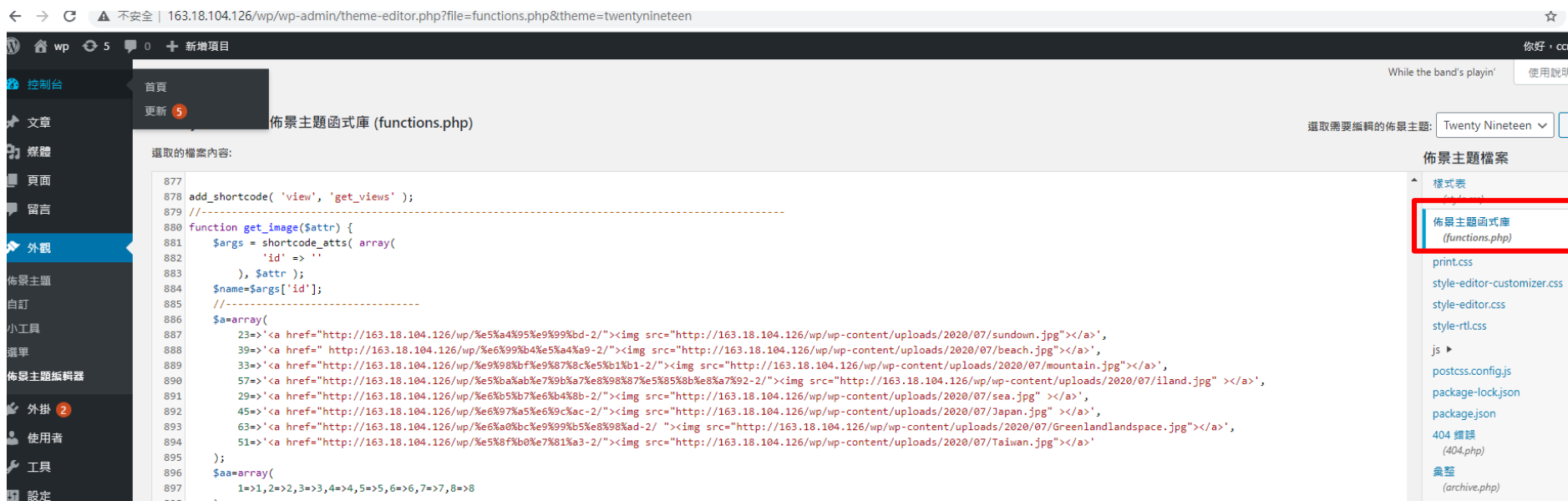
# 網頁設定 (1)

- 進入網頁：<http://163.18.104.126/wp/wp-admin/>
- 選擇佈景主題編輯器



# 網頁設定 (2)

- 點擊functions.php
- 將所有163.18.104.125的IP，更改成自己的WebServer IP：163.18.104.126



# 網頁設定 (3)

- 更改mysql密碼：rootf437
- 並點擊更新檔案

設定  
收合選單

```
595 $post[2]=str_replace("\r\n","", $post[2]);
596 $post[3]=str_replace("\r\n","", $post[3]);
597 date_default_timezone_set("Asia/Taipei");
598 $da=date("Y-m-d H:i:s");
599 $conn=mysqli_connect("163.18.104.126","root","rootf437");
600 //*****
601 mysqli_select_db($conn,"hotvideo");
602 //echo $da;
603 $sql = "DELETE FROM video";
604 mysqli_query($conn,$sql);
605 $sql = "INSERT INTO video (time,id) VALUES ('$da','$post[0]')";
606 mysqli_query($conn,$sql);
607 $sql = "INSERT INTO video (time,id) VALUES ('$da','$post[1]')";
608 mysqli_query($conn,$sql);
609 $sql = "INSERT INTO video (time,id) VALUES ('$da','$post[2]')";
610 mysqli_query($conn,$sql);
611 $sql = "INSERT INTO video (time,id) VALUES ('$da','$post[3]')";
```

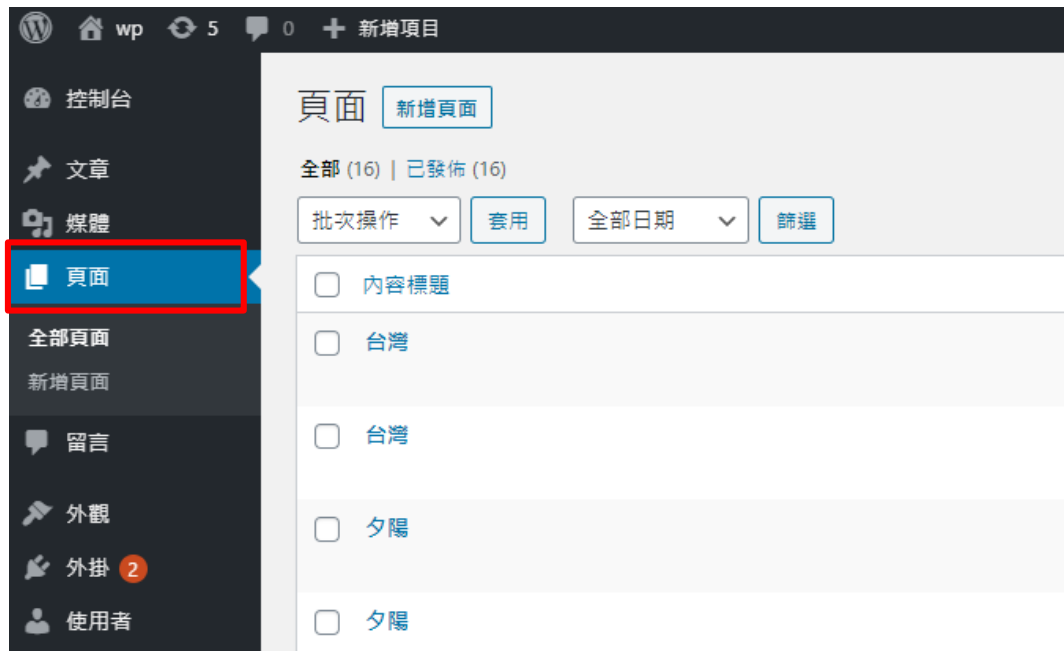
線上說明: 函式名稱... 查詢

檔案已完成編輯。

更新檔案

# 網頁設定 (4)

- 點選頁面
- 有兩種來源影片分別是Edge與Cloud





## 網頁設定 (5)

- 將所有來源都更改成對應的Edge IP與Cloud IP
- Edge IP：163.18.104.132

---

```
<p><object type="application/x-vlc-plugin" pluginspage="http://www.videolan.org/" id="vlc" events="false" width="720" height="410">
<param name="mrl" value="rtmp://163.18.104.132:1935/vod/Taiwan.mp4">
<param name="volume" value="50">
<param name="autoplay" value="false">
<param name="loop" value="false">
<param name="fullscreen" value="false">
<param name="controls" value="true">
</object>
</p>
```

---

# 網頁設定 (6)

- Cloud IP : 163.18.104.142

```
<p><object type="application/x-vlc-plugin" pluginspage="http://www.videolan.org/" id="vlc" events="false" width="720"
height="410">
<param name="mrl" value="rtmp://163.18.104.142:1935/vod/Taiwan.mp4">
<param name="volume" value="50">
<param name="autoplay" value="false">
<param name="loop" value="false">
<param name="fullscreen" value="false">
<param name="controls" value="true">
</object>
</p>
```

---

# 網頁開放設定 (1)

- 到設定->閱讀，將”阻擋搜尋引擎索引這個網站”關掉



The screenshot shows the WordPress Settings interface, specifically the 'Reading' tab. The left sidebar contains a menu with options: 外掛 (2), 使用者, 工具, 設定 (selected), 一般, 寫作, 閱讀, 討論, 媒體, 永久連結, 隱私權, Akismet Anti-Spam, and 收合選單. The main content area displays settings for the Reading tab. The 'Search Engine Visibility' section is highlighted with a red box, showing the checkbox 'Discourage search engines from indexing this site' is unchecked. Below this checkbox, a note states: '這項設定的效力並非絕對，完全取決於搜尋引擎是否遵守這項設定的要求。' (This setting's effectiveness is not absolute, it completely depends on whether the search engine complies with this setting's requirements.)

網站文章頁面每頁文章顯示數量  文章

資訊提供中的近期文章顯示數量  個項目

資訊提供中的文章顯示方式

- ☒ 完整內容
- ☐ 內容摘要

使用中的佈景主題掌控了內容在瀏覽器中的顯示方式。 [進一步瞭解資訊提供](#)

搜尋引擎可見度

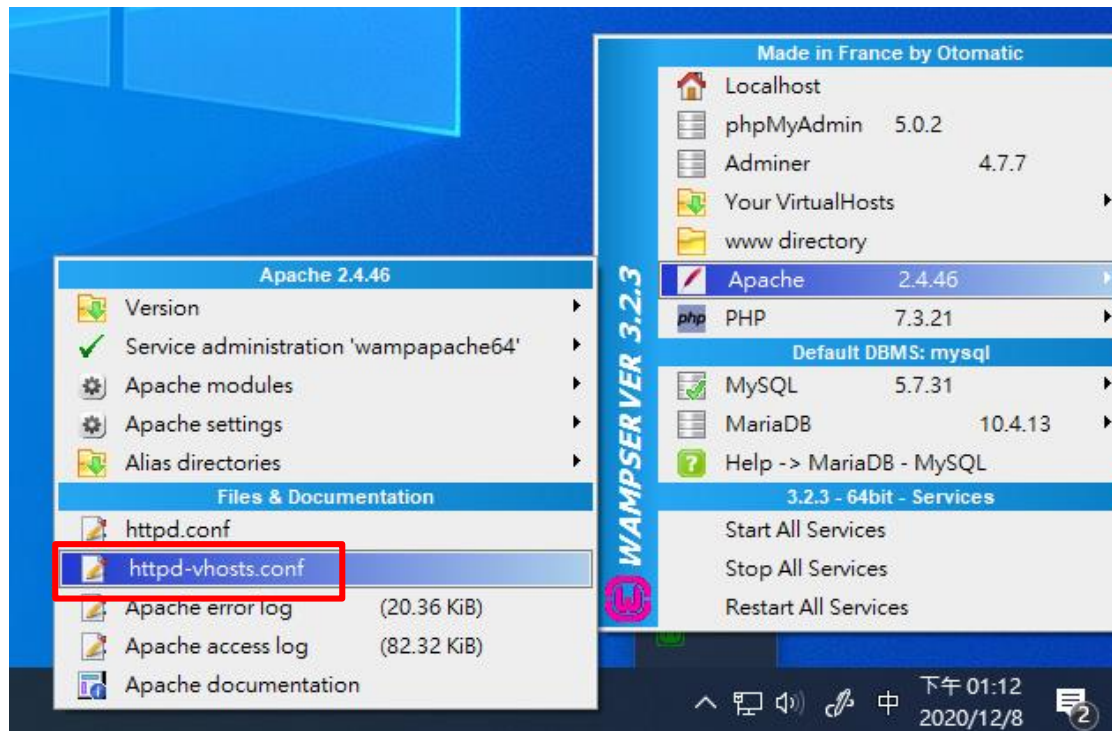
☐ 阻擋搜尋引擎索引這個網站

這項設定的效力並非絕對，完全取決於搜尋引擎是否遵守這項設定的要求。

儲存設定

# 網頁開放設定 (2)

- 左鍵右下角 Wamp Server 程式
- 選 Apache->http-vhosts.conf



# 網頁開放設定 (3)

- Require local更改成Require all granted
- 接著重啟Wamp Server

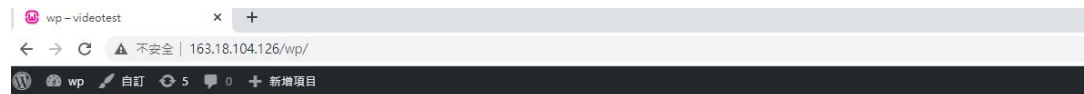
 httpd-vhosts.conf - 記事本

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明

```
Virtual Hosts
#
<VirtualHost *:80>
 ServerName localhost
 ServerAlias localhost
 DocumentRoot "${INSTALL_DIR}/www"
 <Directory "${INSTALL_DIR}/www/">
 Options +Indexes +Includes +FollowSymLinks +MultiViews
 AllowOverride All
 Require all granted
 </Directory>
</VirtualHost>
```

# 網頁開放設定 (4)

- 接著從外部網站輸入<http://163.18.104.126/wp>，就可以連到網頁  
**WebServer IP**



wp — videotest

## 電影目錄(cloud)

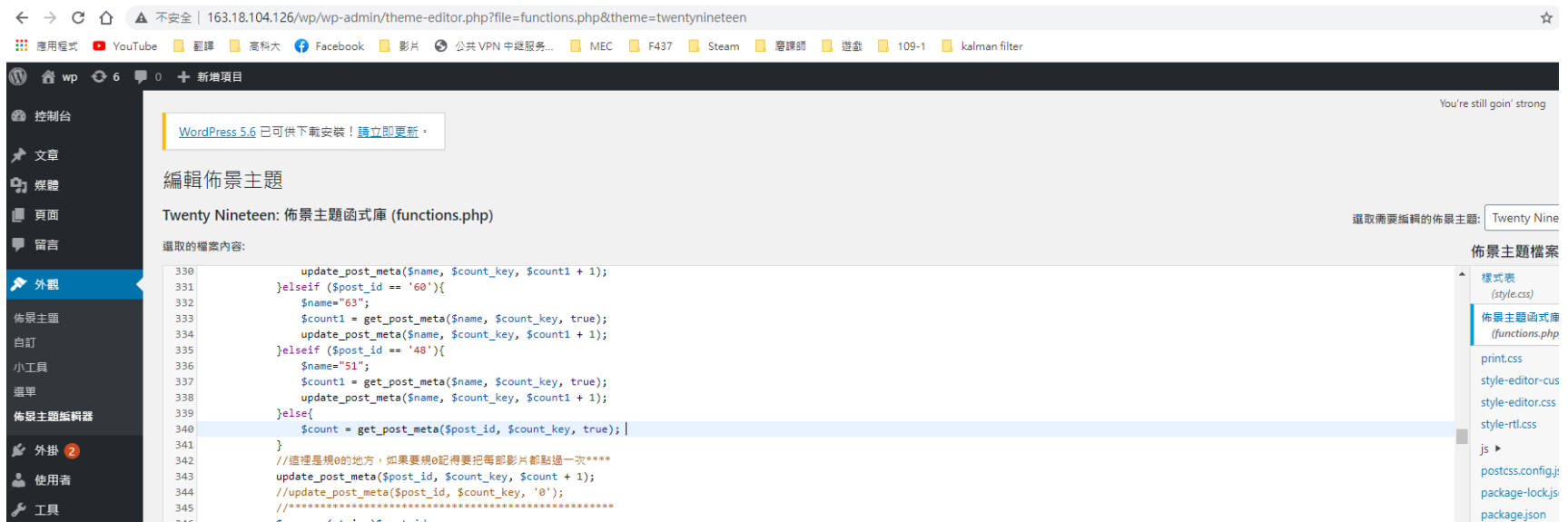


## 電影目錄(edge)

# 網頁的觀看次數重置

# 更改網頁程式碼 (1)

- 進入網頁設定
- 輸入：163.18.104.126/wp/wp-admin
- 進入function.php WebServer IP





## 更改網頁程式碼 (2)

- 將342~352的程式碼改成下圖，之後按更新

```
342 //這裡是規0的地方，如果要規0記得要把每部影片都點過一次****
343 //update_post_meta($post_id, $count_key, $count + 1);
344 update_post_meta($post_id, $count_key, '0');
345 //*****
346 $name = (string)$post_id;
347 $filename = $name.$file;
348 $myfile = fopen($filename, "w");
349 //這裡設把txt檔中觀看次數規0***
350 fwrite($myfile, '0');
351 //*****
352 //fwrite($myfile, $count + 1);
353 fclose($myfile);
354 }
355 }
356 }
```

線上說明:

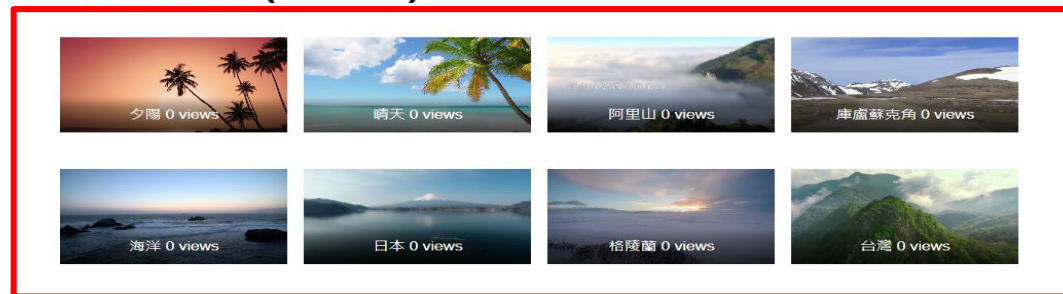
檔案已完成編輯。

# 更改網頁程式碼 (3)

- 進入網頁 **WebServer IP**
- 輸入：**163.18.104.126/wp**
- 點擊Cloud Server影片，它會自動將影片觀看次數都歸0



## 電影目錄(cloud)



## 電影目錄(edge)



# 更改網頁程式碼 (4)

- 進入function.php
- 接著再把342~352的程式碼更改回來

```
342 //這裡是規0的地方，如果要規0記得要把每部影片都點過一次****
343 update_post_meta($post_id, $count_key, $count + 1);
344 //update_post_meta($post_id, $count_key, '0');
345 //*****
346 $name = (string)$post_id;
347 $filename = $name.$file;
348 $myfile = fopen($filename, "w");
349 //這裡設把txt檔中觀看次數規0***
350 //fwrite($myfile, '0');
351 //*****
352 fwrite($myfile, $count + 1);
353 fclose($myfile);
354 }
355 }
```

線上說明:

檔案已完成編輯。

# Outline

- 實驗目的及實驗內容
- OAI安裝
  - 實驗環境
  - 架設OAI的EPC軟體
  - 架設OAI的eNB軟體
  - 測試OAI運行
  - UE註冊與註銷
- Web Server安裝
  - 實驗環境
  - 架設Web Server
  - UE影片瀏覽軟體安裝

# 安裝VLC

- 在Windows10作業系統上安裝VLC
- 安裝VLC 2.2.4版本，太高版本的話，IE無法使用VLC
- 網址：<https://www.videolan.org/vlc/releases/2.2.4.html>

