

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-02：

邊緣計算實作環境建置—雲端伺服器及邊緣計算伺服器

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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
- 實驗環境
- 平台架設需求
- Cloud Server 平台安裝
- Edge Server 平台安裝
- UE 安裝

實驗目的

- 在 Linux 平台架設雲端伺服器 (Cloud Server) 與邊緣伺服器 (Edge Server)。
- UE 連接 Cloud Server 與 Edge Server 的基本觀察與量測。

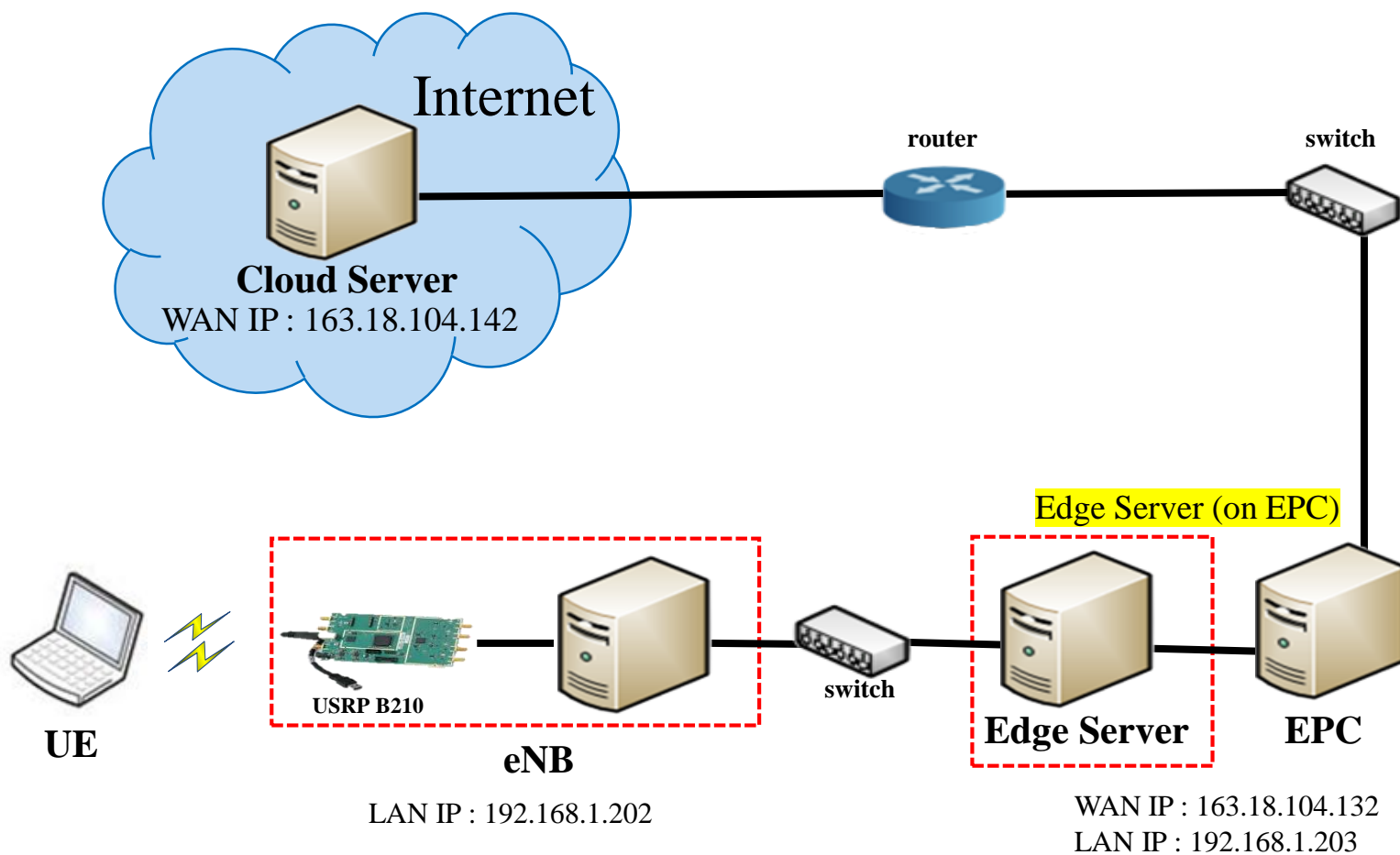
實驗內容

- 使用 Linux 平台架設 Edge Server (邊緣伺服器, 含 OAI-LTE)
- 使用 Linux 平台架設 Cloud Server (雲端伺服器)
- 使用 UE 以 USRP 連接 Edge Server 與 Cloud Server 進行基本觀察與量測

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實驗架構



實驗設備-硬體(1/2)

名稱	硬體	數量	目的
Cloud Server	CPU: i7-6500U RAM: 8 GB HDD: 1 TB	1 台	當雲端伺服器
	Ethernet Network PCIE Card	1 個	連接WAN (for Internet)
Edge Server	CPU: i7-8559U RAM: 32 GB SSD: 1 TB	1 台	當邊緣伺服器(on EPC)
	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，瀏覽影片
	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

名稱	軟體	版本
Cloud Server	OS : Ubuntu	16.04 LTS
	Nginx	1.5.0
	C Language	5.4.0
	OpenCV	4.1.0
Edge Server	OS : Ubuntu	16.04 LTS
	OAI-EPC	https://gitlab.eurecom.fr/oai/openair-cn.git (發布日期:2017/3/31)
	Nginx	1.5.0
	C Language	5.4.0
	OpenCV	4.1.0
eNB	OS : Ubuntu	16.04 LTS
	OAI-eNB	https://gitlab.eurecom.fr/oai/openairinterface5g/tree/17b9a9e917ce2a3a8c7004c7b9a221c350ddfe17 (發布日期:2015/8/8)
UE	OS : Ubuntu	16.04 LTS
	FFmpeg	2.8.17

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Cloud Server 安裝需求

Cloud Server的安裝需求(ubuntu 16.04)

1. Video Streaming Server 安裝
 - Nginx 軟體
2. TCP/UDP Socket 安裝
 - C Language 軟體
3. Digital Image Processing 安裝
 - OpenCV 軟體

Edge Server 安裝需求

Edge Server的安裝需求(ubuntu 16.04)

1. Video Streaming Server 安裝
 - Nginx 軟體
2. TCP/UDP Socket 安裝
 - C Language 軟體
3. Digital Image Processing 安裝
 - OpenCV 軟體
4. Radio Access Network 安裝
 - OAI-EPC 軟體，請參考實驗單元-01

其他安裝需求

UE的安裝需求(ubuntu 16.04)

1. 影片瀏覽
 - FFmpeg

eNodeB安裝需求(ubuntu 16.04)

1. Radio Access Network 安裝
 - OAI-eNB 軟體，請參考實驗單元-01

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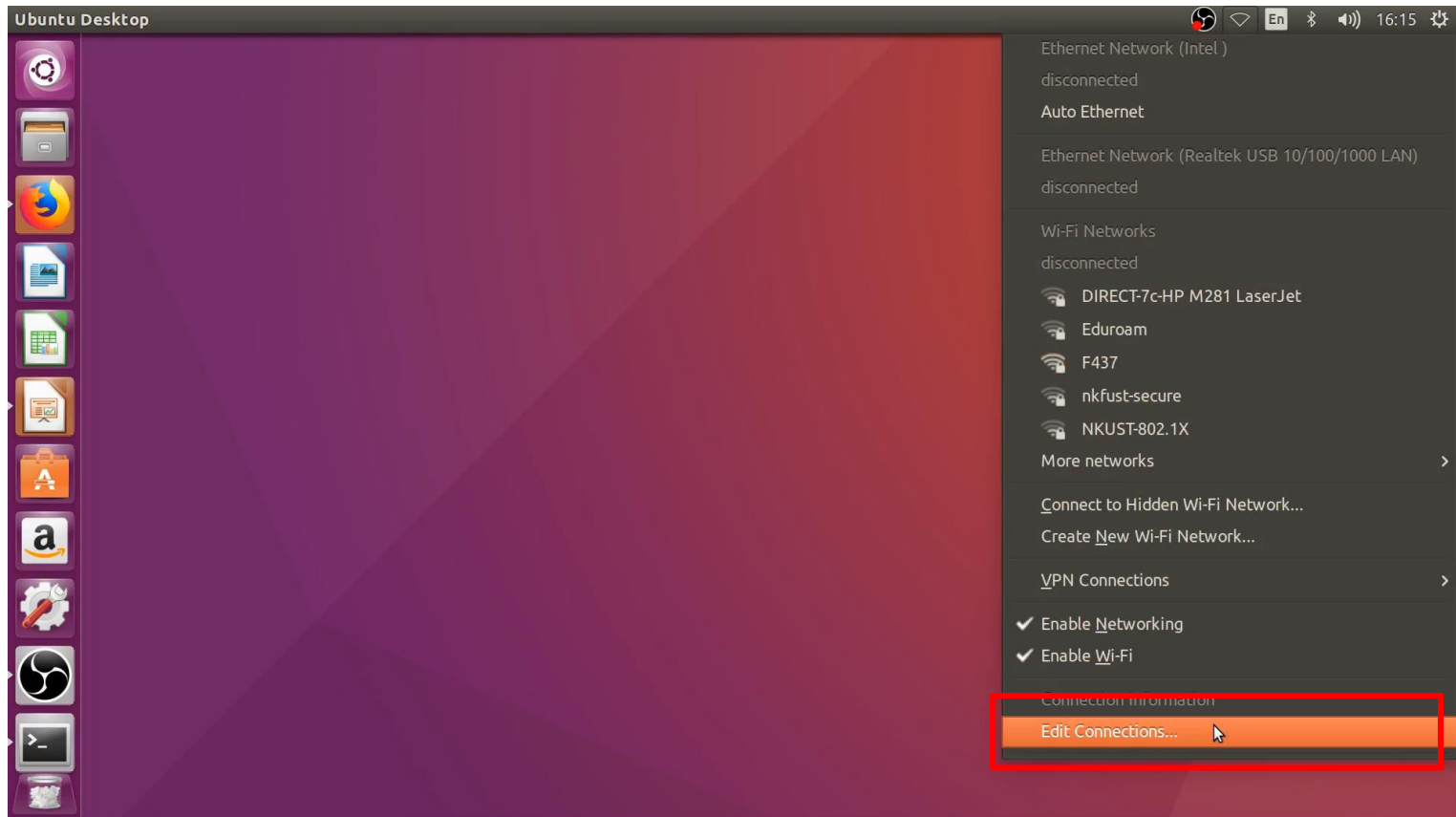
Cloud Server 安裝

Edge Server的安裝需求(ubuntu 16.04)

1. Video Streaming Server 安裝
 - Nginx 軟體
2. TCP/UDP Socket 安裝
 - C Language 軟體
3. Digital Image Processing 安裝
 - OpenCV 軟體

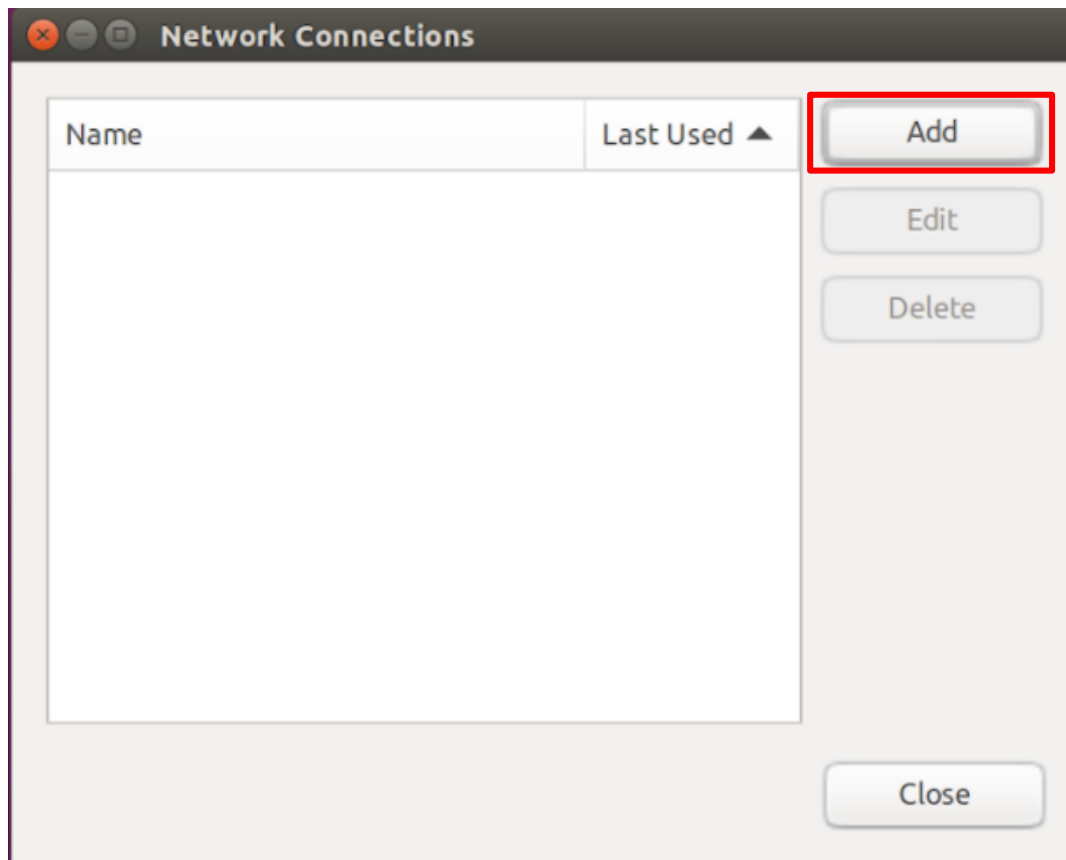
Nginx安裝(新增外網-1)

點選右上角Edit Connections



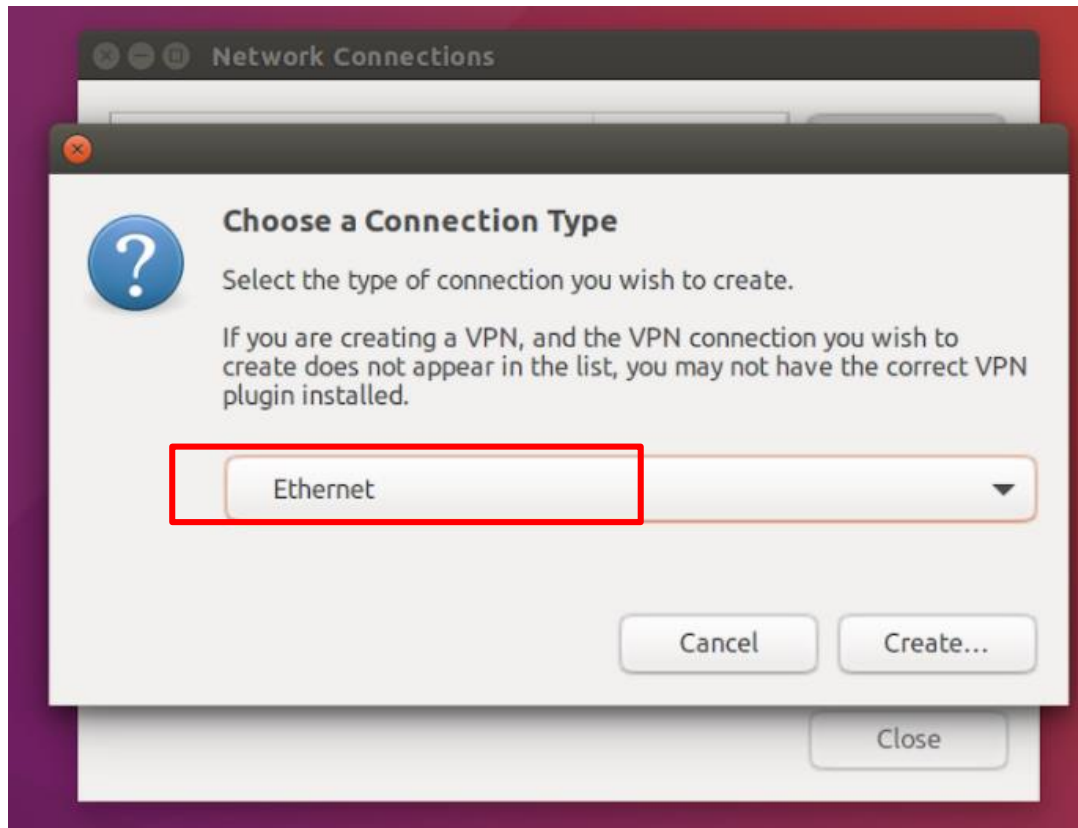
Nginx安裝(新增外網-2)

點選Add新增外網



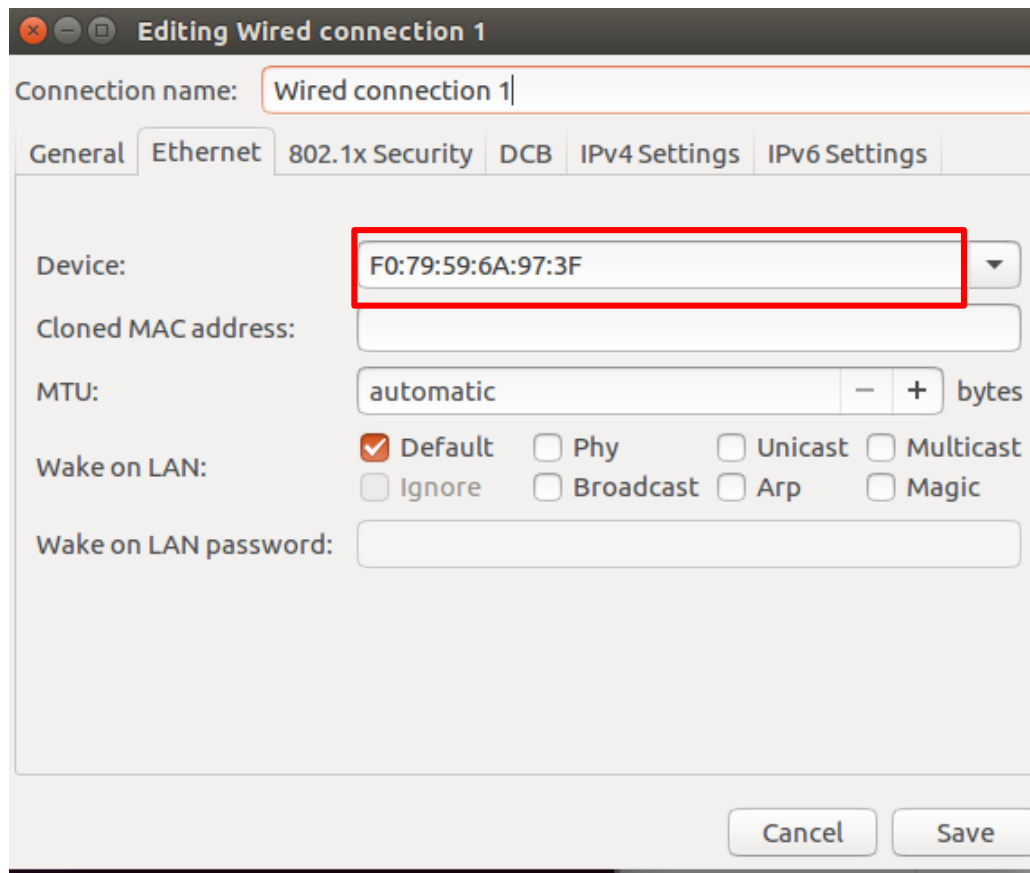
Nginx安裝(新增外網-3)

模式選擇Ethernet



Nginx安裝(新增外網-4)

點選Ethernet -> device 選擇對應網卡



Nginx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)

Editing Wired connection 1

Connection name: Wired connection 1

General Ethernet 802.1x Security DCB **IPv4 Settings** IPv6 Settings

Method: Manual

Addresses

Address	Netmask	Gateway
163.18.104.142	24	163.18.104.254

DNS servers: 163.18.1.7

Search domains:

DHCP client ID:

☐ Require IPv4 addressing for this connection to complete

Routes...

Cancel Save

Nginx安裝(更新ubuntu-1)

在終端機輸入

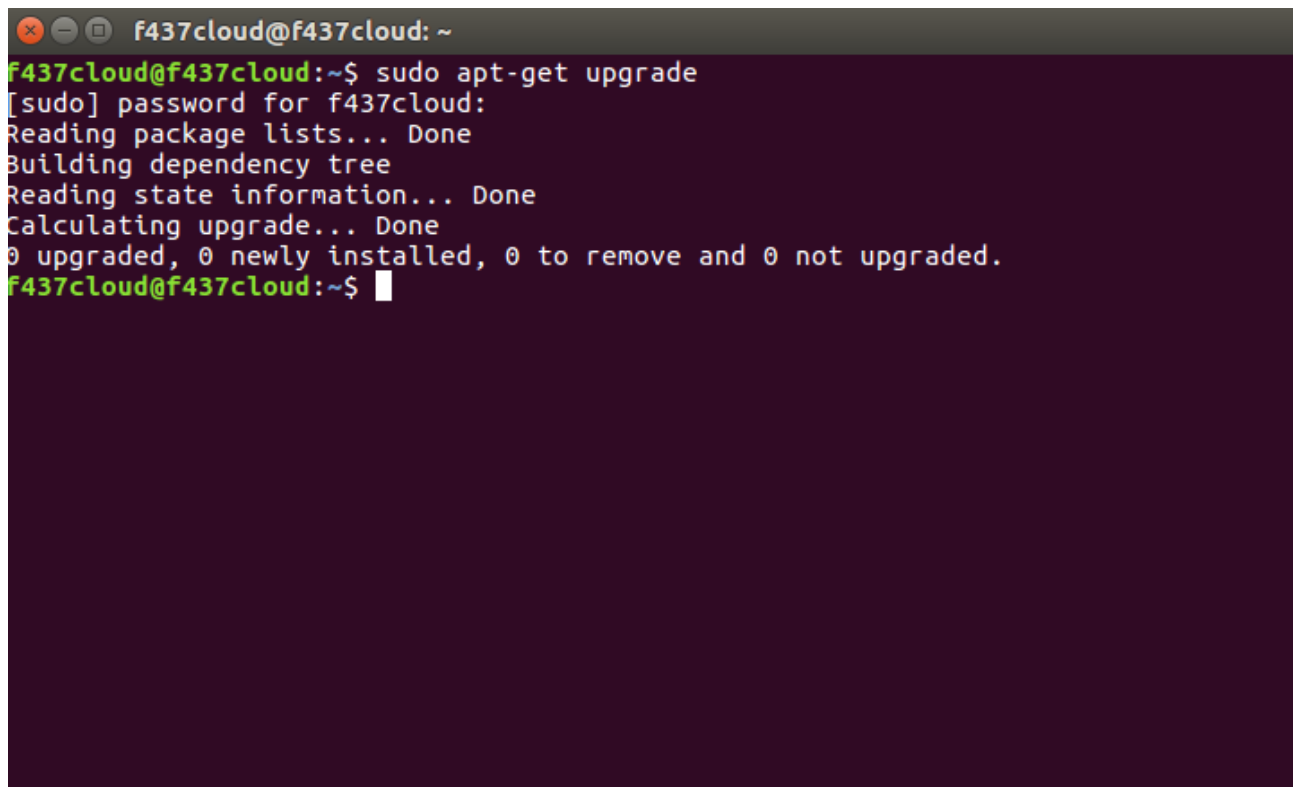
- \$ sudo apt-get update

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get update  
[sudo] password for f437cloud:  
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]  
Get:5 http://security.ubuntu.com/ubuntu xenial-security/main amd64 DEP-11 Metadata [86.9 kB]  
Get:6 http://security.ubuntu.com/ubuntu xenial-security/universe amd64 Packages [502 kB]  
Get:7 http://security.ubuntu.com/ubuntu xenial-security/universe i386 Packages [428 kB]  
Get:8 http://security.ubuntu.com/ubuntu xenial-security/universe Translation-en [207 kB]  
Get:9 http://security.ubuntu.com/ubuntu xenial-security/universe amd64 DEP-11 Metadata [124 kB]  
Get:10 http://security.ubuntu.com/ubuntu xenial-security/multiverse amd64 DEP-11 Metadata [2468 B]  
Fetched 1459 kB in 7s (193 kB/s)  
Reading package lists... Done  
f437cloud@f437cloud:~$
```

Nginx安裝(更新ubuntu-2)

在終端機輸入

- \$ sudo apt-get upgrade

A terminal window with a dark purple background. The title bar shows 'f437cloud@f437cloud: ~'. The prompt is 'f437cloud@f437cloud:~\$'. The command 'sudo apt-get upgrade' has been entered. The output shows the system reading package lists, building a dependency tree, and reading state information, all successfully. It then calculates the upgrade and reports that 0 packages are upgraded, 0 are newly installed, 0 are to be removed, and 0 are not upgraded. The prompt returns to 'f437cloud@f437cloud:~\$' with a cursor.

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get upgrade  
[sudo] password for f437cloud:  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
Calculating upgrade... Done  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
f437cloud@f437cloud:~$
```

Nginx安裝(安裝git)

在終端機輸入

- \$ sudo apt-get install git

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install git  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  git-man liberror-perl  
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  
The following NEW packages will be installed:  
  git git-man liberror-perl  
0 upgraded, 3 newly installed, 0 to remove and 0 not upgraded.  
Need to get 3932 kB of archives.  
After this operation, 25.6 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 liberror-perl all 0.  
17-1.2 [19.6 kB]  
Get:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 git-man all  
1:2.7.4-0ubuntu1.9 [736 kB]  
Get:3 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 git amd64 1:  
2.7.4-0ubuntu1.9 [3176 kB]  
Fetched 3932 kB in 2s (1507 kB/s)  
Selecting previously unselected package liberror-perl.  
(Reading database ... 212616 files and directories currently installed.)
```

Nginx安裝(下載nginx-1.5.0)

網址：<http://nginx.org/download/>

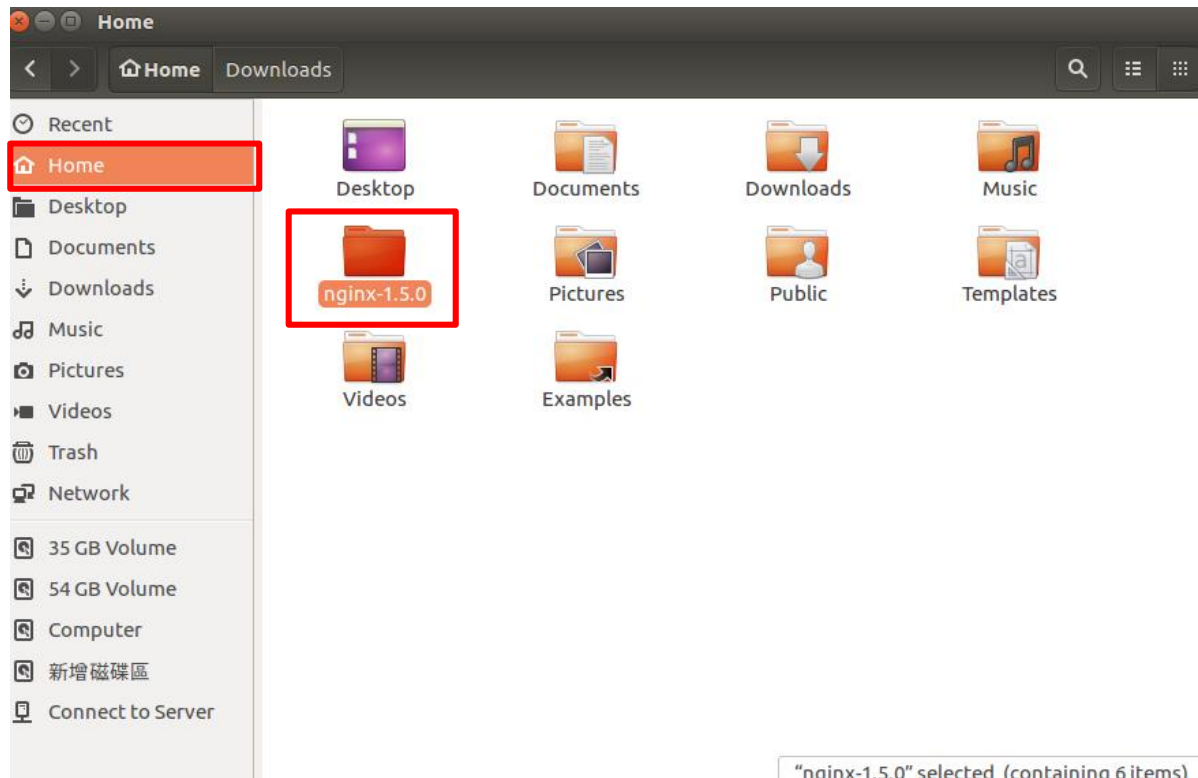
- 下載nginx-1.5.0.tar.gz

[nginx-1.4.7.zip](#)
[nginx-1.4.7.zip.asc](#)
[nginx-1.5.0.tar.gz](#)
[nginx-1.5.0.tar.gz.asc](#)
[nginx-1.5.0.zip](#)
[nginx-1.5.0.zip.asc](#)
[nginx-1.5.1.tar.gz](#)
[nginx-1.5.1.tar.gz.asc](#)
[nginx-1.5.1.zip](#)

08-Apr-2014	15:09	1225841
08-Apr-2014	15:09	488
07-May-2013	11:28	767147
07-May-2013	11:28	488
07-May-2013	11:28	1223506
07-May-2013	11:28	488
04-Jun-2013	13:36	768299
04-Jun-2013	13:36	488
04-Jun-2013	13:36	1224230

Nginx安裝(解壓nginx-1.5.0)

將nginx-1.5.0.tar.gz解壓縮到home下



Nginx安裝(安裝 module)

在終端機輸入

- `$ git clone https://github.com/arut/nginx-rtmp-module.git`

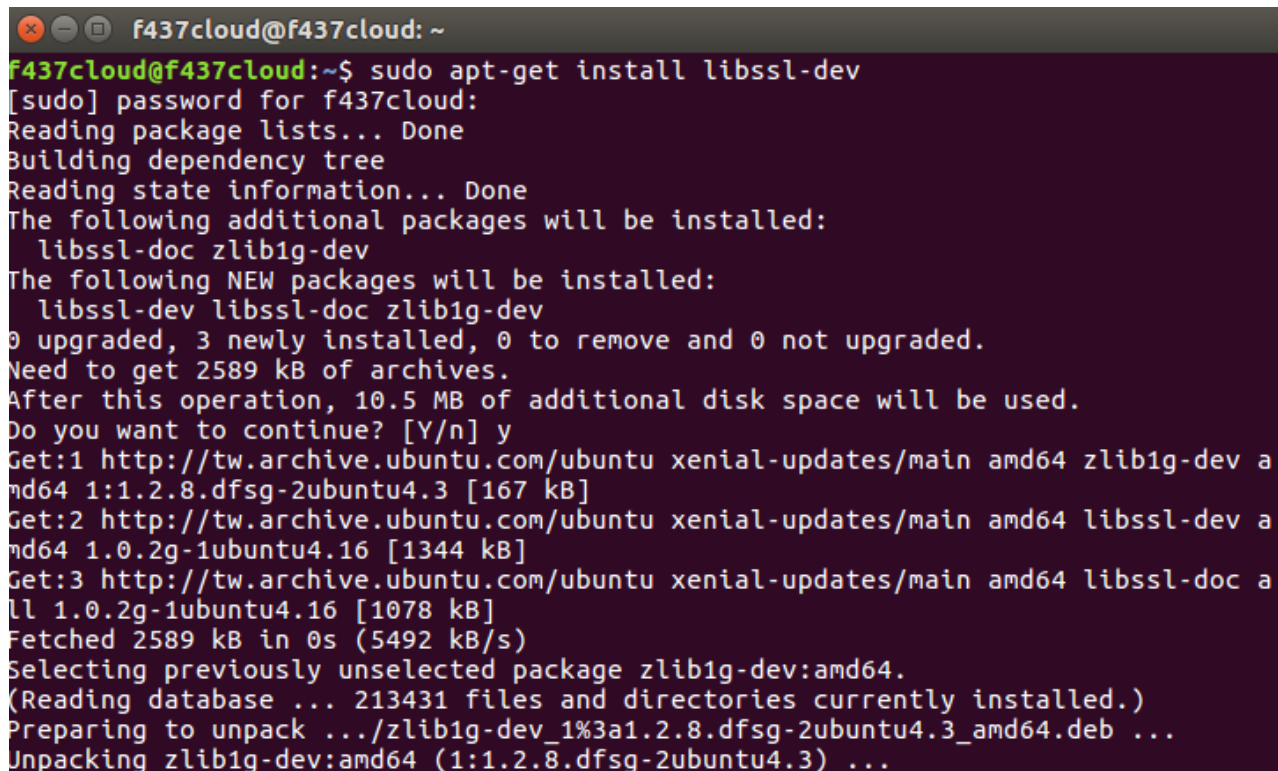


```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ git clone https://github.com/arut/nginx-rtmp-module.git  
Cloning into 'nginx-rtmp-module'...  
remote: Enumerating objects: 4314, done.  
remote: Total 4314 (delta 0), reused 0 (delta 0), pack-reused 4314  
Receiving objects: 100% (4314/4314), 3.10 MiB | 1.95 MiB/s, done.  
Resolving deltas: 100% (2686/2686), done.  
Checking connectivity... done.  
f437cloud@f437cloud:~$
```

Nginx安裝(安裝套件)

在終端機輸入

- `$ sudo apt-get install libssl-dev`

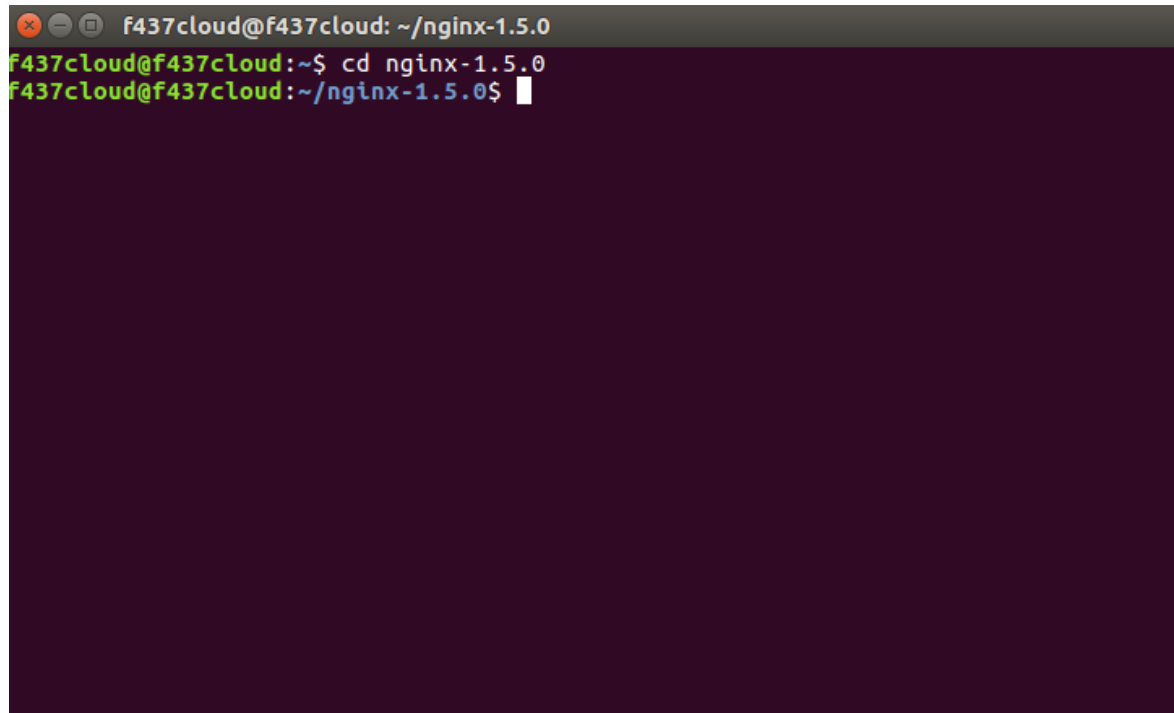


```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install libssl-dev  
[sudo] password for f437cloud:  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  libssl-doc zlib1g-dev  
The following NEW packages will be installed:  
  libssl-dev libssl-doc zlib1g-dev  
0 upgraded, 3 newly installed, 0 to remove and 0 not upgraded.  
Need to get 2589 kB of archives.  
After this operation, 10.5 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 zlib1g-dev a  
md64 1:1.2.8.dfsg-2ubuntu4.3 [167 kB]  
Get:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libssl-dev a  
md64 1.0.2g-1ubuntu4.16 [1344 kB]  
Get:3 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libssl-doc a  
ll 1.0.2g-1ubuntu4.16 [1078 kB]  
Fetched 2589 kB in 0s (5492 kB/s)  
Selecting previously unselected package zlib1g-dev:amd64.  
(Reading database ... 213431 files and directories currently installed.)  
Preparing to unpack .../zlib1g-dev_1%3a1.2.8.dfsg-2ubuntu4.3_amd64.deb ...  
Unpacking zlib1g-dev:amd64 (1:1.2.8.dfsg-2ubuntu4.3) ...
```

Nginx安裝(安裝nginx-1)

在終端機輸入

- `$ cd nginx-1.5.0`



```
f437cloud@f437cloud: ~/nginx-1.5.0
f437cloud@f437cloud:~$ cd nginx-1.5.0
f437cloud@f437cloud:~/nginx-1.5.0$
```

Nginx安裝(安裝nginx-2)

在終端機輸入

- `$ sudo ./configure --add-module=/home/f437cloud/nginx-rtmp-module --with-http_ssl_module --without-http_rewrite_module`

主機名稱



```
f437cloud@f437cloud: ~/nginx-1.5.0
f437cloud@f437cloud:~/nginx-1.5.0$ sudo ./configure --add-module=/home/f437cloud/nginx-rtmp-module --with-http_ssl_module --without-http_rewrite_module
checking for OS
+ Linux 4.15.0-112-generic x86_64
checking for C compiler ... found
+ using GNU C compiler
+ gcc version: 5.4.0 20160609 (Ubuntu 5.4.0-6ubuntu1~16.04.12)
checking for gcc -pipe switch ... found
checking for gcc builtin atomic operations ... found
checking for C99 variadic macros ... found
checking for gcc variadic macros ... found
checking for unistd.h ... found
checking for inttypes.h ... found
checking for limits.h ... found
checking for sys/filio.h ... not found
checking for sys/param.h ... found
checking for sys/mount.h ... found
checking for sys/statvfs.h ... found
checking for crypt.h ... found
checking for Linux specific features
checking for epoll ... found
checking for sendfile() ... found
checking for sendfile64() ... found
checking for sys/prctl.h ... found
```

Nginx安裝(安裝nginx-3)

在終端機輸入

- \$ sudo make

```
make[1]: Leaving directory '/home/f437cloud/nginx-1.5.0'
f437cloud@f437cloud:~/nginx-1.5.0$ sudo make
make -f objs/Makefile
make[1]: Entering directory '/home/f437cloud/nginx-1.5.0'
make[1]: 'objs/nginx' is up to date.
make[1]: Leaving directory '/home/f437cloud/nginx-1.5.0'
make -f objs/Makefile manpage
make[1]: Entering directory '/home/f437cloud/nginx-1.5.0'
make[1]: Nothing to be done for 'manpage'.
make[1]: Leaving directory '/home/f437cloud/nginx-1.5.0'
f437cloud@f437cloud:~/nginx-1.5.0$
```

Nginx安裝(安裝nginx-4)

在終端機輸入

- `$ sudo make install`

```
f437cloud@f437cloud: ~/nginx-1.5.0
f437cloud@f437cloud:~/nginx-1.5.0$ sudo make install
make -f objs/Makefile install
make[1]: Entering directory '/home/f437cloud/nginx-1.5.0'
test -d '/usr/local/nginx' || mkdir -p '/usr/local/nginx'
test -d '/usr/local/nginx/sbin' || mkdir -p '/usr/local/nginx/sbin'
test ! -f '/usr/local/nginx/sbin/nginx' || mv '/usr/local/nginx/sbin/nginx' '/usr/local/nginx/sbin/nginx.old'
cp objs/nginx '/usr/local/nginx/sbin/nginx'
test -d '/usr/local/nginx/conf' || mkdir -p '/usr/local/nginx/conf'
cp conf/koi-win '/usr/local/nginx/conf'
cp conf/koi-utf '/usr/local/nginx/conf'
cp conf/win-utf '/usr/local/nginx/conf'
test -f '/usr/local/nginx/conf/mime.types' || cp conf/mime.types '/usr/local/nginx/conf'
cp conf/mime.types '/usr/local/nginx/conf/mime.types.default'
test -f '/usr/local/nginx/conf/fastcgi_params' || cp conf/fastcgi_params '/usr/local/nginx/conf'
cp conf/fastcgi_params '/usr/local/nginx/conf/fastcgi_params.default'
test -f '/usr/local/nginx/conf/fastcgi.conf' || cp conf/fastcgi.conf '/usr/local/nginx/conf'
cp conf/fastcgi.conf '/usr/local/nginx/conf/fastcgi.conf.default'
test -f '/usr/local/nginx/conf/uwsgi_params' || cp conf/uwsgi_params
```

Nginx安裝(修改nginx)

在終端機輸入

- \$ sudo gedit /usr/local/nginx/conf/nginx.conf
- 以下程式取代原本內容

```
worker_processes 2;
events {
    worker_connections 1024;
}
rtmp {
    server {
        listen 1935;
        chunk_size 4000;

        application myapp {
            live on;
        }
        application vod {
            play /home/
        }
    }
}
```


Nginx安裝(執行nginx)

在終端機輸入

- `$ cd /usr/local/nginx/sbin`
- `$ sudo ./nginx -c /usr/local/nginx/conf/nginx.conf`

```
f437cloud@f437cloud: /usr/local/nginx/sbin
f437cloud@f437cloud:~$ cd /usr/local/nginx/sbin
f437cloud@f437cloud:/usr/local/nginx/sbin$ sudo ./nginx -c /usr/local/nginx/conf/nginx.conf
f437cloud@f437cloud:/usr/local/nginx/sbin$
```

※如果發生下圖時，代表port 1935正在被使用，使用以下指令來刪除

- `$ sudo lsof -i:1935`

```
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] still could not bind()
```

- `$ sudo kill "PID"` (ex:sudo kill 2140)

COMMAND	PID	USER	FD	TYPE	DEVICE	SIZE/OFF	NODE	NAME
nginx	2140	root	6u	IPv4	29207	0t0	TCP	*:1935 (LISTEN)
nginx	2141	nobody	6u	IPv4	29207	0t0	TCP	*:1935 (LISTEN)
nginx	2142	nobody	6u	IPv4	29207	0t0	TCP	*:1935 (LISTEN)

重新執行

- `$ sudo ./nginx -c /usr/local/nginx/conf/nginx.conf`

Nginx直播測試-1

在終端機輸入

- `$ sudo apt-get install ffmpeg`

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install ffmpeg  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  i965-va-driver libaacs0 libass5 libavcodec-ffmpeg56 libavdevice-ffmpeg56  
  libavfilter-ffmpeg5 libavformat-ffmpeg56 libavresample-ffmpeg2  
  libavutil-ffmpeg54 libbdplus0 libbluray1 libbs2b0 libcrystalhd3 libdc1394-22  
  libflite1 libgme0 libgsm1 libmodplug1 libmp3lame0 libopenal-data libopenal1  
  libopencv-core2.4v5 libopencv-imgproc2.4v5 libopenjpeg5 libpostproc-ffmpeg53  
  libschroedinger-1.0-0 libSDL1.2debian libshine3 libsnappy1v5 libsodium18  
  libsoxr0 libssh-gcrypt-4 libswresample-ffmpeg1 libswscale-ffmpeg3 libtbb2  
  libtwolame0 libva1 libvdpau1 libx264-148 libx265-79 libxvidcore4 libzmq5  
  libzvbi-common libzvbi0 mesa-va-drivers mesa-vdpau-drivers va-driver-all  
  vdpau-driver-all  
Suggested packages:  
  ffmpeg-doc libbluray-bdj firmware-crystalhd libfglrx-amdxvba1  
  libvdpau-va-gl1 nvidia-vdpau-driver nvidia-legacy-340xx-vdpau-driver  
The following NEW packages will be installed:  
  ffmpeg i965-va-driver libaacs0 libass5 libavcodec-ffmpeg56  
  libavdevice-ffmpeg56 libavfilter-ffmpeg5 libavformat-ffmpeg56  
  libavresample-ffmpeg2 libavutil-ffmpeg54 libbdplus0 libbluray1 libbs2b0  
  libcrystalhd3 libdc1394-22 libflite1 libgme0 libgsm1 libmodplug1 libmp3lame0  
  libopenal-data libopenal1 libopencv-core2.4v5 libopencv-imgproc2.4v5
```

Nginx直播測試-2

任一臺手機安裝Larix Broadcaster



Larix Broadcaster

Softvelum LLC

解除安裝

開啟

Larix Broadcaster的Connections新增New connection，
新增 Name：test、URL：rtmp://163.18.104.142:1935/myapp/test

Cloud Server外網IP

test

rtmp://163.18.104.142:1935/
myapp/test

Nginx直播測試-3

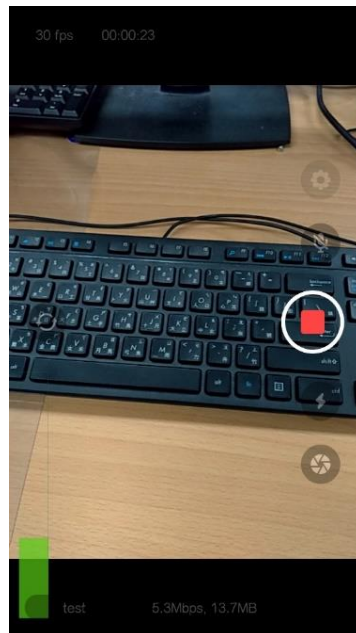
- Larix Broadcaster參數設定

Video size : 1280x720 、 Bitrate : 5000Kbps

Video size
1280x720

Bitrate
5000 Kbps

- 手機按下紅色鍵，開始上傳影片到Cloud Server

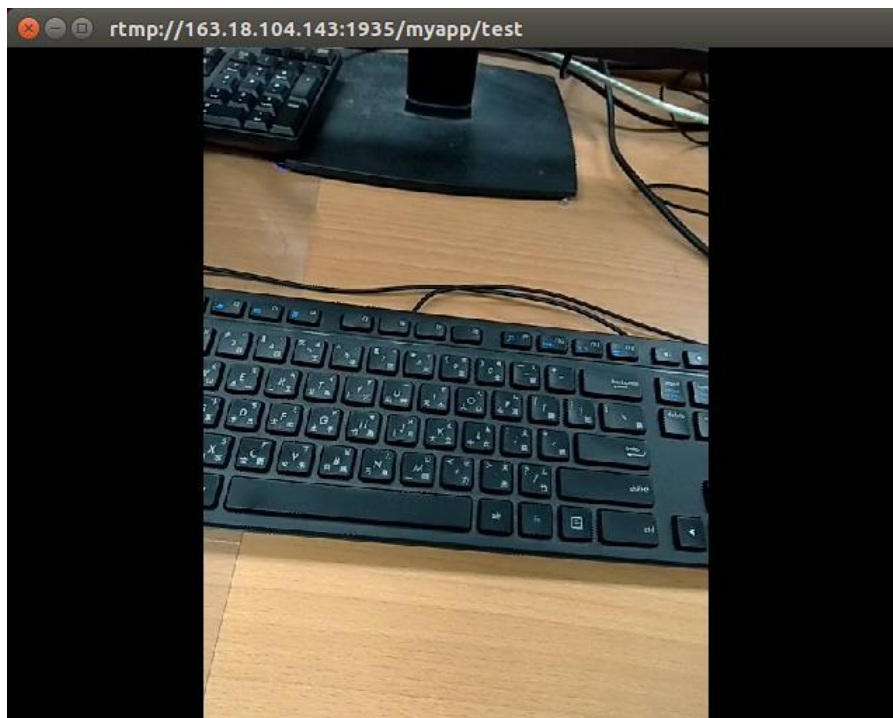


Nginx直播測試-4

- 在ubuntu上觀看手機拍攝上傳的影片

```
$ ffplay rtmp://163.18.104.142:1935/myapp/test
```

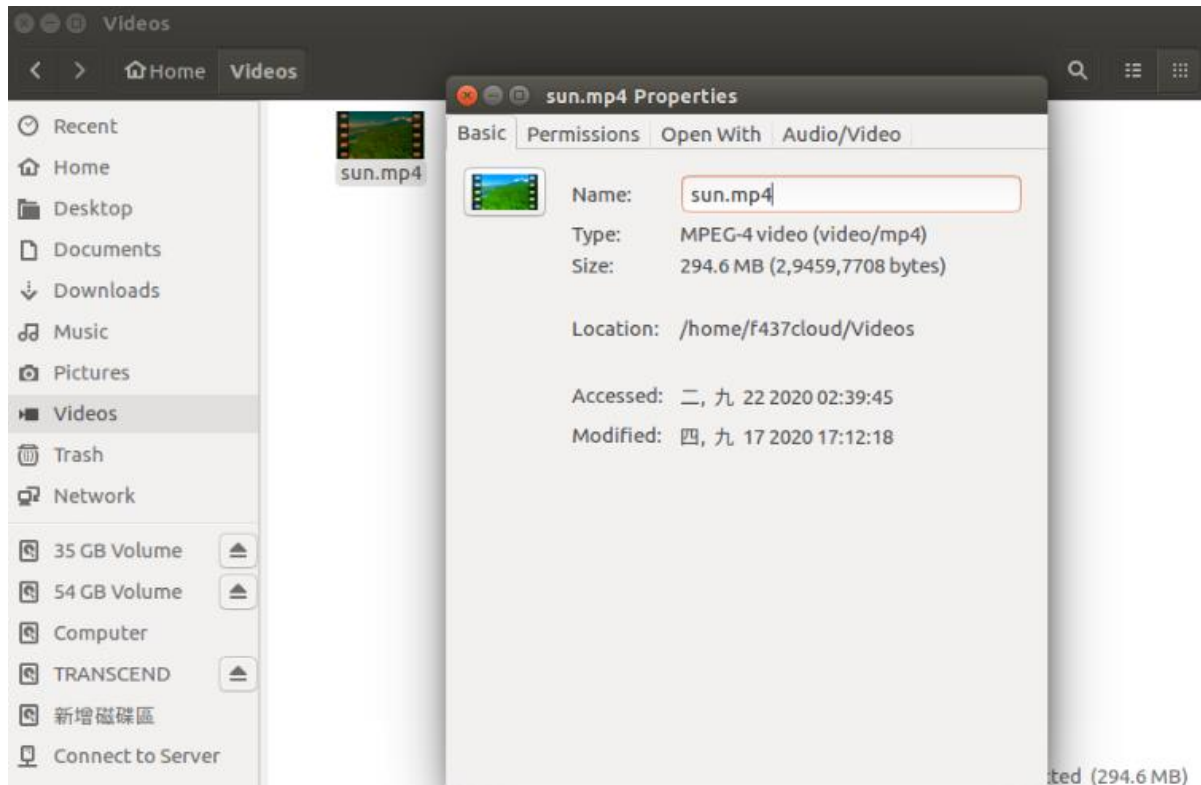
Cloud Server外網IP



Nginx影片瀏覽測試-1

把影片放入到/home/f437cloud/Videos目錄下

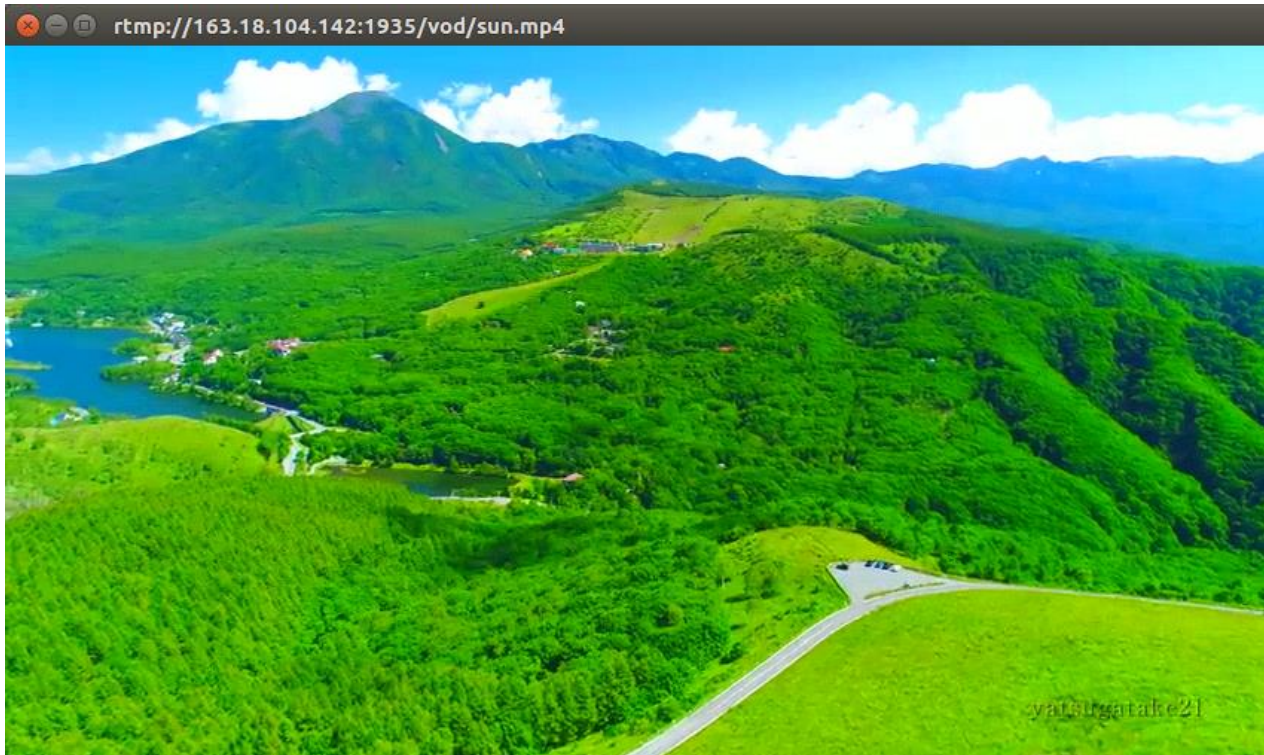
主機名稱



Nginx影片瀏覽測試-2

在終端機輸入

- `$ ffplay rtmp://163.18.104.142:1935/vod/sun.mp4`



Cloud Server 安裝

Edge Server的安裝需求(ubuntu 16.04)

1. Video Streaming Server 安裝
 - Nginx 軟體
2. TCP/UDP Socket 安裝
 - C Language 軟體
3. Digital Image Processing 安裝
 - OpenCV 軟體

C Language(更新ubuntu)

在終端機輸入

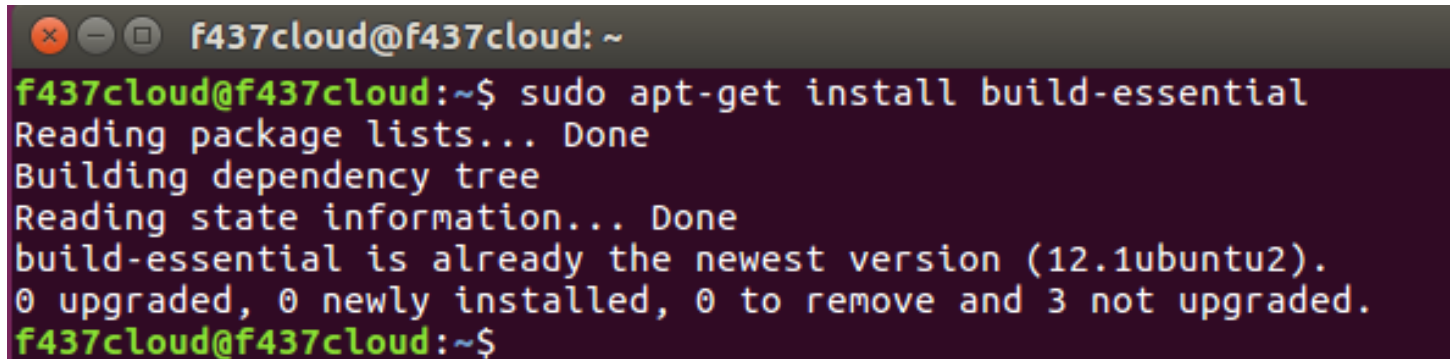
- \$ sudo apt-get update
- \$ sudo apt-get upgrade

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get update  
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  
f437cloud@f437cloud:~$ sudo apt-get upgrade  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
Calculating upgrade... Done  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
f437cloud@f437cloud:~$
```

C Language 安裝(安裝套件-1)

在終端機輸入

- `$ sudo apt-get install build-essential`

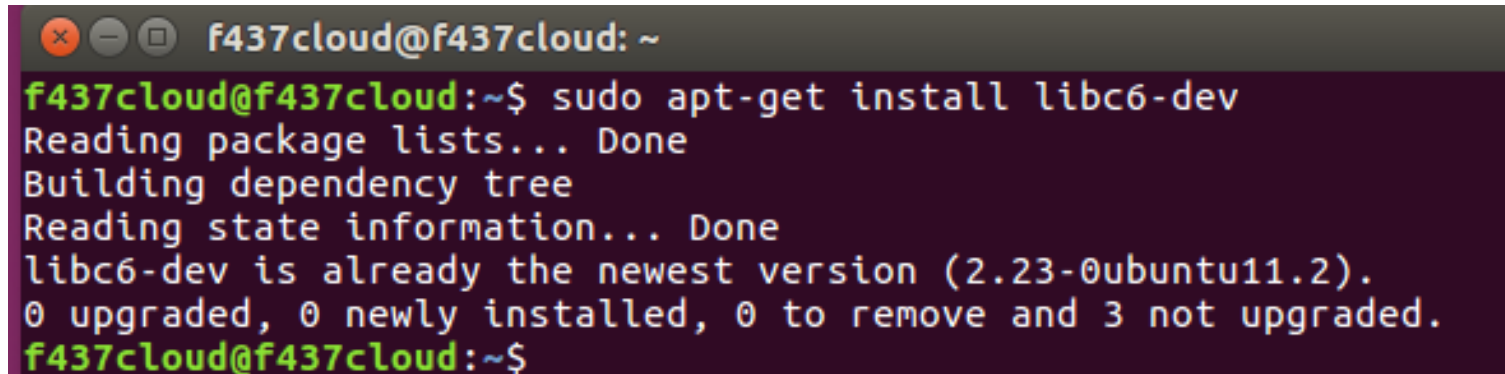


```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install build-essential  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
build-essential is already the newest version (12.1ubuntu2).  
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.  
f437cloud@f437cloud:~$
```

C Language 安裝(安裝套件-2)

在終端機輸入

- `$ sudo apt-get install libc6-dev`

A terminal window with a dark background. The title bar shows window control buttons and the text 'f437cloud@f437cloud: ~'. The prompt is 'f437cloud@f437cloud:~\$'. The command 'sudo apt-get install libc6-dev' has been entered. The output shows the package lists being read, the dependency tree being built, and state information being read. It then states that 'libc6-dev' is already the newest version (2.23-0ubuntu11.2) and that 0 packages were upgraded, 0 newly installed, 0 to be removed, and 3 not upgraded. The prompt returns to 'f437cloud@f437cloud:~\$'.

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install libc6-dev  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
libc6-dev is already the newest version (2.23-0ubuntu11.2).  
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.  
f437cloud@f437cloud:~$
```

C Language 安裝(安裝套件-3)

在終端機輸入

- `$ sudo apt-get install libmysqlclient-dev`

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install libmysqlclient-dev  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  libmysqlclient20 libssl-dev libssl-doc zlib1g-dev  
The following NEW packages will be installed:  
  libmysqlclient-dev libmysqlclient20 libssl-dev libssl-doc zlib1g-dev  
0 upgraded, 5 newly installed, 0 to remove and 3 not upgraded.  
Need to get 4259 kB of archives.  
After this operation, 20.6 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-updates/main amd64 libmysqlclie  
nt20 amd64 5.7.31-0ubuntu0.16.04.1 [683 kB]  
Get:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 zlib1g-dev a  
md64 1:1.2.8.dfsg-2ubuntu4.3 [167 kB]  
Get:3 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libssl-dev a  
md64 1.0.2g-1ubuntu4.17 [1346 kB]  
Get:4 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libmysqlclie  
nt-dev amd64 5.7.31-0ubuntu0.16.04.1 [986 kB]
```

C Language 安裝(測試-1)

在home目錄下新增以下程式

- \$ gedit test.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <mysql/mysql.h>

int main(int argc , char *argv[])
{
    printf("test\n");
    return 0;
}
```

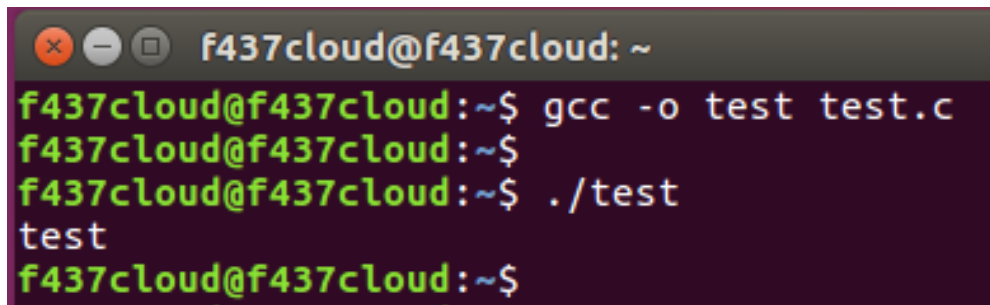
C Language 安裝(測試-2)

在終端機下輸入

- `$ gcc -o test test.c`
- 編譯test.c

在終端機下輸入

- `$./test`



```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ gcc -o test test.c  
f437cloud@f437cloud:~$  
f437cloud@f437cloud:~$ ./test  
test  
f437cloud@f437cloud:~$
```

Cloud Server 安裝

Edge Server的安裝需求(ubuntu 16.04)

1. Video Streaming Server 安裝
 - Nginx 軟體
2. TCP/UDP Socket 安裝
 - C Language 軟體
3. Digital Image Processing 安裝
 - OpenCV 軟體

OpenCV安裝(更新ubuntu)

在終端機輸入

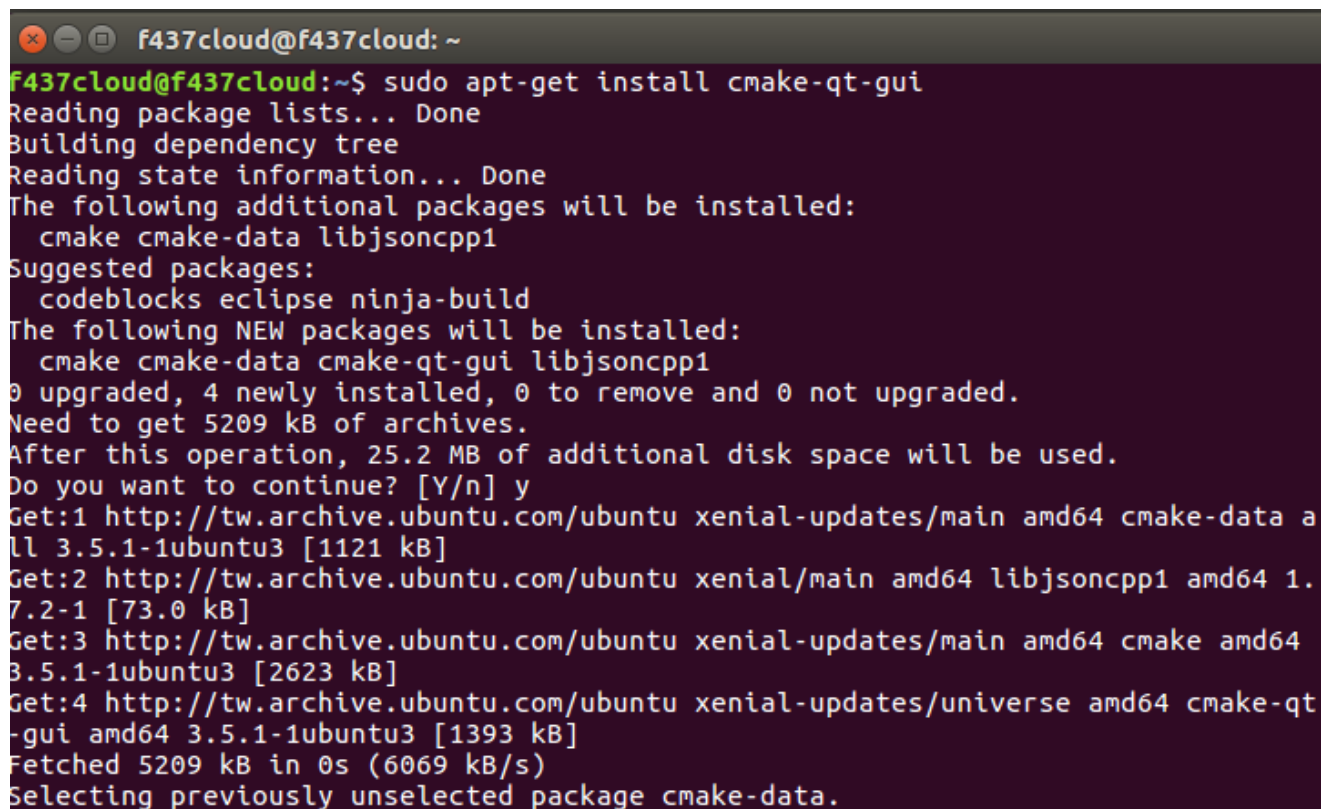
- \$ sudo apt-get update
- \$ sudo apt-get upgrade

```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get update  
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  
f437cloud@f437cloud:~$ sudo apt-get upgrade  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
Calculating upgrade... Done  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
f437cloud@f437cloud:~$
```


OpenCV安裝(安裝cmake-gui)

在終端機輸入

- `$ sudo apt-get install cmake-qt-gui`



```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install cmake-qt-gui  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  cmake cmake-data libjsoncpp1  
Suggested packages:  
  codeblocks eclipse ninja-build  
The following NEW packages will be installed:  
  cmake cmake-data cmake-qt-gui libjsoncpp1  
0 upgraded, 4 newly installed, 0 to remove and 0 not upgraded.  
Need to get 5209 kB of archives.  
After this operation, 25.2 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 cmake-data a  
ll 3.5.1-1ubuntu3 [1121 kB]  
Get:2 http://tw.archive.ubuntu.com/ubuntu xenial/main amd64 libjsoncpp1 amd64 1.  
7.2-1 [73.0 kB]  
Get:3 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 cmake amd64  
3.5.1-1ubuntu3 [2623 kB]  
Get:4 http://tw.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 cmake-qt  
-gui amd64 3.5.1-1ubuntu3 [1393 kB]  
Fetched 5209 kB in 0s (6069 kB/s)  
Selecting previously unselected package cmake-data.
```

OpenCV 安裝 (下載 OpenCV)

下載 OpenCV 4.1.0

網址：<https://github.com/opencv/opencv/tree/4.1.0>

The screenshot shows the GitHub repository for OpenCV 4.1.0. At the top, there are filters for '4.1.0', '3 branches', and '97 tags'. A yellow box with the text '點此下載' (Click here to download) has a red arrow pointing to the 'Code' button, which is highlighted with a red box. Another red arrow points from the 'Code' button to the 'Download ZIP' button in the 'Clone with HTTPS' dropdown menu, which is also highlighted with a red box. The repository name 'alalek release: OpenCV 4.1.0' is visible. Below it, a list of files and folders is shown, including '.github', '3rdparty', 'apps', 'cmake', and 'data'. On the right side, there is an 'About' section with the text 'Open Source Comp' and a link to 'opencv.org'. Below that, there are tags for 'opencv', 'c-plus-plus', 'deep-learning', and 'imag'.

4.1.0 3 branches 97 tags

alalek release: OpenCV 4.1.0

.github Merge pull request #12093 from CYTir

3rdparty Merge remote-tracking branch 'upstream/3.4' into merge-3.4

apps spelling fixes

cmake Merge remote-tracking branch 'upstream/3.4' into merge-3.4 2 years ago

data Same mist type fixes 2 years ago

點此下載

Go to file

Code

Clone with HTTPS ?

Use Git or checkout with SVN using the web URL.

<https://github.com/opencv/opencv.git>

Download ZIP

About

Open Source Comp

opencv.org

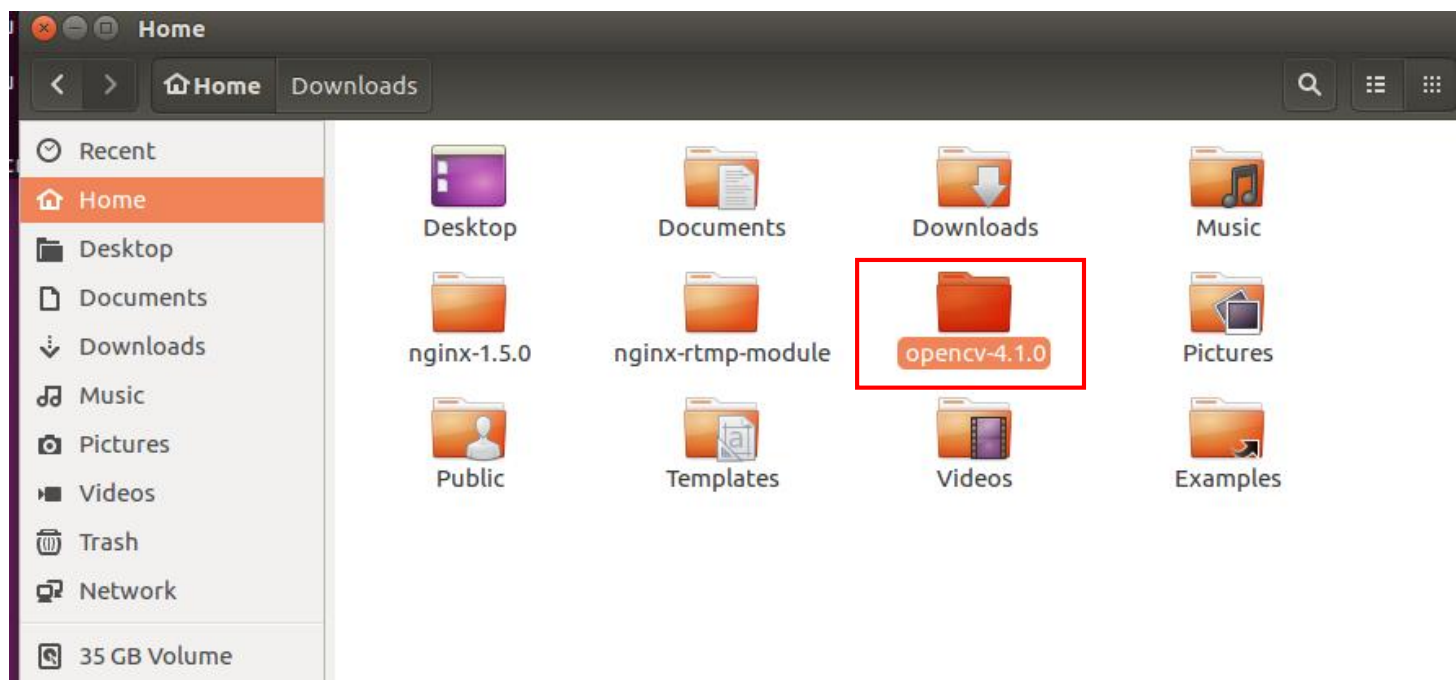
opencv c-plus-plus deep-learning imag

Readme

View license

OpenCV 安裝 (解壓 OpenCV)

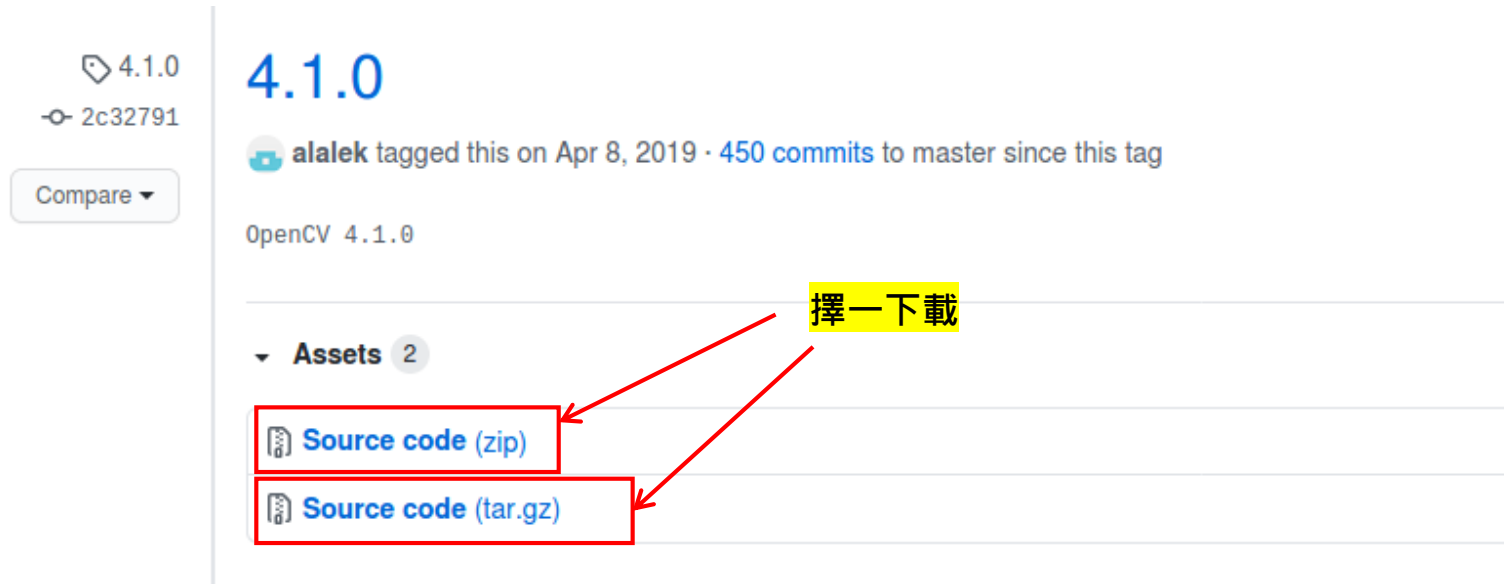
將 OpenCV 4.1.0 解壓縮到 home 下



OpenCV安裝(下載contrib)

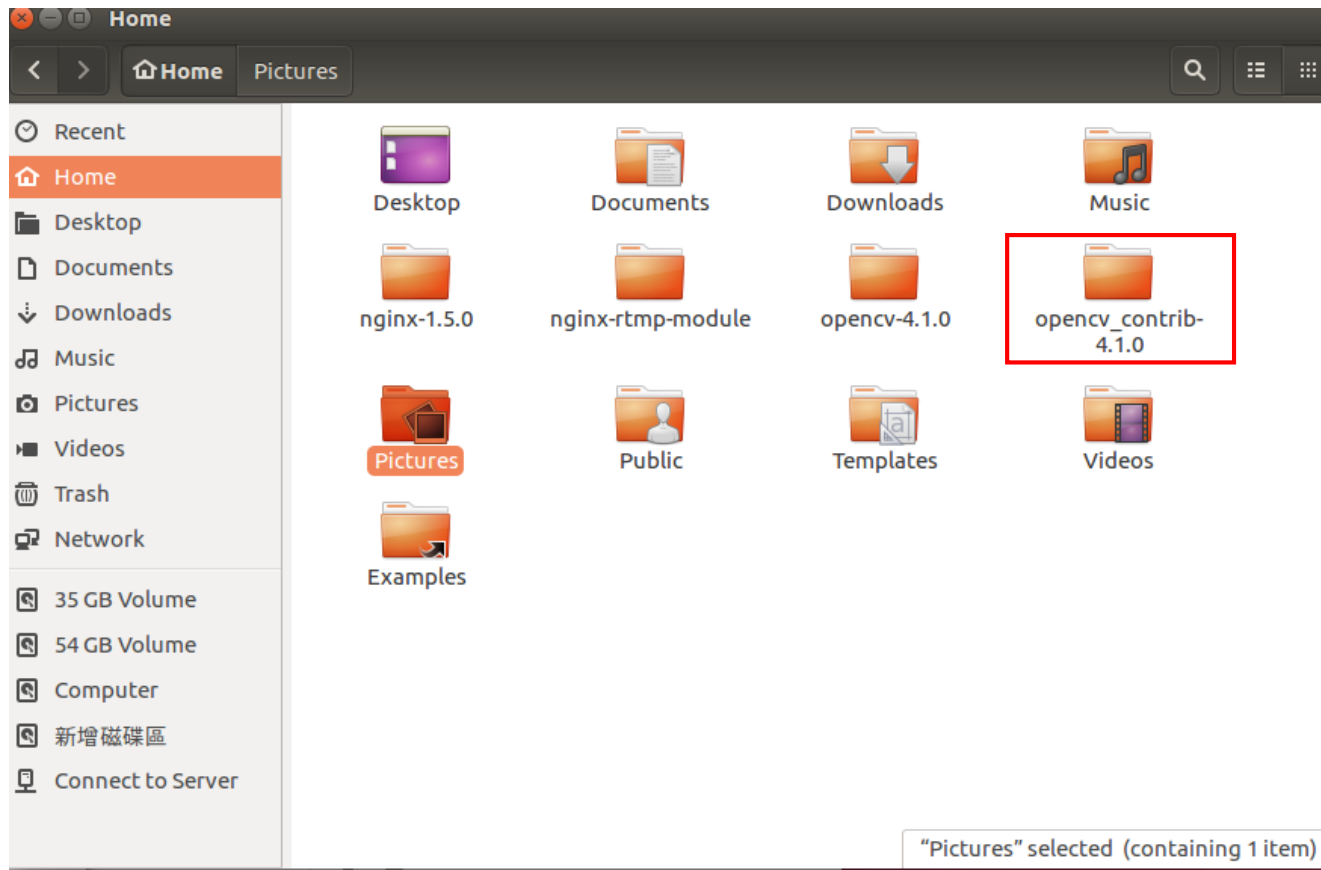
下載OpenCV_contrib 4.1.0

網址：https://github.com/opencv/opencv_contrib/tags



OpenCV安裝(解壓contrib)

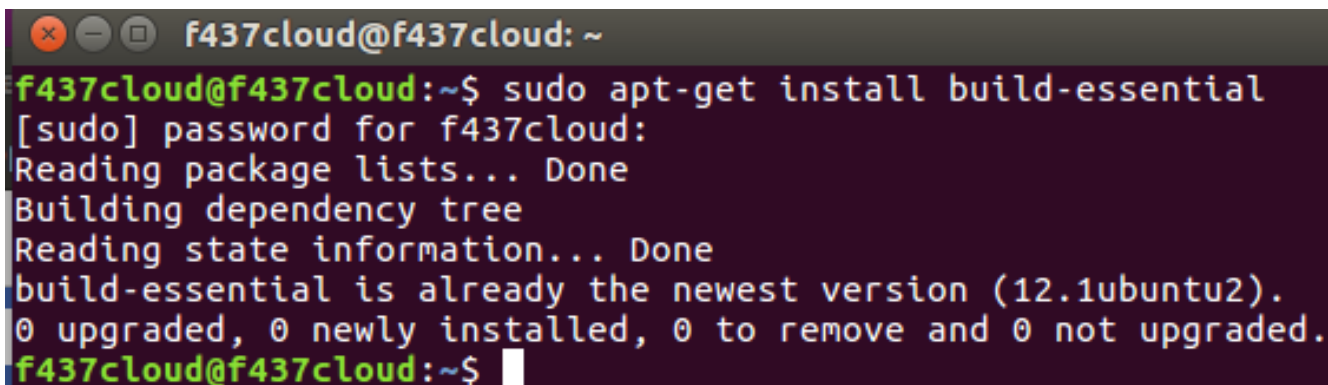
將OpenCV_contrib 4.1.0解壓縮到home下



OpenCV安裝(安裝依賴庫-1)

在終端機輸入

- `$ sudo apt-get install cmake-qt-gui`

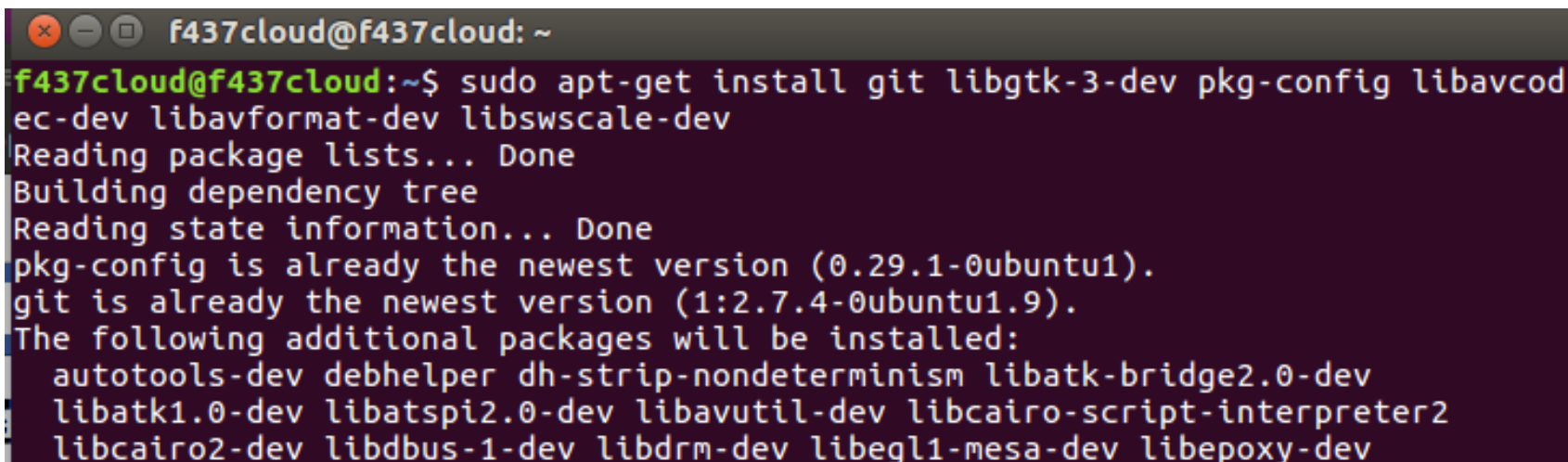


```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install build-essential  
[sudo] password for f437cloud:  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
build-essential is already the newest version (12.1ubuntu2).  
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
f437cloud@f437cloud:~$
```

OpenCV安裝(安裝依賴庫-2)

在終端機輸入

- `$ sudo apt-get install git libgtk-3-dev pkg-config libavcodec-dev libavformat-dev libswscale-dev`

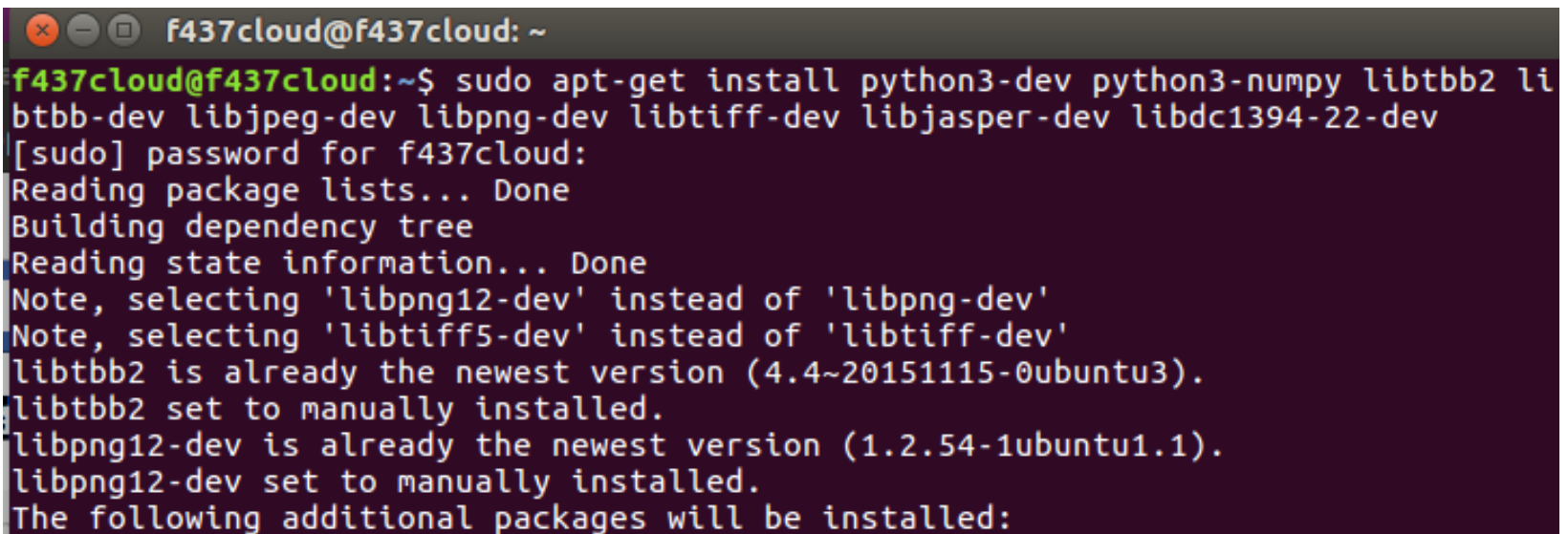


```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install git libgtk-3-dev pkg-config libavcod  
ec-dev libavformat-dev libswscale-dev  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
pkg-config is already the newest version (0.29.1-0ubuntu1).  
git is already the newest version (1:2.7.4-0ubuntu1.9).  
The following additional packages will be installed:  
  autotools-dev debhelper dh-strip-nondeterminism libatk-bridge2.0-dev  
  libatk1.0-dev libatspi2.0-dev libavutil-dev libcairo-script-interpreter2  
  libcairo2-dev libdbus-1-dev libdrm-dev libegl1-mesa-dev libepoxy-dev
```

OpenCV安裝(安裝依賴庫-3)

在終端機輸入

- `$ sudo apt-get install python3-dev python3-numpy libtbb2 libtbb-dev libjpeg-dev libpng-dev libtiff-dev libjasper-dev libdc1394-22-dev`

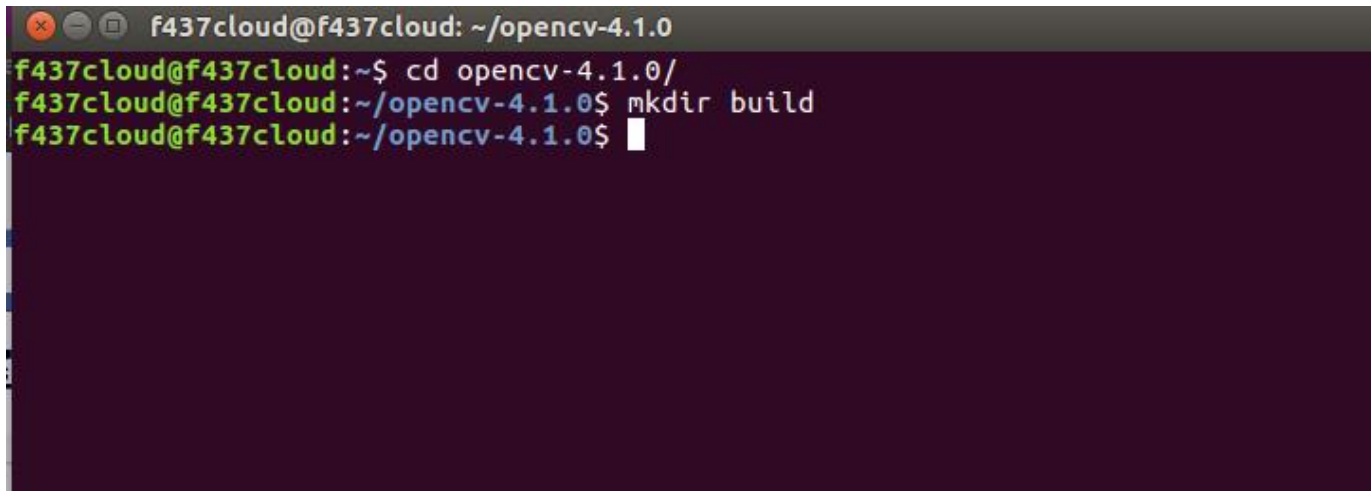


```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo apt-get install python3-dev python3-numpy libtbb2 libtbb-dev libjpeg-dev libpng-dev libtiff-dev libjasper-dev libdc1394-22-dev  
[sudo] password for f437cloud:  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
Note, selecting 'libpng12-dev' instead of 'libpng-dev'  
Note, selecting 'libtiff5-dev' instead of 'libtiff-dev'  
libtbb2 is already the newest version (4.4~20151115-0ubuntu3).  
libtbb2 set to manually installed.  
libpng12-dev is already the newest version (1.2.54-1ubuntu1.1).  
libpng12-dev set to manually installed.  
The following additional packages will be installed:
```


OpenCV安裝(建立build目錄)

在終端機輸入

- `$ cd opencv-4.1.0/`
- `$ mkdir build`

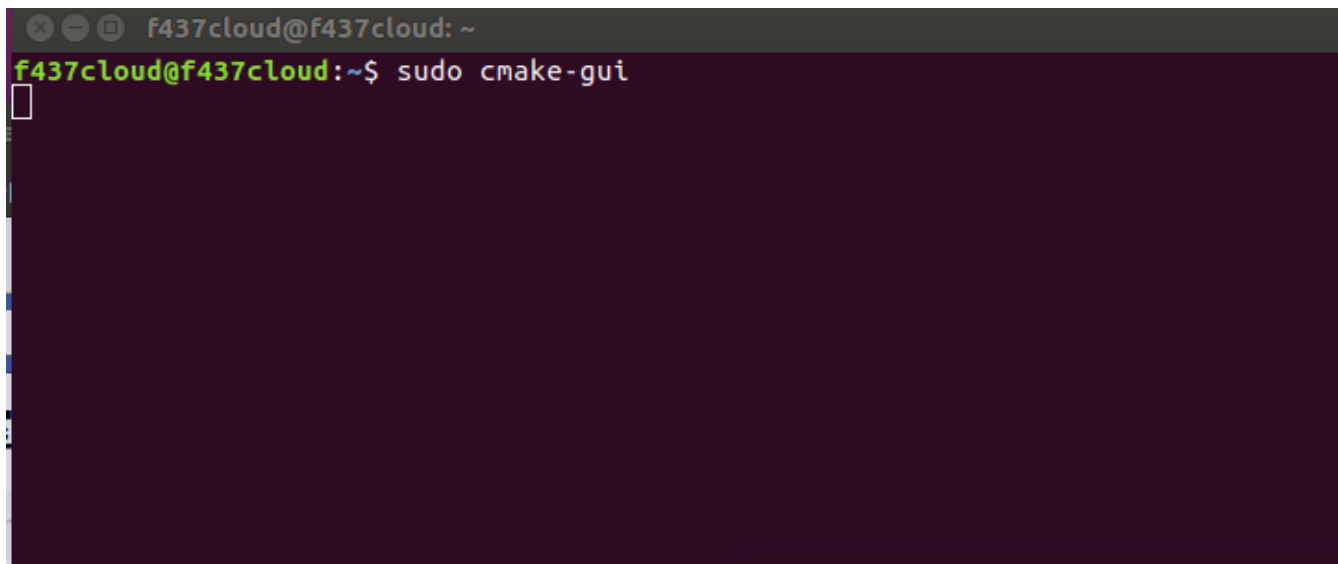


```
f437cloud@f437cloud: ~/opencv-4.1.0
f437cloud@f437cloud:~$ cd opencv-4.1.0/
f437cloud@f437cloud:~/opencv-4.1.0$ mkdir build
f437cloud@f437cloud:~/opencv-4.1.0$
```

OpenCV 安裝 (生成 Makefile-1)

在終端機輸入

- `$ sudo cmake-gui`

A terminal window with a dark purple background. The title bar at the top shows window control icons and the text 'f437cloud@f437cloud: ~'. The terminal content shows the prompt 'f437cloud@f437cloud:~\$' followed by the command 'sudo cmake-gui' in green text. A white cursor is positioned at the end of the command line.

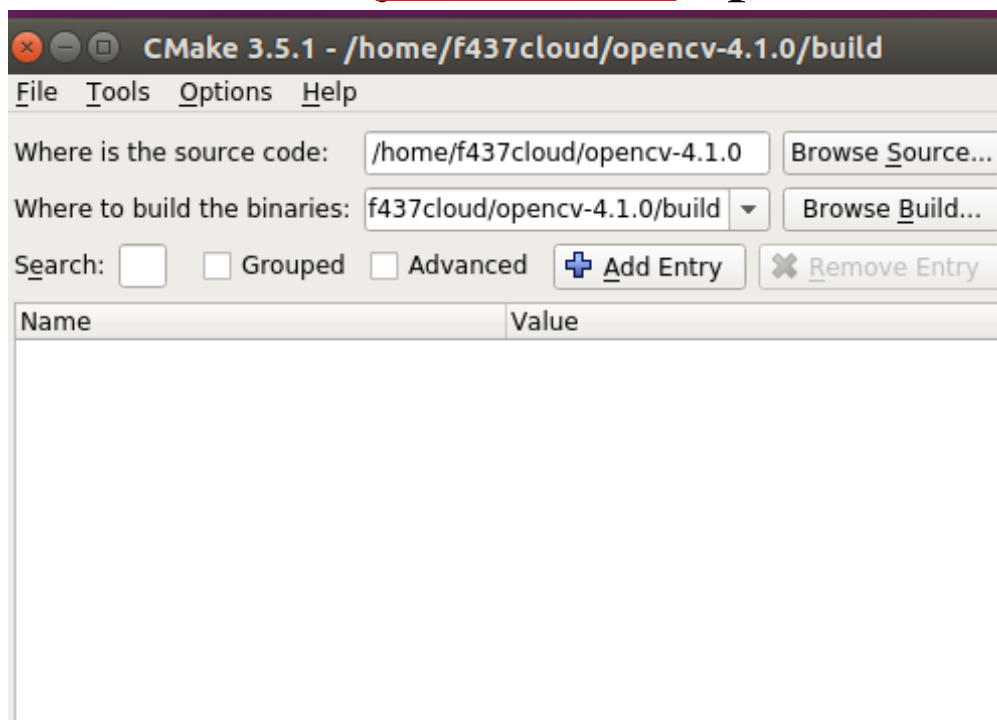
```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo cmake-gui
```

OpenCV 安裝 (生成 Makefile-2)

你的目錄名稱

source code 目錄為 /home/your-name/opencv-4.1.0

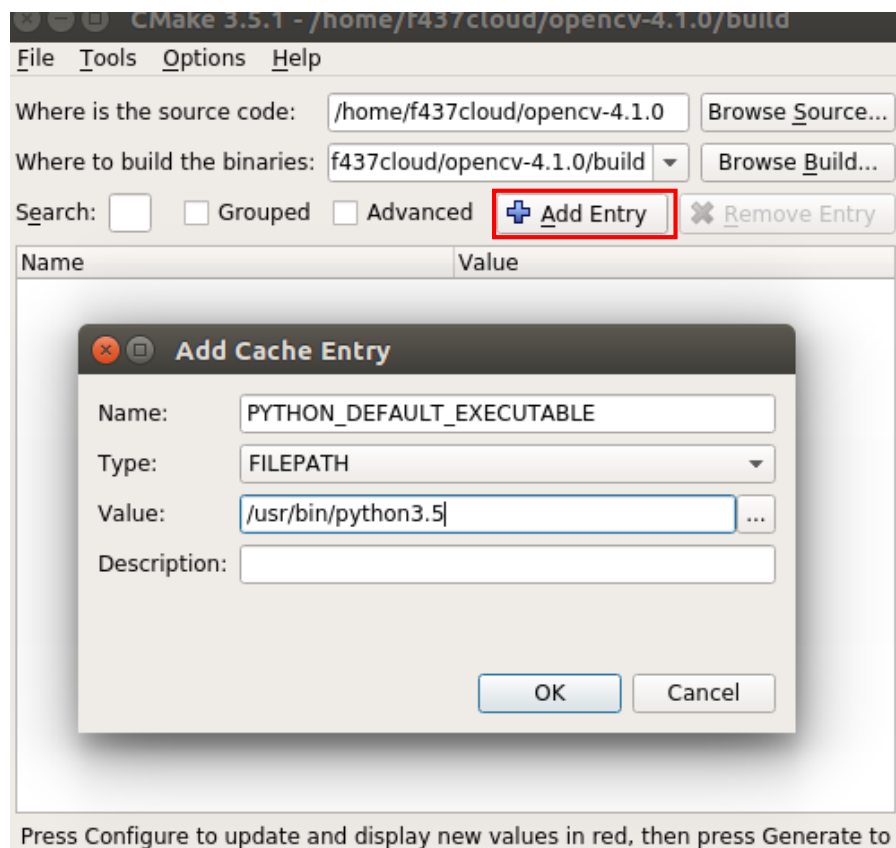
binaries 目錄為 /home/your-name/opencv-4.1.0/build



OpenCV 安裝 (生成 Makefile-3)

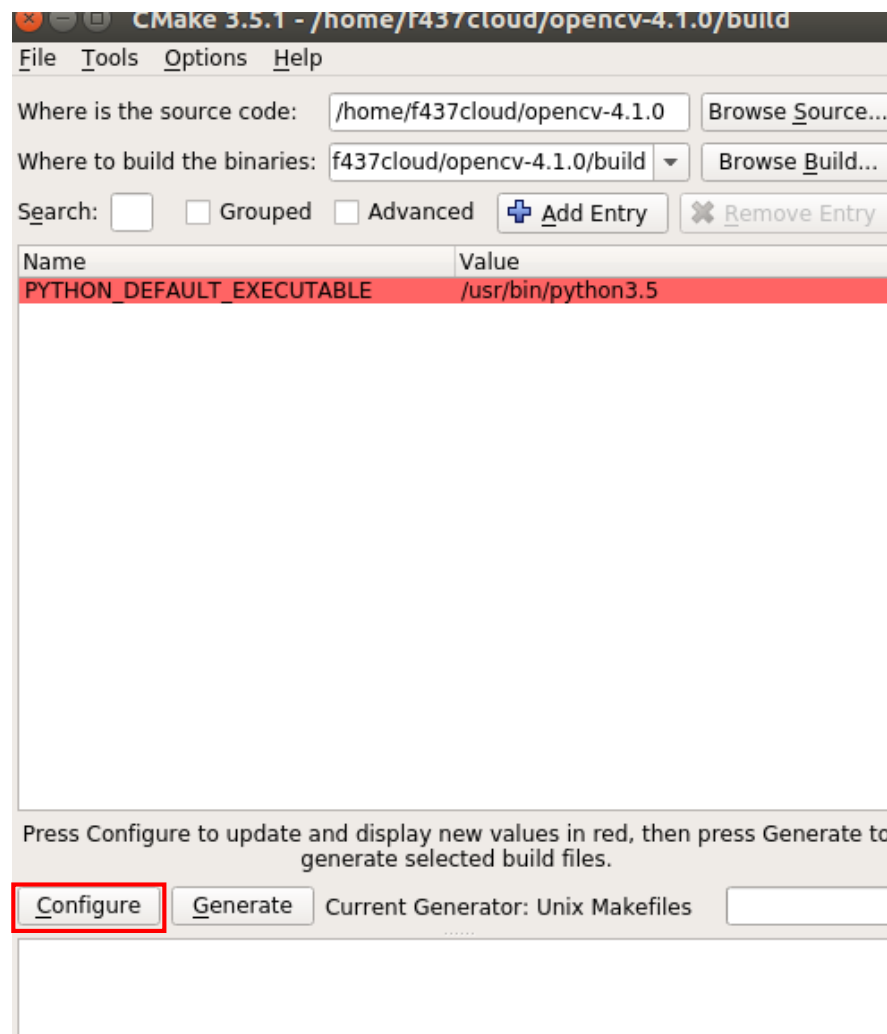
點選 Add Entry

- Name 設定 PYTHON_DEFAULT_EXECUTABLE
- Type 設定 FILEPATH
- Value 設定 /usr/bin/python3.5



OpenCV 安裝 (生成 Makefile-4)

點選 Congifure



OpenCV 安裝 (生成 Makefile-5)

- 勾選OPENCV_GENERATE_PKGCONFIG
- 在OPENCV_EXTRA_MODULES_PATH，填入
/home/your-name/opencv_contrib-4.1.0/modules/

你的目錄名稱

Where is the source code: [Browse Source...](#)

Where to build the binaries: [Browse Build...](#)

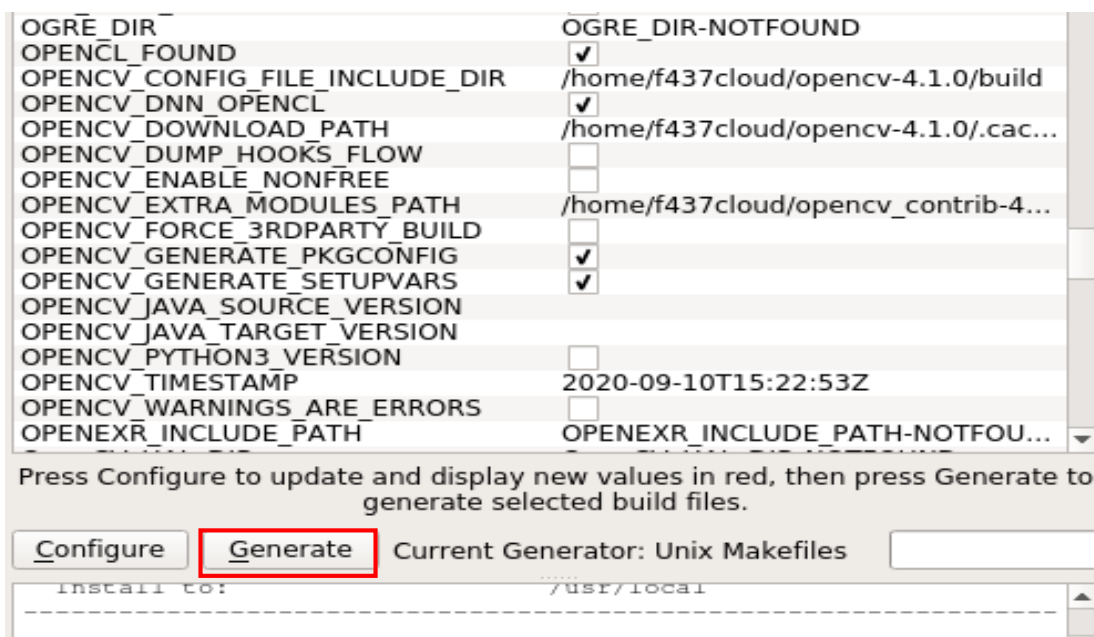
Search: ☐ Grouped ☐ Advanced [+ Add Entry](#) [✕ Remove Entry](#)

Name	Value
MKL_INCLUDE_DIRS	MKL_ROOT_DIR-NOTFOUND/include
MKL_ROOT_DIR	MKL_ROOT_DIR-NOTFOUND
MKL_WITH_OPENMP	<input type="checkbox"/>
MKL_WITH_TBB	<input type="checkbox"/>
OGRE_DIR	OGRE_DIR-NOTFOUND
OPENCV_FOUND	<input checked="" type="checkbox"/>
OPENCV_CONFIG_FILE_INCLUDE_DIR	/home/f437cloud/opencv-4.1.0/build
OPENCV_DNN_OPENCV	<input checked="" type="checkbox"/>
OPENCV_DOWNLOAD_PATH	/home/f437cloud/opencv-4.1.0/.cac...
OPENCV_DUMP_HOOKS_FLOW	<input type="checkbox"/>
OPENCV_ENABLE_NONREE	<input type="checkbox"/>
OPENCV_EXTRA_MODULES_PATH	/home/f437cloud/opencv_contrib-4...
OPENCV_FORCE_3RDPARTY_BUILD	<input type="checkbox"/>
OPENCV_GENERATE_PKGCONFIG	<input checked="" type="checkbox"/>
OPENCV_GENERATE_SETUPVARS	<input checked="" type="checkbox"/>
OPENCV_JAVA_SOURCE_VERSION	
OPENCV_JAVA_TARGET_VERSION	
OPENCV_PYTHON3_VERSION	<input type="checkbox"/>
OPENCV_TIMESTAMP	2020-09-10T15:22:53Z
OPENCV_WARNINGS_ARE_ERRORS	<input type="checkbox"/>
OPENEXR_INCLUDE_PATH	OPENEXR_INCLUDE_PATH-NOTFOU...

Press Configure to update and display new values in red, then press Generate to generate selected build files.

OpenCV 安裝 (生成 Makefile-6)

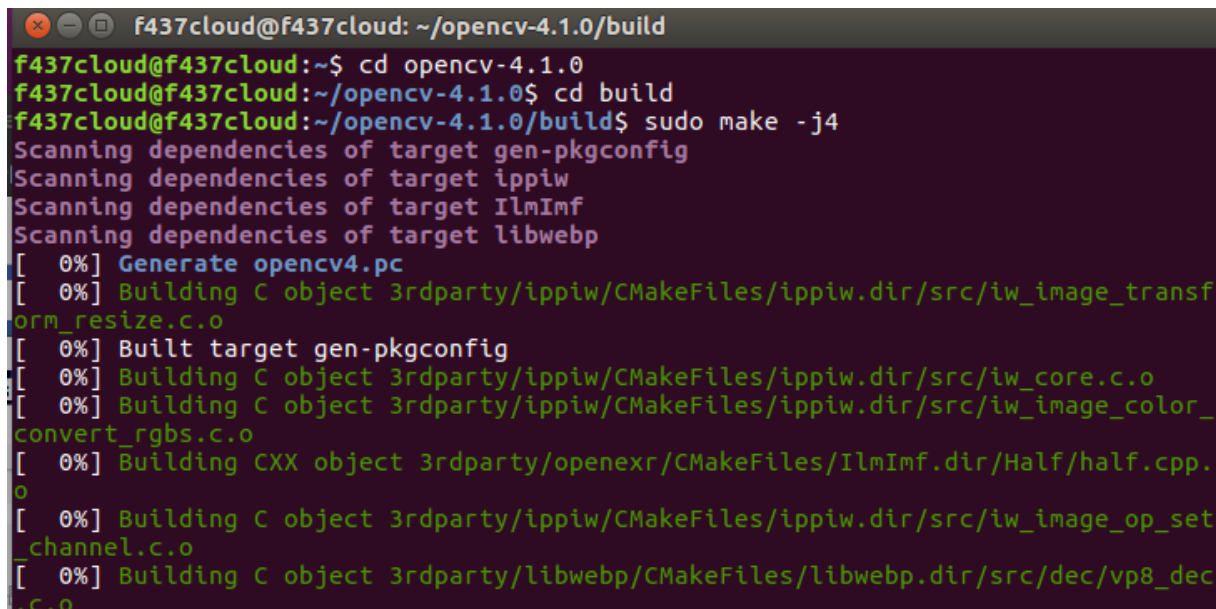
點選 Generate，生成 Makefile



OpenCV 安裝 (編譯 OpenCV)

在終端機輸入

- `$ cd opencv-4.1.0/build`
- `$ sudo make -j4`

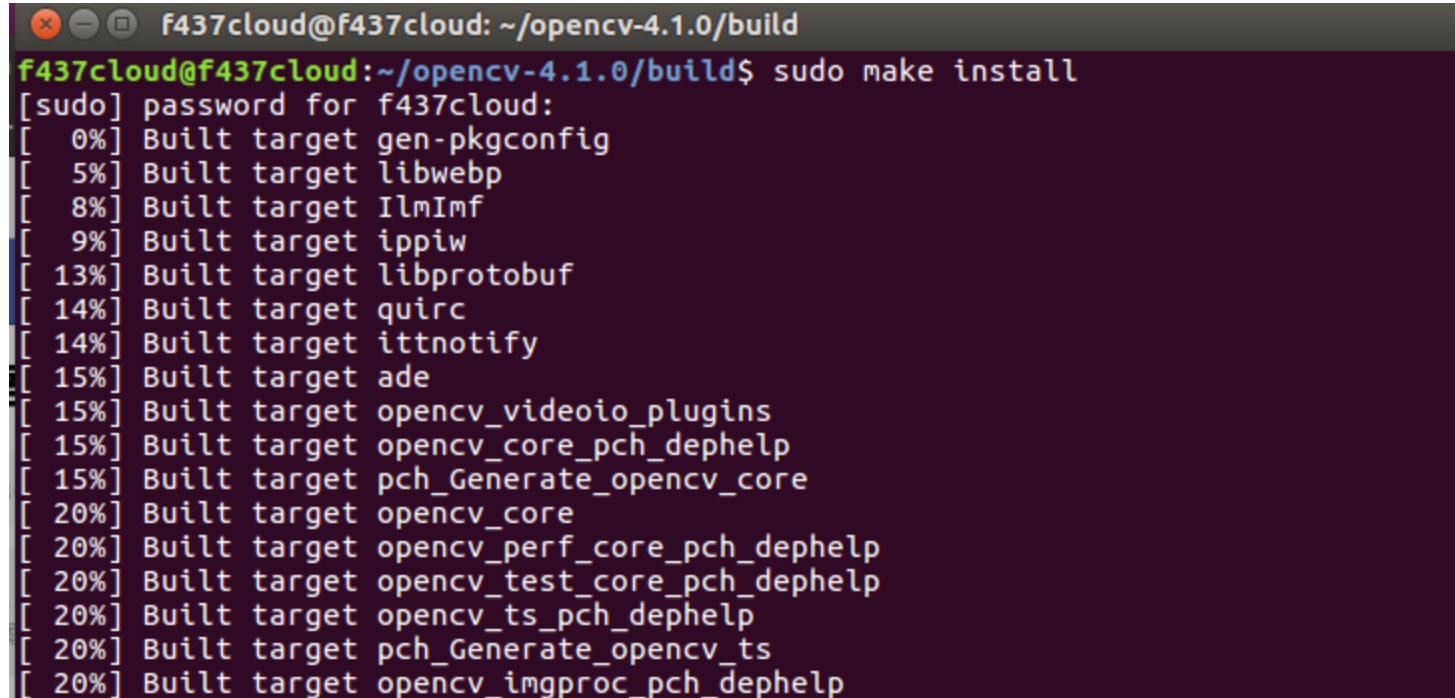


```
f437cloud@f437cloud: ~/opencv-4.1.0/build
f437cloud@f437cloud:~$ cd opencv-4.1.0
f437cloud@f437cloud:~/opencv-4.1.0$ cd build
f437cloud@f437cloud:~/opencv-4.1.0/build$ sudo make -j4
Scanning dependencies of target gen-pkgconfig
Scanning dependencies of target ippiw
Scanning dependencies of target IlmImf
Scanning dependencies of target libwebp
[ 0%] Generate opencv4.pc
[ 0%] Building C object 3rdparty/ippiw/CMakeFiles/ippiw.dir/src/iw_image_transf
orm_resize.c.o
[ 0%] Built target gen-pkgconfig
[ 0%] Building C object 3rdparty/ippiw/CMakeFiles/ippiw.dir/src/iw_core.c.o
[ 0%] Building C object 3rdparty/ippiw/CMakeFiles/ippiw.dir/src/iw_image_color_
convert_rgbs.c.o
[ 0%] Building CXX object 3rdparty/openexr/CMakeFiles/IlmImf.dir/Half/half.cpp.
o
[ 0%] Building C object 3rdparty/ippiw/CMakeFiles/ippiw.dir/src/iw_image_op_set
_channel.c.o
[ 0%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/src/dec/vp8_dec
.c.o
```


OpenCV 安裝 (安裝 OpenCV-1)

在終端機輸入

- `$ sudo make install`

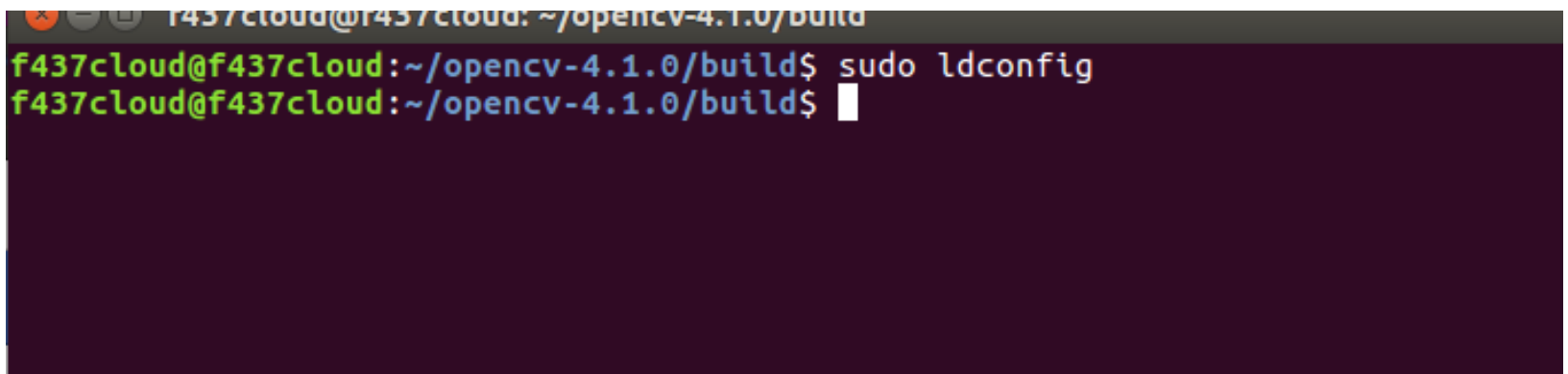


```
f437cloud@f437cloud: ~/opencv-4.1.0/build
f437cloud@f437cloud:~/opencv-4.1.0/build$ sudo make install
[sudo] password for f437cloud:
[ 0%] Built target gen-pkgconfig
[ 5%] Built target libwebp
[ 8%] Built target IlmImf
[ 9%] Built target ippiw
[13%] Built target libprotobuf
[14%] Built target quirc
[14%] Built target ittnotify
[15%] Built target ade
[15%] Built target opencv_videoio_plugins
[15%] Built target opencv_core_pch_dephelp
[15%] Built target pch_Generate_opencv_core
[20%] Built target opencv_core
[20%] Built target opencv_perf_core_pch_dephelp
[20%] Built target opencv_test_core_pch_dephelp
[20%] Built target opencv_ts_pch_dephelp
[20%] Built target pch_Generate_opencv_ts
[20%] Built target opencv_imgproc_pch_dephelp
```

OpenCV 安裝 (安裝 OpenCV-2)

在終端機輸入

- `$ sudo ldconfig`

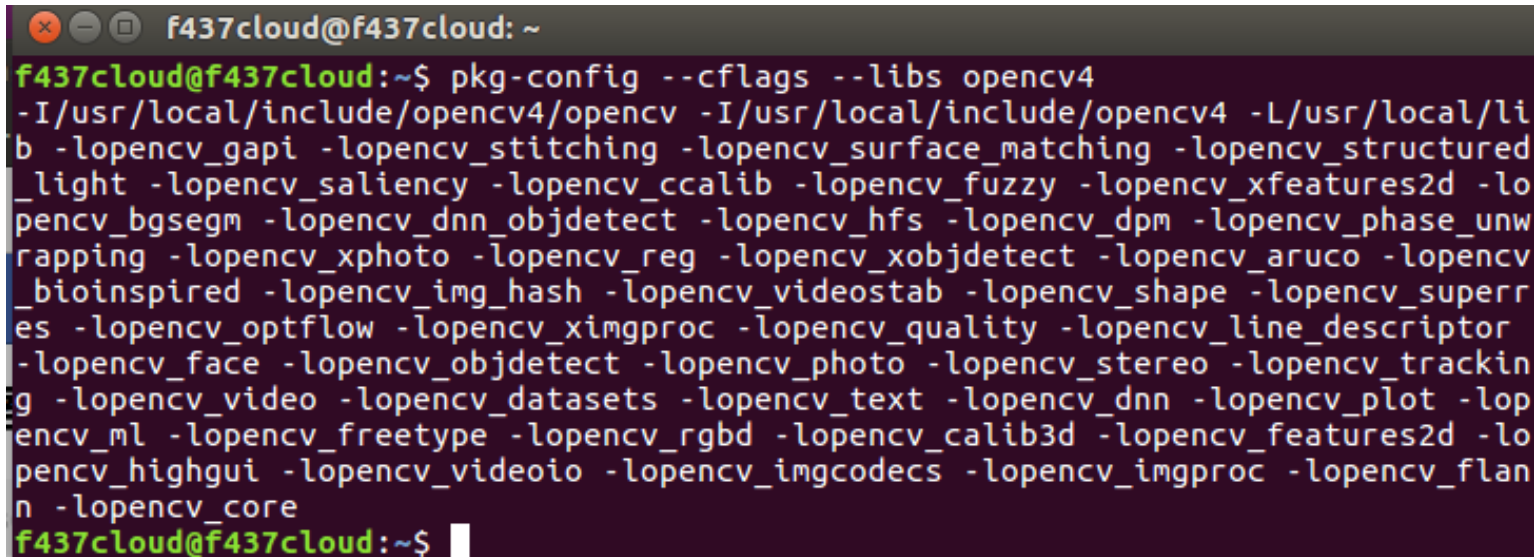


```
f437cloud@f437cloud: ~/opencv-4.1.0/build
f437cloud@f437cloud:~/opencv-4.1.0/build$ sudo ldconfig
f437cloud@f437cloud:~/opencv-4.1.0/build$
```

OpenCV安裝(驗證pkg功能)

在終端機輸入

- `$ pkg-config --cflags --libs opencv4`



```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ pkg-config --cflags --libs opencv4  
-I/usr/local/include/opencv4/opencv -I/usr/local/include/opencv4 -L/usr/local/lib -lopencv_gapi -lopencv_stitching -lopencv_surface_matching -lopencv_structured_light -lopencv_saliency -lopencv_ccalib -lopencv_fuzzy -lopencv_xfeatures2d -lopencv_bgsegm -lopencv_dnn_objdetect -lopencv_hfs -lopencv_dpm -lopencv_phase_unwrapping -lopencv_xphoto -lopencv_reg -lopencv_xobjdetect -lopencv_aruco -lopencv_bioinspired -lopencv_img_hash -lopencv_videostab -lopencv_shape -lopencv_superrc -lopencv_optflow -lopencv_ximgproc -lopencv_quality -lopencv_line_descriptor -lopencv_face -lopencv_objdetect -lopencv_photo -lopencv_stereo -lopencv_tracking -lopencv_video -lopencv_datasets -lopencv_text -lopencv_dnn -lopencv_plot -lopencv_ml -lopencv_freetype -lopencv_rgbd -lopencv_calib3d -lopencv_features2d -lopencv_highgui -lopencv_videoio -lopencv_imgcodecs -lopencv_imgproc -lopencv_flann -lopencv_core  
f437cloud@f437cloud:~$
```

OpenCV測試-1

新增OpenCV程式

- \$ gedit test.cpp

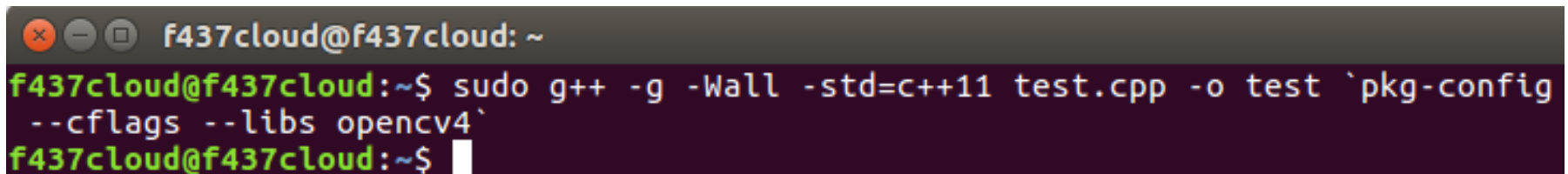
```
#include <opencv2/core.hpp>
#include <opencv2/videoio.hpp>
#include <opencv2/highgui.hpp>
using namespace cv;
using namespace std;
int main (int argc, char** argv) {
    Mat frame;
    VideoCapture cap;
    //cap.open(0); // 表示畫面來源由電腦的相機鏡頭拍攝
    //cap.open("~/test.mp4"); // 表示檔案的路徑與名稱
    cap.open("rtmp://163.18.104.142:1935/myapp/test"); // 表示適用於
    影音串流的網路協定。 URL格式=(協定:IP:port/路徑與檔案名稱)
    while (1) {
        if(!cap.read(frame)) { // 讀取畫面
            waitKey();
            return -1;
        }
        imshow("My Video", frame); // 顯示畫面
        if (waitKey(1) >= 0)
            break;
    }
}
```

video streaming server的IP

OpenCV測試-2

編譯OpenCV程式

- `$ sudo g++ -g -Wall -std=c++11 test.cpp -o test `pkg-config --cflags --libs opencv4``

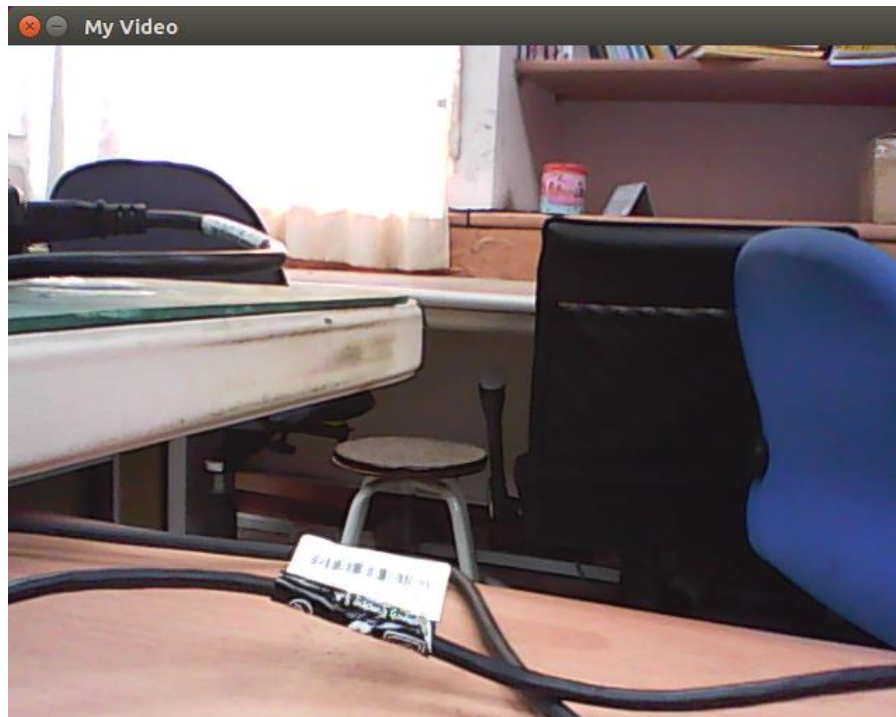


```
f437cloud@f437cloud: ~  
f437cloud@f437cloud:~$ sudo g++ -g -Wall -std=c++11 test.cpp -o test `pkg-config --cflags --libs opencv4`  
f437cloud@f437cloud:~$
```

OpenCV測試-3

執行OpenCV程式

- \$./test



Outline

- 實驗目的及實驗內容
- 實驗環境
- 平台架設需求
- Cloud Server 平台安裝
- Edge Server 平台安裝
- UE 安裝

Edge Server 安裝需求

Edge Server的安裝需求(ubuntu 16.04)

1. Video Streaming Server 安裝
 - Nginx 軟體，請參考Cloud Server安裝
2. TCP/UDP Socket 安裝
 - C Language 軟體，請參考Cloud Server安裝
3. Digital Image Processing 安裝
 - OpenCV 軟體，請參考Cloud Server安裝
4. Radio Access Network 安裝
 - OAI-EPC 軟體，請參考實驗單元-01

Outline

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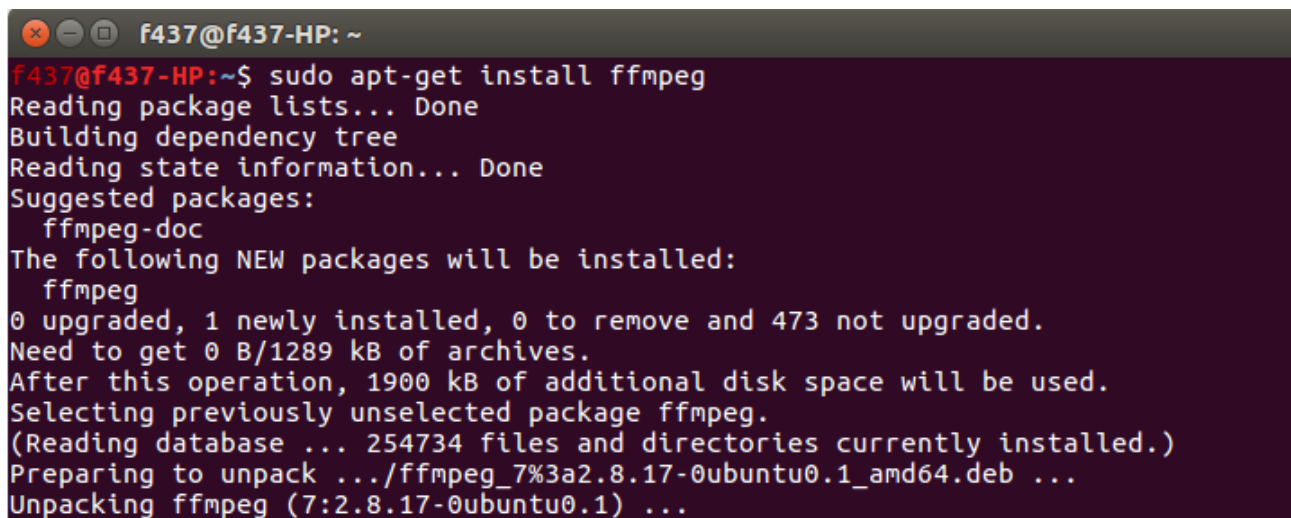
UE安裝

UE的安裝需求(ubuntu 16.04)

1. 影片瀏覽
 - FFmpeg

在終端機輸入

- `$ sudo apt-get install ffmpeg`



```
f437@f437-HP: ~  
f437@f437-HP:~$ sudo apt-get install ffmpeg  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
Suggested packages:  
  ffmpeg-doc  
The following NEW packages will be installed:  
  ffmpeg  
0 upgraded, 1 newly installed, 0 to remove and 473 not upgraded.  
Need to get 0 B/1289 kB of archives.  
After this operation, 1900 kB of additional disk space will be used.  
Selecting previously unselected package ffmpeg.  
(Reading database ... 254734 files and directories currently installed.)  
Preparing to unpack .../ffmpeg_7%3a2.8.17-0ubuntu0.1_amd64.deb ...  
Unpacking ffmpeg (7:2.8.17-0ubuntu0.1) ...
```

UE上傳影片測試-1

開啟Cloud Server影音串流服務

在終端機輸入

- `$ cd /usr/local/nginx/sbin`
- `$ sudo ./nginx -c /usr/local/nginx/conf/nginx.conf`

```
f437cloud@f437cloud: /usr/local/nginx/sbin
f437cloud@f437cloud:~$ cd /usr/local/nginx/sbin
f437cloud@f437cloud:/usr/local/nginx/sbin$ sudo ./nginx -c /usr/local/nginx/conf/nginx.conf
f437cloud@f437cloud:/usr/local/nginx/sbin$
```

※如果發生下圖時，代表port 1935正在被使用，使用以下指令來刪除

- `$ sudo lsof -i:1935`

```
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] bind() to 0.0.0.0:1935 failed (98: Address already in use)
nginx: [emerg] still could not bind()
```
- `$ sudo kill "PID"` (ex:sudo kill 2140)

COMMAND	PID	USER	FD	TYPE	DEVICE	SIZE/OFF	NODE	NAME
nginx	2140	root	6u	IPv4	29207	0t0	TCP	*:1935 (LISTEN)
nginx	2141	nobody	6u	IPv4	29207	0t0	TCP	*:1935 (LISTEN)
nginx	2142	nobody	6u	IPv4	29207	0t0	TCP	*:1935 (LISTEN)

重新執行

- `$ sudo ./nginx -c /usr/local/nginx/conf/nginx.conf`

UE上傳影片測試-2

UE上傳影片至Cloud Server

Cloud Server的IP

- `$ ffmpeg -re -i /dev/video0 -r 10 -q:v 15 -f flv rtmp://163.18.104.142:1935/myapp/test`
1. 設定FPS：`-r 30` (FPS=30)
 2. 設定畫質：`-q:v 1` (1表示最好，30最差)
 3. 設定格式：`-f flv`
 4. 設定輸出位置：`rtmp://163.18.104.132:1935/myapp/test`

```
f437@f437: ~  
f437@f437:~$ ffmpeg -re -i /dev/video0 -r 10 -q:v 10 -f flv rtmp://163.18.104.142:1935/myapp/test  
ffmpeg version 2.8.17-0ubuntu0.1 Copyright (c) 2000-2020 the FFmpeg developers  
built with gcc 5.4.0 (Ubuntu 5.4.0-6ubuntu1~16.04.12) 20160609  
configuration: --prefix=/usr --extra-version=0ubuntu0.1 --build-suffix=-ffmpeg  
--toolchain=hardened --libdir=/usr/lib/x86_64-linux-gnu --incdir=/usr/include/x86_64-linux-gnu --cc=cc --cxx=g++ --enable-gpl --enable-shared --disable-stripping --disable-decoder=libopenjpeg --disable-decoder=libschroedinger --enable-avresample --enable-avisynth --enable-gnutls --enable-ladspa --enable-libass --enable-libbluray --enable-libbs2b --enable-libcaca --enable-libcdio --enable-libflite --enable-libfontconfig --enable-libfreetype --enable-libfribidi --enable-libgme --enable-libgsm --enable-libmodplug --enable-libmp3lame --enable-libopenjpeg
```

UE上傳影片測試-3

- 在UE或Cloud Server上輸入下列指令，就可觀看UE串流影片
- \$ ffplay rtmp://163.18.104.142:1935/myapp/test
Cloud Server的IP

