

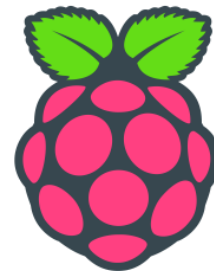
SD card Partition

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What can You Learn?

- 建置embedded system: Raspberry Pi + Linux
- 更細部的客製化自己的embedded system
 - 透過 fdisk 調整SD card中 root filesystem的 partition大小

Booting Sequence in Pi (1)



- Execute the boot ROM
 - The **FAT filesystem reading code** was implemented in the boot ROM to read files (Pi firmware).
- Next the boot ROM checks each of the boot sources for a file called **bootcode.bin**.
 - If it is successful, it will load the code into the local 128K cache and jump to it.
- **bootcode.bin** in turn then loads and runs **start.elf** (and **fixup.dat**) also from the first partition.
- **start.elf** then reads **config.txt** and sets up any GPU configuration requested.

Booting Sequence in Pi (2)

- **start.elf** reads **cmdline.txt** and loads and runs Linux kernel image, **zImage**, passing it the entire command-line that it read from **cmdline.txt**.

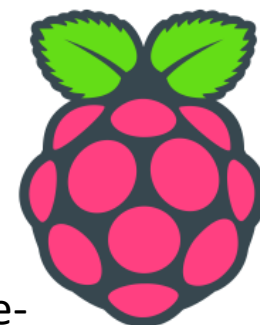
There is a **kernel = zImage** option in **config.txt**.

- **Linux Kernel**
 - Decompress the kernel into SDRAM.
 - Setup peripherals, such as LCD, HDMI, I2C but, USB, audio, ... etc.
 - Mount the Linux root filesystem that contains all userspace libraries and applications.

The root filesystem is on the second partition, so there'll be a **root=/dev/mmcblk0p2** option somewhere in **cmdline.txt**.

Booting Sequence in Pi (3)

- The Linux kernel then mounts the `/dev/mmcblk0p2` partition as the root (/) filesystem, and continues booting the rest of the system from there.
- In most cases the `/etc/fstab` file (File System TABLE) on the root filesystem will have a line asking for the `/dev/mmcblk0p1` partition to be mounted at `/boot`.
 - Easy to modify `config.txt` and `cmdline.txt`

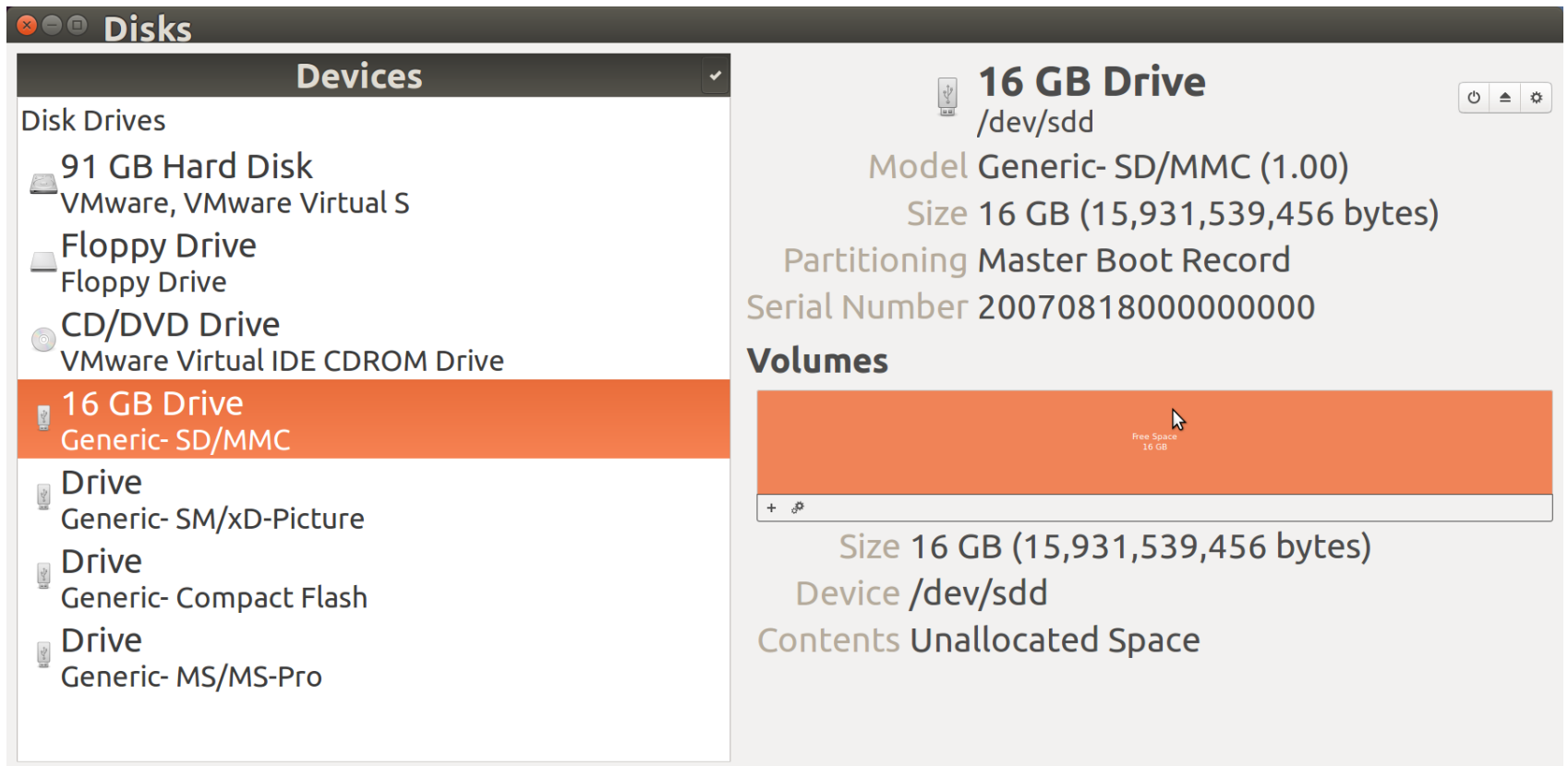


Reference from <https://github.com/raspberrypi/noobs/wiki/Standalone-partitioning-explained>

Partition SD Card

- Insert your SD card into your Linux box
- **Do not mount it**
- 確認/dev裡哪一個檔案代表你的SD card
 - 可使用Ubuntu裡的disk utility or disk顯示相關訊息
 - 在稍後的操作範例裡，我們假設是/dev/sdd

Disks in Ubuntu



Partition SD Card Using fdisk

- **SD card**裡的資料將被清除，若有重要資料，請事先備份
- 將SD card插入讀卡機，並與電腦相連
- 這裡，SD card讀卡機的 device file是/dev/sdd

\$ sudo -s

\$ fdisk /dev/sdd

(目前SD card包含兩個partition)

```
root@ubuntu: ~  
root@ubuntu:~# fdisk /dev/sdd  
  
Command (m for help): p  
  
Disk /dev/sdd: 15.9 GB, 15931539456 bytes  
64 heads, 32 sectors/track, 15193 cylinders, total 31116288 sectors  
Units = sectors of 1 * 512 = 512 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disk identifier: 0x5b155e53  
  
   Device Boot      Start         End      Blocks    Id  System  
/dev/sdd1    *           1        65536       32768    c   W95 FAT32 (LBA)  
/dev/sdd2           65537    16842752     8388608    83   Linux  
  
Command (m for help):
```


Delete the Partitions

```
root@ubuntu: ~  
Disk identifier: 0x5b155e53  
  
   Device Boot      Start         End      Blocks   Id  System  
/dev/sdd1    *           1        65536       32768    c   W95 FAT32 (LBA)  
/dev/sdd2           65537    16842752     8388608    83   Linux
```

```
Command (m for help): d  
Partition number (1-4): 1
```

```
Command (m for help): d  
Selected partition 2
```

```
Command (m for help): p
```

```
Disk /dev/sdd: 15.9 GB, 15931539456 bytes  
64 heads, 32 sectors/track, 15193 cylinders, total 31116288 sectors  
Units = sectors of 1 * 512 = 512 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disk identifier: 0x5b155e53
```

```
   Device Boot      Start         End      Blocks   Id  System
```

```
Command (m for help):
```

root@ubuntu: ~/src/buildroot/output/images

Disk identifier: 0x5b155e53

Device	Boot	Start	End	Blocks	Id	System
--------	------	-------	-----	--------	----	--------

Command (m for help): m

Command action

- a toggle a bootable flag
- b edit bsd disklabel
- c toggle the dos compatibility flag
- d delete a partition
- l list known partition types
- m print this menu
- n add a new partition**
- o create a new empty DOS partition table
- p print the partition table
- q quit without saving changes
- s create a new empty Sun disklabel
- t change a partition's system id
- u change display/entry units
- v verify the partition table
- w write table to disk and exit
- x extra functionality (experts only)

Command (m for help):

Partition Arrangement

- **FAT32**
 - Size: 64MB
 - Bootable
- **Linux ext4**
 - Size: the rest of space.

(假設SD card是16GB)

Create Partition: FAT32

```
root@ubuntu: ~/src/buildroot/output/images
root@ubuntu:~/src/buildroot/output/images# fdisk /dev/sdd

Command (m for help): p

Disk /dev/sdd: 15.9 GB, 15931539456 bytes
64 heads, 32 sectors/track, 15193 cylinders, total 31116288 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0xbaf7cf51
```

Device	Boot	Start	End	Blocks	Id	System
--------	------	-------	-----	--------	----	--------

```
Command (m for help): n
Partition type:
   p   primary (0 primary, 0 extended, 4 free)
   e   extended
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-31116287, default 2048):
Using default value 2048
Last sector, +sectors or +size{K,M,G} (2048-31116287, default 31116287): +64M

Command (m for help):
```

Create Partition: Linux ext4

```
Command (m for help): n
Partition type:
   p   primary (1 primary, 0 extended, 3 free)
   e   extended
Select (default p): p
Partition number (1-4, default 2): 2
First sector (133120-31116287, default 133120):
Using default value 133120
Last sector, +sectors or +size{K,M,G} (133120-31116287, default 31116287):
Using default value 31116287
Command (m for help): █
```

檢視目前分割狀態

Command (m for help): p

Disk /dev/sdd: 15.9 GB, 15931539456 bytes
64 heads, 32 sectors/track, 15193 cylinders, total 31116288 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0xbaf7cf51

Device	Boot	Start	End	Blocks	Id	System
/dev/sdd1		2048	133119	65536	83	Linux
/dev/sdd2		133120	31116287	15491584	83	Linux

Command (m for help):

root@ubuntu: ~/src/buildroot/output/images

Disk identifier: 0x5b155e53

Device	Boot	Start	End	Blocks	Id	System
--------	------	-------	-----	--------	----	--------

Command (m for help): m

Command action

a	toggle a bootable flag
b	edit bsd disklabel
c	toggle the dos compatibility flag
d	delete a partition
l	list known partition types
m	print this menu
n	add a new partition
o	create a new empty DOS partition table
p	print the partition table
q	quit without saving changes
s	create a new empty Sun disklabel
t	change a partition's system id
u	change display/entry units
v	verify the partition table
w	write table to disk and exit
x	extra functionality (experts only)

Command (m for help):

Mark the Partition 1 Bootable

```
root@ubuntu: ~/src/buildroot/output/images
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0xbaf7cf51
```

Device	Boot	Start	End	Blocks	Id	System
/dev/sdd1		2048	133119	65536	83	Linux
/dev/sdd2		133120	31116287	15491584	83	Linux

```
Command (m for help): a
Partition number (1-4): 1
```

```
Command (m for help): p
```

Disk /dev/sdd: 15.9 GB, 15931539456 bytes
64 heads, 32 sectors/track, 15193 cylinders, total 31116288 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0xbaf7cf51

Device	Boot	Start	End	Blocks	Id	System
/dev/sdd1	*	2048	133119	65536	83	Linux
/dev/sdd2		133120	31116287	15491584	83	Linux

```
Command (m for help):
```


root@ubuntu: ~/src/buildroot/output/images

Disk identifier: 0x5b155e53

Device	Boot	Start	End	Blocks	Id	System
--------	------	-------	-----	--------	----	--------

Command (m for help): m

Command action

- a toggle a bootable flag
- b edit bsd disklabel
- c toggle the dos compatibility flag
- d delete a partition
- l list known partition types**
- m print this menu
- n add a new partition
- o create a new empty DOS partition table
- p print the partition table
- q quit without saving changes
- s create a new empty Sun disklabel
- t change a partition's system id**
- u change display/entry units
- v verify the partition table
- w write table to disk and exit
- x extra functionality (experts only)

Command (m for help):

Partition Types

```
root@ubuntu: ~/src/buildroot/output/images
```

0	Empty	24	NEC DOS	81	Minix / old Lin	bf	Solaris
1	FAT12	27	Hidden NTFS Win	82	Linux swap / So	c1	DRDOS/sec (FAT-
2	XENIX root	39	Plan 9	83	Linux	c4	DRDOS/sec (FAT-
3	XENIX usr	3c	PartitionMagic	84	OS/2 hidden C:	c6	DRDOS/sec (FAT-
4	FAT16 <32M	40	Venix 80286	85	Linux extended	c7	Syrinx
5	Extended	41	PPC PReP Boot	86	NTFS volume set	da	Non-FS data
6	FAT16	42	SFS	87	NTFS volume set	db	CP/M / CTOS / .
7	HPFS/NTFS/exFAT	4d	QNX4.x	88	Linux plaintext	de	Dell Utility
8	AIX	4e	QNX4.x 2nd part	8e	Linux LVM	df	BootIt
9	AIX bootable	4f	QNX4.x 3rd part	93	Amoeba	e1	DOS access
a	OS/2 Boot Manag	50	OnTrack DM	94	Amoeba BBT	e3	DOS R/O
b	W95 FAT32	51	OnTrack DM6 Aux	9f	BSD/OS	e4	SpeedStor
c	W95 FAT32 (LBA)	52	CP/M	a0	IBM Thinkpad hi	eb	BeOS fs
e	W95 FAT16 (LBA)	53	OnTrack DM6 Aux	a5	FreeBSD	ee	GPT
f	W95 Ext'd (LBA)	54	OnTrackDM6	a6	OpenBSD	ef	EFI (FAT-12/16/
10	OPUS	55	EZ-Drive	a7	NeXTSTEP	f0	Linux/PA-RISC b
11	Hidden FAT12	56	Golden Bow	a8	Darwin UFS	f1	SpeedStor
12	Compaq diagnost	5c	Priam Edisk	a9	NetBSD	f4	SpeedStor
14	Hidden FAT16 <3	61	SpeedStor	ab	Darwin boot	f2	DOS secondary
16	Hidden FAT16	63	GNU HURD or Sys	af	HFS / HFS+	fb	VMware VMFS
17	Hidden HPFS/NTF	64	Novell Netware	b7	BSDI fs	fc	VMware VMKCORE
18	AST SmartSleep	65	Novell Netware	b8	BSDI swap	fd	Linux raid auto
1b	Hidden W95 FAT3	70	DiskSecure Mult	bb	Boot Wizard hid	fe	LANstep
1c	Hidden W95 FAT3	75	PC/IX	be	Solaris boot	ff	BBT

Change Partition Type of the Partition 1

root@ubuntu: ~/src/buildroot/output/images

Device	Boot	Start	End	Blocks	Id	System
/dev/sdd1	*	2048	133119	65536	83	Linux
/dev/sdd2		133120	31116287	15491584	83	Linux

```
Command (m for help): t
Partition number (1-4): 1
Hex code (type L to list codes): c
Changed system type of partition 1 to c (W95 FAT32 (LBA))
```

```
Command (m for help): p
```

```
Disk /dev/sdd: 15.9 GB, 15931539456 bytes
64 heads, 32 sectors/track, 15193 cylinders, total 31116288 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0xbaf7cf51
```

Device	Boot	Start	End	Blocks	Id	System
/dev/sdd1	*	2048	133119	65536	c	W95 FAT32 (LBA)
/dev/sdd2		133120	31116287	15491584	83	Linux

```
Command (m for help):
```

root@ubuntu: ~/src/buildroot/output/images

Disk identifier: 0x5b155e53

Device	Boot	Start	End	Blocks	Id	System
--------	------	-------	-----	--------	----	--------

Command (m for help): m

Command action

- a toggle a bootable flag
- b edit bsd disklabel
- c toggle the dos compatibility flag
- d delete a partition
- l list known partition types
- m print this menu
- n add a new partition
- o create a new empty DOS partition table
- n print the partition table
- q quit without saving changes
- s create a new empty Sun disklabel
- t change a partition's system id
- u change display/entry units
- v verify the partition table
- w write table to disk and exit
- x extra functionality (experts only)

Command (m for help):

Write the Partition Table

- "w" => write the partition table
- "q" => 若過程中有打錯，隨時放棄重來

```
Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.

WARNING: If you have created or modified any DOS 6.x
partitions, please see the fdisk manual page for additional
information.
Syncing disks.
root@ubuntu:~/src/buildroot/output/images#
```

Format Partitions

//Change to root user

```
$ sudo -s
```

```
$ mkfs.vfat -n BOOT /dev/sdd1
```

```
$ mkfs.ext4 -L filesystem /dev/sdd2
```

root@ubuntu: /src/buildroot/output/images

```
root@ubuntu:~/src/buildroot/output/images# mkfs.vfat -n BOOT /dev/sdd1  
mkfs.fat 3.0.26 (2014-03-07)
```

```
root@ubuntu:~/src/buildroot/output/images#
```

```
root@ubuntu:~/src/buildroot/output/images# mkfs.ext4 -L filesystem /dev/sdd2  
mke2fs 1.42.9 (4-Feb-2014)
```

Filesystem label=filesystem

OS type: Linux

Block size=4096 (log=2)

Fragment size=4096 (log=2)

Stride=0 blocks, Stripe width=0 blocks

969136 inodes, 3872896 blocks

193644 blocks (5.00%) reserved for the super user

First data block=0

Maximum filesystem blocks=3967811584

119 block groups

32768 blocks per group, 32768 fragments per group

8144 inodes per group

Superblock backups stored on blocks:

32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Allocating group tables: done

Writing inode tables: done

Creating journal (32768 blocks): done

Writing superblocks and filesystem accounting information: done

Mount Partitions

//Change to root user

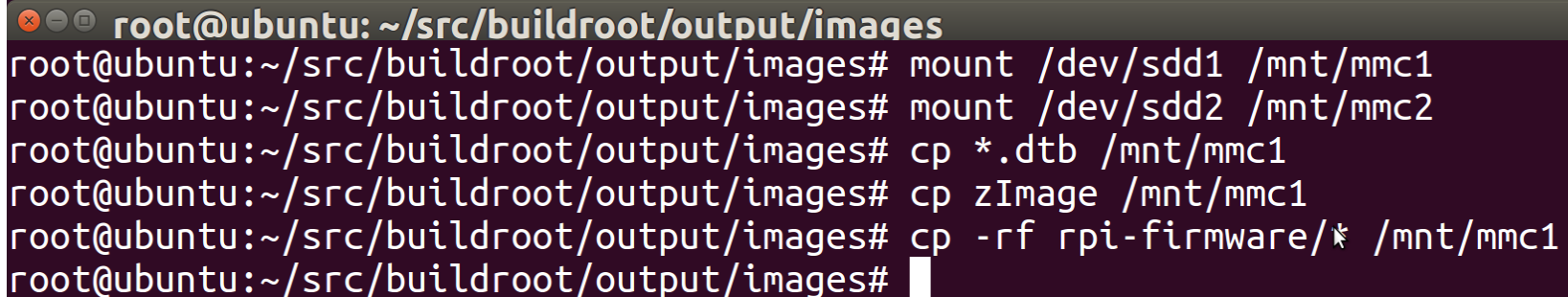
```
$ sudo -s
```

```
$ mkdir /mnt/mmc1
```

```
$ mount /dev/sdd1 /mnt/mmc1
```


Copy Files for the Partition BOOT

```
$ cd <buildroot目錄>/output/images/  
$ cp *.dtb /mnt/mmc1  
$ cp zImage /mnt/mmc1  
$ cp -rf rpi-firmware/* /mnt/mmc1
```



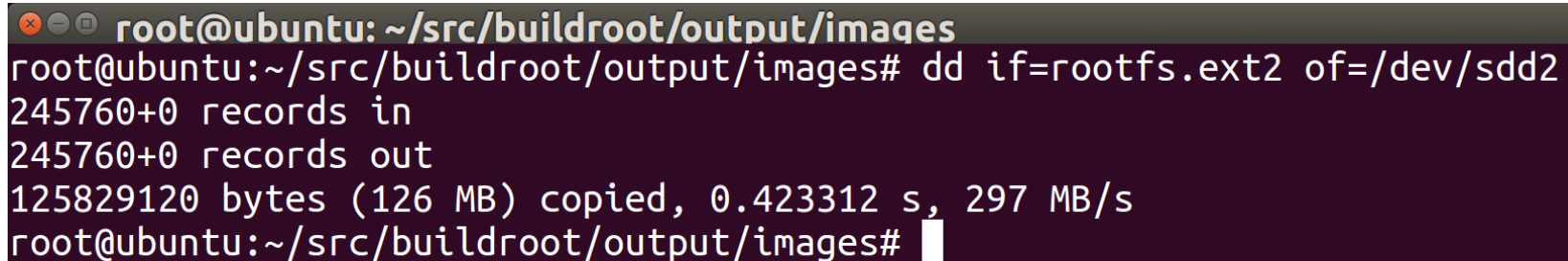
```
root@ubuntu: ~/src/buildroot/output/images  
root@ubuntu:~/src/buildroot/output/images# mount /dev/sdd1 /mnt/mmc1  
root@ubuntu:~/src/buildroot/output/images# mount /dev/sdd2 /mnt/mmc2  
root@ubuntu:~/src/buildroot/output/images# cp *.dtb /mnt/mmc1  
root@ubuntu:~/src/buildroot/output/images# cp zImage /mnt/mmc1  
root@ubuntu:~/src/buildroot/output/images# cp -rf rpi-firmware/* /mnt/mmc1  
root@ubuntu:~/src/buildroot/output/images#
```

Copy Files for the Partition filesystem

```
$ cd <buildroot目錄>/output/images/
```

```
// rootfs.ext2是image file
```

```
$ dd if=rootfs.ext2 of=/dev/sdd2
```



```
root@ubuntu: ~/src/buildroot/output/images
root@ubuntu:~/src/buildroot/output/images# dd if=rootfs.ext2 of=/dev/sdd2
245760+0 records in
245760+0 records out
125829120 bytes (126 MB) copied, 0.423312 s, 297 MB/s
root@ubuntu:~/src/buildroot/output/images#
```

Testing

```
// Umount SD card
```

```
// Change to root
```

```
$ sudo -s
```

```
$ umount /dev/sdd1
```

- 取出SD card，放入Raspberry Pi，重新開機