SD card Partition

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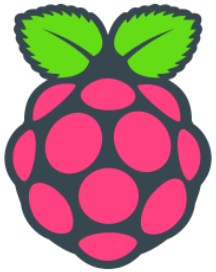
What can You Learn?

- 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**.

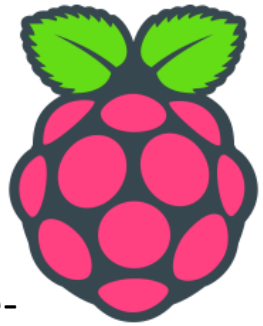
There is a **`kernel = zImage`** option in **config.txt**.

- **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**

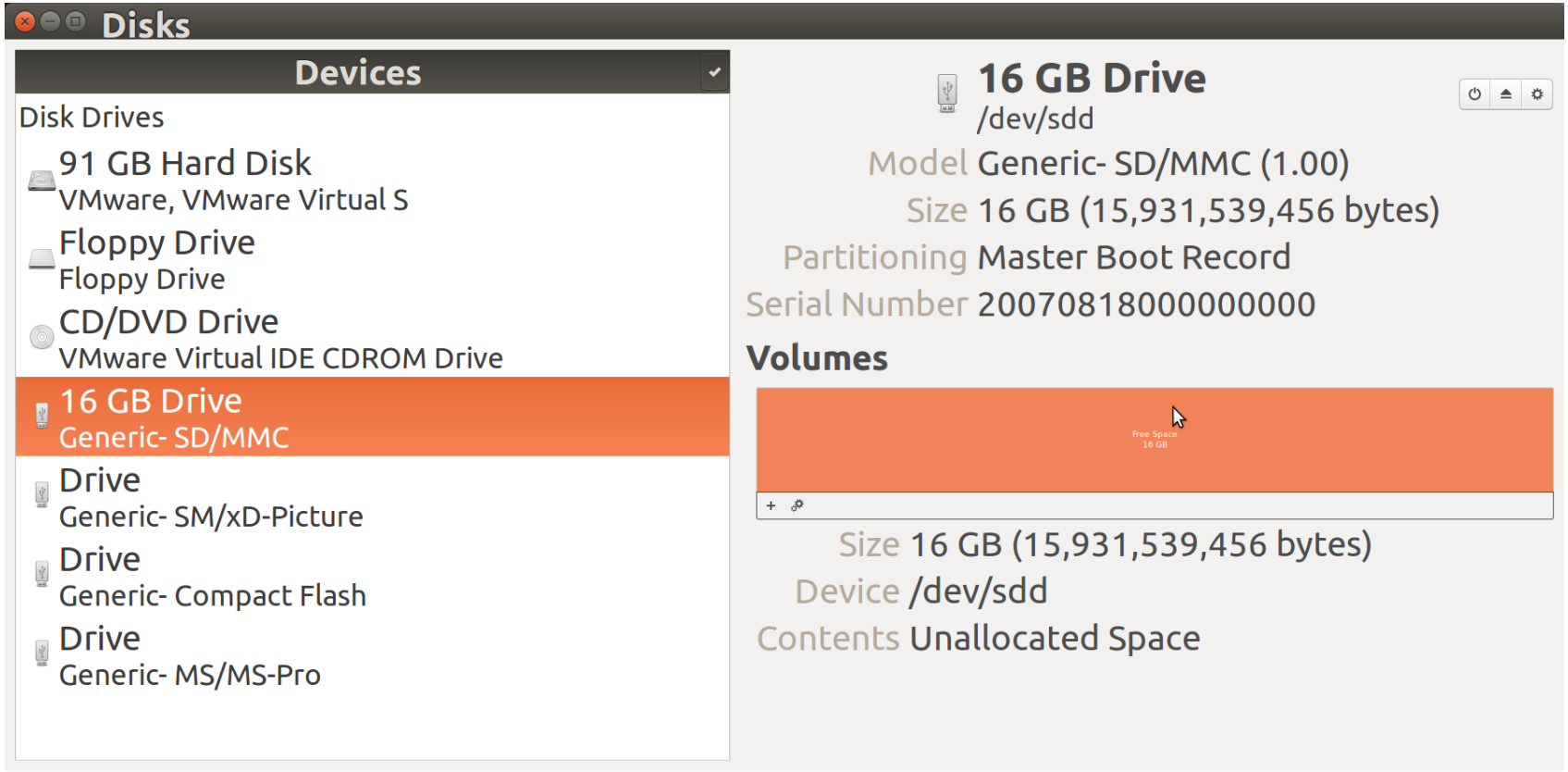


Reference from https://github.com/raspberrypi/noobs/wiki/Standalone-partitioning-explained

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

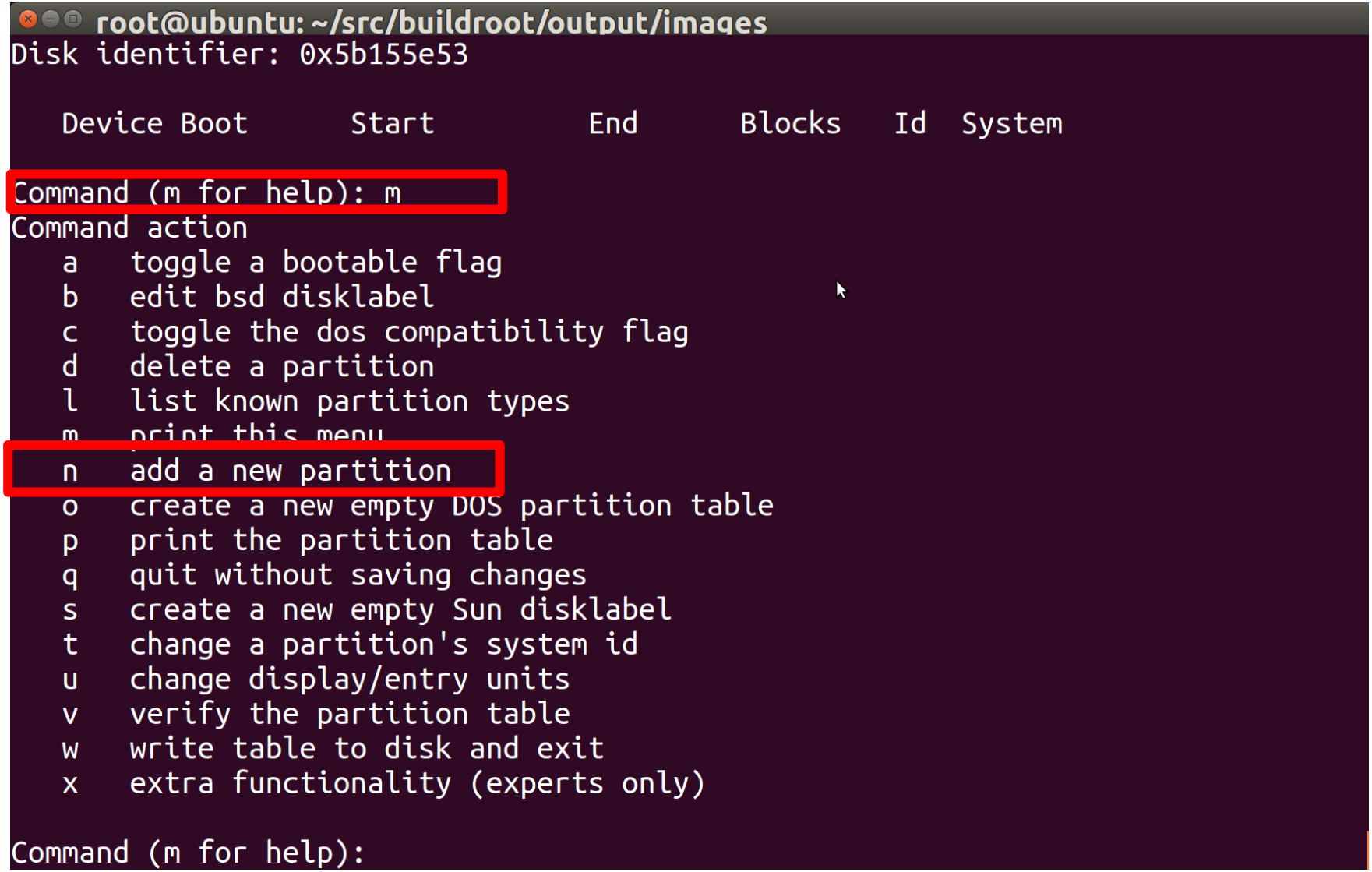
$ sudo –s

$ 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

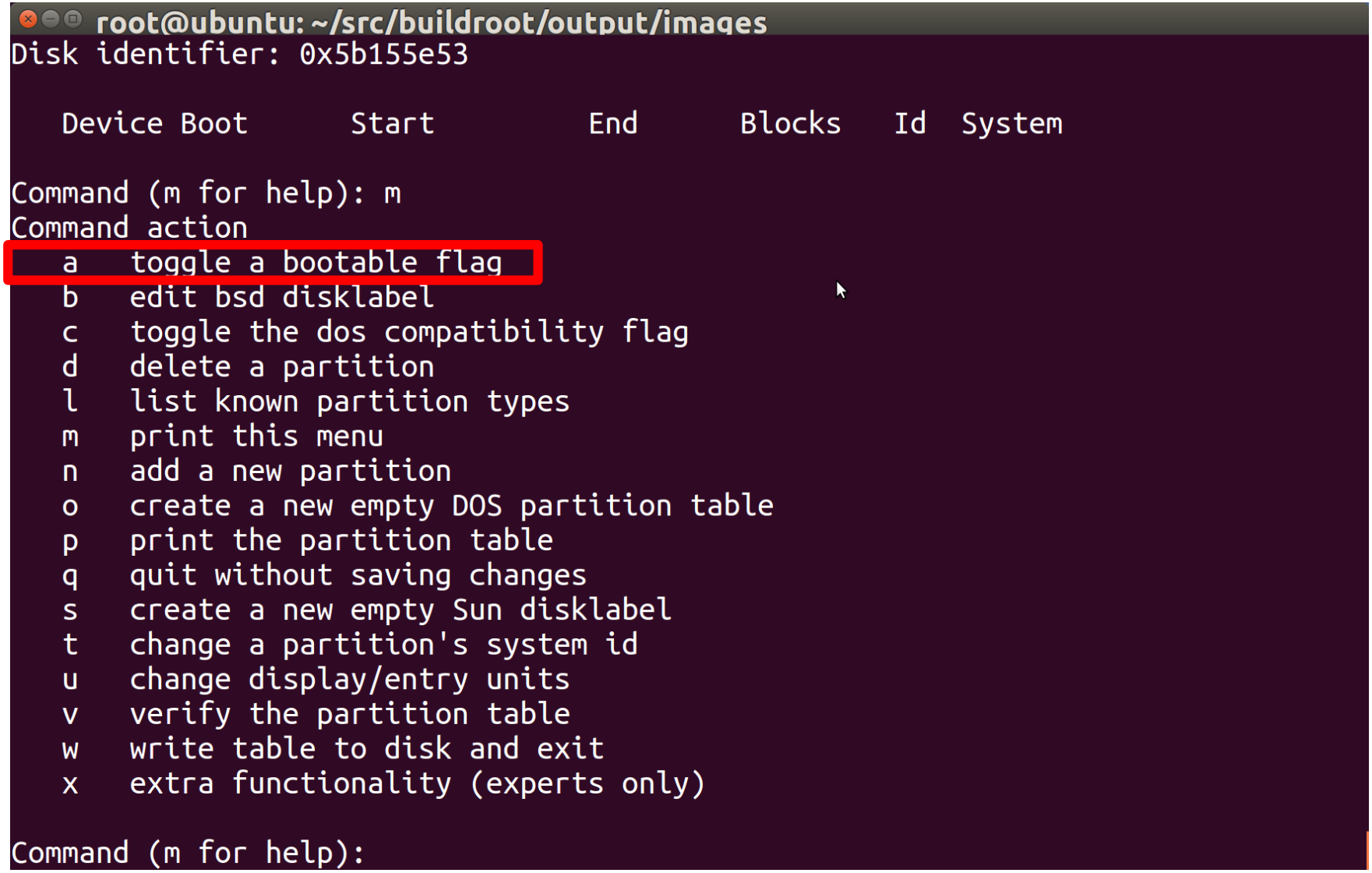
```
root@ubuntu: ~/src/buildroot/output/images
root@ubuntu:~/src/buildroot/output/images# fdisk /dev/sdd

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):
```

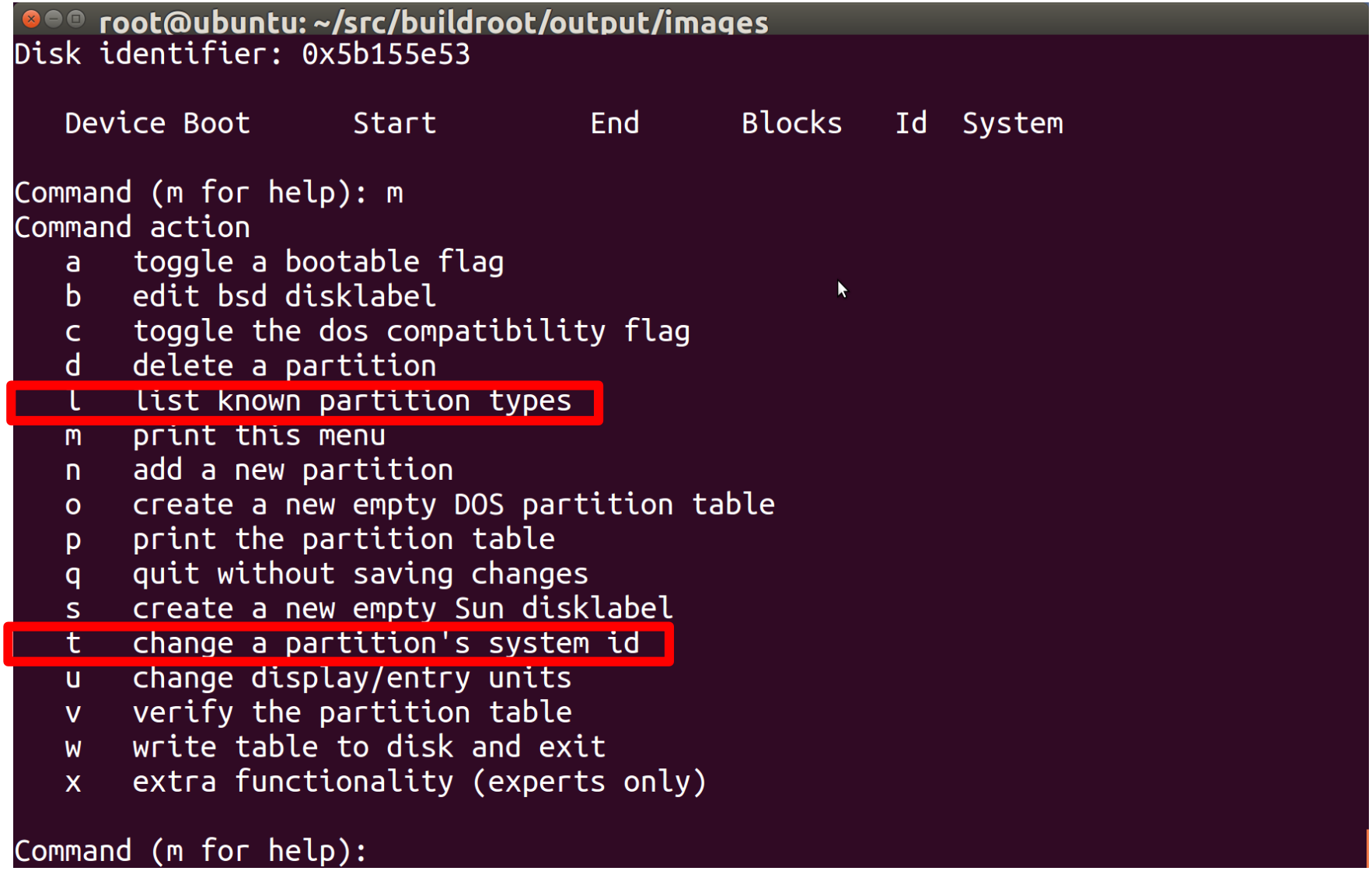
檢視目前分割狀態

```
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):
```

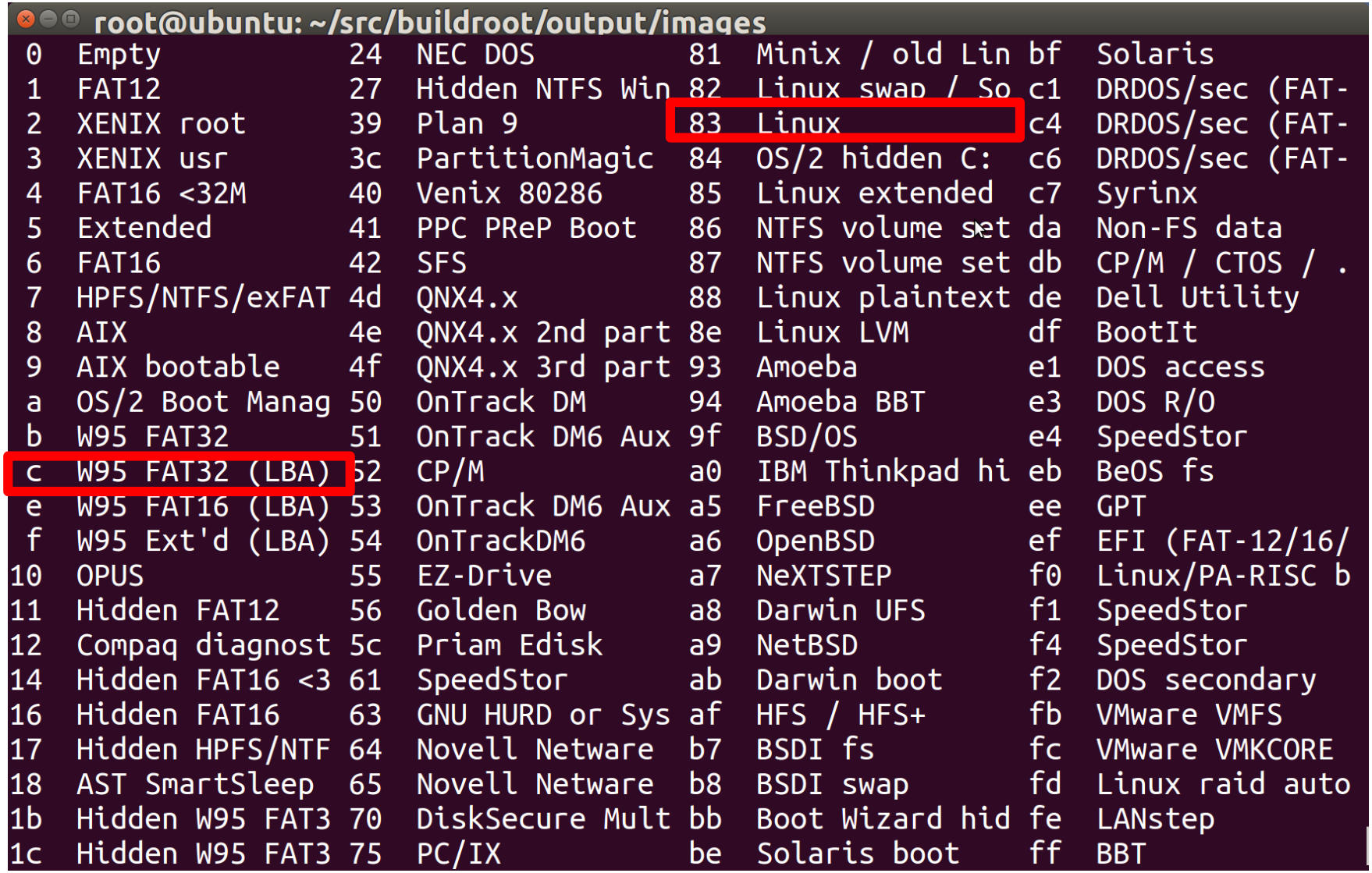

root@ubuntu: ~/src/buildroot/output/images
Disk identifier: 0x5b155e53
Device Boot Start End Blocks Id System
Command (m for help): m
Command action
a toggle a bootable flag
b edit bsd disklabel
c toggle the dos compatibility flag
d delete a partition
l list known partition types
m print this menu
n 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):
```

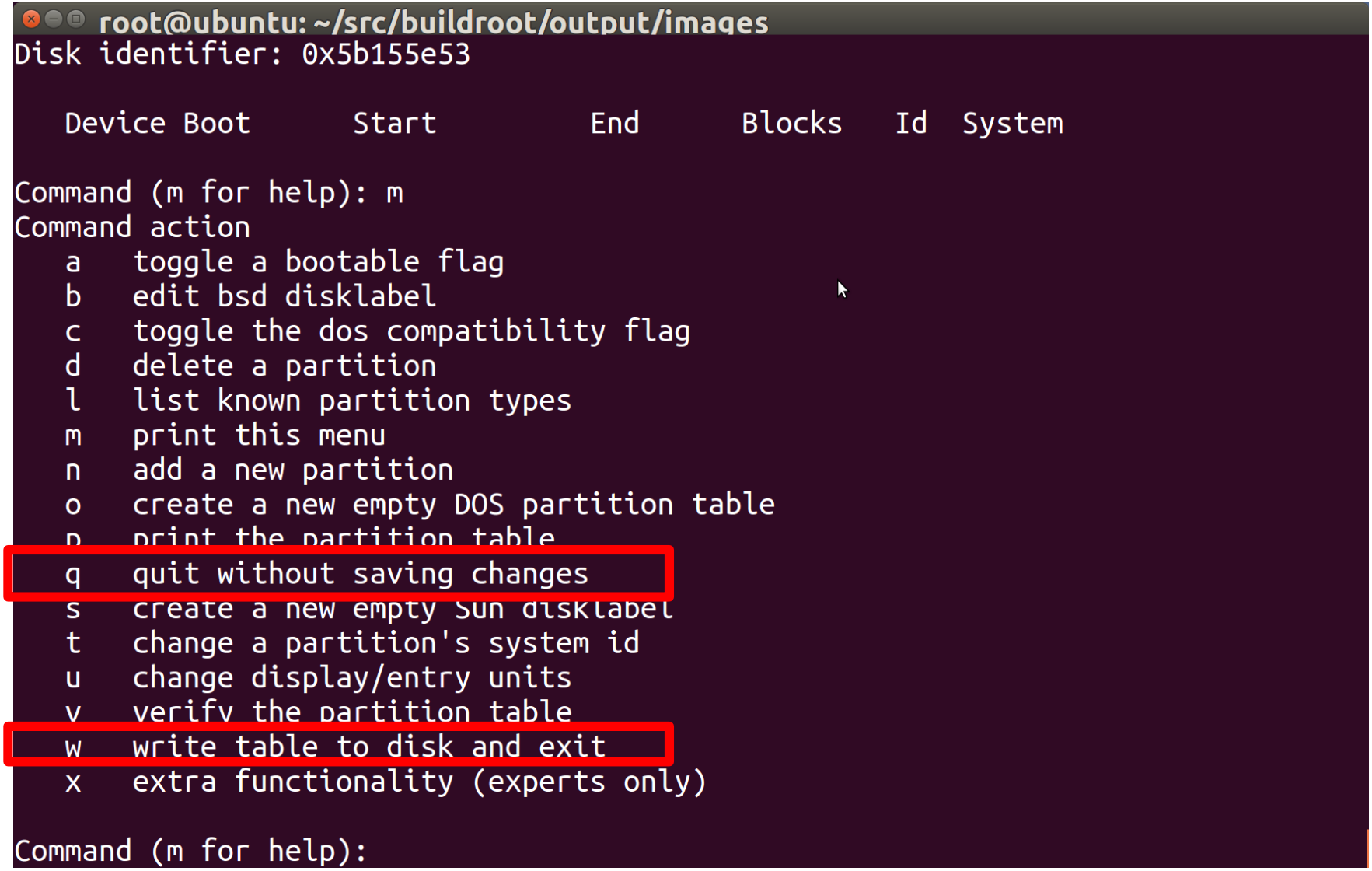

root@ubuntu: ~/src/buildroot/output/images
Disk identifier: 0x5b155e53
Device Boot Start End Blocks Id System
Command (m for help): m
Command action
a toggle a bootable flag
b edit bsd disklabel
c toggle the dos compatibility flag
d delete a partition
l list known partition types
m print this menu
n 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



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
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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):

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# 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

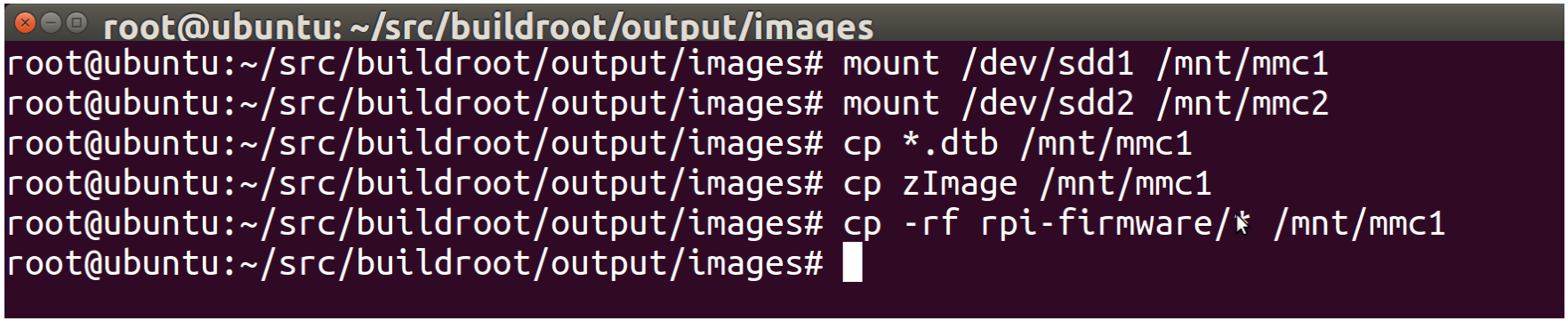
```
//Change to root user
$ sudo –s

$ mkdir /mnt/mmc1

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

Copy Files for the Partition BOOT

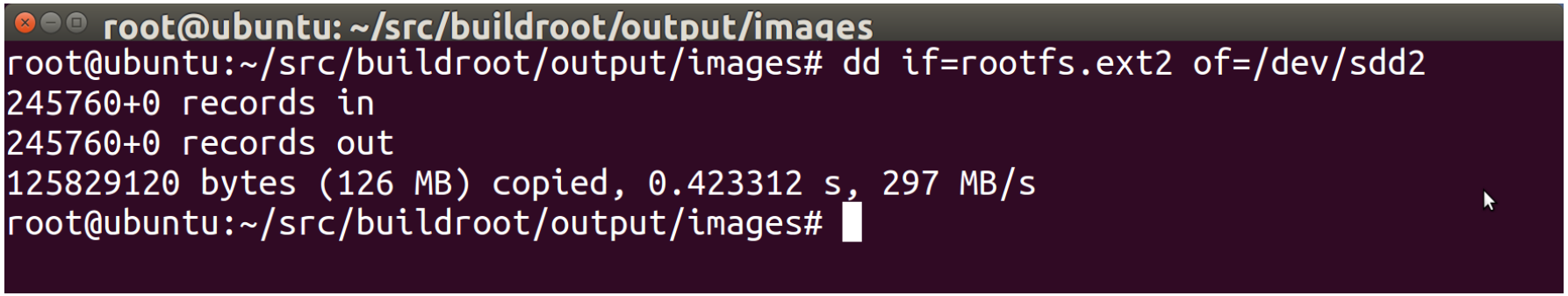
```
$ cd <buildroot目錄>/output/images/
$ cp *.dtb /mnt/mmc1
$ cp zImage /mnt/mmc1
$ cp -rf rpi-firmware/* /mnt/mmc1
```



Copy Files for the Partition filesystem

```
$ cd <buildroot目錄>/output/images/

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



Testing

```
// Umount SD card
// Change to root
$ sudo -s

$ umount /dev/sdd1
```

- 取出SD card，放入Raspberry Pi，重新開機