Technical Note

TN_146

Creating Android Images for Application Development

Version 1.1

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This document shows how to build and install the Android Operating System on the BeagleBoard –xM

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1 Introduction

This document explains how to build a working Android image for the BeagleBoard on a micro SD card. Much of this information was gleaned from the Gumstix.org website. This procedure can be be used with any small embedded Linux system. The BeagleBoard was chosen for its power and flexibility. It is also equipped with 4 USB Host ports, which makes it ideal for USB application development. Figure 1.1 shows the BeagleBoard PCB.

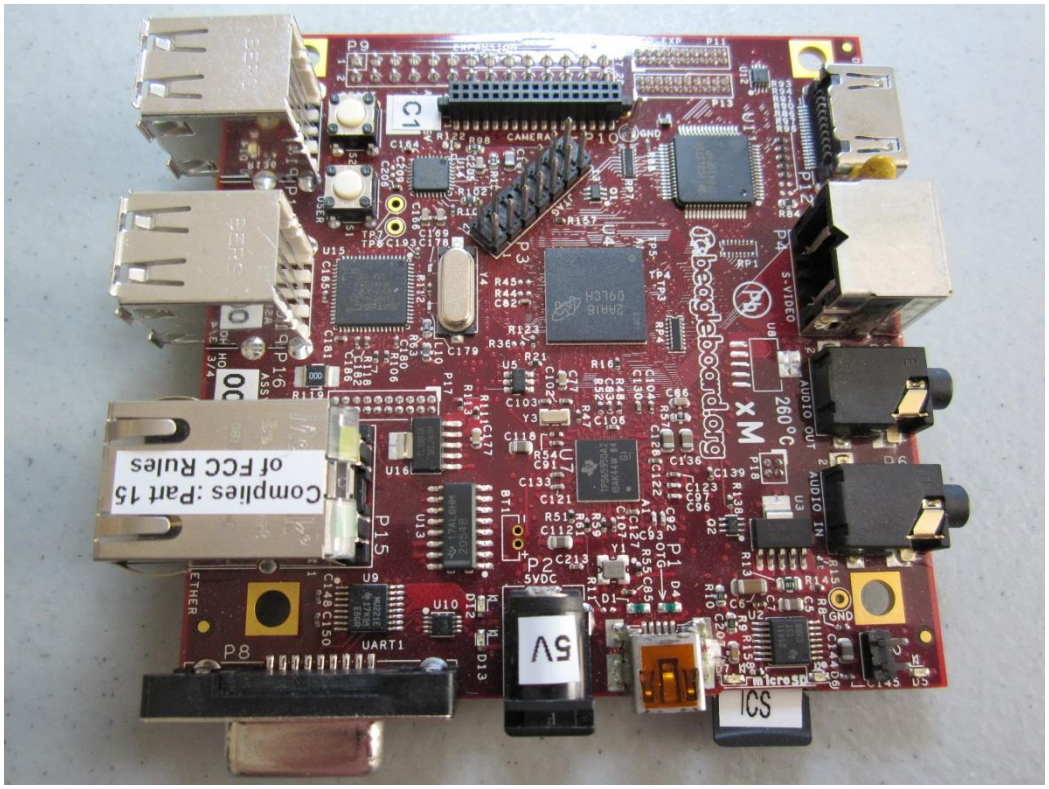

Figure 1.1 BeagleBoard XM

The image build procedure has been verified on the following versions of Android:

- Gingerbread 2.3.4
- Ice Cream Sandwich 4.0.1
- Jelly Bean 4.1.1

1.1 Hardware and Software Required

- 2 GB Class 4 micro SD card (SDSC) with full size SD card adapter.
- Linux PC running Ubuntu 11.10 or Linux Mint 14, equipped with SD card reader. (older laptop with built in SD card reader is ideal)
- Make sure **dosfsutils** is installed on Linux PC.
- Android image source code.
- BeagleBoard-XM development board
- 5V, 2.0A power supply

1.2 Get Android Source Files

Download the BeagleBoard-xM Ice Cream Sandwich image from code.google.com

Extract the files into your target directory.

2 Prepare Micro SD Card

Insert the micro SD card into the Linux PC's card reader slot. Open a Linux terminal window. Use the Linux **df** command to determine the device name of the micro SD Card. Before starting, you will need to unmount any mounted partition of the attached micro SD card:

sudo umount /dev/mmcblk0p1 (SD card name may be different on your Linux machine)

2.1 Calculate Card Size

A specific format of the micro SD card is needed to make micro SD cards work with the Android boot file. Find the card size in the first line of the **fdisk** command (there will be many lines returned by this command) You will calculate the number of "cylinders" for your specific micro SD card.

```
sudo fdisk –l /dev/mmcblk0
```

(returns the following……)

```
Disk /dev/mmcblk0:    1990 MB,  1990197248 bytes
```

Divide the card size in bytes by 255 heads, 63 sectors, and 512 bytes per sectors and round down to the nearest integer, ie:

1990197248/255/63/512 = 241.96 = 241 cylinders

2.2 Partition the Card

The Android image needs at least two partitions: a FAT partition to store the boot files and a Linux partition to store the root file system. To start, clean up any existing partition data:

```
sudo dd if=/dev/zero of=/dev/mmcblk0 bs=1024 count=1024
```

Use the **sfdisk** tools to start the partitioning process:

```
sudo  sfdisk --force –D –uS –H 255 –S 63 –C 241 /dev/mmcblk0
```

In this case, -C refers to the number of cylinders calculated in the previous step. You should see the **sfdisk>** prompt appear. At this prompt, enter the following:

```
sfdisk>128,130944,0x0C,* <ret>
```

```
sfdisk> 1310722,,,-   (press return 3 more times)
```

The micro SD card will now have the following partitions:

```
sudo fdisk -l /dev/mmcblk0

Disk /dev/mmcblk0: 1990 MB, 1990197248 bytes
4 heads, 16 sectors/track, 60736 cylinders, total 3887104 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: 0x00000000

        Device Boot      Start         End      Blocks   Id  System
/dev/mmcblk0p1   *         128      131071       65472    c  W95 FAT32 (LBA)
/dev/mmcblk0p2          131072     3887103     1878016   83  Linux
/dev/mmcblk0p3               1         127          63+  83  Linux
```

Figure 2.1 Micro SD Card Partitions

2.3 Format the Partitions

Next, format the first partition as a FAT file system. (The –n argument names this partition boot)

```
sudo mkfs.vfat –F 32 /dev/mmcblk0p1 –n boot
```

Format the second partition for Linux. (The –L argument gives it the label rootfs).

```
sudo mke2fs –j –L  rootfs /dev/mmcblk0p2
```

(This command will take about one minute to finish)

Mount the partitions:

```
sudo mkdir /media/boot
sudo mkdir /media/rootfs
sudo mount –t vfat /dev/mmcblk0p1 /media/boot
sudo mount –t ext3 /dev/mmcblk0p2 /media/rootfs
```

2.4 Install the Boot Files

The last step is to copy the Android boot files and root filesystem that will run on the BeagleBoard.

Point your terminal window to the directory containing the Android BeagleBoard source files and directories. The working directory will contain:

```
Boot_Images
Filesystem
Media_Clips
Mkmmc.android.sh
README.txt
```

Only the Boot_Images and Filesystem directories will be used to get basic Android functionality on the Beagleboard. You can ignore the README file and shell script (.sh) file.

The MLO (x-loader binary) file must be copied first. Go to the Boot_Images directory:

```
sudo cp MLO  /media/boot/MLO
```

Copy the u-boot bootloader:

```
sudo cp u-boot.bin /media/boot/u-boot.bin
```

Copy the kernel binary image:

```
sudo cp uImage /media/boot/uImage
```

Copy the boot script:

```
sudo cp boot.scr  /media/boot/boot.scr
```

Next, go to the File system directory and extract the compressed root file system onto the second partition. (This file may have a different name, but it will be a compressed file.)

```
sudo tar xavf rootfs.tar.bz2 –C /media/rootfs
```

(This will take about a minute to extract and copy all of the files to the micro SD card)

Run the Sync command to make sure all files are written to micro SD Card:

```
sync
```

Unmount the partitions and the card is ready to load on the BeagleBoard:

```
sudo umount /media/boot
```

```
sudo umount /media/rootfs
```

3 Installing the Micro SD Card on the BeagleBoard

Make sure the monitor, mouse and keyboard are connected. The monitor must be powered up before applying power to the Beagleboard. Insert the micro SD card into the micro SD socket next to the micro USB connector (refer to Figure 1.1). After these steps are completed, you can now apply 5V power to the BeagleBoard. The Android OS will begin to boot.

On first power up, many compressed files on the micro SD card will be uncompressed during boot up. This will take time. It has been found that pressing the reset button, waiting for a minute, and then removing and re-installing the micro SD card will get Android to boot up properly. On first boot, the initial Android screens will take some time to appear. Subsequent boots will load much faster.

4 Conclusion

With the Android image installed, you now have the capability to develop and test Android applications on the Beagleboard. You will need to have the Android SDK and Eclipse IDE installed on your Linux or Windows PC. The use of these tools is beyond the scope of this document.

By following the procedure in TN_134, you can install the FTDI D2XX driver and demo code which will allow you to demonstrate and develop Android to USB communication.

A key advantage of the Beagleboard as a development platform is the straightforward process to rebuild the Android image if it becomes corrupted during application development.

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Appendix A – References

Document References

TN_134 FTDI Android D2XX Driver

Android downloads for BeagleBoard and other devices

Gumstix utilities

Acronyms and Abbreviations

Terms	Description
Boot Partition	In Android, this partition contains the kernel image and boot scripts.
EXT File System	Extended File System, designed for use with Linux operating systems.
FAT File System	File Allocation Table file system, still used on solid state memory cards.
File System Partition	In Android, the file system partition contains the entire operating system, other than the kernel. This includes the Android user interface and all the system applications that come pre-installed on the device.
Kernel	In operating systems, the kernel serves as a bridge between application programs and the actual hardware (CPU, memory, IO devices).
OS Image	An OS image is a file that contains the OS, the executables, and any data files that are related to application programs.
SDSC Card	Secure Digital Standard Capacity card, up to 2 GB capacity.

Appendix B – List of Tables & Figures

List of Figures

Appendix C – Revision History

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Product Page: http://www.ftdichip.com/Android

Document Feedback: Send Feedback

Revision	Changes	Date
1.0	Initial Release – never published	2013-01-28
1.1	Update OS versions supported	29/04/02