ECEN5013: Advanced Practical Embedded Software Design

TFTP NETBOOT of kernel with U-Boot for Beaglebone Green

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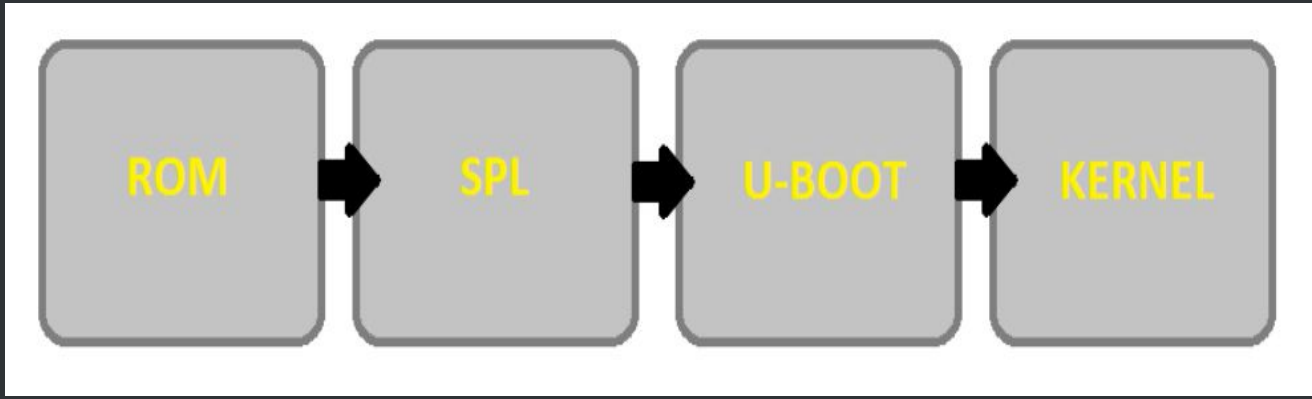
Overview

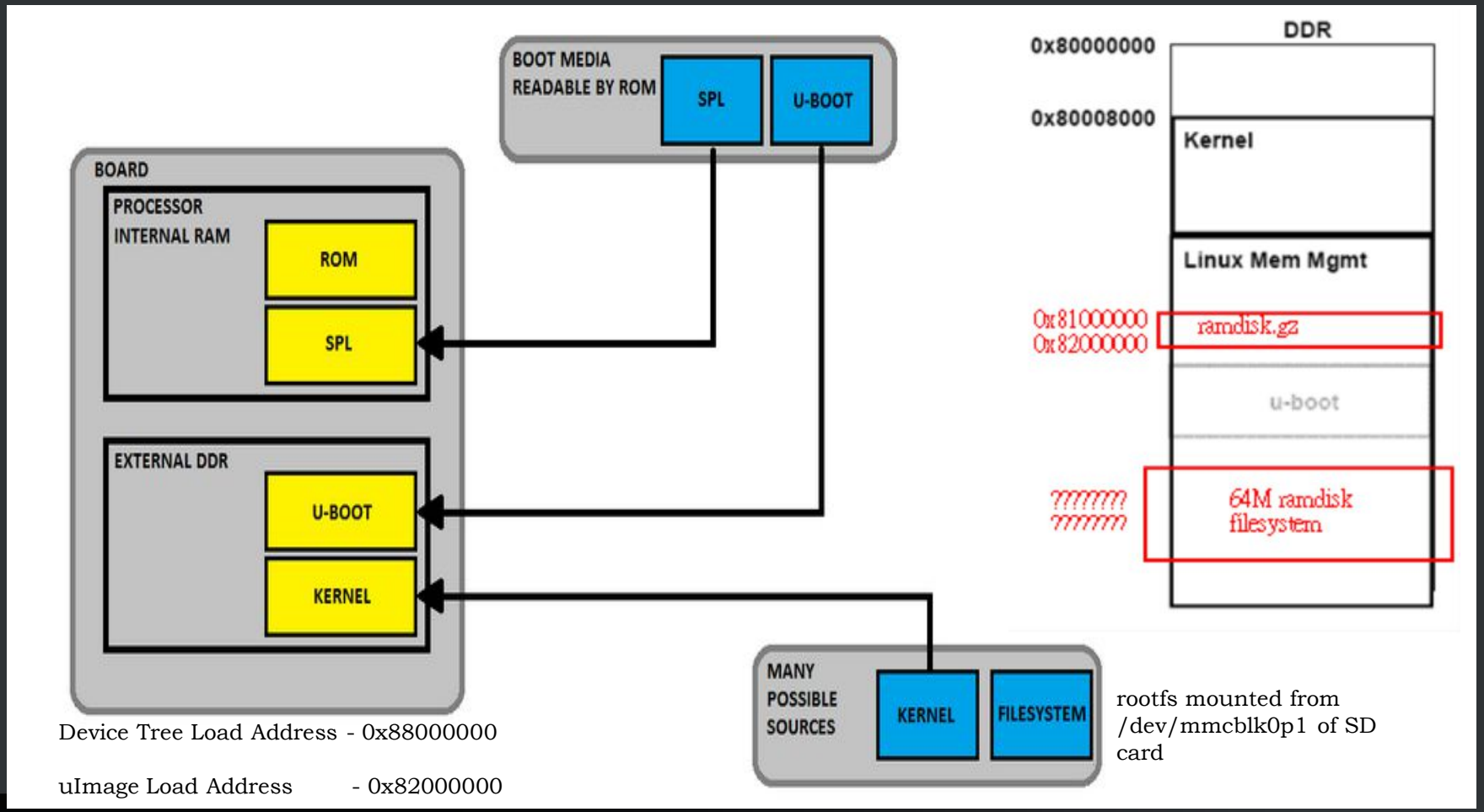
- AM335x Booting process stages
- uImage Generation
- Loading the Kernel and .dtb
- Generating and Mounting RFS
- Loading the RFS

AM335x Booting process stages

- Internal RAM = 128kB
- Four distinct Boot process stages - ROM->SPL->U-boot->Linux Kernel
- ROM – Run on device start up and Power on reset, set up device for Stage 2 bootloader
- SPL – First stage of U-boot, sets up boot process for Stage 3 bootloader
- U-boot – provides control over setting up kernel environment through commands such as setenv
- Linux Kernel - uImage is the kernel image wrapped with header info that describes the kernel

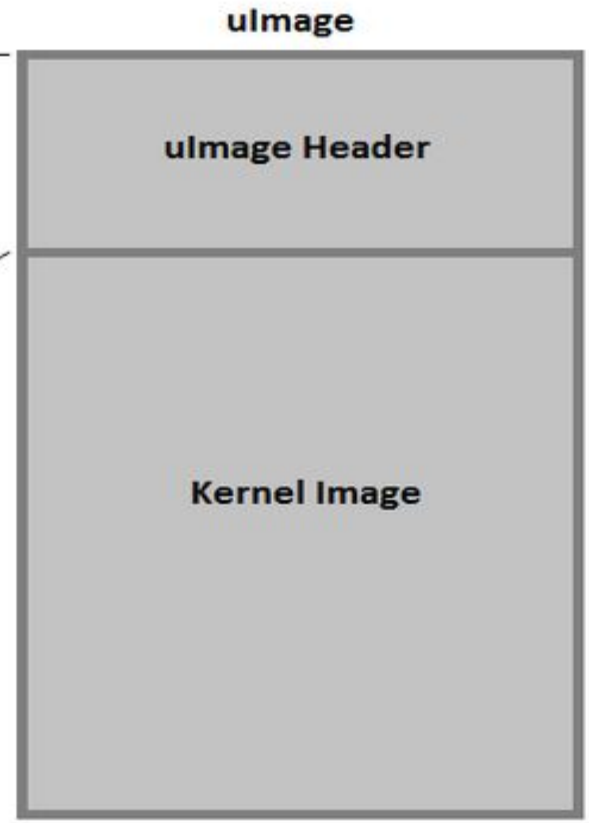


Continued….



U-boot: boot command output

```
## Booting kernel from Legacy Image at 82000000 ...
   Image Name:   Linux-4.4.91
   Created:      2017-10-19   7:29:05 UTC
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    8881144 Bytes = 8.5 MiB
   Load Address: 82000000
   Entry Point:  82000000
   Verifying Checksum ... OK
## Flattened Device Tree blob at 88000000
   Booting using the fdt blob at 0x88000000
   Loading Kernel Image ... OK
   Loading Device Tree to 8ffef000, end 8ffff521 ... OK
```



uImage Generation

Steps:

- Install gcc-arm-linuxeabi, lzop and libssl-dev to build U-boot
- wget ftp://ftp.denx.de/pub/u-boot/u-boot-latest.tar.bz2
- tar -xjf u-boot-latest.tar.bz2
- cd into u-boot directory
- make sandbox_defconfig tools-only
- sudo install tools/mkimage /usr/local/bin
- git clone git://github.com/beagleboard/linux.git
- cd linux
- git checkout 4.4
- make ARCH=arm CROSS_COMPILE=arm-linux-gnueabi- bb.org_defconfig
- make ARCH=arm CROSS_COMPILE=arm-linux-gnueabi- -j4
- make ARCH=arm CROSS_COMPILE=arm-linux-gnueabi- uImage dtbs LOADADDR=0x82000000 -j4

Loading the Kernel and .dtb

Steps:

- setenv autoload no
- setenv ipaddr 192.168.7.2
- setenv serverip 192.168.7.3
- setenv gatewayip 192.168.7.3
- setenv bootfile uImage
- tftp 0x88000000 am335x-bonegreen.dtb
- tftp 0x82000000 uImage

Here, we set a static IP for a TFTP Server to 192.168.7.3, BBG address to 192.168.7.2 and gateway to 192.168.7.3. The Ethernet is connected over USB

Generating and mounting RFS

On the Linux Machine:

- wget -c https://rcn-ee.com/rootfs/eewiki/minfs/ubuntu-16.04.3-minimal-armhf-2017-10-07.tar.xz
- mkdir trial
- tar -xvf ubuntu-16.04.3-minimal-armhf-2017-10-07.tar.xz -C ~/u-boot-2017.09/trial/
- sudo mount /dev/mmcblk0p1 rootfs/
- tar -xvf ~/u-boot-2017.09/trial/ubuntu-16.04.3-minimal-armhf-2017-10-07/armhf-rootfs-ubuntu-xenial.tar -C rootfs/
- make ARCH=arm CROSS_COMPILE=arm-linux-gnueabi- INSTALL_MOD_PATH=~/u-boot-2017.09/linux/kernel/rootfs/ modules_install
- sudo umount rootfs

Loading the RFS

On Tera Term:

- setenv bootargs console=ttyO0,115200n8 root=/dev/mmcblk0p1 rw rootfstype=ext4 init=/sbin/init rootwait ip=192.168.7.2
- bootm 0x82000000 – 0x88000000

Voila! And it boots!

References

- http://processors.wiki.ti.com/index.php/The_Boot_Process
- http://processors.wiki.ti.com/images/d/d4/BOOT_PROCESS_STAGES.png
- http://processors.wiki.ti.com/images/1/13/UImage.png
- Professor Alex Fosdick's Slides for template