Working with U-boot S4SK

Rev. 1.00
April/16/2024

This document describes overview about U-Boot for S4SK

References

- Embedded Linux Projects Using Yocto Project Cookbook.pdf
- Porting U-Boot and Linux on new ARM boards: a step-by-step guide

Rev.	Modified points	Approver	Checker	Author
1.0	Newly created	-- (April/--/2024)	-- (April/--/2024)	Nguyen Tran (April/16/2024)

Table of Contents

1. Building the U-boot approach

The build machine in this case is: **192.168.2.25**

The host machine of S4SK in this case is: **192.168.2.23**

1.1 External source development using Yocto

We will use the Yocto build system from a local directory by cloning a local copy of the source used in the reference design and configuring our project to use it as an external source. **We will then develop from it, extract the patches, and add them to a bbappend file on our BSP layer**

1. *Find the upstream Git repository of u-boot S4SK:*

2. *Clone source code:*

Build machine terminal:

```
$ git clone https://github.com/renesas-rcar/u-boot.git -b v2020.10/rcar-5.1.1.rc9.2
```

3. *Config local.conf file*

To configure our *conf/local.conf* file to work from the cloned source, modify it as follows:

```
INHERIT += "externalsrc"
EXTERNALSRC:pn-myrecipe = "/path/to/my/source/tree"
EXTERNALSRC_BUILD:pn-myrecipe = "/path/to/my/source/tree"
```

Please refer **externalsrc.bbclass** file in Yocto source tree to get more information.

Apply to S4SK board:

local.conf file:

INHERIT += "externalsrc"

EXTERNALSRC_pn-u-boot = "/home/nguyen.tran-van/yocto-rcar/build/ext-src/u-boot"

EXTERNALSRC_BUILD_pn-u-boot = "/home/nguyen.tran-van/yocto-rcar/build/ext-src/uboot-build"

4. *Build.*

Build machine terminal:

```
$ bitbake virtual/bootloader
```

We will see: **NOTE: u-boot: compiling from external source tree**

The newly compiled U-Boot image is available under build path: */home/nguyen.tran-van/yocto-rcar/build/ext-src/uboot-build and /tmp/deploy/images/s4sk/ (in this case)*

This approach can be applied to any recipes like Linux, ATF, etc if we need to custom. (Recommended in development phase)

1.2 Working directory development using Yocto

A typical workflow when working on a small modification would be:

1. Start the U-Boot package compilation from scratch:

Build machine terminal:

```
$ bitbake -c cleanall virtual/bootloader
```

This will erase the build folder, shared state cache, and downloaded package source.

2. Start a development shell:

Build machine terminal:

```
$ bitbake -c devshell virtual/bootloader
```

This will fetch, unpack, and patch the U-Boot sources and spawn a new shell with the environment ready for U-Boot compilation. The new shell will change to the U-Boot build directory, which contains a local Git repository.

3. Perform your modifications on the local Git repository.

4. Leave the devshell open and use a different terminal to compile the source without erasing our modifications:

Build machine terminal:

```
$ bitbake -C compile virtual/bootloader
```

Note the capital C. This invokes the compile task but also all the tasks that follow it.
The newly compiled U-Boot image is available under /tmp/deploy/images/s4sk/

1.3 External development

1. Clone the source u-boot code that is supported for S4SK board:

Build machine terminal:

```
$ git clone https://github.com/renesas-rcar/u-boot.git -b v2020.10/rcar-5.1.1.rc9.2
```

2. Build:

Build machine terminal:

```
$ cd u-boot
# Use a cross compile by your choice. In this case use aarch64-poky-linux-
$ make ARCH=arm CROSS_COMPILE=aarch64-poky-linux- distclean -j$nproc
$ make ARCH=arm CROSS_COMPILE=aarch64-poky-linux- r8a779f0_s4sk_defconfig -j$nproc
$ make ARCH=arm CROSS_COMPILE=aarch64-poky-linux- -j$nproc
# We will get u-boot-elf.srec file after build success. Let rename that is u-boot-elf-s4sk.srec for burn.
$ cp u-boot-elf.srec u-boot-elf-s4sk.srec
```

2. How to update the U-boot for S4SK

Debug interface of S4SK:

Host terminal:

```
# Open /dev/ttyUSB0 use picocom
$ picocom -b 921600 -d 8 -y n -p 1 -f n /dev/ttyUSB0
# Exit picocom use : Ctrl A + Ctrl X
```

Note: Exit picocom before it burns.

How to flash/update by using "Renesas BSP ROM Writer"

Download

Host terminal:

```
$ git clone https://github.com/morimoto/renesas-bsp-rom-writer
```

Download ICUMX loader and copy the built binaries (u-boot-elf-s4sk.srec, tee-s4sk.srec and bl31-s4sk.srec)

Link

Flashing loader

Host terminal:

```
$ cd ${PATH}/ICUMX_Loader_and_Flashwriter_Package_for_R-Car_S4_Starter_Kit_SDKv3.16.xx/
$ ${renesas-bsp-rom-writer}/board/s4_sk/linux/sdk_writer
```

Apply to the S4SK:

1. Copy u-boot binary file that is used to burn to **ICUMX_Loader_and_Flashwriter_Package_for_R-Car_S4_Starter_Kit_SDKv3.16.0** folder of host machine of S4SK board:

Build machine terminal:

```
$ scp u-boot-elf-s4sk.srec <username>@192.168.2.23:/path/to/ICUMX_Loader_and_Flashwriter_Package_for_R-Car_S4_Starter_Kit_SDKv3.16.0
```

2. Run burn script and follow steps for burn proceed:

Host terminal:

```
$ cd /path/to/ICUMX_Loader_and_Flashwriter_Package_for_R-Car_S4_Starter_Kit_SDKv3.16.0
$ ../renesas-bsp-rom-writer/board/s4_sk/linux/sdk_writer
```

```
+-----------+
OK? (y/n): y
```

3. Switch board to burn mode

Host terminal:

```
$ cpld-control-1.8.11082022 -w S4SK 276697 0x0008 0x00000080804922BF 0x0024 0x01
```

```
+---------------------------------+
OK? (y/n): n
```

4. Switch board to boot mode:

Host terminal:

```
$ cpld-control-1.8.11082022 -w S4SK 276697 0x0008 0x00000080804922A9 0x0024 0x01
```

How to reset board:

Host terminal:

```
$ cpld-control-1.8.11082022 -w S4SK 276697 0x0024 1
```

3. Working with U-Boot S4SK

3.1 List of working files with S4SK

No	Path	Remarks
1	u-boot/arch/arm/dts/r8a779f0.dtsi	R-Car S4 (R8A779F0) SoC specific device tree file
2	u-boot/arch/arm/dts/r8a779f0-s4sk.dts	S4SK board specific device tree file
3	u-boot/board/renesas/s4sk/s4sk.c	S4SK board support.
4	u-boot/configs/r8a779f0_s4sk_defconfig	S4SK defconfig file
5	u-boot/include/configs/rcar-gen4-common.h	S4SK board header file. This file is R-Car Gen4 common configuration file.

3.2 Explore file specific

Explore the S4SK defconfig file: r8a779f0_s4sk_defconfig

- CONFIG_BOOTARGS: This config support config default u-boot environment variable **bootargs.**

Example: CONFIG_BOOTARGS="rw root=/dev/mmcblk0p1 rootwait ignore_loglevel cma=560M"

It set bootargs =rw root=/dev/mmcblk0p1 rootwait ignore_loglevel cma=560M

With:

  - Rootfs located in mmc0, partition 1 (SD Card interface of S4SK), read/write file system.
  - Rootwait: wait for rootfs availble then mount it
  - CMA memory allocation is 560MB, this memory region is used to GPU, VPU or etc. Usually, it configured around 25% RAM size, also depending on application.

- CONFIG_DEFAULT_FDT_FILE: This config supports config default device tree that we want to use.

Example: CONFIG_DEFAULT_FDT_FILE="r8a779f0-s4sk.dtb"

It set default dtb file is r8a779f0-s4sk.dtb

- CONFIG_CMD_BOOTZ=y: This config support for boot zImage
- CONFIG_CMD_MMC=y: This config support for mmc boot
- CONFIG_CMD_PING=y: This config enables ping command
- CONFIG_CMD_EXT4=y: This config enables ext4load command
- CONFIG_CMD_FAT=y: This config enables fatload command
- CONFIG_ENV_IS_IN_SPI_FLASH=y: This config direct u-boot environment variable store in FLASH (in case of S4SK)
- CONFIG_SYS_PROMPT: This config support for sys-prompt

Example: CONFIG_SYS_PROMPT="U-Boot S4SK # "

U-boot S4SK terminal:

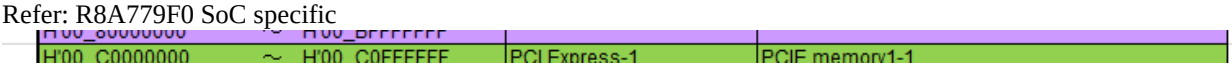
- CONFIG_CMD_TFTPBOOT=y: This config enables tftpboot command
- CONFIG_CMD_PXE=y: This config enables pxe boot support

More information can be referring documentation in u-boot source tree:

- README
- doc

Explore the DRAM of S4SK:

Refer: R8A779F0 SoC specific



Base address of SDRAM is 0x40000000

Refer memory node in S4SK device tree file: r8a779f0-s4sk.dts

This describes 2 bank RAM with total size 3456MB

Bank1: Base address is 0x48000000 and size is 1408MB (58000000 in hex)

Bank2: Base address = 0x480000000 and size is 2048MB (80000000 in hex)

Explore the board header file: rcar-gen4-common.h

Let concentrate on memory config:

SDRAM_BASE is 0x40000000 but reserve first 128MB for secure area, so Rcar's DRAM memory always starts at 0x48000000, and u-boot shall have relocated itself to higher in memory by the time this value is used.
The default kernel load address is set to a 256MB offset (CONFIG_SYS_LOAD_ADDR 0x58000000).
Note: Please do not conflict load address and bank 1 RAM size value that defined at memory node

We can use region 0x48000000 – 0x58000000 (256MB) for device tree, device tree overlay, script, init ramdisk, or etc (fdtaddr, dtboaddr, pxefile_addr_r, scriptaddr, initrd_addr, splashimage, etc)

3.3 Define u-boot environment variable for S4SK

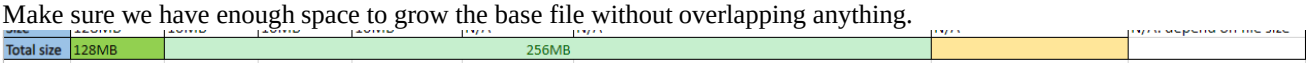
We can define FDT at 0x48000000 or above (0x48000000 – 0x58000000 = 256MB)
fdtaddr=0x48000000
fdt_addr_r=0x48000000

We can define DTBO at 0x49000000 or above (0x48000000 - 0x49000000 = 16MB)
dtboaddr=0x49000000
fdtoverlay_addr_r=0x49000000

We can define pxefile_addr_r at 0x4A000000 or above (0x49000000 - 4A0000000 = 16MB)
pxefile_addr_r=0x4A000000

We can define scriptaddr at 0x4B000000 or above
scriptaddr=0x4B000000
We can define more if needed (initrd_addr, splashimage, etc)

Make sure we have enough space to grow the base file without overlapping anything.



Define u-boot environment variable for S4SK approach:

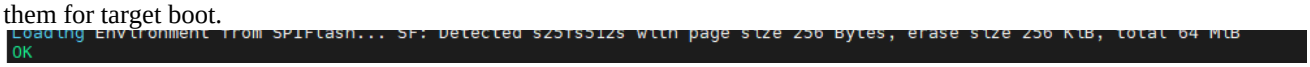
1. Define manually during boot time

U-boot S4SK terminal:

```
$ setenv fdt_addr_r 0x48000000
$ setenv fdtaddr 0x48000000
```

```
$ setenv dtboaddr 0x49000000
$ setenv fdtoverlay_addr_r 0x49000000
$ setenv pxefile_addr_r 0x4A000000
$ setenv kernel_addr_r 0x58000000
$ setenv loadaddr 0x58000000
$ saveenv
```

Some env variables are stored in FLASH of S4SK, after power on reset, u-boot loads some env form FLASH and uses them for target boot.



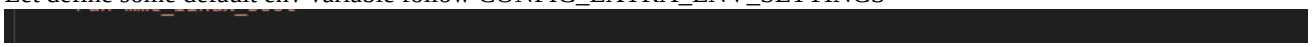
2. Define as default env variable

Open file **rcar-gen4-common.h** in u-boot S4SK source tree:

```
"tftp 0x48000000 Image-"CONFIG_DEFAULT_FDT_FILE"; " \
"booti 0x48080000 - 0x48000000"
```

This is origin default env form Renesas.

Let define some default env variable follow CONFIG_EXTRA_ENV_SETTINGS



We can define more env variables if needed.

We also define default **bootcmd** variable follow CONFIG_BOOTCOMMAND

In this case, **bootcmd** is pxe boot, and mmc0 (S4SK SD card). If pxe boot failed, u-boot trying to boot next command is mmc0.

To reset default env we use command:

U-boot S4SK terminal:

```
$ env default -a
```

Default env available is some env that defined at CONFIG_EXTRA_ENV_SETTINGS

Use **bdinfo** command in u-boot to display information of board:

Enable this command if u-boot not yet built-in: CONFIG_CMD_BDI=y

We can easily see more information about our board.