R-Car Gen3

For system evaluation board

Performance evaluation

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Contents

1. Purpose

1.1. Common background and purpose to performance assessment

- A standard bench mark is prepared beforehand. (system performance that includes H/W and S/W of QoS setting etc.)
  - ・Man-hour reduction on customer side by prior presentation to customer of bench mark
  - ・Unification of bench mark presented to customer and reduction in REL support man-hour
- The in-vehicle youth case can be examined beforehand, and it proposes a new index.
  - ・A current bench mark result is not suitable for the realities in the in-vehicle youth case. The customer's LSI selection is facilitated.
  - ・Quantification of REL strong point (The domination of R-Car is clarified to the other companies).
- It feeds back to NextGen the extraction of the problem of the Gen3 generation.
  - ・The corrective strategy is extracted and fed back the bottleneck ..current performance.. grasp.

1.2. Purpose of performance evaluation of uptime

It aims at the bottleneck that is the part where it takes time in the boot sequence in the bench mark result and it aims to investigate, to investigate the cause, and to improve the performance.

The performance evaluation scope that this specifications target is shown below.

- Object OS

Table one-list of a couple of elephant OS

No	OS name	Remarks
1	Linux	Priority
2	Integrity	Adjustment at time
3	Android	Adjustment at time
4	Virtualization (Linux + Integrity)	Adjustment at time

- Object device: R-CarGen3 (R-CarH3/R-CarM3) Salvator-X
- Object performance item: System performance in in-vehicle youth case (uptime)
  - Display Opening animation display from ACC power supply ON
  - Camera display from ACC power supply ON
  - Meter cluster or Map app drawing from ACC power supply ON
  - Display Opening animation display from Resume beginning
  - Camera display from Resume beginning
  - Meter cluster or Map app drawing from Resume beginning
- Method of booting object
  - Cold boot
  - Warm boot (Suspend to RAM)

2. Schedule

Work is executed by the following schedules.

Table2-1Daily sheet

Date	Content of work	Result schedule
12/5 weeks	This specifications review (the 1st time and 12/9)	This specifications tentative versions
12/12 weeks	This specifications review (the 2nd times and 12/16)	This specifications tentative versions
12/19 weeks	This specifications review (finality and 12/21)	This specifications tentative versions
12/26 weeks	This specifications FIX version (preliminary week)	This specifications FIX version
1/2 weeks	Measurement environment construction and software installation	
1/9 weeks	Measurement environment construction and software installation	
1/16 weeks	Measuring method details examination and stamp processing mounting of time	
1/23 weeks	R-Car H3･M3 (Linux) measurement	
1/30 weeks	R-Car H3･M3 (Linux) measurement One ..measurement result middle review *(undecided)..	
2/6 weeks	Consequence analysis and consideration	
2/13 weeks	Measures that measurement point additions and are already-known are executed and the remeasuring.	
2/20 weeks	Measures that measurement point additions and are already-known are executed and the remeasuring. Alpha result summary (specifications description) Alpha result review (undecided)	
2/27 weeks	Preliminary week	Bench mark result alpha
3/6 weeks	It considers, measures are executed from the alpha result, and the remeasuring.	
3/13 weeks	Optimized bench mark result summary from result of a measurement The other companies comparison result document creation The other companies comparison result material review (undecided)	Optimized bench mark result The other companies comparison result two ..material *..
3/20 weeks	The document creation for NextGen based on the result of a measurement. Material review for NextGen (the first time and undecided)	
3/27 weeks	Material FIX version for NextGen Material review for NextGen (finality and undecided)	NextGen feedback material
It is April-. June	The flow in January - March is executed by "R-Car H3(WS2.0)(Linux)" and "R-Car H3/M3W (Integrity) (undecided Rev)".	

- 1 The measurement result middle review is done by the situation on 1/23 weeks.
- 2 The other companies result is presented from [runesasu] to the worker.

3. System requirements

3.1. Hardware list

The hardware used for the uptime measurement is as follows.

Table3-1 Hardware list

No	Category	Product	Ver	Remarks
1	Object board	R-Car H3	WS1.1	After April, WS2.0 is adjusted.
2		R-Car M3W	WS1.0	
3		R-Car M3N T.B.D		
4		R-Car E3 T.B.D		
5	PC	LinuxOS	Ubuntu 14.04	For build of Linux BSP
6	Display (LVDS monitor)	Mitsubishi Electric Corporation AA121TD01	-	For the screen display of the application program
7	Mouse	Arbitrariness	-	For USB
8	Keyboard	Arbitrariness	-	For USB
9	Cable	LVDS cable	-	
10		Audio cable	-	
11		USB2.0 cable	-	Micro-type B (male male)
12	DVD player	Panasonic DMR-BW750-K	-	For the Camera display
13	Video camera	Hitachi DZ-BD10H	-	For the measurement of time with the camera
14	Speaker	Boston BA265	-	For the audio confirmation

Moreover, the system requirements of H3/M3 is shown in Table 3-2.

Table 32 System requirements of H3/M3

Item	R-CarH3	R-CarM3
CPU core used	CA57×4 core	CA57×2 core
CPU operation frequency	1.5GHz	1.5GHz
DDR operating frequency	2400MHz	3200MHz

3.2. Software list

The software used for the uptime measurement is as follows.

Table3Three set of software list

No	Software	Version
1	R-Car Gen3 Linux BSP + 3D Graphics + Multimedia package	Yocto v2.12.31 (kernel v4.6) V2.12.0 to patch application 2017/1/E From Yocto v2.16.0 (kernel v4.9) 2017/2/B
2	Flower (Wayland sample application program)	T.B.D
3	Gst-launch 1.0 (Camera display)	T.B.D
4	Rightware KPA	T.B.D
5	Daimler Bench	T.B.D
6	OGLES2Navigation3D	T.B.D
7	Aplay (voice Wav file reproduction)	T.B.D

3.3. Software arrangement

The software arrangement is described as follows.

Table3Four set of software arrangement

No	Software	Arrangement place
1	Root file system	MMC
2	Linux kernel image	HyperFlash

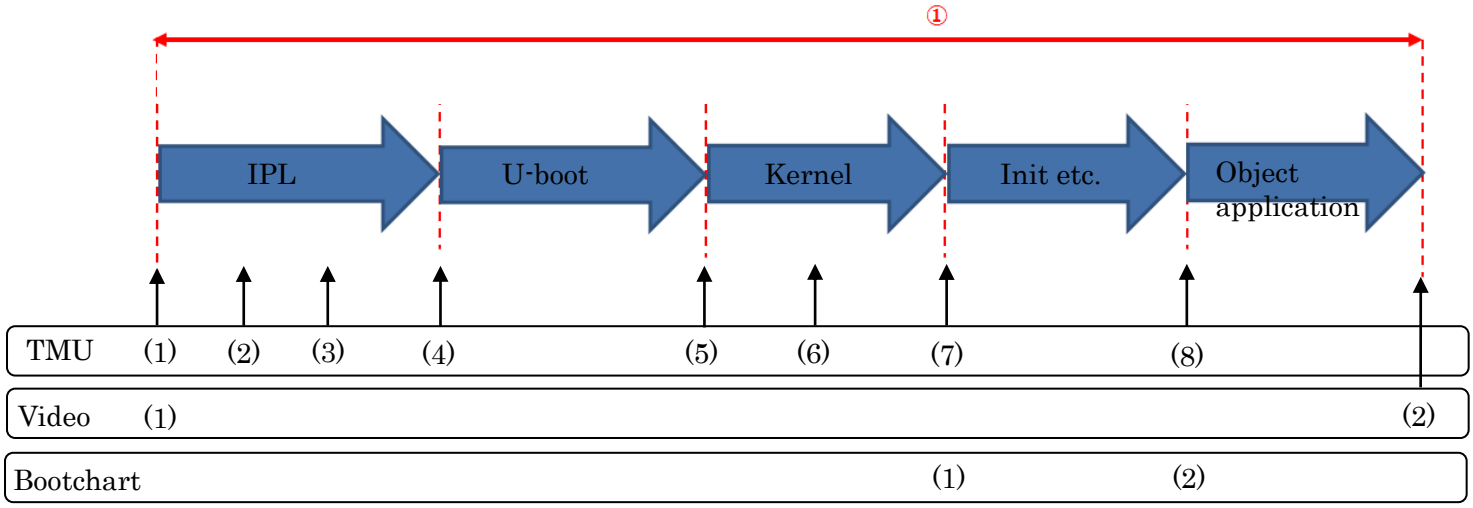
It is because of more high-speed than USB thumb drive and NFS, and the neighborhood to customer's environment as the reason to use MMC and HyperFlash.

4. Outline of operation

4.1. Cold boot

The following figures show the sequence of the cold boot.

Figure 4-1 cold boot sequence



① :Total time

The measurement of the cold boot measures time (UI reaction time) until measurement beginning - ending the measurement.
The reading point is set as follows. (Refer to 5.1 outlines for the measuring method.)

- TMU
  (1) IPL beginning
  (2) DDR initialization beginning and end
  (3) Loading beginning and end of U-boot kernel
  (4) It jumps to U-boot.
  (5) Kernel main function (main.c main())
  (6) Before the device is initialized and after
  (7) init_process
  (8) Object application program start

- Video camera
  (1) IPL beginning
  (2) Object application program display

- Bootchart
  (1) init_process
  (2) Object application program start

The measurement of time is described as follows.
- TMU
  The measurement beginning: Time when the TMU timer was started by (1) of the reading point is assumed to be beginning timing.
  The measurement end: It is assumed to be end timing that the application program of the reading point starts by (8) the object (head of main()).
  As for the measurement performance of TMU, it is ① of 5.2 details Refer to the ch setting of TMU.
- Video camera
  The measurement beginning: Time when the ACC power supply was turned on is assumed to be beginning timing.
  The measurement end: It is different depending on the object application program. Refer to paragraph 4.3-4.7 for details.
As for the frame rate of the video camera, it is T.B. D.
- Bootchart
  The measurement beginning: Time when the Init process started by (1) of the reading point is assumed to be beginning timing.
  The measurement end: It is assumed to be end timing that the application program of the reading

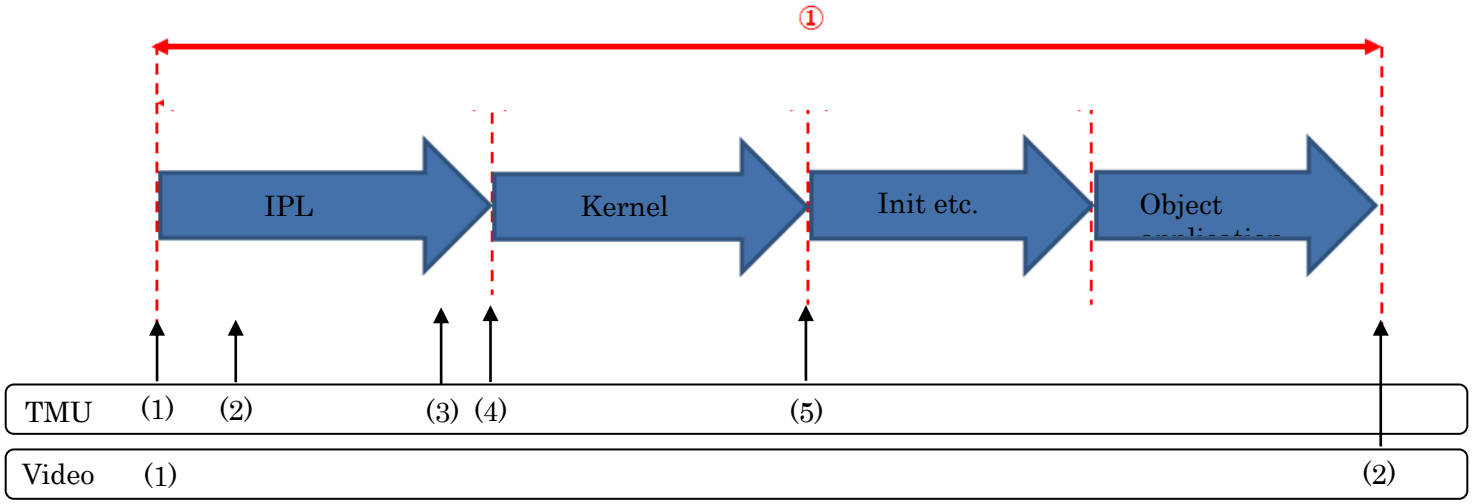
point starts by (2) the object (head of main()).

- The penguin display and the Yocto opening movie display that is the reading point of the video camera are deleted from the specification because it is not displayed because the version of Yocto became new.

4.2. Warm boot (Suspend to RAM)

The following figures show the sequence of the warm boot.

Figure 4-2 warm boot sequence



① :Total time

The measurement of the warm boot measures time (UI reaction time) until measurement beginning - ending the measurement.
The reading point is set as follows. (Refer to 5.1 outlines for the measuring method.)

- TMU
  (1) IPL beginning
  (2) DDR initialization beginning and end
  (3) It jumps to the resume position.
  (4) Before kernel resume and after
  (5) In front of resume in the process

- Video camera
  (1) IPL beginning
  (2) Object application program display

The measurement of time is described as follows.
- TMU
  The measurement beginning: Time when the TMU timer was started by (1) of the reading point is assumed to be beginning timing.
  The measurement end: It is assumed to be end timing that the application program of the reading point restarts by (5) the object (head of main()).
  As for the measurement performance of TMU, it is ① of 5.2 details Refer to the ch setting of TMU.
- Video camera
  The measurement beginning: Suspend to RAM is done, and time when Resume began is assumed to be beginning timing.
  The measurement end: It is different depending on the object application program. Refer to paragraph 4.3-4.7 for details.
  As for the frame rate of the video camera, it is T.B. D.

-
Before resume of the device which is the measurement point of TMU, (4) Before resume of the process and the measurement point are the same, it is deleted from the specification. Also, regarding the resumption of the target application, it is difficult to specify the measurement point, so it is deleted from the specification..

- As for measurement of Bootchart, since weston does not start up, it is difficult to measure when activating the target application, so it is up to the point where weston started up. Also, at warm boot time, it is difficult to measure by Bootchart, so delete from specification.

4.3. Display Opening animation display

When starting, animation is displayed to maker's logo.
It is assumed to be measurement end timing that the figure was displayed by using Wayland sample application program flower as an application program in this measurement.

4.4. Camera display

The image of the camera installed in the body such as the backing cameras is displayed in the monitor.
It is assumed to be measurement end timing that DVD player's image was displayed in the monitor by using gstreamer of the multimedia framework as an application program in this measurement.

4.5. Meter cluster or Map app drawing

Meter cluster is the one to display information on the meter etc. necessary for driving on an in-vehicle display.
The Map app drawing is to be displayed the screen of the map application program.
The following application programs are used in this measurement and each measurement end timing is as follows.
Cold boot:
・Rightware KPA … When the character named Loading Digital Cockpit and please wait is displayed
・Daimler Bench … When the emblem of the manufacturer began to be displayed
・OGLES2Navigation3D … When the character of PLEASE WAIT is displayed
Warm boot:
・Rightware KPA … When you display it again
・Daimler Bench … When you display it again
・OGLES2Navigation3D … When you display it again

4.6. Animation reproduction

When it begins to display animation by using gstreamer of the multimedia framework as an application program in this measurement, it is assumed the measurement end timing.

4.7. Audio reproduction

When it begins to output the voice by using aplay as an application program in this measurement, it is assumed the measurement end timing.

4.8. Target performance

The target performance value is indicated as follows.

Table 41 Display Opening animation display

	R-CarH3		R-CarM3	
	Cold boot	Warm boot	Cold boot	Warm boot
Flower				

Table 42 Camera display

	R-CarH3		R-CarM3	
	Cold boot	Warm boot	Cold boot	Warm boot
Gstreamer				

Table 43 Meter cluster or Map app drawing

	R-CarH3	R-CarM3

	Cold boot	Warm boot	Cold boot	Warm boot
Rightware KPA				
Daimler Bench				
OGLES2Navigation3D				

Table 44 animation reproduction

	R-CarH3		R-CarM3	
	Cold boot	Warm boot	Cold boot	Warm boot
Gstreamer				

Table 45 audio reproduction

	R-CarH3		R-CarM3	
	Cold boot	Warm boot	Cold boot	Warm boot
Aplay				

5. Measuring method

5.1. Outline

The measurement is done by the following three methods, and measured three times respectively.

(1) Time stamp with TMU timer counter
The TMU timer is begun with IPL, and to write the value of the timer in the register for which TMU is not used in each reading point, and to read, time is acquired.

(2) Video camera
It takes a picture with the video camera, and Total Time is measured from the image.

(3) Bootchart
The time of the start and the end of the automatically started process is acquired by using Bootchart. However, the object is assumed to be only a cold boot.

【 current state 】
(2), (3)After minute [ha] of [**], this it

5.2. Details

① Ch setting of TMU
The channel is 0 in R-CarH3/R-CarM3 It is to -14, and uses 0ch in this measurement.
[2] 80.2.3 of R-CarGen3_HW_Users_Manual_rev0.52E.pdf The TCNTn register is used. It is 80.2.1 to begin the timer The bit of the TCNTn register used by the TSTRn register is set up. 80.2.2 The TCORn register ..number of clocks.. counts down from initial value (0xFFFFFFFF).
80.2.4 What each clock is counted by the TPSC bit of the TCRn register is set.
The corresponding number of clocks is 8.33 because it uses 0ch this time It becomes MHz (two references).
The following tables show the one that the time that was able to be measured with resolution based on this value was requested.

Table 51 Timer Prescaler performance value

TCNT count clock	Resolution	Time that can be measured	Remarks
(input-clock)/4	0.48 μ s	It is 22 seconds of 34 minutes.	It is mounted.
(input-clock)/16	1.92 μ s	2 hours and 17 minutes	
(input-clock)/64	7.68 μ s	Nine hours and nine minutes	

It is assumed that it counts from the above-mentioned result every four clocks in this measurement because it is a value enough to measure it at 22 seconds of 34 minutes in time that prescale=4 can be measured.

② Measurement part of Counter (IPL,U-boot,Kernel,TP)
The measurement part of Counter is assumed to be each reading point of the cold boot and the warm boot.
Details of each reading point in TMU are shown as follows.

Table 52 cold boot measurement point list

Reading point	Source part
(1) IPL beginning (TMU timer start)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/

(TMU 0ch use)	git/plat/renesas/rcar/bl2_rcar_setup.c

```
380     /* Initialize CPG configuration */
381     bl2_cpg_init();
        - It adds it here.
382
383     /* Initialize the console to provide early debug support */
384     (void)console_init(0U, 0U, 0U);
```

(2) DDR initialization beginning (TMU 1ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/git/plat/renesas/rcar/bl2_rcar_setup.c Just before InitDram() in bl2_early_platform_setup()

```
519     if((modemr == MODEMR_BOOT_CPU_CA57) ||
520       (modemr == MODEMR_BOOT_CPU_CA53)) {
                - It adds it here.
521             /* Initialize SDRAM */
522             InitDram();
523
524             /* initialize QoS configration */
525             qos_init();
526     }
```

(3) DDR initialization end (TMU 2ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/git/plat/renesas/rcar/bl2_rcar_setup.c Just behind InitDram() in bl2_early_platform_setup()

```
519     if((modemr == MODEMR_BOOT_CPU_CA57) ||
520       (modemr == MODEMR_BOOT_CPU_CA53)) {
521             /* Initialize SDRAM */
522             InitDram();
                - It adds it here.
523
524             /* initialize QoS configration */
525             qos_init();
526     }
```

(4) Loading beginning of U-boot kernel (TMU 4ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/git/bl2/bl2_main.c Load_bl33() in bl2_main()

```
249
        - It adds it here.
250     e = load_bl33(bl2_to_bl31_params);
251     if (e) {
252             ERROR("Failed to load BL3-3 (%i)¥n", e);
253             panic();
254     }
```

(5) Loading end of U-boot kernel (TMU 5ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/git/bl2/bl2_main.c Load_bl33() in bl2_main() just behind

```
249
250     e = load_bl33(bl2_to_bl31_params);
        - It adds it here.
251     if (e) {
252             ERROR("Failed to load BL3-3 (%i)¥n", e);
```

(6) It jumps to U-boot. (TMU 7ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/v1.1+renesas+gitAUTOINC+c2f9fc9f13-r0/git/bl2/bl2_main.c Immediately before end smc() of bl2_main() is called
(7) Kernel main function (main.c main()) (TMU 8ch use)	build/tmp/work/salvator_x-poky-linux/linux-renesas/4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/source/init/main.c Immediately after calling mm_init() in start_kernel()
(8) Before initializing the device (TMU 10ch use)	build/tmp/work/salvator_x-poky-linux/linux-renesas/4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/source/init/main.c Immediately before driver_init() in do_basic_setup() is called
(9) After initializing the device (TMU 11ch use)	build/tmp/work/salvator_x-poky-linux/linux-renesas/4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/source/init/main.c Immediately after calling driver_init() in do_basic_setup()

```
259     /*
260      * Run BL3-1 via an SMC to BL1. Information on how to pass control to
261      * the BL3-2 (if present) and BL3-3 software images will be passed to
262      * BL3-1 as an argument.
263      */
        - It adds it here.
264     smc(RUN_IMAGE, (unsigned long)bl31_ep_info, 0, 0, 0, 0, 0, 0);
```

```
534     vfs_caches_init_early();
535     sort_main_extable();
536     trap_init();
537     mm_init();
        - It adds it here.
```

```
855     cpuset_init_smp();
856     shmem_init();
        - It adds it here.
857     driver_init();
858     init_irq_proc();
859     do_ctors();
```

```
855     cpuset_init_smp();
856     shmem_init();
857     driver_init();
        - It adds it here.
858     init_irq_proc();
859     do_ctors();
```

(10) init_process (TMU 13ch use)	build/tmp/work/salvator_x-poky-linux/linux-renesas/ 4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/ source/init/main.c Immediately before run_init_process() in kernel_init() is called
(11) Object application program start (TMU 0ch reading)	ExecStartPost of systemd configuration file To ExecStartPost of/etc/systemd/system/autostart.service Command (/home/root/write_phy r 0xE61E000C 1) that reads the value of the register of TMU 0ch is set. The content of autostart.service is described as follows.

```
        - It adds it here.
946     if (ramdisk_execute_command) {
947             ret = run_init_process(ramdisk_execute_command);
948             if (!ret)
949                     return 0;
950             pr_err("Failed to execute %s (error %d)¥n",
951               ramdisk_execute_command, ret);
952     }
```

```
[Unit]
Description=Auto Start Test

[Service]
Environment="XDG_RUNTIME_DIR=/run/user/root"
ExecStart=/etc/init.d/autostart.sh
ExecStartPost=/home/root/write_phy r 0xE61E000C 1
Restart=on-failure
RestartSec=1

[Install]
WantedBy=multi-user.target
```

Table 53 warm boot measurement point list

Reading point	Source part
(1) IPL beginning (TMU timer start) (TMU 0ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/ git/plat/renesas/rcar/bl2_rcar_setup.c Immediately after calling bl2_cpg_init() in

```
380     /* Initialize CPG configuration */
381     bl2_cpg_init();
        - It adds it here.
382
383     /* Initialize the console to provide early debug support */
384     (void)console_init(0U, 0U, 0U);
```

(2) DDR initialization beginning (TMU 1ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/git/plat/renesas/rcar/bl2_rcar_setup.c Just before InitDram() in bl2_early_platform_setup()
(3) DDR initialization end (TMU 2ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/git/plat/renesas/rcar/bl2_rcar_setup.c Just behind InitDram() in bl2_early_platform_setup()
(4) It jumps to the resume position. (TMU 4ch use)	build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/git/plat/renesas/rcar/bl2_rcar_setup.c Immediately before end smc() in bl2_plat_get_bl31_ep_info() is
(5) Before kernel resume (TMU 6ch use)	build/tmp/work/salvator_x-poky-linux/linux-renesas/4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/source/kernel/power/suspend.c Label Resume_devices in suspend_devices_and_enter()

```
519     if((modemr == MODEMR_BOOT_CPU_CA57) ||
520      (modemr == MODEMR_BOOT_CPU_CA53)) {
                - It adds it here.
521             /* Initialize SDRAM */
522             InitDram();
523
524             /* initialize QoS configration */
525             qos_init();
526     }
```

```
519     if((modemr == MODEMR_BOOT_CPU_CA57) ||
520      (modemr == MODEMR_BOOT_CPU_CA53)) {
521             /* Initialize SDRAM */
522             InitDram();
                - It adds it here.
523
524             /* initialize QoS configration */
525             qos_init();
526     }
```

```
253     /*
254      * Run BL3-1 via an SMC to BL1.
255      * Need to jumps entrypoint of Suspend to RAM at SMC handler.
256      */
        - It adds it here.
257     smc((unsigned long)RUN_IMAGE, (unsigned long)bl31_ep_info,
258             0UL, 0UL, 0UL, 0UL, 0UL, 0UL);
```

```
426     do {
427             error = suspend_enter(state, &wakeup);
428     } while (!error && !wakeup && platform_suspend_again(state));
429
430 Resume_devices:
        - It adds it here.
431     suspend_test_start();
```

(6) After kernel resume (TMU 8ch use)	build/tmp/work/salvator_x-poky-linux/linux-renesas/ 4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/ source/kernel/power/suspend.c Label Resume_devices in suspend_devices_and_enter()
(7) In front of resume in the process (TMU 10ch use)	build/tmp/work/salvator_x-poky-linux/linux-renesas/ 4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/ source/kernel/power/process.c Immediately before macro for_each_process_thread() in

```
426     do {
427             error = suspend_enter(state, &wakeup);
428     } while (!error && !wakeup && platform_suspend_again(state));
429
430 Resume_devices:
431     suspend_test_start();
432     dpm_resume_end(PMSG_RESUME);
        - It adds it here.
433     suspend_test_finish("resume devices");
```

```
197     thaw_workqueues();
198
199     read_lock(&tasklist_lock);
        - It adds it here.
200     for_each_process_thread(g, p) {
201             /* No other threads should have PF_SUSPEND_TASK set */
202             WARN_ON((p != curr) && (p->flags & PF_SUSPEND_TASK));
203             __thaw_task(p);
204     }
```

③ Patch and Init script for measurement
The following patch is applied to the IPL kernel of default.

Table 54 patch list

Patch	Content
0001-Place-kernel-image-in-HyperFlash.patch	HyperFlash is booted.
0001-Add-TMU-timestamp-process.patch	The stamp processing of the TMU time is added (IPL).
0002-Add-TMU-timestamp-process.patch	The stamp processing of the TMU time is added (kernel).

The following file is added or is corrected to rootfs of default.

Table 55 change file list

File	Addition/correction	Content
/home/root/RunEnv_Rightware_2.0.2/*	Addition	One ..application program (Rightware KPA) *..
/home/root/RunEnv_Daimler_2.0.2/*	Addition	Two ..application program (Daimler Bench) *..
/home/root/OGLES3Navigation3D	Addition	Application program (OGLES2Navigation3D)
/home/root/OGLES3Navigation3D_wl	Addition	Application program (OGLES2Navigation3D)
/home/root/1kHz_-18dB_30s.wav	Addition	Audio file
/home/root/big-buck-bunny-30sec-800x480.mp4	Addition	Animation file
/home/root/write_phy	Addition	Register R/W program
/home/root/tmu.sh	Addition	The value of the time stamp is output by using write_phy.
/etc/init.d/autostart.sh	Addition	The object application program is started.
/etc/systemd/system/autostart.service	Addition	The start and the TMU time stamp of autostart.sh are done.
/lib/systemd/system/weston.service	Correction	Autostart.service is started.
/etc/xdg/weston/weston.ini	Correction	The RGB･HDMI output is invalidated, and only LVDS is made effective.

- 1 As follows, it corrects it to the defrosted file.
･RunEnv_Daimler_2.0.2/ run.sh

1. The 25th line # It changes to ID_HDMI_A_1 of Get Display Settings and grep TMDS → grep LVDS of CRTC_HDMI_A_1.
2. 2880×1080 of the 52nd lines It changes to → 1024×768.

･RunEnv_Daimler_2.0.2/powervr/powervr.ini

1. SetDefaultDisplay=1 of the H3:60 line is made SetDefaultDisplay=3.
   SetDefaultDisplay=1 of the M3:60 line is made SetDefaultDisplay=2.

- 2 As follows, it corrects it to the defrosted file.
･RunEnv_Rightware_2.0.2/weston.ini

```
[output]
name=HDMI-A-1
mode=off
[output]
name=HDMI-A-2
mode=off
```

5.3. Measurement pattern

Here, the pattern to measure uptime is shown.
・Type A: Yocto v 2.12.31 Standard BSP
Type B: Yocto v 2. 16.0 Kernel shrink ・U-Boot skip ・Log output invalid
Type C: Yocto v 2.1 6.0 Kernel Shrink Part 2 ・Skip U-Boot ・Disable log output
・Sleep shortening of GFX application start script run.sh
(Rightware KPA 5 seconds -> 1.5 seconds, Daimler Bench 15 seconds -> 0 seconds)
Reduction of retry time of systemd (1 second → 0.4 seconds)

5.4. Measurement procedure

Here, the patch application, the build, and the measurement procedure are shown.
① Patch application and build
The method of the build of Linux BSP is described.
TypeA:
1) [1] 3 of Yocto recipe Start-Up Guide . Step 2 of Building Instructions and step 3 are executed.

2) 3.1. In case of BSP + 3D Graphics + Step 5-step 11 of Multimedia package is executed.

3) It applies patch to the IPL kernel.

```
1. cd $WORK/build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/
   v1.1+renesas+gitAUTOINC+940eaabe89-r0/git
2. patch -p1 < 0001-Place-kernel-image-in-HyperFlash.patch
3. patch -p1 < 0001-Add-TMU-timestamp-process.patch
4. cd $WORK/ build/tmp/work/salvator_x-poky-linux/linux-renesas/
   4.6+gitAUTOINC+f100fac1e2-r1/linux-salvator_x-standard-build/source
5. patch -p1 < 0002-Add-TMU-timestamp-process.patch
```

4) The build is done again.

```
1. source poky/oe-init-build-env
2. bitbake core-image-weston
```

5) The IPL kernel is written in HyperFlash.
[1] 4 of Yocto recipe Start-Up Guide . Writing of IPL/Secure is executed. Moreover, following srec is written in HyperFlash.

Table 56 writing poop sheet

Filename	Program Top Address	Flash Save Address
Image-r8a7795-salvator-x.dtb.srec	H'48000000	H'6C0000
Image.srec	H'48080000	H'700000

6) Rootfs is written in eMMC.
A detailed procedure is 4 Refer to EMMC_boot.pdf.

② Measurement procedure
It acquires it without stopping the time of each reading point of the cold boot and the warm boot by using TMU. The acquired value of each reading point is written in the register not used by another function.
The write_phy application program made by oneself is used to read the value written in the register.

The measurement procedure in TMU is shown as follows.
Cold boot:
1) The power supply is turned on.
2) It is root and log in in Linux.
3) ./tmu.sh
4) TMU0.TCNT1: The result of 0xe61e0018 is assumed to be a result of time stamp (2).
TMU0.TCNT2: The result of 0xe61e0024 is assumed to be a result of time stamp (3).
TMU1.TCNT3: The result of 0xe6fc000c is assumed to be a result of time stamp (4).
TMU1.TCNT4: The result of 0xe6fc0018 is assumed to be a result of time stamp (5).
TMU1.TCNT5: The result of 0xe6fc0024 is assumed to be a result of time stamp (6).
TMU2.TCNT6: The result of 0xe6fd000c is assumed to be a result of time stamp (7).
5) journalctl -b | grep 0xe61e000c
6) The output result is assumed to be a result of time stamp (8) (It is assumed the end when output two or more times).

【 supplementation 】
The application program that reads the value written in the register is made, and the procedure is described.

Warm boot:
1) The power supply is turned on.
2) It is root and log in in Linux.
3) i2cset -f -y 7 0x30 0x20 0x0F
4) The power supply is turned off.
5) echo mem > /sys/power/state
6) The power supply is turned on.
7) ./tmu.sh
8) TMU3.TCNT9: The result of 0xe6fe000c is assumed to be a result of time stamp (2).
TMU2.TCNT8: The result of 0xe6fd0024 is assumed to be a result of time stamp (3).
TMU3.TCNT10: The result of 0xe6fe0018 is assumed to be a result of time stamp (4).

【 supplementation 】
Whenever doing, at the time of add it the result of the TMU channel and the time stamp is updated.

The measurement procedure in the video is shown below.
Cold Boot:
1) Start of shooting
2) Turn on the power supply
3) Target application is displayed
4) Shooting stop
5) Convert mts file to m2ts file with ImageMixer 3 AVCHD Edition for HITACHI
6) Start mpc-be.exe and play m2ts file
7) 2), and sets the time at that time as the result of the time stamp (1)
3), and sets the time at that time as the result of the time stamp (2)

Warm boot:
1) Taking a picture beginning
2) The power supply is turned on.
3) It is root and log in in Linux.
4) i2cset -f -y 7 0x30 0x20 0x0F
5) The power supply is turned off.
6) echo mem > /sys/power/state
7) The power supply is turned on.
8) The object application program is displayed.
9) Taking a picture stop
10) The mts file is converted into the m2ts file with ImageMixer 3 AVCHD Edition for HITACHI.
11) The m2ts file is reproduced by starting mpc-be.exe.
12) 7)It drinks and it stops according to timing, and time of that time is assumed to be a result of time stamp (1).
13) 8)It drinks and it stops according to timing, and time of that time is assumed to be a result of time stamp (2).

6. Result of a measurement

Type A: Yocto v 2.12.31 Standard BSP
Type B: Yocto v 2. 16.0 Kernel shrink ・U-Boot skip ・Log output invalid
Type C: Yocto v 2.1 6.0 Kernel Shrink Part 2 ・Skip U-Boot ・Disable log output
・Sleep shortening of GFX application start script run.sh
(Rightware KPA 5 seconds -> 1.5 seconds, Daimler Bench 15 seconds -> 0 seconds)
Reduction of retry time of systemd (1 second → 0.4 seconds)

6.1. Total time (video camera shoot measurement result)

6.1.1. flower

Table 61 Display Opening animation display (unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot
The first	10.287	2.537	5.673	2.753	3.737	2.753	11.578	2.469	5.534	2.839	3.631	2.536
The second			5.537	2.870	3.548	2.720	11.628	2.436	5.521	2.823	3.685	2.519
The third			5.606	2.803	3.716	2.736	10.477	2.435	5.656	2.786	4.351	2.533

6.1.2. Gstreamer

Table 62 Camera display (unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot
The first	10.227	2.519	6.990	2.522	5.122	2.519	11.456	2.451	5.873	2.576	5.054	2.526
The second			5.607	2.519	5.056	2.519	10.075	2.453	5.872	2.519	5.089	2.518
The third			5.822	2.386	5.103	2.536	9.867	1.519	5.874	2.537	5.606	2.538

6.1.3. Rightware KPA

Table 63 Meter cluster or Map app drawing (unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot
The first	14.815	2.519	8.441	2.519	5.030	2.503	15.863	2.419	9.789	2.519	5.738	2.503
The second			8.490	2.503	5.054	2.502	14.711	2.469	9.634	2.522	5.785	2.536
The third			8.444	2.519	5.092	2.503	16.048	2.435	8.641	2.536	5.789	2.536

6.1.4. Daimler Bench

Table 64 Meter cluster or Map app drawing (unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot
The first	30.643	8.023	24.274	2.520	9.076	1.052	30.632	6.039	24.252	2.519	9.293	2.520
The second			23.978	2.501	9.076	1.003	30.514	9.376	24.391	2.537	9.243	2.552
The third			24.136	2.502	9.193	1.051	30.470	8.759	24.358	2.519	9.360	2.553

6.1.5. OGLES2Navigation3D

Table 65 Meter cluster or Map app drawing (unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot
The first	10.973	2.503	5.705	1.754	4.119	2.519	10.900	2.419	5.756	2.536	4.491	2.542
The second			5.889	2.520	4.071	2.501	10.729	2.470	5.823	2.536	4.568	2.540
The third			5.890	2.505	4.072	2.519	12.079	2.469	5.872	2.523	4.495	2.535

6.1.6. Gstreamer

Table 66 animation reproduction
(unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot
The first	10.093	2.502	5.211	2.519	3.837	2.521	10.260	2.401	5.222	2.520	4.707	2.481
The second			5.222	2.521	3.888	2.515	11.523	2.436	5.125	2.519	4.771	2.502
The third			5.221	2.519	3.888	2.517	11.642	2.436	5.370	2.536	4.436	2.537

6.1.7. Aplay

Table 67 audio reproduction (unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot	Cold boot	Warm boot
The first	8.942	2.632	2.889	2.708	2.824	2.540	8.780	2.474	2.712	2.703	2.847	2.631
The second			2.936	2.708	2.611	2.659	8.919	2.475	2.901	2.721	2.676	2.523
The third			2.824	2.700	2.792	2.560	8.661	2.607	2.933	2.698	2.584	2.612

6.2. Time between each reading point

Reading point (TypeA)

- Cold boot
  (1) IPL beginning
  (2) DDR initialization beginning
  (3) Loading beginning of U-boot kernel
  (4) It jumps to U-boot.
  (5) Kernel main function (main.c main())
  (6) Before initializing the device
  (7) init_process
  (8) Object application program start

- Warm boot
  (1) IPL beginning
  (2) It jumps to the resume position.
  (3) Kernel resume position
  (4) In front of resume in the process

Reading point (TypeB, TypeC)

- Cold boot
  (1) IPL beginning
  (2) DDR initialization beginning
  (3) DDR initialization end
  (4) Loading beginning of U-boot kernel

- Warm boot
  (1) IPL beginning
  (2) DDR initialization beginning
  (3) DDR initialization end
  (4) It jumps to the resume position.

(5) Loading end of U-boot kernel
(6) It jumps to U-boot.
(7) Kernel main function (main.c main())
(8) Before initializing the device
(9) After initializing the device
(10) init_process
(11) Object application program start

(5) Before kernel resume
(6) After kernel resume
(7) In front of resume in the process

6.2.1. Cold boot

6.2.1.1. flower

Table 68 Display Opening animation display (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)	0.069	0.088	0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.081	0.100
	(3)-(4)	0.164	0.252	0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.161
	(4)-(5)	3.791	4.043	0.111	0.224	0.083	0.197	3.731	4.029	0.111	0.271	0.083	0.244
	(5)-(6)	0.148	4.191	0.000	0.224	0.000	0.197	0.115	4.144	0.000	0.271	0.000	0.244
	(6)-(7)	3.181	7.372	0.267	0.492	0.263	0.460	2.858	7.002	0.231	0.502	0.227	0.471
	(7)-(8)	3.236	10.608	0.275	0.766	0.274	0.734	4.600	11.602	0.211	0.713	0.210	0.681
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.687
	(9)-(10)			1.456	2.229	1.244	1.985			1.244	1.962	1.083	1.771
	(10)-(11)			3.385	5.614	1.784	3.769			3.532	5.494	1.895	3.666
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.684	3.983	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.097	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.829	6.926	0.232	0.502	0.227	0.470
	(7)-(8)			0.275	0.767	0.274	0.734	4.665	11.591	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.385	2.159	1.217	1.958			1.253	1.972	1.087	1.772
	(10)-(11)			3.327	5.486	1.745	3.703			3.467	5.439	1.921	3.694
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.081	0.101
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.161
	(4)-(5)			0.111	0.224	0.083	0.197	3.684	3.982	0.111	0.271	0.083	0.244
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.097	0.000	0.271	0.000	0.244
	(6)-(7)			0.267	0.492	0.263	0.460	2.843	6.940	0.232	0.502	0.227	0.471
	(7)-(8)			0.275	0.766	0.274	0.734	3.499	10.439	0.211	0.713	0.210	0.681
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.687
	(9)-(10)			1.362	2.136	1.221	1.962			1.242	1.961	1.084	1.771
	(10)-(11)			3.308	5.444	1.751	3.713			3.587	5.548	2.531	4.302

6.2.1.2. Gstreamer

Table 69 Camera display (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)	0.069	0.088	0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)	0.164	0.252	0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)	3.785	4.037	0.111	0.224	0.083	0.197	3.710	4.008	0.111	0.271	0.083	0.243
	(5)-(6)	0.148	4.185	0.000	0.224	0.000	0.197	0.115	4.123	0.000	0.271	0.000	0.243
	(6)-(7)	3.033	7.218	0.267	0.491	0.263	0.460	2.860	6.983	0.231	0.502	0.227	0.470

	(7)-(8)	1.880	9.097	0.275	0.766	0.274	0.734	3.673	10.656	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.362	2.136	1.218	1.959			1.260	1.978	1.094	1.780
	(10)-(11)			3.643	5.779	1.914	3.873			2.629	4.607	2.129	3.908
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.663	3.962	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.076	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.853	6.930	0.231	0.502	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	3.549	10.479	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.373	2.146	1.225	1.966			1.272	1.991	1.084	1.770
	(10)-(11)			2.412	4.558	1.928	3.894			2.712	4.703	2.746	4.516
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.680	3.979	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.094	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.856	6.950	0.232	0.502	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	3.670	10.620	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.390	2.163	1.226	1.967			1.249	1.968	1.099	1.785
	(10)-(11)			2.268	4.431	1.947	3.913			2.674	4.642	2.736	4.521

6.2.1.3. Rightware KPA

Table 610 Meter cluster or Map app drawing (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)	0.069	0.088	0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)	0.164	0.252	0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)	3.754	4.006	0.111	0.224	0.083	0.197	3.707	4.006	0.111	0.271	0.083	0.243
	(5)-(6)	0.148	4.154	0.000	0.224	0.000	0.197	0.115	4.121	0.000	0.271	0.000	0.243
	(6)-(7)	3.087	7.241	0.267	0.491	0.263	0.460	2.693	6.813	0.232	0.502	0.227	0.470
	(7)-(8)	1.869	9.110	0.275	0.766	0.274	0.734	2.189	9.002	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.368	2.141	1.215	1.956			1.251	1.970	1.081	1.767
	(10)-(11)			0.694	2.835	1.048	3.004			0.947	2.917	1.133	2.901
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.704	4.002	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.117	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.817	6.934	0.232	0.502	0.227	0.470
	(7)-(8)			0.275	0.767	0.274	0.734	2.035	8.969	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.358	2.132	1.221	1.962			1.241	1.959	1.093	1.778
	(10)-(11)			0.724	2.856	1.013	2.975			0.860	2.819	1.131	2.910
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.081	0.100
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.161
	(4)-(5)			0.111	0.224	0.083	0.197	3.706	4.005	0.111	0.271	0.083	0.244
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.119	0.000	0.271	0.000	0.244
	(6)-(7)			0.267	0.492	0.263	0.460	2.812	6.931	0.231	0.502	0.227	0.471
	(7)-(8)			0.275	0.766	0.274	0.734	1.935	8.866	0.211	0.713	0.210	0.681
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.687

	(9)-(10)			1.378	2.151	1.229	1.970			1.244	1.963	1.090	1.777
	(10)-(11)			0.699	2.850	1.050	3.019			0.908	2.871	1.192	2.969

6.2.1.4. Daimler Bench

Table 611 Meter cluster or Map app drawing (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)	0.069	0.088	0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)	0.164	0.252	0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)	3.806	4.058	0.111	0.224	0.083	0.197	3.718	4.016	0.111	0.271	0.083	0.243
	(5)-(6)	0.148	4.205	0.000	0.224	0.000	0.197	0.115	4.131	0.000	0.271	0.000	0.243
	(6)-(7)	3.075	7.280	0.266	0.491	0.263	0.460	2.750	6.881	0.232	0.502	0.227	0.470
	(7)-(8)	1.489	8.769	0.275	0.766	0.274	0.734	1.637	8.519	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.772	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.364	2.137	1.209	1.949			1.259	1.978	1.087	1.772
	(10)-(11)			0.477	2.613	0.683	2.633			0.716	2.694	0.638	2.411
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.701	3.999	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.114	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.711	6.825	0.231	0.501	0.227	0.470
	(7)-(8)			0.275	0.767	0.274	0.734	1.546	8.371	0.211	0.712	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.718	0.006	0.686
	(9)-(10)			1.368	2.141	1.514	2.255			1.228	1.946	1.086	1.771
	(10)-(11)			0.561	2.702	0.685	2.940			0.701	2.647	0.732	2.503
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.696	3.994	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.109	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.491	0.263	0.460	2.858	6.967	0.231	0.501	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	1.505	8.472	0.211	0.712	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.718	0.006	0.686
	(9)-(10)			1.371	2.144	1.205	1.946			1.247	1.965	1.088	1.774
	(10)-(11)			0.574	2.718	0.628	2.574			0.606	2.571	0.758	2.533

6.2.1.5. OGLES2Navigation3D

Table 612 Meter cluster or Map app drawing (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)	0.069	0.088	0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)	0.164	0.252	0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)	3.822	4.074	0.111	0.224	0.083	0.197	3.732	4.031	0.111	0.271	0.083	0.243
	(5)-(6)	0.148	4.221	0.000	0.224	0.000	0.197	0.115	4.146	0.000	0.271	0.000	0.243
	(6)-(7)	2.939	7.160	0.267	0.492	0.263	0.460	2.833	6.979	0.232	0.502	0.227	0.470
	(7)-(8)	3.306	10.466	0.275	0.766	0.274	0.734	3.604	10.583	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.367	2.141	1.224	1.965			1.265	1.984	1.085	1.771
	(10)-(11)			3.449	5.590	1.727	3.692			3.638	5.622	2.618	4.389
The	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019

second	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.683	3.982	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.097	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.837	6.933	0.232	0.502	0.227	0.470
	(7)-(8)			0.275	0.767	0.274	0.734	3.669	10.602	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.393	2.167	1.212	1.953			1.259	1.978	1.082	1.767
	(10)-(11)			3.369	5.536	1.766	3.718			3.665	5.643	2.622	4.389
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.686	3.985	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.099	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.815	6.915	0.232	0.502	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	3.682	10.596	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.375	2.148	1.229	1.969			1.244	1.963	1.085	1.771
	(10)-(11)			3.397	5.545	1.827	3.796			3.610	5.572	2.000	3.771

6.2.1.6. Gstreamer

Table 613 animation reproduction
(unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)	0.069	0.088	0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)	0.164	0.252	0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)	3.800	4.052	0.111	0.224	0.083	0.197	3.697	3.996	0.111	0.271	0.083	0.243
	(5)-(6)	0.148	4.200	0.000	0.224	0.000	0.197	0.115	4.110	0.000	0.271	0.000	0.243
	(6)-(7)	3.040	7.239	0.267	0.491	0.263	0.460	2.893	7.003	0.232	0.502	0.227	0.470
	(7)-(8)	1.857	9.096	0.275	0.766	0.274	0.734	3.773	10.776	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.358	2.132	1.230	1.971			1.235	1.954	1.091	1.776
	(10)-(11)			3.591	5.723	0.912	2.883			2.593	4.547	4.572	6.348
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.664	3.962	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.077	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.855	6.932	0.232	0.502	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	2.069	9.002	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.370	2.143	1.227	1.968			1.245	1.964	1.107	1.793
	(10)-(11)			2.383	4.526	0.901	2.869			2.685	4.649	2.141	3.934
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.637	3.936	0.111	0.271	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.051	0.000	0.271	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.459	2.740	6.791	0.232	0.502	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	5.001	11.792	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.380	2.153	1.230	1.971			1.247	1.966	1.089	1.775
	(10)-(11)			2.369	4.522	0.961	2.932			2.632	4.599	2.191	3.966

6.2.1.7. Aplay

Table 614 audio reproduction
(unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)	0.069	0.088	0.034	0.053	0.034	0.053	0.115	0.135	0.080	0.099	0.080	0.099
	(3)-(4)	0.164	0.252	0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.160	0.061	0.160
	(4)-(5)	3.790	4.042	0.111	0.224	0.083	0.197	3.677	3.975	0.111	0.271	0.083	0.243
	(5)-(6)	0.148	4.190	0.000	0.224	0.000	0.197	0.115	4.090	0.000	0.271	0.000	0.243
	(6)-(7)	3.173	7.362	0.267	0.492	0.263	0.460	2.793	6.883	0.232	0.502	0.227	0.470
	(7)-(8)	1.597	8.959	0.275	0.766	0.274	0.734	1.967	8.850	0.211	0.713	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.719	0.006	0.686
	(9)-(10)			1.368	2.142	1.206	1.947			1.228	1.947	1.085	1.771
	(10)-(11)			0.584	2.726	0.510	2.458			0.630	2.576	0.733	2.504
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.081	0.100	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.161	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.670	3.968	0.111	0.272	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.083	0.000	0.272	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.875	6.958	0.232	0.504	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	1.505	8.463	0.211	0.714	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.720	0.006	0.686
	(9)-(10)			1.368	2.141	1.213	1.954			1.236	1.956	1.082	1.768
	(10)-(11)			0.559	2.700	0.678	2.632			0.595	2.551	0.699	2.467
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.115	0.135	0.081	0.100	0.080	0.099
	(3)-(4)			0.061	0.114	0.061	0.114	0.164	0.298	0.061	0.161	0.061	0.160
	(4)-(5)			0.111	0.224	0.083	0.197	3.655	3.953	0.111	0.272	0.083	0.243
	(5)-(6)			0.000	0.224	0.000	0.197	0.115	4.068	0.000	0.272	0.000	0.243
	(6)-(7)			0.267	0.492	0.263	0.460	2.848	6.916	0.232	0.504	0.227	0.470
	(7)-(8)			0.275	0.766	0.274	0.734	1.426	8.343	0.211	0.714	0.210	0.680
	(8)-(9)			0.007	0.773	0.007	0.741			0.006	0.720	0.006	0.686
	(9)-(10)			1.368	2.142	1.207	1.948			1.234	1.954	1.092	1.778
	(10)-(11)			0.477	2.619	0.511	2.459			0.569	2.524	0.734	2.512

6.2.2. Warm boot

6.2.2.1. flower

Table 615 Display Opening animation display (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.094	0.094	0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)	0.079	0.173	0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)	2.329	2.502	0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.247	2.516			2.240	2.518	2.240	2.518
	(6)-(7)			0.001	2.509	0.000	2.516			0.001	2.519	0.000	2.519
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.426	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.239	2.518	2.240	2.518
	(6)-(7)			0.001	2.509	0.001	2.508			0.000	2.518	0.000	2.519

The third	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.240	2.518	2.240	2.519
	(6)-(7)			0.000	2.508	0.001	2.508			0.001	2.519	0.001	2.519

6.2.2.2. Gstreamer

Table 616 Camera display (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.094	0.094	0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)	0.079	0.173	0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)	2.330	2.503	0.041	0.094	0.041	0.094	2.255	2.426	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.240	2.518	2.240	2.518
	(6)-(7)			0.000	2.508	0.000	2.508			0.001	2.518	0.001	2.519
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.264	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.504	2.239	2.508			2.239	2.518	2.240	2.519
	(6)-(7)			0.001	2.505	0.001	2.508			0.000	2.518	0.000	2.519
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.178	0.272			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.511			2.240	2.518	2.240	2.518
	(6)-(7)			0.000	2.508	0.000	2.512			0.001	2.519	0.001	2.519

6.2.2.3. Rightware KPA

Table 617 Meter cluster or Map app drawing (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.094	0.094	0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)	0.079	0.173	0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)	2.329	2.502	0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.178	0.272			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.511			2.240	2.518	2.236	2.515
	(6)-(7)			0.001	2.509	0.000	2.512			0.001	2.519	0.001	2.515
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.239	2.518	2.240	2.518
	(6)-(7)			0.001	2.509	0.001	2.508			0.000	2.518	0.000	2.518
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.240	2.518	2.240	2.518
	(6)-(7)			0.001	2.509	0.001	2.508			0.001	2.519	0.000	2.519

6.2.2.4. Daimler Bench

Table 618 Meter cluster or Map app drawing (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.094	0.094	0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)	0.079	0.173	0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)	2.333	2.506	0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.239	2.508	2.247	2.516			2.240	2.518	2.240	2.518
	(6)-(7)			0.001	2.508	0.001	2.516			0.001	2.519	0.000	2.518
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.239	2.508	2.239	2.508			2.239	2.518	2.236	2.514
	(6)-(7)			0.001	2.508	0.000	2.508			0.000	2.518	0.001	2.515
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.170	0.264			0.138	0.278	0.138	0.278
	(5)-(6)			2.239	2.507	2.239	2.504			2.251	2.530	2.240	2.518
	(6)-(7)			0.001	2.508	0.001	2.504			0.000	2.530	0.001	2.519

6.2.2.5. OGLES2Navigation3D

Table 619 Meter cluster or Map app drawing (unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.094	0.094	0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)	0.079	0.173	0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)	2.329	2.503	0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.239	2.518	2.240	2.519
	(6)-(7)			0.001	2.509	0.001	2.508			0.000	2.518	0.000	2.519
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.166	0.260			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.500			2.239	2.518	2.240	2.518
	(6)-(7)			0.001	2.509	0.001	2.500			0.000	2.518	0.000	2.519
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.239	2.517	2.240	2.518
	(6)-(7)			0.001	2.509	0.001	2.508			0.000	2.517	0.000	2.519

6.2.2.6. Gstreamer

Table 620 animation reproduction (unit: Second)

	R-CarH3						R-CarM3					
	TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time

The first	(1)-(2)	0.094	0.094	0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)	0.079	0.174	0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)	2.329	2.503	0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.239	2.518	2.240	2.518
	(6)-(7)			0.001	2.508	0.000	2.508			0.000	2.518	0.000	2.519
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.166	0.260	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.500	2.239	2.508			2.239	2.517	2.240	2.518
	(6)-(7)			0.001	2.501	0.000	2.508			0.000	2.518	0.000	2.519
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.240	2.508	2.239	2.508			2.239	2.518	2.240	2.518
	(6)-(7)			0.001	2.508	0.001	2.508			0.000	2.518	0.001	2.519

6.2.2.7. Aplay

Table 621 audio reproduction
(unit: Second)

		R-CarH3						R-CarM3					
		TypeA		TypeB		TypeC		TypeA		TypeB		TypeC	
		Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time	Lap time	Total time
The first	(1)-(2)	0.094	0.094	0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)	0.079	0.173	0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)	2.332	2.505	0.041	0.094	0.041	0.094	2.255	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.178	0.272			0.138	0.278	0.138	0.278
	(5)-(6)			2.239	2.508	2.240	2.512			2.239	2.518	2.240	2.518
	(6)-(7)			0.001	2.508	0.001	2.513			0.000	2.518	0.000	2.519
The second	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.254	2.425	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.174	0.268			0.138	0.278	0.138	0.278
	(5)-(6)			2.239	2.508	2.240	2.508			2.240	2.518	2.239	2.517
	(6)-(7)			0.001	2.508	0.001	2.509			0.001	2.519	0.000	2.518
The third	(1)-(2)			0.019	0.019	0.019	0.019	0.141	0.141	0.019	0.019	0.019	0.019
	(2)-(3)			0.034	0.053	0.034	0.053	0.030	0.171	0.080	0.099	0.080	0.099
	(3)-(4)			0.041	0.094	0.041	0.094	2.253	2.423	0.041	0.141	0.041	0.141
	(4)-(5)			0.174	0.268	0.178	0.272			0.138	0.278	0.138	0.278
	(5)-(6)			2.239	2.508	2.240	2.512			2.239	2.517	2.240	2.518
	(6)-(7)			0.000	2.508	0.001	2.513			0.001	2.518	0.000	2.519

6.3. Result summary

The above-mentioned result can be brought together as follows.

- TypeA
  - Total time
    - ✧ Cold boot
      - It was H3/M3 and about 10-11 seconds roughly. However, about Rightware KPA did, about 15 seconds Daimler Bench did, and about 30 seconds Aplay was 9 seconds.
    - ✧ Warm boot
      - It was H3/M3 and about 2-3 seconds roughly. However, Daimler Bench was about 8-9 seconds.
  - Time between each reading point
    - ✧ Section in H3 and M3 with difference at processing time
      - Cold boot
        - ➢ (2) DDR initialization beginning- (3) Loading beginning of U-boot kernel----- 0.05 About s H3 is earlier.
        - ➢ (5) Before initializing kernel main function-(6) device----- 0.03 About s M3 is earlier.
        - ➢ (6) Before device is initialized- (7) Init_process----- About 0.1-0.3 s M3 is earlier.
        - ➢ (7) Init_process-(8) object application program start----- About 0.1-0.3 s H3 is earlier.
      - Warm boot
        - ➢ (1) IPL beginning- (2) It jumps to the resume position. ----- 0.05 About s H3 is earlier.
        - ➢ (2) It is kernel resume jump-(3) position in the resume position. ----- 0.05 About s M3 is earlier.
        - ➢ (3) In front of resume in kernel resume position-(4) process----- 0.08 About s M3 is earlier.
    - ✧ Especially, section where it takes time
      - Cold boot
        - ➢ (4) It is a kernel main jump-(5) function in U-boot. ----- 3.8 About s
        - ➢ (6) Before device is initialized- (7) Init_process----- About three s
        - ➢ (7) Init_process-(8) object application program start----- About 1.4 5.0 ..s -.. s
      - Warm boot
        - ➢ (3) In front of resume in kernel resume position-(4) process----- 2.3 About s
- TypeB
  - Total time
    - ✧ Cold boot
      - It was H3/M3 and about 5-6 seconds roughly. However, about Rightware KPA did, about nine seconds Daimler Bench did, and about 24 seconds Aplay was 3 seconds.
    - ✧ Warm boot
      - It was H3/M3 and about 2-3 seconds roughly.
  - Time between each reading point
    - ✧ Section has been shortened by cold boot compared with TypeA
      - (3) Loading beginning- (4) of the U-boot kernel It jumps to U-boot. -----0.053 S shortening
        - ➢ It is thought the effect of the kernel shrink and the U-boot skip.
      - (4) It is a kernel main jump-(5) function in U-boot. -----3.5 About s shortening
        - ➢ It is thought the effect of the U-boot skip.
      - (5) Object application program kernel main function-(8) start----- About 0-2.8 s shortening (However, about a part of of the 0.2 s or less is increased by the application program).
        - ➢ It is thought the effect to which the log output is invalid.
- TypeC
  - Total time

- ✧ Cold boot
  - It was H3/M3 and about 4-5 seconds roughly. However, about Rightware KPA did, about six seconds Daimler Bench did, and about nine seconds Aplay was three seconds.
- ✧ Warm boot
  - It was H3/M3 and about 2-3 seconds roughly. However, Daimler Bench of H3 was about one second.

・ Time between each reading point

- ✧ Section has been shortened by cold boot compared with TypeB
  - (4) Loading beginning- (5) of U-boot kernel Loading end of U-boot kernel-----0.03 About s shortening
    - ➢ It is thought the effect of the [ka-nerushurinku] two.
  - (9) After device is initialized- (10) Init_process-----About 0.1-0.2 s shortening
    - ➢ It is thought the effect of the [ka-nerushurinku] two.
  - (10) Init_process-(11) object application program start-----About 1.5 s or less shortening (However, it increases with Rightware KPA, Daimler Bench, and Aplay, and about 0.3 s or less is increased).
    - ➢ It is thought the effect of shortening for [ka-nerushurinku] the 2 and systemd.

7. Consideration

7.1. Conclusion

7.1.1. Cause of H3/M3 performance difference

In the result of paragraph 6.2, there is a section in R-CarH3 and R-CarM3 with the difference at time.
It is thought that the cause of the difference can be confirmed respectively by the following work.

- Cold boot

・(2) DDR initialization beginning- (3) Loading beginning of U-boot kernel----- 0.05 About s H3 is earlier.
In bl2_early_platform_setup() of git/plat/renesas/rcar/bl2_rcar_setup.c
DDR is initialized in InitDram(), and it is thought that it is because the content of the processing is different in H3 and M3.
Therefore, it is possible to confirm it by putting the time stamp just behind InitDram().

・(5) Before initializing kernel main function-(6) device----- 0.03 About s M3 is earlier.
In start_kernel() of linux-salvator_x-standard-build/source/init/main.c
There is a function named smp_prepare_cpus(setup_max_cpus) in kernel_init_freeable().
The possibility that there is a cause in the number of CPU cores is thought.
Therefore, it is possible to confirm by making the number of cores of H3 the same as M3 two cores (*).

・(6) Before device is initialized- (7) Init_process----- About 0.1-0.3 s M3 is earlier.
It is thought that it is because the content of the device initialization is different in H3 and M3.
Therefore, it is possible to confirm it by putting the time stamp just behind do_initcalls().

・(7) Init_process-(8) object application program start----- About 0.1-0.3 s H3 is earlier.
It is thought that it is the one by retrying of systemd though it differs greatly according to the application program.
Hereafter, two points are thought about differences except it.
・The content of the boot process of systemd is different.
It is possible to confirm it by taking diff of/lib/systemd/
・The number of CPU cores is different.
It is possible to confirm by making the number of cores of H3 the same as M3 two cores (*).

- Warm boot

・(1) IPL beginning- (2) It jumps to the resume position. ----- 0.05 About s H3 is earlier.
The cold boot is thought to be (2) - (3) with this matter.

・(2) It is kernel resume jump-(3) position in the resume position. ----- 0.05 About s M3 is earlier.
In suspend_enter() of kernel/power/suspend.c
It is thought that it is because the starting number of CPU is different enable_nonboot_cpus().
Therefore, it is possible to confirm by making the number of cores of H3 the same as M3 two cores (*).

・(3) In front of resume in kernel resume position-(4) process----- 0.08 About s M3 is earlier.
In suspend_devices_and_enter() of kernel/power/suspend.c
It is thought that it is because the content of device resume is different in H3 and M3.
Therefore, it is possible to confirm it by measuring the time of dpm_resume_end() that does device resume.

- To adjust the number of cores to two, maxcpus=2 is added to bootargs.

7.1.2. Measures against bottleneck

In the result of paragraph 6.2, it is thought that the section where it especially takes time can be shortened respectively by the following measures.

- Cold boot

・(4) It is a kernel main jump-(5) function in U-boot. ----- 3.8 There is about s.
It is thought that it is almost an execution time of U-boot (DeLay 3 s is included), and 0 s can be shortened by skipping U-boot, and making it jump directly from IPL to the kernel to be near.
The time of the jump ..U-boot.. decreases, too.

・(6) Before device is initialized- (7) Init_process----- There are about three s.
Does it take time to initialize which device, and? it digs up by the stamp addition of time, and the config that doesn't include an unnecessary device is done.

・(7) Init_process-(8) object application program start----- 1.4 There are about s-5.0 s.
An unnecessary waiting has been generated by a restart following systemd settings for one second or less. There is a possibility that one second or less can be shortened by the tuning.
Restart=on-failure
RestartSec=1

- Warm boot

・(3) In front of resume in kernel resume position-(4) process----- 2.3 There is about s.
It is thought that the resume time of an unnecessary device is reduced by measures of cold boot (6) - (7).

7.1.3. About ..initialization.. three-device driver second

[1]The breakdown at the device initialization time was measured by using kernel parameter initcall_debug to dig up. whether to take time to initialize which deviceTable 7-1 shows the one with especially long initialization time.

Table 71 device initialization time (one of 100ms or more)

Initialization name	H3 [ms]	M3 [ms]
sci_init	937.183	925.973
deferred_probe_initcall	644.900	587.486
adv7482_driver_init	267.787	275.834
ohci_platform_init	231.711	118.196
sh_mobile_sdhi_driver_init	138.798	152.723

In addition, it was examined very there was an influence with the log output in these time. [1]。Table 7-2 shows this.

Influence with log output in Table 72 device initialization time

Initialization name	H3			M3		
	When it is invalid, it is log output ms.	Influence with log output		When it is invalid, it is log output ms.	Influence with log output	
		Time ms	Ratio		Time ms	Ratio

[1] 全デバイスの結果は別紙[デバイスドライバ初期化時間_ログ出力影響.xlsx]を参照

sci_init	60.706	876.477	94%	58.368	867.605	94%
deferred_probe_initcall	423.512	221.388	34%	405.139	182.347	31%
adv7482_driver_init	219.368	48.419	18%	218.975	56.859	21%
ohci_platform_init	173.675	58.036	25%	87.686	30.510	26%
sh_mobile_sdhi_driver_init	121.654	17.144	12%	122.848	29.875	20%

Therefore, the following conclusion was obtained.

- Especially longing among the device initializations (100ms or more) is five processing shown in Table 7-1.
- The initialization time of sci_init accounts for 94% by the influence with the log output, and is very large.
- On the other hand, a long device at other initialization time is large the time that hangs to not about 12%-34% the influence with the log output, and the log output but the device initialization waiting.

7.1.4. About the difference of Daimler Bench at the warm boot

Table 6-3 The difference is seen for 6.039-9.376 seconds the warm boot time of TypeA of R-CarM3 of Daimler Bench.
It is thought that it causes because the volume of data that saves and returns according to timing in which suspend is done is different Daimler Bench is a bench mark into which the image greatly changes by the scene. It is thought that the difference can be reduced by doing suspend when measuring it according to the same timing.

7.1.5. About the difference at uptime by the application program

Table 6-6 flower and Table 6-7 There is a difference for about 1.4 seconds for 3.236 seconds and 1.880 seconds respectively the time of (7)-(8) section of the cold boot of TypeA of R-CarH3 of Gstreamer (Camera display).
It causes from there is a difference because of failing in the start of the application program once. Moreover, it is thought that the breakdown of this delay of about 1.4 seconds is as follows.

Time until failing + from one time of application program start delay = beginning of application program start due to failure Between at systemd
= For about 0.4 seconds (presumption) + One second.

= About 1.4 seconds

7.1.6. About the difference at the warm boot time by Type

When the warm boot time of Table 6-1-Table 6-5 is compared with TypeB with TypeA, neither R-CarH3, R-CarM3 nor the improvement are seen. The reason is as follows.
・The effect of the U-boot skip is not achieved because U-boot doesn't pass in the warm boot.
・Because the kernel is not loaded in the warm boot, the effect of the kernel shrink is not achieved.
・Because the log doesn't come out so much in the warm boot, the effect of the log output invalidity is not so achieved.

7.1.7. Effect of TypeC

Each effect was confirmed about ..retrying.. shortening between of systemd and [ka-nerushurinku] the 2 among measures of TypeC.

- Shortening between of systemd
  The time of the init_process-(11) object application program start confirmed shortening for about the maximum 1.5 seconds. However, there was a case of which increasing number according to the application program, too.
  It is possible to increase. happen become 0.2-sec increase for instance (One second × once)(three times of 0.4 seconds ×)However, it is thought that this measures are effective because it has been shortened difficult, and overall to evade such a case completely.

- Two of that ..[ka-nerushurinku]..

It was confirmed to measure with R-CarH3 for flower, and to shorten about 1.4 seconds by measures. Especially, (10) About 1.1 seconds have been shortened in the section of the init_process-(11) object application program start.

It is thought that it causes about shortening in this section because the start of an unnecessary process disappeared by the config. Then, when the ps commands were executed and compared after it had been started whether there was a difference in the process that started by the presence of measures further, it was able to be confirmed that the following result was obtained, and the start of six processes had disappeared actually.

A decrease in starting process by the Table 73 [ka-nerushurinku] two

	Measures none	There are measures.
Number of processes	197	191
Process that doesn't start		[ipv6_addrconf]
		[kauditd]
		[vfio-irqfd-clea]
		[watchdogd]
		avahi-daemon: chroot helper
		avahi-daemon: running [salvator-x.local]

7.2. Future tasks

T.B. D (The content of feedback is scheduled to be described).

7.2.1. Measures to execute

Next, measures to execute are shown.

・Log output invalidity

The effect of shortening is a part spent on the log output processing within about 4.5-7.6 seconds (time of cold boot (5) - (8)).

・U-boot skip

It is estimated that four seconds are weak shortened. (From paragraph 7.1.2.)

・Kernel shrink

The effect of shortening is a part of about 0.16 seconds (time of cold boot (3) - (4)).

7.2.2. Examination item

The measures item for which the examination is necessary is shown.

・Two of that ..[ka-nerushurinku]..

The config that doesn't include an unnecessary device is done. There is a possibility that three seconds or less can be shortened.

・Tuning of start of application program of systemd

It is estimated that one second is shortened in the maximum.

・Application program uptime

The application program is set great weight from the start to the display, and examines a part of necessity.

・Daimler Bench (It is Sleep of 15 seconds in start script run.sh).

・Rightware KPA (It is Sleep of five seconds in start script run.sh).

・GFX application program tuning

The tuning in the GFX application program.

・Initialization (processing of the texture loading) is multithreaded.

・The texture data is built into the execution file.

8. Summary

The content fed back to another team is described as follows.

Table 81 feedback content list

Problem	Feedback ahead	Details
The DDR initialization is done by the warm boot.	Loader team	Time passes before and behind InitDram() though the DDR initialization is sure not to be done in the warm boot.

T.B.D
The content of feedback obtained from the result of the device initialization and the breakdown analysis of the resume

9. Reference literature

[1] Linux Interface Specification Yocto recipe Start-Up Guide
RENESAS_RCH3M3_YoctoStartupGuide_UME_v2.12.0.pdf

[2] HWmanual
R-CarGen3_HW_Users_Manual_rev0.52E.pdf

[3] RENESAS_RCH3M3_YoctoReleaseNote_E_v2.12.31.pdf

[4] EMMC_boot.pdf

[5] Linux Interface Specification Yocto recipe Start-Up Guide
RENESAS_RCH3M3_YoctoStartupGuide_UME_v2.16.0.pdf

付録 A. Environmental construction procedure of TypeB and TypeC

The content of the change for shortening uptime is described as follows.

A.1. TypeB

・Patch

The following patch is used.

Table A1 patch list

Patch	Content
0001-Add-U-boot-skip.patch	U-boot is skipped.

・0001-Add-U-boot-skip.patch

```
diff --git a/plat/renesas/rcar/bl2_rcar_setup.c b/plat/renesas/rcar/bl2_rcar_setup.c
index 20bd8fd..4c706dd 100755
--- a/plat/renesas/rcar/bl2_rcar_setup.c
+++ b/plat/renesas/rcar/bl2_rcar_setup.c
@@ -754,6 +754,9 @@ void bl2_plat_set_bl33_ep_info(image_info_t *image,
 {
                SET_SECURITY_STATE(bl33_ep_info->h.attr, NON_SECURE);
                bl33_ep_info->spsr = rcar_get_spsr_for_bl33_entry();
+#ifdef BL33_ARG0
+               bl33_ep_info->args.arg0 = BL33_ARG0;
+#endif
 }

diff --git a/plat/renesas/rcar/platform.mk b/plat/renesas/rcar/platform.mk
index d56ab0d..a43be1d 100644
--- a/plat/renesas/rcar/platform.mk
+++ b/plat/renesas/rcar/platform.mk
@@ -207,6 +207,13 @@ PMIC_LEVEL_MODE := 1
 endif
 $(eval $(call add_define,PMIC_LEVEL_MODE))

+BL33_ARG0 := 0x48000000
+
+# Process BL33_ARG0 flag
+ifdef BL33_ARG0
+$(eval $(call add_define,BL33_ARG0))
+endif
+
 include plat/renesas/rcar/ddr/ddr.mk
 include plat/renesas/rcar/qos/qos.mk
```

```
 include plat/renesas/rcar/pfc/pfc.mk


diff --git a/tools/dummy_create/sa6.c b/tools/dummy_create/sa6.c
index bc124b8..ff32000 100644
--- a/tools/dummy_create/sa6.c
+++ b/tools/dummy_create/sa6.c
@@ -38,7 +38,8 @@


 /* Number of content cert for Non-secure Target Program(BL33x) */
 /* #define RCAR_IMAGE_NUM                  (0x00000001U) */
-#define RCAR_IMAGE_NUM                  (0x00000003U)
+/* #define RCAR_IMAGE_NUM                  (0x00000003U) */
+#define RCAR_IMAGE_NUM                  (0x00000002U)
 /* Source address on flash for BL31 */
 #define RCAR_BL31SRC_ADDRESS            (0x001C0000U)
 /* Reserved */
@@ -48,7 +49,8 @@
 /* Reserved */
 #define RCAR_BL32_PARTITION             (0x00000000U)
 /* Source address on flash for BL33 */
-#define RCAR_BL33SRC_ADDRESS            (0x00640000U)
+/* #define RCAR_BL33SRC_ADDRESS            (0x00640000U) */
+#define RCAR_BL33SRC_ADDRESS            (0x00700000U)
 /* Reserved */
 #define RCAR_BL33_PARTITION             (0x00000000U)
 /* #define RCAR_BL332SRC_ADDRESS           (0x00000000U) */
@@ -58,7 +60,8 @@
 #define RCAR_BL332_PARTITION            (0x00000000U)
 /* #define RCAR_BL333SRC_ADDRESS           (0x00000000U) */
-#define RCAR_BL333SRC_ADDRESS           (0x00700000U)
+/* #define RCAR_BL333SRC_ADDRESS           (0x00700000U) */
+#define RCAR_BL333SRC_ADDRESS           (0x00000000U)
 /* Reserved */
 #define RCAR_BL333_PARTITION            (0x00000000U)
 #define RCAR_BL334SRC_ADDRESS           (0x00000000U)
@@ -126,22 +129,27 @@
 /* Destination size for BL32 */
```

```
 #define RCAR_BL32DST_SIZE              (0x00020000U)
 /* Destination address for BL33 */
-#define RCAR_BL33DST_ADDRESS                (0x50000000U)
+/* #define RCAR_BL33DST_ADDRESS             (0x50000000U) */
+#define RCAR_BL33DST_ADDRESS                (0x48080000U)
 #define RCAR_BL33DST_ADDRESSH               (0x00000000U)
 /* Destination size for BL33 */
-#define RCAR_BL33DST_SIZE              (0x00040000U)
+/* #define RCAR_BL33DST_SIZE                (0x00040000U) */
+/* #define RCAR_BL33DST_SIZE                (0x00337A00U) */
+#define RCAR_BL33DST_SIZE              (0x00400000U)
 /* Reserved */
 /* #define RCAR_BL332DST_ADDRESS            (0x00000000U) */
 #define RCAR_BL332DST_ADDRESS               (0x48000000U)
 #define RCAR_BL332DST_ADDRESSH              (0x00000000U)
 /* #define RCAR_BL332DST_SIZE               (0x00000000U) */
-#define RCAR_BL332DST_SIZE             (0x00004000U)
+#define RCAR_BL332DST_SIZE             (0x00008000U)
 /* Reserved */
 /* #define RCAR_BL333DST_ADDRESS            (0x00000000U) */
-#define RCAR_BL333DST_ADDRESS               (0x48080000U)
+/* #define RCAR_BL333DST_ADDRESS            (0x48080000U) */
+#define RCAR_BL333DST_ADDRESS               (0x00000000U)
 #define RCAR_BL333DST_ADDRESSH              (0x00000000U)
 /* #define RCAR_BL333DST_SIZE               (0x00000000U) */
-#define RCAR_BL333DST_SIZE             (0x00380000U)
+/* #define RCAR_BL333DST_SIZE               (0x00400000U) */
+#define RCAR_BL333DST_SIZE             (0x00000000U)
 /* Reserved */
 #define RCAR_BL334DST_ADDRESS               (0x00000000U)
 #define RCAR_BL334DST_ADDRESSH              (0x00000000U)
```

・Patch application and build

1) To skip U-boot, it applies patch to IPL.

1. cd $WORK/build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/v1.1+renesas+gitAUTOINC+940eaabe89-r0/git
2. patch -p1 < 0001-Add-U-boot-skip.patch

2) To make kernel shrink, change kernel config as follows

1. Check only the following items with Platform selection and uncheck all other items
   [*] Renesas SoC Platforms
   [*] Renesas R-Car H3 SoC Platform
   [*] Renesas R-Car M3-W SoC Platfor

2. In File systems, uncheck the following items
   [*] Network File Systems --->

3) To skip U-boot, the device tree is changed.
The content of environment variable bootargs of U-boot set is posted in bootargs of Image-<SOC_FAMILY>-salvator-x.dts.

4) To do the log output invalidity, the device tree is changed.
Quiet is added to bootargs of Image-<SOC_FAMILY>-salvator-x.dts.

5) The build is done again.

1. bitbake core-image-weston

6) The kernel size definition of IPL is corrected according to the size after the shrink of the kernel.
A re-build of IPL is done by the following command.

1. bitbake arm-trusted-firmware -c compile -f
2. bitbake arm-trusted-firmware -c deploy -f

A.2. TypeC

・Patch application and build

1) To skip U-boot, it applies patch to IPL.

1. cd $WORK/build/tmp/work/salvator_x-poky-linux/arm-trusted-firmware/v1.1+renesas+gitAUTOINC+940eaabe89-r0/git
2. patch -p1 < 0001-Add-U-boot-skip.patch

2) To do the kernel shrink, [ka-nerukonfigu] is changed as follows.

1. The check on the following items is removed with General setup.

   [*] Initial RAM filesystem and RAM disk (initramfs/initrd) support

2. Only the following items are checked with Platform selection, and all checks on other items are removed.

   [*] Renesas SoC Platforms

   [*] Renesas R-Car H3 SoC Platform

   [*] Renesas R-Car M3-W SoC Platform

3. The check on the following items is removed with Bus support.

   [*] PCI support

4. The check on the following items is removed with Kernel Features.

   [*] Xen guest support on ARM64

5. Only the following items are checked with Networking support, and all checks on other items are removed.

   Networking options --->

      <*> Unix domain sockets

6. The check on the following items is removed with Device Drivers.

   [*] Memory Technology Device (MTD) support

   SCSI device support --->

      <*> SCSI disk support

      [*] SCSI low-level drivers

   <*> Generic Thermal sysfs driver

   [*] Watchdog Timer Support

   Multimedia support --->

      [*] Analog TV support

      [*] Digital TV support

   Graphics support --->

      [*] Bootup logo

   [*] LED Support

   DMA Engine support --->

      <*> Qualcomm Technologies HIDMA Management support

    <*> Qualcomm Technologies HIDMA Channel support

   Common Clock Framework --->

[*] Clock driver for Versatile Express OSC clock generators

<*> Clock driver for S2MPS1X/S5M8767 MFD

[*] Clock driver for Freescale QorIQ platforms

[*] Clock driver for APM XGene SoC

Clock Source drivers --->

[*] Workaround for Freescale/NXP Erratum A-008585

<*> Industrial I/O Support

[*] Pulse-Width Modulation (PWM) Support

[*] Reliability, Availability and Serviceability (RAS) features

7. The check on the following items is removed with File systems.

[*] Second extended fs support

<*> The Extended 3 (ext3) filesystem

[*] Quota support

<*> Kernel automounter version 4 support (also supports v3)

[*] Miscellaneous filesystems

Native language support --->

<*> Codepage 437 (United States, Canada)

<*> NLS ISO 8859-1 (Latin 1; Western European Languages)

8. The check on the following items is removed with Virtualization.

[*] Kernel-based Virtual Machine (KVM) support

9. The check on the following items is removed with Kernel hacking.

[*] Magic SysRq key

[*] Memtest

10. The check on the following items is removed with Security options.

[*] Enable different security models

3) To skip U-boot, the device tree is changed.
The content of environment variable bootargs of U-boot set is posted in bootargs of Image-<SOC_FAMILY>-salvator-x.dts.

4) To do the log output invalidity, the device tree is changed.
Quiet is added to bootargs of Image-<SOC_FAMILY>-salvator-x.dts.

5) The build is done again.

```
1. bitbake core-image-weston
```

6) The kernel size definition of IPL is corrected according to the size after the shrink of the kernel.
A re-build of IPL is done by the following command.

```
1. bitbake arm-trusted-firmware -c compile -f
2. bitbake arm-trusted-firmware -c deploy -f
```

Change record	起動時間性能評価仕様書

Rev.	Issue month	Content of revision	
		Page	Point
1.00	2016.12	All pages	First edition issue
1.01	2017.02	4	The reading point of the video camera is changed: Deletion: (2) penguin display and (3) Yocto opening movie display
		5	The reading point of TMU is changed: The addition: It jumps to (2) resume position. The deletion: The (5) object application program is restarted in front of resume of the (3) device. The number is arranged.
		5	Bootchart is deleted.
		6	4.5. The measurement end timing of the Meter cluster or Map app drawing is filled in.
		8	The outline of Bootchart is filled in.
		8	The clock frequency of TMU 0ch is corrected (16.66MHz→8.33MHz).
		8-9	Table 5-2 cold boot measurement point list is changed: T.B. D part is filled in: (2) DDR initialization beginning and (3) The loading beginning of the U-boot kernel. Change: (5) kernel main function and (8) object application program start
		10-11	Table 5-3 warm boot measurement point list is changed: T.B. D part is filled in: (2) kernel resume position. The deletion: The (5) object application program is restarted in front of resume of the (3) device. The number is arranged.
		11-12	RGB and HDMI are omitted and the setting that starts only LVDS is filled in.
		13	The result of a measurement (at the time of the middle review) is filled in.
1.02	2017.02	4	The reading point of TMU is added: (2)DDR initialization end (3)Loading end of U-boot kernel (4)After initializing the device
		4	The effect to delete the reading point of the video camera with Rev1.01 is filled in.
		5	The reading point of TMU is added: (2)DDR initialization beginning and end (4)After kernel resume The number is arranged.
		5	The effect to delete the reading point of TMU with Rev1.01 is filled in. The effect to delete the measurement of Bootchart with Rev1.01 is filled in.
		6	4.5. The measurement end timing at the warm boot of the Meter cluster or Map app drawing is filled in.
		8	Table 51 The remarks row is added to the Timer Prescaler performance value.

		8-10	Table 5-2 cold boot measurement point list is changed: The reading point is added: After initializing the loading end of the kernel and the (4) device of (3) U-boot of (2) DDR initialization end (1) It is filled in that it is TMU timer start on the IPL beginning. The TMU channel is filled in on each reading point. (3)Loading beginning U-boot kernel and measurement part correction of end (8)A set content is filled in on the object application program start.
		10-11	Table 5-3 warm boot measurement point list is changed: The reading point is added: After kernel resume of (4) (2) DDR initialization beginning and the end (1) It is filled in that it is TMU timer start on the IPL beginning. The TMU channel is filled in on each reading point.
		12	③ The patch and the Init script for the measurement are filled in.
		13-14	5.4. The procedure of the patch application, re-build, and HyperFlash writing and eMMC writing is filled in on ① patch application and build of the measurement procedure.
		14-15	④ The measurement procedure is changed: The procedure of the measurement cold boot in TMU is filled in. The result acquisition part is filled in on the procedure of the measurement warm boot in TMU. The measurement procedure in the video is filled in.
		16-21	6. Whether it measured it with which Type like standard BSP etc. is filled in on the result of a measurement.
		17-21	6. As a result of the TMU time stamp, (Three times), it fills it in on the result of a measurement.
		22	7. Consideration is filled in.
		23	The reference literature is changed: [2], 3 Doc of HWmanual is changed to pdf. [4] EMMC_boot.pdf is added. The number is arranged.
1.03	2017.02	10	(8)The content of autostart.service is described to the object application program start.
		16	6.1. It is 6.1 as for Total time . It changes to Total time (video camera shoot measurement result).
		23	7.1.2. Measures against the bottleneck are filled in.
		23	7.2.2. The examination item is filled in.
1.04	2017.03	16-26	6. The result of TypeB (kernel shrink, U-Boot skip, and log output invalidity) is filled in on the result of a measurement.
1.05	2017.03	12	The patch of the U-boot skip is added to Table 5-4 patch list.
		13	5.3. Type is filled in on the measurement pattern.
		14-15	5.4. The procedure of TypeB is filled in on the measurement procedure.
		29-30	7.1.3. [Wo] addition of device driver initialization of three seconds
		31	8. Five is added to the reference literature.
1.06	2017.03	12	Note for TypeB is added to the patch of Table 5-4 patch list U-boot skip.
1.07	2017/03	19	6.2. The mistake at the time between each reading point is corrected.
		29	6.3. The result summary is added.
		30	7. (TypeA) and it specifies it for consideration T.B. D comment.
1.08	2017/03	3	3.1. Table 32 is added to the hardware list.

		9-14	5.2. To divide the one that two or more reading points had been brought together, ② is changed.
		14	5.2. The patch of ③ Table 5-4 patch list U-boot skip is moved to Appendix.
		16	5.4. TypeB of the measurement procedure is moved to Appendix.
		19-28	6. The result of TypeC is filled in on the result of a measurement. The chapter of each application program is added to 6.1 and 6.2.1 paragraphs 6.2.2. The composition of the table is changed to be comparable in each Type.
		20-28	6.2. To divide the table of the time between each reading point into the cold boot and the warm boot, it changes.
		29-30	6.3. TypeC is filled in on the result summary.
		33-34	7.1.4. [Wo] filling in of difference of Daimler Bench at warm boot 7.1.5. [Wo] filling in of difference at uptime by application program 7.1.6. [Wo] filling in of difference at warm boot time by Type 7.1.7. The effect of TypeC is filled in.
		35	8.The summary is filled in.
		37-43	The environmental construction procedure of TypeB and TypeC is filled in as Appendix.

起動時間性能評価仕様書

User's Manual

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RENESAS

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