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IVI Essential Requirements: BSP and Hardware.

06/02/2015
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About Myself

FUJITSU TEN

- Yuichi Kusakabe (Fujitsu TEN LIMITED)

- Software Engineer of IVI about 10 years
  (for 16-bit and 32-bit architecture)

- Linux Software Engineer(2011-2013)
- Linux Software Lead Engineer(2013-Now)

- BSP Porting/Customizing
- Supporting for in-house software developers

Agenda

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- IVI Typical Requirements v.s. Technical Issues
- Proposals for BSP as AGL Standard
- Customizing BSP in detail
- Proposals for Hardware as AGL Reference

IVI Typical Requirements v.s. Technical Issues

IVI Typical Requirements

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- Functional Requirements :
  - Navigation
  - DTV/DVD/USB-VIDEO
  - HD-RADIO/XM/DAB/RDS
  - Bluetooth/WiFi
  - MirrorLink/Miracast/Carplay
  - Voice Recognition
  - Full Browser
  - Download Apps
  - Back Camera/Image Recognition
  - CAN/MOST/Ether AVB

Apple CarPlay | android auto

Wi Fi ALLIANCE | MirrorLink

- Non-Functional Requirements :
  - Fast boot(Booting in 2 seconds)
  - Protecting system against power outage
  - BSP Update/Security Fix
  - Very Long-Term Support (7 years)

Point: These requirements are quite different from 'Smartphones'.

IVI Typical Requirements v.s. Technical Issues (App)

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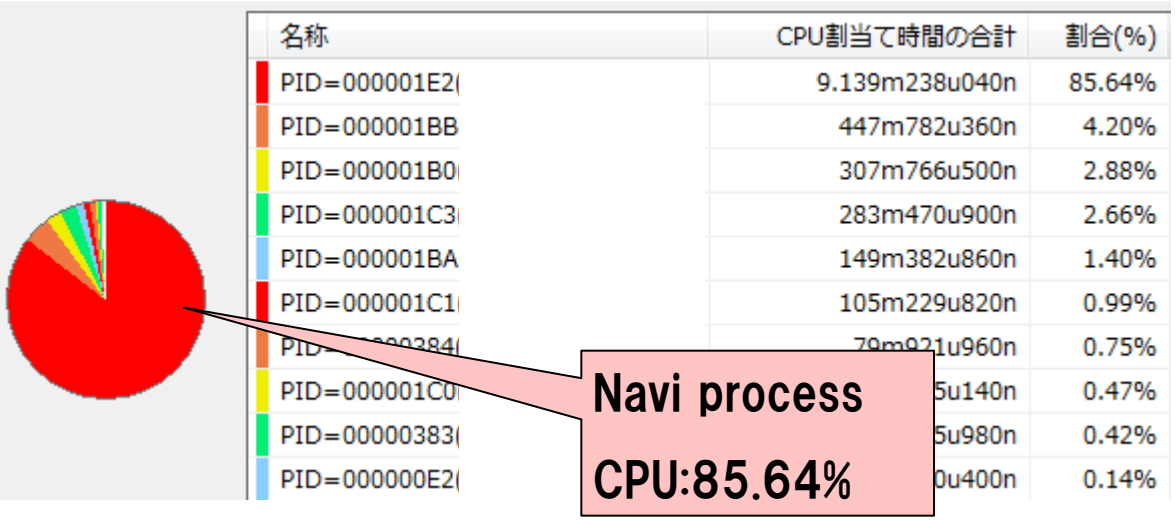
- Navigation (Application/kernel)
  - Searching route very quickly
  - Moving map very smoothly

Tech Issue

- About 1,000 threads sometimes consume 100% of CPU resources
- Reduce CPU resources as possible as we can, even 1%



IVI Typical Requirements v.s. Technical Issues (Middleware)

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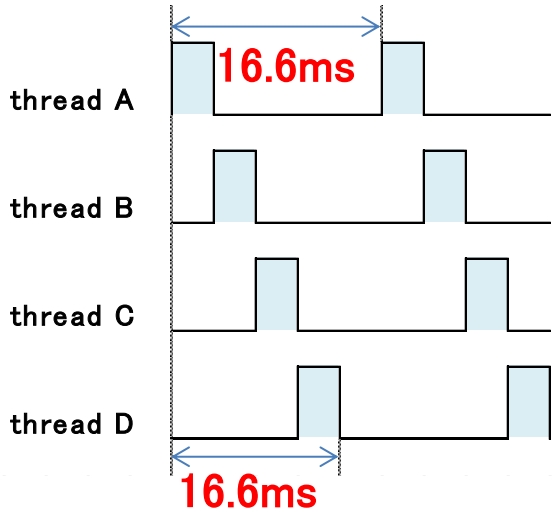
- DTV/DVD/USB-VIDEO (Middleware)
  - H.264 Full HD(60fps->16.6ms) Decoding
  - Multi-Display/Multi-Window (for Map and Video)
  - Playing different movies on front and rear screens simultaneously

Tech Issue

- Customizing is needed for :
- Output Paths for video, worked in 60 fps(16.6ms)
- Window System that can manage Multi-Display/Multi-Window



IVI Typical Requirements v.s. Technical Issues (driver)

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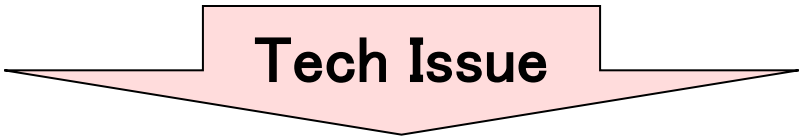
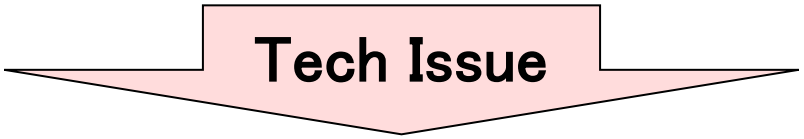
- HD-RADIO/XM/DAB/RDS(Application/kernel)
  - Data Analyzing process does not allowed at its best efforts



➢Finishing Data Analyzing process in every 5ms with no delay

- Bluetooth/WiFi(Driver/kernel/SoC Reference HW)
  - Ultra-High-Speed UART communication with BT-HCI module(1～4Mbps)
  - High-Speed SDIO communication with the WiFi module (SDR50/104)



➢Baud rate of Linux Standard tty is not so high speed
➢Serial overrun error sometimes occurs when CPU usage is so high
➢No implementation about Bluetooth and WiFi on the SoC reference hardware

IVI Typical Requirements v.s. Technical Issues (Fast boot)

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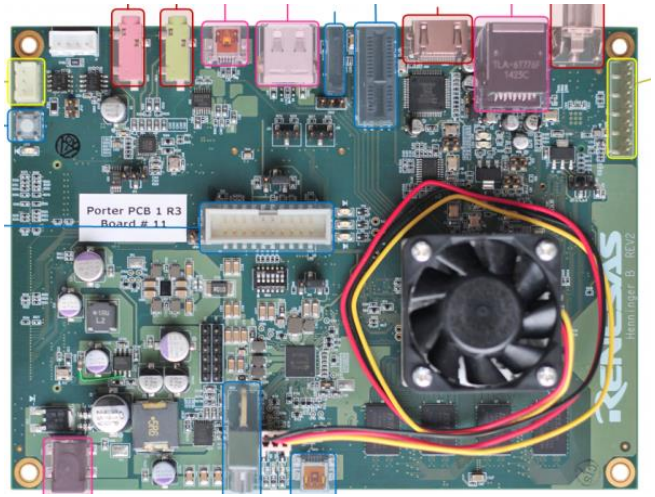
- Fast boot (Driver/kernel/Middleware/Application)
  - Starting CAN communication : 60ms
  - Displaying Back Camera Image : 2sec
  - Playing music : 2sec
  - Displaying Last Screen Image : 3sec

Tech Issue

- Starting CAN communications before kernel booting
- Getting ready for user land in 1.5 sec with Cold Start



R-CAR M2N: http://elinux.org/R-Car

Renesas R-CAR M2N
-CPU : ARM CA15 (1.5GHz)
-MEMORY : DDR3 1GB
-64MB QSPI
-SD CARD (SDR50)

Boot time : 6.3 sec (user land)
-> Not optimized

IVI Typical Requirements v.s. Technical Issues (File system)

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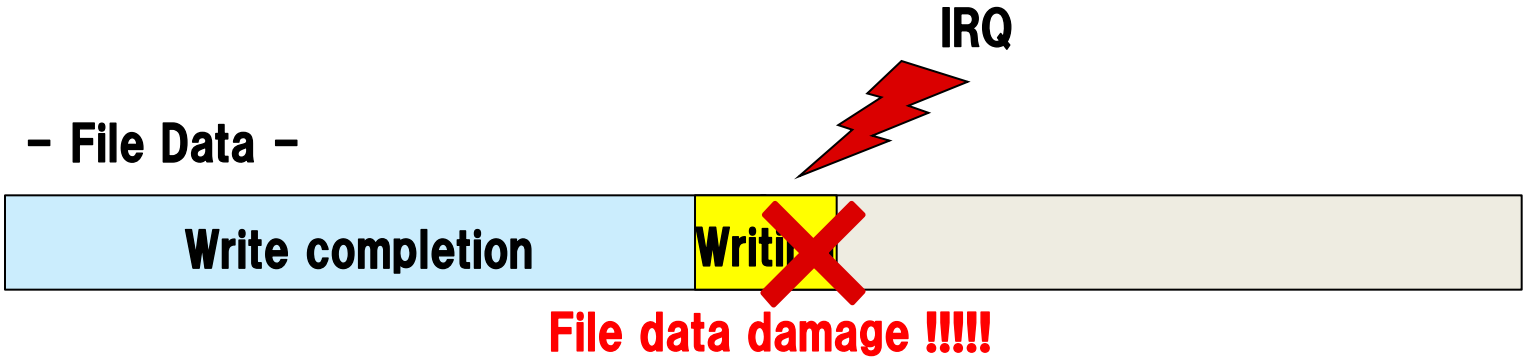
- Protecting system against power outage
  (Driver/kernel/Middleware/Application)
  - Changing its mode to Standby immediately (Engine Cranking)
  - IVI can't have a battery such as Smartphone

Tech Issue

- Changing its mode to Standby in a few milliseconds(1～3ms) when IRQ signals are catched.
- Protecting the files when it is being written
- Customizing binary software offered by other software companies to protect system against power outage



IVI Typical Requirements v.s. Technical Issues (Update)

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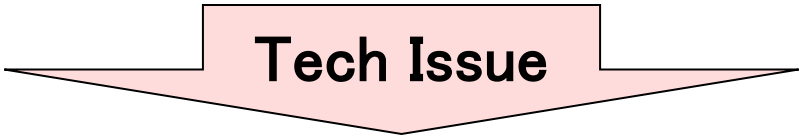
- BSP Update (Driver/kernel/Middleware)
  - SoC corresponding updates
  - Bug Fix Update
  - Security Fix Update



- Regression testing is needed when BSP is updated
- Checking license dependencies when Yocto is updated
- Continuing to maintenance BSP by ourselves if SoC vendor stop supporting it
- Plugging up the security holes of OSS with patches as soon as possible we can, just like Smartphones.

IVI Typical Requirements v.s. Technical Issues (Support)

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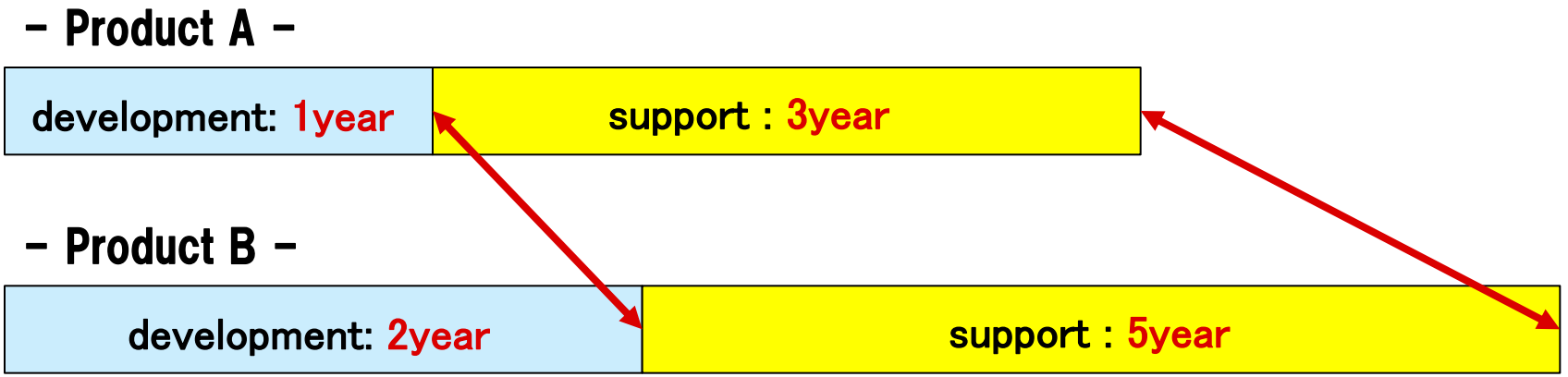
- Very Long-term support (Driver/kernel/Middleware)
  - IVI development period : 6 months ～ 2 years
  - IVI support period :1 ～ 5 years

Tech Issue

- Supporting at least 7 years for IVI
- Maintenance cost will occur again and again and again



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Proposals for BSP as AGL Standard

Proposals for BSP as AGL Standard(App)

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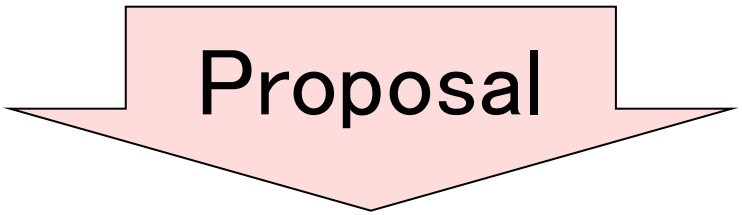
- Application
  - Guaranteeing performance of periodicity and real-time of particular thread even if over 1,000 threads work simultaneously and complicatedly
  - Controlling binary software from outside, that software offered by 3rd party.



  - Developing the management system controlling resource of CPU dynamically by taking advantage of Linux Standard resource management system

Proposals for BSP as AGL Standard(Middleware)

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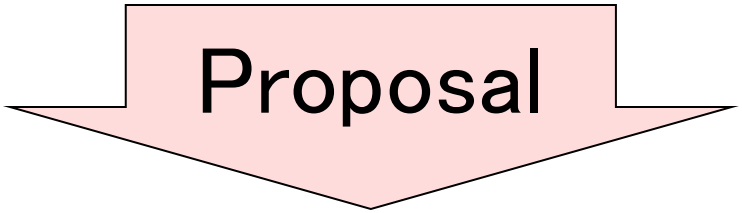
- Middleware
  - Adding some OSS middleware
  - Checking license dependencies of OSS
  - Customizing IVI for multi-display such as Weston
  - Develop the environment of Degradation testing for middleware update



  - Aggregating OSS middleware for IVI used by suppliers and offering then by AGL as Standard packages
  - Developing the environment of testing framework and also offering it by AGL for suppliers.

Proposals for BSP as AGL Standard(kernel)

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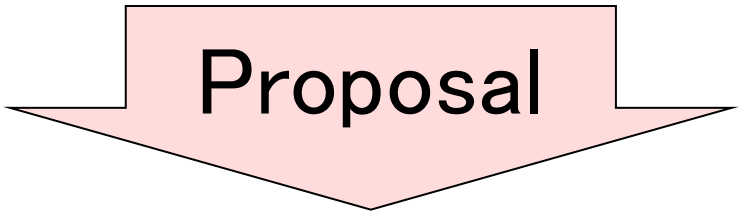
- kernel
  - Long-term supporting such as LTSI
  - Fast booting kernel
  - Maintenance without supporting by SoC vendors



- Customizing original BSP for fast booting(1.5 sec)
- Supporting them over 7 years

Proposals for BSP as AGL Standard(driver)

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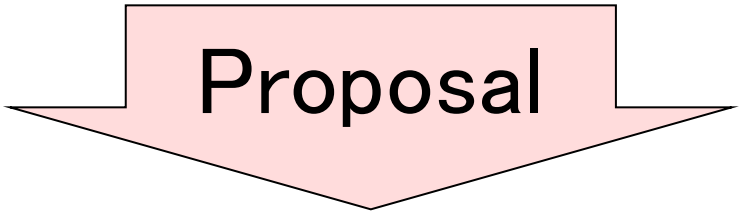
- Device Driver
  - Adding some device software cause of lack of them in BSP
  - Reinforcing performance of driver, error handling and log
  - Sharing the information of error and feedback them to SoC vendors



- Aggregating in-house patches developed by each supplier and offering them by AGL as Standard

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Customizing BSP in detail

Customizing BSP in detail(driver)

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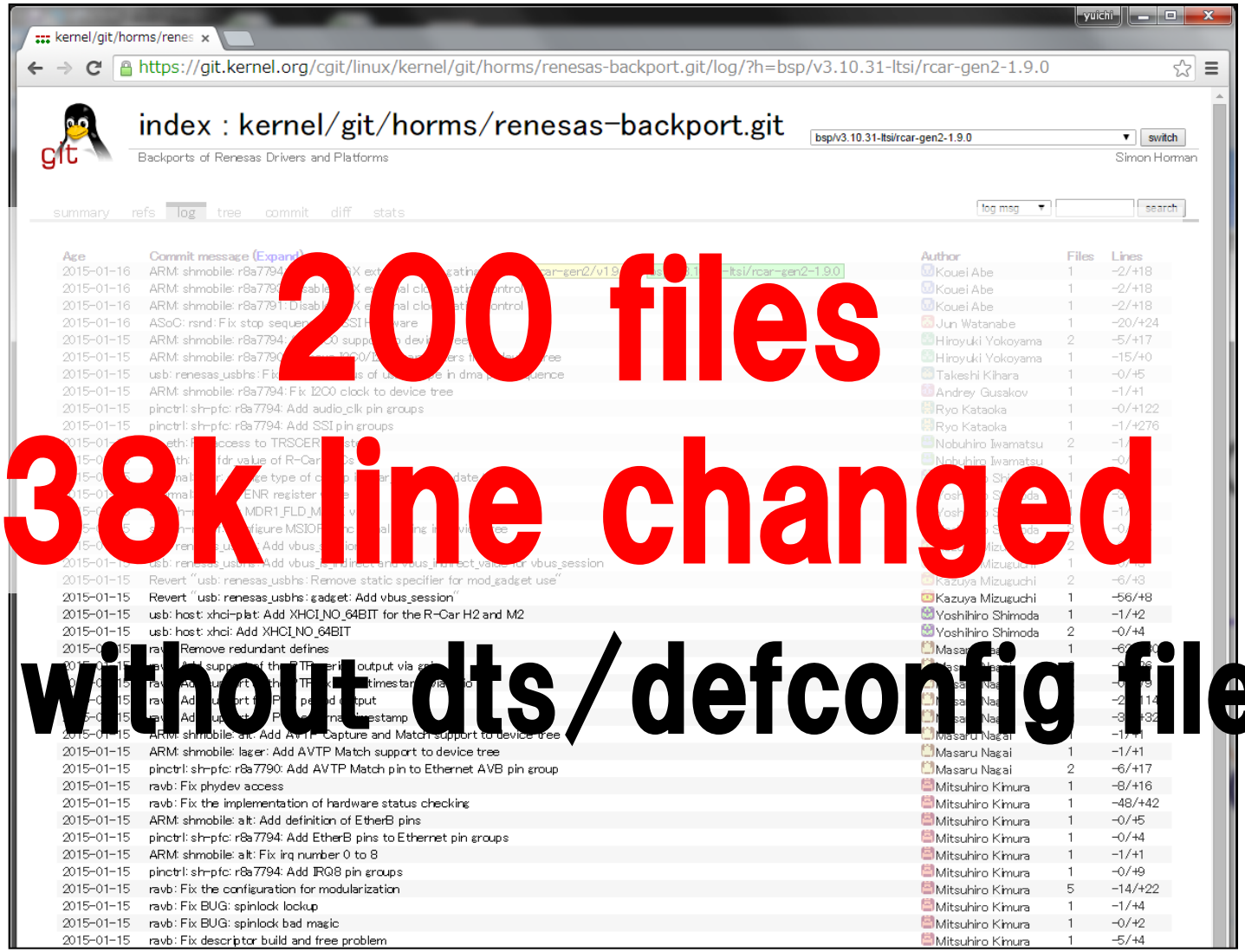
「kernel」SoC BSP LTSI3.10 vs In house LTSI3.10



200 files

38k line changed

without dts/defconfig file

https://git.kernel.org/cgit/linux/kernel/git/horms/renesas-backport.git/log/?h=bsp/v3.10.31-ltsi/rcar-gen2-1.9.0

Customizing BSP in detail(driver)

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「kernel」SoC BSP LTSI3.10 vs In house LTSI3.10

```
drivers/gpu/drm/drm_drv.c                  |  10
drivers/gpu/drm/drm_fb_helper.c            |   6
drivers/gpu/drm/i2c/Kconfig                |   9
drivers/gpu/drm/i2c/Makefile               |   6
drivers/gpu/drm/i2c/adv7390.h              | 150
drivers/gpu/drm/i2c/adv7390_core.c         | 695 ++
drivers/gpu/drm/i2c/ak8818.h               | 135
drivers/gpu/drm/i2c/ak8818_core.c          | 500 +
drivers/gpu/drm/rcar-du/Kconfig            |   7
drivers/gpu/drm/rcar-du/Makefile           |   1
drivers/gpu/drm/rcar-du/rcar_du_crtc.c     |   7
drivers/gpu/drm/rcar-du/rcar_du_crtc.h     |   7
drivers/gpu/drm/rcar-du/rcar_du_drv.c      | 136
drivers/gpu/drm/rcar-du/rcar_du_drv.h      |   7
drivers/gpu/drm/rcar-du/rcar_du_lvdsconn.c | 120
drivers/gpu/drm/rcar-du/rcar_du_lvdscon.h  |   7
drivers/gpu/drm/rcar-du/rcar_du_lvdsenc.c  |   7
drivers/gpu/drm/rcar-du/rcar_du_plane.c    |   7
drivers/gpu/drm/rcar-du/rcar_du_plane.h    |   7
drivers/gpu/drm/rcar-du/rcar_du_regs.h     |  34
drivers/i2c/busses/Kconfig                 |  11
drivers/i2c/busses/Makefile                |   1
drivers/i2c/busses/i2c-sh_mobile.c         |  61
drivers/i2c/busses/i2c-sh_mobile.c         |  61
drivers/i2c/i2c-dev.c                      |  20
drivers/ide/Kconfig                        |   8
drivers/ide/Makefile                       |   3
drivers/ide/ide-cd.c                       |  64
drivers/ide/ide-dma.c                      |   3
drivers/ide/ide-eh.c                       |  63
drivers/ide/ide-io.c                       |  30
drivers/ide/ide-ioctls.c                   |  19
drivers/ide/ide-iops.c                     |   5
drivers/ide/rcar-ide.c                     | 633 +
drivers/mmc/card/block.c                   |  74
drivers/mmc/core/core.c                    |  42
drivers/mmc/core/host.c                    |  28
drivers/mmc/core/lock.c                    |  59
drivers/mmc/core/mmc_ops.c                 |   4
drivers/mmc/core/sd.c                      |   6
drivers/mmc/core/sd_ops.c                  |  10
drivers/mmc/host/Kconfig                   |  16
drivers/mmc/host/Makefile                  |   6
drivers/mmc/host/renesas_sdhi_sys_dmac.c   | 159 +
drivers/mmc/host/sh_mmcif.c                |  16
drivers/mmc/host/sh_mobile_sdhi.c          |  46
drivers/mmc/host/tmio_mmc_pio.c            |  96
drivers/tty/serial/Kconfig                 |   4
drivers/tty/serial/Makefile                |   1
drivers/tty/serial/serial_core.c           |  34
drivers/tty/serial/sh-sci.c                | 402 +
drivers/tty/serial/sh-sci.h                |   8
drivers/tty/tty_ioctl.c                    |  21
kernel/printk.c                            |  20
sound/soc/generic/Kconfig                  |   5
sound/soc/generic/Makefile                 |   2
sound/soc/generic/dirana3.c                | 256
sound/soc/generic/simple-card.c            |  17
sound/soc/sh/rcar/Makefile                 |   4
sound/soc/sh/rcar/ften_adg.c               | 240
sound/soc/sh/rcar/ften_cmd.c               | 270
sound/soc/sh/rcar/ften_core.c              |1261 +++
sound/soc/sh/rcar/ften_gen.c               | 576 +
sound/soc/sh/rcar/ften_rsnd.h              | 686 ++
sound/soc/sh/rcar/ften_src.c               | 862 ++
sound/soc/sh/rcar/ften_ssi.c               | 887 ++
```

Customizing Driver Features

-Performance Tuning

-Error handling

-Log Enhancement

Customizing BSP in detail(driver)

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「kernel」SoC BSP LTSI3.10 vs In house LTSI3.10

filename	line	AGL	F10
arch/arm/mach-shmobile/board-ften-r8a7791.c	101		○
arch/arm/mach-shmobile/board-ften-r8a7793.c	68		○
drivers/dma/sh/rcar-lbscdma.c	2,773	○	
drivers/gpio/gpio-ften_asic.c	300		○
drivers/gpu/drm/i2c/adv7390_core.c	699	○	○
drivers/gpu/drm/i2c/ak8818_core.c	500	○	○
drivers/gpu/drm/rcar-du/rcar_du_compositecon.c	167	○	
drivers/gpu/drm/rcar-du/rcar_du_crtc.c	123	○	
drivers/gpu/drm/rcar-du/rcar_du_drv.c	136	○	
drivers/gpu/drm/rcar-du/rcar_du_encoder.c	74	○	
drivers/gpu/drm/rcar-du/rcar_du_lvdscon.c	120	○	
drivers/gpu/drm/rcar-du/vspd_drv_main.c	52	○	
drivers/i2c/busses/i2c-ften_asic.c	850		○
drivers/i2c/busses/i2c-sh_mobile.c	61	○	
drivers/ide/ide-cd.c	64	○	
drivers/ide/ide-eh.c	76	○	
drivers/ide/rcar-ide.c	835	○	
drivers/input/misc/ften_asic_remocon.c	439		○
drivers/irqchip/irq-ften-asic-intc.c	372		○
drivers/media/i2c/cxd4906gg.c	1,026	○	○
drivers/media/i2c/vcamera.c	493	○	
drivers/media/platform/soc_camera/rcar_vin.c	327	○	
drivers/mfd/ften_asic-core.c	144		○
drivers/misc/ften_asic_adc.c	285		○
drivers/misc/ften_asic_irq_notifier.c	529		○
drivers/misc/lites/buffer.c	109	○	
drivers/misc/lites/const.c	177	○	
drivers/misc/lites/dev.c	608	○	
drivers/misc/lites/ioctl.c	1,417	○	
drivers/misc/lites/mgmt_info.c	854	○	
drivers/misc/lites/parse.c	124	○	
drivers/misc/lites/printk.c	633	○	
drivers/misc/lites/region.c	769	○	
drivers/misc/lites/syslog_init.c	358	○	

common drivers
- -dma
- -drm(gpu)
- -i2c
- -ide
- -mmc
- -mtd
- -net
- -spi
- -tty
- -usb
- -sound

Customizing BSP in detail(Yocto)

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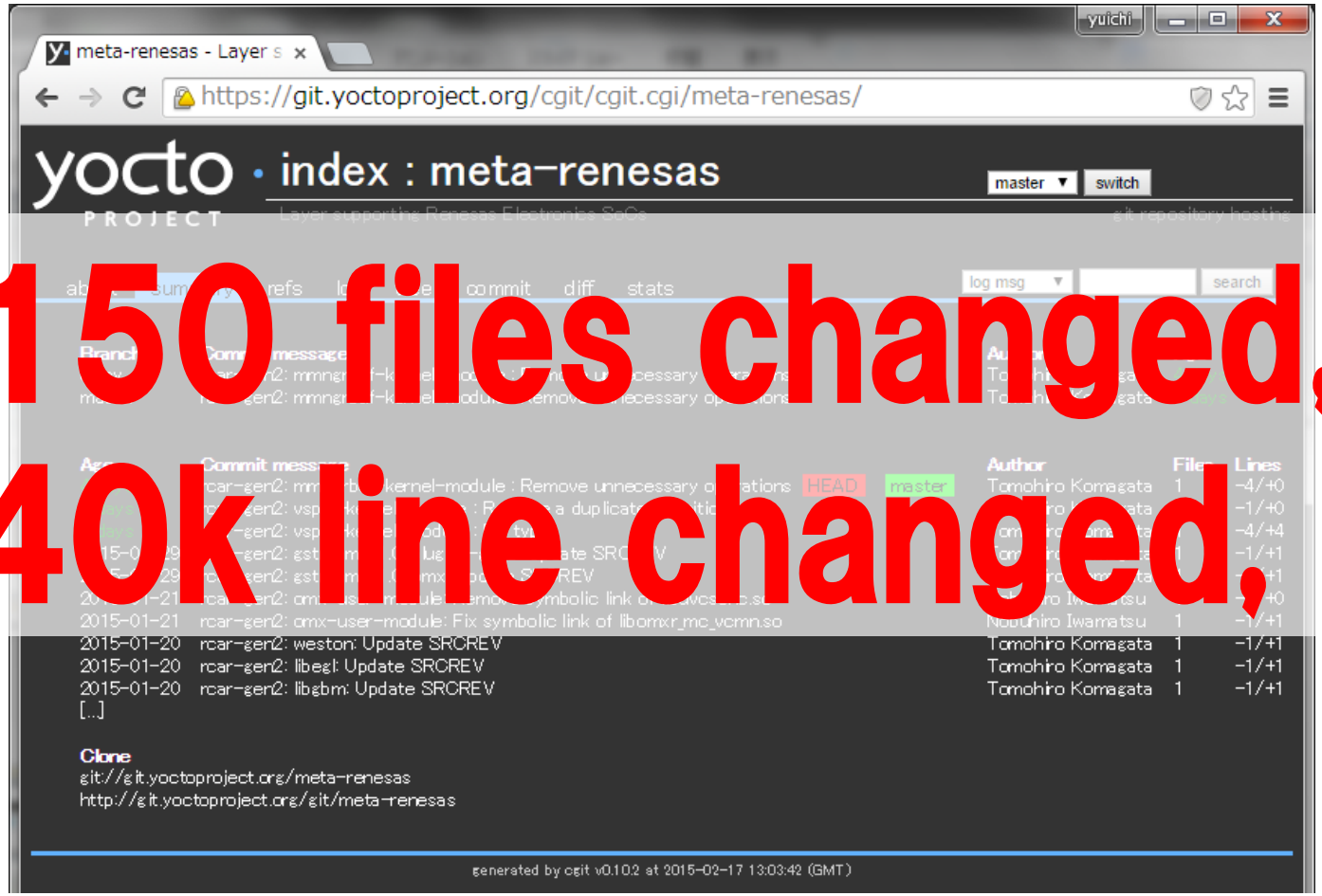
「OSS Middleware」SoC Yocto1.6.1 vs In house Yocto1.6.1



150 files changed,
40k line changed,

http://elinux.org/R-Car/Boards/Yocto
https://git.yoctoproject.org/cgit/cgit.cgi/meta-renesas/
http://git.yoctoproject.org/cgit/cgit.cgi/poky/tag/?id=yocto-1.6.1
git://git.openembedded.org/meta-openembedded
git://git.linaro.org/openembedded/meta-linaro.git

Customizing BSP in detail(Yocto)

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「OSS Middleware」SoC Yocto1.6.1 vs In house Yocto1.6.1

```
meta-ften/recipes-core/ncurses/ncurses_5.9.bbappend                                |   4
meta-ften/recipes-core/sysvinit/sysvinit-inittab_2.88dsf.bbappend                  |   3
meta-ften/recipes-core/util-linux/util-linux_2.24.1.bbappend                       |   8
meta-ften/recipes-devtools/smem/smem.inc                                           |  15
meta-ften/recipes-devtools/smem/smem_0.9.bb                                        |  26
meta-ften/recipes-extended/dlmalloc/dlmalloc.inc                                   |   4
meta-ften/recipes-extended/dlmalloc/dlmalloc_2.8.6.bb                              |  26
meta-ften/recipes-extended/iputils/files/arping-break-libsysfs-dependency.patch    | 296
meta-ften/recipes-extended/iputils/files/debian/add-icmp-return-codes.diff         |  43
meta-ften/recipes-extended/iputils/files/debian/fix-arping-timeouts.diff           |  26
meta-ften/recipes-extended/iputils/files/debian/fix-dead-host-ping-stats.diff      |  16
meta-ften/recipes-extended/iputils/files/debian/targets.diff                       |  15
meta-ften/recipes-extended/iputils/files/debian/use_gethostbyname2.diff            |  31
meta-ften/recipes-extended/iputils/files/nsgmls-path-fix.patch                     |  27
meta-ften/recipes-extended/iputils/iputils_s20101006.bb                            |  73
```

- Adding/Customising OSS middleware
- Managing license dependencies

```
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base/gstvspfilter-bb2-smp-highmem.conf |   2
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base/gstvspfilter-bb2-smp.conf         |   2
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base/gstvspfilter-bb2.conf             |   2
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base/gstvspfilter-eps.conf             |   2
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base/gstvspfilter-mop-na-cd.conf       |   2
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base/gstvspfilter-mop-row-cd.conf      |   2
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base/gstvspfilter-mop-row-dvd.conf     |   2
meta-ften/recipes-multimedia/gstreamer/gstreamer1.0-plugins-base_1.2.3.bbappend                    |  18
meta-ften/recipes-multimedia/packagegroups/packagegroup-rcar-gen2-multimedia.bbappend              |  20
meta-ften/recipes-support/libnl/libnl/fix-lib-cache_mngr.c-two-parentheses-bugs.patch              |  37
meta-ften/recipes-support/libnl/libnl/fix-pc-file.patch                                            |  17
meta-ften/recipes-support/libnl/libnl/fix-pktloc_syntax_h-race.patch                               |  36
meta-ften/recipes-support/libnl/libnl_3.2.23.bb                                                    |  44
meta-openembedded/meta-oe/recipes-support/nonworking/syslog-ng/syslog-ng.inc                       |   3
poky/meta/recipes-core/busybox/busybox.inc                                                         |   2
```

Customizing BSP in detail(TEST FW)

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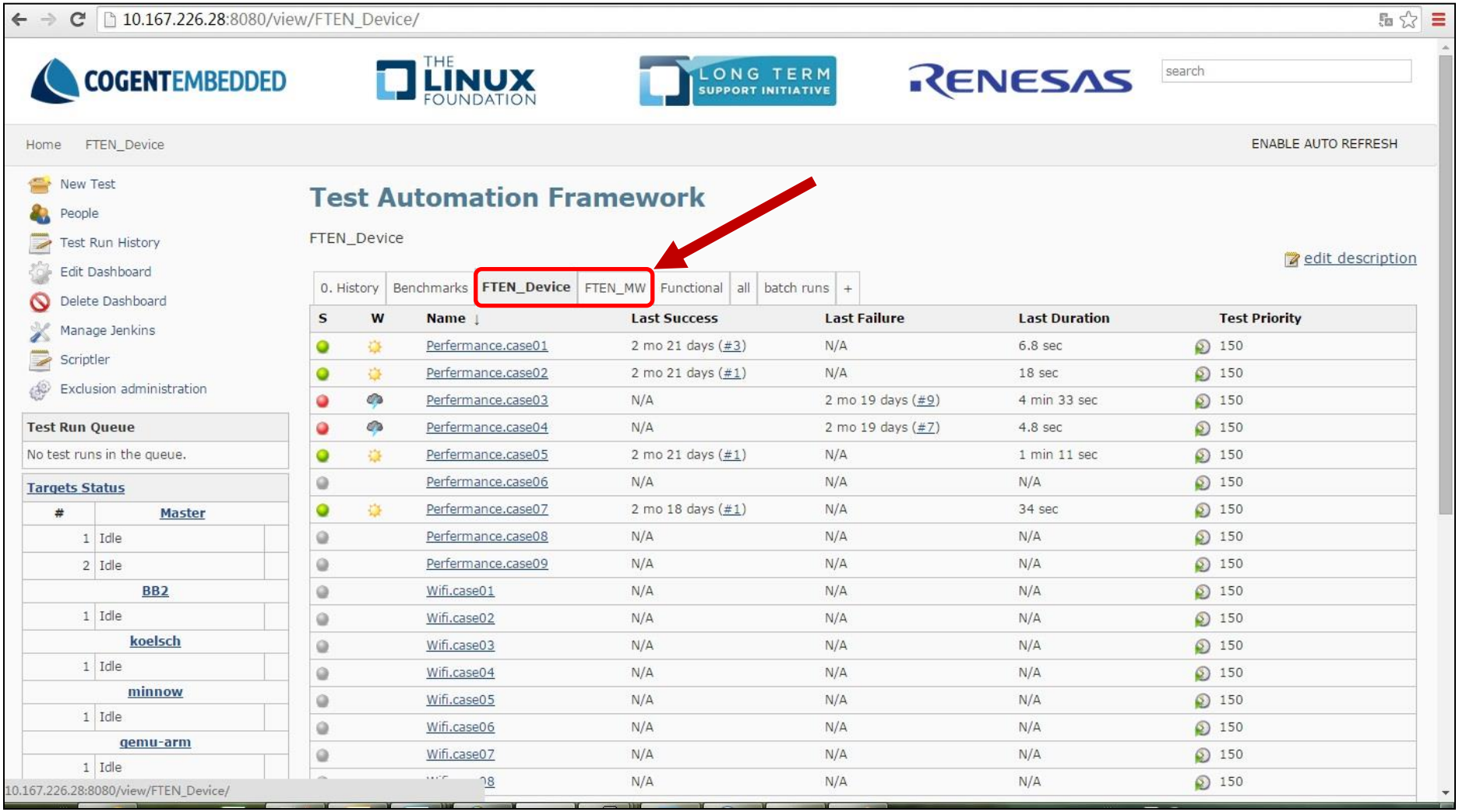
Developing testing framework that based on Jenkins recommended by LTSI



LTSI TEST FW: http://ltsi.linuxfoundation.org/ltsi-test-project

Customizing BSP in detail(TEST FW)

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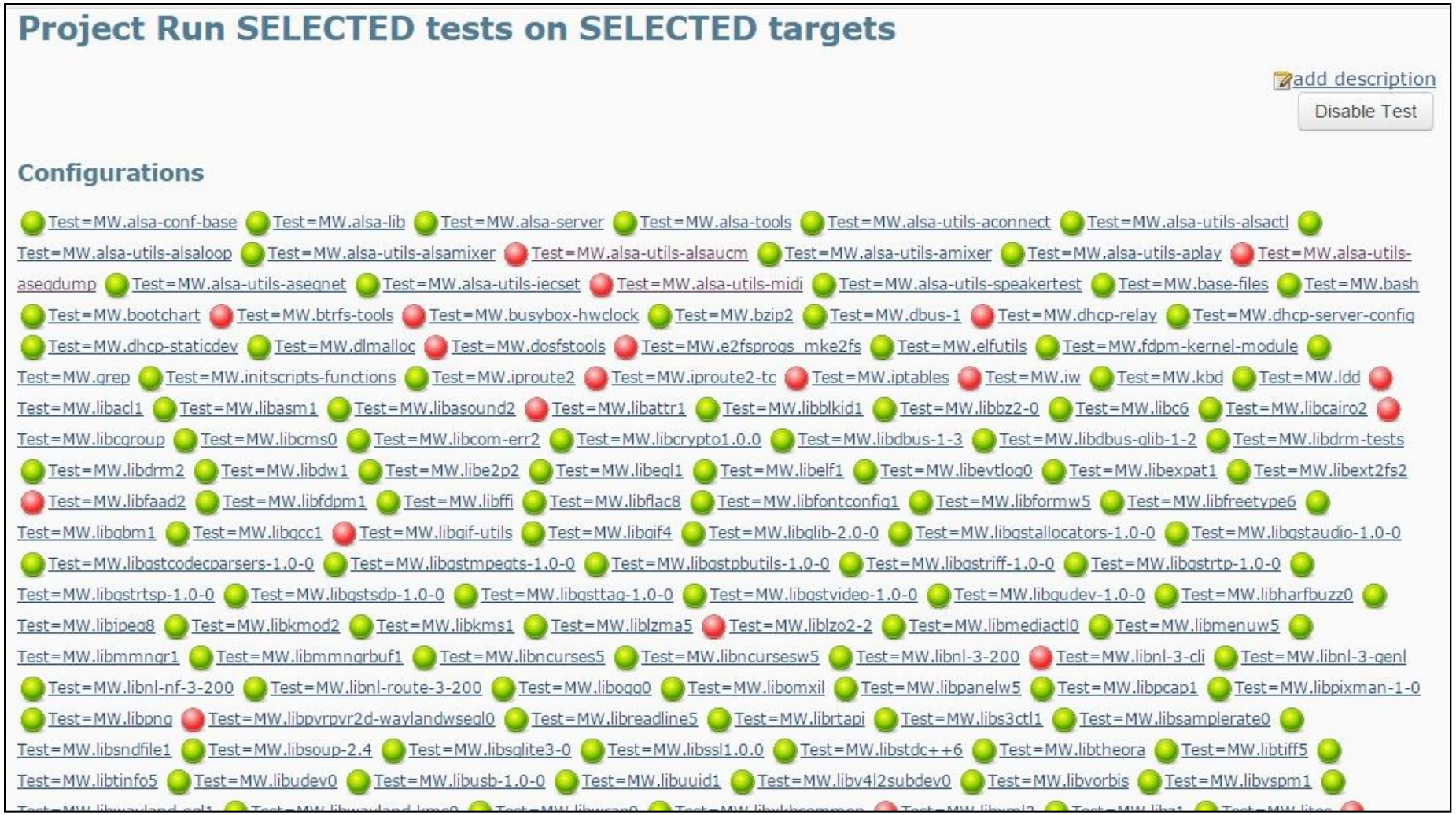
Creating 5.5k test cases for Device Drivers and Middlewares



LTSI TEST FW: http://ltsi.linuxfoundation.org/ltsi-test-project

Customizing BSP in detail(optimized)

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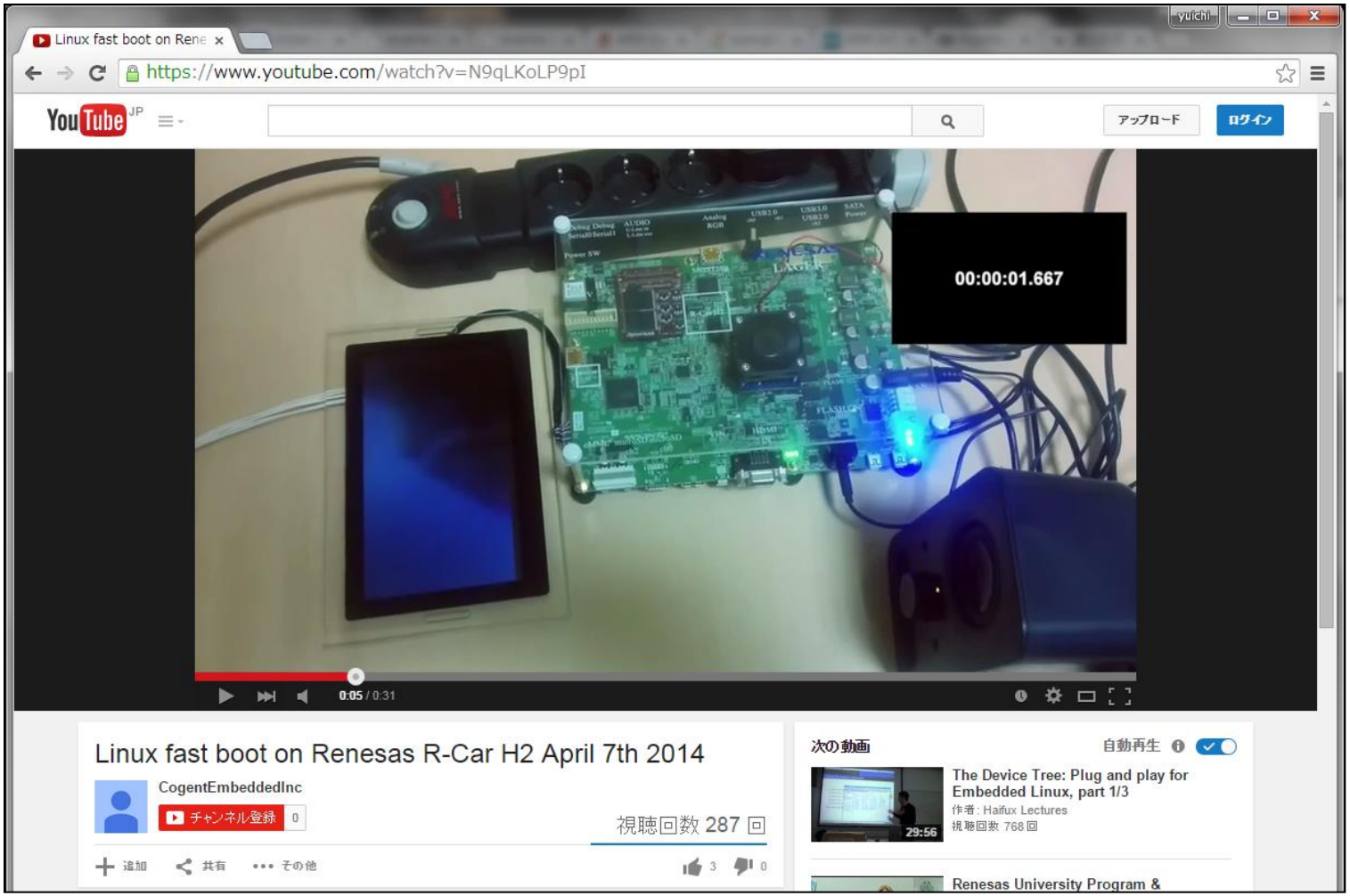
Fast boot : Customizing BSP by SoC Vendor

Starting video playback in 1.6 sec (user space)



https://www.youtube.com/watch?v=N9qLKoLP9pI

R-CAR H2: http://elinux.org/R-Car

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Proposals for Hardware as AGL Reference

Proposals for Hardware as AGL Reference

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Typical IVI System vs Porter (M2)

Differences between Porter offered by Renesas and Typical IVI System

- **e.g. GSP, BT and WiFi**

Porter(M2)

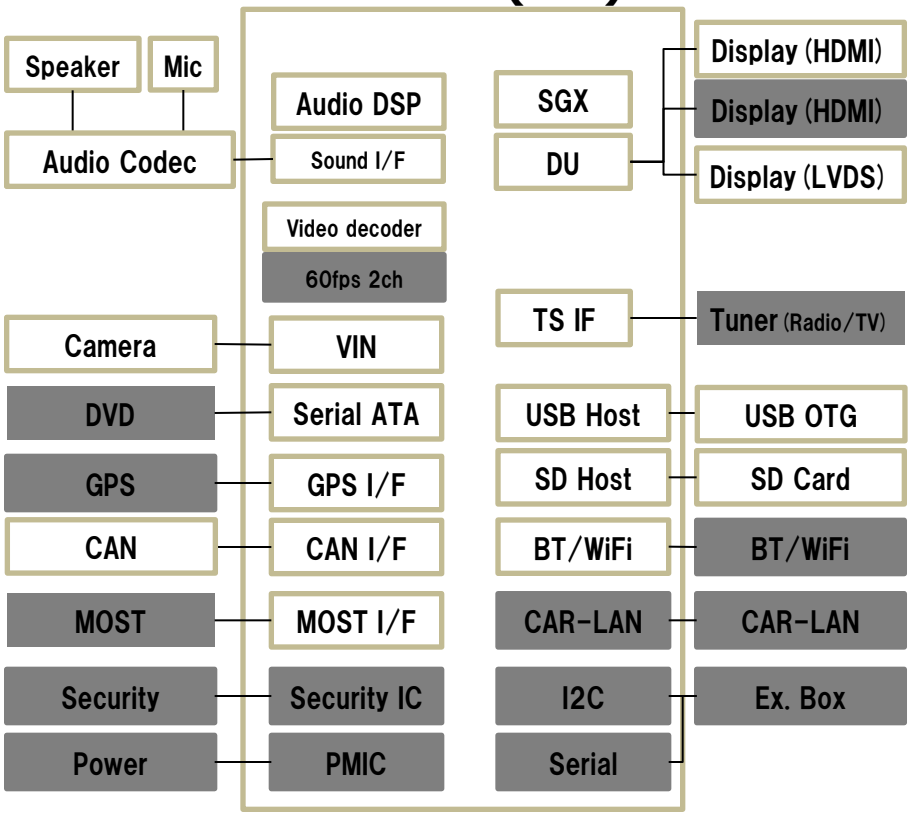

Fig. a Hardware Block: Porter(M2)

Porter: http://elinux.org/R-Car/Boards/Porter

Typical IVI System

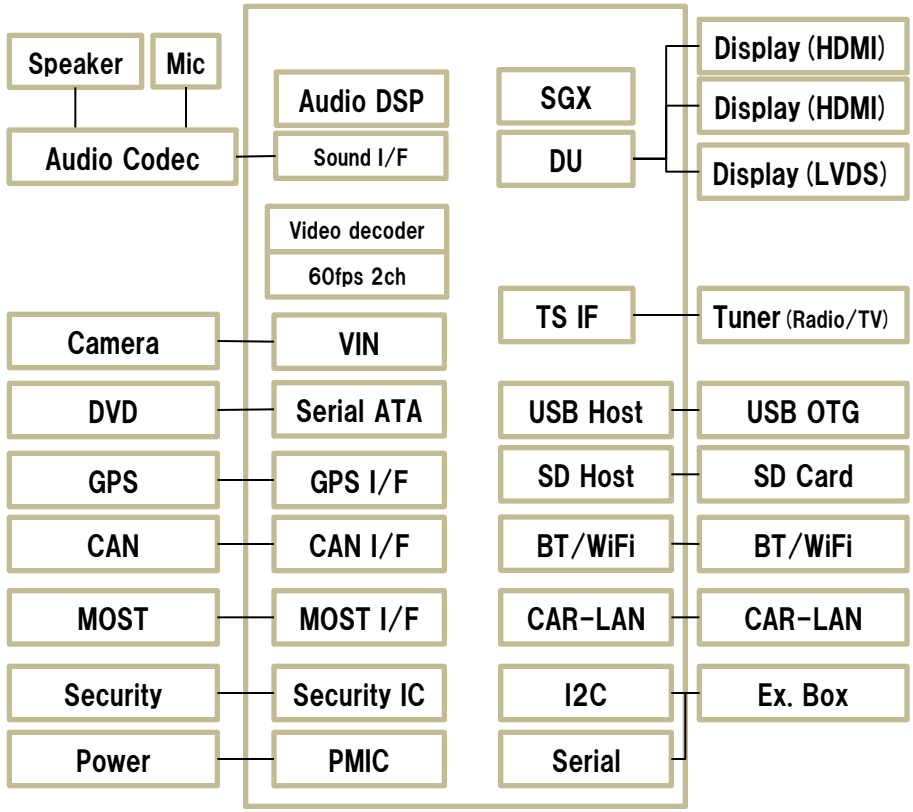

Fig. b Hardware Block: Typical IVI System

Thank you!!!

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