

# AGL ARM prototype development update

## Toward the AGL spec 2.0 definition

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Linux Foundation : Automotive Grade Linux

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# Who am I ?

- From embedded SoC provider company Renesas
- Linux Foundation **AGL (Automotive Grade Linux)** Advisory Board and Steering committee member
- **One of LF/CEWG LTSI<sup>1</sup> project initial proposer**
- At my company, I had been encouraging team developers to send a patches upstream
- Also, I worked with various 1st and 2nd tier IVI makers as well as car OEMs

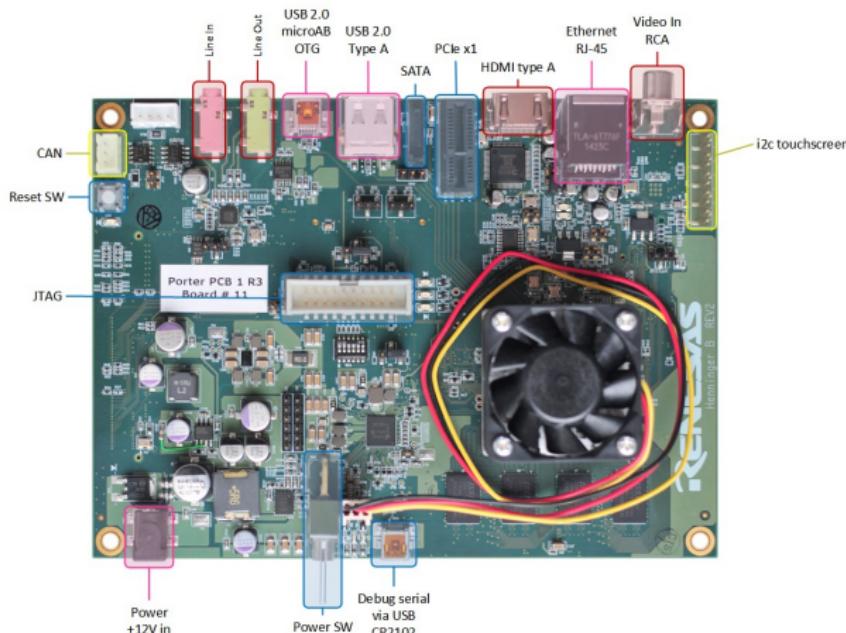
# Project outline

## Scope and goal

# AGL ARM prototype project (motivation and goal)

- Identify the gap between Tizen IVI and real product
  - performance (on generic ARM based SoC)
  - supported feature (=capability)
  - cross platform compatibility (Intel and ARM, GPU feature)
- Attract non-AGL member to join the activity
  - complete OSS implementation
  - proven integrated solution for the real product
  - unique AGL features (FUSA, ADAS,...)

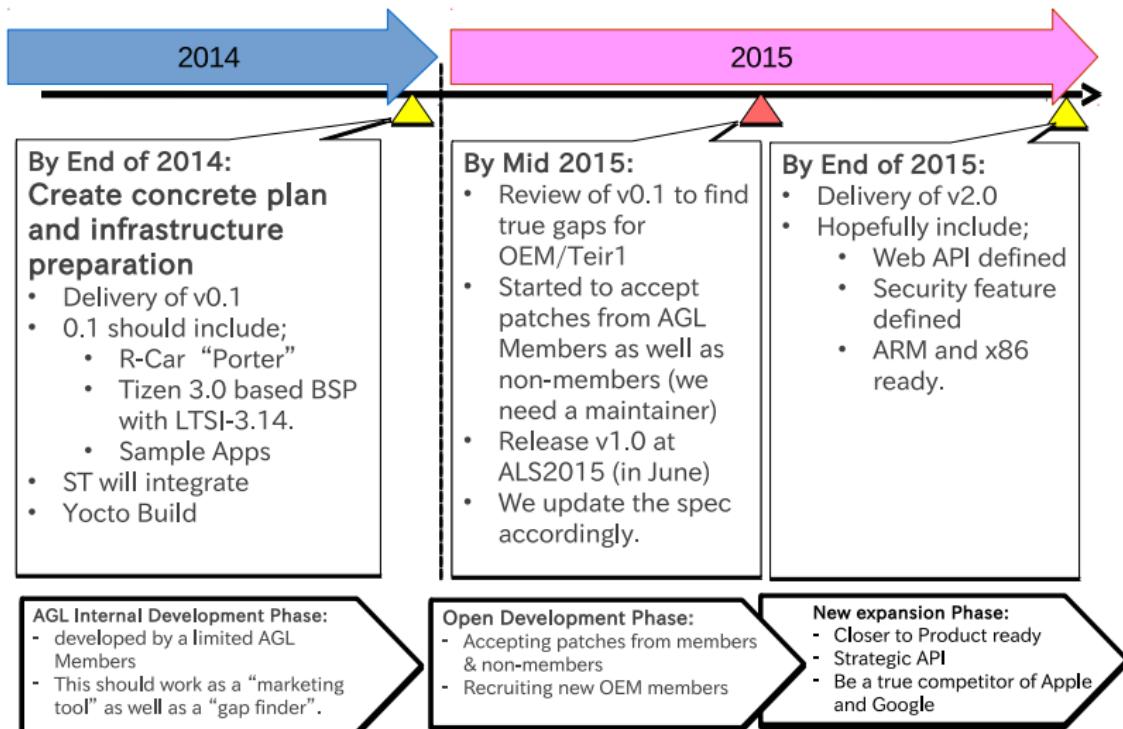
# Project target hardware (is R-CarM2 Porter board)



- ARM Cortex A15 x2
- IMG SGX540MP2
- HDMI, DVI and RGB out (2 display)
- 32bit DDR3 (upto 2GByte)
- QSPI, NAND
- CAN, EthernetAVB, Spped pulse

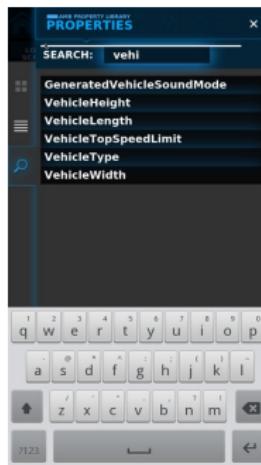
<http://elinux.org/R-Car/Boards/Porter>

# Project schedule and milestone (as of 12-2014)



## Tizen IVI dependency

# AGL and Tizen IVI relationship (till today)



The AGL Reference Platform **utilizes Tizen IVI as its core operating system stack** and adds middleware packages and a user experience to it. <https://wiki.automotivelinux.org/start>

# Tizen IVI reference (mostly on Intel ATOM/Bay Trail)

- NEXCOM VTC 7120-BK & VTC 7120-D1K  
(Celeron QM67 32bit)
- NEXCOM NDiS 166  
(Celeron QM67 32bit)
- Intel NUC Kit DE3815TYKHE  
(Bay Trail 3815 64bit)
- NEXCOM VTC 1010-IVI (BIOS  
MV11A094)  
(Bay Trail 3827 64bit)



[https://wiki.tizen.org/wiki/IVI/IVI\\_Platforms](https://wiki.tizen.org/wiki/IVI/IVI_Platforms)

# Tizen 3.0 code structure (profile and common)

## How to Create a New Tizen Profile

Profiles

Mobile

IVI

...

Common

QA & Tests

Devel

HAL / platform

Core

EFL

Qt

Ofono

...

Tools

Base (mandatory)

Shared (optional)

## Project participants and focused area

# kernel and platform area

## ■ Fujitsu-ten

- Create IVI system prototype  
(microphone, camera, vehicle information)
- Improve back-camera start-up time
- BSP optimization
  - Performance tuning (avoid audio playback interruption)
  - OSS license clarification (avoid GPL v3)

## ■ Renesas

- Tizen IVI 3.0 port to R-CarM2 “Porter” board
- Adopt yocto recipe (despite OBS)
- Enable hardware acceleration (GFX and MMP)
- Enable Crosswalk integration on ARM/IMG environment

# html5 based web application area

## ■ Panasonic

- Performance investigation
  - multiple html5 applications
  - high-load html application
  - html5 app and high-load native app
- check html5 browser performance (Intel vs. ARM)
- AMB and html5 application integration

## ■ Pioneer

- Audio related
  - Create html5 based audio player application
  - Webkit, PulseAudio integration
  - Draft checklist

# other areas

- AISIN AW
  - Navigation application
    - integrate navigation apps on AGL 0.1 environment
    - Gap analysis

## Achievement (by Renesas)

## Tizen IVI 3.0 enablement on R-CarM2

# Renesas R-Car enablement on Tizen IVI upstream

3) Tizen IVI userland (from Tizen Common ARM build)

Gstreamer migrated 1.2.x to (M14.3) to 1.4.x (M14.4)

2) Renesas private patches (for DU/DT/HDMI on 3.14)

1) SMAC related backport (in Tizen upstream)

Genuine LTSI 3.14 kernel

- To comply with Tizen IVI 3.0 requirement, we support LTSI 3.14 for Tizen IVI upstreaming code.
- For AGL ARM prototype trial, we reverted kernel to LTSI-3.10 that is adopted for Renesas R-Car official Linux BSP.

# Renesas R-Car support code at Tizen IVI upstream

[projects](#) / [platform](#) / [adaptation](#) / [renesas\\_rcar](#) / [renesas\\_kernel.git](#) / summary

[summary](#) | [shortlog](#) | [log](#) | [commit](#) | [commitdiff](#) | [tree](#)

[commit](#) | [commitdiff](#) | [tree](#) | [snapshot](#)

[search:](#)  [re](#)

description none  
owner  
last change Tue, 3 Feb 2015 10:37:17 +0900 (17:37 -0800)

[shortlog](#)

Author	Date	Commit Message	Links	Actions
Damian Hobson...	2015-02-03	Correct gbs.conf settings	<a href="#">97/34797/2</a>   <a href="#">accepted/tizen_ivi_tizen</a>   <a href="#">accepted/tizen_ivi/20150204.080604</a>   <a href="#">submit/tizen_ivi/20150203.064147</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Tomohito Esaki	2015-01-30	r8a7791: dtb: change clock name for GPU from "3dg..."	<a href="#">66/34666/1</a>   <a href="#">submit/tizen_ivi/20150202.052133</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Damian Hobson...	2015-01-30	Add FHANDLE defconfig	<a href="#">65/34665/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Tomohito Esaki	2015-01-30	r8a7791: PM: add power on SGX in pm init	<a href="#">64/34664/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Tomohito Esaki	2015-01-30	r8a7791: add SGX device to devicetree	<a href="#">63/34663/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Damian Hobson...	2015-01-19	packaging: Packaging updates for installation in boot...	<a href="#">62/34662/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Damian Hobson...	2015-01-19	Enable HDMI output for Renesas R-Car M2 platform	<a href="#">59/31998/1</a>   <a href="#">accepted/tizen_ivi/20150120.050700</a>   <a href="#">submit/tizen_ivi/20150120.015107</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Ben Doeks	2015-01-19	I2c: gpio: OF gpio code does not handle deferred probe...		<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Damian Hobson...	2015-01-14	Revert "ARM: shmobile: multipoint: add Aduo DMAAC..."		<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Tony SIM	2015-01-14	packaging: Only build for armv7l	<a href="#">34/33634/2</a>   <a href="#">accepted/tizen_3.0_ivi</a>   <a href="#">tizen_3.0_ivi</a>   <a href="#">accepted/tizen_ivi/20150114.121045</a>   <a href="#">submit/tizen_ivi/20150114.094404</a>   <a href="#">tizen_3.0_ivi_release</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Damian Hobson...	2014-12-22	Add packaging	<a href="#">30/31930/2</a>   <a href="#">submit/tizen_ivi/20150108.095140</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Damian Hobson...	2014-12-22	Add tizen_rcar_m2_defconfig	<a href="#">29/31929/2</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Yoshihito Ogawa	2014-12-12	drm: rcar-du: Fix the DU register setting for Hsync	<a href="#">28/31928/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Koji Matsuoka	2014-12-12	drm: rcar-du: Add procedure of memory width update	<a href="#">27/31927/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Koji Matsuoka	2014-12-12	drm: rcar-du: Add max resolution support	<a href="#">26/31926/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>
Koji Matsuoka	2014-12-12	drm: rcar-du: Add interlaced mode support	<a href="#">25/31925/1</a>	<a href="#">commit</a>   <a href="#">commitdiff</a>   <a href="#">tree</a>   <a href="#">snapshot</a>

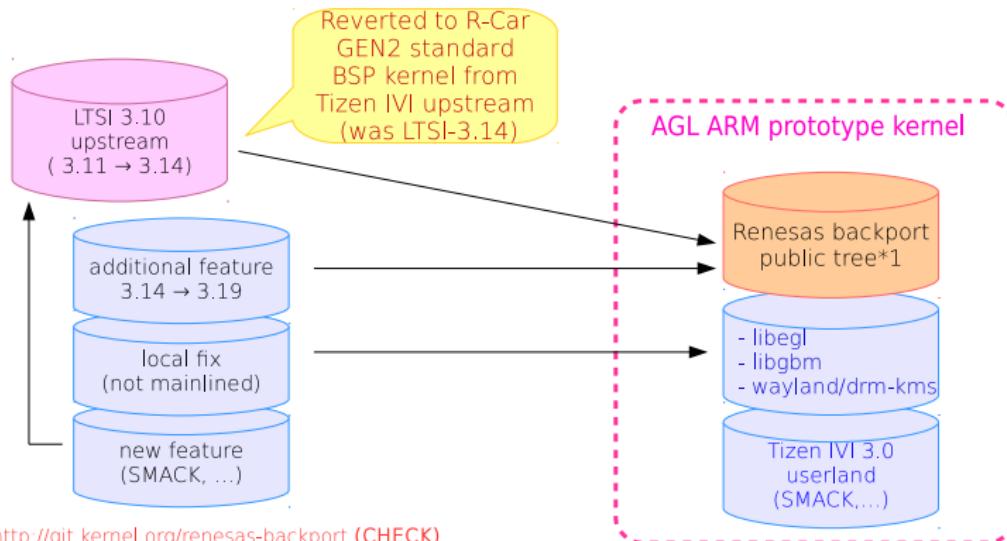
[tags](#)

Tag	Description	Links
2 months ago tizen_3.0_ivi_release	Release Tizen 3.0 IVI	<a href="#">tag</a>   <a href="#">commit</a>   <a href="#">shortlog</a>   <a href="#">log</a>
3 months ago accepted/tizen_ivi/20150204.080604	The SR (Submit Request) has been...	<a href="#">tag</a>   <a href="#">commit</a>   <a href="#">shortlog</a>   <a href="#">log</a>
3 months ago submit/tizen_ivi/20150203.064147	Correct gbs.conf	<a href="#">tag</a>   <a href="#">commit</a>   <a href="#">shortlog</a>   <a href="#">log</a>
3 months ago submit/tizen_ivi/20150202.052133	Updates for packaging and enabling...	<a href="#">tag</a>   <a href="#">commit</a>   <a href="#">shortlog</a>   <a href="#">log</a>

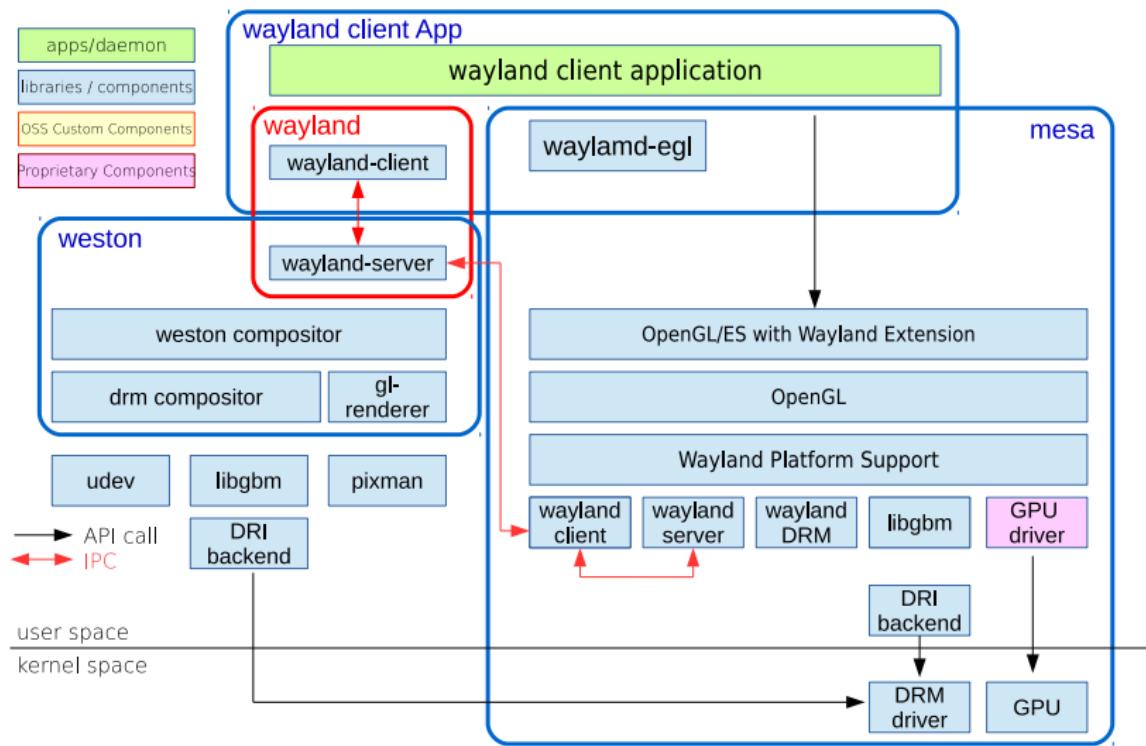
[https://review.tizen.org/git/?p=platform/adaptation/renesas\\_rcar/renesas\\_kernel.git;a=summary](https://review.tizen.org/git/?p=platform/adaptation/renesas_rcar/renesas_kernel.git;a=summary)

# AGL prototype kernel (LTSI-3.10 + feature backport)

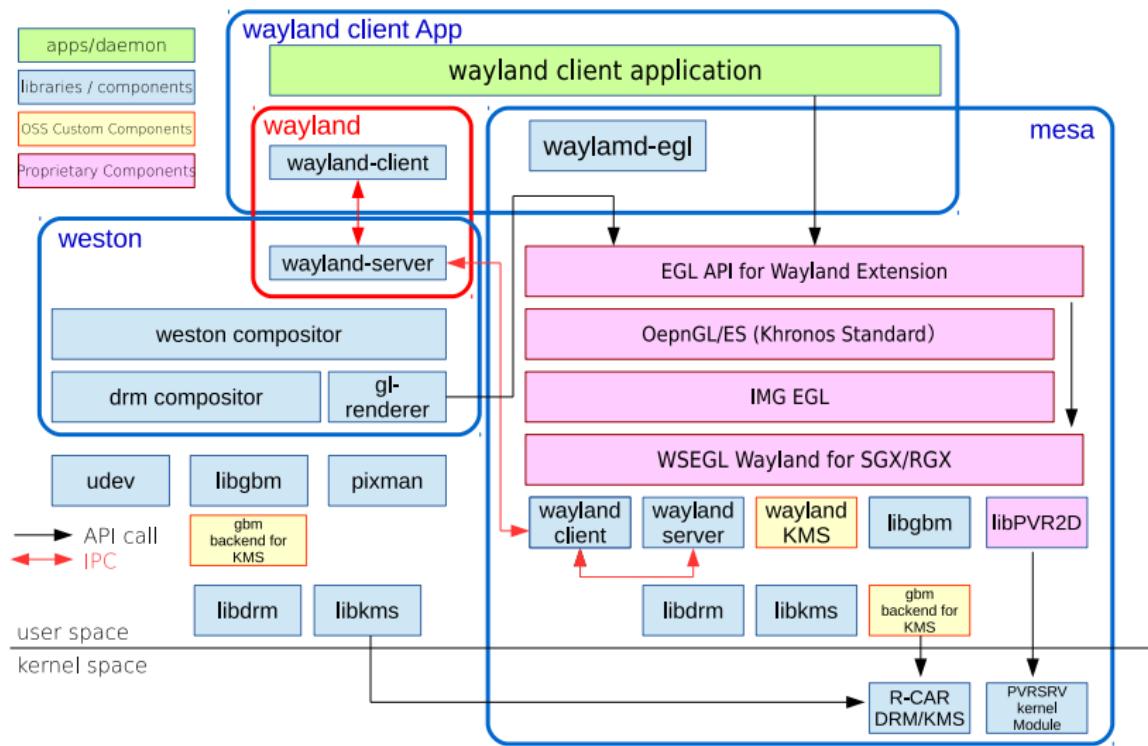
- Based on R-Car gen2 BSP for the commercial product
- Tizen IVI specific backport (SMACK related)
- Renesas R-Car specific backport (GPU, MMP related)



# Wayland/Weston architecture (for MESA = Intel)



# Wayland/Weston architecture (for R-Car = IMG GPU)



## Tizen common userland (ARM hf ABI support)

- ARM v7 has two different ABI
  - hf : hard float, use VFP
  - soft : soft float, use CPU for floating calculation
- Default Tizen ARM userland (by Samsung) adopts “soft”
- “soft to hard migration” might cause compatibility issue
  
- Now, Tizen IVI 3.0 (final) comes with yocto recipe that can generate ARM hf userland binary (-800 packages)

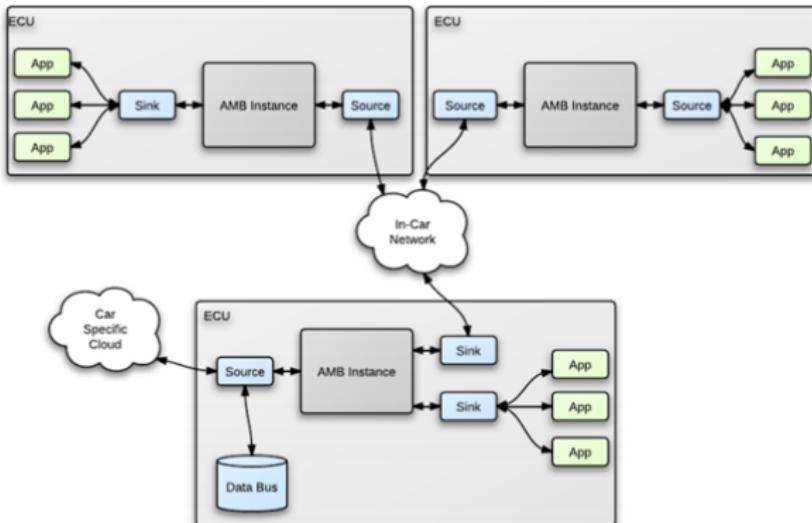
Tizen IVI ARM gains 5 to 10% performance improve by VFP

# Platform dependent binary support (GFX and MMP)

- GFX (GPU composition support)
  - GPU utilization becomes key factor for the performance
  - Wayland/Weston requires hardware composition capability
- MMP (multi-media codec engine support)
  - HD video playback/record becomes common demands
  - R-Car has contains hardware for h.264 encode/decode
- GFX and MMP requires restricted binary firmware
- Now, evaluation version (w/time bomb) of binary firmware can be downloaded from public web.
  - [http://www.renesas.com/secret/r\\_car\\_download/rcar\\_demoboard.jsp](http://www.renesas.com/secret/r_car_download/rcar_demoboard.jsp)

## AMB code optimization proposal

# Automotive Message Broker (AMB)



**The goal of AMB is to transfer realtime data between applications within one ECU, or transparently, across multiple ECUs.**

# AMB: Current State

- Official repository

<https://github.com/otcshare/automotive-message-broker>

- Website

<https://01.org/automotive-message-broker>

- Maintained by Kevron Rees, Intel Corp.

- Latest stable version v0.14 (v0.15 is in development)

- Implemented features

- Core & plugin system
- CAN, Bluetooth, GPS, ODB-II
- Logitech G27 racing wheel
- DBus, WebSockets, Murphy
- Basic OpenCV integration

# Proposal Summary

- (A) CAN bus support
- (B) Bug-fixes
- (C) Improvements to AMB Core
- (D) Documentation and Specifications
- (E) Extra changes beyond the scope

## (A) CAN bus support (current status)

CAN bus support in v0.14 is very preliminary

- CAN BCM is supported only for cyclic messages
- \*.dbc file parser is limited to simple cases
- Manual configuration of CAN messages without \*.dbc file is difficult
- No variant CAN messages supported
- Messages are only received, no capabilities for sending
- Multi-threaded code in CAN plugin locks on a single mutex in AMB core held for a relatively long time
- No prioritization of data in CAN plugin

## (A) Improvements in CAN bus support (proposals)

- (A01) Parsing of multiple \*.dbc and \*.msg files
- (A02) Manual definition of messages in \*.msg file
- (A03) Full CAN BCM support with timeout and Value-Time-Quality support (requires (C01))
- (A04) Sending of cyclic and triggered CAN messages with configuration in \*.msg file
- (A05) Option in \*.msg file to select CAN RAW socket interface
- (A06) Parallel data updates in CAN plugin avoiding single mutex in AMB Core
- (A07) Variant CAN message support (multiplexing)

## (B) Bug-fixing (current known issues)

AMB v 0.14 produces Segmentation Faults every few minutes

- Memory corruption in multi-threaded code in various modules
- Memory leaks in Core class
- Priority inversion in Core and AsyncQueue class
- Improper use of std::shared\_ptr
- Many temporary workarounds still exist
- Specifications and requirements are not clear so is the implementation

## (B) Bug-fixing (proposals)

- (B01) Analyze multi-threaded code, fix memory corruptions where possible, introduce locks where required
- (B02) Analyze and fix memory leaks in AMB::Core class
- (B03) Analyze and fix std::shared\_ptr usage
- (B04) Improve error handling, add try-catch sections in Core class
- (B05) Reduce overhead on data updates, improve AsyncQueue class

## (C) Improvements to AMB Core (proposals)

- (C01) Improve Value-Time-Quality support
- (C02) Selection of POSIX CLOCK\_REALTIME or CLOCK\_MONOTONIC for automatic data timestamping
- (C03) New Data Logging plugin
- (C04) OPC UA binary protocol adoption for AMB-to-AMB data transfer over UDP/IP in multi-ECU configurations
- (C05) libambclient as an alternative to plugin system with XML and binary OPC UA transfer protocols
- (C06) Simple ncurses/GUI tool for viewing AMB data in real-time on host (Python/Qt/Tk ?)
- (C07) Node configuration with data dictionary

Beside listed items, we need essential improvement of AMB Core code

# OPC UA = OLE4 Process Control Unified Architecture

- OPC UA is a cross-platform successor of scattered OPC standards for data access, alarms and events, data logging etc
- OPC is
  - industry-proven
  - works well with large number of variables in real-time
  - supports timestamps and quality
- OPC UA supports XML and Binary transfer protocols
- AMB project can collaborate on JSON transfer protocol

## (D) Documentation and Specifications (proposals)

- (D01) Manual for plugin developers with requirements and guidelines
- (D02) Redefinition (new specifications for) of “sink” and “source” plugins with bidirectional data transfer (push/subscribe)
- (D03) Study the possibility of merging with OPC UA specifications

## (E) Extra changes beyond the scope (proposal)

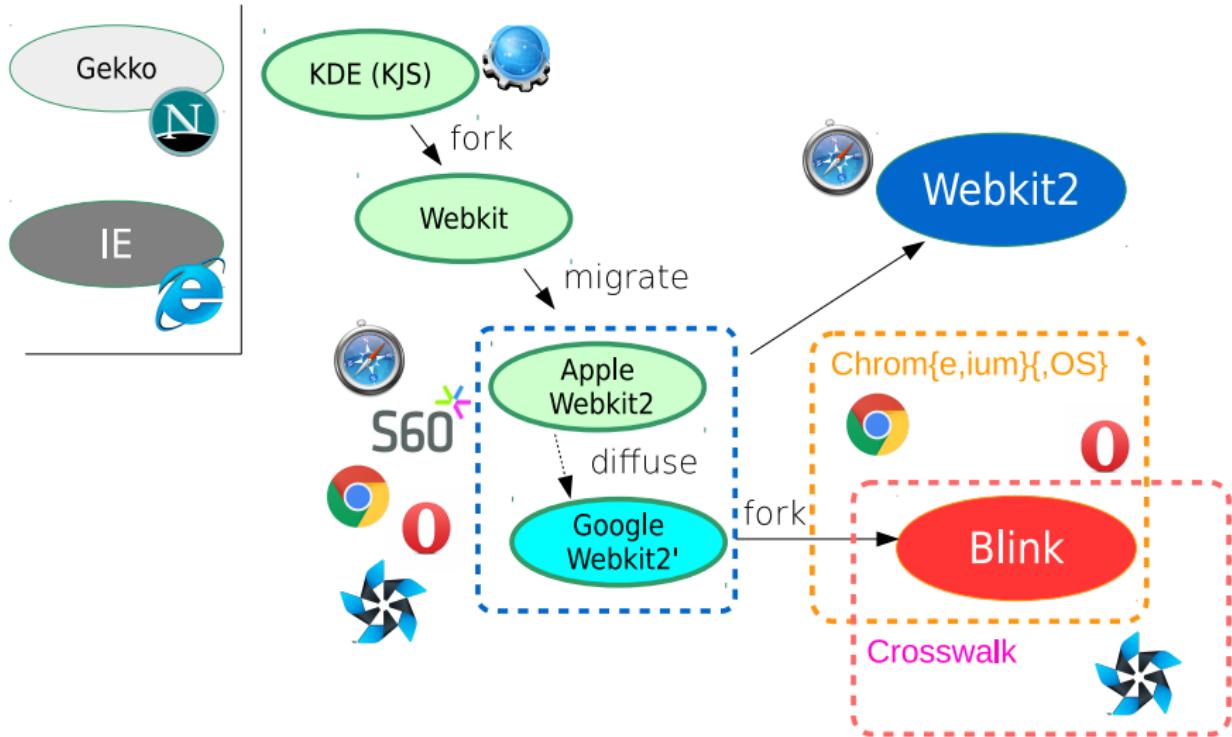
- (E01) Data security (access control)
- (E02) Switch from dbus to kdbus
- (E03) Binary transport protocol over CAN (FlexRay?)
- (E04) Object-oriented data model  
(Chasis.Wheels.LeftFront.Speed.rpm) as a replacement  
for Zone enum
- (E05) Full OPC UA support (Discovery, Server, Client, XML  
and binary protocols)
- (E06) Merge with OPC UA. Improvements to OPC UA  
specs “OPC UA in automotive applications” chapter in  
OPC UA standard
- (E07) Multi-node auto-configuration with routing support
- (E07) datafs (/sys/data/amb/vehicle/speed)

## Chromium integration on ARM platform

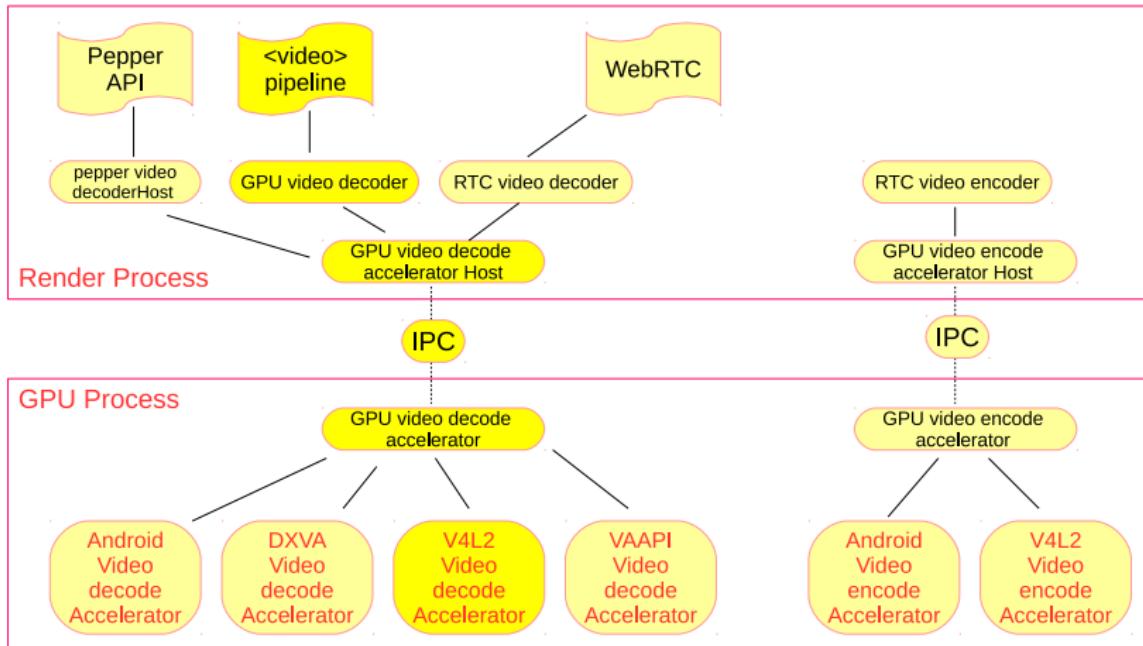
# Research points

- Chromium (=blink) Integration
  - Required to implement APIs
  - OpenGL integration
- FUSE
  - ioctl overhead estimation
- Buffer management
  - buffer allocation
  - zero-copy transmission

# Web RunTime trends (Tizen migrated to Blink now)



# HW Video Acceleration in Chrom{e,i}um}{,OS}



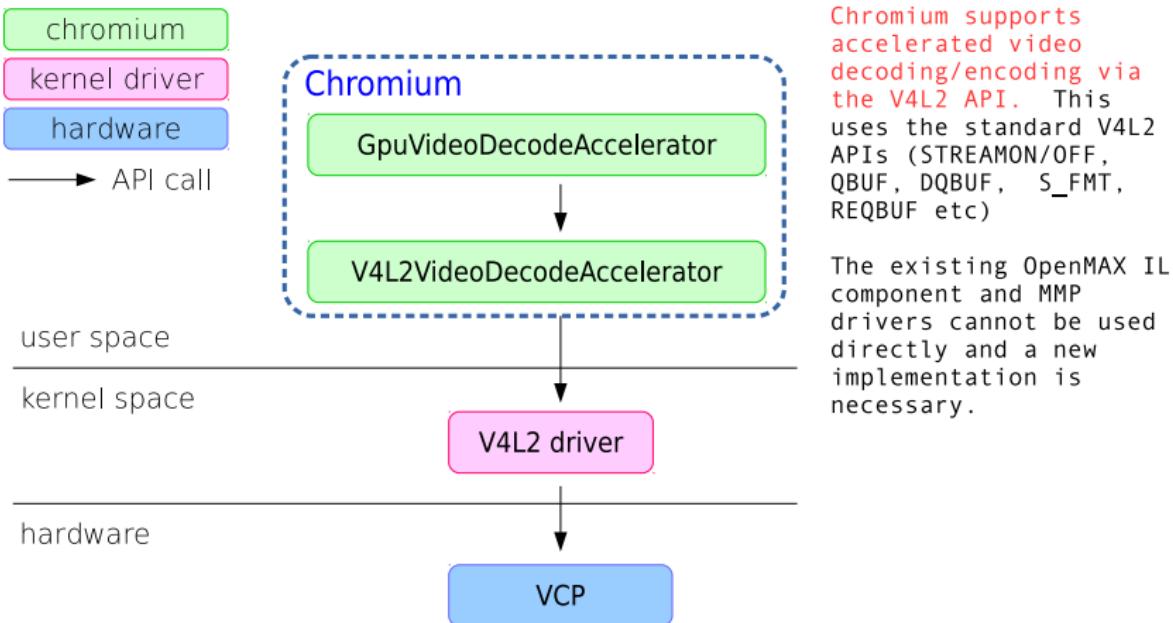
Refereed from Google Docs titled = "HW Video Acceleration in Chrom{e,i}um}{,OS}"

# Glossary for Chromium ARM (R-Car) integration

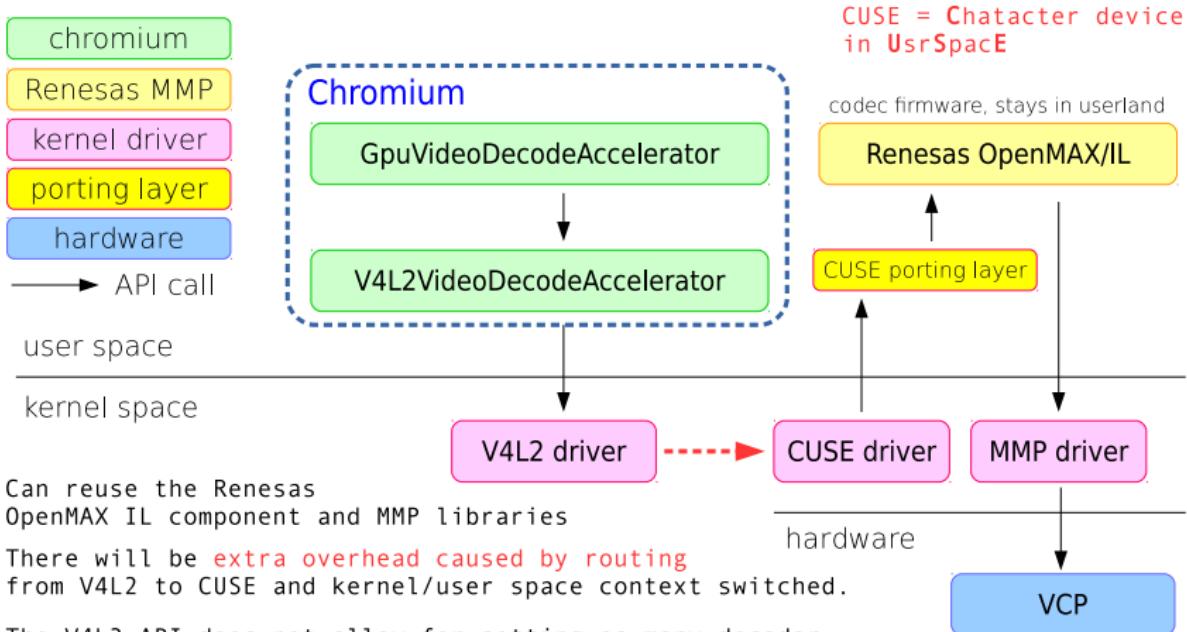
Term	Meaning
FUSE	File system in Userspace (upstream kernel driver / framework)
CUSE	Character device in Userspace (upstream kernel driver / framework based on FUSE)
VUSE	4L2 device in Userspace (extension based on upstream CUSE driver)
appsink	GStreamer plugins that allow an application to directly exchange buffers with a GStreamer pipeline
vsfilter	GStreamer plugin to control the Renesas image processing IP (VSP)
Renesas OMXIL	Library that provides access to Renesas hardware accelerated video decoder (based on OpenMAX IL interface)
MMP	Renesas Multimedia package, used by/with the Renesas OMXIL to access the platform hardware



# V4L2 Video Decode Integration for Chromium



# Binding Renesas OMXIL to V4L2 with CUSE = VUSE



# CUSE overhead can be minor (if designed correctly)

## ■ ioctl overhead (RTT=Round Trip Time)

CPU load (by 500 RTT samples)	latency (usec)		
	min.	max.	avg.
19% - video playback (1080p)	110	1,300	132
76% - canvas API demo on xwalk	120	6,630	267
86% - video + xwalk (1080p)	125	4,650	286

canvas API demo: <http://alteredqualia.com/canvasmol/>

Must keep buffer queues in kernel driver (not daemon)  
to avoid expensive RTT during decode data streaming

## ■ client/daemon CPU load

ioctl calls per second	call period	client CPU load	daemon CPU load
60	16	<1%	<1%
1,000	1	2%	4%

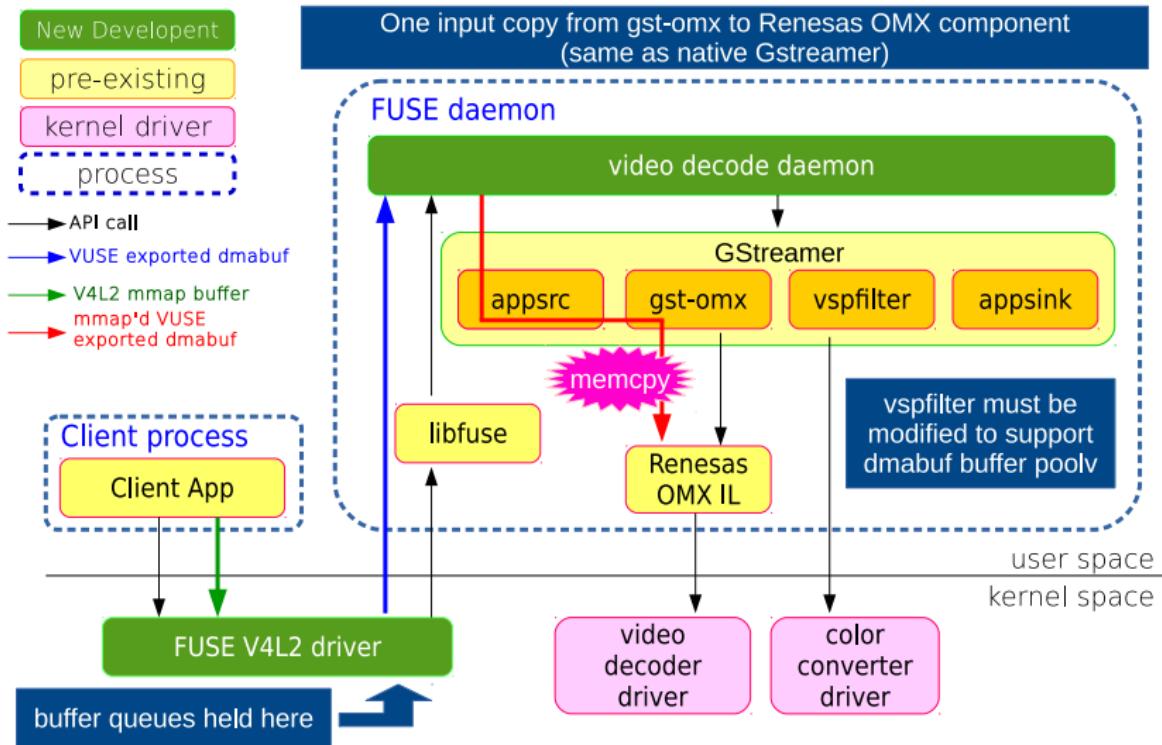
# Chromium Buffer Management

- Buffer allocation
  - Chromium requests buffers from V4L2 kernel driver
- Possible buffer types
  - input buffer : vmalloc
  - output buffer : dma-contig (CMA)

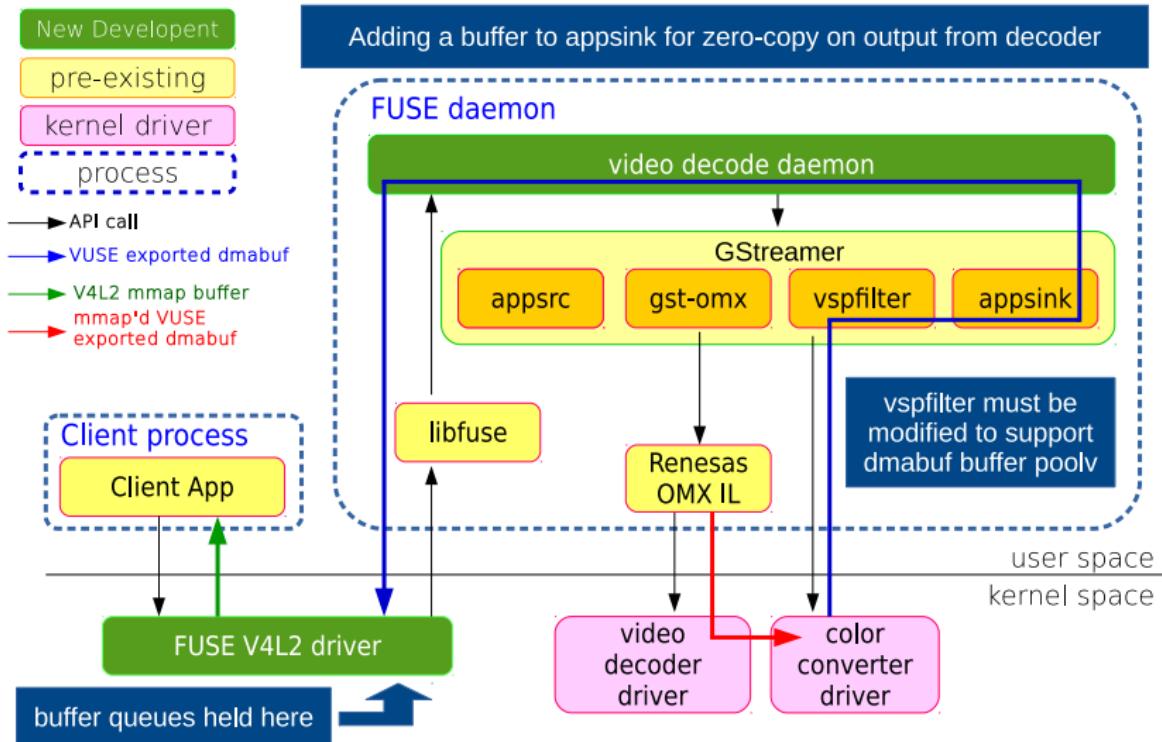
Need to be mindful of available vmalloc memory

- currently increased to **384MB** for decoder driver.
- input buffers will require **8 - 10MB** more
- other options under investigation

# VUSE decoder daemon (Input buffer flow)



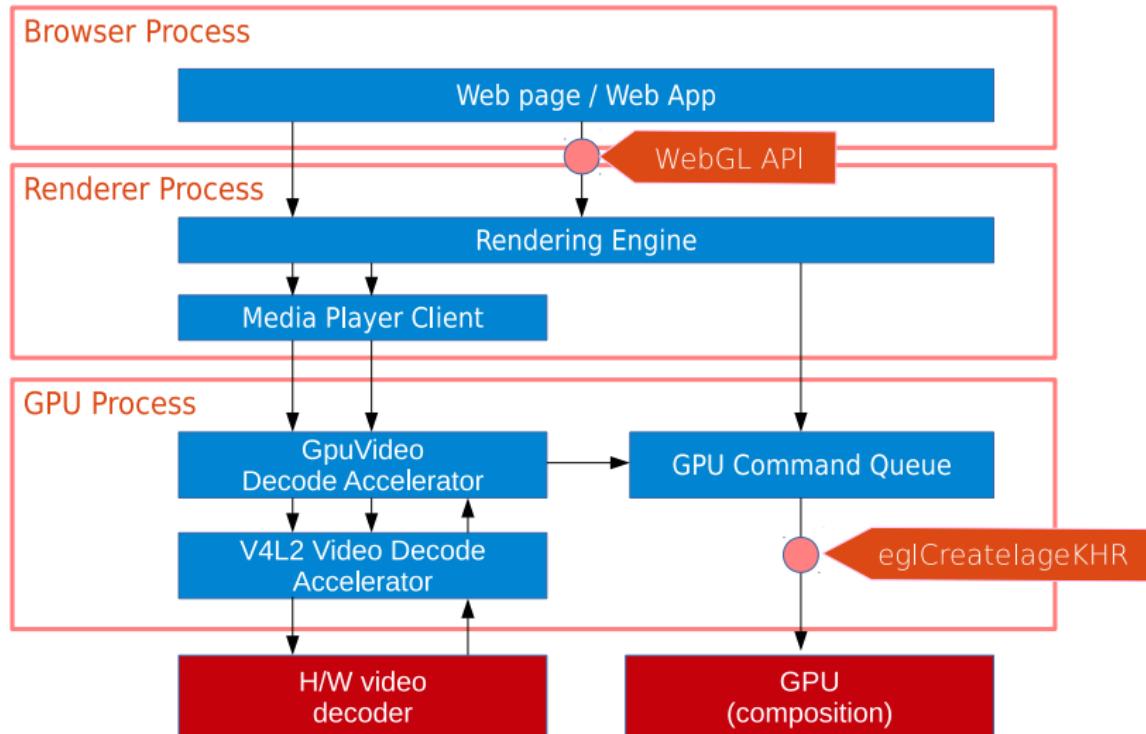
# VUSE decoder daemon (Output buffer flow)



# WebGL support on Chromium

- OpenGL integration
  - Output buffers must be passed as EGL Images
  - Use `eglCreateImageKHR` with Renesas extension (already supported) to map buffers

# WebGL support for R-Car using IMG GPU



# conclusion

# Conclusion

- AGL ARM prototype project aims cross compatibility across Intel and ARM environment. To find the gaps, we **ported Tizen IVI 3.0 on R-CarM2 Porter board**.
- Now Tizen IVI 3.0 (final) can run on Porter board. To achieve this goal, we developed **couples of R-Car CPU/GPU specific implementation**.
- We examined current **AMB** implementation on R-Car platform using CAN interface. To obtain missing features and performance gap, we propose utilizing existing **OPC UA stacks**.
- Reflecting latest Web RunTime engine trends, we tried **Crosswalk (=Blink)** on ARM platform and noticed V4L2 interface became mandatory request. We propose **VUSE (expose V4L2 API using CUSE)** to satisfy this goal.

# Resources

- R-CarH2 intro =  
[http://am.renesas.com/applications/automotive/cis/cis\\_highend/rcar\\_h2/index.jsp](http://am.renesas.com/applications/automotive/cis/cis_highend/rcar_h2/index.jsp)
- R-CarM2 intro =  
[http://am.renesas.com/applications/automotive/cis/cis\\_highend/rcar\\_m2/](http://am.renesas.com/applications/automotive/cis/cis_highend/rcar_m2/)
- R-CarE2 intro =  
[http://am.renesas.com/applications/automotive/cis/cis\\_highend/rcar\\_e2/index.jsp](http://am.renesas.com/applications/automotive/cis/cis_highend/rcar_e2/index.jsp)
- R-Car series road map =  
<http://www.renesas.eu/products/soc/assp/automotive/index.jsp>
  
- R-CarM2 Porter board = <http://elinux.org/R-Car/Boards/Porter>
- R-CarE2 SILK board = <http://elinux.org/R-Car/Boards/SILK>
- R-Car gen2 public yocto intro = <http://elinux.org/R-Car/Boards/Yocto>
- R-Car gen2 GFX/MMF evaluation download =  
[http://www.renesas.com/secret/r\\_car\\_download/rcar\\_demoboard.jsp](http://www.renesas.com/secret/r_car_download/rcar_demoboard.jsp)
  
- e-mail = Hisao Munakata ([hisao.munakata.vt\(at\)renesas.com](mailto:hisao.munakata.vt(at)renesas.com))