Open Hardware
in In-Vehicle Infotainment System

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Some IVI projects are going up in flames
Reference Hardware System Architecture Expert Group in AGL

- Expert Group members

- Seiji Goto - Mazda Motor Corporation
- Shinji Tsunoda - SUBARU CORPORATION
- Toshihisa Haraki - SUZUKI MOTOR CORPORATION
Conventional AGL Reference Board

- **Gap between AGL community and Product**
  - Difference in hardware architecture constrains the utilization of AGL software asset in Product.

**AGL community**
- **Reference Board**
  - Porter, Minnow, Vayu, NXP, DragonBoard, Raspberry Pi, ...

**Proprietary**
- Car OEM /Tier1

**Large GAP**

**Unified Code Base (AGL UCB)**

**Product**
- Car OEM /Tier1
- Hardware

**General Purpose**

- Large GAP
Conventional AGL Reference Board

- Develop hardware to fill the gap between AGL community and Product.
  - Facilitate the interaction of software assets to develop software ecosystem.

AGL community

Reference Board
Porter, Minnow, Vayu, NXP, DragonBoard, Raspberry Pi, ...

General Purpose

AGL UCB
(Unified Code Base)

Narrow this GAP

Reference Hardware
(Open Hardware for IVI)

Interaction of software assets

Product

Car OEM /Tier1 Hardware

Proprietary

Car OEM /Tier1 Software
Challenge: Product Variations

“Number of Car makers × Number of car types = Hundreds of product variations”
→ Diversification in IVI system configuration is inevitable.

Car makers
- HONDA
- MAZDA
- SUBARU
- SUZUKI
- TOYOTA

Types of Cars
- Compact, Sports, Luxury
- Sedans, SUVs, Crossovers
- Electric Cars, Hybrid Cars
Analysis of Variation

Several hundred versions of products

Same hardware structure is applied in each Car OEM

Different hardware should be applied to each Car OEM

2DIN System

Integrated Infotainment System

Collect hardware requirements from Car OEMs

Car OEM A
Car OEM B
Car OEM C
Analysis of Variation

Same hardware structure is applied in each Car OEM

Performance diversification
- Display / Cluster resolution
- Application (ex. Navigation)
- Vehicle Data processing

Different hardware should be applied to each Car OEM

Peripheral device diversification
- Input (Camera, Media, Tuner, Mic, Sensor, Input Device)
- Output (Display, Amp/Speaker)
- I/O (CAN, DCM/TCU)

SoC (System on Chip)
Memory/Storage

50 km/h
CAN Ethernet
TCU
AMP
Proposed Reference HW

- "AGL Reference Hardware Specification" was published on October, 2017
  - Two Board constitution (Main board / Extension board)
  - Main Boards are interchangeable
  - Extension Boards are interchangeable (and replaceable with OEM specific boards)

Performance diversification

Peripheral device diversification

- SoC (System on Chip)
- Memory / Storage

Main Board

Extension (Interface) Board

SoC

Memory/Storage

Peripheral Interface

Dedicated microcomputer

AMP

CAN

Ethernet

TCU
Proposed Reference HW

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Interchangeable

Main Board

Extension (Interface) Board

Can be combined freely = Common I/F

SOC A
Mountable on a real vehicle: “2DIN Target”
Schedule (Two board constitution)

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[1st step] Scorp and Cooperative system of the 1st step

Collaboration between RHSA-EG and SoC / Board vendors

- R-Car Gen3 Starter Kit
- Intel Arch. Main Board
- Common Interface set
- Kingfisher Advanced
- Kingfisher Standard
- Main Board
- Extension Board
# 1st step: board & I/F spec

## Main Board
- R-Car Gen3 Starter Kit
  - COM Express Type2 Connector

## Extension Board
- HDMI
- LVDS
- Camera Exp. Board A/B
- Line In
- HP out
- Line out
- Mini PCIe
- USB3.0
- USB2.0
- SD slot
- SDIO
- PCIe
- CAN
- M.2 Key “M”
- USB
- SDIO
- CAN
- VIN
- CSI
- SSI
- USB
- SDIO
- VIN
- CSI
- SSI
- USB

## Kingfisher Board
- HDMI
- LVDS
- Camera Exp. Board A/B
- Line In
- HP out
- Line out
- Mini PCIe
- USB3.0
- USB2.0
- SD slot
- SDIO
- PCIe
- CAN
- M.2 Key “M”
- USB
- SDIO
- CAN
- VIN
- CSI
- SSI
- USB

## Welcome other main board
- Kingfisher Board

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**Common I/F set**
- Reuse the interface between R-Car Starter Kit and Kingfisher Board

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**Intel ApolloLake Main Board**
- COM Express Type2 Connector

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**Intel ApolloLake Main Board**
- COM Express Type2 Connector

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**Re-use the interface between R-Car Starter Kit and Kingfisher Board**

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**Intel ApolloLake Main Board**
- COM Express Type2 Connector

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**Intel ApolloLake Main Board**
- COM Express Type2 Connector
[2nd step] Scope of the 2nd Step

Reference Hardware in the 1st step

- R-Car Gen3 Starter Kit
- Intel Arch. Main Board

Freely combinable with Common I/F set

Main board

- Kingfisher Advanced
- Kingfisher Standard

Extension board

- Other Main Board (Other SoC maker)
- Other Main Board (Other SoC maker)
- Extension Board (simple)
- Extension Board (high-end)
**2nd step** What to be realized: Hardware

- Redefine the function allocation to the main boards and extension boards.
  - Main boards absorb functional differences between SoCs
  - Consolidate Car OEM-common functions to the main boards as many as possible to improve hard/software reusability.
- Adopt a more versatile common I/F.
  - From the existing I/F to what it should be.
- (Support of BSP for the main/extension board, Establishment of the structure to maintain compatibility)
[2nd step] What to be realized: Software

• Build the SW platform which is compatible with HW flexibility.
  – HW discovery
  – Configuration registry
  – Software(μcode) upload
  – ...

• Support the audio/video function for high-end car.
  – Networked Audio/Video system
  – Processing on Extension board
Open Collaboration