



Open Hardware in In-Vehicle Infotainment System

- Seiji Goto - Mazda Motor Corporation
- Shinji Tsunoda - SUBARU CORPORATION
- Toshihisa Haraki - SUZUKI MOTOR CORPORATION

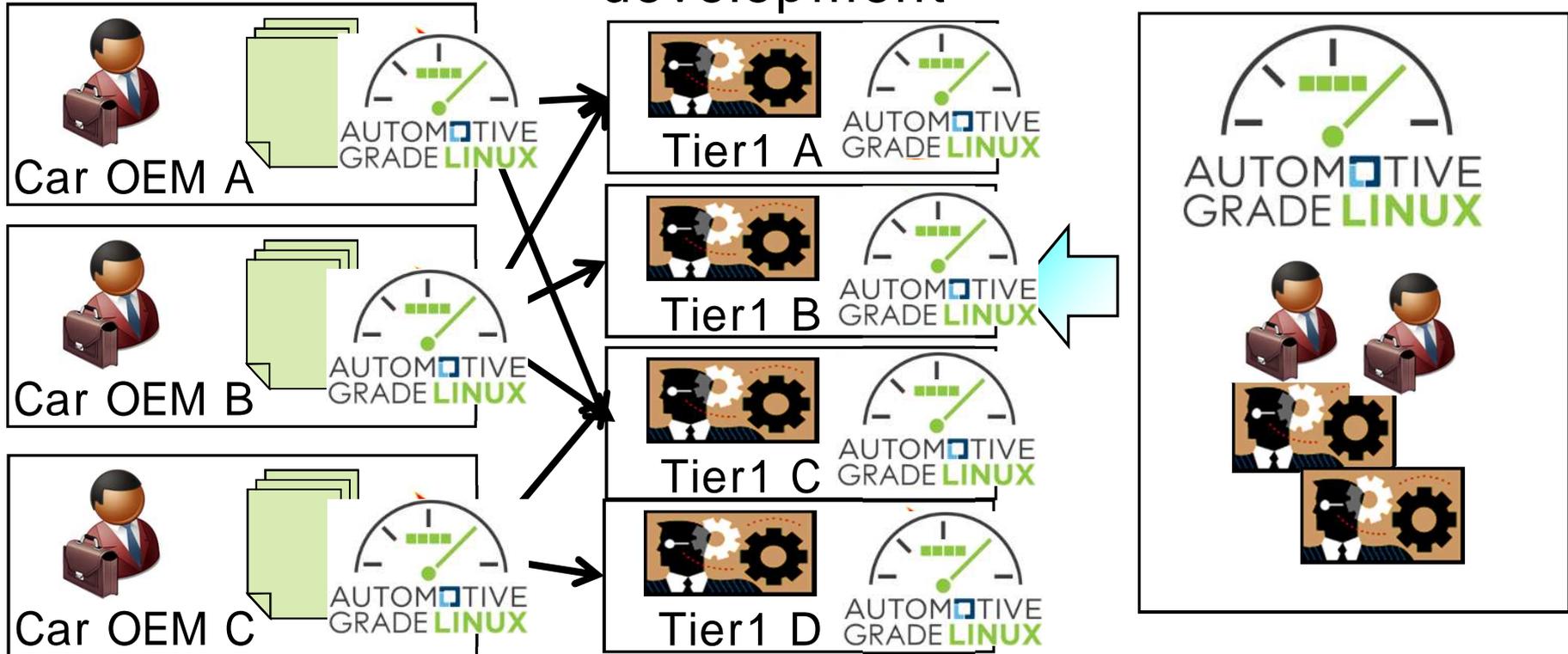
Some IVI projects are going up in flames

ALS2017

Specifications required by Car OEM

Tier1 Product development

Corporate development in non-competitive field



Reference Hardware System Architecture Expert Group in AGL

- Expert Group members



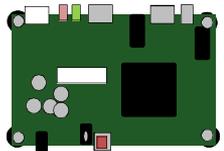
TOYOTA

- Today's speakers
 - Seiji Goto
 - Shinji Tsunoda
 - Toshihisa Haraki
 - Mazda Motor Corporation
 - SUBARU CORPORATION
 - 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.

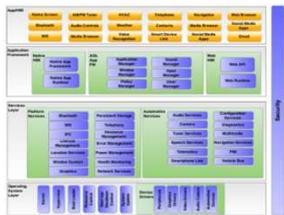
AGL community



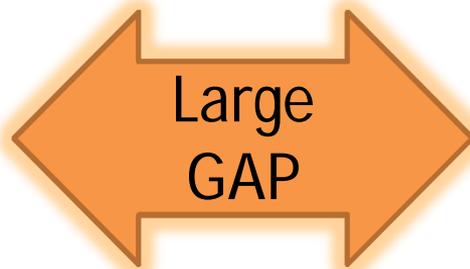
Reference Board

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

General Purpose



AGL UCB
(Unified Code Base)



Product



Car OEM
/Tier1
Hardware

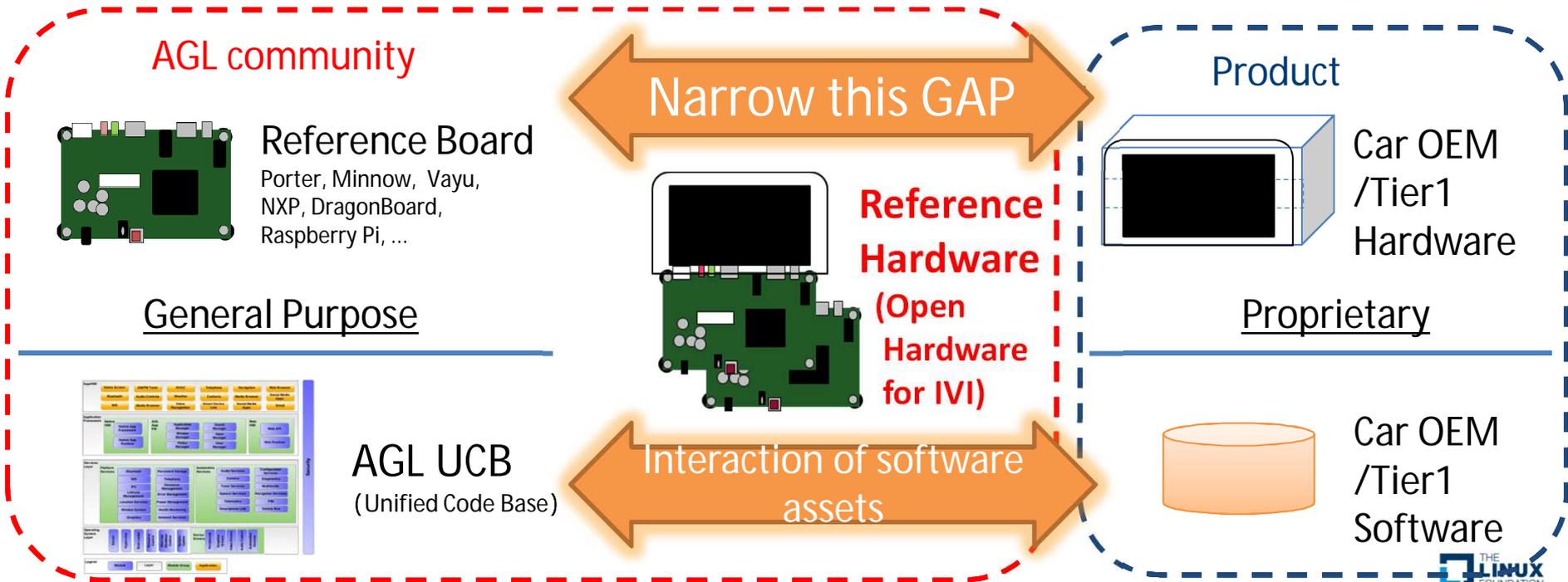
Proprietary



Car OEM
/Tier1
Software

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.



Challenge: Product Variations

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

Car makers

HONDA

The Power of Dreams



MAZDA



SUBARU



SUZUKI

TOYOTA



Types of Cars

Compact, Sports, Luxury

Sedans, SUVs, Crossovers

Electric Cars, Hybrid Cars



Analysis of Variation

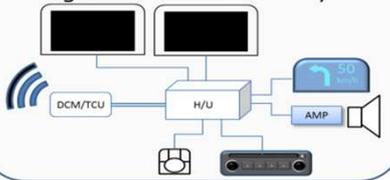
Car OEM C
Car OEM B
Car OEM A

2DIN System

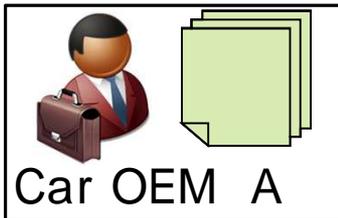


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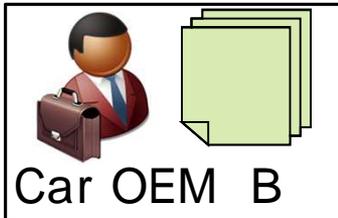
Integrated Infotainment System



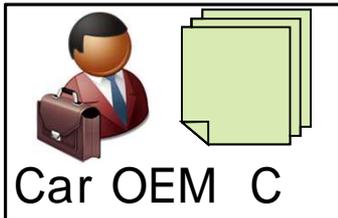
Several hundred versions of products



Car OEM A



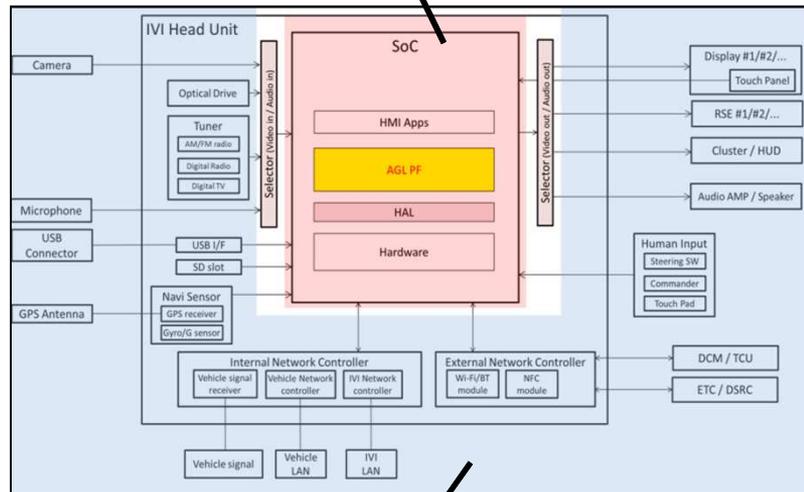
Car OEM B



Car OEM C

Collect hardware requirements from Car OEMs

Same hardware structure is applied in each Car OEM

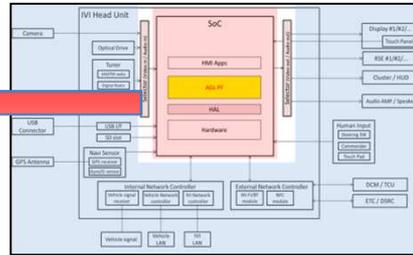


Different hardware should be applied to each Car OEM

Analysis of Variation

Same hardware structure is applied in each Car OEM

Different hardware should be applied to each Car OEM

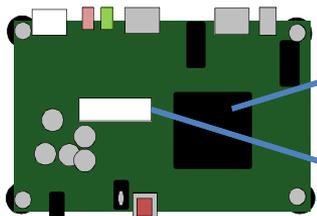


Performance diversification

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

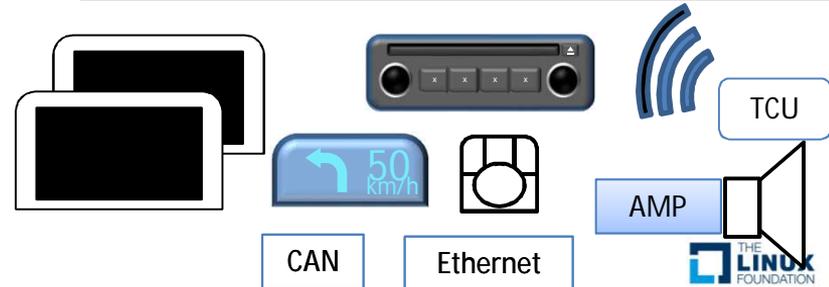
Peripheral device diversification

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



SoC
(System on Chip)

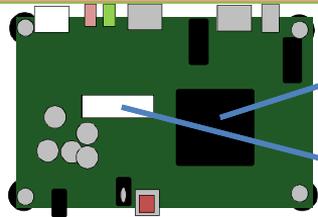
Memory/Storage



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



SoC
(System on Chip)
Memory
/Storage

Peripheral device diversification



AMP



CAN

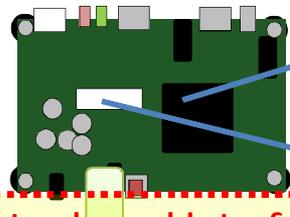


Ethernet

TCU



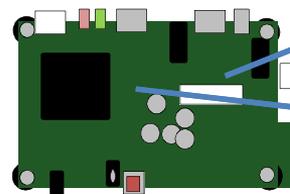
Main
Board



SoC
Memory/Storage

Inter-board interface

Extension
(Interface)
Board

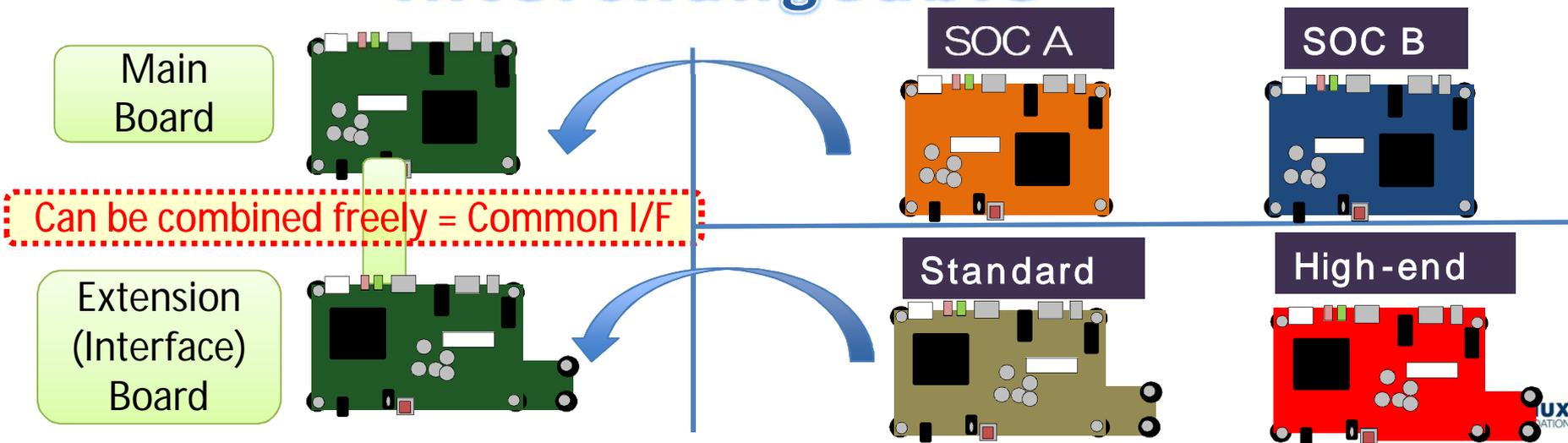


Peripheral Interface
Dedicated microcomputer

Proposed Reference HW

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Interchangeable

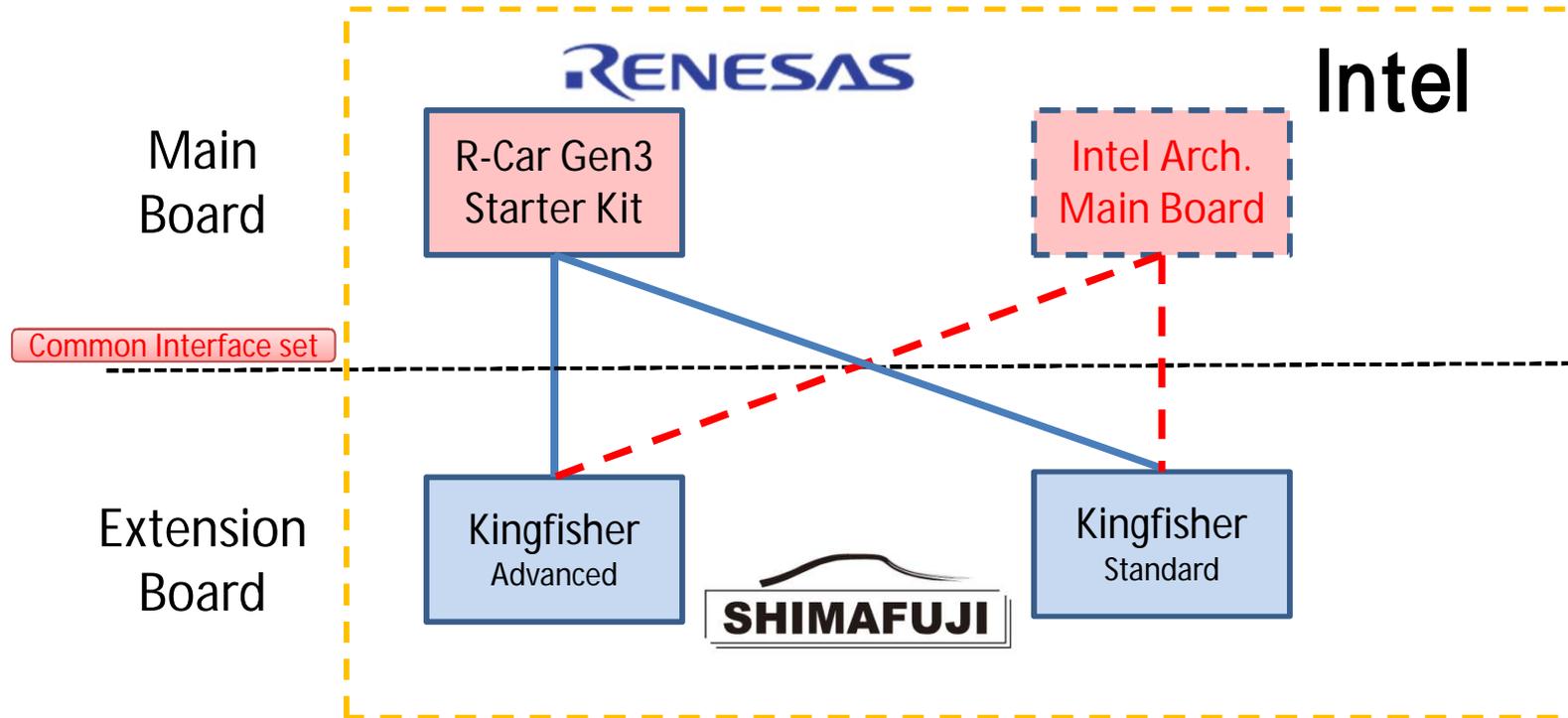


Schedule (Two board constitution)

	2018		2019		2020
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-
Hardware Specification					
Reference Hardware 1 st Step					
Reference Hardware 2 nd Step					

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

Collaboration between RHSA-EG and SoC / Board vendors



[1st step] board & I/F spec

Main Board

R-Car Gen3 Starter Kit

or

Intel ApolloLake Main Board

Welcome other main board

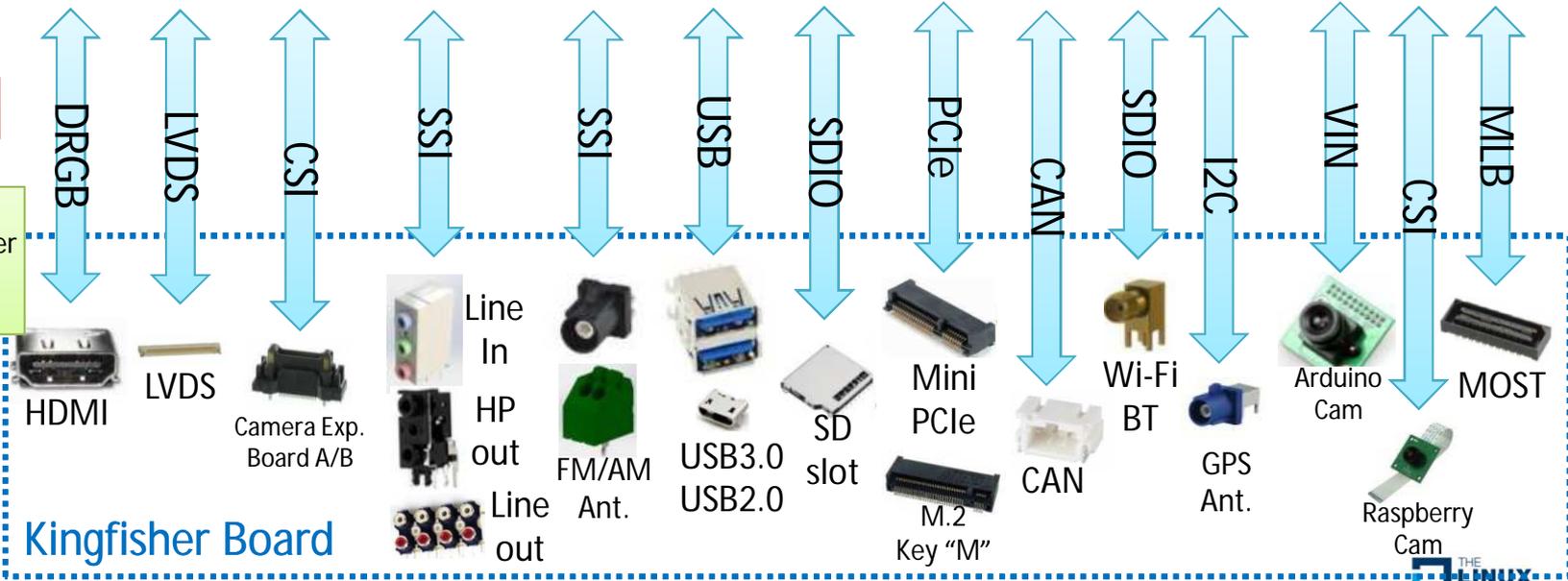
COM Express Type2 Connector

COM Express Type2 Connector

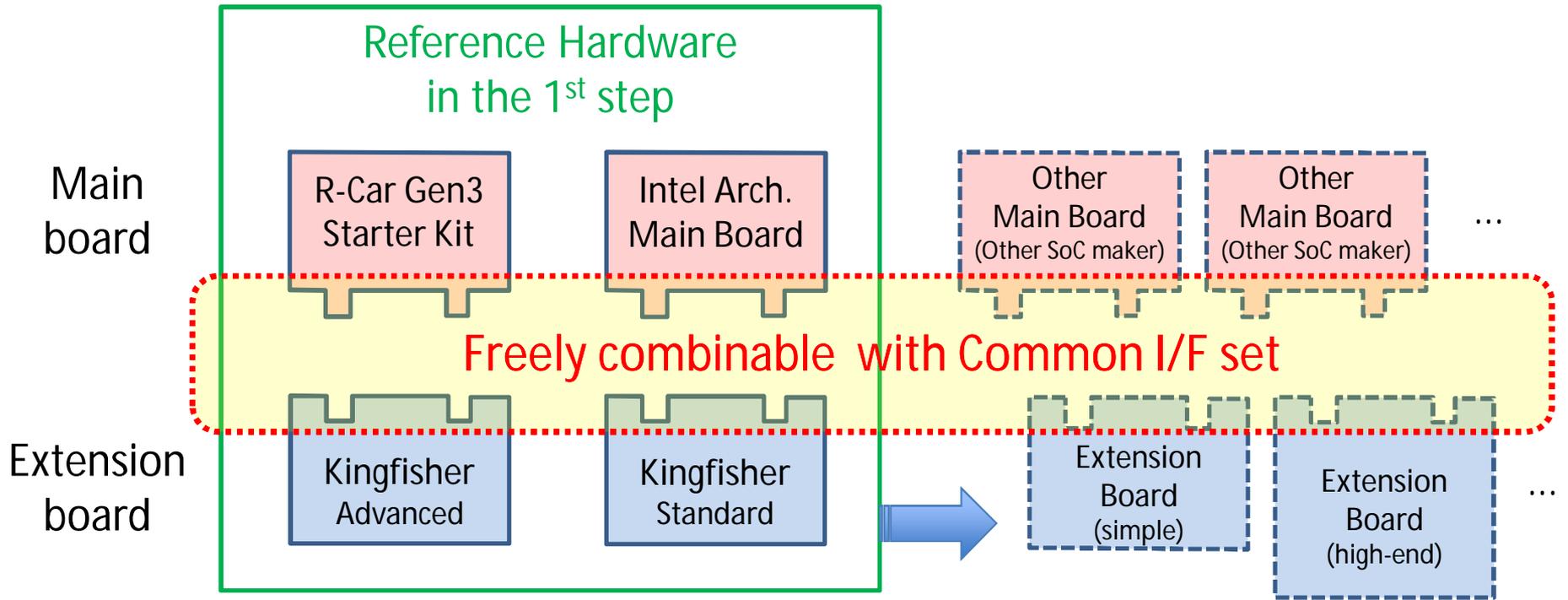
Common I/F set

Reuse the interface between R-Car Starter Kit and Kingfisher Board

Extension Board

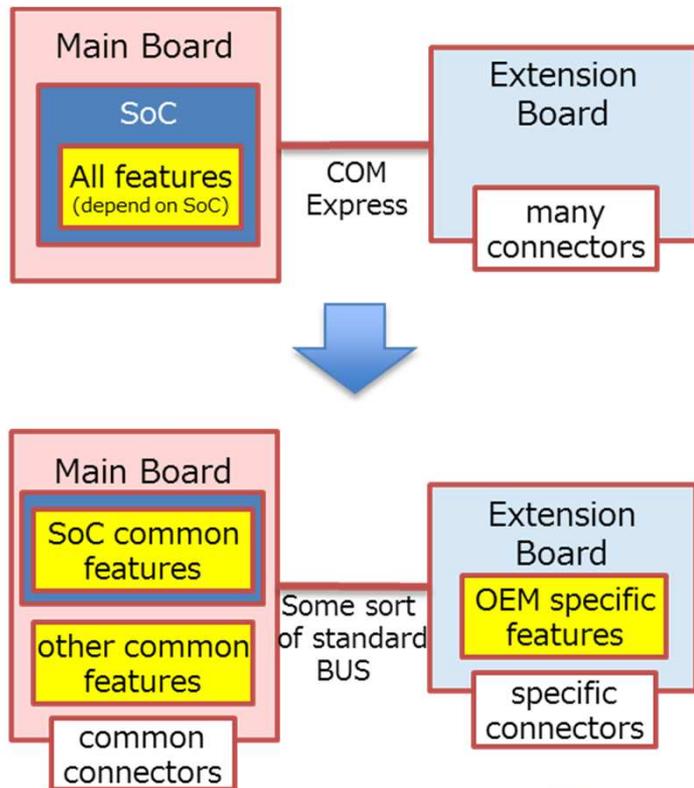


[2nd step] Scope of the 2nd Step



[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

AMM 2018 winter :
“The Software Side of AGL Reference Hardware”
(Domingar Foll, Intel Open Source)

Registry – SW upload

HW Discovery

- **Some Interfaces are ready**
Warning: twice the same HW is still an issue
 - PCI
 - USB
 - Ethernet
- **Some are partially ready**
Note: crash during discovery is very possible
 - IC2
 - GPIO
- **Some are not at all**
 - FPGA
 - DSP



SW (Driver or HAL) can only manage what it knows exists

AGL Advanced Audio Architecture (4A)

Display & Video

- **Multiple Displays**
 - GPU will always be in the SoC
 - VirtualGL is not that great
 - Waltham can cover simple needs
- **Video playback**
 - GPU can be used for 2/3 Displays
 - Video Mux (MPEG-TS) is well supported
 - DRM – HDCP is a serious hurdle
- **Camera and other Video sources**
 - SoC will never support enough CSI inputs
 - Need composition on interface extension board
 - Required complex SW and Configuration



High end car will need video processing on the Interface Extension board

Open Collaboration

HONDA

The Power of Dreams



mazda



SUBARU



SUZUKI

TOYOTA

THE LINUX FOUNDATION
OPEN SOURCE SUMMIT
JAPAN



AUTOMOTIVE
LINUX SUMMIT

