Open Hardware in In-Vehicle Infotainment System

Reference Hardware System Architecture Expert Group

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Mazda Motor Corporation
Akio NAKADACHI

MAZDA 100+1TH ANNIVERSARY

About MAZDA

New Technologies and Infrastructure	
Connected	• Introduce Mazda Connect with on-board communication device • Start connected services
Autonomous	• Evolve and offer advanced safety technologies • Deliver Mazda Co-Pilot Concept
Shared	• Study participation in sharing business • Jointly pilot shared mobility in rural area
Electrification	• Introduce EVs • Develop multiple electrification technology • Introduce plug-in hybrids

MAZDA MX-30

In-Vehicle Infotainment System

Expanding Use-case of IVI System

Car Audio

Navigation

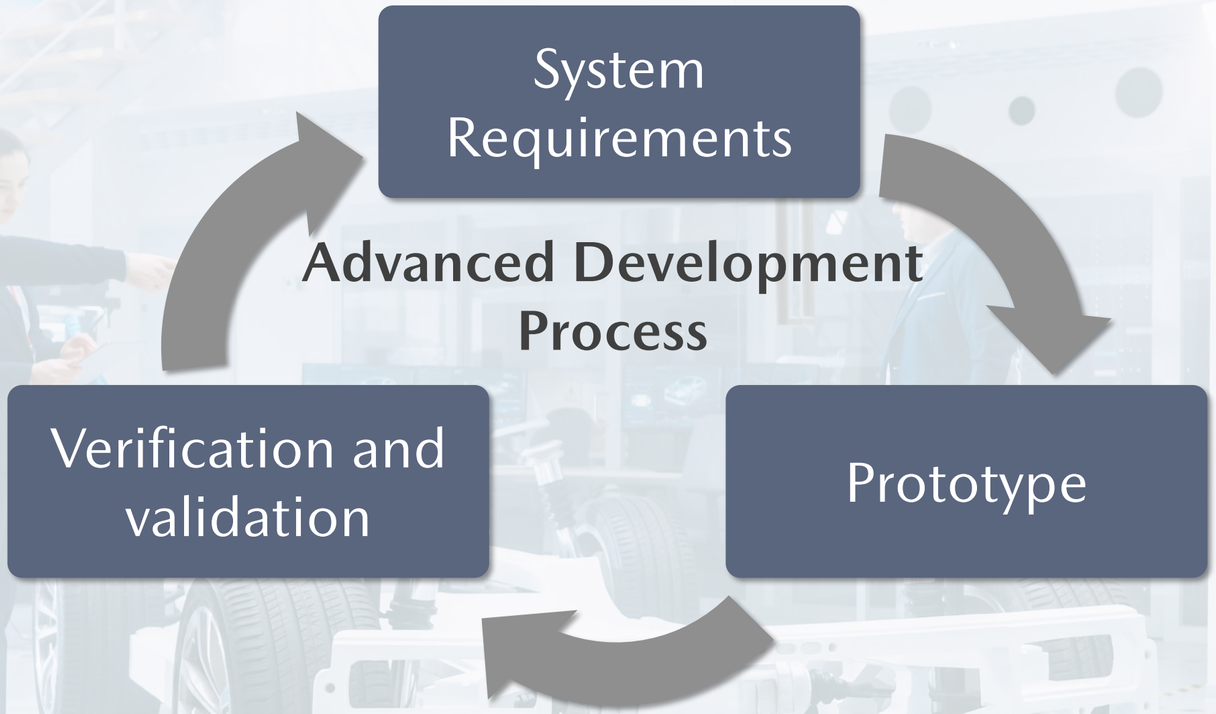
IVI System

Software scales

1990 2000 2010 2020 2025 2030

Development of IVI System

IVI systems become more sophisticated and complex, and requirements diversify.
An efficient advanced development process is essential.



Feasibility study
- Performance
- Resource
- Usability

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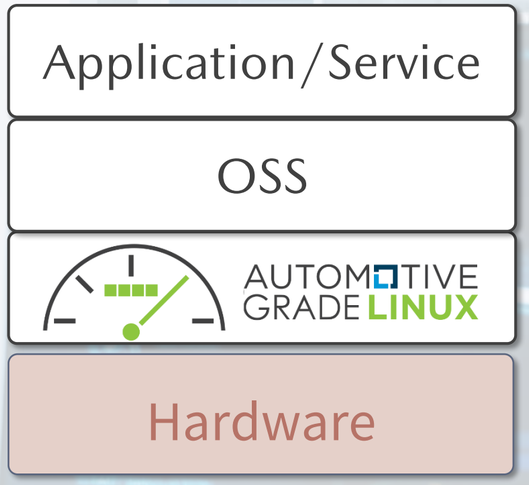


No suitable hardware for prototyping

Reference Hardware Expert Group

Reference Hardware System Architecture Expert Group(RHSA-EG) is established by OEMs.

Objectives

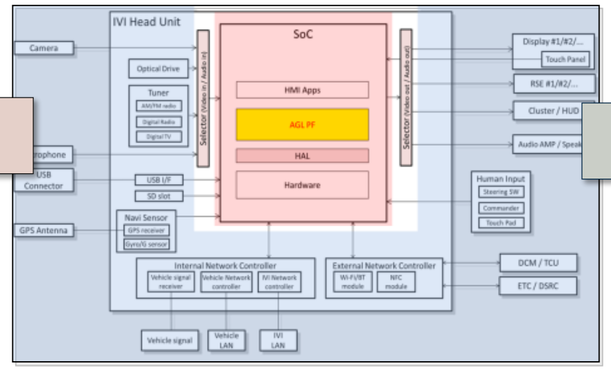
- Design a hardware architecture for prototyping to meet the various requirements of an automobile.
- Manufacture as reference hardware and introduce to the community.
- Accelerate the AGL software ecosystem by proposing the use of reference hardware.

Variation of hardware

Variation of performance

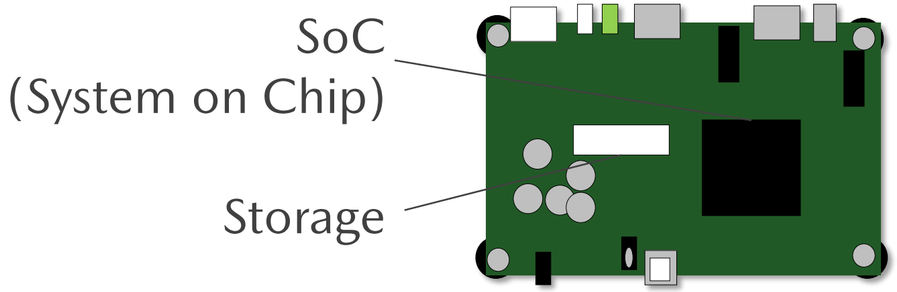
Display resolution
Application
Data processing
...

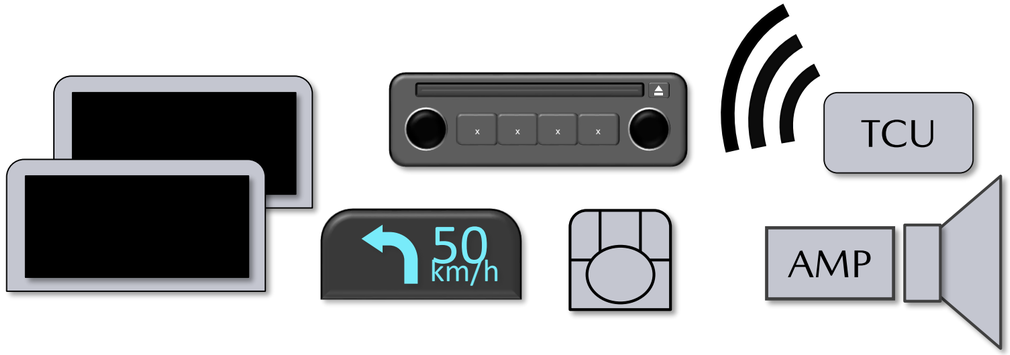
Hardware configuration



Variation of peripherals

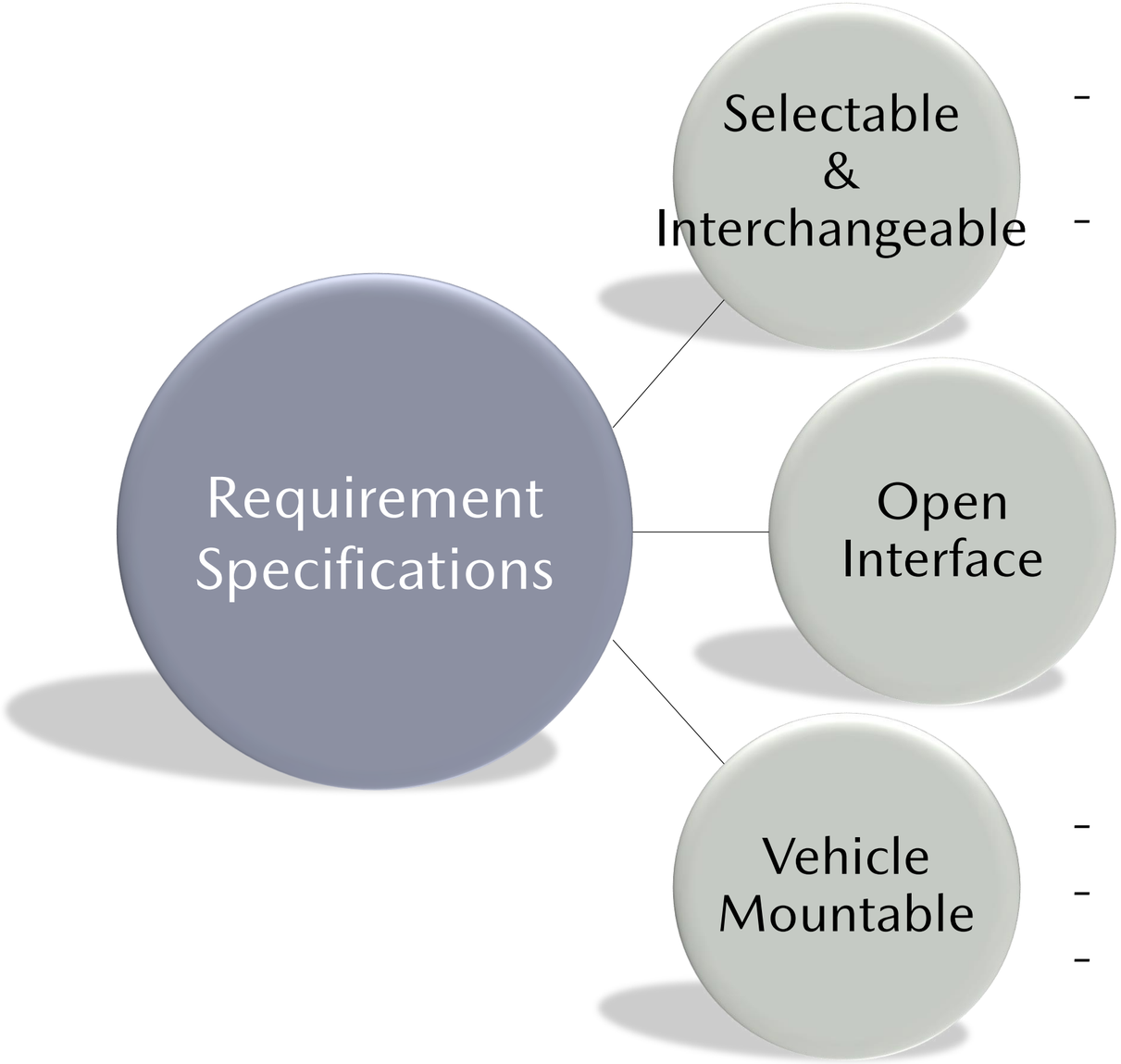
Camera, External Media, Tuner, Mic, Sensor, Manipulation Device, Display, Speaker, CAN, WiFi, Bluetooth...





Realize the variation of hardware in an unified architecture

Requirement for Open Hardware



- Flexible and scalable hardware configurations = ‘Modular Architecture’
- Multiple SoCs and Peripherals support

- Disclose interface specification
- Community members are free to design and manufacture their own boards.

- Automotive grade devices
- Vehicle Interfaces
- 2 DIN Form factor

Use-cases

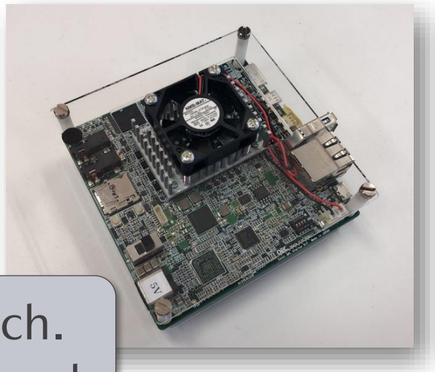
- AGL Demonstration
  - Richer demonstration with vehicle or vehicle devices
  - Easier deployment of software

- PoC/Prototype of Advanced Development
  - Customizable specs for system requirements
  - Prototyping of cutting-edge hardware
  - Feasibility study with vehicles

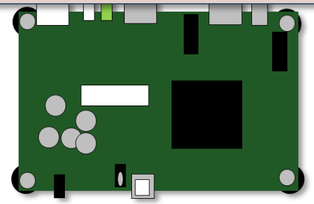
Available to many members of the community for a variety of use-cases

1st Step: Proof of Concept

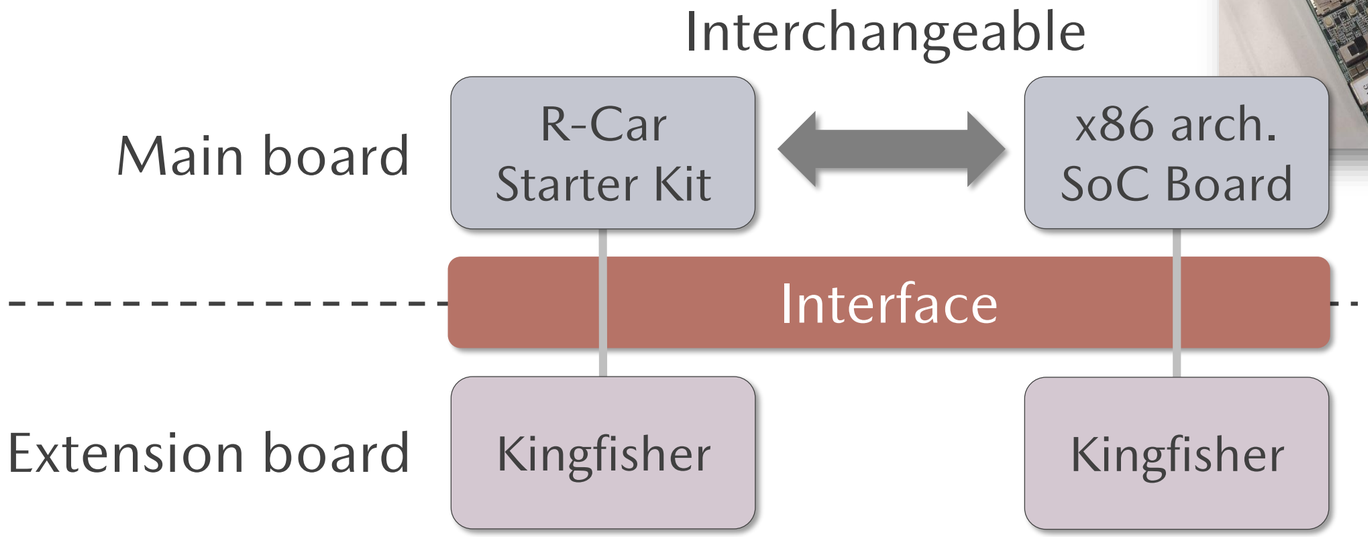
Validation and verification of 'Modular Architecture'
- 2 boards structure - Main board/Extension board
- Main board is interchangeable



Variation of performance



Variation of peripherals



Developed x86 SoC board connectable to Kingfisher
validated and verified the interchangeability with R-Car Starter Kit

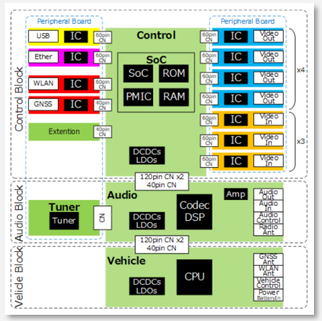
2nd Step: Reference Hardware Development

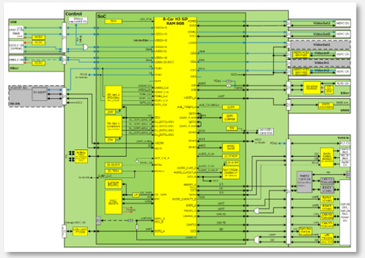
Challenges

1. Reallocation of functions of Main / Extension Board for reusability improvement
2. Versatile interface between Main / Extension boards
3. BSP support and compatibility

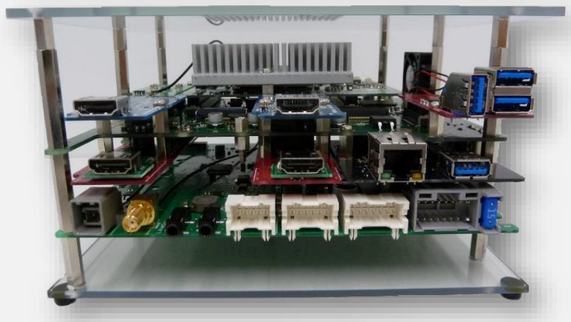
Design

- Selectable & Interchangeable
- Vehicle Mountable





Manufacturing

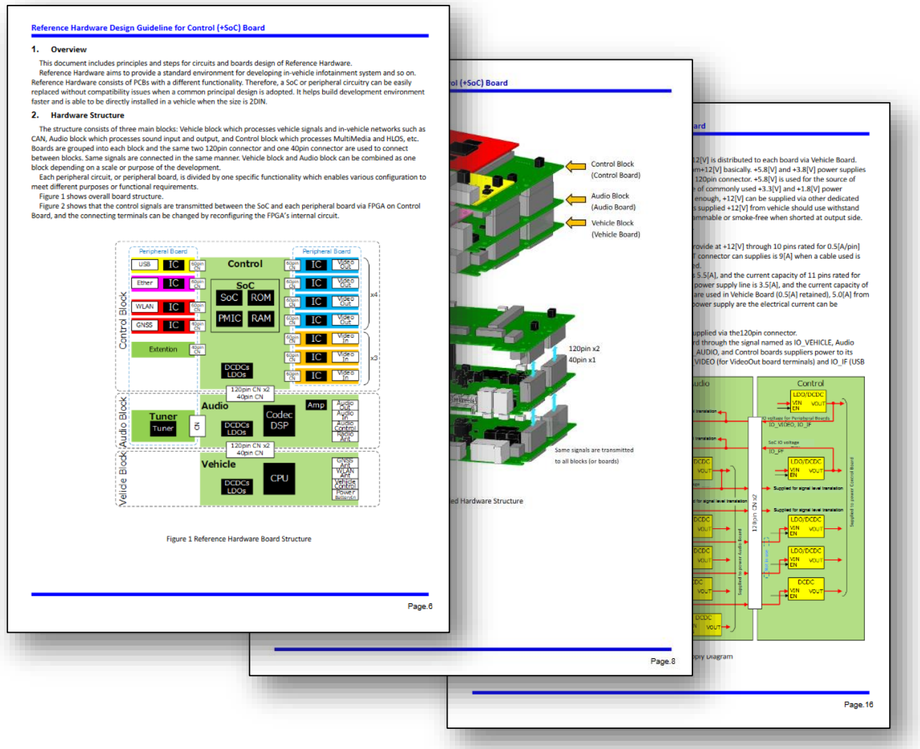


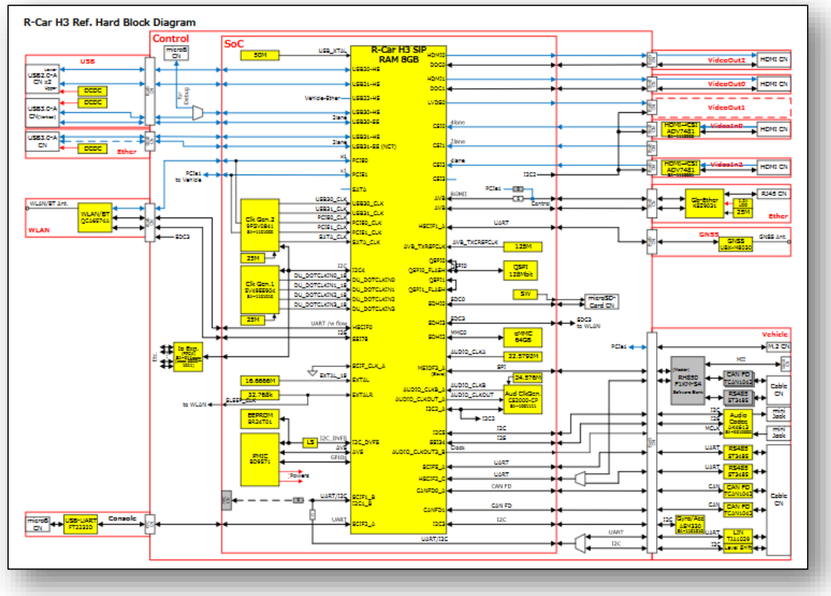
Distribution

- Distributed to AGL major members for evaluation and BSP development.
- UCB 11.0 with supported BSP released.

2nd Step: Open Interfaces

Design Guidelines and Block Diagram are available on RHSA-EG Wiki page.

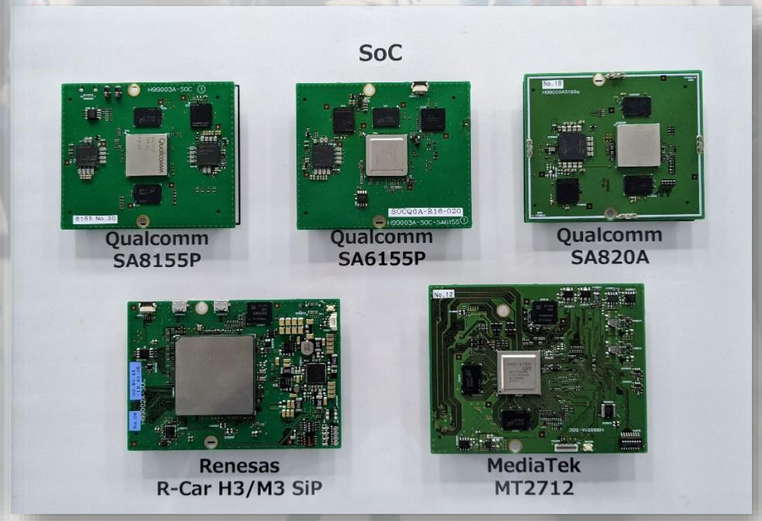




AGL Community members are free to design and manufacture your own boards.

Exhibition at CES 2020

Demonstration of Reference Hardware with vehicle devices



Variation of SoC and Peripherals

Next Step: Efforts to promote reference hardware

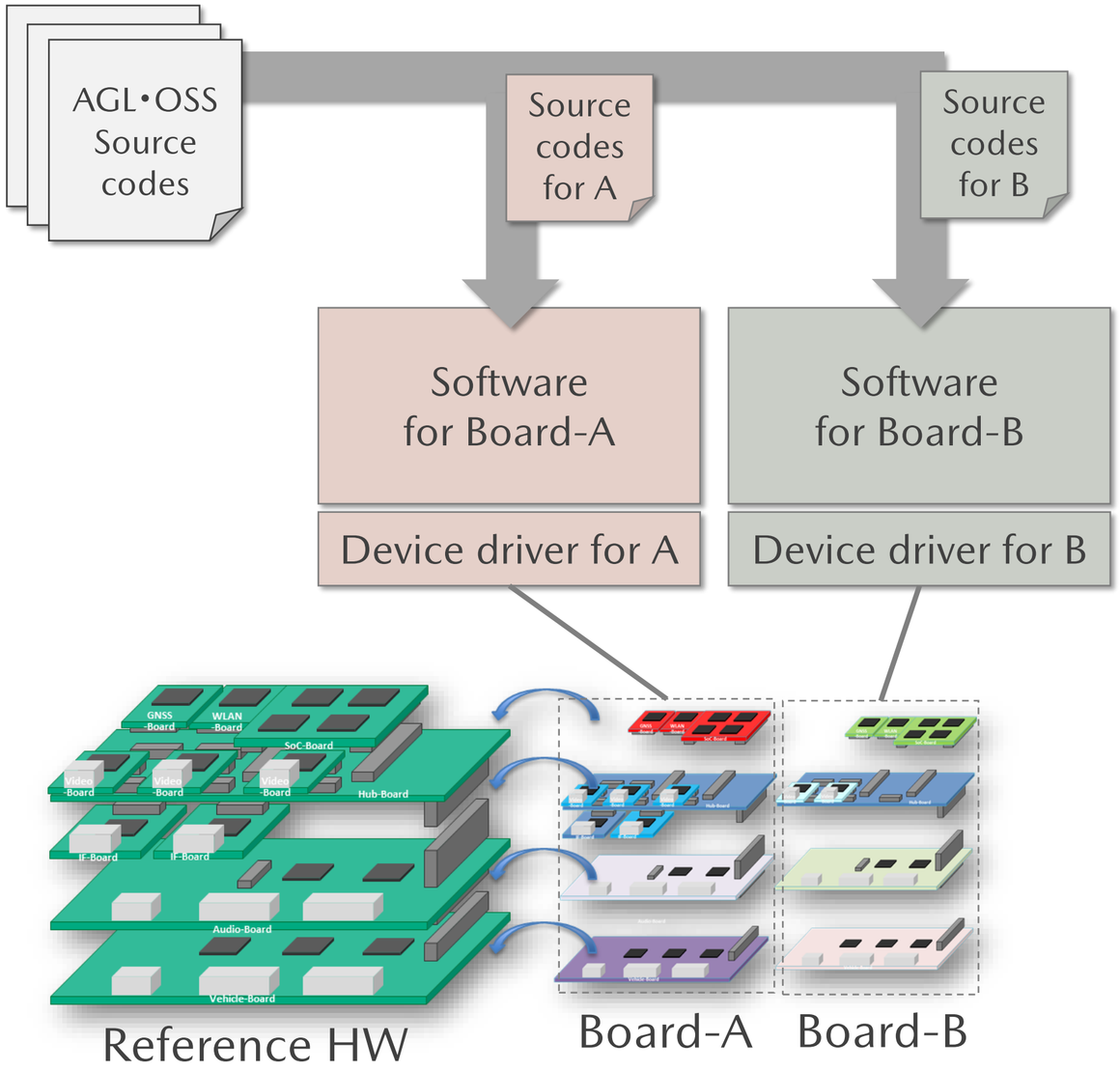
1. Modular architecture of software
   Minimize the impact of changes in SoC and peripherals on software

Introduce a mechanism to localize device-dependency

2. Distribution of Reference Hardware
   Offer reference hardware available to community members.

Establish sales channels to the community

Modular architecture of software

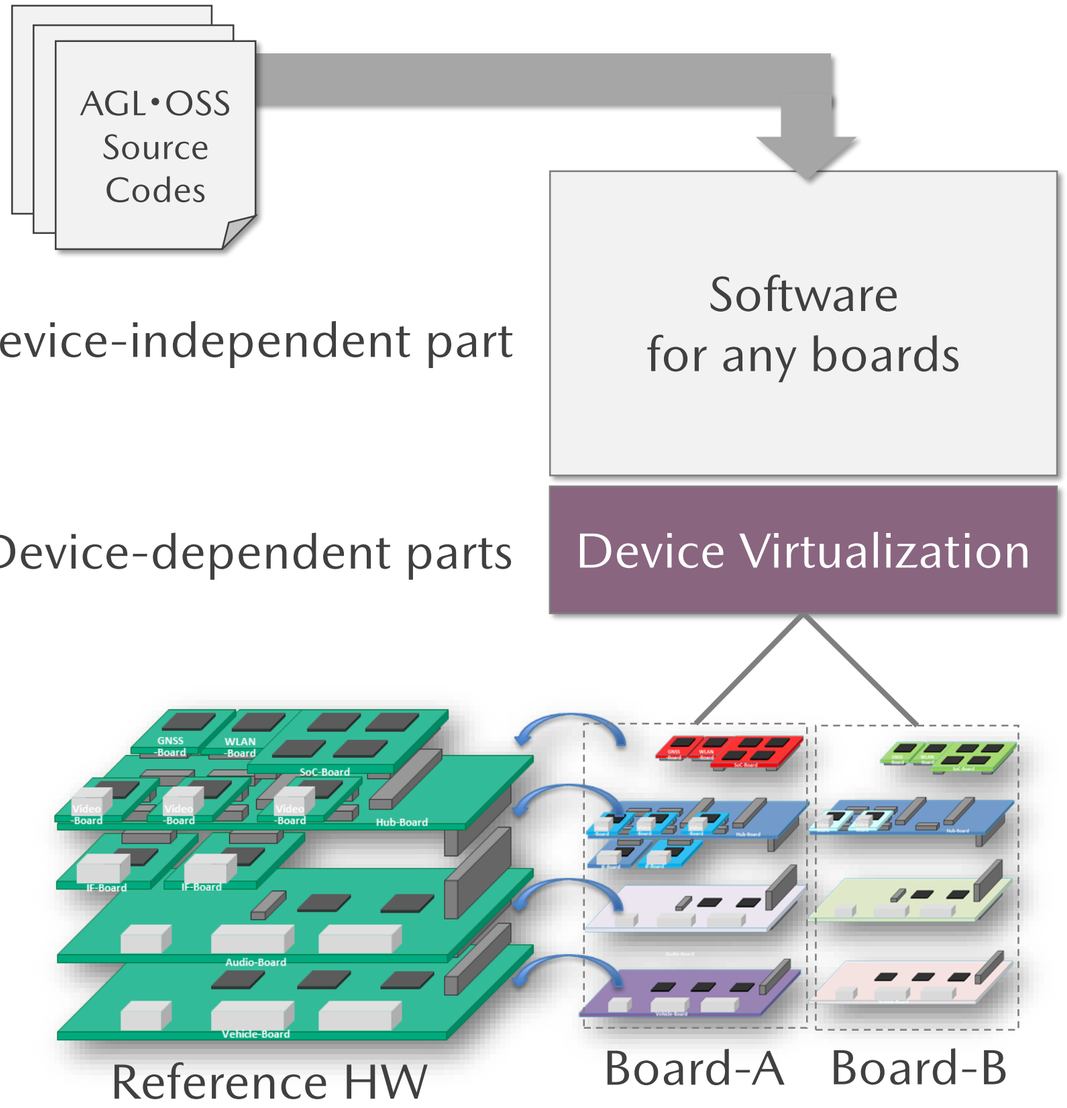


Software build for each hardware configuration is necessary.

- Software is not reusable when the combination of SoC and peripheral devices is changed.
- Software rebuilding takes time.

Disturb development efficiency

Modular architecture of software

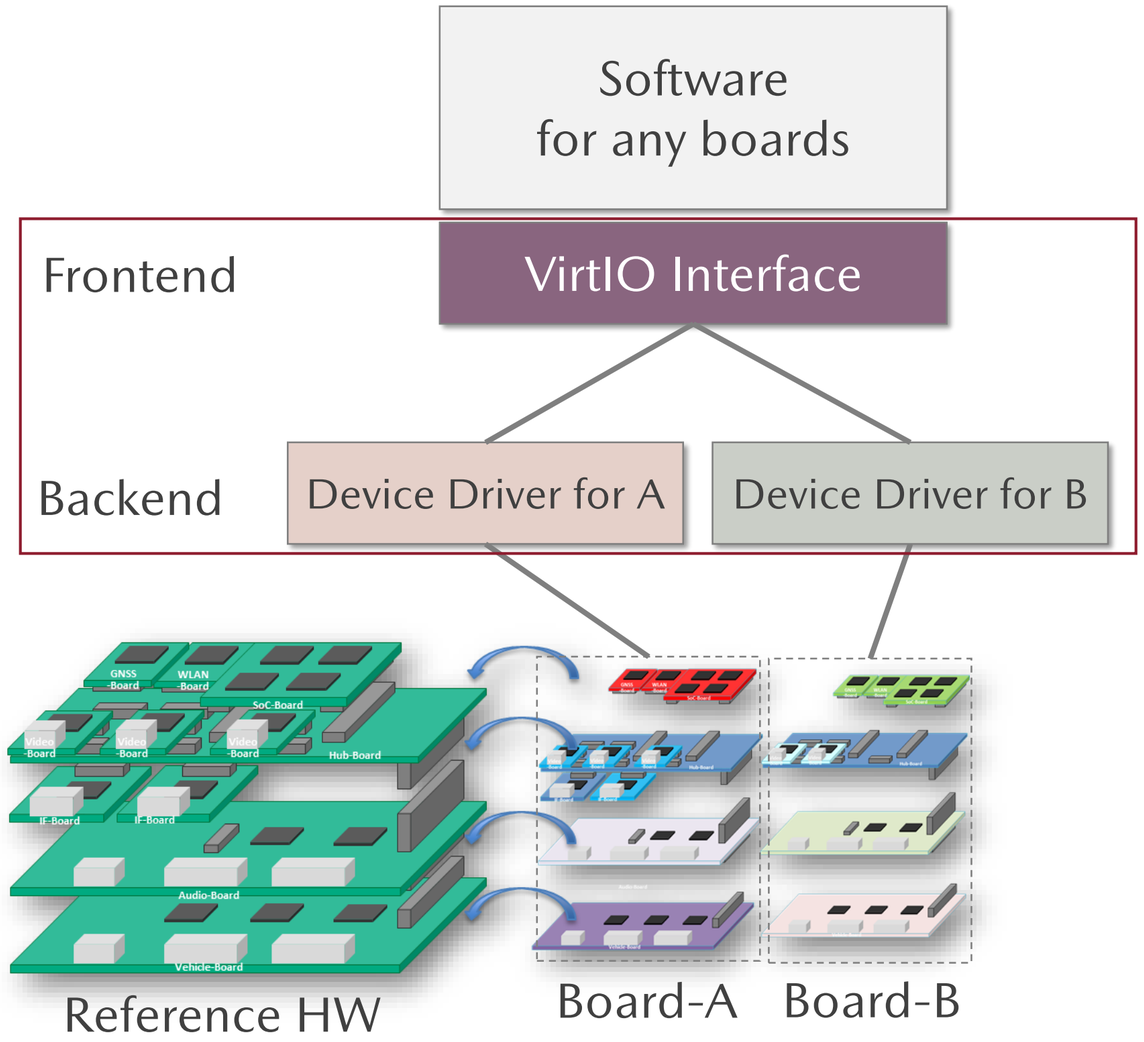


Introduction of Device Virtualization Technology

- Separate software into device-dependent and device-independent parts
- Introduce device virtualization technology to the device-dependent part, and device differences are absorbed by the virtualization technology.
- By changing only the device-dependent part of the software, support for various SoCs and peripherals can be realized.

Improve development efficiency

Implementation Idea of Device Virtualization - VirtIO



- VirtIO is an I/O framework that virtualize devices through paravirtualization device driver.
- Device-dependent part can be consolidated in the Backend.
- Virtualization EG is introducing VirtIO to AGL UCB.
- Session ‘Software Define Architecture in a Car: Using VIRTIO to Change the Way the Car Software Developed’ is performed by OpenSynergy.

RHSA-EG will collaborate with Virtualization EG to consider modular architecture of software using VirtIO

Distribution of Reference Hardware

- Usage of distributed Reference Hardware (20 units)
  - BSP development / Continuous integration and automated test
  - Demonstration / Exhibition

- Sales of Reference Hardware
  - Improving availability
    - AGL community members become available for purchase.
  - Sales starts from summer of 2021.(T.B.D.)

Reference Hardware Expert Group

Expert Group Members

Concept

mazda

HONDA
The Power of Dreams

SUZUKI

TOYOTA

Development

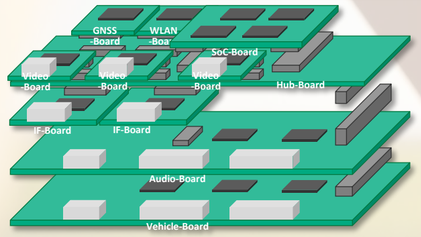
Panasonic

AUTOMOTIVE GRADE LINUX

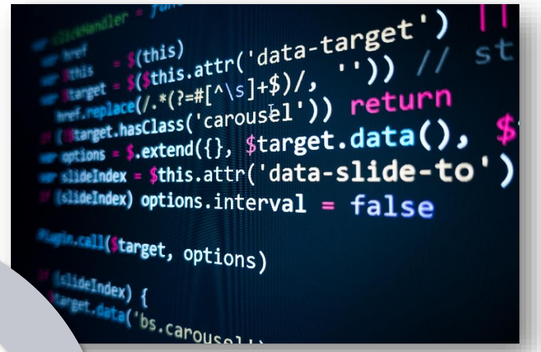
Conclusion

Accelerating AGL eco-system cycle by Reference Hardware

Introduction of Reference Hardware



More source code Contribution



AGL eco-system cycle

Expanding use-case

More AGL users

THANK YOU