Modular and Open Real-Time Platform for Future Automotive Computing Environment
THE EVOLUTION WEIGHT

35 years of electronic legacy

> 90 ECU per vehicle

+ 10% Annual growth of Electronic
THE NEWCOMER ATTRACTIVENESS

Software Defined Car
THE AGILITY CHALLENGE

Concept freeze

3 years

Vehicle SOP

3+ years

Vehicle restyle

Specification

Parts dev.

System integration

Plant tuning

Production

Marketing targets

Market expectations cannot be reached during vehicle design and production phases due to strong electronic and features intrication.
SOFTWARE ORIENTED ARCHITECTURE

Need to rethink Electronic Architecture around Software and Services

TCO advantage of USD 175 per vehicle when gathering just 4 ECU in 1!

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Cockpit ECUs (IVI, cluster, TCU and Radio)</td>
<td>USD 800</td>
</tr>
<tr>
<td>HW redundancy impact</td>
<td>USD 110</td>
</tr>
<tr>
<td>System reduction (wiring) impact</td>
<td>USD 13</td>
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<tr>
<td>OEM (procurement, development and test, COM complexity reduction, supply chain)</td>
<td>USD 6</td>
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<tr>
<td>Assembly plant complexity reduction</td>
<td>USD 8</td>
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<tr>
<td>Improve upgradeability (all in one place)</td>
<td>USD 30</td>
</tr>
<tr>
<td>Reduction of system weight (1.5 kg - fuel save)</td>
<td>USD 8</td>
</tr>
</tbody>
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Up to 19 ECU can be saved within 3 years and 39 in 5 years
THREE KEY MAINSTAYS

1. HW architecture and design

   Offer an innovative E/E architecture enabling centralized computing approach
   Towards a plug & play, scalable, heterogeneous computer system

2. Software and run-time

   Offer innovative services to ensure the security and the dependability of the E/E architecture
   Guarantee real-time, deterministic and critical and non-critical execution

3. Development and integration process

   Adapt the software function development and integration for the project
   Ensure software services validation against safety and security requirements
EE ARCHITECTURE BASICS

Multi-application centralized computing Unit

Localized Data concentration and Power distribution

Modular architecture to scale with applications needs

Service Oriented Communication Infrastructure

Multi-Gbps Ethernet Backbone

High Performance Ethernet Backbone

PCU

Back Left PIU

Back Right PIU

Front Left PIU

Front Right PIU
PCU IP ARCHITECTURE

- Modular PCU prototype
  - Motherboard running legacy applications common to all vehicles
  - Up to 4 daughter boards to insure its scalability and its upgradability
  - Initial portfolio includes
    - Renesas RCAR-M3, Kalray Bostan
    - Specific daughterboard for high-speed camera links management, with Xilinx UltraScale+ for low latency data fusion

- Multi-SoC platform integrating high end computing solutions
  - Renesas RCAR-H3 for high performance computing
  - RH850 for Real-time and safety critical processing
  - PCIe based High-speed internal communication network (32Gbps per link)
  - UltraScale+ for Low-latency synchronizations and communications
PIU ARCHITECTURE

- Multi-protocol gateway prototype
  - Low-latency multi-protocols translation services running on FPGA for high speed Ethernet (de-)packetization
  - ~180 I/Os pins available, including automotive standard protocols (CAN, LIN, PWMI/O, etc.)

- Real-time RH850 micro-controller
  - Functional safety & embedded security features

- Ethernet TSN backbone
  - Enabling fast & deterministic communications for packetized data delivered to the PCU
**SW ARCHITECTURE AND MOCC**

- System level design relies on a communication and computing model enabling multi-source Real Time SW assembly
  - Combining RT and high performance constraints
  - Foundation of conformity and application deployment tools

- Taking benefits from runtime support to detect abnormal behaviors

- SW Architecture leveraging on hypervision and heterogeneous runtime environments
  - Autosar Classic, Adaptive, automotive grade linux
3 CONCERNS FOR A SINGLE TOOL

- Tools for functional-level application specification and design
- Tools for applications deployment and platform configuration
- Tools for checking conformity of applications implementation to the specification
- HW and eSW platforms are fully operationnal and available in different configurations
  - 4 kind of CPU, 3 OS

- Tools and integration framework demonstrated in CES’19
  - Management of a configurable and adaptable Advanced braking system

CONCLUSIONS AND PERSPECTIVES

- The whole automotive industry is moving toward centralized computing solutions.

- The real game changer will be the ability to open the data and the computing platform.

- With a joint HW/SW and tools approach we show that we can leverage the full value of centralization.

- After 3 intensive years of joint Renault-CEA R&D it’s time to accelerate opening securely the electronics of the mobility industry.
COMING SOON

alkalee
Thank You