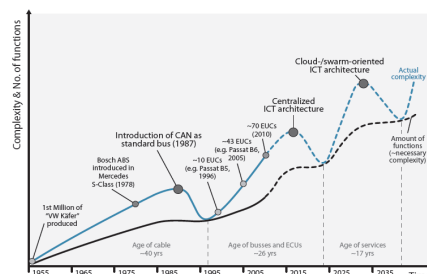
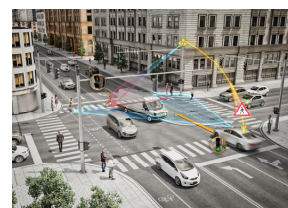


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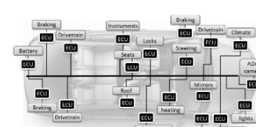
A mandatory evolution to answer future needs

- The architecture must be adapted to future processing needs
 - Computing power
 - Heterogeneity for efficiency
 - E.g. control-oriented, compute intensive, safety critical applications...
 - High-data volumes generation
 - E.g. multiple HD cameras for autonomous driving
 - V2V and V2I interactions and communications
- Must integrate new services as new SW functions during its lifetime
 - SW-oriented architecture
 - HW should also be adapted/upgraded
 - Function integration should be automated and secured
- And always with the capacity to remain compatible with the existing infrastructure

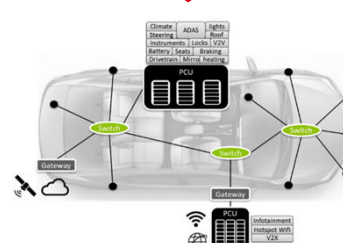


FACE: an innovative E/E architecture

- A centralized computer system architecture
 - Secured, dependable, heterogeneous
 - Scalable and modular
 - Follow the ISO26262 standard
- With a fast and deterministic high-speed network
- With a unified SW architecture
 - For real-time and mixed-critical execution
- A virtualized distributed architecture
 - Hypervision, attribute-based data protection, virtual links



~ One ECU per major function

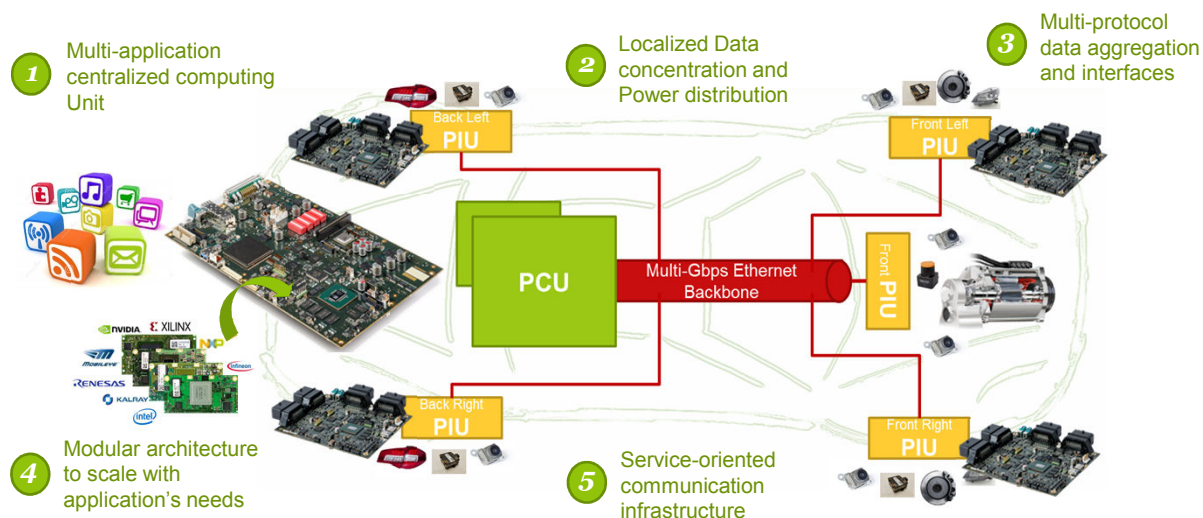


Open

Secured

Universal

FACE E/E architecture

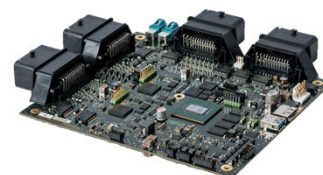
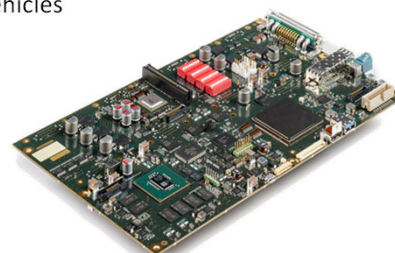


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Automotive E/E HW designs

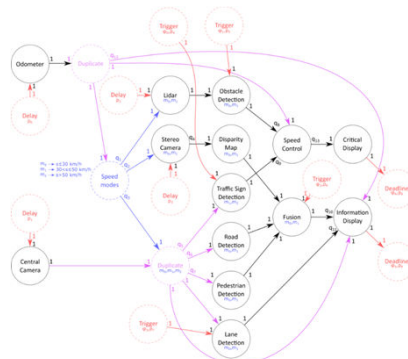
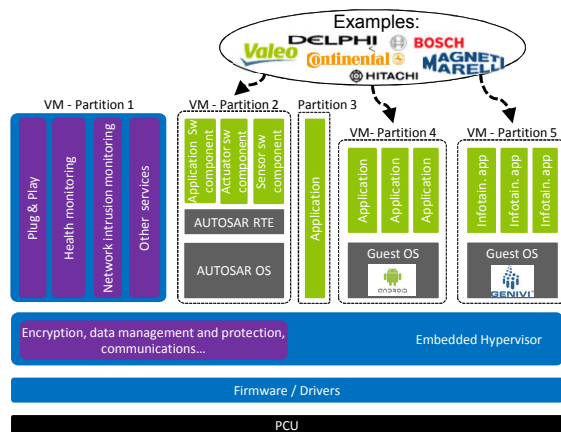
- PCU prototype
 - Motherboard running legacy SW and applications common to all vehicles
 - Renesas RCAR-H3 for high performance computing
 - RH850 for Real-time and safety critical processing
 - UltraScale+ for Low-latency synchronizations and communications
 - High-speed communication networks
 - PCIe Gen3 and Ethernet TSN
 - Scalable and upgradeable thanks to daughter boards
 - Renesas RCAR-M3 and Kalray MPPA Bostan
 - Xilinx UltraScale+ daughterboard for high-speed cameras
- PIU prototype
 - Low-latency multi-protocol gateway
 - Support multiple automotive standards (CAN, LIN, PWM/O, etc.)
 - Real-time RH850 micro-controller
 - Functional safety & embedded security features
 - Ethernet TSN backbone
 - Enabling fast & deterministic communications



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Software Architecture and MoCC



- SW architecture leveraging on hypervision and heterogeneous runtime environments
 - Autosar Classic, Adaptive, automotive grade linux

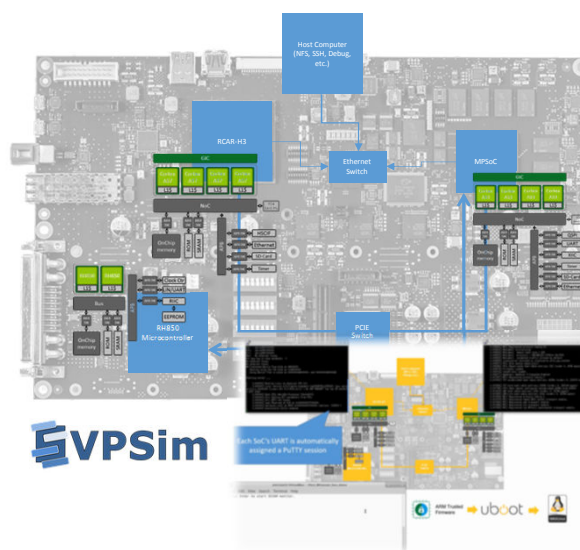
- System level design relies on a MoCC enabling multi-source Real-time SW composition
 - Combining RT and high performance constraints
 - Foundation of conformity and application deployment tools
 - Taking benefits from runtime support to detect abnormal behaviors

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Electronic architecture modeling

- PCU modeling with SESAM/VPSim
 - SESAM/VPSim (from CEA LIST)
 - Fully-integrated virtual prototyping environment
 - SystemC/TLM 2.0, QEMU
 - Multi-physics co-simulation (FMI)
 - Hybrid prototyping and HW co-emulation
 - Dynamic accuracy control
 - Modeling of all the SoCs and their interactions
- Full SW stacks to be run on the virtual prototype
 - Boots Linux in 12 seconds (5s on real HW)
- Functional validation, performance evaluation and debug
 - E.g. Eth/PCIe communication inspection, separate GDBs, inline debug-level verbosity, checkpointing...



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Conclusion

- Design of a new automotive E/E architecture
 - Centralized, virtually distributed
 - Flexible, upgradeable, heterogeneous
- A all-in-one strategy
 - *HW architecture and design*
 - *Software and run-time*
 - *Development and integration process*
- FACE demonstrator at CES 2019 (MoCC and tools)
 - Highlight flexibility and upgradability of the FACE platform
 - Multiple applications deployed on a centralized heterogeneous computing system
 - HW Nvidia TX2, Renesas Rcar-H3 and Kalray Bostan



<http://www.cea.fr/multimedia/pages/videos/activites-du-cea/projet-labo-installation/face-ces-2019.aspx>

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