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Components and tooling to reduce complexity and cost in E/E powertrain system design for Hybrid electric Vehicles

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In collaboration with EVAAP EDTA

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NextSTEP Solutions

- A new Powertrain MCU (Scaleo chip)
- An efficient development tools chain (IFP-EN)
- An advanced Vehicle EEA sustaining Functions Grouping

Demonstrated in NextSTEP Project (2011-2014)

With a full parallel Hybrid-Plugin demonstration car

Introduction

- Increase of E/E systems complexity and amounts of electronic systems (ECU) within vehicles
- Electronics to account 40% of vehicle costs by 2016 (figures: McKinsey & Co)
- Powertrain case :
  - Increase of ECU amounts
  - Increase of actuators and sensors amounts
  - Increase in precision/resolution and actuation frequency
  - Increase of SW code size and sophistication
  - Increase of thermal engine/ electric motor variants

→ Need of E/E systems rationalization and adapted HW/Tooling systems

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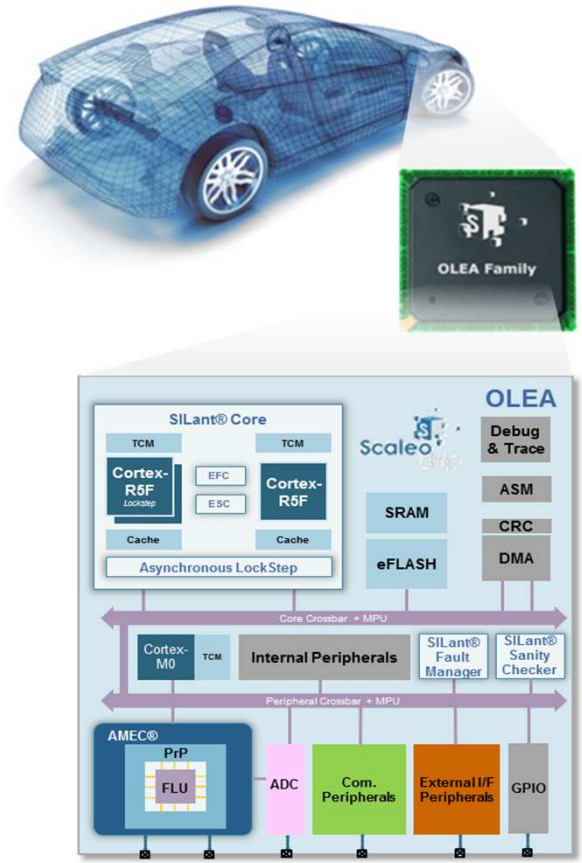
OLEA

Innovative Flexible Multi-core MCU

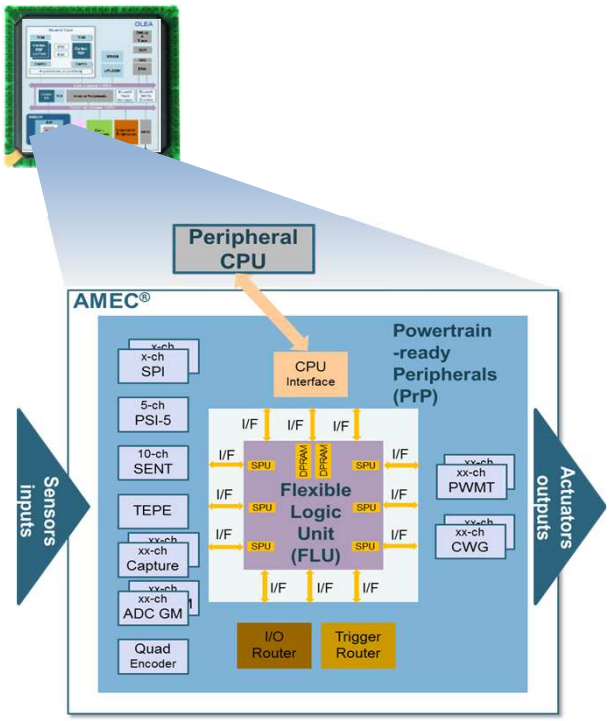


Key benefits to Advanced Powertrain systems

- Fixed event timings whatever the number of events to be processed in parallel
- High system integration capability enabling powertrain functions grouping
- Hardware flexibility enabling integration of sophisticated functions elaborated directly from models (eg: Matlab Simulink)
- High computing performances gains
- High system scalability (eg: to adopt new emerging actuators technology).
- High safety integrity level

AMEC® in OLEA

Engine/Motor interfacing & control



New HW/SW partitioning relying on:

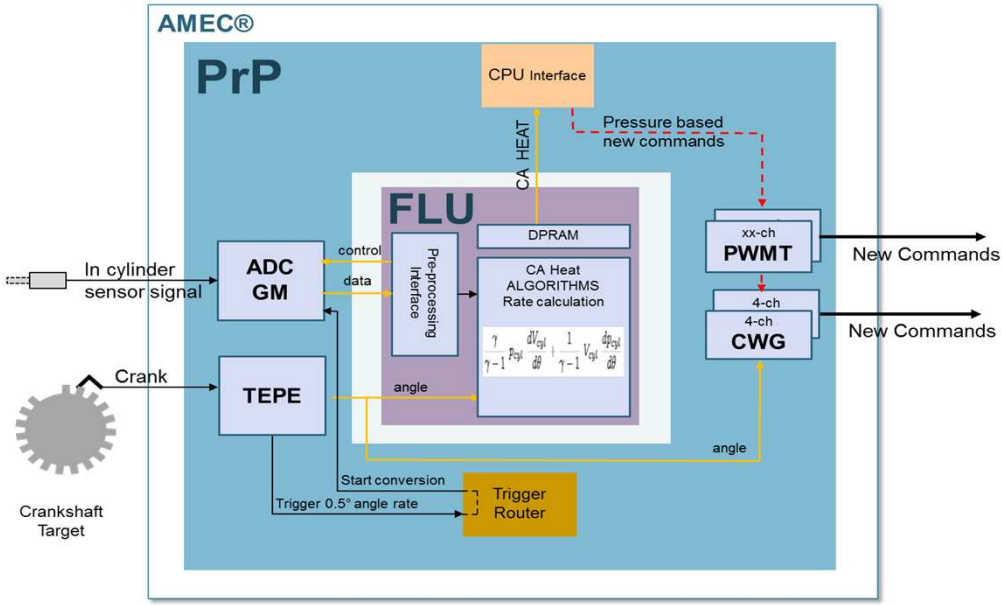
- Powertrain-ready-Peripherals (PrP) unit
  - Autonomous & Hard Real-time peripherals
  - ICE & Electric function support
- Flexible Logic Unit (FLU)
  - An integrated DSP resource for sophisticated control loop and high resolution measures
  - A parallel architecture for fixed events timing

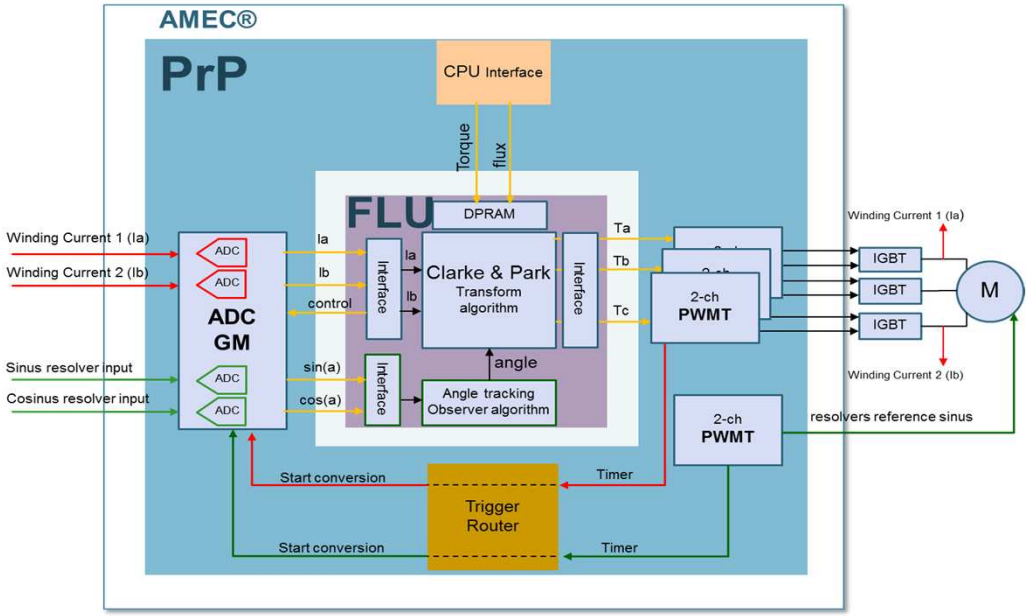
➔ Saves CPU load from measures and actuations processing

➔ Supports yet to come sensors, actuators & standards

AMEC® in OLEA

use cases implementing IFP-EN system IP





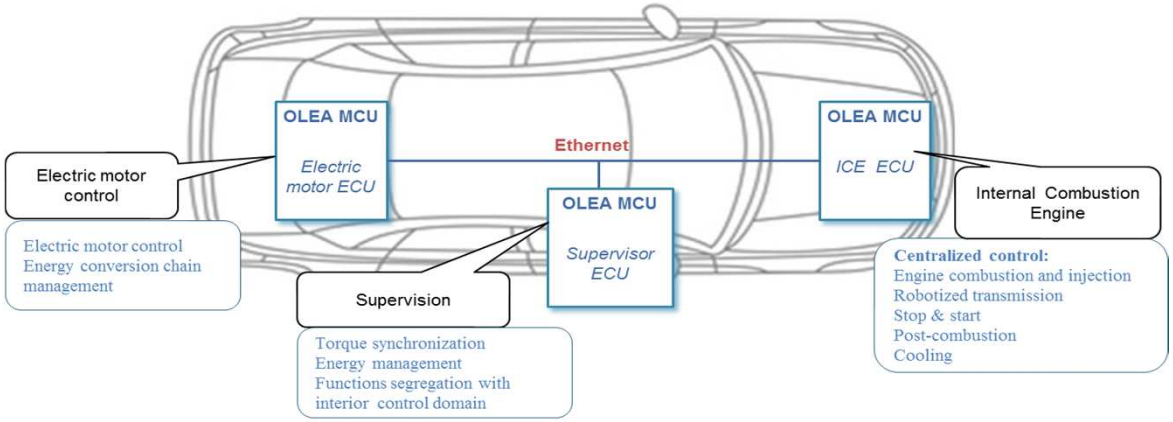
ICPS use case

"CA Heat"

Electric Motor

"Clarke & Park"

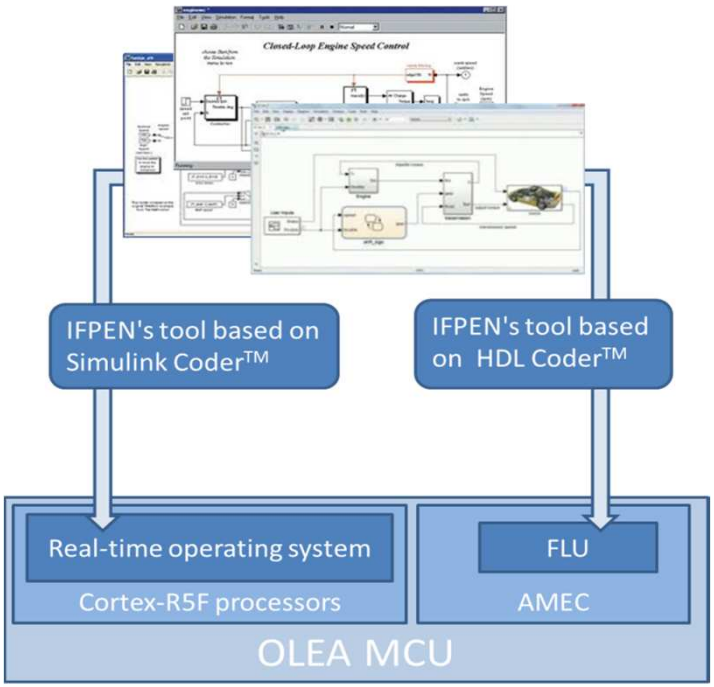
Flexhybrid E/E Architecture
New Functions Grouping



- 3 OLEA based ECUs based:
  - ICE ECU: stop & start, thermal engine management and transmission control
  - Electric motor ECU: electric motor control & associated energy dc-dc conversion chain
  - Supervisor ECU: global powertrain supervision, energy management and body control
- IFPEN Flexhybrid: A parallel full hybrid vehicle prototype

IFPEN Development tools

A flexible model driven design



A tool chain designed for H/W & S/W to:

- Give access to internal parameters and signals during execution for rapid prototyping and calibration purposes
- Prototype & Measure different implementations (FLU/CPU) in support of the optimal H/W & S/W partitioning
- Generate from models either S/W & H/W
  - Multi-core ready S/W tasks to run in OLEA MCU cores
  - H/W functions/control loop ready to run in parallel in the OLEA AMEC FLU unit.

IFPEN Development tools

3 steps - Chain of validation

1. Models off-line co-simulation using xMOD™
2. Hardware-in-the-Loop:
   - OLEA ECUs under HiL testing via code generation solution
   - xMOD-HiL running real-time vehicle and powertrain models
3. Vehicle integration and tests
   - Flexhybrid Car Lab

Conclusion

- OLEA, a H/W Flexible MCU, joint to IFP-EN development tool chain enables:
  - Advanced solution designs for cleaner and economic HEV
  - Vehicle EEA optimization
  - Optimal support of Hybrid architecture variance
  - Design complexity and design cycles reduction
- April 2014: Demonstrated in a running vehicle
- Come & visit us on IFP EN booth for demos

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