Self-adaptation of Cyber-Physical Systems

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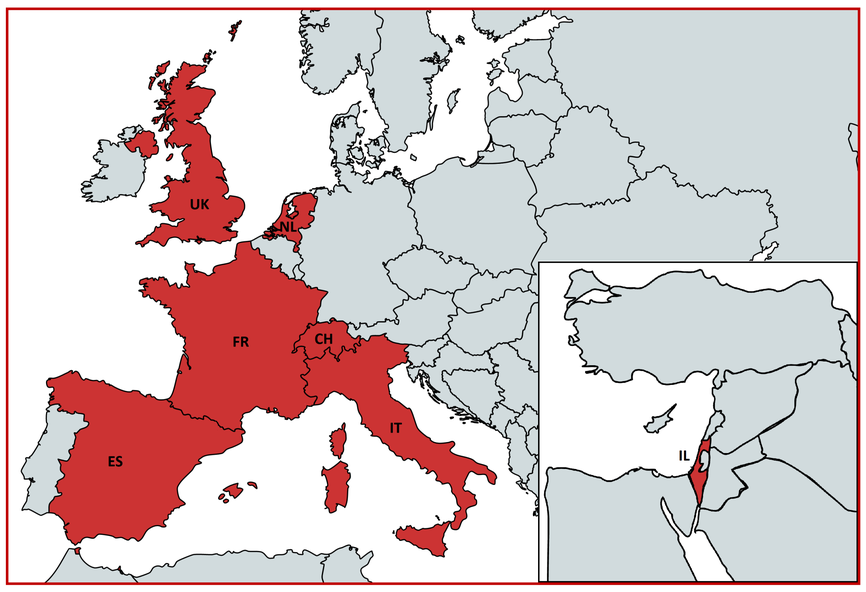
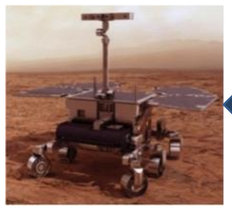
This work has received funding from the EU Commission's H2020 Programme under grant agreement No 732105

CERBERO IN A NUTSHELL

Cyber Physical Systems (CPS) are embedded computational collaborating devices, capable of controlling physical elements and responding to humans. CERBERO aims at developing a CPS design environment based on two pillars: a cross-layer model based approach to describe, optimize, and analyze the system and all its different views concurrently; and an advanced adaptivity support based on a multi-layer autonomous engine.
CERBERO effectiveness is assessed in challenging and diverse scenarios: planetary explorations, ocean monitoring and a smart travelling for electric vehicle.

CONSORTIUM & PROJECT OVERVIEW





CPS HW-ORIENTED

Copses SW-ORIENTED

Self Healing for Planetary Explorations
This use case focuses on a single unique **embedded CPS**.
*CERBERO technologies are going to be adopted to define **self-healing** and **self-adaptive** processing systems capable of operating in such a critical environment.*

Ocean Monitoring
Smart video-sensing unmanned vehicles with immersive environmental monitoring capabilities.
*CERBERO will define algorithms for data analysis and information fusion to enable **smart (self-) adaptation** strategies to address rapidly changing environment and system conditions.*

Smart Travelling for Electric Vehicle
Highly networked. Heterogeneous concurrent subsystems: **Electric Vehicle**, **Person** (partially observable personal agenda), **Smart Mobility** (parking, charge points, etc.), etc.
*CERBERO will support **adaptability,** plus **modelling and managing** the **distributed communication layers**.*

	IL	IT	ES	NL	UK	FR	CH
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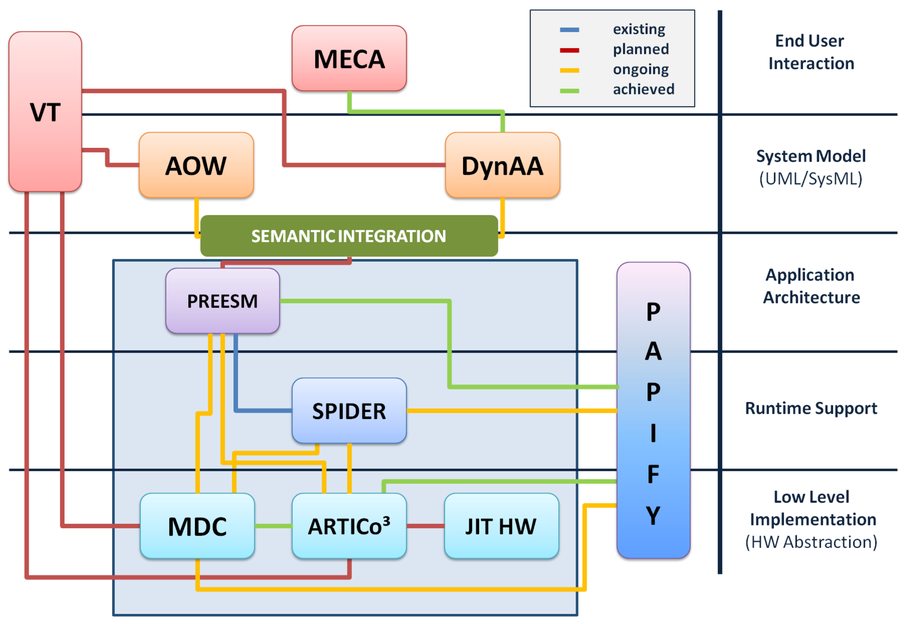
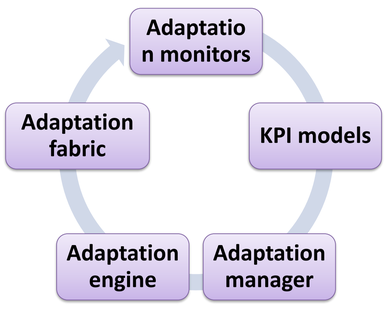


- **MECA**: decision support for user of a CPS
- **VT**: quantitative requirements verification to provide correct-by-construction design.
- **AOW**: multi-objective multi-view cross-level optimization.
- **DynAA**: system analysis and design tool, combines features from system and network simulators.
- **PREESM**: dataflow to core mapping with static optimization capabilities (i.e. latency and load balancing).
- **PAPI**: runtime monitoring.
- **SPIDER**: runtime manager.
- **JADE**: Just-in-time compilation.
- **MDC, ARTICO³**: hardware acceleration and support for adaptivity.

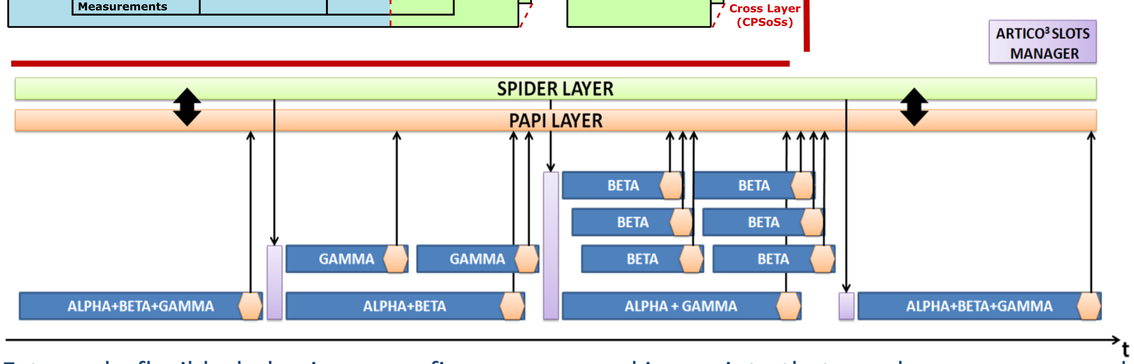
Michael Masin, Francesca Palumbo, et al.
Cross-layer design of reconfigurable cyber-physical systems
DATE 2017 - Design, Automation & Test in Europe Conference

Self-Adaptivity in CERBERO H2020



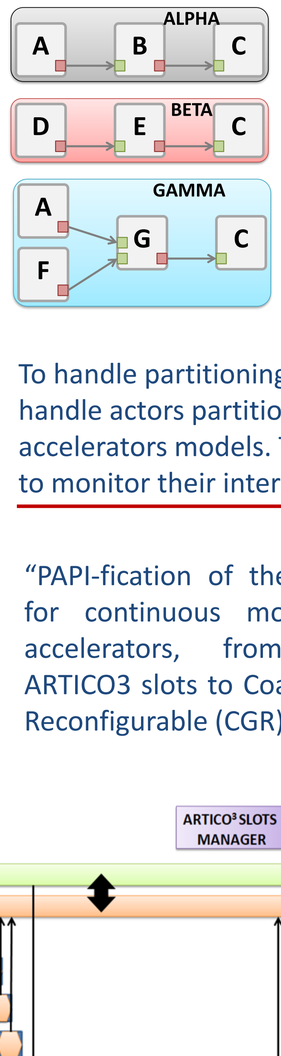
In CERBERO, tackling the development of self-adaptive CPS and CPS of Systems, we provided a generic definition of a self-adaptive system: ***the adaptation loop***.

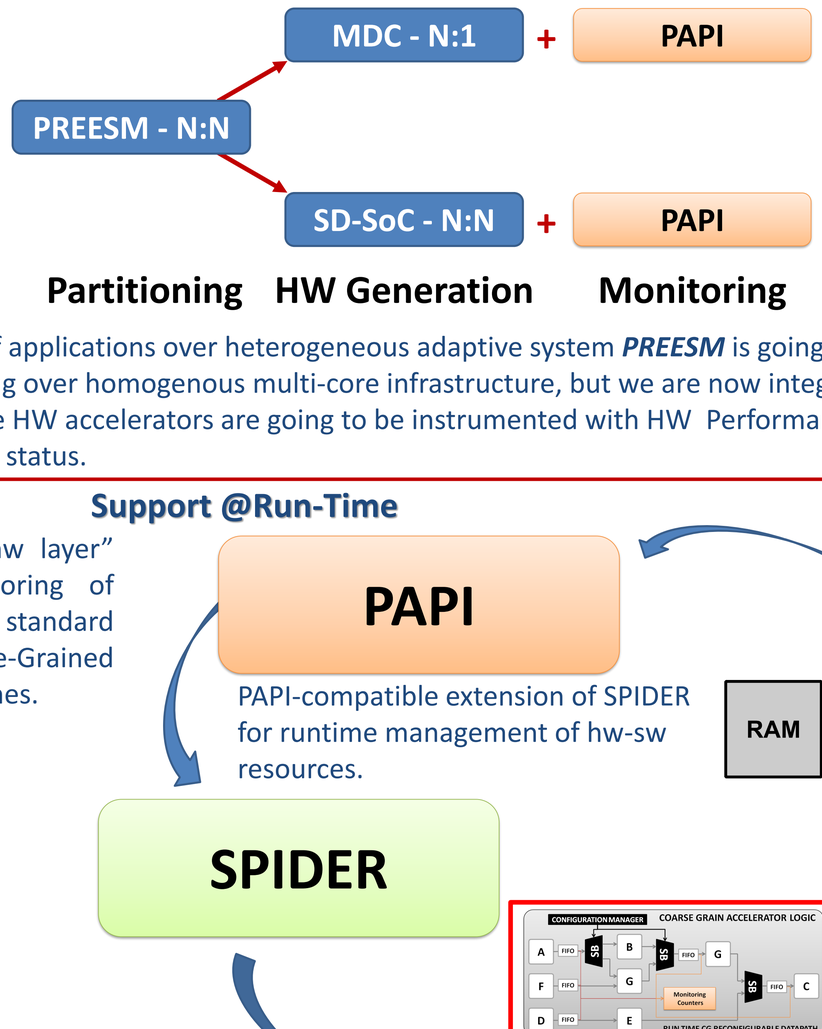
CERBERO adaptivity support is based on ***a multi-layer heterogeneous (HW-SW) autonomous engine***

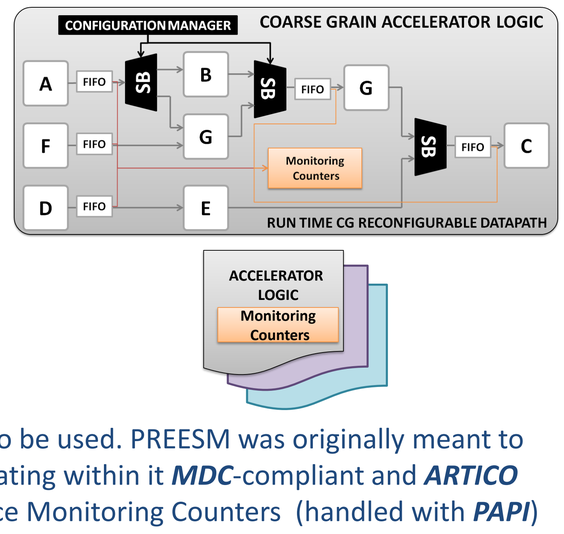


Extremely flexible behaviours: surfing among working points that can be user commanded or self-determined (i.e. low battery level).

Support @Design-Time







To handle partitioning of applications over heterogeneous adaptive system ***PREESM*** is going to be used. PREESM was originally meant to handle actors partitioning over homogenous multi-core infrastructure, but we are now integrating within it ***MDC***-compliant and ***ARTICO*** accelerators models. The HW accelerators are going to be instrumented with HW Performance Monitoring Counters (handled with ***PAPI***) to monitor their internal status.

Support @Run-Time

"PAPI-fication of the hw layer" for continuous monitoring of accelerators, from standard ARTICO3 slots to Coarse-Grained Reconfigurable (CGR) ones.

PAPI

PAPI-compatible extension of SPIDER for runtime management of hw-sw resources.

SPIDER