Horizon 2020
European Union funding
for Research & Innovation

CERBERO

Cross-layer modEl-based fRamework for multi-oBjective dEsign of Reconfigurable systems in unceRtain hybRid envirOnments

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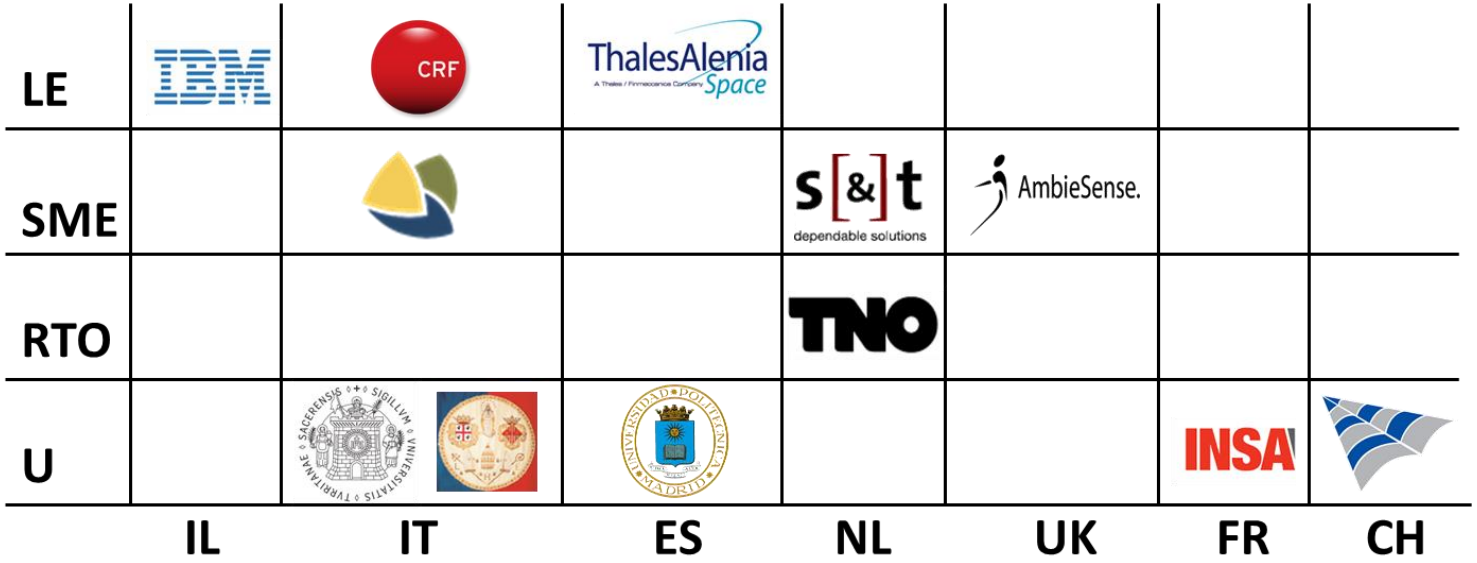
Agenda

- CERBERO consortium in a glance
- Background on Cyber Physical Systems (CPS) and Cognitive CPS
- CERBERO goal (WHAT)
- CERBERO use cases (WHY)
- CERBERO tool chain (HOW)
- Summary of CERBERO approach
- Next steps

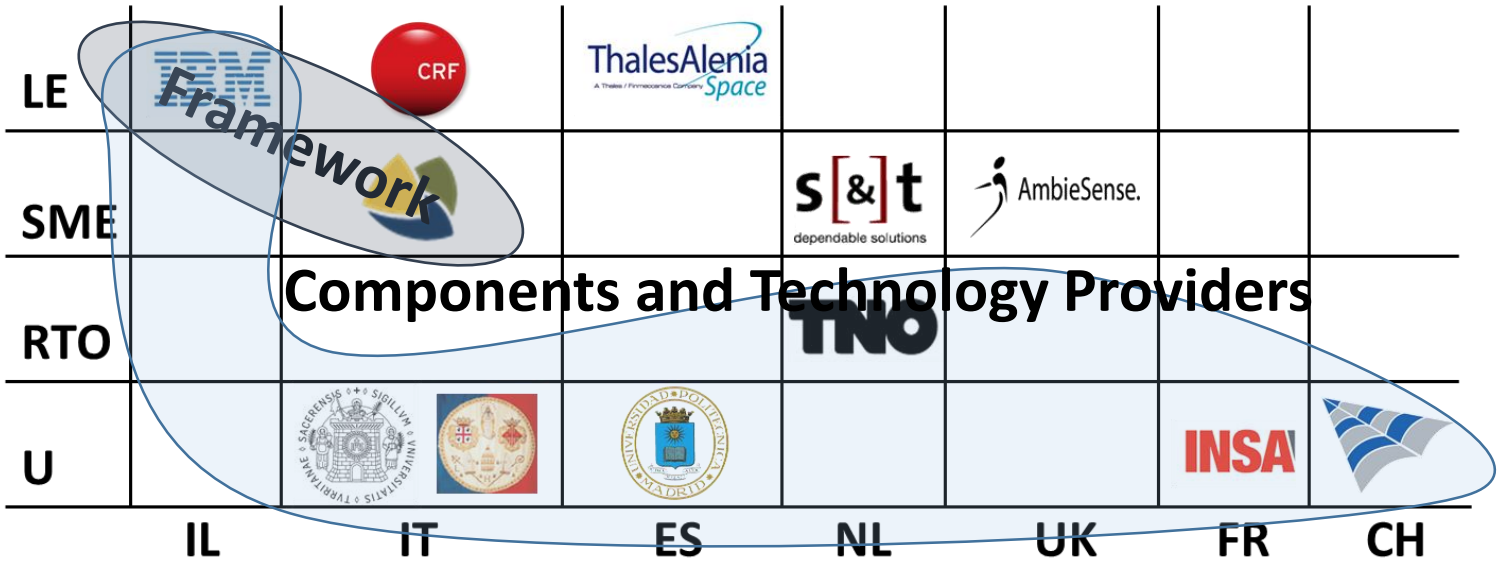
Consortium: 12 partners from 7 countries



Started: January 1, 2017

Duration: 36 months

To build Cognitive Cyber Physical Systems



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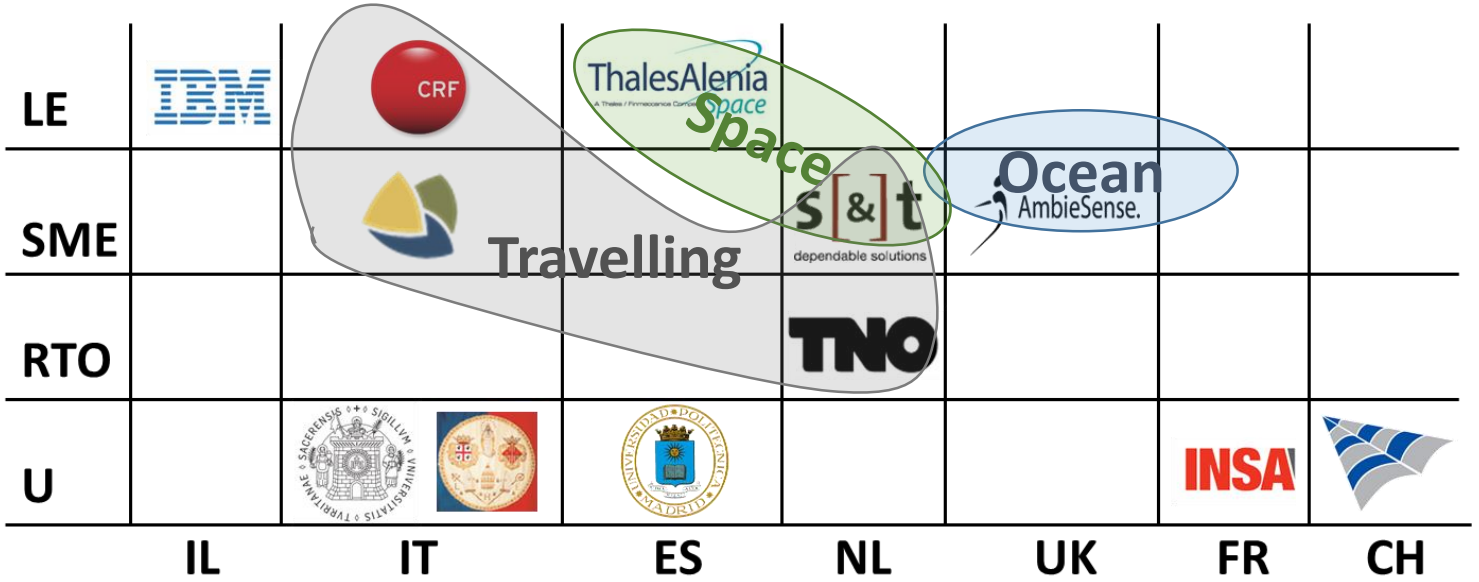
and evaluate by 3 use cases



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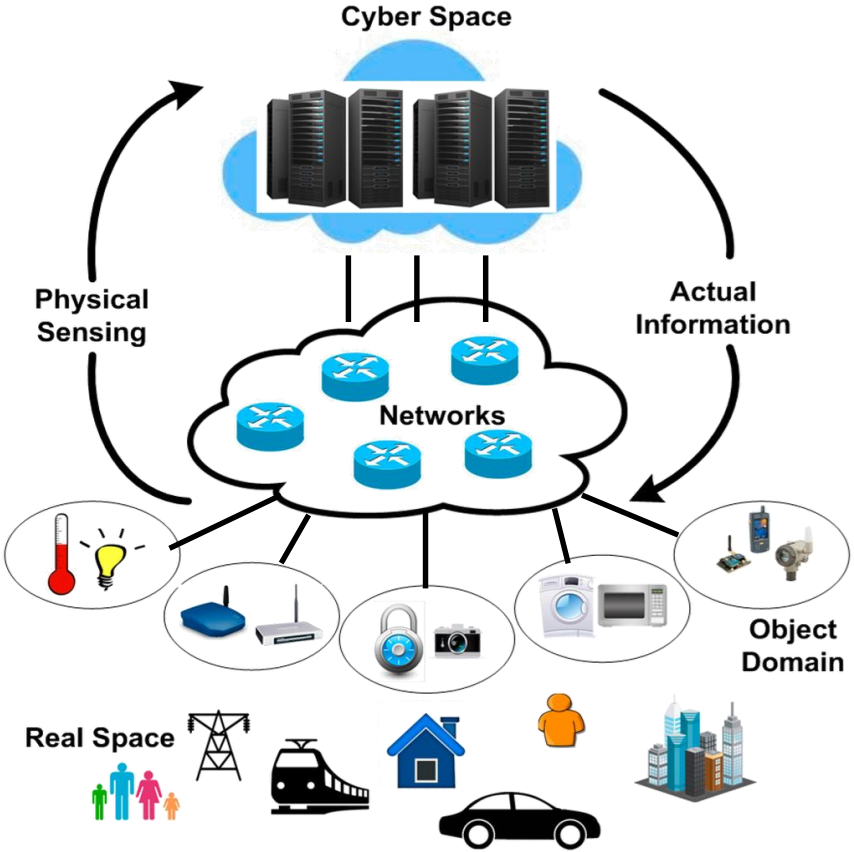
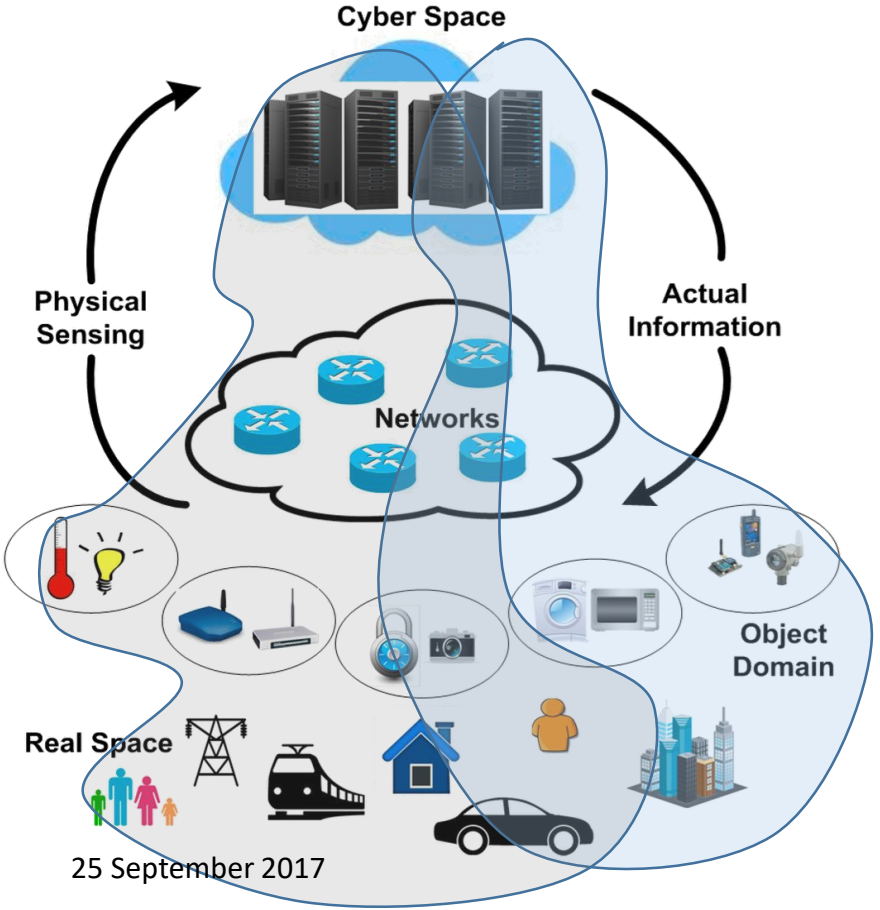
Cyber Physical Systems (CPS)



- **Autonomous cyber** systems communicating with **physical** environment
- Examples
  - **embedded controllers**
  - **home appliances and cars communicated with cloud**
  - **industrial controllers, SCADA**
- Usually **small** System of Systems (SoS) or **star** topology of similar devices connected to cloud
- **Main challenge:** Combine Cyber and Physical Models for design, analysis and operation
- **Established** technologies for design and operation

Cognitive CPS



- **Reconfigurable** CPS that understand operational [redacted] in real time, especially with **humans** or **teams** of machines and humans
- Examples
  - **mars rover**
  - **autonomous vehicles**
  - **autonomous vessel fleets**
  - **self healing appliance**
  - **self adaptive manufacturing**
- Usually **large** SoS and **fog** topology between hybrid devices
- **Big challenge:** Reconfigurable "Smart" Cyber Systems in Uncertain Hybrid Environments
- **Emerging** design and operation methodologies

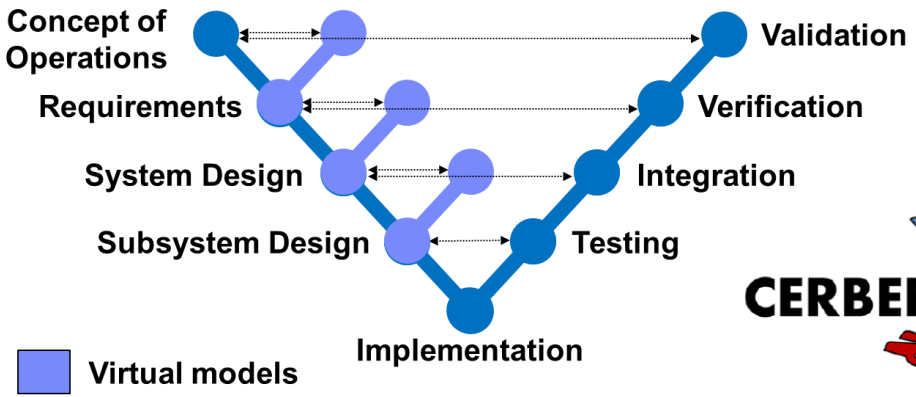
CERBERO Goal

- **Integrated model-based framework for multi-objective design, fast prototyping and continuous DevOps of Cognitive Cyber Physical Systems**
  - *From* (User Requirements)
  - SoS and System level
  - Application / Service level
  - Real Time Manager level
  - *To* Real Time Software and Hardware implementation

CERBERO Approach

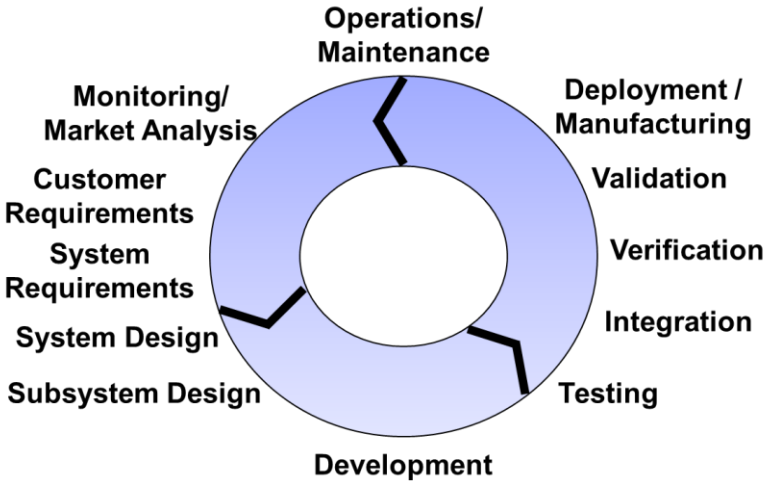
- **BEYOND SEPARATION OF CONCERNS:**
  - Modeling, optimization and analysis of hybrid systems with *continuous* physical and human behavior and *discrete* cyber models of computation and communication
  - Many layers of abstraction with unique models and tools
- **BEYOND REQUIREMENTS ANALYSIS:**
  - High level functional and non-functional (i.e. security, sustainability, usability) requirements analysis and continuous verification
  - Generalization of requirements by means of common Key Performance Indicators
- **BEYOND SCENARIO AWARENESS:**
  - Methodology for designing cognitive system architectures
  - Autonomous and sensor-based hardware/software reconfiguration
  - Multi-layer runtime adaptation approach by means of a high-level self-adaptation engine
- **BEYOND TOOL INTEGRATION:**
  - Semantic integration of different design automation components
  - Incremental prototyping and verification, with system-in-the-loop co-simulation capabilities

CERBERO Expected Impact



MBSE

CERBERO



Use models to create models
Virtual / real environment

- **Collection of partially integrated toolchains and methodologies for CPS that**
  - collect data usage
  - apply predefined control
  - find shortest path navigation
- **Integrated modelling and design environment for Cognitive CPS with**
  - self adaptation and self healing capabilities
  - adaptive control based on global objectives
  - congestion, accident (and other risks) avoidance

CERBERO Use Cases

Self-Healing System for Planetary Exploration:

- **Self-healing** and **self-adaptive** embedded CPS processing systems capable of operating in such a critical environment
- Robotic arm and motors control for space vessel

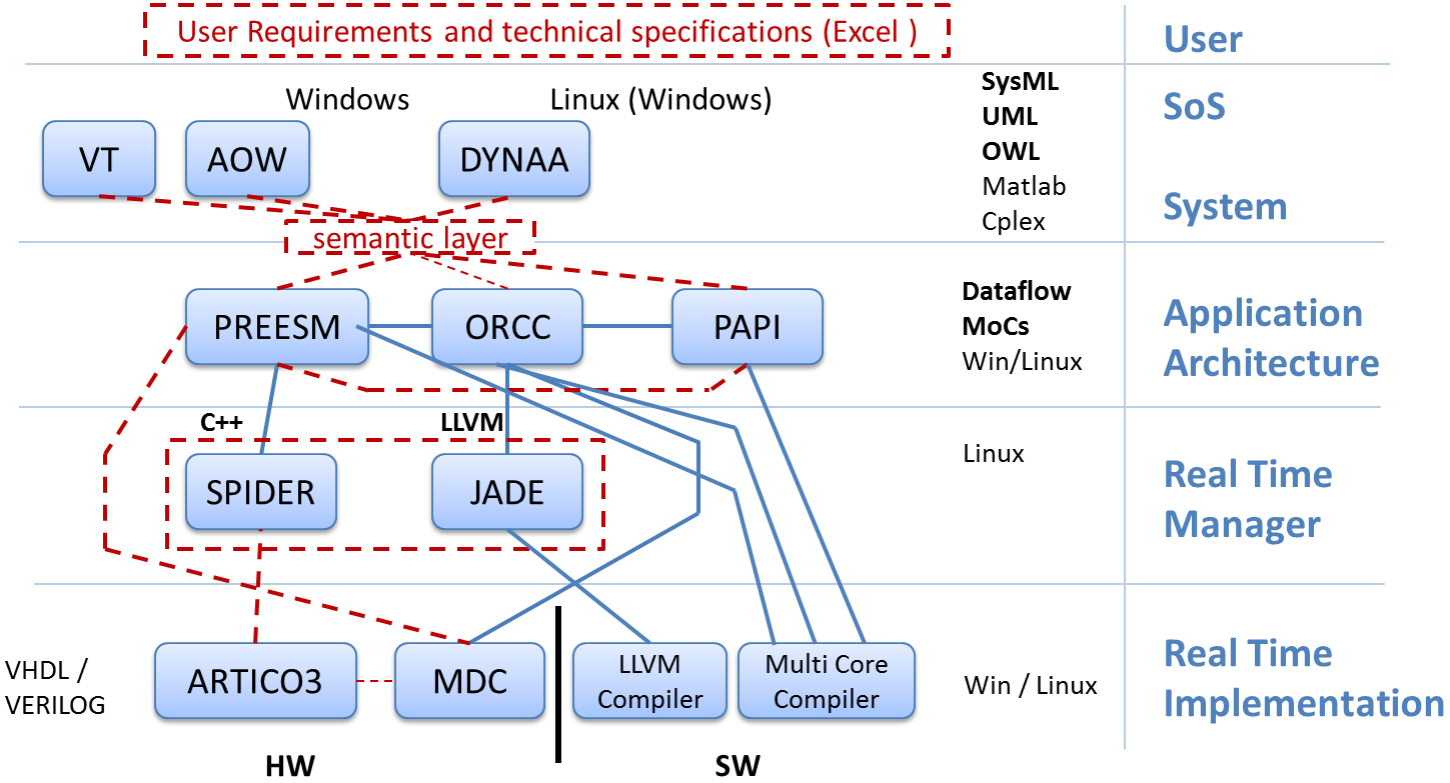
Ocean Monitoring:

- Smart video-sensing unmanned vehicles with **immersive environmental monitoring** capabilities
- **Individual** and **fleet self-operation, power management** and **navigation**
- Data analysis and information fusion to enable **smart adaptation** strategies to address rapidly changing environment conditions in order to obtain or maintain positions on sea and other missions objectives

Smart Travelling for Electric Vehicle:

- **Virtual Reality** simulated environment
- **Highly networked** scenario composed of heterogeneous concurrent subsystems
    - **Electric Vehicle**, **Person** possessing a only partially observable personal agenda, the **Smart Energy Grid** and the **Smart Mobility** that provides mobility-aware functionality (e.g. parking places, charge points, smart home, smart office, etc.)
- High degree of **autonomy** and support for **adaptability,** plus modelling and managing the distributed communication layers.

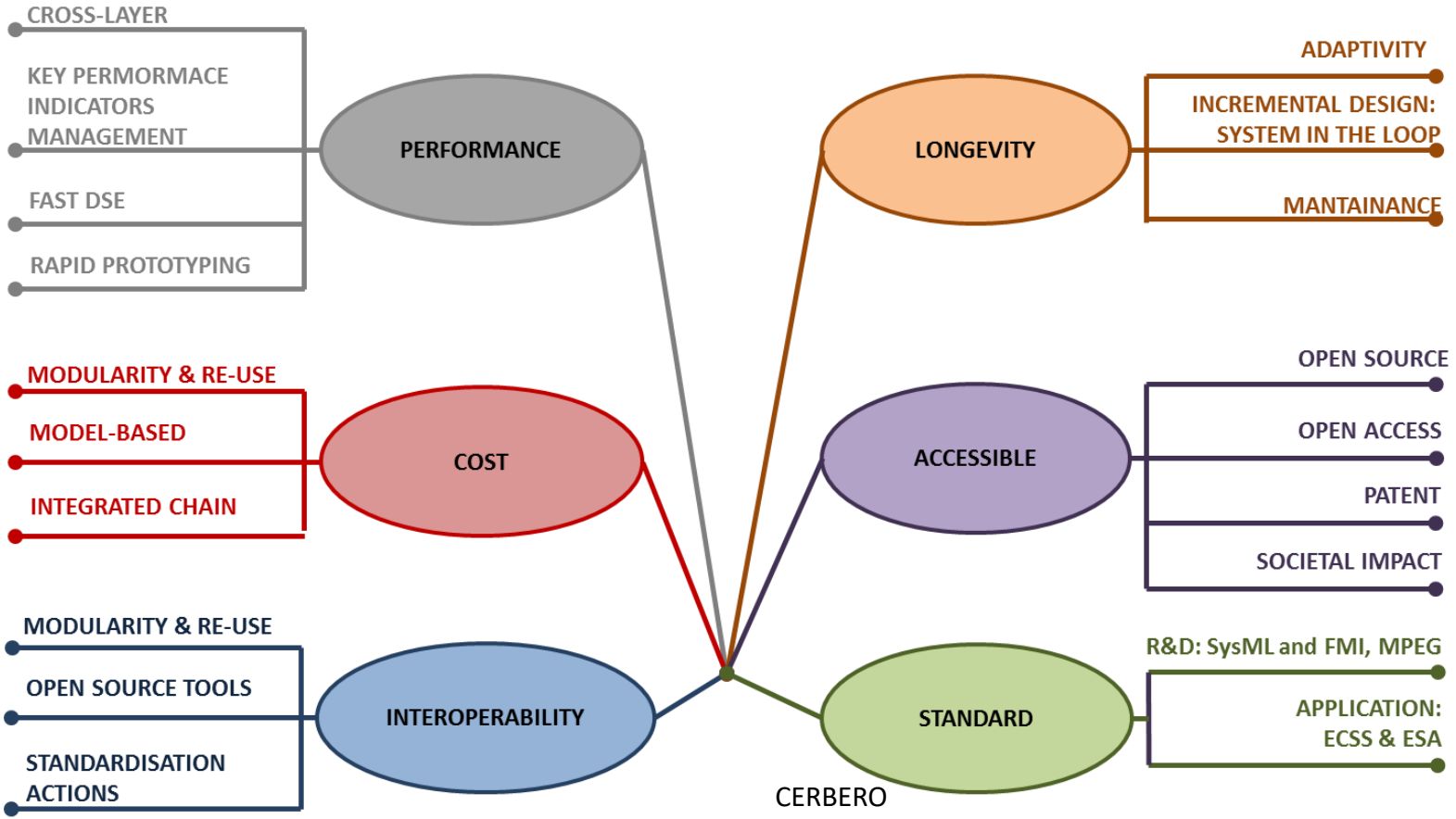
CERBERO Toolchain v0.1



Current status and next steps

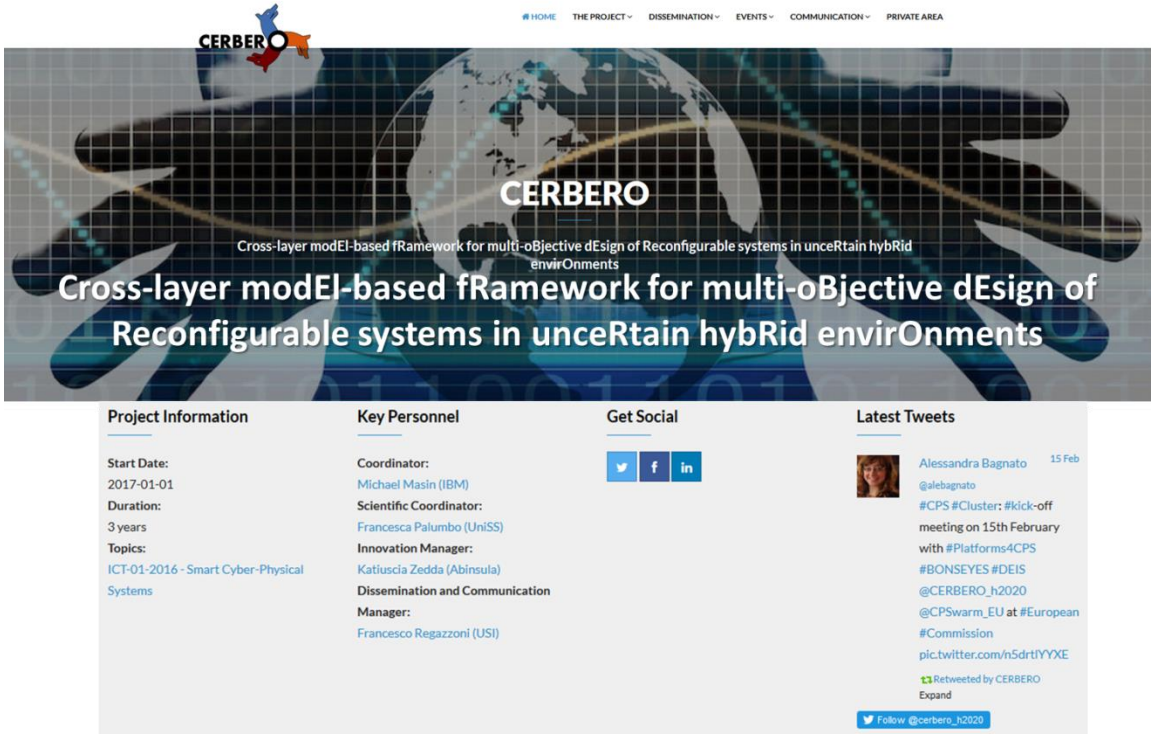
- Elaboration of use cases
- **Requirements for the tools and integration platform**
- **Initial methodology, integration framework, and sub-toolchains**
- **Review in Brussels on October 24**
- **General Assembly in Haifa, Israel**

CERBERO Drivers



Thank you for your attention!

Any questions?



http://www.cerbero-h2020.eu/