Designing Cloud-based Self-Healing Cyber-Physical Systems

Cyber-Physical Systems (CPSs) are a new generation of systems capable of representing more than networking and information technology, information and knowledge being integrated into physical objects. These types of systems are physical and engineered systems whose actions are monitored, controlled, and integrated by a computing and communication kernel.

CPS Architecture

- CPS Top (cyber) Layer
- CPS Middle Layer
- CPS Bottom (physical) Layer

The **CPS top layer** contains the private cloud:
- Web Service Integration Gateway (WSIG) add-on, on the web server side
- Web services (WSs) (SaaS)
- Client applications

The **CPS middle layer** contains the multi-agent systems and the database:
- Multi-agent system with two kinds of agents on the JADE platform:
  - NA (negotiation agent)
    - Negotiates for the resources (managed by Resource Agent)
  - RA (resource agent)
    - Sends to RA the operation which needs to be executed by the CPS bottom layer
- RA (resource agent)
  - Initiates the FPGAs programming sequences in order to load on the FPGAs the required code

The **CPS bottom layer** contains several physical nodes having the structure:
- FPGA devices with an active role in the control of the physical layer and in assuring node dependability and data acquisition from the sensors
- Wi-Fi devices with the capabilities: adding sensors on analogical inputs (ex. temperature, light), Wi-Fi communication (TCP / IP and HTTP) and „scanning“ of the network for determining the neighbours to which they can associate

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**CycloSe Project Goals**

- To develop an infrastructure for designing self-healing Cyber-Physical Systems (CPSs) using cloud computing technology
- To develop an experimental model for CPSs using wireless sensor networks (WSNs) for data acquisition, reliable hardware components based on reconfigurable devices - Field Programmable Gate Arrays (FPGAs) and cloud computing technology to store, manage and analyse data in a large context

**CPS Top Layer**

**CPS Middle Layer**

**CPS Bottom Layer**

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