Enabling the Business-Based Internet of Things and Services

Cognitive/Self-IoT Opportunities, Challenges and Approaches in EU Projects: ebbits Perspective

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SEVENTH FRAMEWORK PROGRAMME

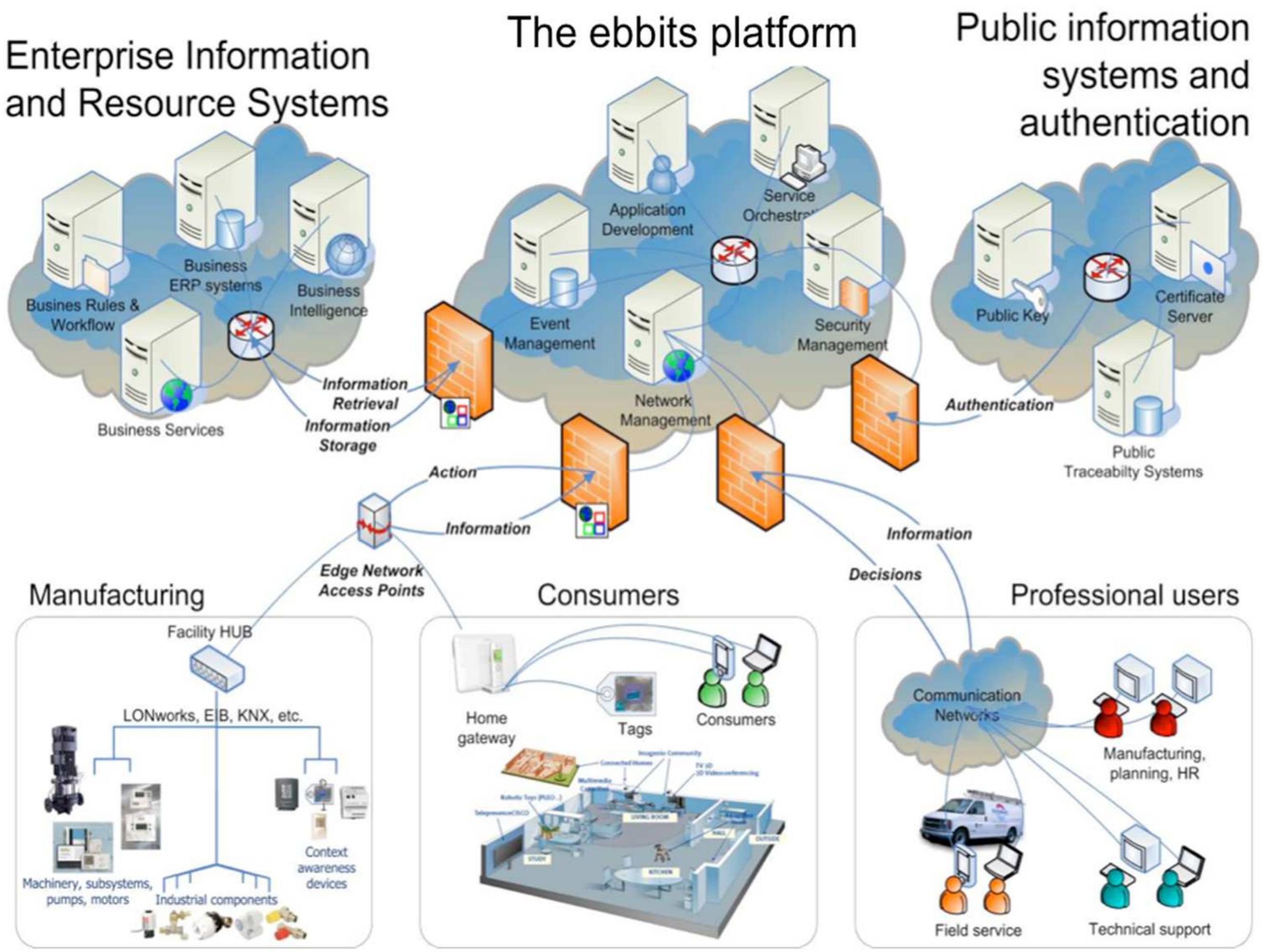
ebbits consortium

48 months /9 partners/12,0 M€ budget, 1091 pms.

Technical aim

- Develop an ***Internet of People, Things and Services (IoPTS)***-based Service Oriented platform that allows entreprises to develop and deploy a new range of ***business*** applications
  - Everything is a ***service*** and can be integrated into ***enterprise systems***
  - ***Physical world data*** feeds directly and seamlessly into ***mainstream business systems***

Enabling technologies for the Internet of Things and Services

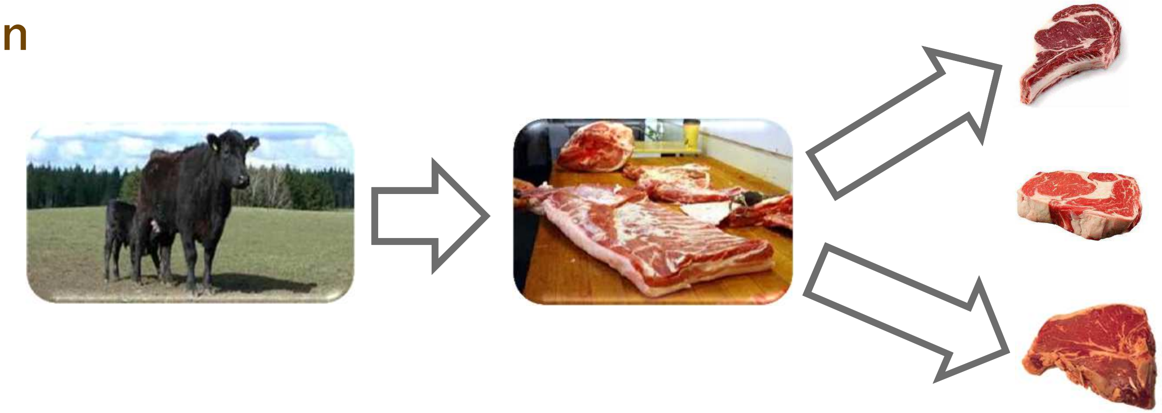


ebbits business scenarios

- ***Car Manufacturing***
  - Life cycle analysis in automotive industry
  - Energy optimization of production process
  - Performance monitoring of production process

ebbits business scenarios

- ***Food traceability***
  - Life cycle management
  - Product identification
    - Supply chain management
    - Logistics optimisation

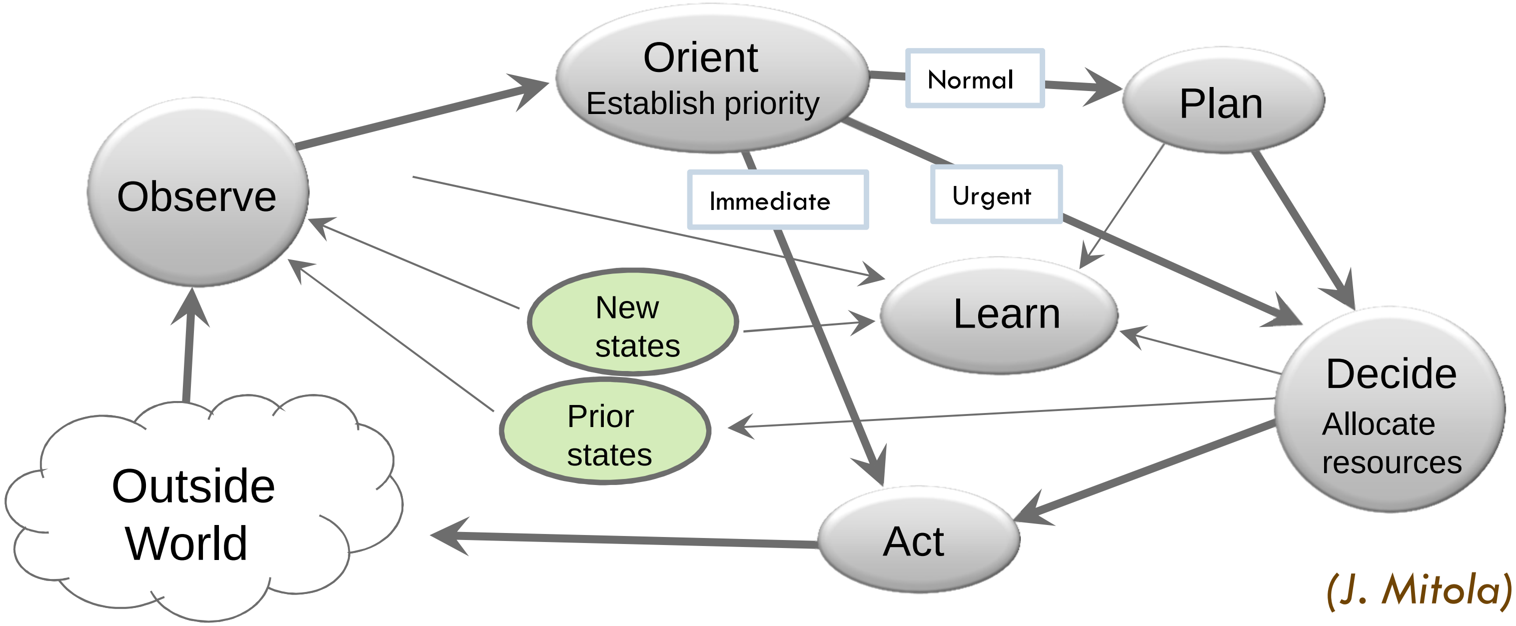


Project challenges

- Communication related issues
  - Car manufacturing scenario
    - Reliable and unattended operations in harsh environment
    - Adaptability to time-varying spectrum conditions
  - Food traceability scenario
    - Robustness to intermittent network connectivity
- Management of Core ebbits framework components
  - Resilience and adaptability to changing conditions w.r.t.
    - Network, processing and energy resources availability
    - Presence of failures

Proposed approach

- Apply the **cognitive process** to support
  - Dynamic management of radio communication resources
  - Self-* properties



(J. Mitola)

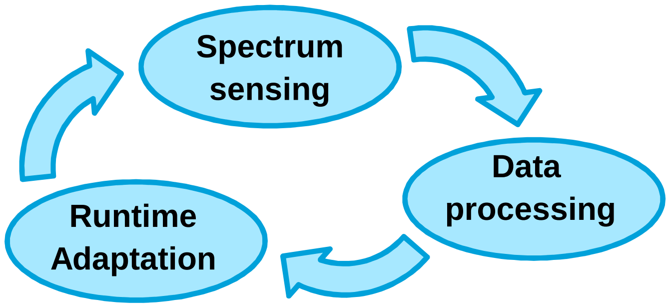
Management of communication resources

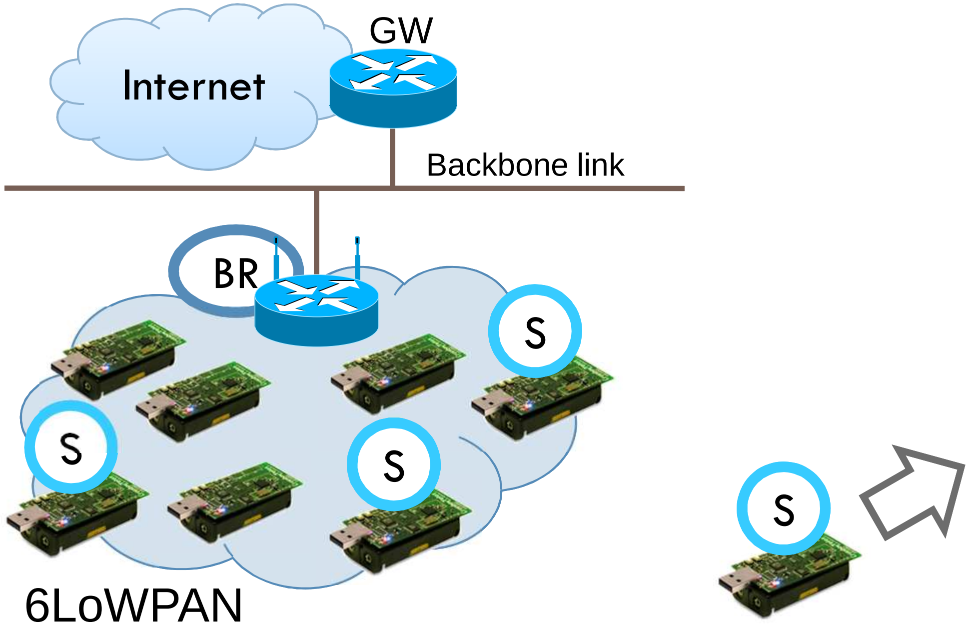
- Ability to **adapt** the use of radio communication resources/features by **observing**
  - the **dynamic conditions/properties** of the ***network*** or
  - the ***environment***, and the specificities of each node and its neighbours
- The adaptation decision could be based on
  - *physical radio constraints* (e.g. interference and intermittent signal/no network connectivity) and
  - possibly on *higher level context* (e.g. application information)
- This results into enhanced communication **flexibility** and **reliability.**

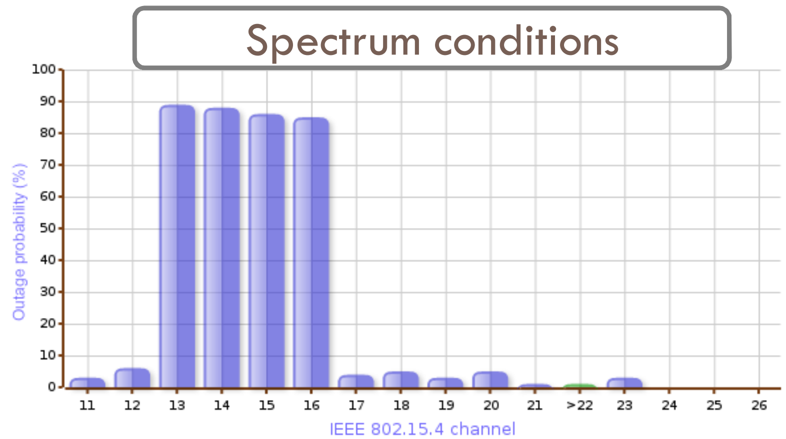
⇨ *Dynamic Frequency Allocation in 6LoWPANs*

Dynamic Frequency Allocation

- Dynamic channel selection based on evaluation of current spectrum conditions (robustness against interference)
  - Sensing / throughtput trade-off
  - Decision policies







Self-* properties

- ***Concept**: resources capable of managing their own behavior in response to higher-level goals, and interacting with other resources to provide or consume computational services*

- Functional areas of a ***self-managing autonomous system*** (IBM)
  - ***Self-Configuration***
    - Automatic configuration, deployment and removal of components
  - ***Self-Healing***
    - Automatic discovery, and correction of faults
  - ***Self-Optimization***
    - Automatic monitoring and control of resources to ensure the optimal functioning
  - ***Self-Protection***
    - Proactive identification and protection from arbitrary attacks

Adaptation

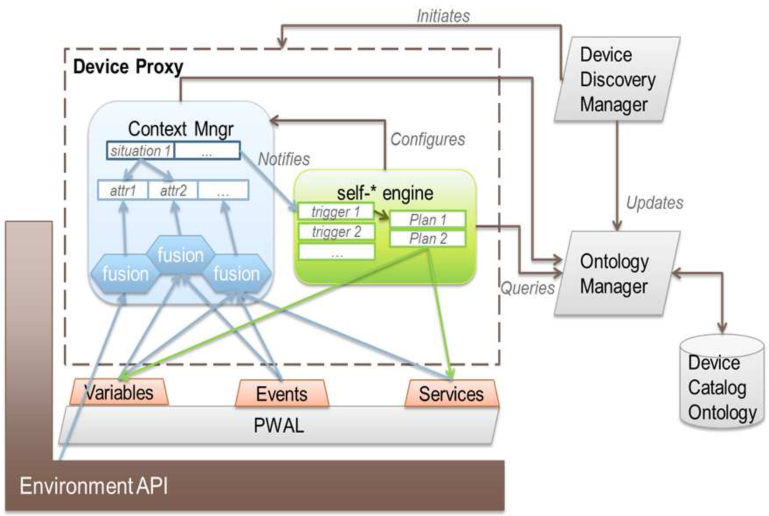
- **Anticipated adaption**
  - The different contexts to be accommodated at run-time are known at design-time
- **Un-anticipated adaption**
  - The variation possibilities are recognized and computed at run-time
  - The decision which variant is best is computed using self-awareness and environmental context information
- Pure un-anticipated self-adaptive systems are rare
  - Most self-adaptive systems feature a combination of anticipated self-adaptation and un-anticipated self-adaptation

(Hausi A. Müller University of Victoria, Canada, IWPSE-EVOL

Amsterdam, The Netherlands August 24-25, 2009)

Context-aware Approach

- Definition of a ***Self-* engine***
  - receiving inputs from a ***Context Manager*** in charge of monitoring and analyzing the situations (related to devices and networks)
  - executing plans according to ***high level policies***
    - policies are defined using simple rules specifying which actions must be executed when a situation happens
  - *Drools could be used or possibly semantic DL reasoners*



Open Issues

- Management of communication resources
  - Support ***Scalability*** – towards the IoT vision
  - Optimize "***observe***" ***duty-cycle***
  - Leverage on other ***context information*** to make decisions
- Self*-properties
  - Effectively handle ***unknown situations***
  - Manage ***complex rules*** to define all possible situations

Thank you for your attention!