SAPERE: Self-aware Pervasive Service Ecosystems

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STREP – 3 years

www.sapere-project.eu

AWARE Meeting - December 14, 2010
The Consortium

- Università di Modena e Reggio Emilia
  - Franco Zambonelli & Marco Mamei
- Birkbeck College University of London
  - Giovanna Di Marzo Serugendo
- Alma Mater Studiorum – Università di Bologna
  - Mirko Viroli & Andrea Omicini
- St. Andrews University
  - Simon Dobson
- Johannes Kepler Universitaet Linz
  - Alois Ferscha

AWARE Meeting - December 14, 2010
The Scenario

• Pervasive computing
  – Sensor rich and always connected smart phones
  – Sensor networks and information tags
  – Localization and activity recognition
  – Internet of things and the real-time Web

• Innovative pervasive services arising
  – Situation-aware adaptation
  – Interactive reality
  – Pervasive collective intelligence and pervasive participation

• Open co-production scenario, very dynamic, diverse needs and diverse services, continuously evolving
The Overall Objective

• Develop and demonstrate a highly-innovative theoretical and practical framework for pervasive service ecosystems
  – Adaptivity and self-management as inherent properties of the ecosystem
  – Systemic self-awareness as an observable property of the overall system
  – Long-lasting (eternal) adaptivity
  – Bio-chemical inspiration
• Foundational re-thinking of
  – Service architectures and associated middleware
  – Self-* algorithms and contextual knowledge management
The Architectural Approach

• Open production model
• Smooth data/services distinction
  – LSA → live semantic annotations
• Interactions
  – Sorts of bio-chemical reactions among components
  – In a spatial substrate
• Eco-laws
  – Rule all interactions
  – Discovery + orchestration seamlessly merged
• Built over a pervasive network world
Specific Objectives

• Both of a scientific and technological nature
• Around which the various WPs are organized
Model, Structures, and Knowledge

• Model & Methodology
  – Innovative chemical-inspired semantic model for interactions among components and their dynamic composition/aggregation
  – Semantic (LSA) description and semantic pattern-matching
  – Uniform treatment of data and services
  – Methodological guidelines associated

• Structures & Space
  – Model distributed self-* algorithms via the chemical LSA framework
  – Innovative flexible means for aggregation and composition
  – Define decentralized means to control the behaviour of the ecosystem

• Knowledge & Time
  – Distributed knowledge management algorithms via the LSA framework
  – Define new means to perform distributed recognition of current situations
  – As well as to enable recognition of future situations
Key Challenges for model, structure and knowledge

• Can our chemically-inspired computation model and the eco-laws?
  – Be flexible and general-purpose enough?
  – Effectively deal with the complexity and diversity of modern pervasive scenarios?
  – Be effectively implementable?

• And, for structure and knowledge
  – Can it accommodate all needed distributed aggregation and self-composition algorithms
  – Can it express all needed forms of knowledge management?

• Or should we rather go for application-specific (or location-specific) eco-laws?
Infrastructure and Applications

• Infrastructure
  – A very lightweight infrastructure
  – Ruling all interactions (from discovery to data exchange and synchronization) by embedding the concept of eco-laws
  – To most extent, acting as a recommendation and planning engine
  – Possibly inspired by tuple space coordination models
  – Yet made it more “fluid” and suitable for a pervasive computing continuum substrate \( \rightarrow \) not a network but a continuum of tuple spaces

• Applications
  – The “Ecosystem of Display” as a general and impactful testbed
  – To put at work and demonstrate the SAPERE findings
  – Active and dynamic information sharing in urban scenarios
  – Active participation of citizens to the working of the urban infrastructure
Key Tangible Results (hopefully)

- A novel model and methodology to support the development of complex service systems in open and dynamic pervasive scenarios
- A uniform set of:
  - Self-* algorithms for service/data composition and aggregation (in the form of libraries)
  - Algorithms and tools for distributed management of contextual-knowledge, to enforce present- and future-awareness in the ecosystem
- A novel middleware for pervasive computing scenarios (Open Source)
  - Integrating the stated algorithms in the form of libraries
- A set of released innovative application showcased on the Ecosystem of Displays testbed