COGMAN: A cognitive management framework to support exploitation of the Future Internet

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An iCORE Concept

- IP project (call 7, Objective 1.3 “Internet Connected Objects”)
- Internet Connected Objects for Reconfigurable Ecosystems
- Built on top of IoT-A and UniverSelf: empowering IoT through Cognitive Technologies
- IERC view: unique approach for ensuring the efficient integration of IoT into the service layer of the FI

IoT Services

- IoT landscape means large heterogeneity
- Current efforts (IoT-A) align the architecture in network layers
- NOW: mostly custom solutions for integration and service exposure
- NOW: Very limited capability to re-configure on-the-fly a deployed solution
- NOW: Low sensitivity to the context

Need for intelligence in IoT

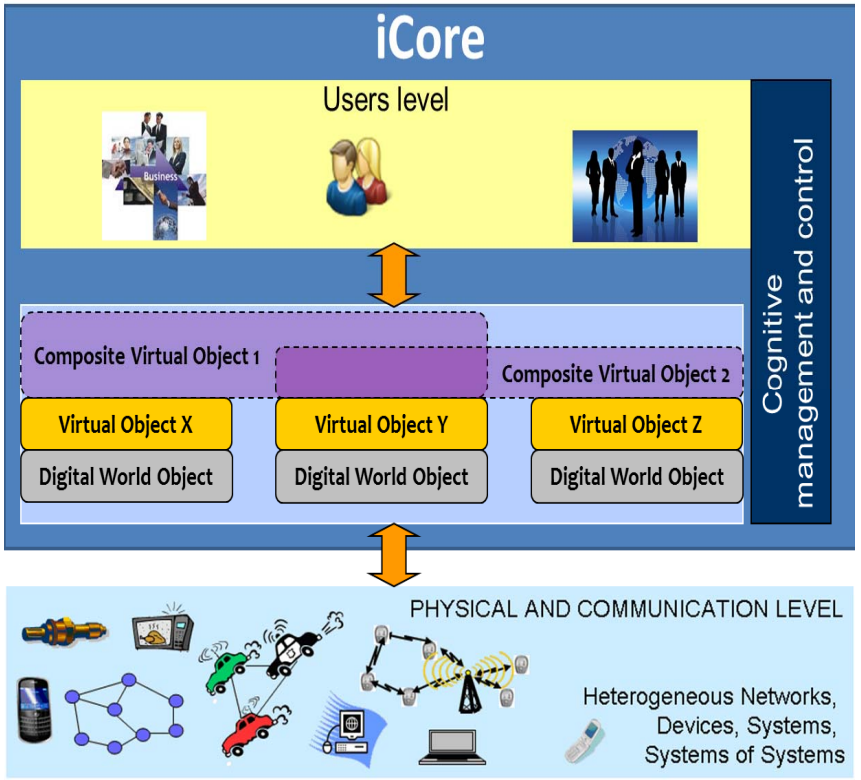
- “7 trillion devices for 7 billion people”
- Context sensitivity
- Optimal management of a large population of resource constrained devices
- Adapted security for distributed networks of cooperating objects
- Service provisioning taking in account continuous learning: any observable/accesible object can be intergrated as a Virtual Object

CogMan framework

Concepts

Open cognitive framework for the Internet of Things (IoT) addressing three levels:

i) **Virtual Objects** (VOs) = Virtual representations of real-world objects
ii) **Composite Virtual Objects** (CVOs) = Cognitive mash-ups of semantically interoperable VOs
iii) **Users/stakeholders** perspectives



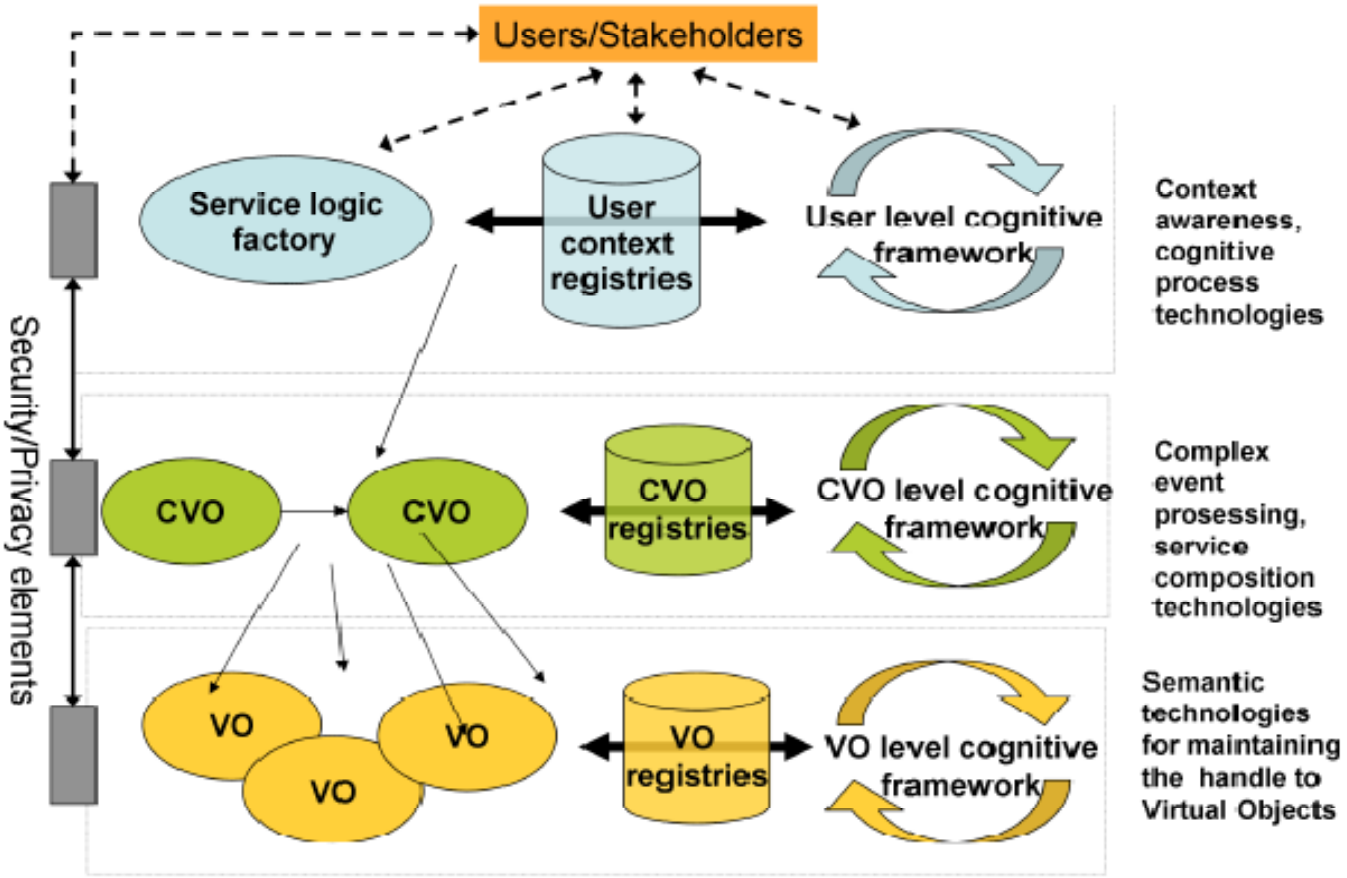
Key Issues

- Addressing **interoperability** issues through VO/CVOs
- Increase the **reusability** of objects outside the scope in which they were originally deployed
- Increase **reliability**, **availability of services** and **energy efficiency**
- Allow business **integration of the views of multiple stakeholders** in the composition of services

CogMan Concepts 1

- Any object (real or digital) can be represented as Virtual Object and its features and functionalities can be **accessed and reused** by any user or service provider having sufficient access/usage rights
- Virtual objects do provide “services” and they need to be kept accessible, or at least addressable throughout the life-cycle of any application that uses the services of a particular virtual object (real and digital)
- Virtual objects of different type and function can be mashed-up forming Composite Virtual Objects with a richer set of features and functions
- Due to mobility or changes in context, virtual objects may not be constantly available/accessible, but other VOs may offer similar services that can be dynamically bound into the existing VO mash-ups (i.e. run time replacement of VOs in a CVO)
- Users and stakeholders do have their own requirements about when, where and how applications are provided and the services of virtual objects are used. To instantiate and execute an application, a given set of services (provided by the available virtual objects) needs to be available (for the relevant parts of the application life-cycle)

CogMan Concepts 2

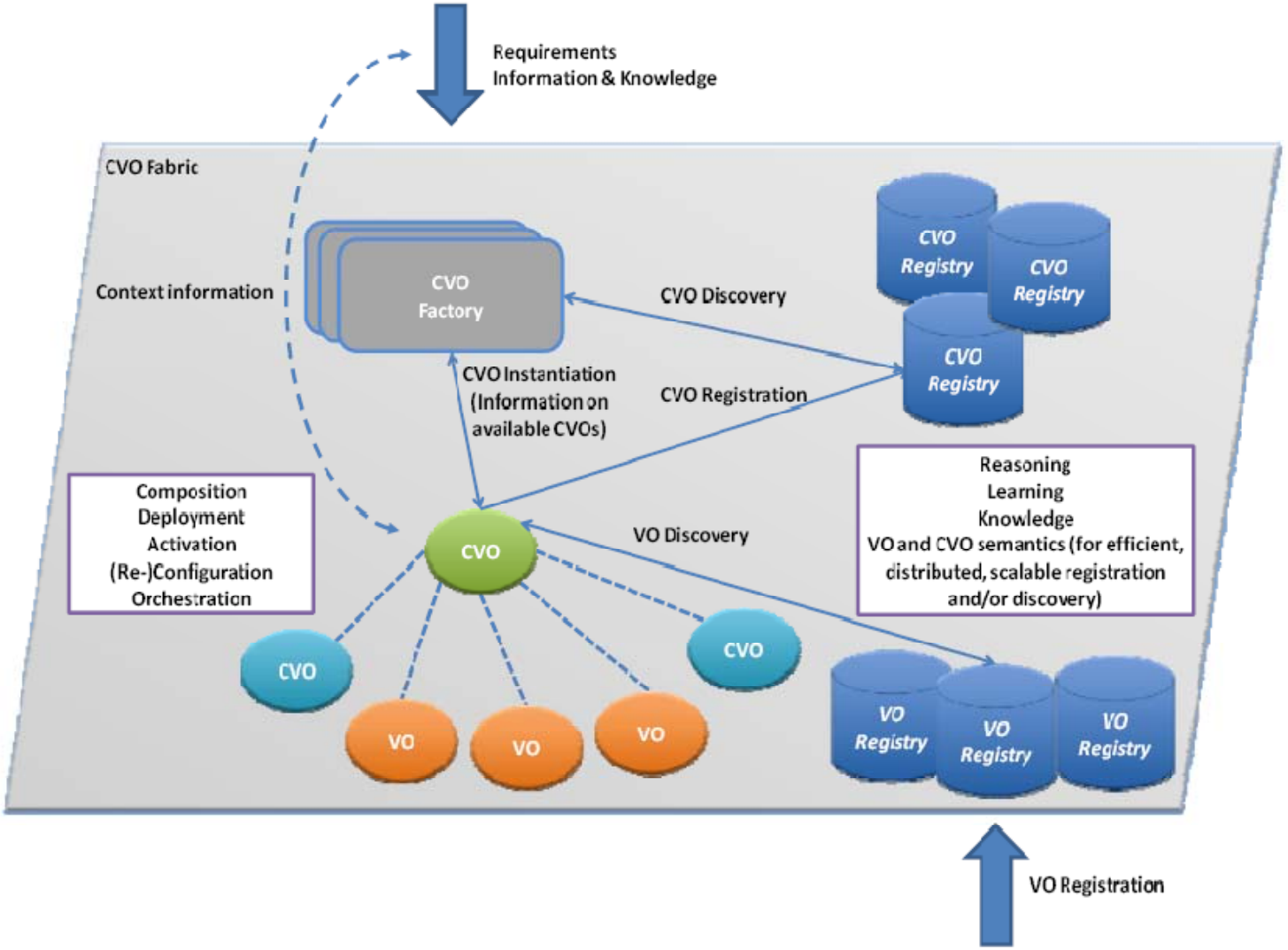


VO = Virtual Object, CVO = Composite Virtual Object

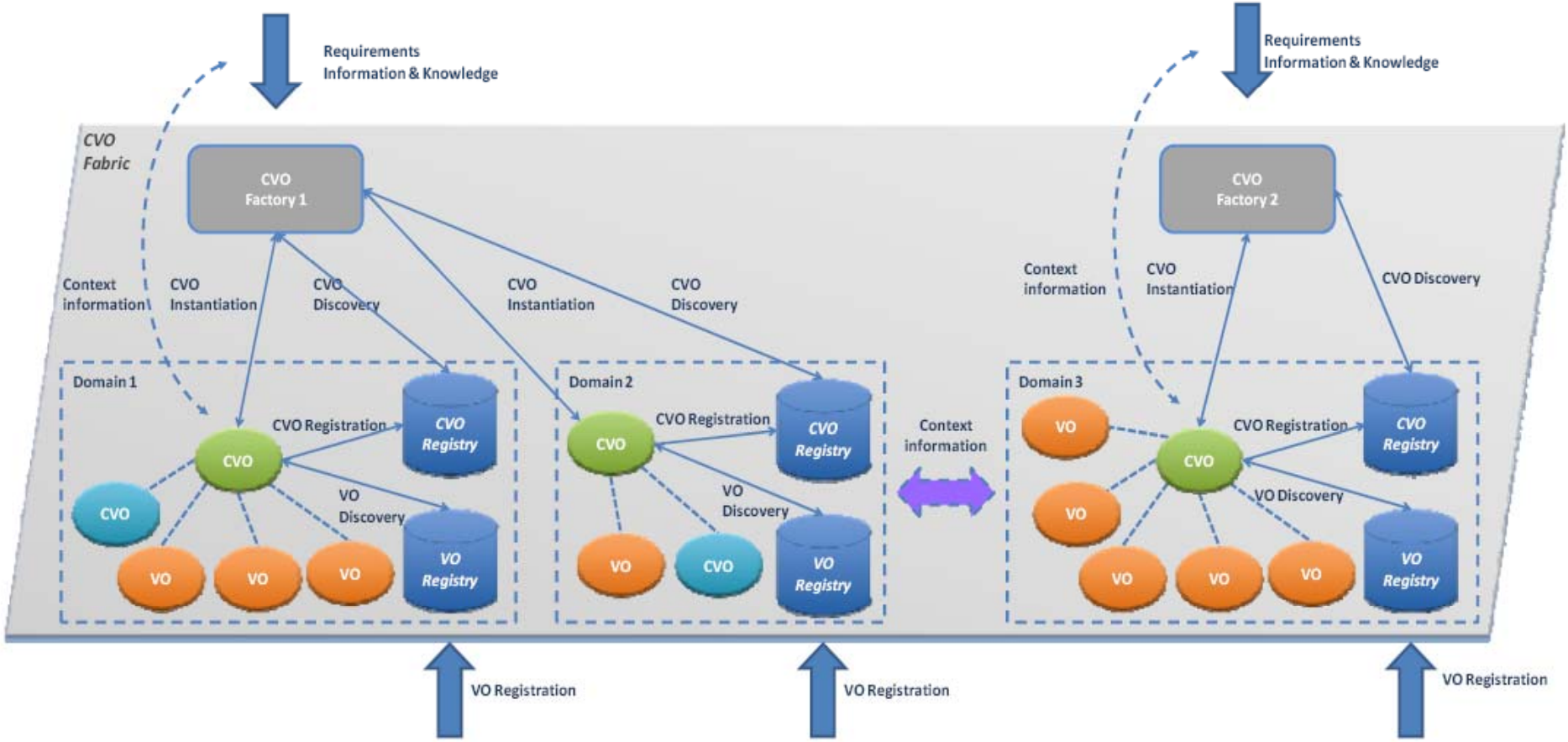
CogMan tools

- Means for self-management (configuration, healing, optimization, protection)
- Continuous learning (smart sensing, streams processing, run-time monitoring)
- Capabilities of perceiving and reasoning on the context (e.g., based on **event filtering**, **pattern recognition**, **machine learning**)
- Knowledge-based **decision-making** (through associated optimization algorithms and machine learning)
- Integrated security mechanisms (domain and object level ownership, digital access rights)
- Semantic profiles
- Distributed constraints
- Complex Event Processing

Composite Virtual Objects 1



Composite Virtual Objects 2



User/Service Level