OPEN THE BOX

Open the telecom infrastructure to 3rd party applications based on Home networks to support various creative business models

Orange, Bouygues Telecom, Delta Dore, Sagemcom, Sogeti High Tech, IS2T, ST SA, ST Rousset SAS, LIG
French collaborative project

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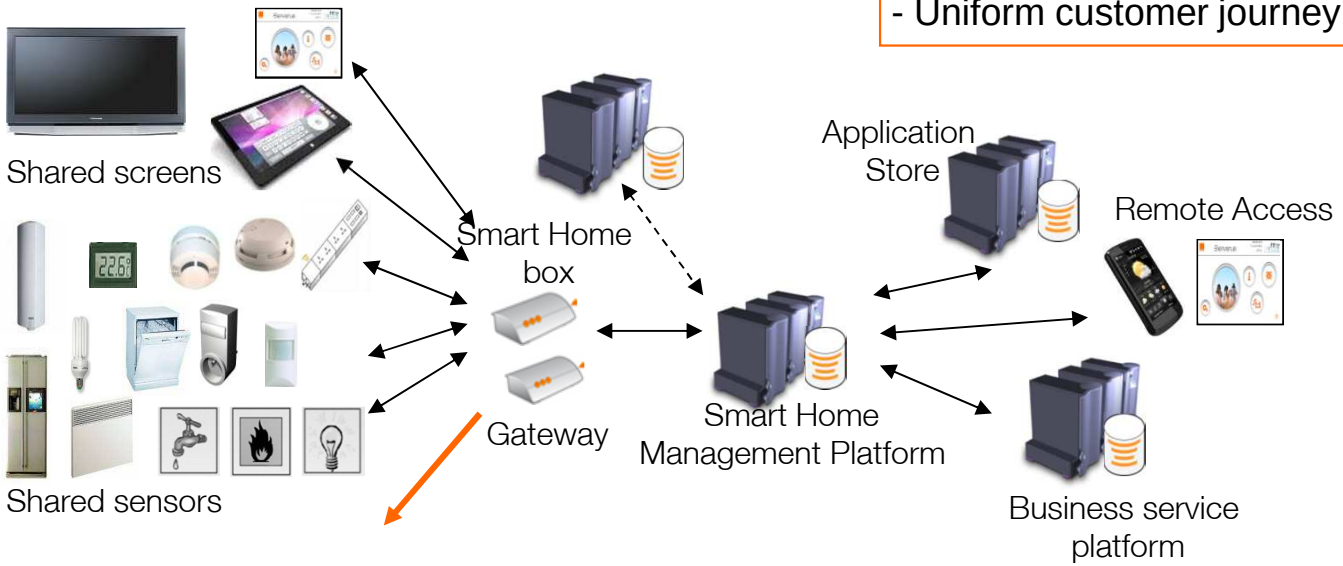
Summary

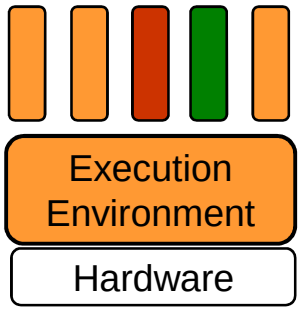
- A **new world of applications** is about to emerge at home thanks to the growing variety of available sensors and actuators
- To unleash service delivery, a telecom infrastructure is to be **open to third party applications** through cloud and embedded APIs and **open to any device** through local area networks.
- Today technology status enables to open the infrastructure to a set of trusted partners. **Remaining challenges are addressed in the project**.
- This presentation introduces the results of the project.

Open the Box project results

An open infrastructure with an ecosystem role model

An end-to-end technical architecture
- Open APIs to 3rd party applications
- Uniform customer journey (demo)





Research issues solved on the embedded platform
- Security attacks and testing platform**
- Hardware resource management*
- Stale reference resolution for Java components*
- Conflict management and application collaboration
- 3 embedded targets: openness vs hardware costs

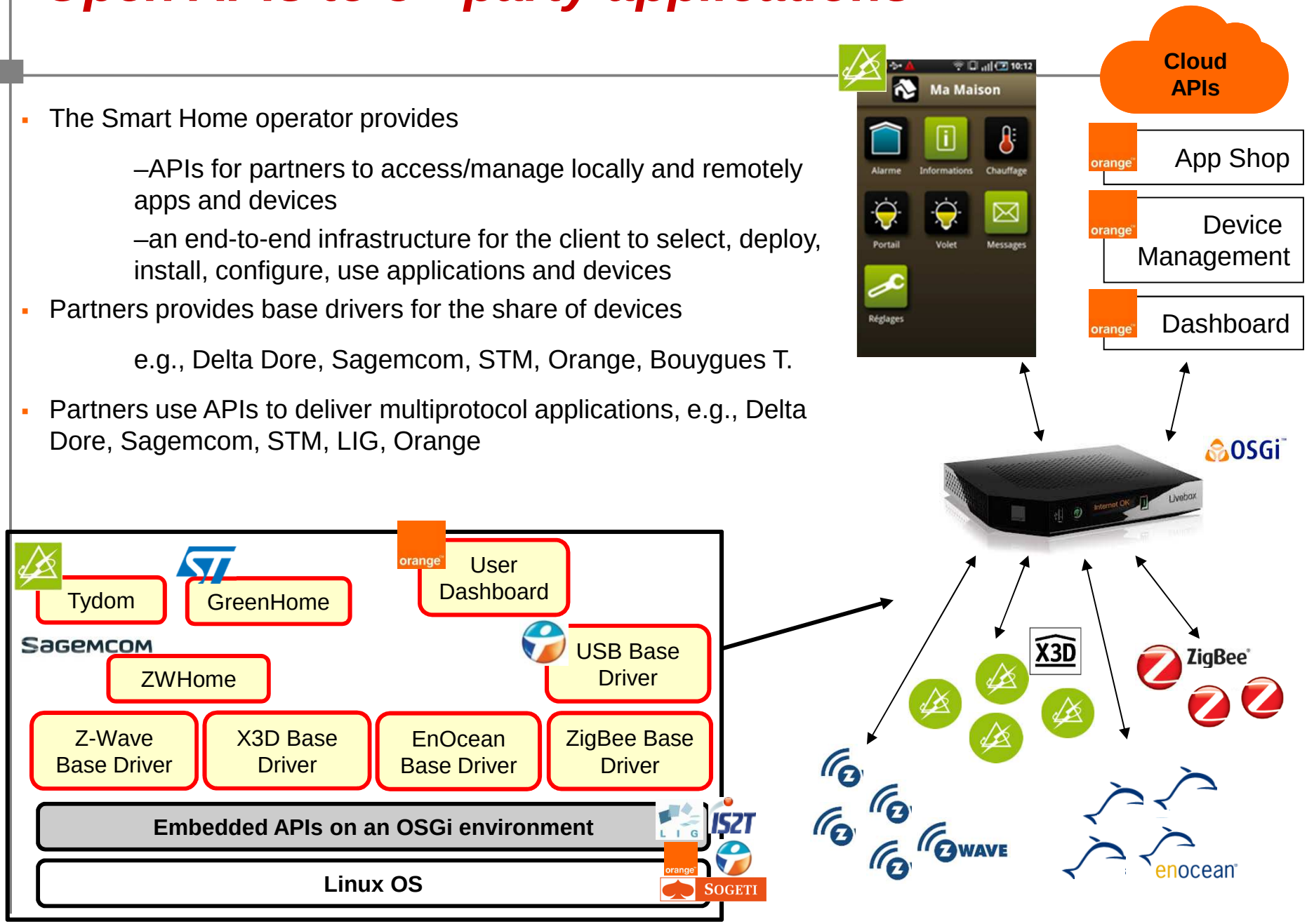
**see next slides*

***see D. Appel's presentation*

Dissemination
- products
- standards
- open source
- publications

Open APIs to 3rd party applications

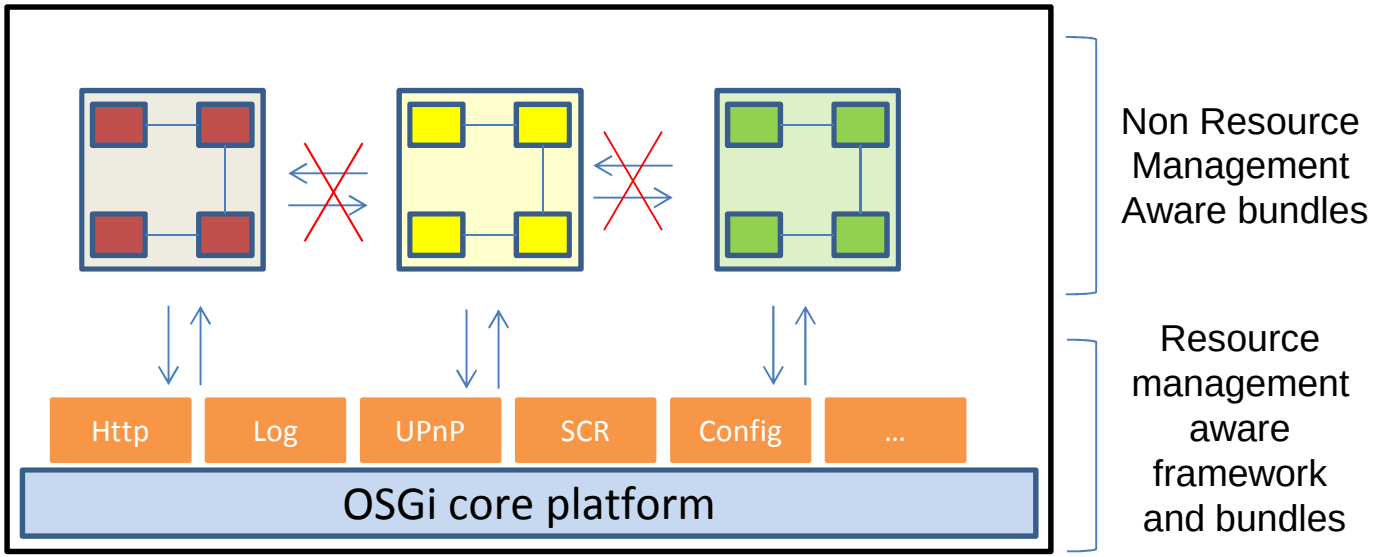
- The Smart Home operator provides
  - –APIs for partners to access/manage locally and remotely apps and devices
  - –an end-to-end infrastructure for the client to select, deploy, install, configure, use applications and devices
- Partners provides base drivers for the share of devices
  - e.g., Delta Dore, Sagemcom, STM, Orange, Bouygues T.
- Partners use APIs to deliver multiprotocol applications, e.g., Delta Dore, Sagemcom, STM, LIG, Orange



Resource Management
State of the art and Open the Box innovation

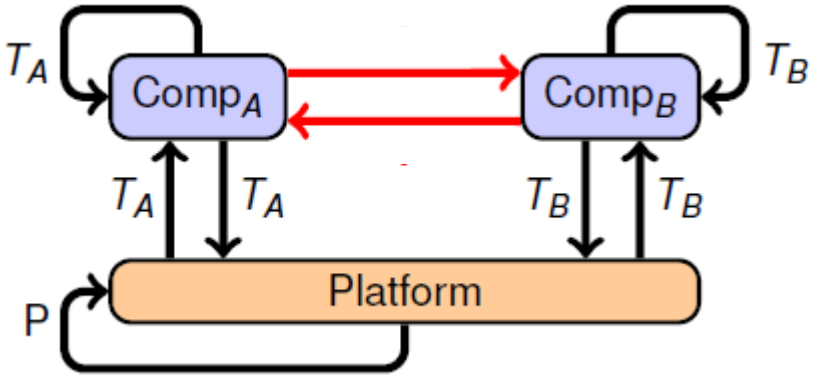
- Initial idea: resource management at the software component level
  - Numerous interactions between components of any application
  - Definition of an application as a set of software components
  - Definition of the operator framework as the association “OSGi framework + technical bundles”

- Industrial state of the art: Partitioning of players (applications) and isolation of every application – implemented by several OSGi framework providers
  1. IS2T provides an implementation for very constrained environments – and larger ones
  2. Standardization: *Specification and implementation at OSGi Alliance by ProSyst and Orange
     *Use cases and technical requirements passed to HGI



Resource Management
Innovation beyond the state of the art

- Resource management can handle communications between applications with an external configuration of resource consumption
  - Solution demonstrated on an open source JVM – Orange, UPMC



T_A, T_B: Tenants
$Comp_A \in T_A$
$Comp_B \in T_B$

- Opportunity to industrialize the solution by JVM and OSGi platform editors
  - Implementation of resource management mechanisms in the JVM
  - Accounting rules configurable by the platform operator through an external file

[See "Memory monitoring in a multi-tenant OSGi execution environment", CBSE'14]

Incinerator
An answer to stale reference issue in Java VMs

- Many code objects become **unusable** after **updates** and **uninstallation** of apps
  - A **stale reference** is a reference to an object that became **unusable**
  - Applications keeping stale references lead to memory leaks, data corruption, physical hazards

- Incinerator is a technical solution that
  - **detects** and **eliminates** stale references
  - and makes stale references **visible** to Java developers

- **The implementation** is mostly **independent** of
  - The OSGi framework implementation
  - The garbage collection algorithm

- **Execution cost < 4%** ➔ tolerable in constrained production environments

[See Incinerator - Eliminating Stale References in Dynamic OSGi Applications, 2013]

Industrial, standardization and research perspectives

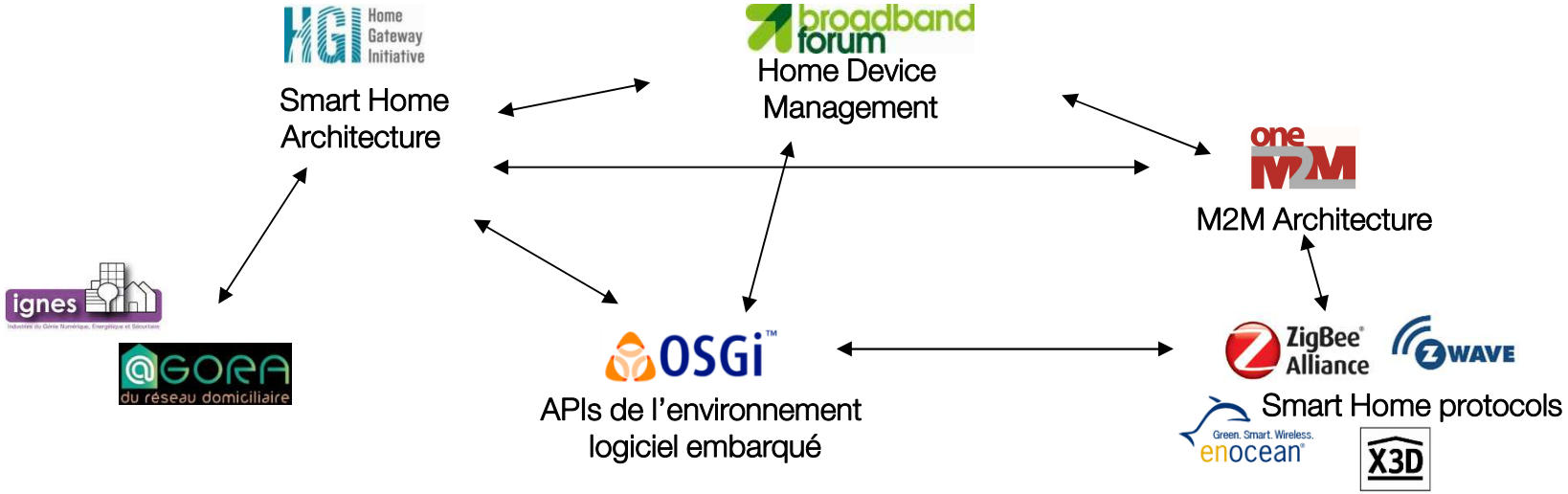
- Industrialization
  - Low cost implementation of Open the Box embedded platform by IS2T
  - Testing platform maintained by Sogeti High Tech, with a public list of security attacks
  - Stale reference resolution and resource management to be integrated by JVM providers
- Standardization
  - Base driver layer and resource management in HGI architecture and OSGi specifications
  - Remaining efforts: Standardize IoT device abstraction layer
- Research perspectives
  - How to detect and handle device access conflicts between applications?
  - How to share data for the better aggregation, management and mining?
  - How to manage an IoT infrastructure as cloud resources with optimal deployment of application parts?

Standardization,

open source results,

and scientific communications

Contributions to the standardization ecosystem



- ***Contributions to HGI reference architecture***
  - *technical requirements for resource management on an open gateway*
  - *a Base Driver sublayer in the full abstraction layer*

- ***Specifications in the next OSGi Residential Specification release – March 2015***
  - *ZigBee Device Service (RFC 192)*
  - *EnOcean Device Service (RFC 199)*
  - *Resource Monitoring (RFC 200)*

Open source results

EnOcean Base Driver	Orange
SimpleBee Base Driver	Orange, LIG
GreenNet Base Driver	STMicroelectronics
INCINERATOR – JVM for stale reference free OSGi platforms	Orange
Secure coding good practices (French)	Sogeti High Tech
Attacks defined and implemented on a testing platform targeting OSGi technology (French – to be translated)	Sogeti High Tech
MODUS – TR-069 Device Management client	Orange
RoSE – Distributed OSGi framework and sensor interaction	LIG
APAM – Framework for applications collaboration	LIG

Technical and scientific communications
Two topics

- **Software Engineering of adaptive applications**

  Open the Box project has contributed to the state of the art the functionalities of an embedded service platform: dynamic dependency management, applications modeling, automatic deployment, autonomic application management.

- **Software engineering of multi-tenant service platforms**

  Open The Box project envisions a software platform shared by a dynamically extensible set of applications from distinct providers. This objective raises challenges to enable fair resource sharing and isolation, and to address security issues with respect to bugged and malicious applications.

Software engineering of adaptive applications

Publications

- Jacky Estublier, German Vega, Thibaud Flury. Completeness for Adaptable Applications. Submitted to 37th International Conference on Software Engineering. ICSE 2015, May 2015, Florence, Italy.
- Jacky Estublier, German Vega. Causality Control in Dynamic Platforms. Proceedings of the 9th International Conference on Software Engineering Advances, ICSEA 2014, October 2014, Nice, France.
- Jacky Estublier, German Vega. Building Reliable Dynamic Applications for Ubiquitous Computing. Proceedings of the 5th International Workshop on Principles of Engineering Service-Oriented Systems (PESOS), San Francisco, May 2013.
- Jacky Estublier, German Vega. Reconciling Components and Services: The Apam Component-Service Platform. International Conference on Service Computing, Jun 2012, Honolulu, HI, United States.
- Diana Moreno, Jacky Estublier. Model-Driven Design, Development, Execution and Management of Service-Based Applications. International Conference on Service Computing, Jun 2012, Honolulu, HI, United States
- Diana Moreno, Elmehdi Damou. Model-driven execution of service-based applications. Journées sur l'Ingénierie Dirigée par les Modèles, Jun 2011, Lille, France.

PhD theses

- J. Bardin (LIG) RoSe : a framework to design and execute dynamic distributed heterogeneous applications. Oct. 2012. (French)
- Diana Moreno-Garcia. Modèles, outils et plate-forme d'exécution pour les applications à service dynamiques. Grenoble University, Feb. 2013. (French)

Software engineering of multi-tenant service platforms

Publications

- K. Attouchi, G. Thomas, A. Bottaro, J. Lawall, G. Muller. Memory Monitoring in a Multi-tenant OSGi Execution Environment. Proceedings of the 17th symposium on Component Based Software Engineering (CBSE), June 2014, Marcq-en-Baroeul, France.
- K. Attouchi, G. Thomas, A. Bottaro, G. Muller. Incinerator – Eliminating stale references in Dynamic OSGi applications. INRIA – Research Report N° 8485, February 2014
- Y. Maurel, A. Bottaro, R. Kopetz, K. Attouchi. Adaptive Monitoring of End-user OSGi-based Home Boxes. Proceedings of the 15th symposium on Component Based Software Engineering (CBSE), June 2012, Bertinoro, Italy.
- M. Anne, K. Attouchi, D. Henry-de-Villeneuve, J Pulou. Jasmin: an alternative for secure modularity inside the digital home. Proceedings of the 15th symposium on Component Based Software Engineering (CBSE), June 2012, Bertinoro, Italy.
- Jacky Estublier, German Vega, Elmehdi Damou. Resource Management for Pervasive Systems. International Workshop on Engineering Service-Oriented Applications, WESOA'12, Nov 2012, Shanghai, China.
- Jacky Estublier, German Vega. Managing Multiple Applications in a Service Platform. International Workshop on Principles of Engineering Service-Oriented Systems, PESOS 2012, Jun 2012, Zurich, Switzerland.

PhD theses

- Koutheir Attouchi. Managing Resource Sharing Conflicts in an Open Embedded Software Environment, Pierre et Marie Curie University, July 2014. (English)
- Elmehdi Damou. ApAM : An Environment to develop and execute Ubiquitous Applications. Grenoble University, Oct. 2013. (French)

Thanks