Semantic description, discovery, brokering and monitoring of Cloud Resources, Services and SLs for portability and interoperability

ETSI Cloud 23rd Meeting – June 20th 2012 – Sophia Antipolis (FR)

Project mOSAIC: Open-Source API and Platform for Multiple Clouds
http://www.mosaic-cloud.eu

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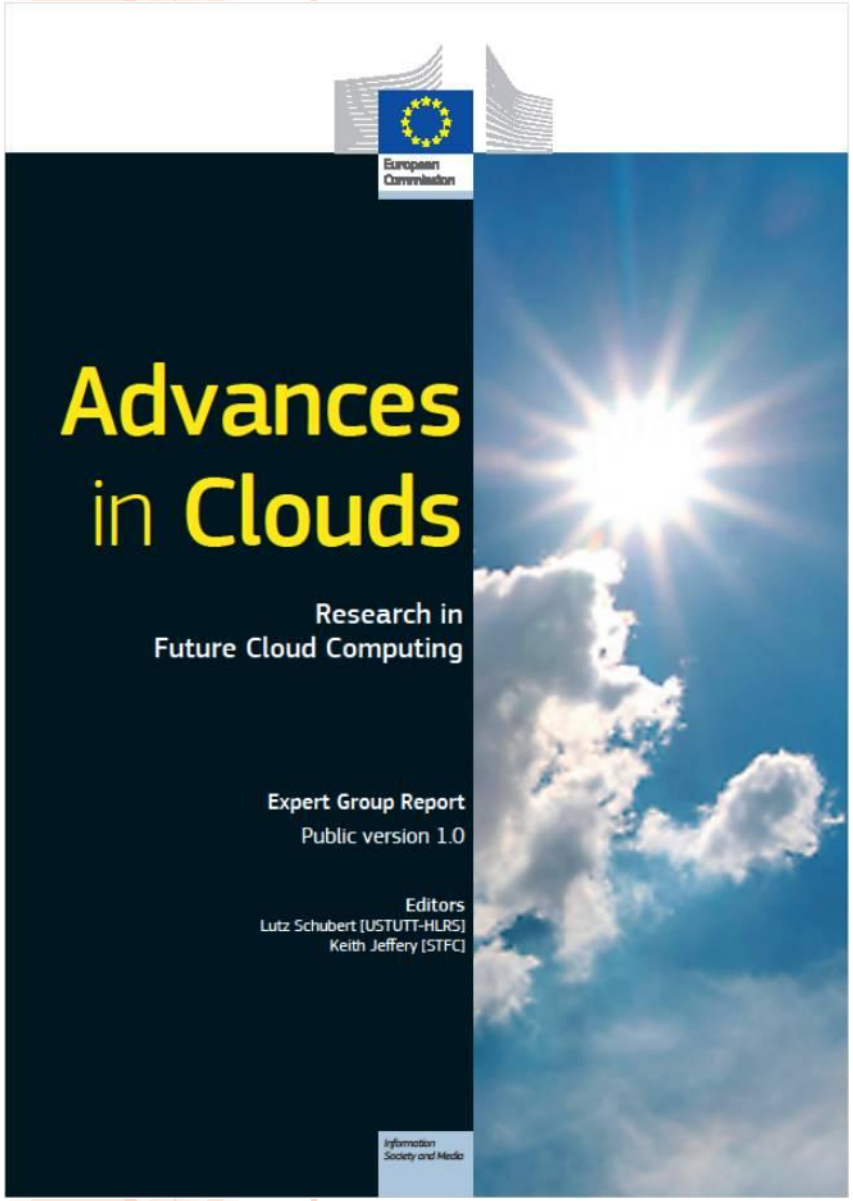
Report "Advances in Clouds"



- Report from the Cloud Computing Experts Working Group of the European Commission (DG INFSO, Unit Internet of Services, Software and Virtualization)
- Presented in Brussels on May 2° 2012

http://cordis.europa.eu/fp7/ict/ssai/docs/future-cc-2may-finalreport-experts.pdf

Credit where credit is due

- Maximilian Ahrens, Zimory, Germany
- Prashant Barot, Oracle, Germany
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- Dr. Marcus Brunner, NEC Europe Ltd., Germany
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- Dr. Thierry Coupaye, France Telecom Orange Labs, France
- Dr. Peter Dickman, Google, Switzerland
- Dr. Margot Dor, ETSI, France
- Dr. Ake Edlund, KTH, Sweden
- Prof. Dr. Erik Elmroth, Umeå University, Sweden
- Andreas Ebert, Microsoft Corporation, Austria
- Jürgen Falkner, Fraunhofer IAO, Germany
- Ana Maria Juan Ferrer, Atos Research and Innovation, Spain
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- Dr. Yaron Wolfsthal, IBM, Israel

Thank you for your contribution!

Contributing Experts

Cloud Standards Customer Council

Practical Guide to SLAs Webinar

Download the SLA Whitepaper

Melvin Greer, Senior Fellow and Chief Strategist, Cloud Computing, Lockheed Martin; Chair, CSCC Steering Committee

Cloud service level agreements are important to clearly set expectations for service between cloud consumers and providers. Providing guidance to decision makers on what to expect and what to be aware of as they evaluate and compare SLAs from cloud computing providers is critical since standard terminology and values for cloud SLAs are emerging but currently do not exist.

Amy Wohl, Editor, Amy Wohl's Opinions

Today, customers complain regularly that SLAs are just another form of vendor boilerplate, to the extent they exist at all, and that it is difficult if not impossible to get much modification. They also point out that they want the SLA because it will cause the provider to put some skin in the game, not because the penalties would solve their problems in the case of outages or other situations covered by the SLA. That doesn't mean we don't need SLA's; we do. It's important we make it clear what is going on now versus what we would like to see/influence for the future and when we are hoping that future will occur.

The Cloud Standards Customer Council held a webinar to introduce the completed "Practical Guide to Cloud Service Level Agreements," on Tuesday, April 10, 2012.

If you missed any or all of the webinar you can download the deck or the entire webcast below:

Download Webrar | Download PDF

Download the SLA Whitepaper

The Guide highlights the critical elements of a service level agreement (SLA) for cloud computing and provides guidance on what to expect and what to be aware of when negotiating an SLA. The guide articulates a set of requirements from a consumer's perspective and identifies elements that need to be addressed via open standards through CSCC's liaison partnerships with key standards development organizations.

Melvin Greer, senior fellow and chief strategist, Cloud Computing, Lockheed Martin; chair, CSCC steering committee, lead the webinar describing the rationale behind the development of the guide, the target audience and the intended benefits of the guide. A question and answer period will immediately follow the presentation.

Representatives from the following organizations developed the Practical Guide to Cloud Service Level Agreements, along with input and feedback from the general CSCC membership: Boeing, CA Technologies, cebe IT & KM, Cloud Perspectives, CloudOne Corporation, Elkartha, Fort Technologies, Hoboken Consulting Group LLC, IBM, Kroger, Lockheed Martin, Powersoft Computer Solutions Ltd, Second University of Naples, and Wohl Associates.

Practical Guide to Cloud Service Level Agreements
Version 1.0

April 10, 2012

Acknowledgements

The *Practical Guide to Cloud Service Level Agreements* is a collaborative effort that brings together diverse customer-focused experiences and perspectives into a single guide for IT and business leaders who are considering cloud adoption. The following participants have provided their expertise and time to this effort.

Workgroup Leaders

John Meegan (IBM) – Lead Technical Editor; Introduction and Keys to Success Section Leader
Gurpreet Singh (Ekartha) – Current SLA Landscape and Disaster Recovery Section Leader
Steven Woodward (Cloud Perspectives) – Roles & Responsibilities; Performance Objectives Leader
Salvatore Venticinque (Second University of Naples) – Service & Deployment Model Section Leader
Massimiliano Rak (Second University of Naples) – Service & Deployment Model Section Leader
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[illegible] (CA Technologies) – Security and Privacy Section Leader
John McDonald (CloudOne Corporation) – Service Management Section Leader
Ryan Kean (The Kroger Co.) – Service Failure Management Section Leader
Marlon Edwards (Hoboken Consulting Group, LLC) – Disaster Recovery Section Leader
Dave Russell (IBM) – Management Process Section Leader
George Malekkos (Powersoft Computer Solutions Ltd) – Exit Process Section Leader

Extended Workgroup Members

The workgroup leaders wish to recognize the following individuals for their outstanding efforts to provide content, share their expertise and ensure completeness of the *Practical Guide to Service Level Agreements*: Amy Wohl (Wohl Associates), Asher Bond (Elastic Provisioner, Inc.), Claude Baudoin (cebe IT & KM), Christopher Ferris (IBM), Melvin Greer (Lockheed Martin), Richard Miga (Synergistic Solutions), Thomas Somers (IBM).

Additional Reviewers

The following reviewers provided feedback on the *Practical Guide to Cloud Service Level Agreements*: Jenny Huang (AT&T), Karen Caraway (The MITRE Corporation), Kenneth Dilbeck (TMForum), Roopali Thapar (IBM), Tobias Kunze (Red Hat).

IEEE P2302 – "Intercloud"
Standard for Intercloud Interoperability and Federation (SIIF)

Contribution to:

Section 6.9, Ontology Definition:

Section 6.10, Decentralized Ontology Deployment:

IEEE
Advancing Technology for Humanity

mOSAIC european FP7 project: main facts

- **Project acronym**: mOSAIC
- **Project full title:** Open-Source API and Platform for Multiple Clouds
- **Grant agreement no**: 256910
- **Funding Scheme**: STREP
- **Call**: FP7-ICT-2009-5 **Obj**: ICT-2009.1.2
- **Cost**: 3,705 Meur (EC financing: 2,85 M)
- **Duration**: 30 months
- **Start**: Sept 1st 2010. **End**: Feb 28th 2013
- **Web site**: http://www.mosaic-cloud.eu

mOSAIC Partners

Second University of Naples – It (Prj Coordinator)

Institute IeAT – Ro

European Space Agency - Fr

AITIA - Hu

Tecnalia - Sp

Terradue - It

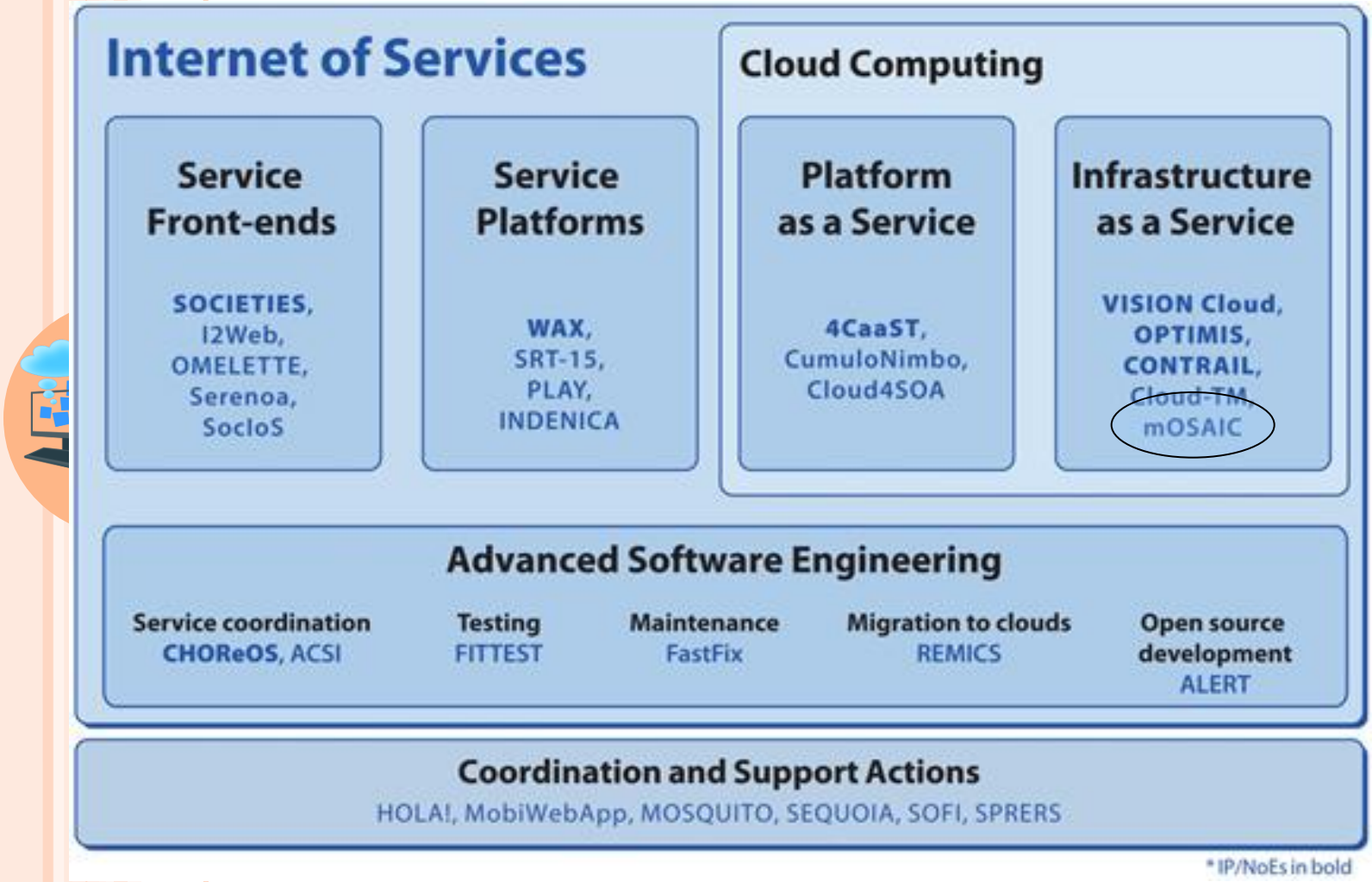
XLAB - Slo

University of Lubljiana - Slo

Brno University of Technology - Ck

Position in The FP7

Within Objective 1.2, a total of 195 proposals were received, of which 28 were selected. Together with one project from Objective 9.4.



(Some) Portability and interoperability issues

The process of developing, deploying, executing cloud applications is strongly influenced by the specifics of the cloud providers.

Application Programming Interfaces

- ✓ Syntactical differences
- ✓ Differences in programming models
  - ❖ Object oriented
  - ❖ REST based
  - ❖ Event driven
- ✓ Differences in API semantics
  - ❖ Different functional abstractions (expecially at PaaS level)
  - ❖ Linked to application domains (expecially at SaaS level e.g. enterprise patterns)

(Some) portability and interoperability issues

Resources and services

- ✓ Different resource semantics (expecially at PaaS: e.g. stores)
- ✓ Different resources' configurations and templates
- ✓ Different linkages of resources and configurations to provided services
- ✓ In order to interoperate, resources and services need to be retrieved and accessed; a Resource/Service Catalogue is needed, where the resources and services are (semantically) described, together with their groundings

(Some) portability and interoperability issues

Non-functional requirements and service levels

- ✓ Differences in semantics of Service level offerings and their level
- ✓ Mismatch between nonfunctional requests and offers
- ✓ no linkage of provided services and resources with service levels (expecially at PaaS and SaaS)
- ✓ No standard or common KPIs and mechanisms to measure them

Portability, Interoperability and Semantic technologies in the mOSAIC project

- ✓ An Agnostic, vendor neutral, API at PaaS level and an Open Source Platform, with adapters to most notable Cloud Providers' APIs
- ✓ A Cloud Agency for Services brokering and SLA monitoring and resource reconfiguration
- ✓ A Cloud Ontology
- ✓ A Semantic Engine, for finding mOSAIC API components and resources, driven by functional and Application domain concepts, patterns and rules
- ✓ A Dynamic Semantic Discovery Service, for discoverying Cloud providers' resources and services, allineating them with mOSAIC API components and resources

mOSAIC Approach

The mOSAIC project aims to develop an open-source platform that enables applications to negotiate Cloud services as requested by their users.

The platform will implement a multi-agent brokering mechanism that will search for services matching the applications' request, and possibly compose the requested service if no direct hit is found.

Using the Cloud ontology and Semantic Engine, application developers will be able to specify their requirements (functionalities and resources) and service level requests.

mOSAIC Approach

Cloud-application developers will be able to postpone their decision on the procurement of Cloud services until runtime

End-user applications will be able to find best-fitting Cloud services to their actual needs and efficiently outsource computations.

mOSAIC will facilitate competition and cooperation among Cloud providers, who, in return, will be able to reach customers they could not reach before.

mOSAIC Architecture and components

An API

- Cloud-based language- and platform-independent API
- Extends the existing language- or platform-dependent API capabilities with composite features based on *patterns*

A framework

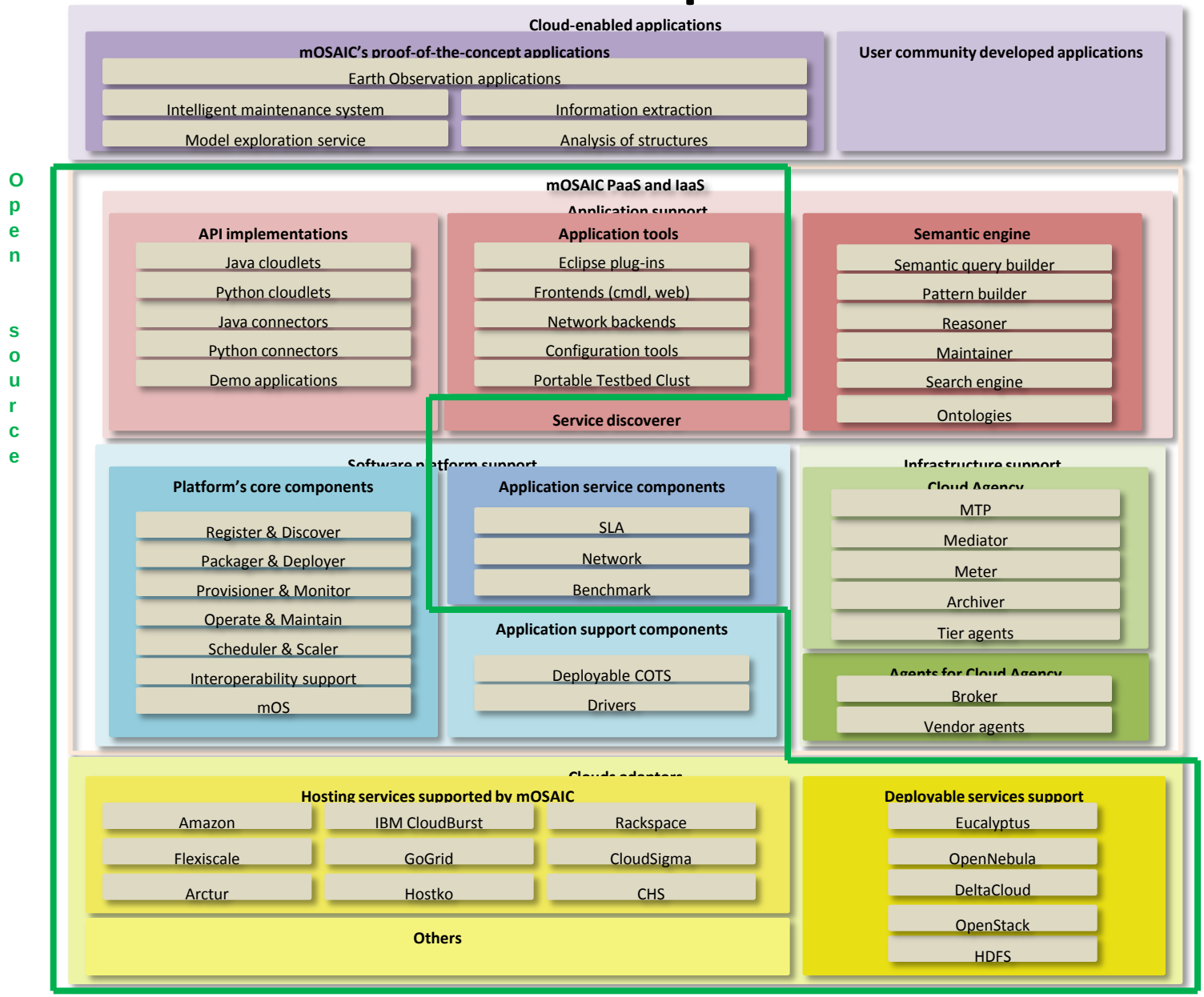
- Semantic engine
  - Cloud ontology & Semantic representation of Cloud resources
  - Applications's needs in terms of SLAs and QoS requirements
- Cloud agency
- Dynamic Semantic Discovery Service
- Application Tools

An open-source platform

- a proof-of-the-concept prototype ready to be tested, exploited or extended by its users
- include instances of the APIs for two programming languages and application tools

Proofs of validity through the use cases and applications

mOSAIC Components



mOSAIC Key features and technologies

- Vendor agnostic API
- Open source PaaS
- Cloud resources and services brokering
- Cloud Agency
- SLA negotiations and monitoring
- Cloud Ontology
- Semantic Engine
- Dynamic Semantic Discovery Service

- Component-based applications
- Multiple Clouds
- Long time running applications
- Event driven, asynchronous programming model

mOSAIC API

Concepts:

in public D1.3/Sept 2011 & papers

Implementations:

In Java, available at:

http://www.mosaic-cloud.eu -> <For Developers> box

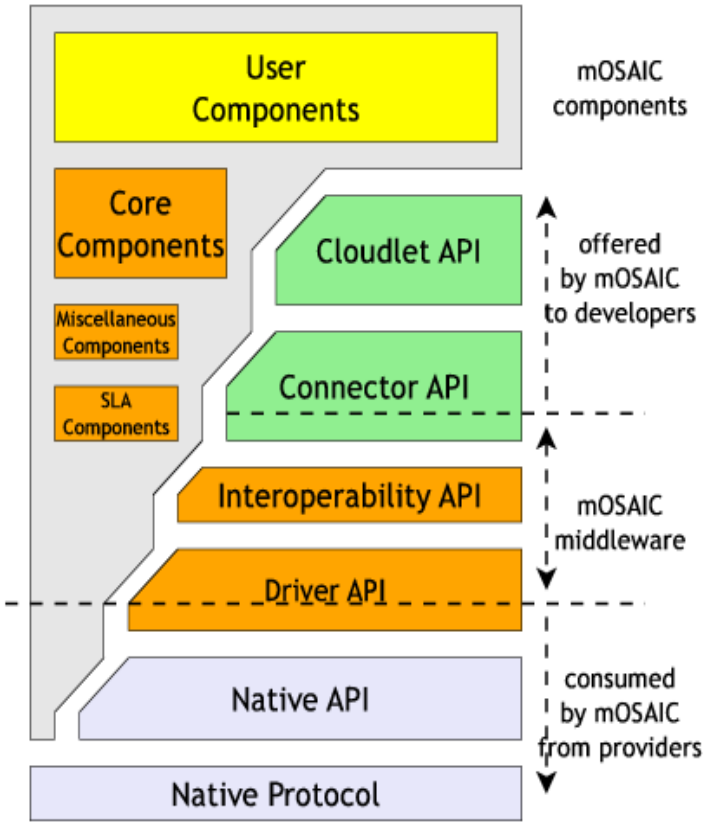
https://bitbucket.org/mosaic/

Guide in mosaic-api / mosaic-mvn / doc

In Python, in September 2012

mOSAIC API Architecture

mOSAIC API Layers



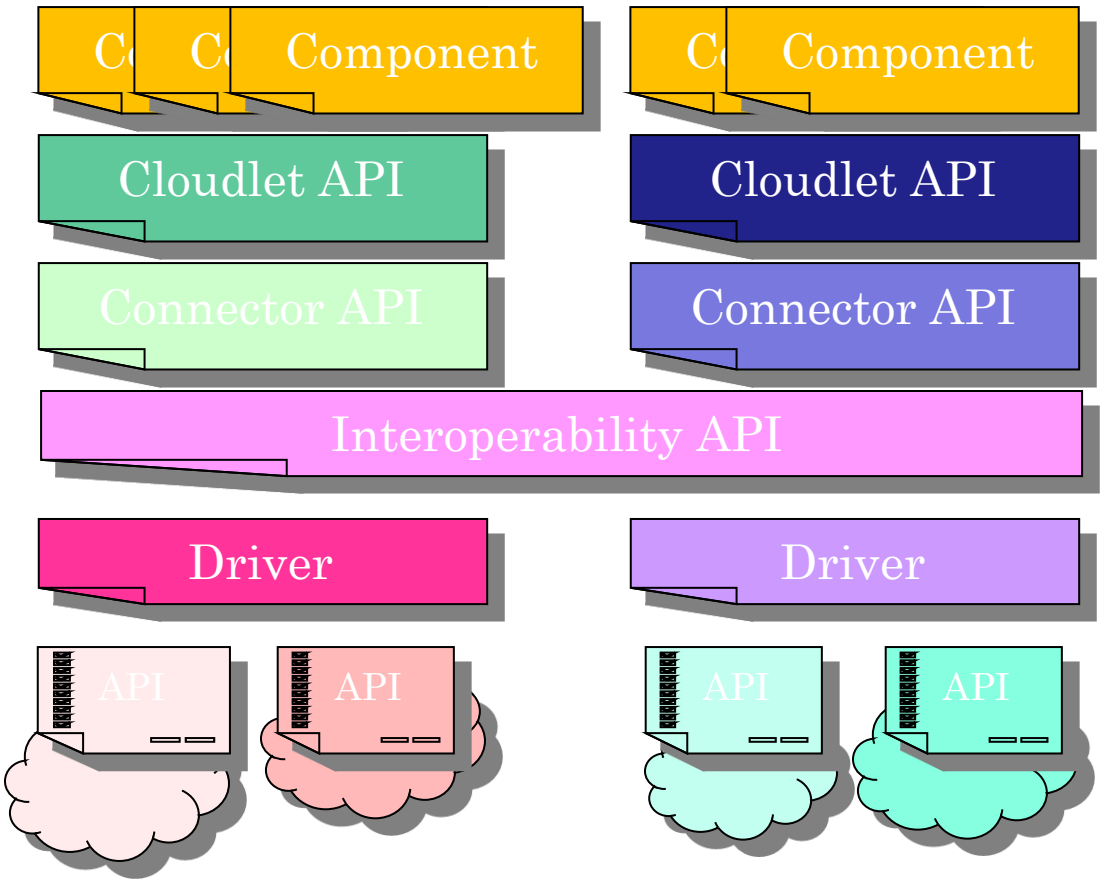
Lowest Layer: Native resource protocol} (Web service, RPC, etc.), or a native resource API provided as a library by the vendor for a certain programming language. No uniformity.

Driver API: Wraps the native API, providing the first level of uniformity: all resources of the same type are exported with the same interface. Thus exchanging, for example, an Amazon S3 with a Riak key-value store is just a matter of configuration.

Connector API: depending on the programming language, provides abstractions for the cloud resources, suitable for the programming paradigm. This is where we provide the second kind of uniformity for the programming paradigms, as all the implementations of the connector API in object oriented programming languages will have similar class hierarchies, method signatures, or patterns.

Cloudlet API: Even thought the developer already can access cloud resources, he or she must restrict himself or herself to a cloud compliant programming methodology, which we provide (integrated with all the layers already mentioned) that we call Cloudlet, as similar with the existing Java Servlet technology that provides standard programming components in J2EE environments.

mOSAIC API's Layers



Application components

Support for components

For different languages

Reference API

For same service

Semantic technology for portability - interoperability

To define a common, machine readable, dictionary, able to express resources, services, APIs and related parameters, SL requirements and offers, and related KPIs

To support code portability, by allineating and reconciliating different APIs and resources

To bridge the gap between the domain related functionalities and cloud resources and services

To support interoperability, by matchmaking Service interfaces

To support (semantic based) resource and services discovery

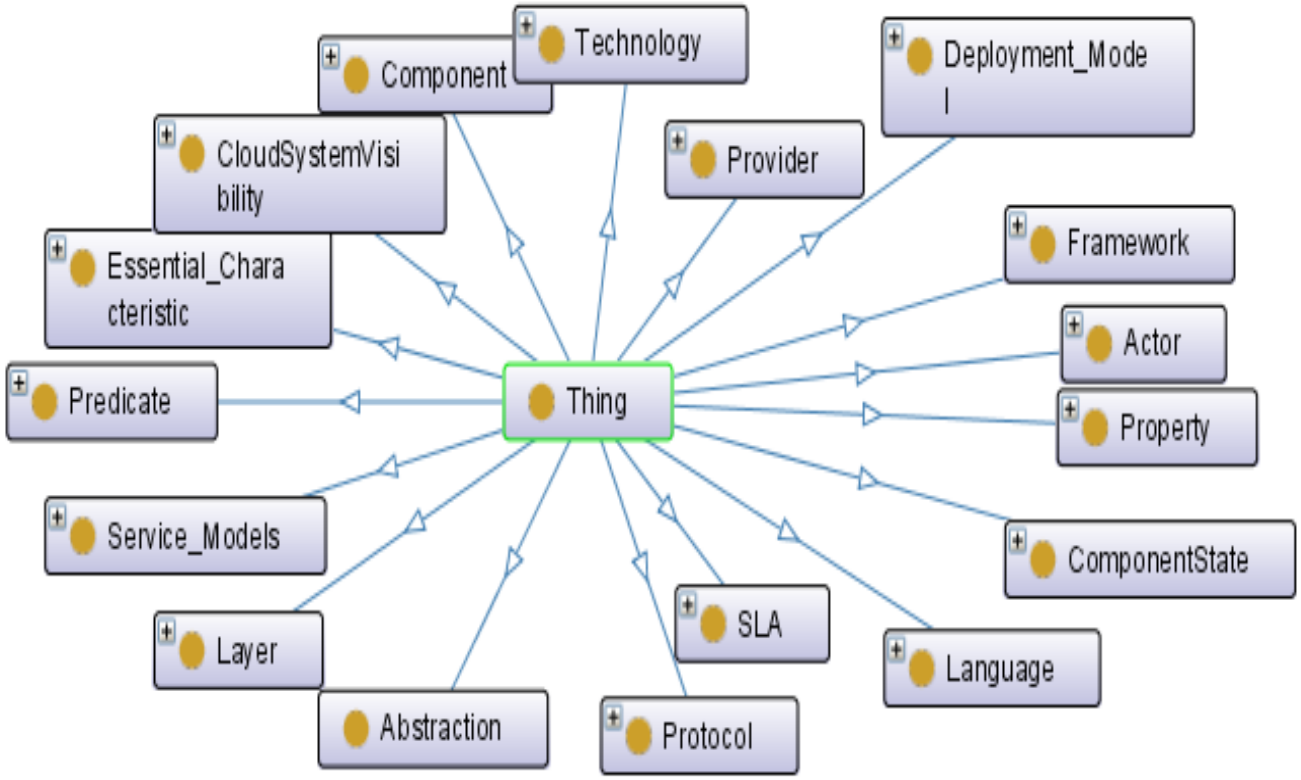
Semantic technology for portability - interoperability

To support Brokering, Negotiation and Service level Agreement, by matckmaking nonfunctional user requirements and provider offers

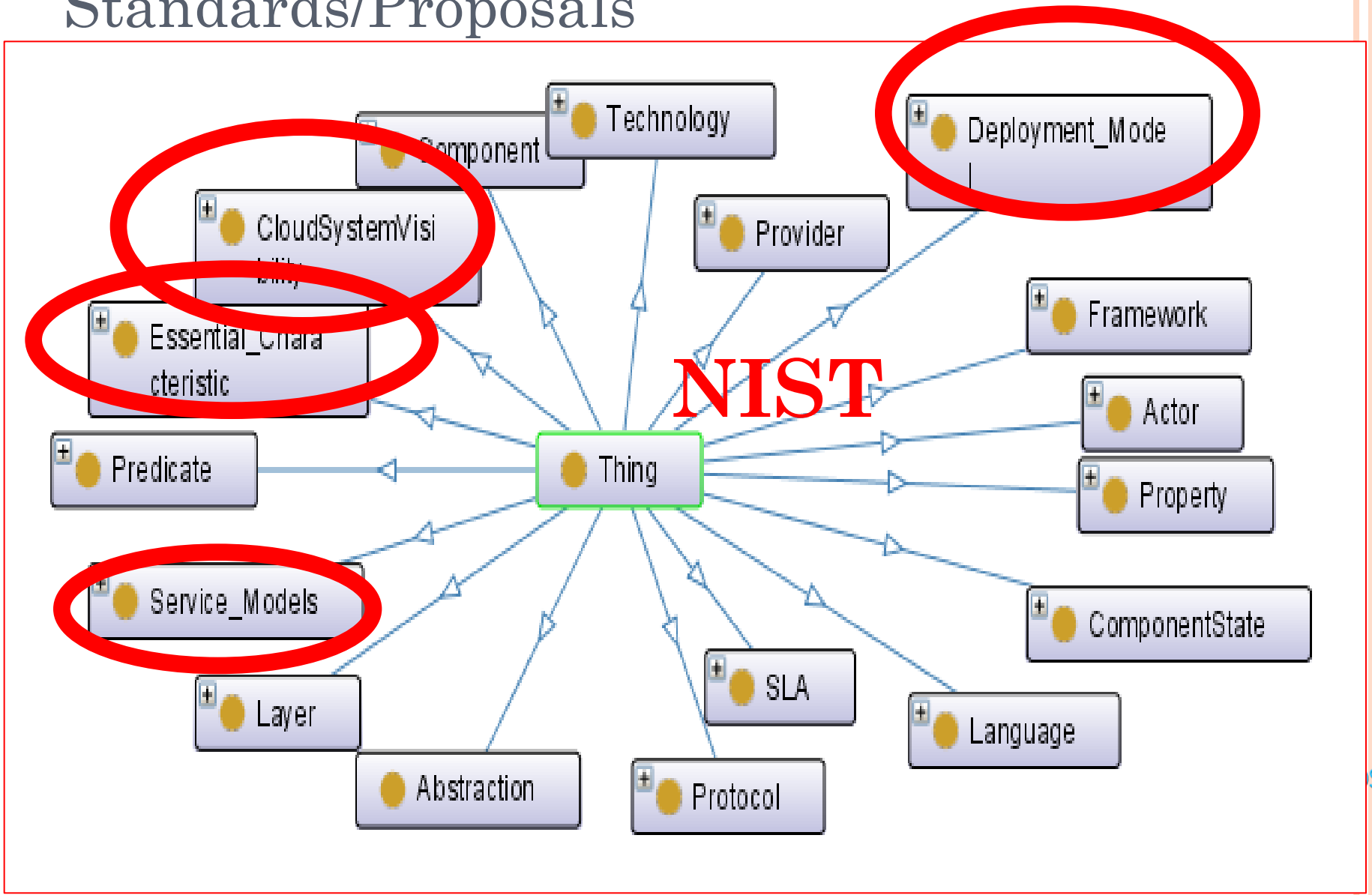
To support dynamic resources reconfiguration, by monitoring SL parameters and reacting with applying heuristic rules

Semantic technologies in the mOSAIC project

A Cloud Ontology able to provide a common definition of concepts related to Cloud domains and to describe Cloud components like infrastructures, platforms and services.



mOSAIC Ontology: Top Level and Standards/Proposals



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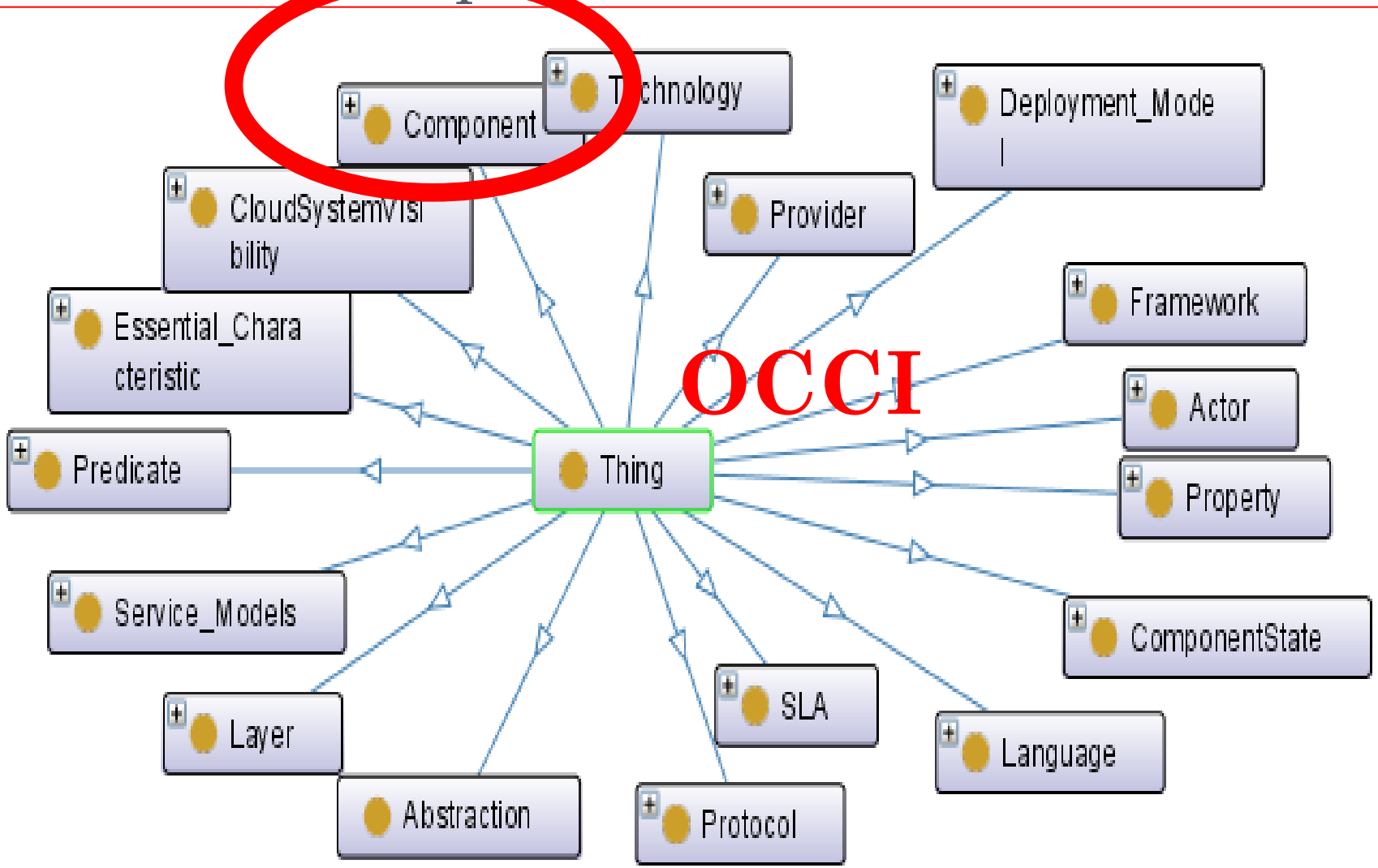

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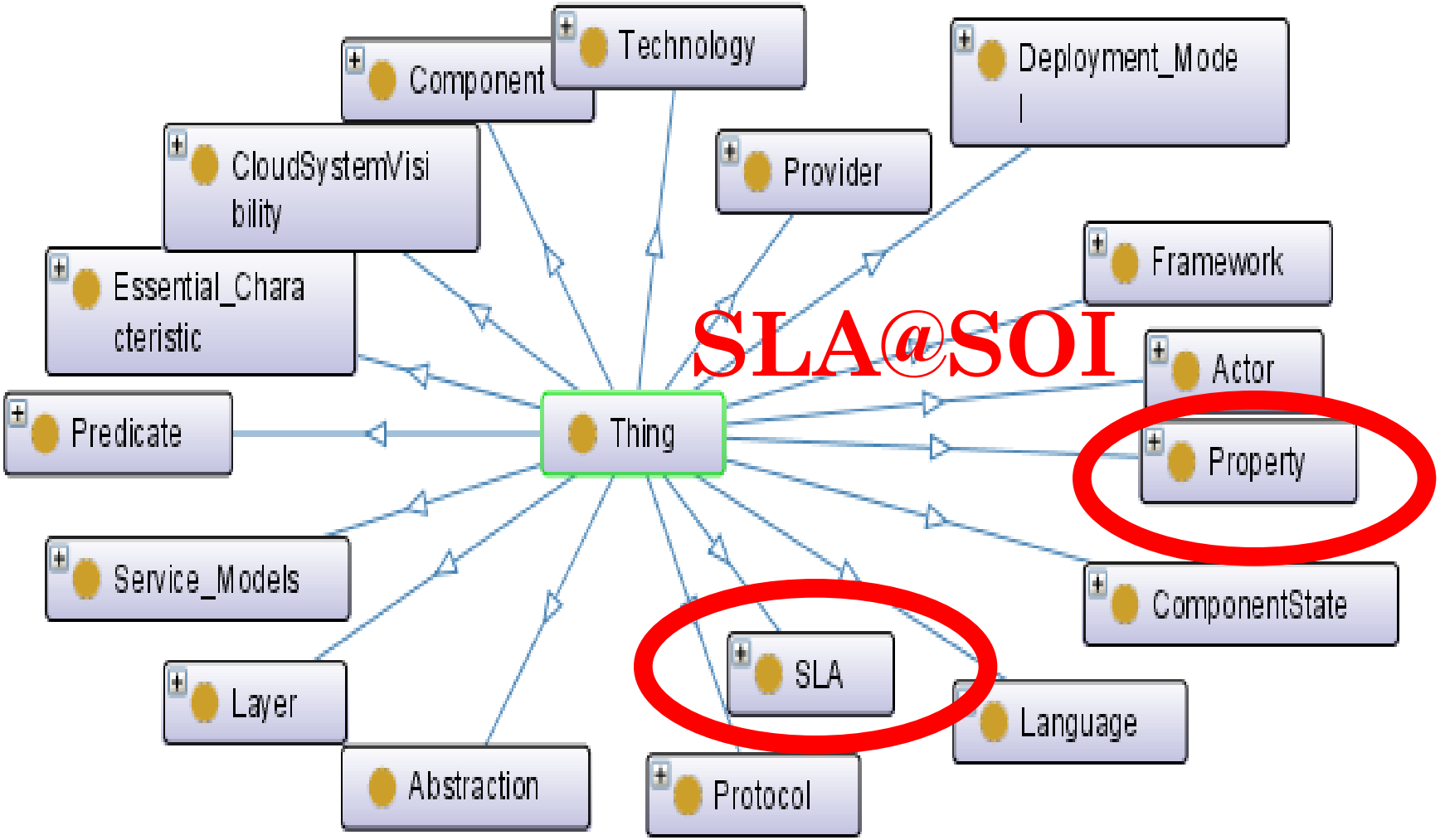
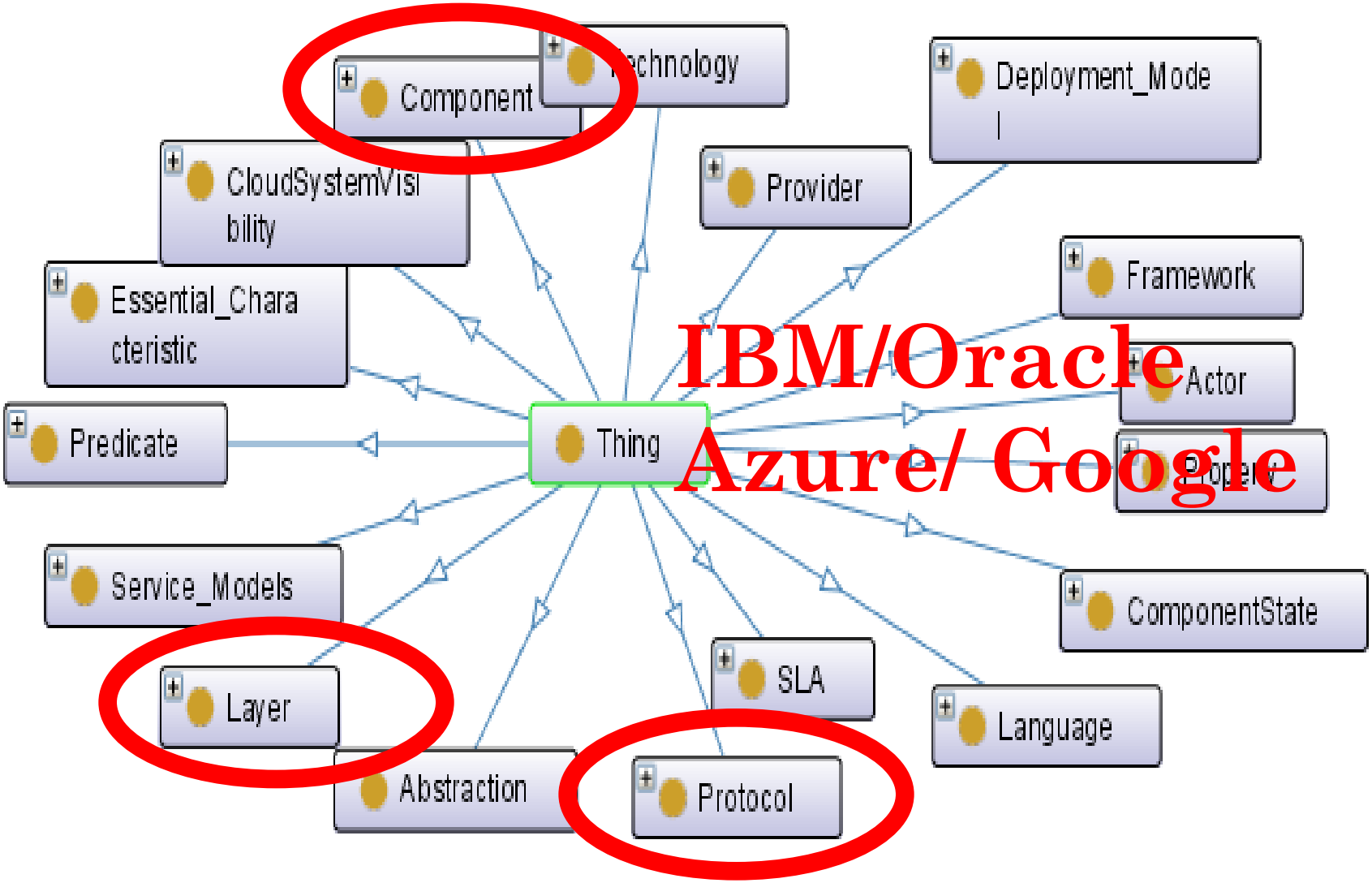


mOSAIC Ontology: Top Level and Standards/Proposals



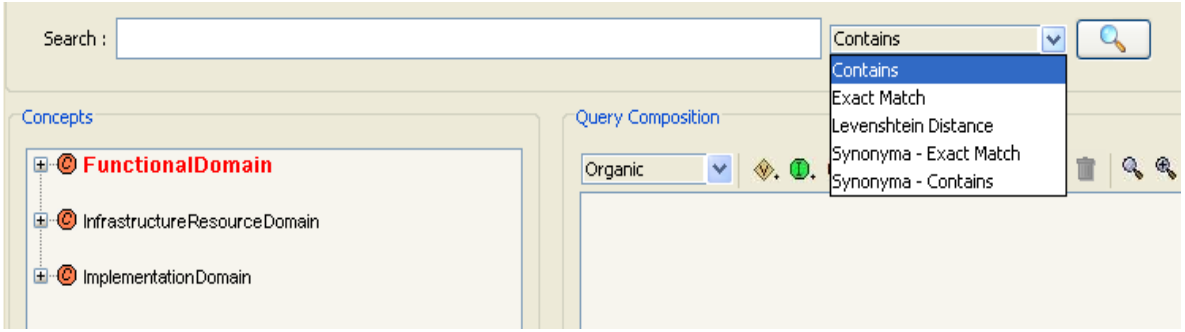
Semantic technologies in the mOSAIC project

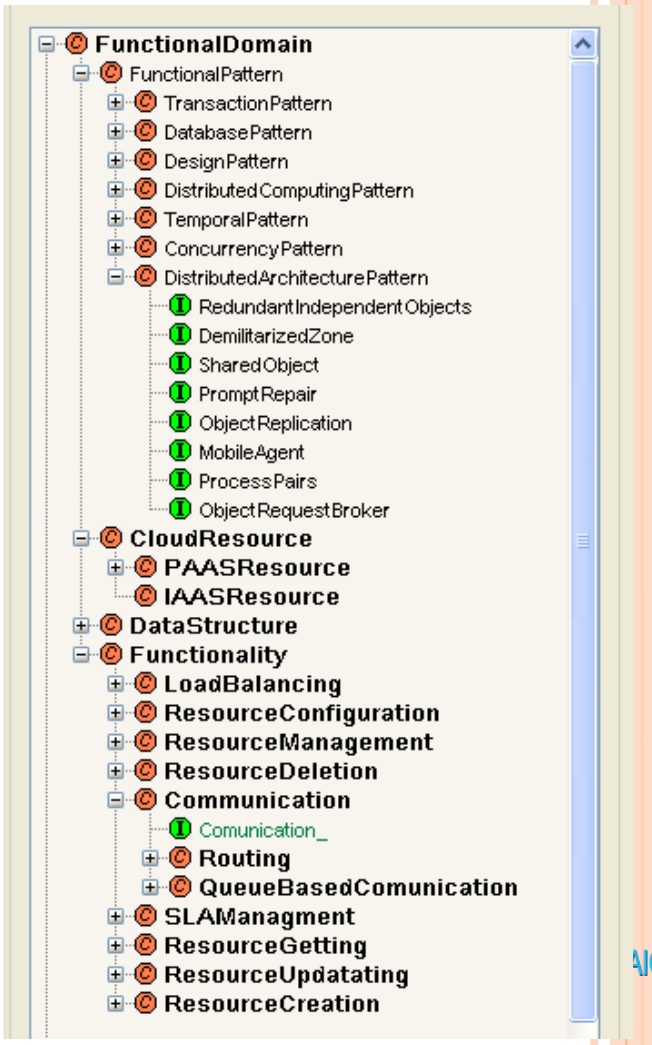
The Semantic Engine:

overcomes syntactical differences representing and annoting the API semantically, independently from programming model.

offers a catalogue of functionality related to Cloud domain, representing specific services in agnostic way.

offers semantic full text search with the use of semantic thesaurus.



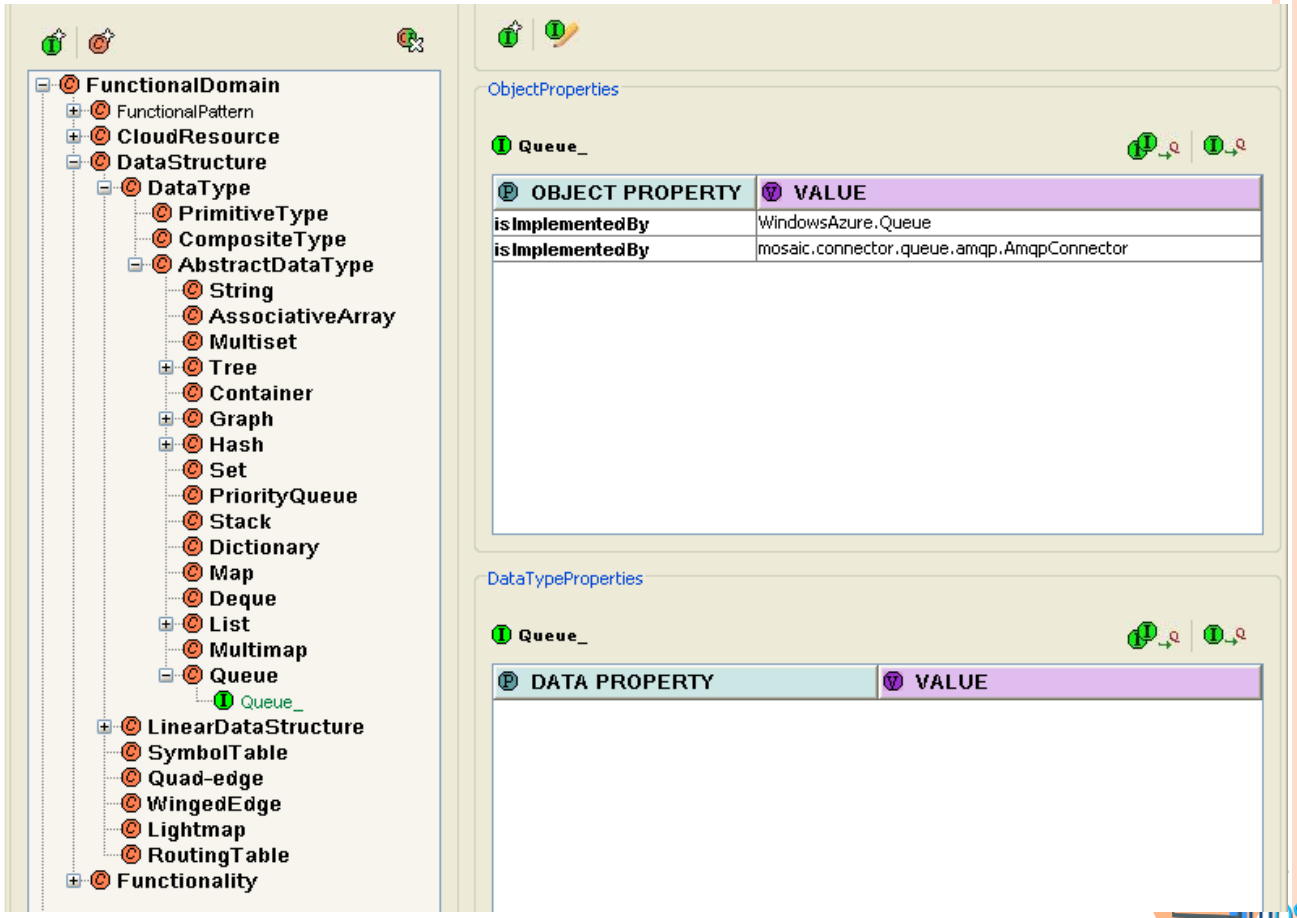


Semantic technologies in the mOSAIC project

The Semantic Engine:

Links together services and resources and maps them with grounding implementation.

Helps to express non functional requirments and supports contruction of SLAs depending on concepts related to patterns and heuristic rules.

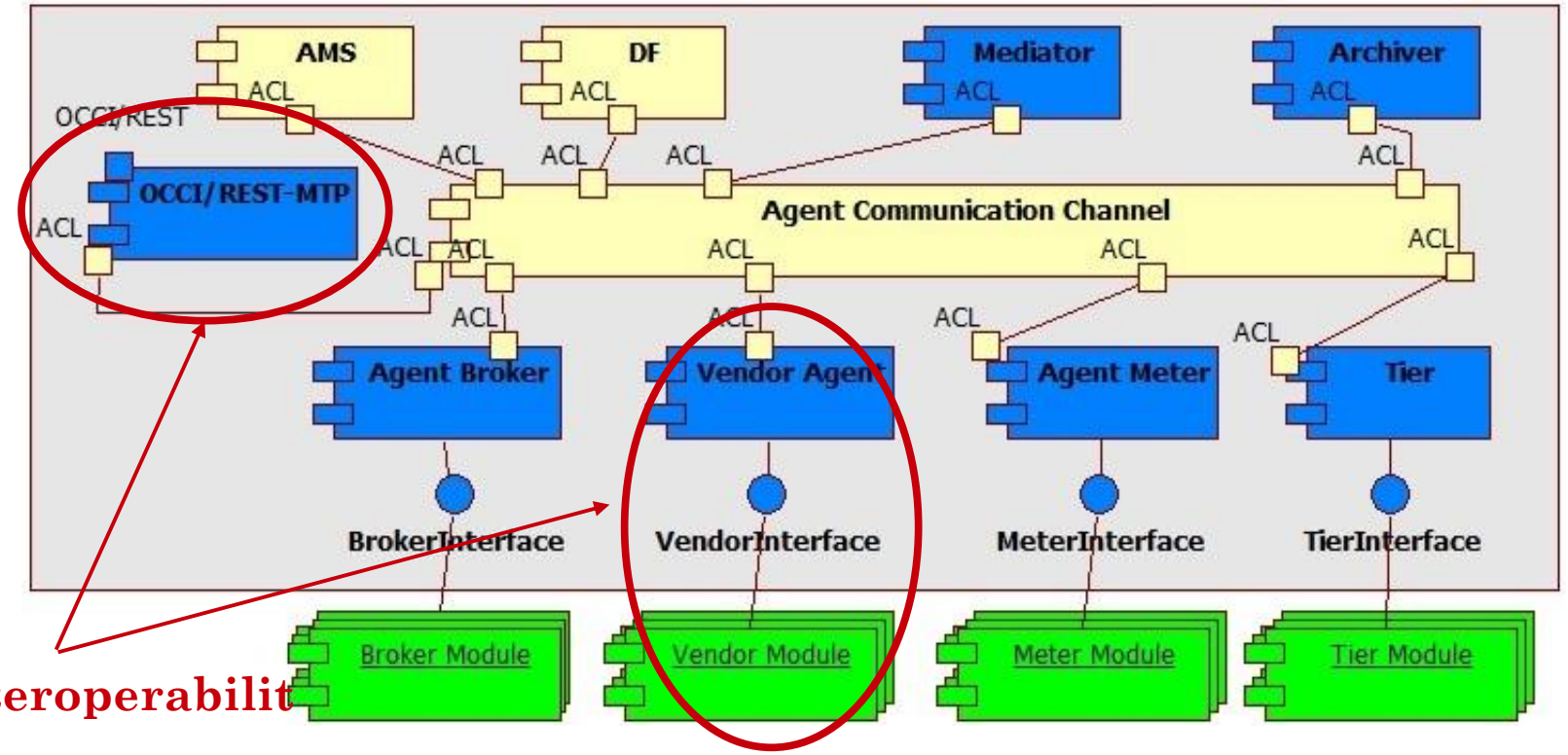


Semantic technologies in the mOSAIC project

- ✓ A Dynamic Semantic Discovery Service, for discoverying Cloud providers' resources and services, allineating them with mOSAIC API components and resources. Together with Semantic Engine, the discovery service helps to enrich the catalogue of services and automatically classify them, abstracting and annotating them.
- ✓ Support to mOSAIC's Cloud Agency to express brokering policies and to find best fitting provider according to SL requests. Semantic based rules can be defined in Cloud Agency to express Service level monitoring and reconfiguration rules.

Cloud Agency

Cloud Agency is a multi agent system (MAS) that accesses, on behalf of the user, the utility market of Cloud computing to manage always the best resources configuration that satisfies the application requirements.



Interoperability

Vendor Agents

- The overall goal of the Vendor Agents (VA) inside the Cloud Agency is to mediate the relationship of their clients with the specific cloud providers they are connected to.
- VAs create a separation layer between the Cloud Agency and the Cloud Provider and hide the user applications and other agents from the details of the cloud provider, the resources they use and the infrastructure they run on.
- Vendor Agents provide ***resource provisioning*** and ***resource management.***

Vendors' specifics addressed

- ***The resources types they provide:*** compute and storage resources are quite common. But they are sometimes complemented with load balancers, relational databases, map-reduce, elastic IPs, etc;
- ***The operations on resources*** including the way they are created, destroyed, related with each other, etc;
- ***The resource characteristics***: CPU, RAM, prices and the quality of the services
- ***Interaction mechanisms:*** there are various API types which are available depending on the cloud provider like REST, SOAP or language libraries.
- ***Security credentials:*** usernames and passwords are widely used. But there are also specific keys which can even differ for accessing different resources types on the same provider.

Thanks for your attention!

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http://www.mosaic-cloud.eu