Research activities related to Cloud computing

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Why Cloud at HOST?

- **Which are the most communalities of Clouds with Clusters, HPC, and Grids?**
  - E-infrastructure services
  - Trends towards on-demand
- **Which is the novelty?**
  - Shorter time to access in Clouds
  - Lower the accesibility level
  - E-Infrastructure is „programmable" and „elastic"

=> HOST intends to build a HPC [as a] Service

Back in the future…

- ## Starting points:

  - Early involvement in developing middleware and applications for Cluster, Grid and HPC computing
  - Recent deep involvement in the hot topics of building "Clouds of Clouds"

    [Re: "Clusters of Clusters" = Grids]

ICT R&D in the last 10 years at UVT & IeAT

Level	Programme	Subprogramme	Periods	RO-Associate State to EC Progs.				RO-Full member of EC Progs.						Topics
			Years	2001 2002 2003 2004	2005	2006	2007 2008	2009	2010	2011	2012	Forecast	Topics
EC	FP7	Cooperation	ICT		VISP								Web services
						AVANTSSAR							Secure services
						DEHEMS							ICT for Energy
							SPRERS						Software services
							mOSAIC						Cloud computing (PaaS)
							SPaCIoS						Secure services
										To announce			Cloud computing
		Capacities	Res. Infra			SCIEnce							Grid for maths
			Res. e-Infra			EGEE-2							Grid supply
						SEE-Grid-II							Grid tools
						EGEE-3							Grid supply
						SEE-Grid-Sci							Grid tools & appls
							EGI-Inspire						Grid supply
							HP-SEE						HPC tools & appls
			Reg.potential							HOST			HPC & Cloud
		Peoples	ERG		SysteMaThEx								Formal verification
			IRG			PhaseTrans							Algs & physics
	Structural funds (SF)	Research Infra	e-Infra				InfraGrid						Cluster/Grid/IaaS(Cloud)
			Instutional supp				ICAM						HPC for computational problems
	ESA	PECS					GiSHEO						Grid for Earth Observation
	INTAS					Formal Verific							Formal verification
	CIP	ICT							SEED				Cloud for e-Citizens
	COST	ICT					Complex HPC						HPC/Cloud/Grid/Cluster
							Agreement techs						Artificial Intelligence
Bilateral	RO-Austria	Austrian Progrs.		IeAT start-up									Distributed comp &AI & Soft.Eng.
		RO-Austrian Prj.					AEMTIA						Formal verification & AI
		Swiss Progs.	SCOPES				SciCom						Computational problems
	RO-Swiss				NOREX								Formal verification
	RO-Ukraine	RO-Ukraine Prj.				CobUrDiS							Computational Mathematics
	NATO				Event								Formal verification
	Industry	IBM					OCR						HPC
		A/D/F companies			Know-how transfer			Know-how tr.					Software engineering
National	CEEX/PNII	Cooperation			MedioGrid								Grids for Earth Observation
					GridMOSI								Grid for computational problems
					NanoSim								Simulations for material sciences
					FORMOL								Simulators for bio computers
					SIAPOM								Parallel comp, CFD, optimization
					SINRED								Grids for librarians
						SIPADOC							Grids for document management
						PEGAF							Grid for computational problems
						NatComp							Natural Computing
						SCIPA							Web services & AI
						ASISTSYS							Sensor networks & AI
		Capacities			ProWest								EC Info Days, visibility
		People			GRAI								Grid &AI
		Ideas			CompGrid								Grid for computational problems
					MindSoft								Artificial Intelligence
										C-OPTIM		Optimization
									AMICAS			Automation in Cloud computing
	Others	InfoSoc		DistrEnv									Cluster for computational fileds
				HPC&Grid									HPC & Grid
		Academy			P-Systems								Simulators for bio computers
Regional	IT Park Companies	IT Cluster			IT Park			IT Cluster					Knowledge transfer
		Multinational	Acatel, Siemens										Knowledge transfer & trainings
		Local	Eta-2U, Lasting										Infrastructure

Colors legend:

Stages	Pre-EC/Pre-CEEX	CEEX/Pre-SF	SF/Lead EC prj
UVT	IeAT	Subcontract	e-Infras	Cluster	& Grid	& Cloud	& HPC

Btw…

- 2 positions free for PostDocs

  in the frame of HOST:
  - Cloud & HPC
  - Image processing & HPC
- Next workshops /UVT/September 2012:
  - HOST: http://host.hpc.uvt.ro/wohs/
  - AMICAS: http://amicas.hpc.uvt.ro/first-workshop-in-september-2012/
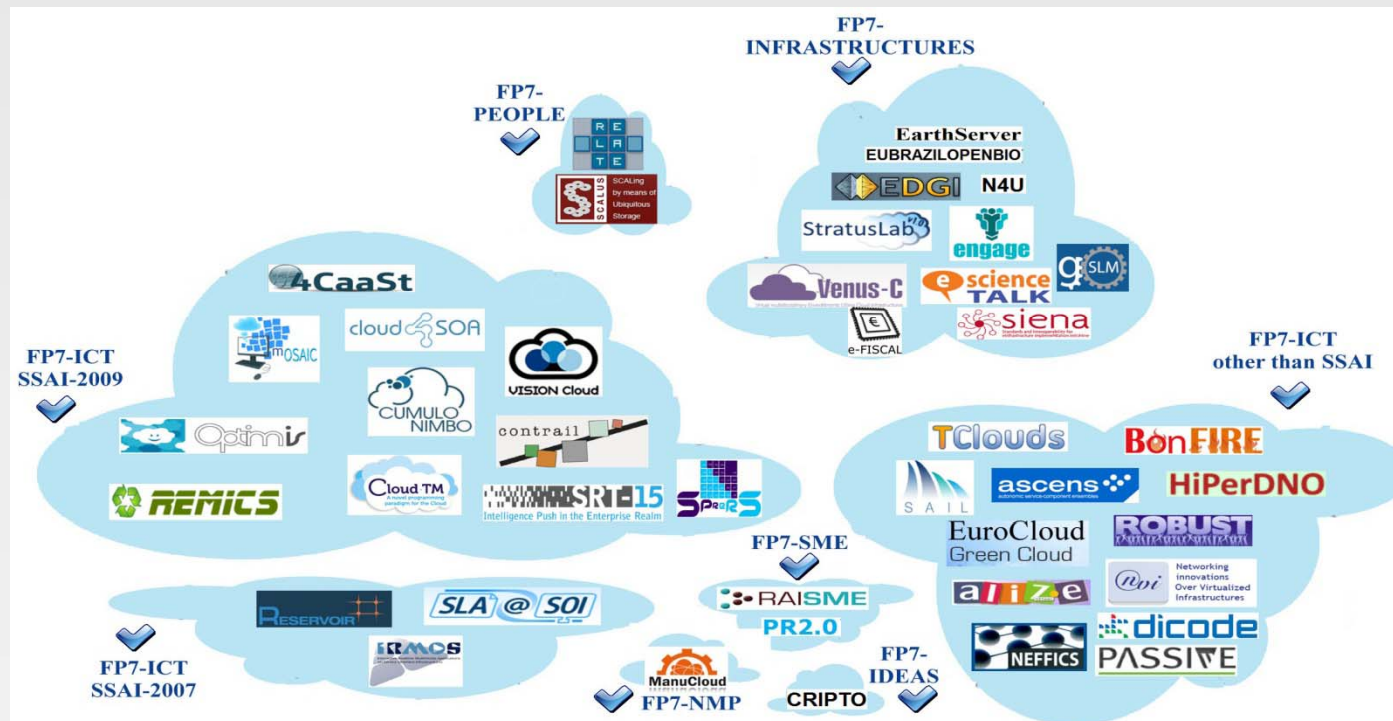
mOSAIC consortium

- Second University of Naples, Italy
- European Space Agency, France
- Terradue SRL, Italy
- Tecnalia, Spain

- Institute e-Austria Timisoara, Romania
- AITIA International Informatics, Hungary
- Xlab, Slovenia
- University of Ljubljana, Slovenia
- Brno University of Technology, Czech Republic

www.mosaic-cloud.eu

FP7 context before 2012

Content

- Problem definition
- General approach

Interoperability in Clouds?

Portability in Clouds?

API spec

API spec

0101
1001

API spec
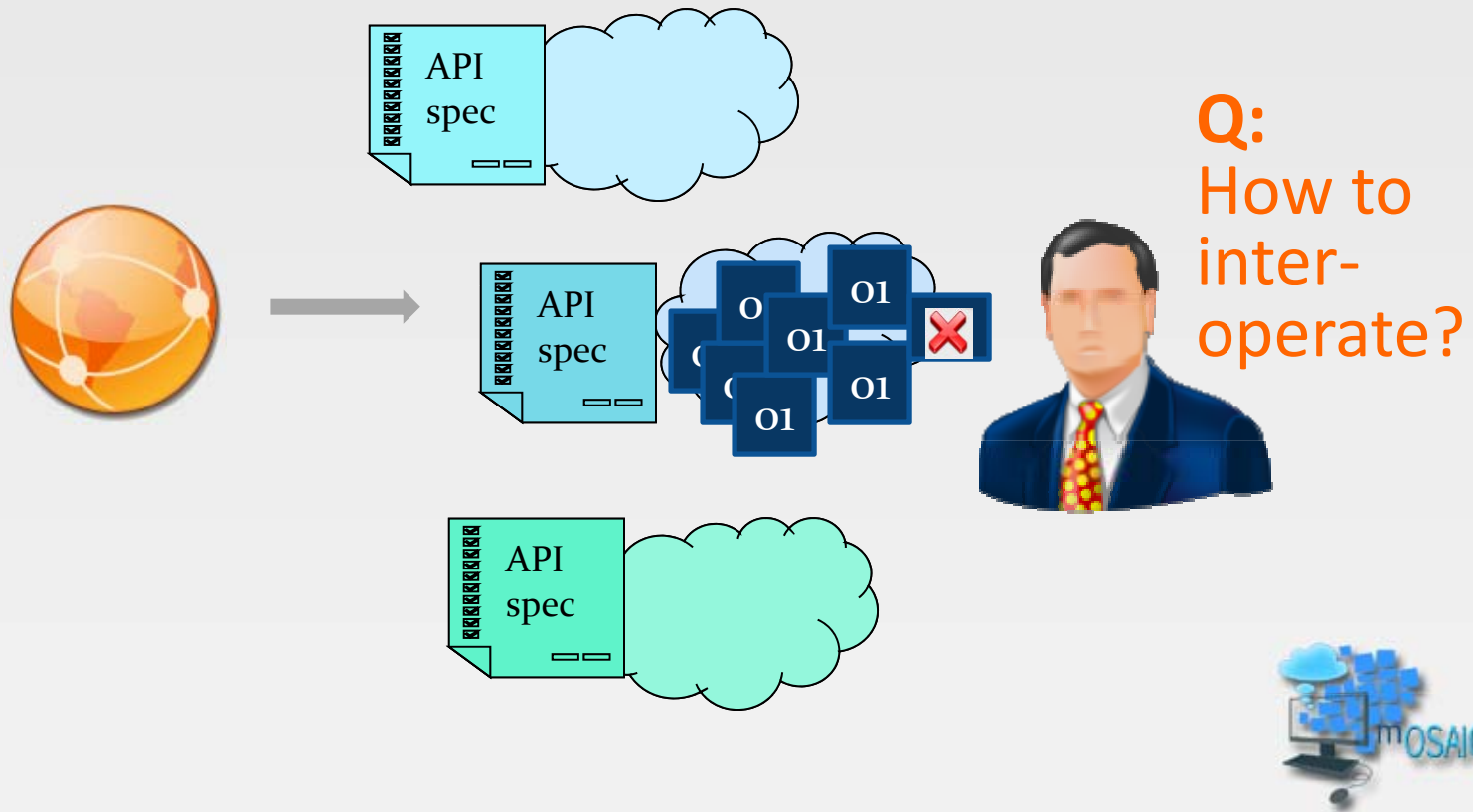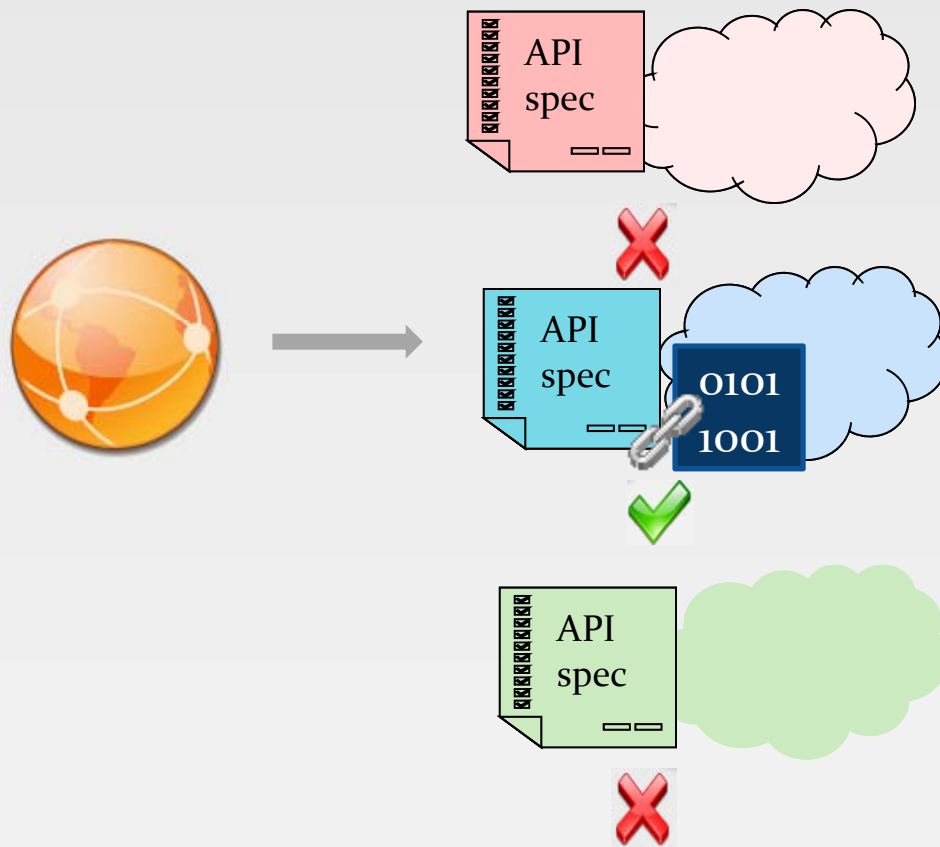
Q:
How to port the appl?

mOSAIC

Scenarios for multiple Clouds

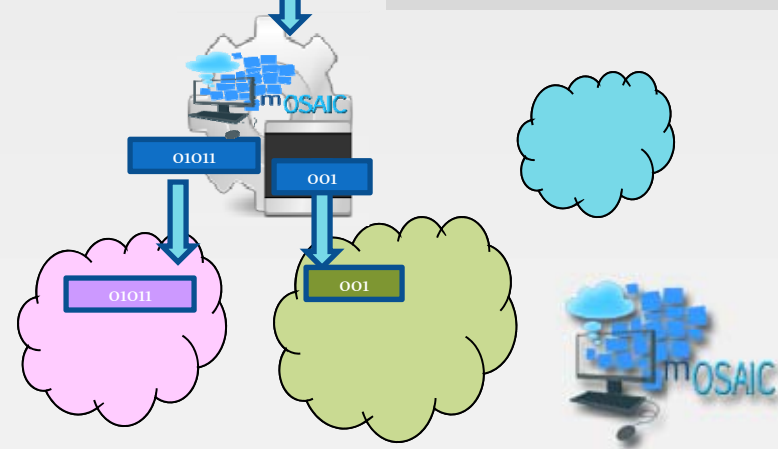**Federation of Clouds:**

Horizontal or InterClouds
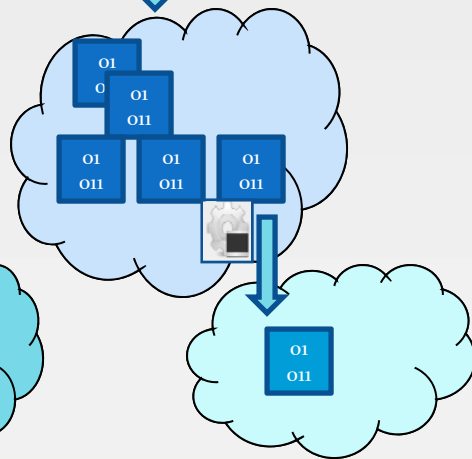
Main issue:

Inter-operability

Main issue:

Portability

On-the-fly Multiple Clouds:

Cross-Cloud or Sky computing

Current approaches

1. **Open APIs**
2. Open protocols
3. Standards
4. **Abstraction layers**
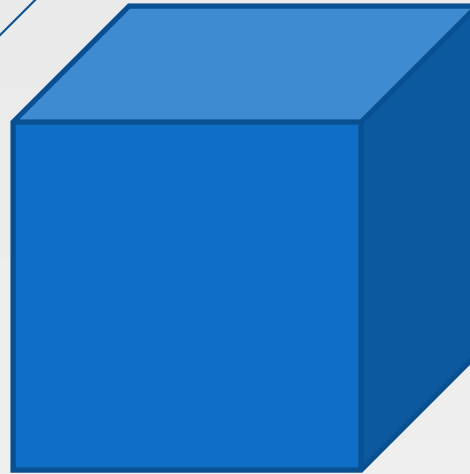5. Semantic repositories
6. Domain specific languages

Interoperability/Clouds-dimensions

POLICY:
Federate, communicate between providers
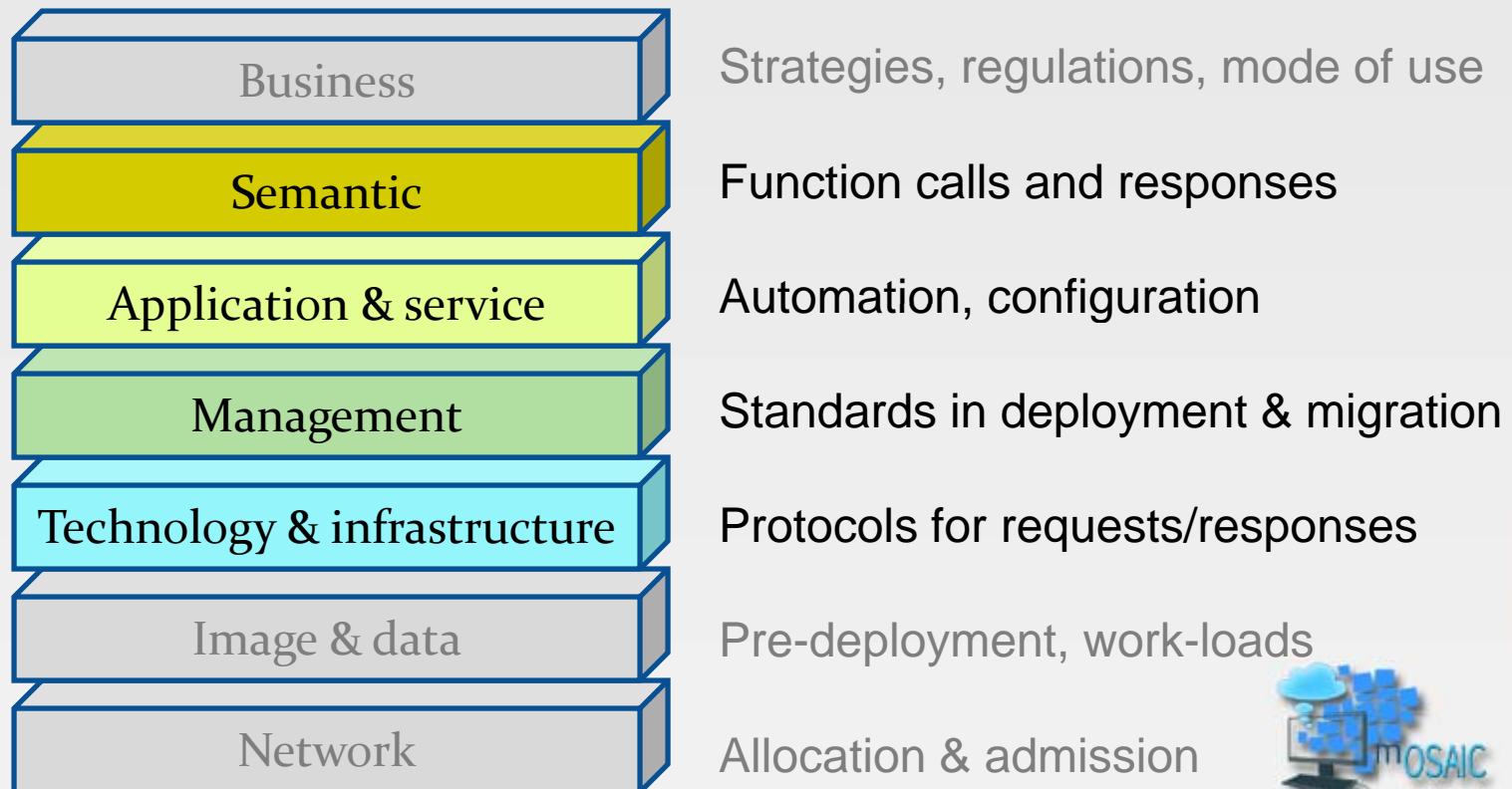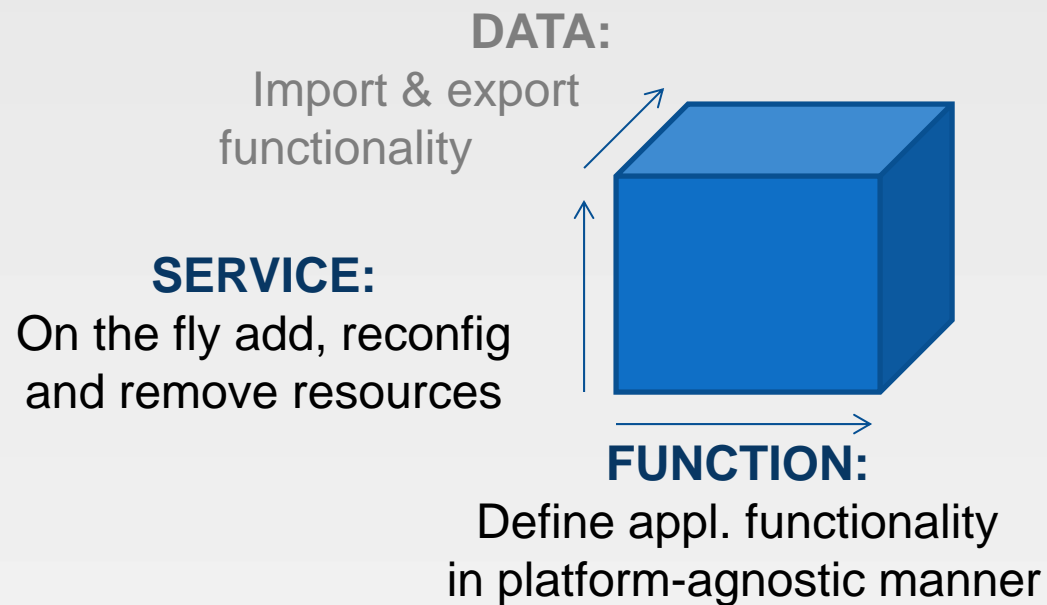
RUNTIME:
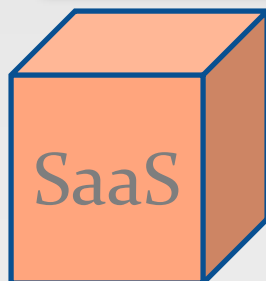Migration support

DESIGN:
Abstract the programmatic differences

Interoperability/Clouds-targets

Layer	Description
Business	Strategies, regulations, mode of use
Semantic	Function calls and responses
Application & service	Automation, configuration
Management	Standards in deployment & migration
Technology & infrastructure	Protocols for requests/responses
Image & data	Pre-deployment, work-loads
Network	Allocation & admission

Portability between Clouds

DATA:
Import & export
functionality

SERVICE:
On the fly add, reconfig
and remove resources

FUNCTION:
Define appl. functionality
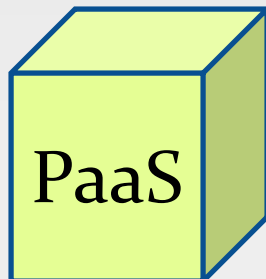in platform-agnostic manner

Portability at XaaS level

SaaS

Preserve/enhance functionality when substitute softw
Measures:
- open source; proprietary/open formats;
- integration techs; appl server/OS

PaaS

Minim.appl.rewriting while preserve/ enhance control
Measures:
- proprietary vs. open APIs, progr.languages, data formats
- tight vs. loose coupled services
- abstract layers for queuing & messaging

IaaS

Appls and data migrate and run at a new provider
Measures:
- ability to port VMs and data
- underlying configurations across providers

mOSAIC

Requirements

|	
Market	Economic models, cost-effectiveness, license flexibility, negotiated SLAs, leasing mechanisms
Application	Data portability and exchange, scale-out, location-free, workflow management
Programming	**Minimal reimplementation when move, standard APIs, same tools for cloud-based & entreprise-based appls**
Monitoring	SLA and performance monitoring, QoS aware services, service audit, sets of benchmarks
Deployment	Deploy in multiple clouds with single management tool, navigation between services, automated provisioning, resource discovery and reservation, behavior prediction
AA & Security	Single sign-on, digital identities, security Standards, trust mechanisms, authentication

mOSAIC approach

O<u>pen</u>-<u>s</u>ource
<u>API</u> and Platform
for <u>m</u>ultiple <u>C</u>louds

Motto: Fly through the Clouds
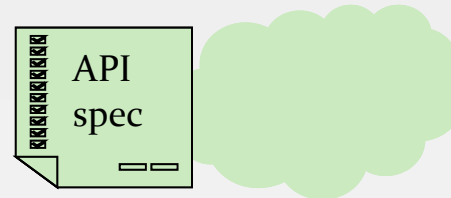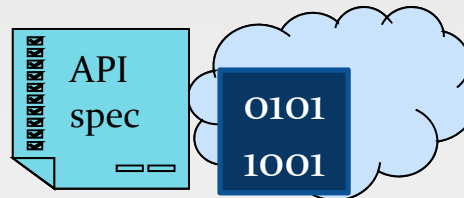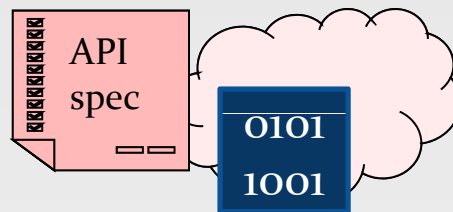
mOSAIC promises

September 2011:   1st implementation of API

September 2012:   Platform available

March 2013:   Full software package

Promises kept?

- All links: http://www.mosaic-cloud.eu
  - Code: http://bitbucket.org/mosaic
  - Video: http://youtu.be/ctO9fqaDMBc
  - Documentation for PaaS:
    http://developers.mosaic-cloud.eu
  - Example of sci. paper:
  http://dx.doi.org/10.1016/j.future.2012.01.009

Architecture (Copyright 2012: mOSAIC Consortium)

Cloud-enabled applications	mOSAIC PaaS and IaaS			Clouds adaptors
mOSAIC's proof-of-the-concept applications	**Application support**			**Hosting services supported by mOSAIC**
	API implementations	**Application tools**	**Semantic engine**	
		Service discoverer		**Deployable services support**
User community developed applications	**Software platform support**		**Infrastructure support**	
	Platform's core components	**Application service components**	**Cloud Agency**	
		Application support components	**Agents for Cloud Agency**	**Other Cloud hosting or deployable services**

Other similar initiatives

- VMWare CloudFoundry
- Redhat OpenShift

...

What's next? / IeAT

- [EC-FP7 HOST] Customization for HPC as a Service
- Techs to sustain the on-the-fly usage of multiple Clouds
  - [RO-PNII AMICAS]

    Automated management of resources in Cloud and Sky
    - Scheduling
    - Auto-scaling
    - …
  - [EC-FP7 xxxx]

    Model-driven architectures for multiple Clouds
- [EC-CIP SEED] Applications on top of the PaaS