

U. PORTO



“IES+Perto” Project Cloud Computing

Instituições de Ensino Superior Mais Perto
Higher Education Institutions Closer

Universities: Aveiro, Coimbra, Porto

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IES+Perto Project Context

- Universities Consortium: Aveiro, Coimbra, Porto, Beira Interior e IPP
- Support by European Funds (SAMA - Administrative Modernization Support System)



- Proximity to the citizen
- Interoperability in Higher Education Institutions and Public Administration
- IT Infrastructures Consolidation
- Cost reduction
- Increased revenues

Expected Results

- Mobility for digital content
- Open Standards
- Interoperability Platform
- **Cloud Computing**
 - The cloud computing shows herself as a new paradigm for the distributed use of ICT resources, tailored to dynamic and real demands of modern organizations and allowing for management delegation to meet the users specific needs.



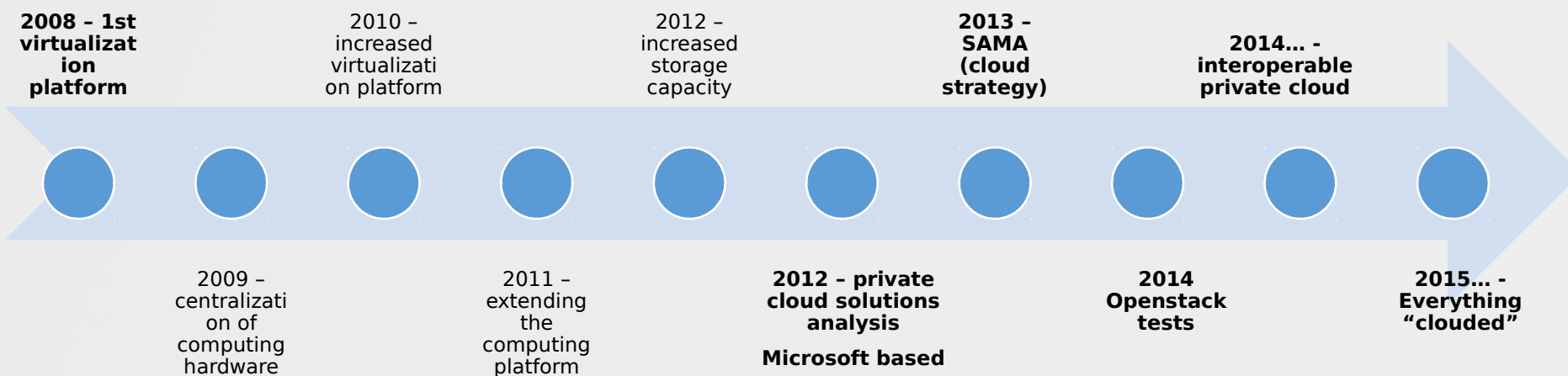
About Aveiro University

Aveiro University (40 years)

- **16 Departments** + 4 Polytechnic Schools
- ~ 18 R&D Institutes
- ~ 210 Study programs
- ~ **14.700 Students**
- ~ 1050 Teachers and researchers
- ~ 650 Technical and administrative staff
- Geographic dispersion: 3 campus (Aveiro, Águeda and Oliveira de Azeméis Campus)

Aveiro University

Evolution of ICT support services



Aveiro University

IT Platforms

- Virtualization:
 - 2 clusters - Hyper-V 2012 (10 servers)
 - 1 VMWare ESXi
 - 2 Hyper-V (Windows 2012 R2 e 2008 R2)
 - 2 KVM:
 - total 300 cores, 1,8 TB RAM e 78,5 TB Storage
 - 290 VMs (194 Windows + 96 Linux)
- HPC platform:
 - 71 servers
 - 864 cores
 - 2,5 TB RAM
 - 115,5 TB Storage
- GRID
 - EGI integration nodes



About Coimbra University

Coimbra University

- **12 Organic Units**
 - Education: 8
 - Research: 2
 - Education and Research: 2
- ~ 406 Study programs
- ~ **23 000 Students**
- ~ 1535 Teachers and researchers
- ~ 860 Technical and administrative staff
- Geographic dispersion: 3 Poles

Coimbra University

Strategic Orientation

- Profitability of common ICT services
- Migrate services to cloud
- Adjust infrastructure and service levels
- Human resources and material optimization
- Use of open source solutions
- Application development autonomy

Coimbra University

IT Platforms

- virtualization:
 - 2 clusters - high availability (10 servers)
 - 50 VMWare ESXi
 - 460 cores, 2,5 TB RAM and 160 TB Storage
 - 270 VMs (90 Windows + 180 Linux)
- HPC
 - 164 servers
 - 4500 cores
 - 17T RAM
 - 220T storage

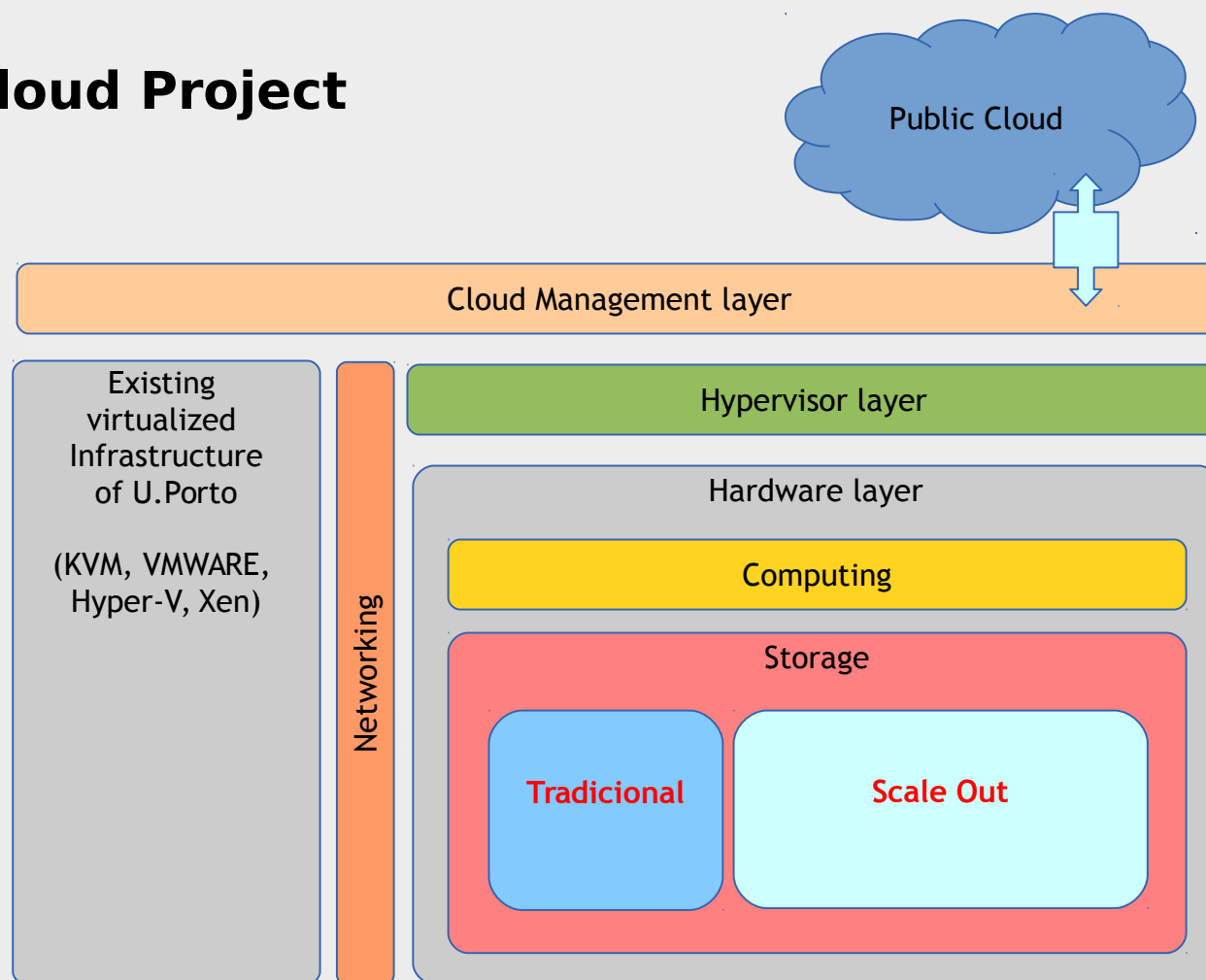
About Porto University

Porto University

- **14 Faculties** + 1 Business School
- ~ 60 R&D Institutes
- ~ 600 Study programs
- ~ **32.000 Students**
- ~ 2.400 Teachers and researchers
- ~ 1.600 Technical and administrative staff (FTE)
- Geographic dispersion
 - 3 locations (pole 1, 2 e 3)

Porto University

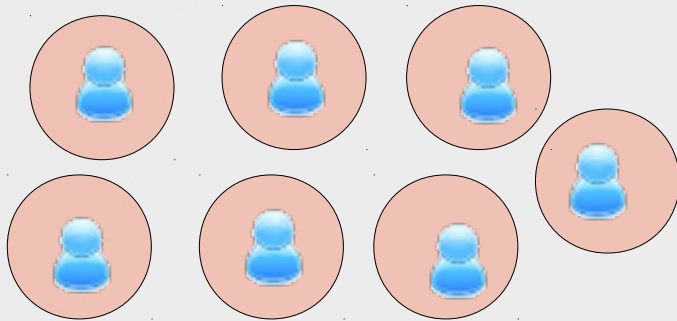
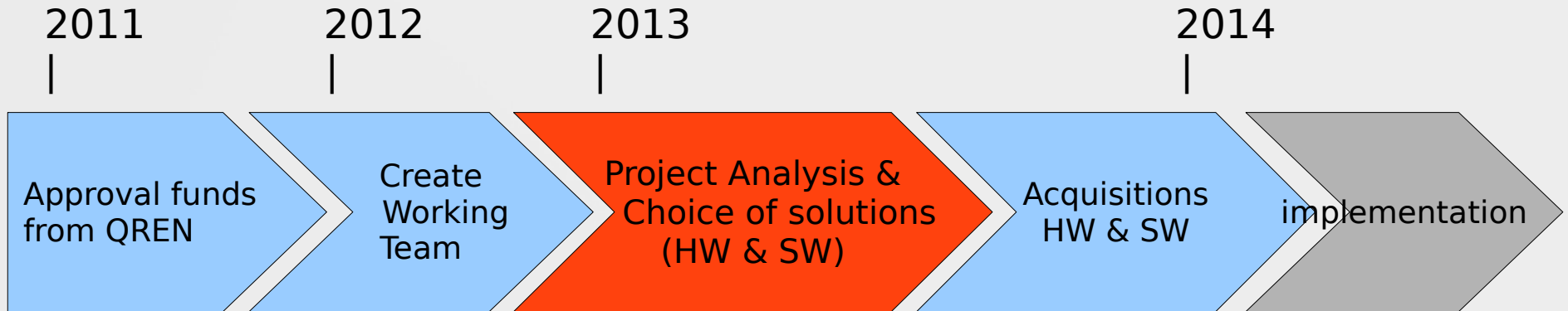
U.Porto Private Cloud Project Overview Diagram



Porto University

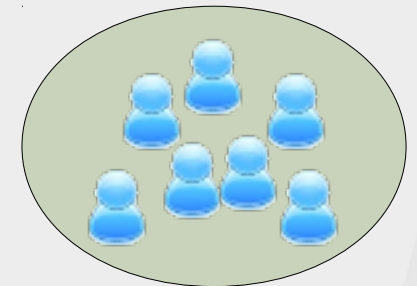
U.Porto Private Cloud Project

Timeline



Dispersed IT team (1 team for each faculty)
Difficulties working together

May 2013
U.Porto created
Shared Services for IT



One IT team for all U.Porto
Working together efficiently

Porto University

U.Porto Private Cloud Project

The Project Analysis (2013) - Survey for IT teams of U.Porto

- Almost all Faculties already have virtualization implementations
- State of existing IT resources:
 - 92 physical servers | ~732 Virtual Machines | 70% LINUX server
 - 415 TB total storage | 5.5 TB RAM
- Main Needs
 - Backup (storage) | Disaster Recover for some services
 - Migrate services to new infrastructures | Implementation of new IT services
- Minimum Resource needs identified
 - VCPU 463 | 961 GB RAM | 180 TB storage

U.Porto Private Cloud Project

Technological analysis (SW & HW) (until july 2013)

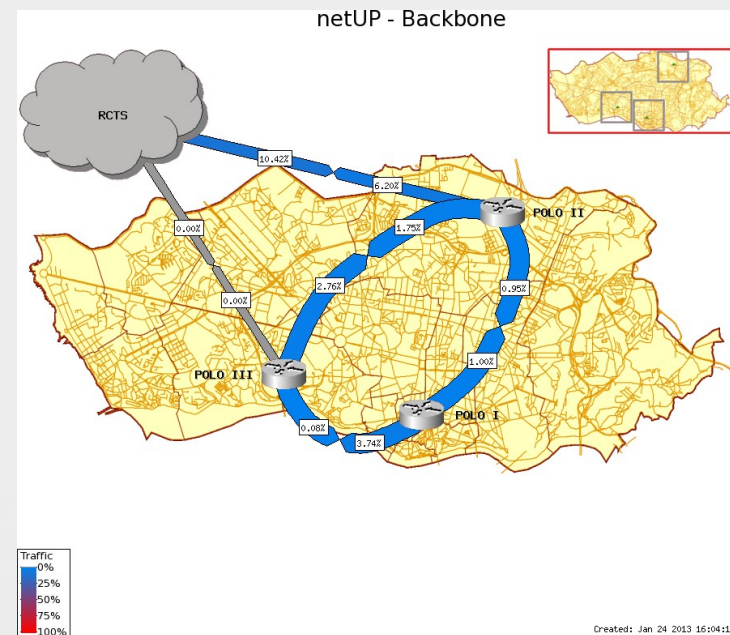
- Cloud Management platforms
 - **OpenStack** | Eucalyptus | CloudStack | Ganeti | OpenNebula | Vcloud | HP CloudSystem Matrix | Citrix CloudPlatform
- Virtualization Software (Hypervisors)
 - **KVM** | Xen | VMware | Hyper-V
- Compute nodes
 - > 500 Vms | 20 nodes (Xeon E5 2x12C [2.6] Ghz | 256 GB RAM | Disk: 2x300 GB SAS RAID | 10 Gbit)
- Open-Source Scale Out Storage
 - **GlusterFS** | Ceph
- Proprietary Traditional Storage
 - HP, NetApp, EMC (Guarantees reasons → IT team have large experience → fast deployment)

Porto University

U.Porto Private Cloud Project

Technological analysis (SW & HW) (until July 2013)

- Networking
 - 10 Gbit Switches for Interconnection of compute nodes and storage nodes
 - 10GBASE-CU SFP+ Cables
 - 1 Gbit Switches
- Data Center
 - Distributed implementation (Pole 2 and 3)



Design / Vision of Consortium: Aveiro, Coimbra e Porto

Data Center and Cloud Computing

Data Centers Investment

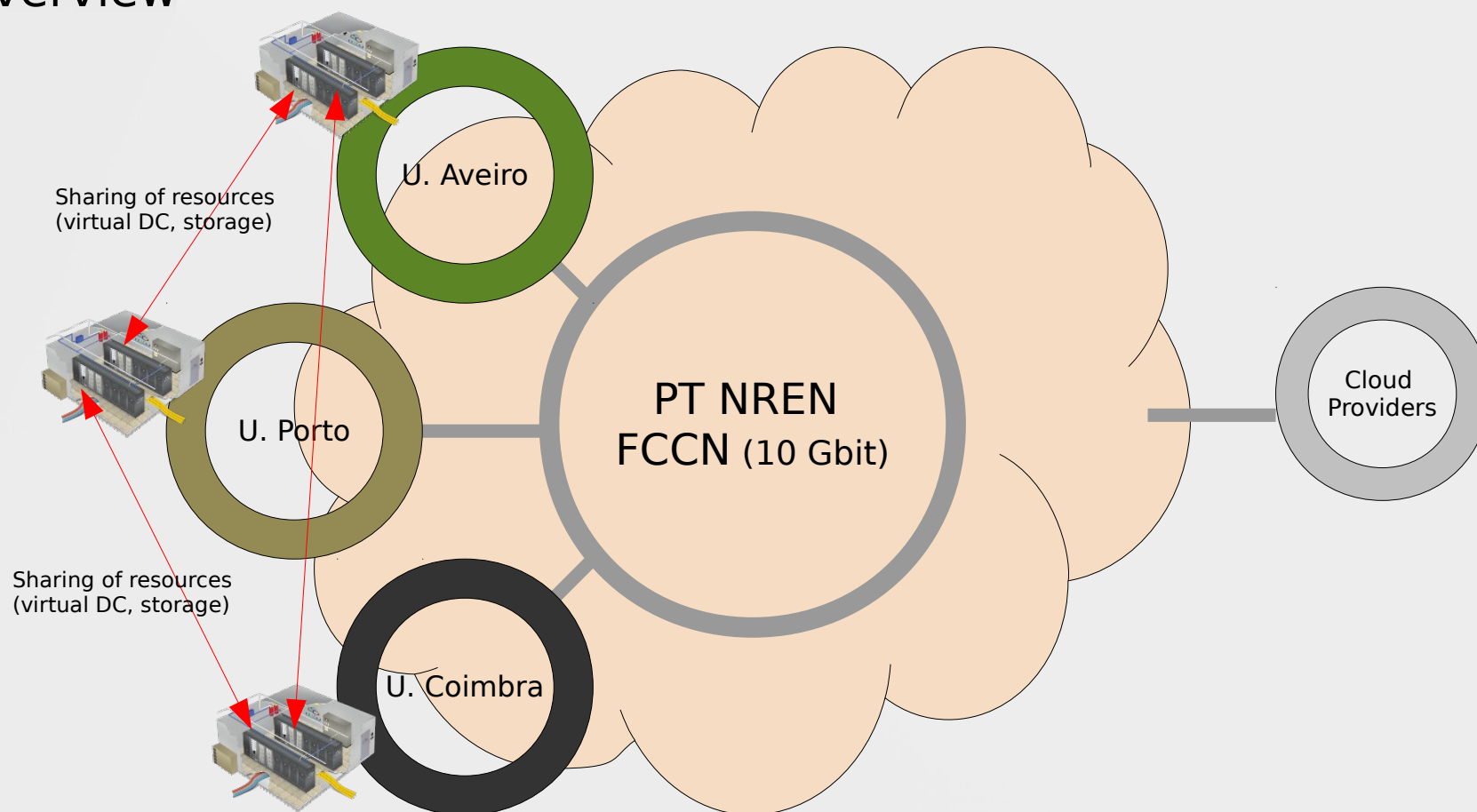
- Existing infrastructures increase
 - Electric power and UPS
 - Air-conditioning systems
 - Server rack cabinets
 - Security (access and automatic fire detection and extinction)
 - Certification
 - Improve connectivity for compute nodes and storage

Virtualization Infrastructure Investment

- OpenStack + KVM choice based on:
 - U.Porto Private Cloud analysis
 - U.Aveiro tests
 - U.Coimbra tests
 - Literature e technological trend
- Interoperability between Universities
 - Sharing of resources
 - Virtual Data Center
 - Sharing storage – Cloud Storage (like Amazon S3)
 - Backup
- Hardware and Software Investment
 - Compute nodes, storage, networking
 - OpenStack Support
 - Security - firewall

Interoperability between Universities

- Overview

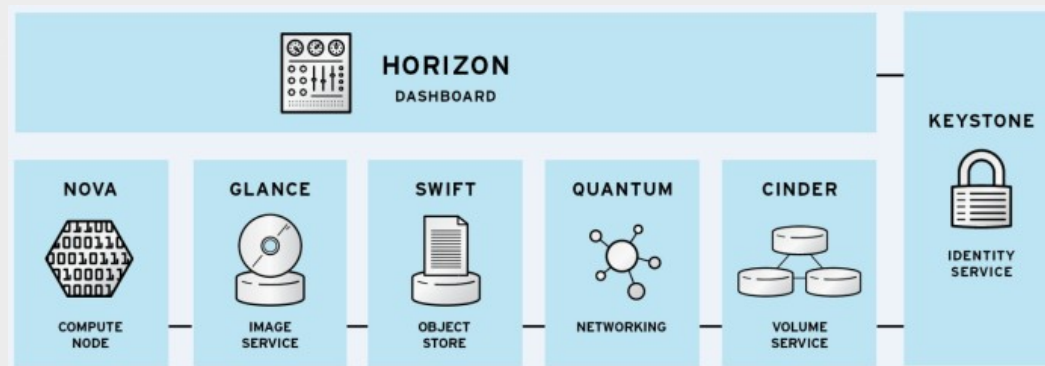
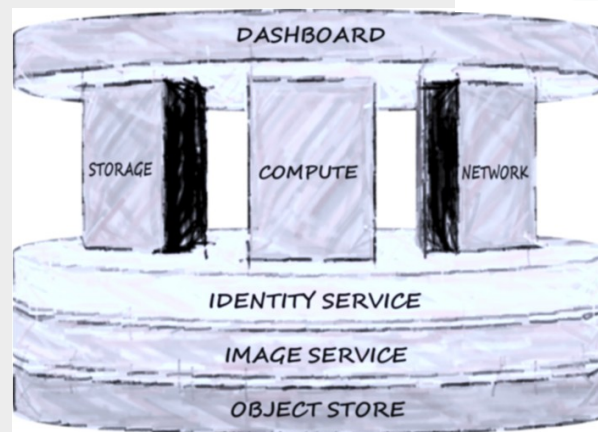


Interoperabilidade Operadores

- **FCCN (PT NREN) Support**
 - Provide contacts and conditions for interoperability testing with commercial Cloud providers

OpenStack layers

- Storage (Cinder + Swift)
- Compute (Nova)
- Orchestration (Heat)
- Identity Service (Keystone)
- Networking (Neutron/Quantum)
- Dashboard (Horizon)
- Telemetry (Ceilometer)
- Image Service (Glance)



Questions



OpenStack choice

Cloud Management platforms (analysis)

- Focus on **OpenStack** | CloudStack | OpenNebula (@July 2013)

solution	advantages	disadvantages
OpenStack	<ul style="list-style-type: none">- used for large projects- support by RedHat- fairly comprehensive API- supports Xen, KVM, VMware and Hyper-V- very modular solution	<ul style="list-style-type: none">- dashboard little flexible- migrations and upgrades can be more complex
CloudStack	<ul style="list-style-type: none">- robust- good APIs and documentation- support Xen, KVM e VMware	<ul style="list-style-type: none">- required a uniform infrastructure
OpenNebula	<ul style="list-style-type: none">- simple self-service- good integration with public cloud- based on templates and VMs- supports Xen, KVM and VMware	<ul style="list-style-type: none">- based on Ruby → is not simple

OpenStack choice

Cloud Management platforms (analysis)

Main functionalities (@July 2013)	OpenStack	Cloudstack	OpenNebula
storage protocols	NFS, iSCSI, glusterFS	NFS preferred support FC, Ceph and glusterFS, with "shared storage".	File (NFS, SSH), Block (iSCSI, LVM),
Installation/maintenance/use	Not easy	Easy, some bugs	Easy
Hypervisor support	KVM (100%), Xen, Hyper-V, VMware, LXC	KVM, Xen, VMware	KVM, Xen, VMware, Hyper-V
Development Codebase	Python; OpenStack API; EC2 compatibility API.	Java and some bash scripts	Ruby, Java and XML-RPC (system interface)
Self-service Interface? WF complexity ?	YES simple, functional	YES simple, functional	YES simple, functional

OpenStack choice

Cloud Management platforms (analysis)

Main functionalities (@July 2013)	OpenStack	Cloudstack	OpenNebula
Public Cloud API support	EC2 and S3 compatibility API	EC2 and S3 compatibility	EC2 and S3 compatibility
Billing support	Not implemented but it is possible develop interfaces base on CEILOMETER metrics	Need development base on "usage server" add-on	Support accounting and quotas. Need development for billing
Network configuration	YES "Open Flow" standard	YES	YES Firewalling (host e bridges), VLANs and Open vSwitch.

OpenStack choice

Cloud Management platforms (analysis)

Main functionalities (@July 2013)	OpenStack	Cloudstack	OpenNebula
Virtual datacenter	YES - projects	YES - Pods	YES - Cluster, Zone
Open Storage integration	GlusterFS (100% by Red Hat))	CEPH	CEPH

technical analysis → Our choice was **OpenStack!**

KVM choice

Virtualization Software (Hypervisors)

- Focus of analysis on KVM | Xen | VMware | Hyper-V

Hypervisor	advantages	disadvantages
KVM	<ul style="list-style-type: none">- Linux drivers compatibility- Open-Source- Supports a wide range of hardware- better for Linux server (high performance)	<ul style="list-style-type: none">- Less good management tool
Xen	<ul style="list-style-type: none">- Paravirtualization support- Good management tool	<ul style="list-style-type: none">- High price- Supports a limited set of hardware
VMware	<ul style="list-style-type: none">- Good management tool	<ul style="list-style-type: none">- Very high price
Hyper-V	<ul style="list-style-type: none">- Good management tool- better for Windows server	<ul style="list-style-type: none">- High price but diluted by the Microsoft Campus licensing

Our choice was KVM!

GlusterFS choice

Open-Source Scale Out Storage

- Focus of analysis : GlusterFS | Ceph
- Analysis by “Literature” and meetings with suppliers (Red Hat and Inktank)
- Our choice was GlusterFS – main reasons:
 - economic advantage – after discounts negotiation
 - strong integration and 100% compatible with OpenStack Cloud Management
 - more mature solution
 - solution with a strong company support - Red Hat