lxcloud

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A few words on "whole machine"

- Condor can do it
  - https://condor-wiki.cs.wisc.edu/index.cgi/wiki?p=WholeMachineSlot
  - +RequiresWholeMachine = True
  - Requirements = IsWholeMachineSlot
- PBS can do it
  - `[sebgoa@user001 ~]$ qsub -I -l nodes=1:ppn=8`
  - `[sebgoa@node0347 ~]$ echo $PBS_NODEFILE`
    ```
    /var/spool/torque/aux//1496074.pbs001.palmetto.clemson.edu
    [sebgoa@node0347 ~]$ cat /var/spool/torque/aux//1496074.pbs001.palmetto.clemson.edu
    node0347
    node0347
    node0347
    node0347
    node0347
    node0347
    node0347
    node0347
    ```

A few words on "whole machine"

And LSF as well.

```
bsub -n N -span[host=1] myjob
```

Current scheduling policy is **_spread them..._**

We would need to **_pack them_** ...to reduce the average waiting time to obtain a full node.

A few words on "community" cluster

Multiple stakeholders buy nodes
Access guaranteed for their share at all times

Preemtable queue gives access to non-owners in an opportunistic manner.

Job framework needs to be able to deal with preempted jobs...

Outline

- Basics of cloud computing
- Key Features
- Internal Cloud
- Hybrid Cloud
- Public Cloud
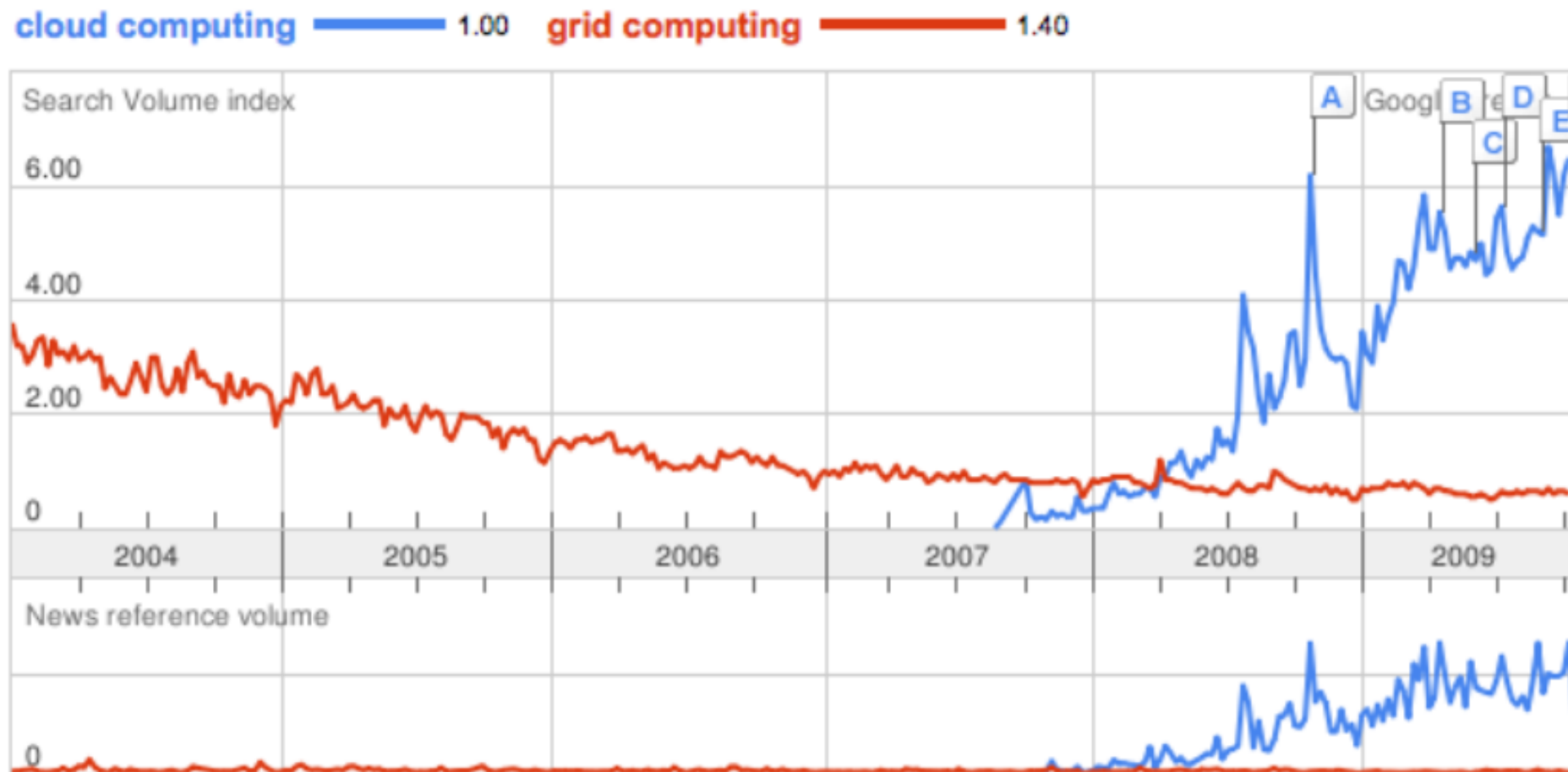- Cloud infrastructure at CERN

What is Cloud Computing ?

On the Hype curve

Figure 1. Hype Cycle for Emerging Technologies, 2008
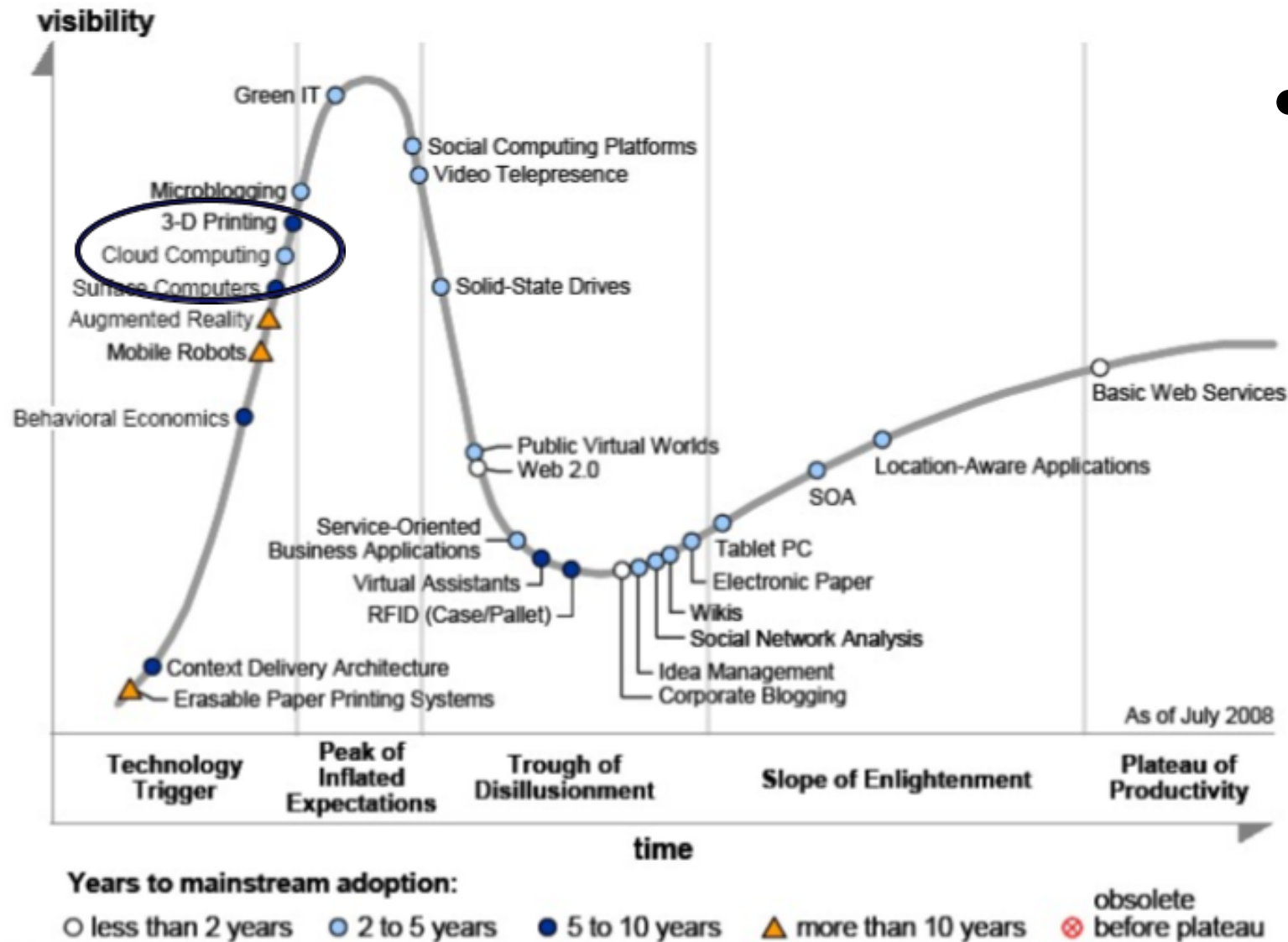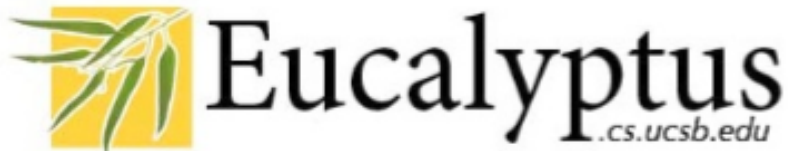
- Now probably at the top of the Hype – Oct 09

Trendy…

Source: http://www.google.com/trends

Cloud formation

- Slide adapted from Rich Wolski, UCSB

White House is going to the Cloud

- Reduce costs … See Apps. gov

DOE (Magellan) and NASA too

What is the Cloud ? The *aaS

- **SaaS –Software as a Service –**
  - Easy Access to hosted applications over the network. Most likely using your Browser
  - API to these applications

- **PaaS –Platform as a Service –**
  - Environment to deploy new applications
  - Restricted capabilities offered
  - API to this platform and access to SaaS API

- **Iaas –Infrastructure as a Service –**
  - Access to Hardware resources
  - API to make resource allocation requests

References

"Above the clouds: A Berkeley view of cloud computing"
http://berkeleyclouds.blogspot.com/

"A break in the clouds: towards a cloud definition"
L.M Vaquero et al. SIGCOMM computer communication review, 2008.
http://portal.acm.org/citation.cfm?id=1496100

"An *EGEE* Comparative Study - Grid *cloud* comparative study"
M-Elian Begin, 2009

Key Features

- **You don't know what's behind but it works**
  - Transparency
- **You Pay what you use**
  - Utility pricing (real $?)
- **You get what you ask for (On-demand)**
  - Instant provisioning of machines
- **It scales if you need more (Elasticity)**
  - How far does it scale ?
  - Doesn't this mean the underlying resources are underutilized ?
- **Virtualization is a key enabler of IaaS**

Free resources or not ?
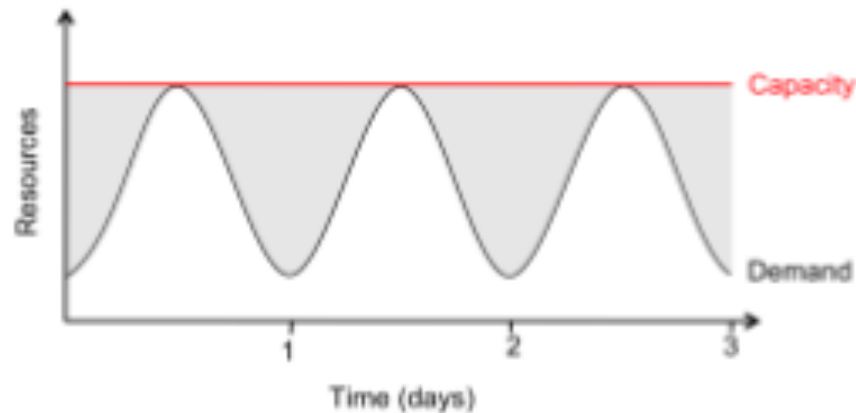
(a) Provisioning for peak load
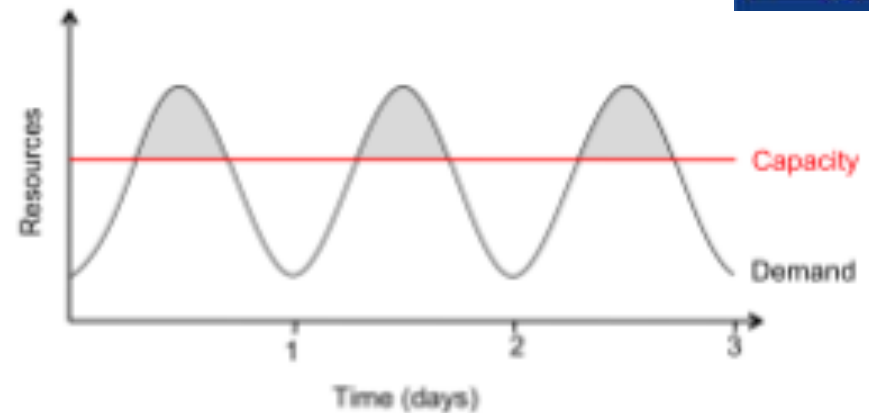
(b) Underprovisioning 1
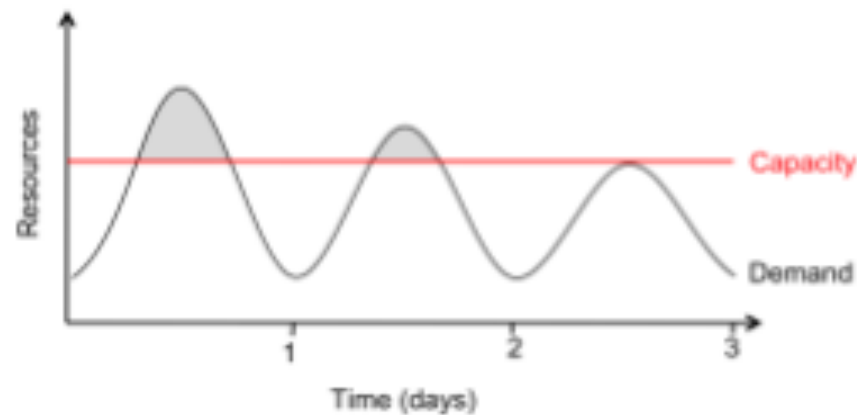
(c) Underprovisioning 2

Figure 2: (a) Even if peak load can be correctly anticipated, without elasticity we waste resources (shaded area) during nonpeak times. (b) Underprovisioning case 1: potential revenue from users not served (shaded area) is sacrificed. (c) Underprovisioning case 2: some users desert the site permanently after experiencing poor service; this attrition and possible negative press result in a permanent loss of a portion of the revenue stream.

Deployment Models

Model	Definition	Examples of Deployment
Private	Infrastructure is owned by a single organization and made available only to the organization	• Optimize and simplify **internal operation** • **SaaS/PaaS** support • IT consolidation within **large organizations** (Goverment Clouds, University Clouds…)
Public	Infrastructure is owned by a single organization and made available to other organizations	• **Commercial cloud providers** • **Community public clouds** by ICT service centers to enable scientific and educational projects to experiment with cloud computing • **Special purpose clouds** with dedicated capabilities (Science Clouds, HPC Clouds..) • **Regional clouds** to address regulatory or latency issues
Hybrid	Infrastructure is a composition of two or more clouds	• **Cloudbursting** to address peak demands • **Cloud Federation** to share infrastructure with partners • **Cloud Aggregation** to provide a larger resource infrastructure

dsa-research.org

Main components/characteristics

Set of Hypervisors
- Physical machines with a virtual machine monitor
- Xen or KVM ...or Hyper-V...or VMware ESx...

VM provisioning system
- OpenNebula
- Nimbus
- Eucalyptus
- Platform ISF
- or even traditional schedulers like PBS/Maui.

Image distribution mechanism
- Shared file system (e.g NFS, AFS, PVFS, Lustre...)
- Copy images (e.g scp, wget, Bittorent)

Networking
- Private / Public bridged
- NAT

CERN's lxcloud architecture

- Image repository with Golden nodes.
- VM instances not quattor managed have finite lifetime
- Specific IP/MACs are pinned to hypervisors
- Currently testing two provisioning system: Opennebula and Platform ISF.
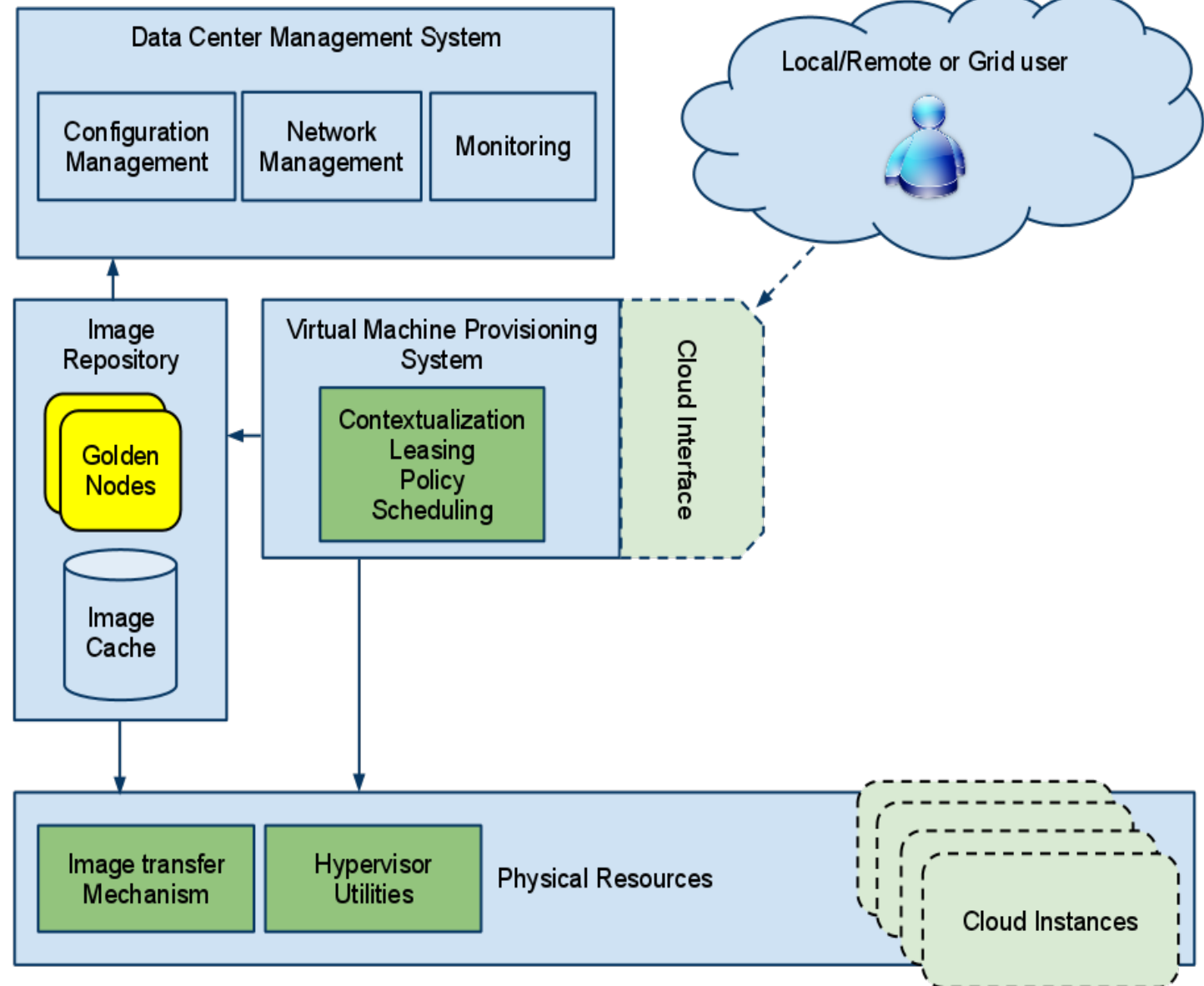
Provisioning system

OpenNebula and Platform ISF are currently being evaluated. Results shown in this talk were obtained with OpenNebula.

OpenNebula out of the University Compultense of Madrid
- C/C++ core with Ruby drivers and command line interface
- Mysql and Sqlite backends
- Use ssh as communication between frontend and hosts
- XML-RPC API
-
- Support for LVM contributed by CERN
- Enables *Hybrid clouds* (i.e instantiation on remote cloud providers)
- Implements subset of EC2 interface as well as upcoming OCCI interface for *Public cloud* interface

OpenNebula.org

Building a Cloud: Interoperability Map

Innovation in Cloud Computing Architectures

Comparison with Similar Technologies

OpenNebula - Architecture, Current Status & Roadmap

	Platform ISF	VMware Vsphere	Eucalyptus	Nimbus	OpenNebula
Virtualization Management	VMware, Xen	VMware	Xen, KVM	Xen	Xen, KVM, VMware
Virtual Network Management	Yes	Yes	No	Yes	Yes
Image Management	Yes	Yes	Yes	Yes	Yes
Service Contextualization	No	No	No	Yes	Yes
Scheduling	Yes	Yes	No	No	Yes
Administration Interface	Yes	Yes	No	No	Yes
Hybrid Cloud Computing	No	No	No	No	Yes
Cloud Interfaces	No	vCloud	EC2	WSRF, EC2	EC2 Query OGF OCCI vCloud
Flexibility and Extensibility	Yes	No	Yes	Yes	Yes
Open Source	No	No	GPL	Apache	Apache

Cloud Interfaces...Standards ?

CERN

amazon webservices™

🖳 Sign in to the AWS Management Console

| ᵛ **AWS** | ᵛ **Products** | ᵛ **Developers** | ᵛ **Community** | ᵛ **Supp** |

Amazon Elastic Compute Cloud

Home > ... > Amazon Elastic

Amazon EC2 API To

🖨 Printer Friendly ▪ Sav

The API tools serve as t
register and launch inst

Submitted By: Dave

Download

Download the Amazon

See the related Amazo
tools.

OCCi
OPEN CLOUD COMPUTING INTERFACE

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OGF Open Cloud Computing Interface Working Group

NEWS

Have a look at our Open Cloud Computing Interface specification and provide us your comments: http://www.ogf.org/gf/docs/?public_comment

About the Open Cloud Computing Interface Working Group

Cloud computing currently is covered by three models offering Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS), which all involve the on-demand delivery of computing resources. There are a growing number of providers offering **IaaS solutions for elastic capacity**, whereby server "instances" are executed in their proprietary infrastructure and billed on a utility

econe-describe-images

```
[oneadmin@lxcloud bin]$ econe-describe-images -
H -K sebgoa -S '********' -U http://lxcloud.
cern.ch:5555

Owner   ImageId                      Lo
cation
----------------------------------------------
sebgoa  ami-
0000001                      /dev/xen_vg/c
ernvm
```

econe-run-instances

```
[oneadmin@lxcloud bin]$ econe-run-instances -H
-K sebgoa -S '******' -U http://lxcloud.cern.
ch:5555 ami-0000001
```

econe-describe-instances

```
[oneadmin@lxcloud bin]$ econe-describe-
instances -H -K sebgoa -S '******' -U http:
//lxcloud.cern.ch:5555
```

Issues to work on

- Leaving aside VM provenance/certification/distribution mechanisms and policies...

- VM accounting: who instantiated what VM for how long ?
- Pricing: what is the incentive to turn off your instance ?
- Authentication to "EC2" interface with grid proxies ?
- Additional service to maintain in CERN-IT and other sites...

A Tool for Innovation

Innovation in Cloud Computing Architectures

European Projects on Cloud Computing Infrastructures

RESERVOIR

EU grant agreement 215605
Service and Sw Architectures and Infrastructures
(2008-2011)

Resources and Services Virtualization without Barriers
- Open source technology to enable deployment and management of complex IT services across different administrative domains

StratusLab

Proposal in negotiation
e-Infrastructure
(2010-2012)

Enhancing Grid Infrastructures with Cloud Computing
- Simplify and optimize its use and operation, providing a more flexible, dynamic computing environment for scientists.
- Enhance existing computing infrastructures with "IaaS" paradigms

BonFIRE

Proposal in negotiation
New Infrastructure Paradigms and Experimental Facilities
(2010-2013)

Building Service Testbeds on FIRE
- Design, build and operate a multi-site cloud-based facility to support research across applications, services and systems targeting services research community on Future Internet

Conclusions

lxcloud is a reality but not yet a production service

Production processes are being worked on
- See Ulrich's talk

Policies are being worked on
- See Tony's talk

- Working on running CERNVM as a "standalone" appliance
- Working on running virtual batch worker nodes.