UVA HPC & BIG DATA COURSE

Cloud Computing

Adam Belloum

Landscape

… From ~ 1986

to ~ 2023…

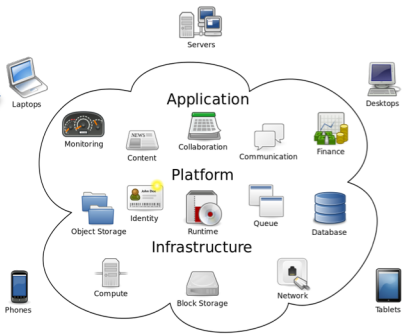
From mono-core to exa-scale computer

Aggregation

Unreliable not very fast network

central control

Virtualisation



Cloud computing

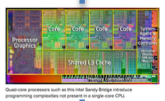
Abstraction

No central control

Reliable fast network

central control

central control



Bigger systems

outline

- Cloud computing: Approach and vision
- Resource Provisioning in Cloud systems:
- Cloud Systems: IaaS, PaaS, SaaS
- Using Cloud Systems in practice
- Cloud system providers
- Open source Cloud middleware

What is Cloud Computing?

IBM

Cloud Computing is an Evolution in IT

Grid Computing

- Solving large problems with parallel computing
- Made mainstream by Globus Alliance

Utility Computing

- Offering computing resources as a metered service
- Introduced in late 1990s

Software as a Service

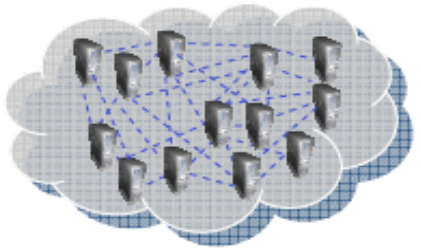
Network-based subscriptions to applications

Gained momentum in 2001

Cloud Computing

Next-Generation Internet computing

Next-Generation Data Centers

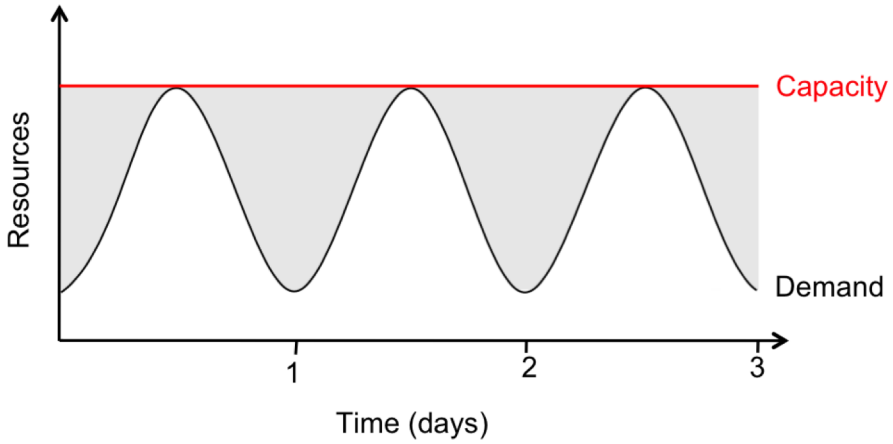


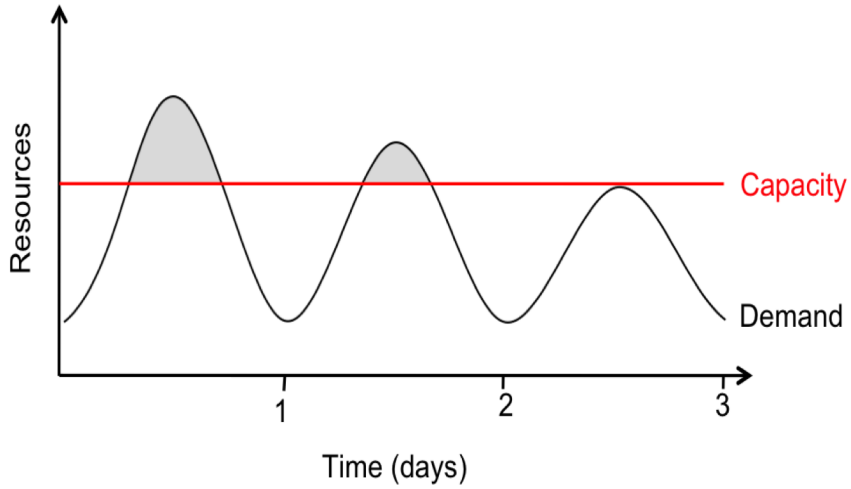
What is the cloud

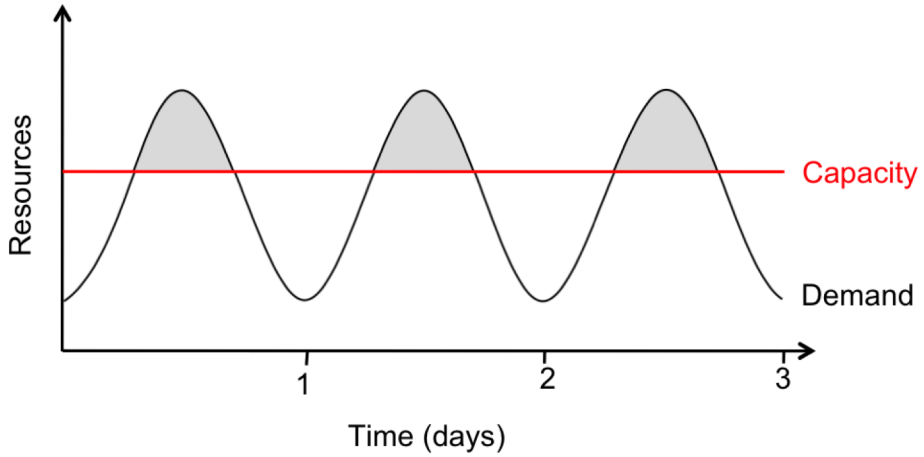
- IT as a **service**
- Cloud allows access to **services** without **user technical knowledge** or control of supporting infrastructure
- Best describe in terms of what happened to electrical power over 100 years ago
- Now computers are simple devices connected to the leader cloud

Data processing, storage and software application that used to run locally are now being supplied by big central computing station, They are becoming in essence **computing utilities**

Traditional ways of provisioning resources





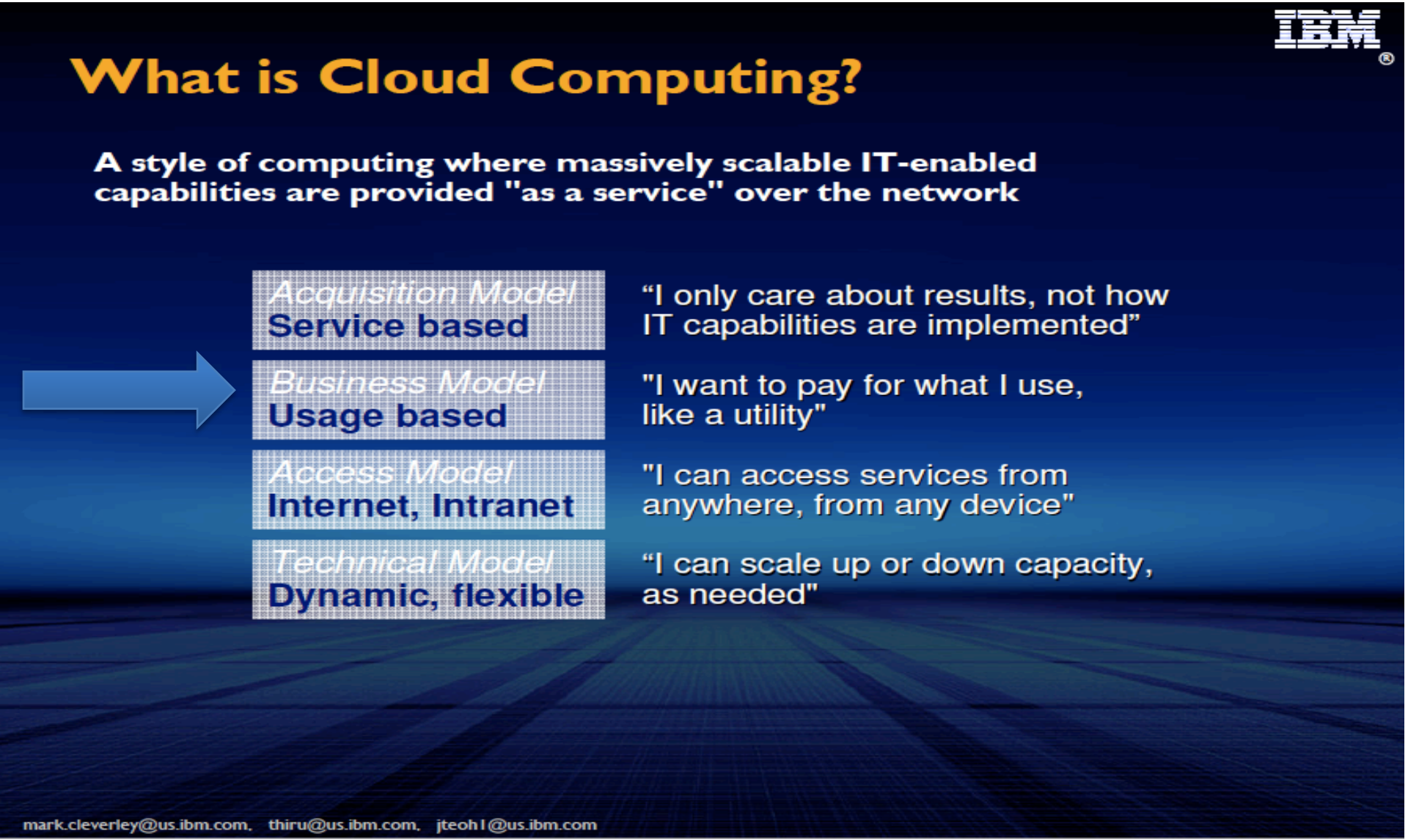


Expand your Infrastructure!
Buy new servers, increase your software costs, provision more datacenter capacity!!

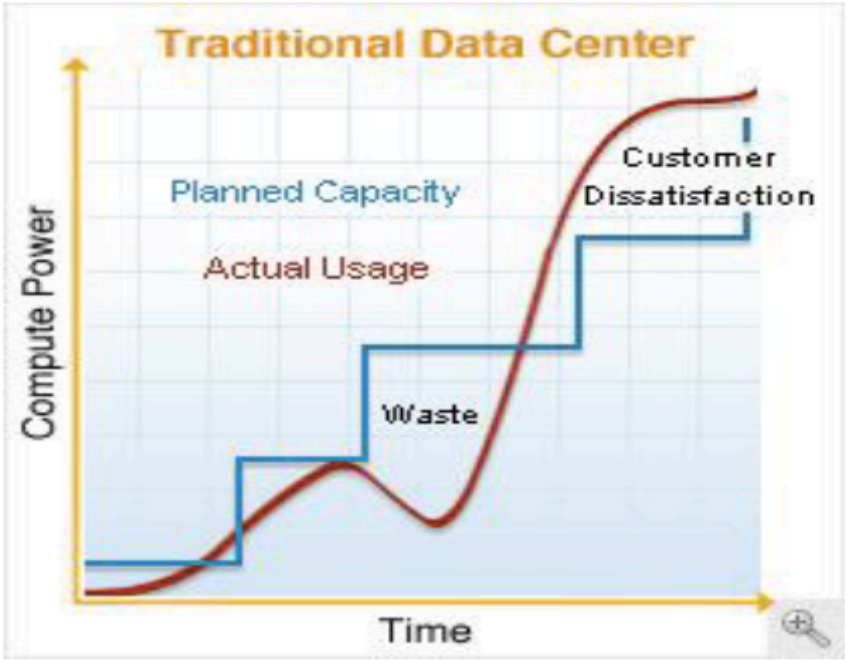
Look to the cloud!
Pay for the bandwidth and server resources that you need. When your push is done then turn the whole thing off!

- **The Three Reasons to Cloud Compute :**
  http://www.youtube.com/watch?annotation_id=annotation_308603&feature=iv&src_vid=SgujaIzkwrE&v=OIbkMjrrdjQ

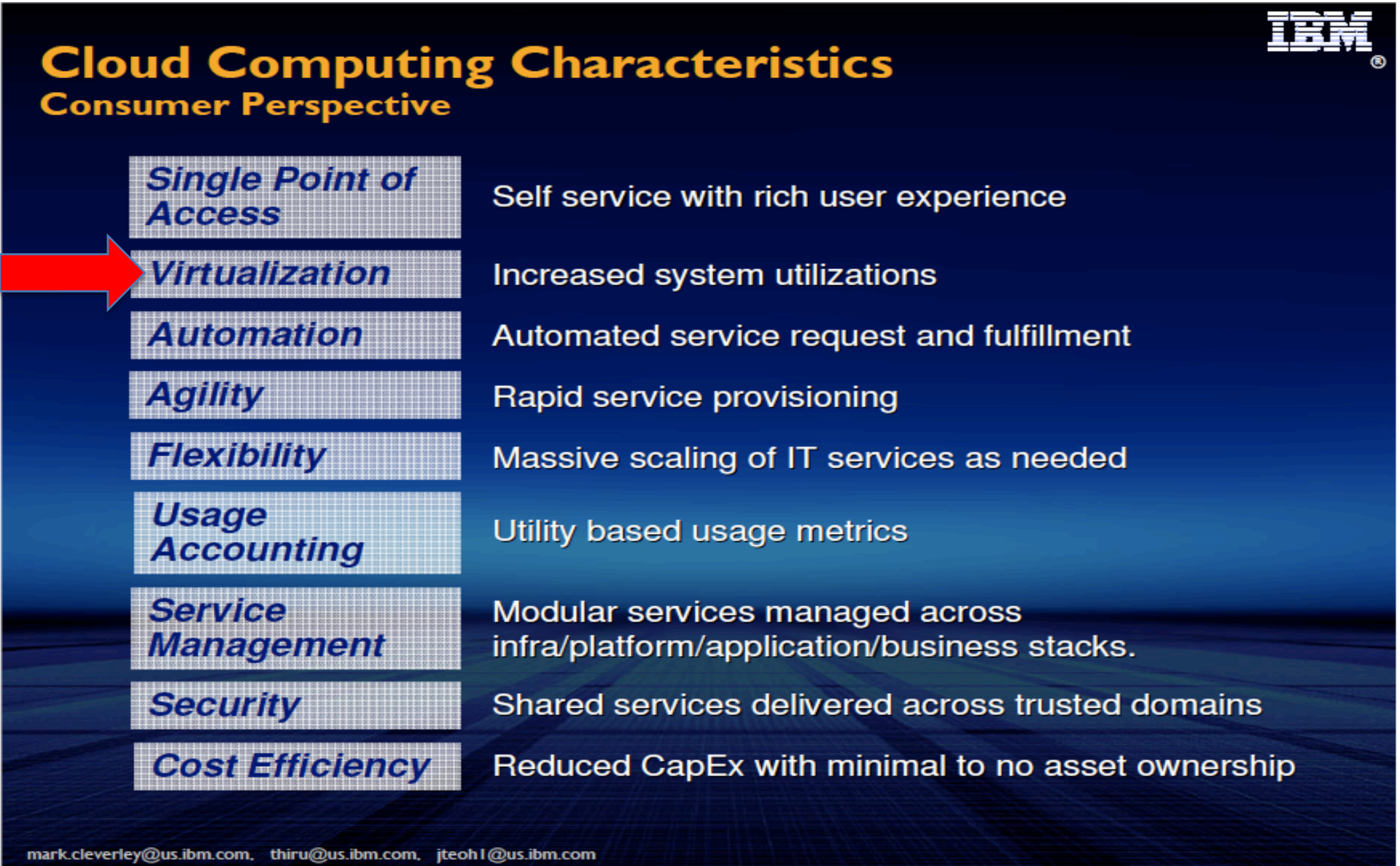
Style of computing & usage model



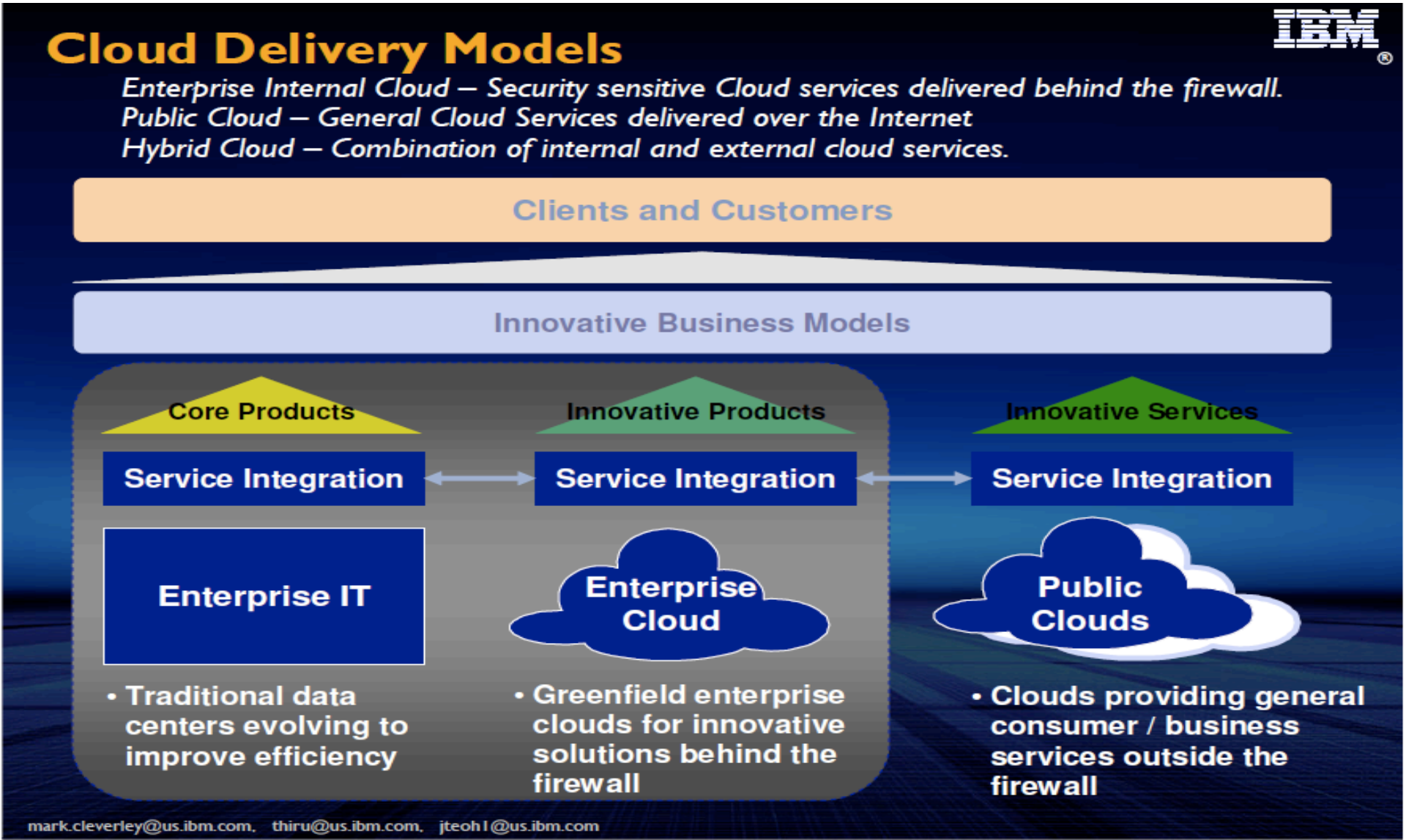
Elastic approach to resource provisioning



Utility based usage metric



Delivery Models



outline

- Cloud computing: Approach and vision
- Resource Provisioning in Cloud systems:
- Cloud Systems: IaaS, PaaS, SaaS
- Using Cloud Systems in practice

A new consumption Model for IT

Self Service

Instantly Provisioned

Pay For Use

Efficient

Scale Up & Down

Enabling Cloud

Software

Monolithic Applications

Distributed Services

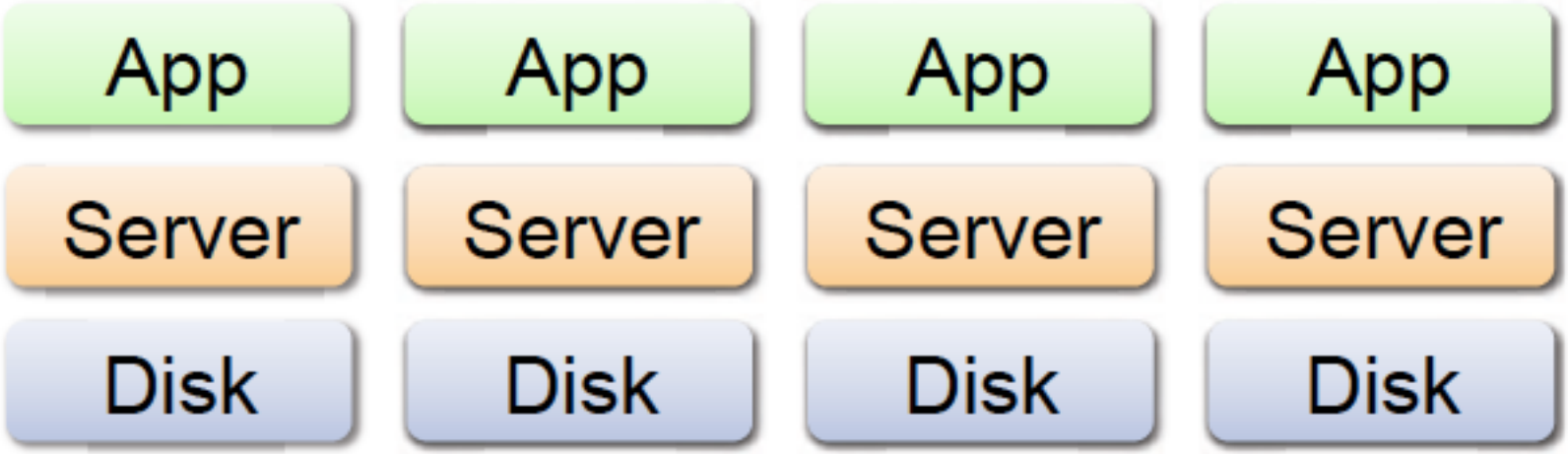
Platform

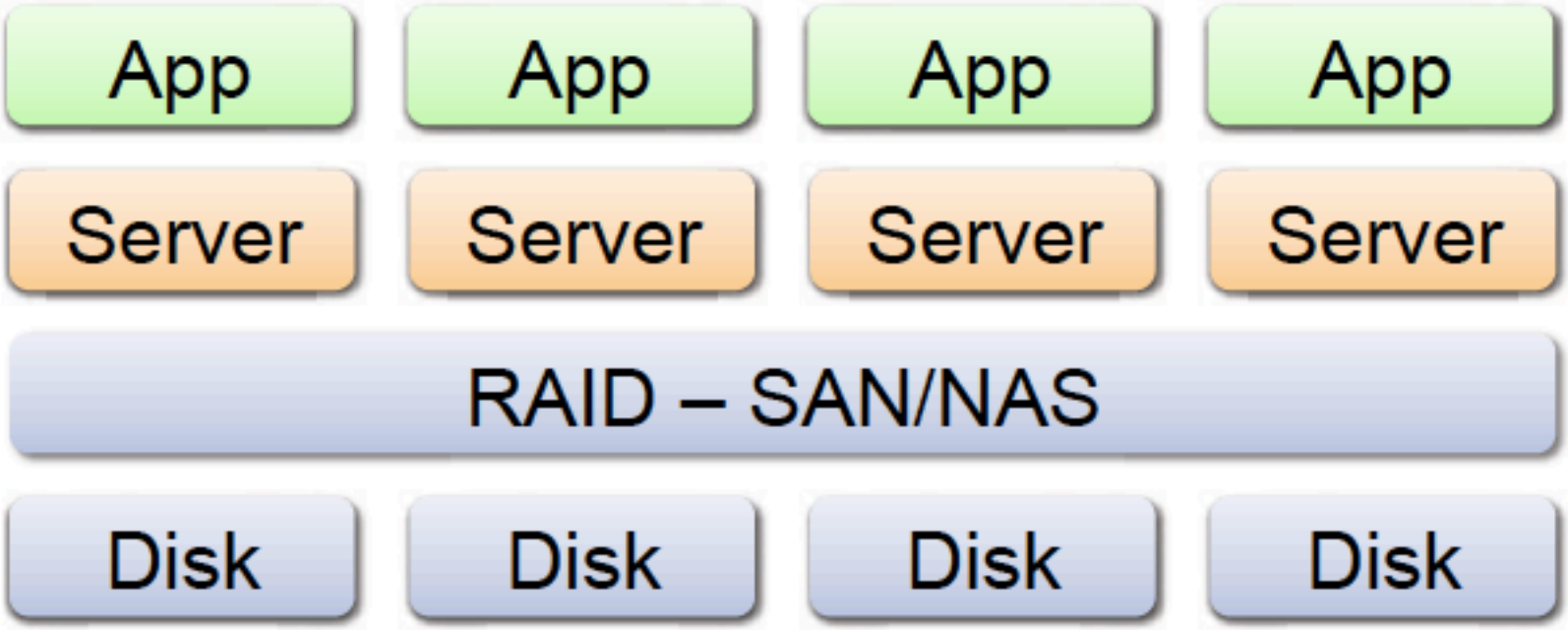
Loosely Connected, Discrete Resources

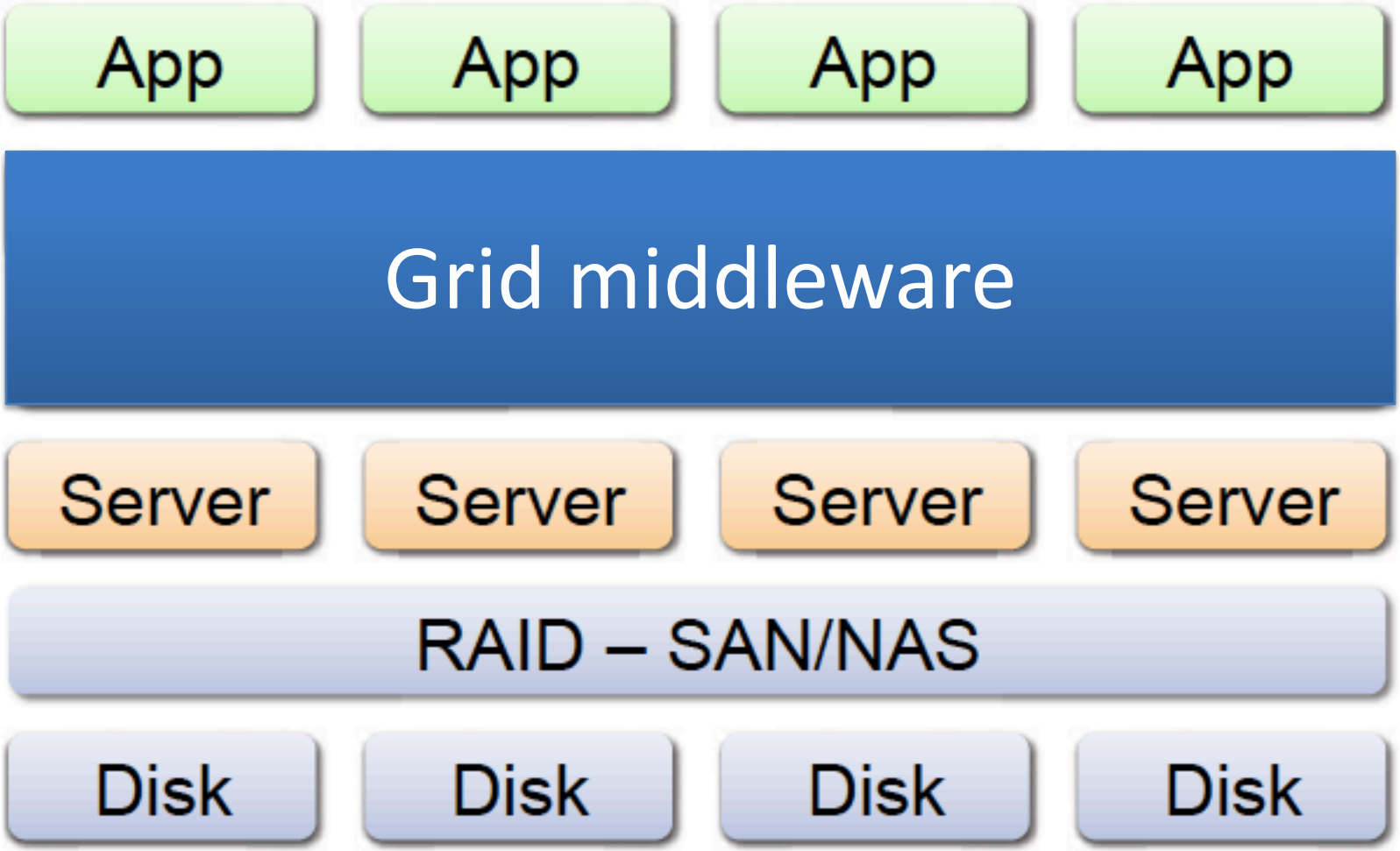
Virtualized Fabric Of Resources

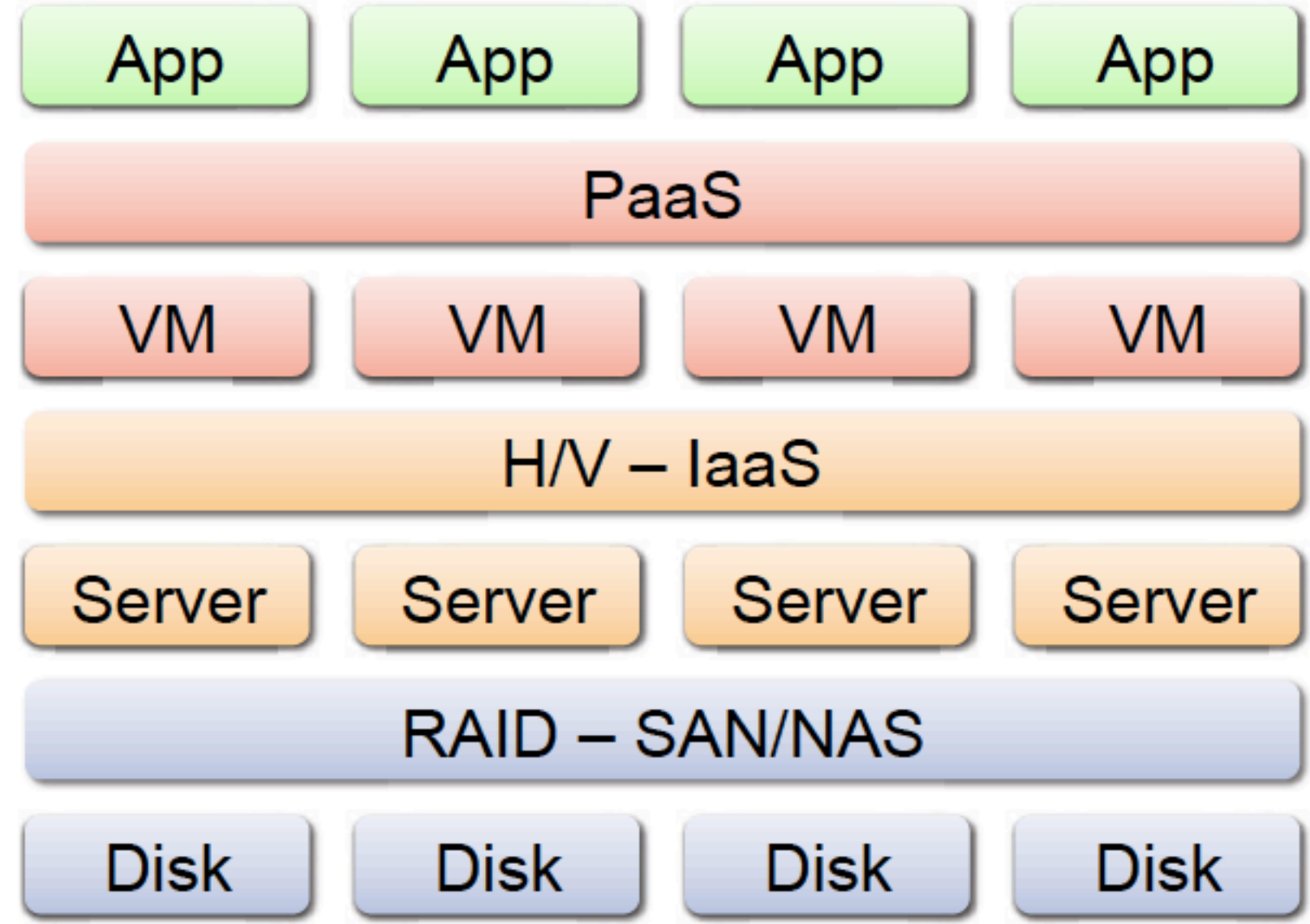
Abstract, Pool, automate

Abstract, Pool, automate

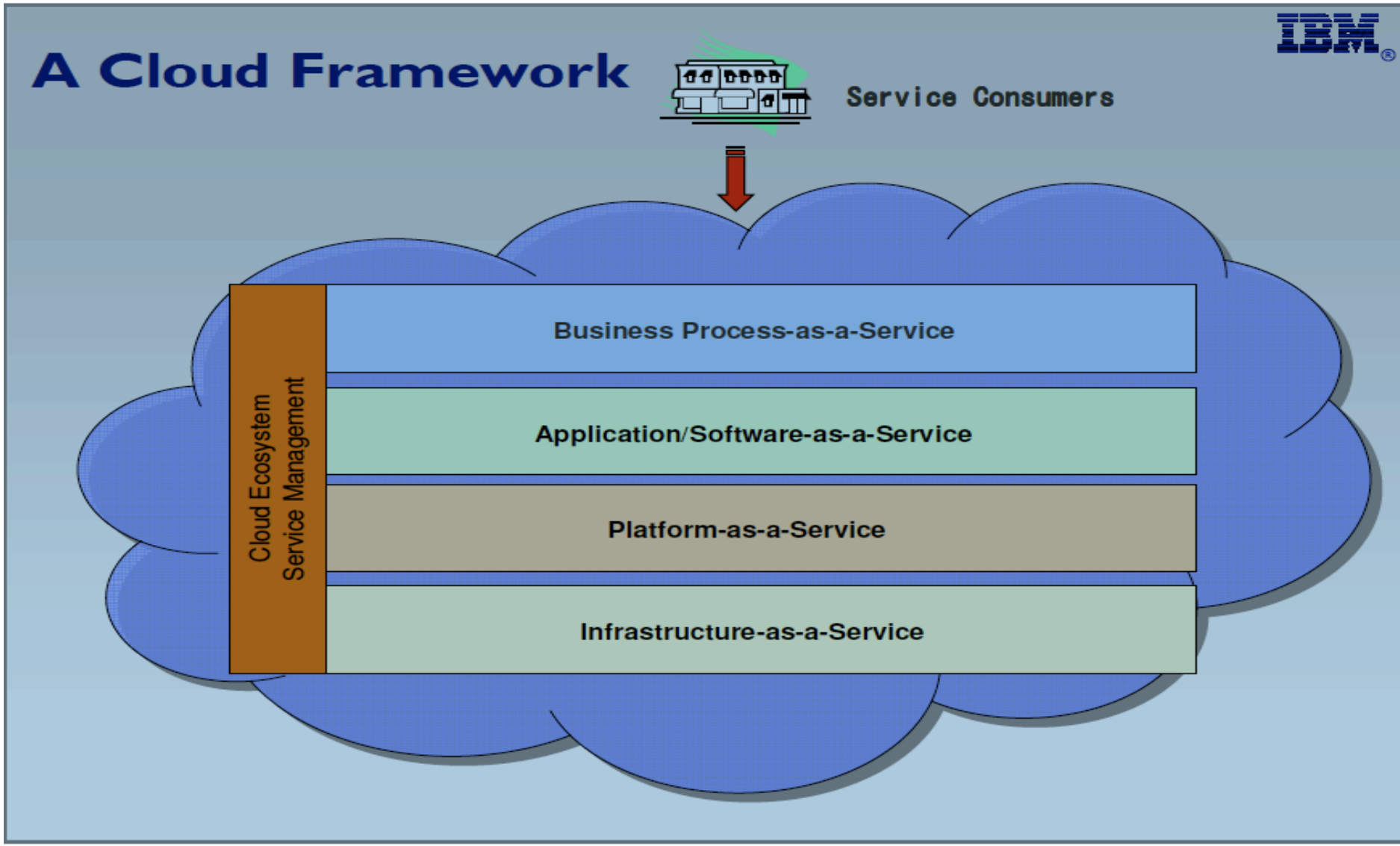



App
App
App
App
Server
Server
Server
Server
RAID – SAN/NAS
Disk
Disk
Disk
Disk

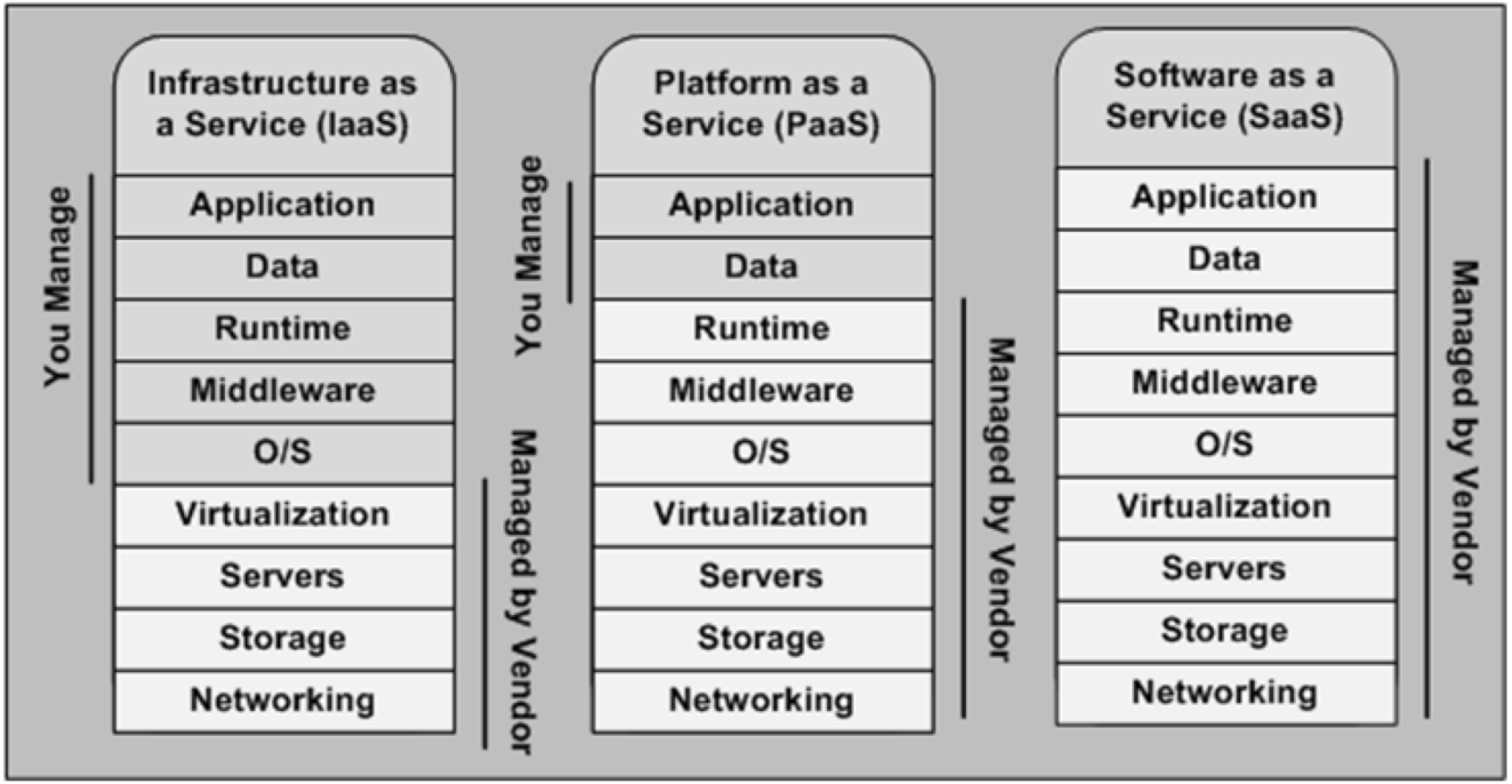

App
App
App
App
Grid middleware
Server
Server
Server
Server
RAID – SAN/NAS
Disk
Disk
Disk
Disk


App
App
App
App
PaaS
VM
VM
VM
VM
H/V – IaaS
Server
Server
Server
Server
RAID – SAN/NAS
Disk
Disk
Disk
Disk

Everything-as-a-Service



Relation between IaaS, PaaS, SaaS



outline

- Cloud computing: Approach and vision
- Resource Provisioning in Cloud systems:
- Cloud Systems: IaaS, PaaS, SaaS
- Using Cloud Systems in practice
- Cloud system providers
- Open source Cloud middleware

Example of the elasticity and scalability (IaaS)

- To test the possibilities and performance of Grid on Demand a Biomedical Application and a workflow manager are used

- Biomedical Application: WAVE
  - Parallel (MonteCarlo simulation) application

- Workflow Manager
  - A (graphical) tool to assist complex e-Science application creation
  - Creates a series of jobsubmissions
  - WS-VLAM created by UvA SNE Group
  - Connects to Globus Grid Interface

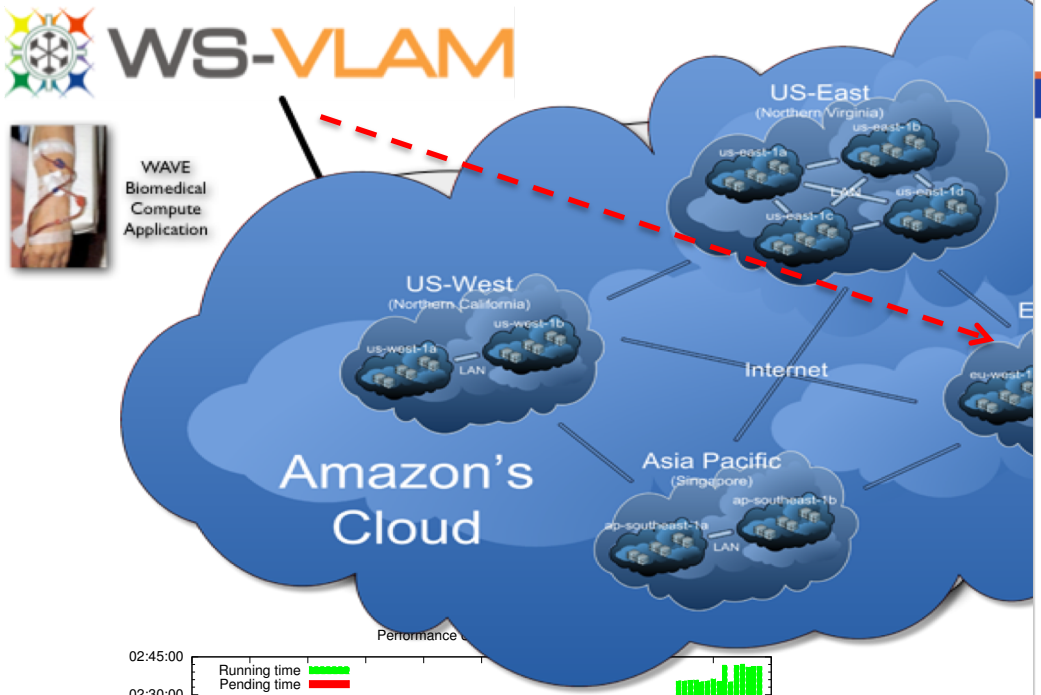
Example of the elasticity and scalability (IaaS)

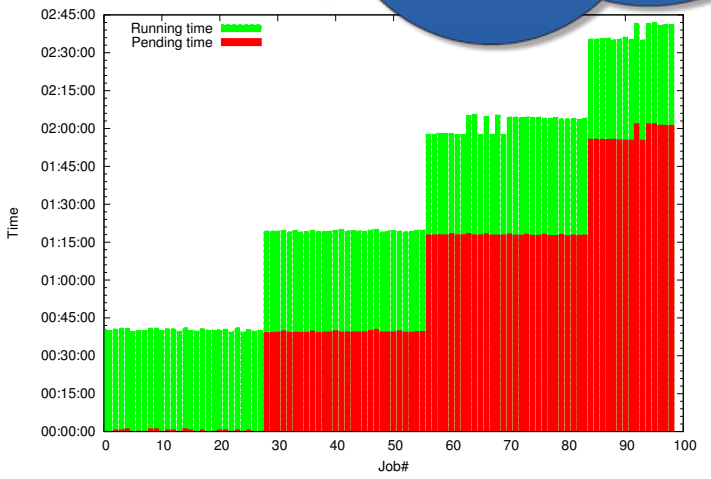
demand compared to a 32 node physical UvA cluster (DAS3)
Globus Grid interface

Resource provisioning	Jobs	Total execution time
DAS3	28	00:42:58
Grid on Demand		00:46:22
DAS3	98	02:46:36
Grid on Demand		00:52:26

Example of the elasticity and scalability

Example of successful LMS project





isgtw international science grid this week

Advanced Searc

ABOUT | CALENDAR | ARCHIVE | LEARN | COMMUNITY |

Home

Building a grid-enabled cluster in the Amazon cloud

Like 11 Share

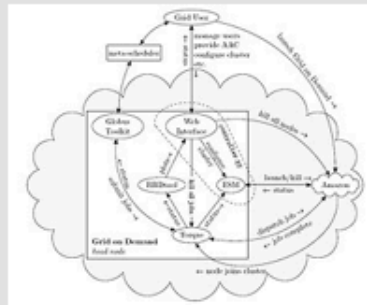
FEATURE | JANUARY 12, 2011

Can grid computing be offered as a cloud service?

Willem Toorop and Alain van Hoof of the University of Amsterdam sought to find out for a research project called "Grid on Demand." (Click here for the full 60-page report.)

The project sought to combine the distributed resource model of grid computing with cloud computing's ability to quickly (but temporarily) cope with sudden demands for massive amounts of computing power, or what is known as "urgent computing."

An "on-demand grid" could provide this ability, thus helping to support current or newly developed e-Science applications.



Components responsible for the operation of the cluster. The web interface is provided by a python script (controller.py) which also provides the Elastic Site Manager (ESM) that monitors Torque's Job-queue and launches and kills compute nodes as needed. All images courtesy Willem Toorop and Alain van Hoof.

To test this prospect, the team created an Amazon Machine Image (AMI) to operate as a grid-on-demand and made it publicly available in most regions as a community AMI for 32-bit, 64-bit and cluster instance types. Due to issues with upper and lowercase hostnames the image can not yet run in the eastern region of the US, and therefore the cluster instance type is not supported either. Otherwise, the AMI runs off-the-shelf and does not need external support services.

The AMI contains Ubuntu (Lucid) Linux with Torque Resource Manager 2.6.8 (Torque) as cluster software and Globus Toolkit 4.2.1 (GT) for grid participation. An initial instance operates as the cluster's head node and first compute node. A new Certificate Authority (CA) is created with which an initial host and grid-user certificate are generated. A just-launched instance can immediately be used as a grid resource.

Further configuration of the instance is offered through a web interface, to — among other things — authorize additional Grid EECs to use the resource.

Time

Job#

outline

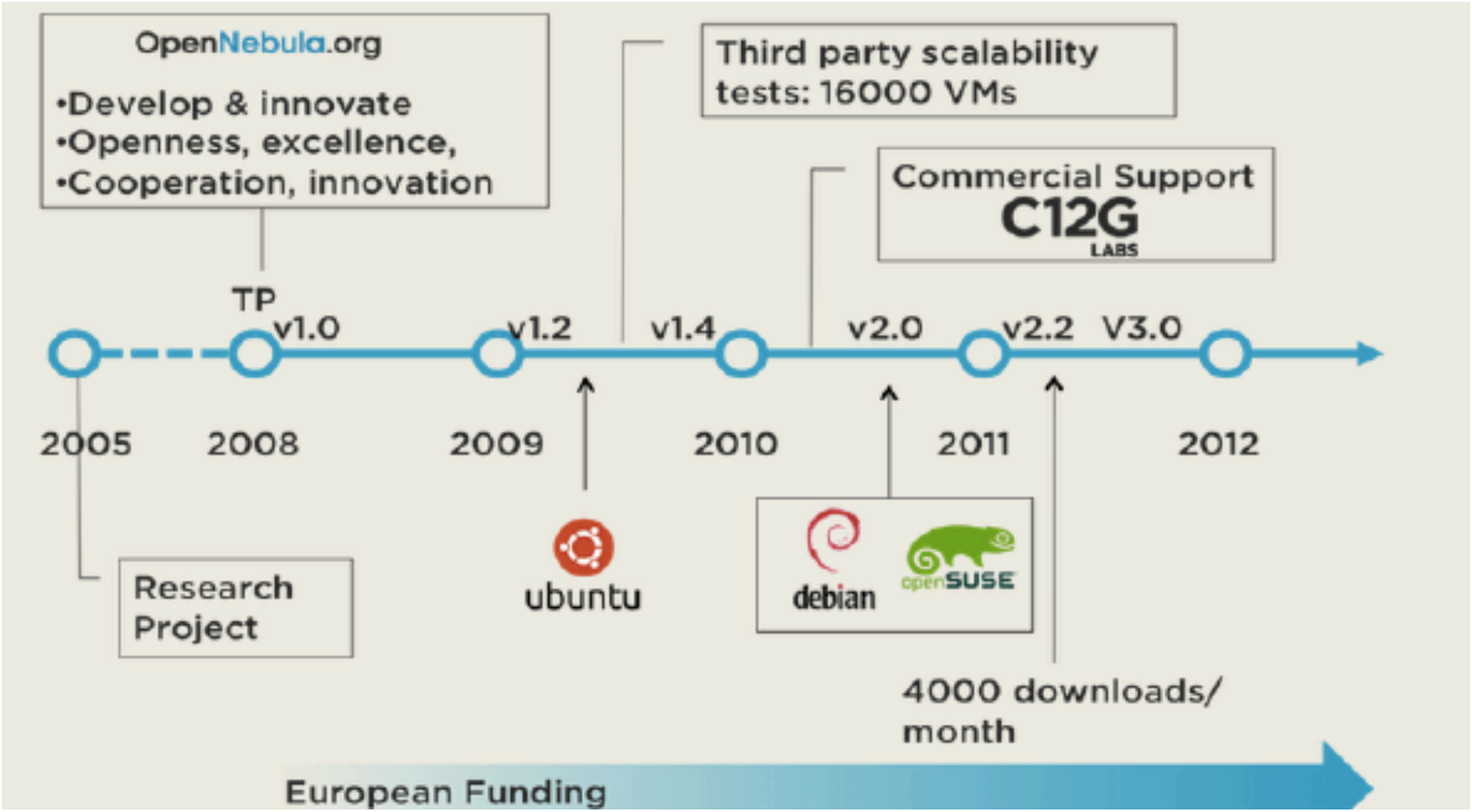
- Cloud computing: Approach and vision
- Resource Provisioning in Cloud systems:
- Cloud Systems: IaaS, PaaS, SaaS
- Using Cloud Systems in practice
- Cloud system providers
- Open source Cloud middleware


Cloud Marketplace
AppDirect
APPIRIO
INGRAM MICRO
Partner Smart
myGravitant
...
Cloud Broker Platform
cloudMatrix™
jamcracker
...
Cloud Management
apptio
cloudability
CLOUDSWITCH
Cloudyn
Gravitant
The Power to Transform
TECH
RIGHTSCALE
...
SaaS, PaaS, and IaaS
Google Apps
NETSUITE
Salesforce
Taleo
...
Azure
force.com
platform as a service
Google App Engine
heroku
...
amazon web services
GOGRID
Joyent
rackspace
SAVVIS
terremark
...
Cloud Platform
cloudstack
open source cloud computing
cloud.com
ElasticStack
Powering your own-brand cloud
enomaly
elastic computing
Eucalyptus
flexiant
utility computing on demand
onapp
openstack
vmware
vCLOUD
...
Virtualization Software/Mgmt
Parallels
VirtualIron
Virtuozzo
vmware
Xen
CITRIX
XenServer
Hyper-V
KVM
vSphere
...
Hardware
IBM
BladeCenter®
DELL
PowerEdge
Blade Servers
ORACLE
Sun Blade
hp
BladeSystem
...

outline

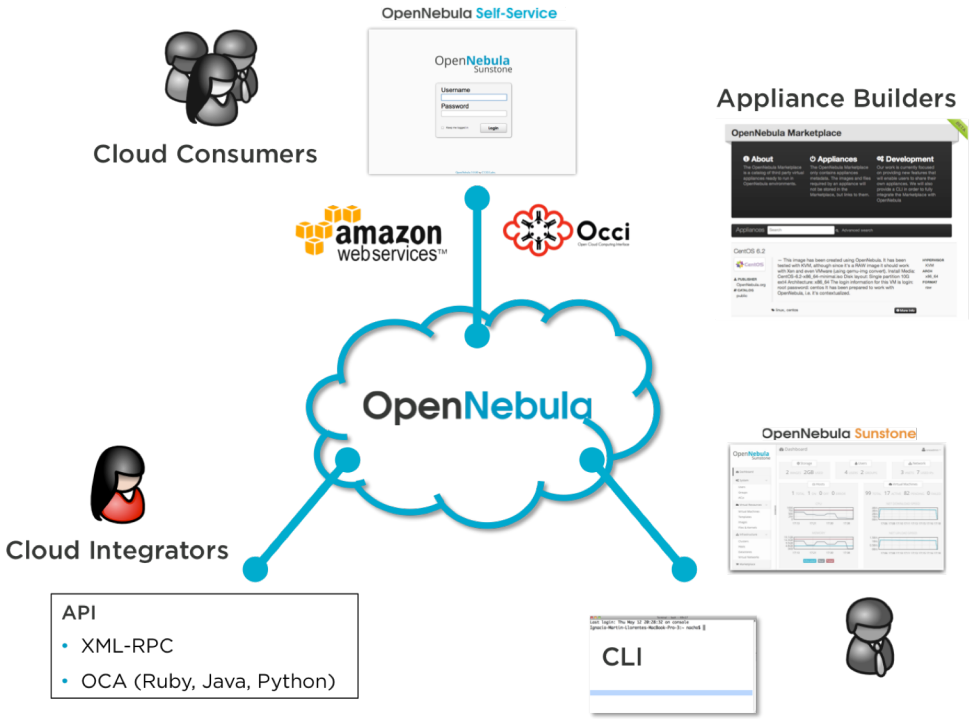
- Cloud computing: Approach and vision
- Resource Provisioning in Cloud systems:
- Cloud Systems: IaaS, PaaS, SaaS
- Using Cloud Systems in practice
- Cloud system providers
- Open source Cloud middleware

OpenNebula


OpenNebula.org
•Develop & innovate
•Openness, excellence,
•Cooperation, innovation
Third party scalability tests: 16000 VMs
Commercial Support
C12G
LABS
TP
v1.0
v1.2
v1.4
v2.0
v2.2
V3.0
2005
2008
2009
2010
2011
2012
Research Project
ubuntu
debian
openSUSE
4000 downloads/ month
European Funding

OpenNebula

- OpenNebula provides different interfaces to interact and manage physical and virtual resources.



OpenStack

- The OpenStack Open Source Cloud Mission:

  "to produce the **ubiquitous** Open Source Cloud Computing platform that will meet the needs of **public** and **private** clouds regardless of size, by being simple to implement and massively scalable. "

- **Originated by Rackspace and NASA In 2010**

openstack™
CLOUD SOFTWARE