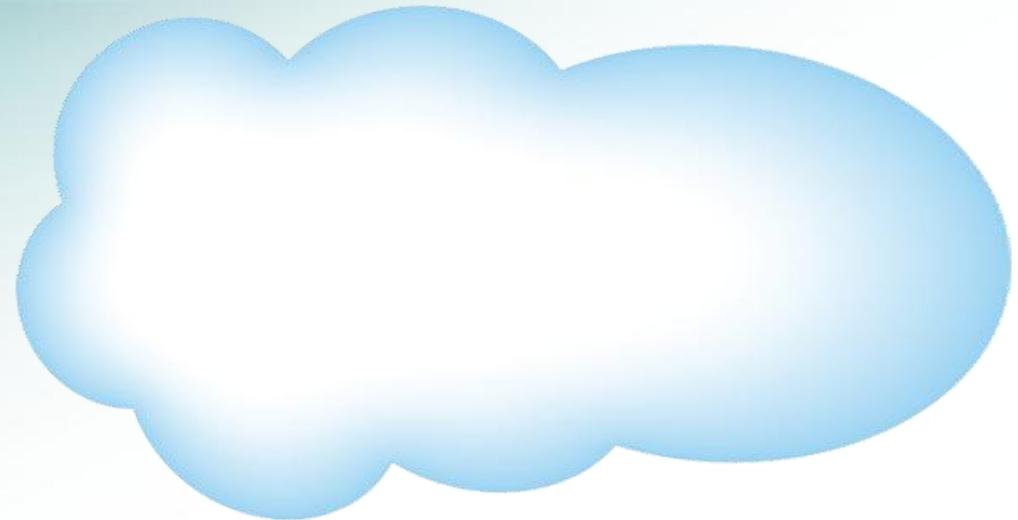


Introduction to Cloud computing

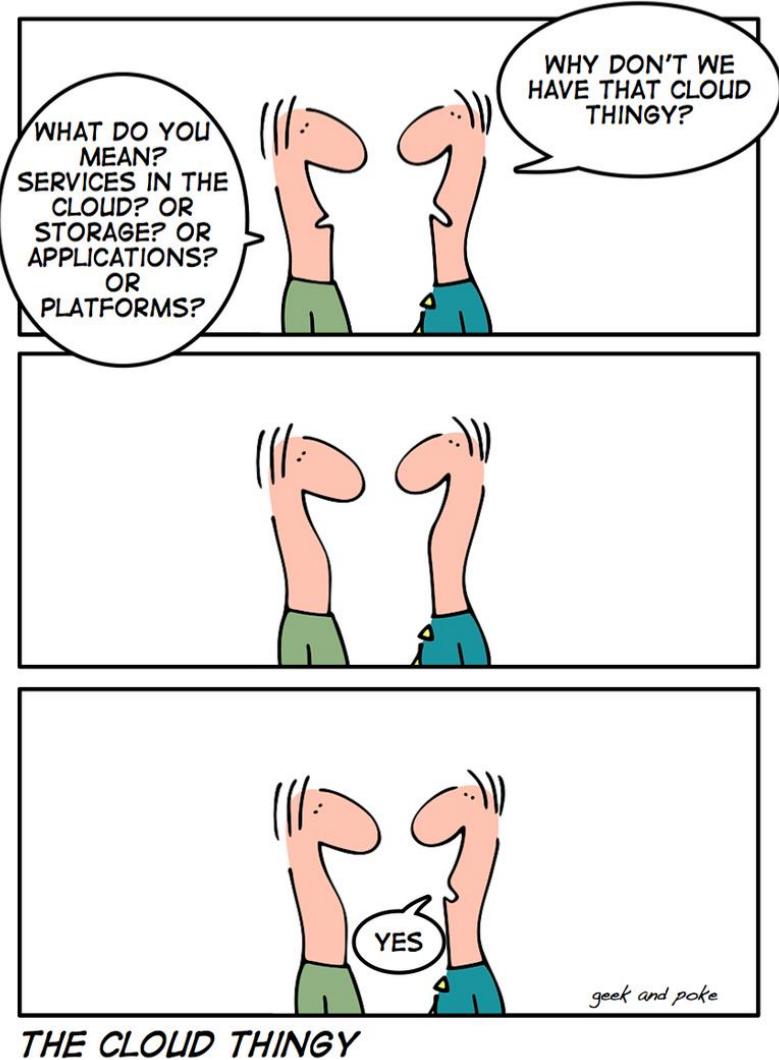


Agenda

- Incentives
- Definition
 - Cloud
 - XAAS
- Evolution & Market Drivers
- Service types in details
- Pros & Cons
- Vendors positioning
- Israeli examples

Incentives

Everybody is “Doing it”



Incentives

Technologies You Can't Afford to Ignore

Top 10 Strategic Technology Areas for 2009

1. Virtualization
2. Business Intelligence
3. Cloud Computing
4. Green IT
5. Unified Communications
6. Social Software and Social Networking
7. Web-Oriented Architecture ..
8. Enterprise Mashups
9. Specialized Systems
10. Servers — Beyond Blades

Top 10 Strategic Technology Areas for 2010

1. Cloud Computing
2. Advanced Analytics
3. Client Computing
4. IT for Green
5. Reshaping the Data Center
6. Social Computing
7. Security — Activity Monitoring
8. Flash Memory
9. Virtualization for Availability
10. Mobile Applications

■ Modified for 2010

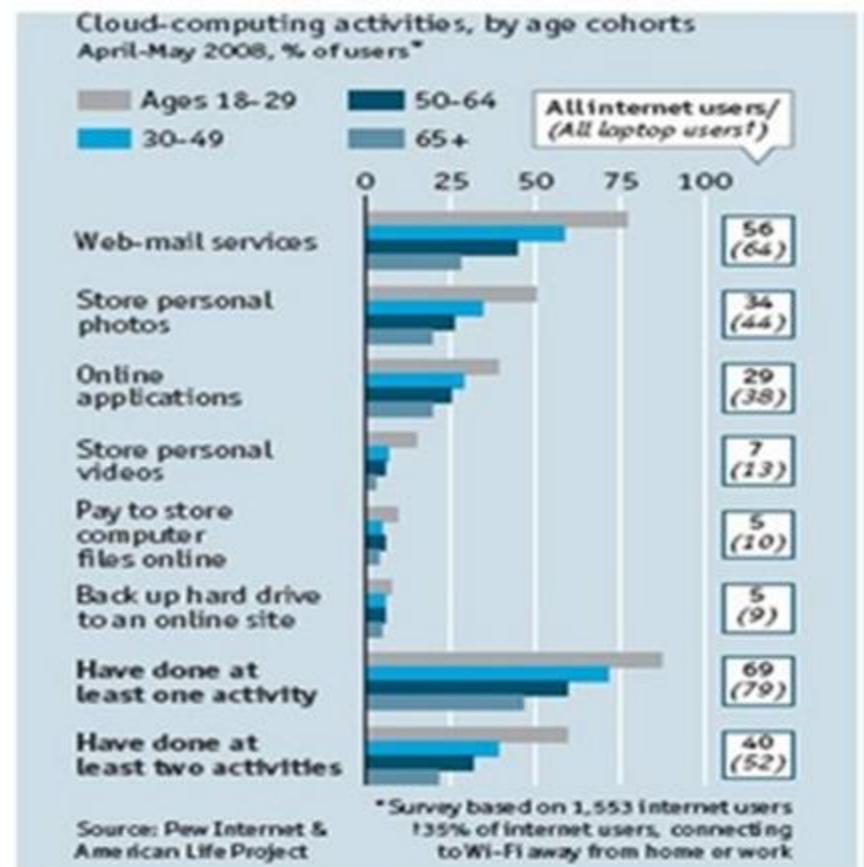
■ New for 2010

■ Dropped for 2010

Gartner.

Cloud Computing Usage

- 69% of Americans use some kind of “cloud service” The Economist



Cloud Computing Growth

	Currently using or implementing	Plan to use in 1 to 5 years	On the radar/researching	No plans
Collaboration tools	50%	15%	18%	18%
Enterprise applications (e.g. CRM, ERP, BI)	35%	12%	19%	34%
Application platforms/development software	34%	9%	27%	31%
Utilities (e.g. antivirus spam filters, desktop management)	33%	14%	21%	32%
Servers	32%	11%	18%	39%
Storage	31%	16%	22%	30%
Networks	27%	12%	17%	45%
Personal productivity software	23%	13%	22%	43%

Source: CIO Magazine, 173 responses, November 2008

Cloud Computing Success Stories

- **GE**

- Global procurement hosting 500k suppliers and 100k users in six languages on SaaS platform to manage \$55B/yr in spend

- **Washington DC**

- Google Apps used by 38k employees reducing costs to 50/user per year for email, calendaring, documents, spreadsheets, wikis, and instant messaging

- **Eli Lilly**

- Using Amazon Web Services can deploy a new server in 3min vs 50days and a 64-node Linux cluster in 5min vs 100days

- **NASDAQ**

- Using Amazon Storage to store 30-80GB/day of trading activity

Cloud Computing Success Stories

ON THE CLOUDS

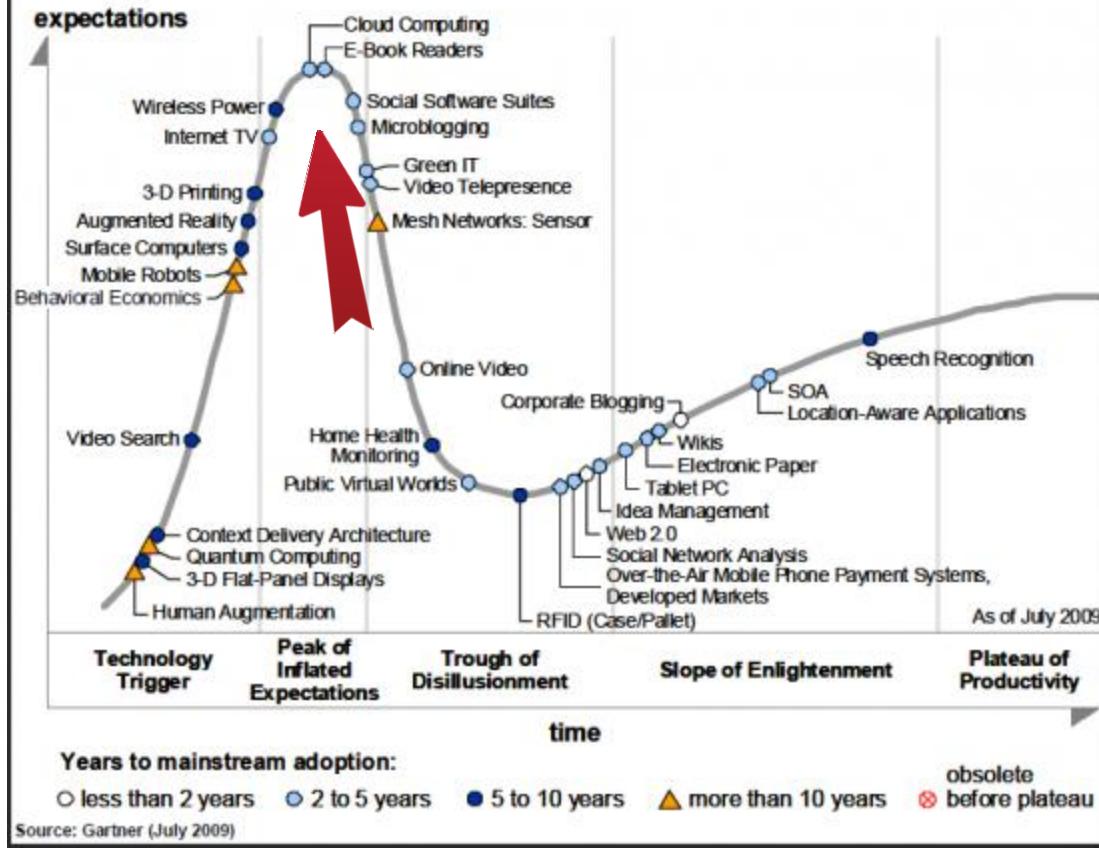
Small and medium businesses are major implementers, though banks are also getting into cloud computing in a small way

COMPANY	BUSINESS	APPLICATIONS ON CLOUDS	BENEFITS
ACE Data	Business & support mgmt.	ERP, CRM, HR, sales, project, cash	Has saved upfront and maintenance expense worth in lakhs
Axis Bank	Banking & financial serv.	Non-core storage infrastructure	Will save on infrastructure cost
Elbee Express	Courier & delivery	CRM, HR, mailing and delivery	Increased mobility, reduced cost
ING Vysya	Banking & financial serv.	CRM and lead management	Management cost reduced by 90%
ISFC	Non-banking financial serv.	Marketing/Relationship mgmt.	Increased flexibility reducing operational expense
Latent View	Data analysing	CRM and advertising	Reduction in capex by 10% to 20%
LifeSpring Hospitals	Healthcare	Customer data	Helps in monitoring patients' records
Vembu Technologies	Software products	Storage and softwares	No server costs

Source: Companies

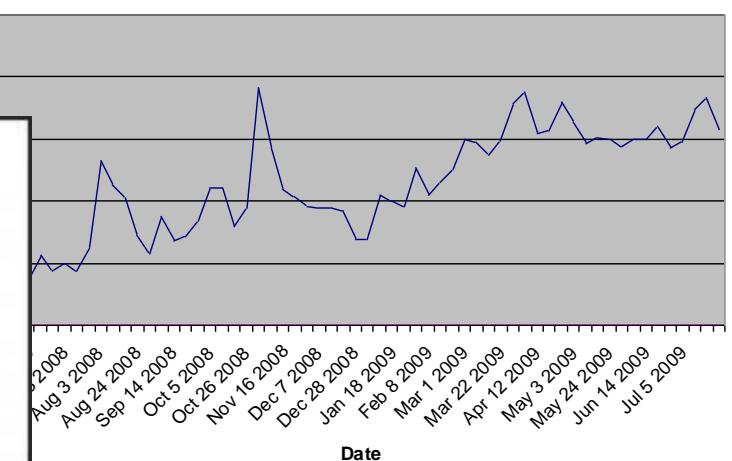
Is it just Hype?

Gartner Hype Cycle 2008



Source: Gartner (July 2008)

Worldwide "Cloud Computing" Google Queries



Source: Google Trends (July 2008)

Failure stories



The Panacea for Most IT Ills

Cloud Computing: Are We There Yet?

Salesforce.com Outage
Inconveniences Customers

CLOUD COMPUTING DEFINITION

DEFINING AN ELUSIVE TERM



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Ideas about cloud services

- Interactive Session
 - Write Ideas on board

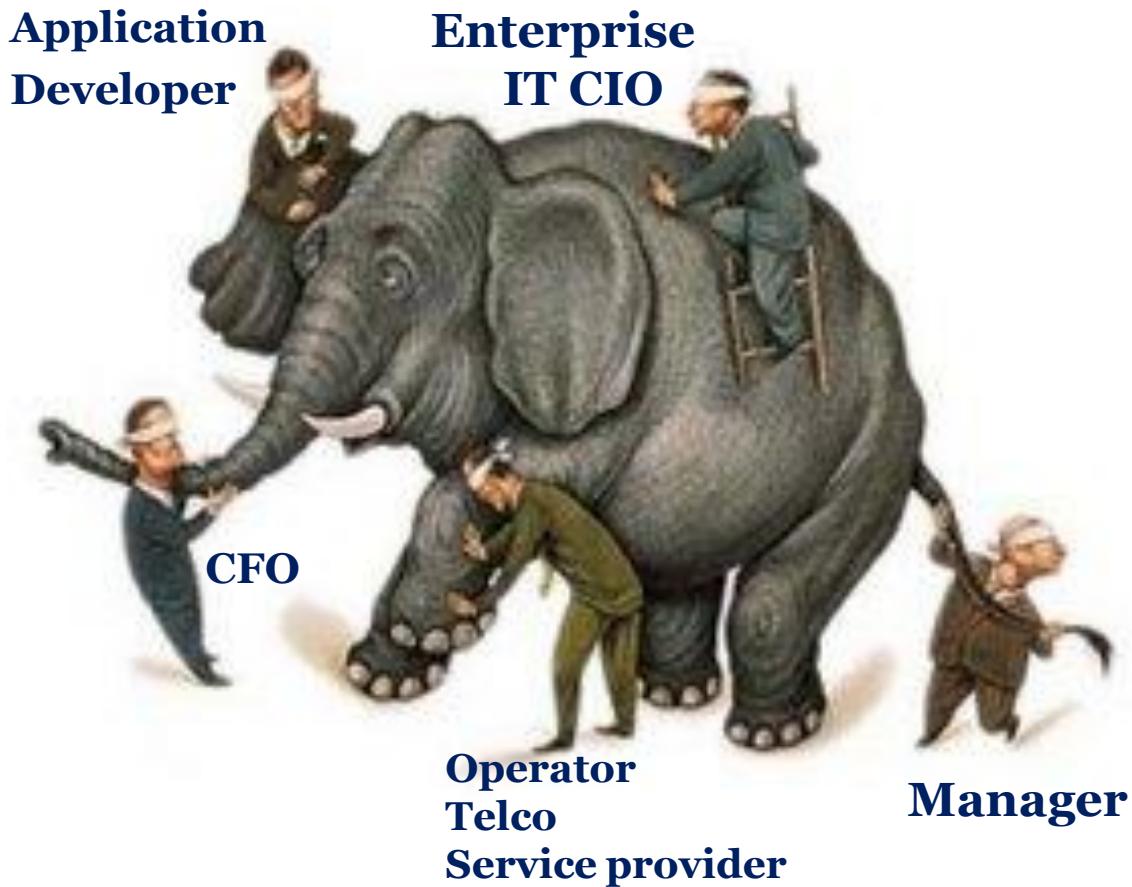
The word cloud illustrates the following concepts:

- Cloud computing
- Architecture
- Security
- Scalability
- Identity
- Data
- Management
- Virtualization
- Service-oriented
- Stewardship
- Reliability
- Authentication
- XML
- Utilities
- Syndication
- Infrastructure-as-a-service
- Software-plus-services
- Quality-of-service
- Compliance
- Sustainability
- Storage ownership
- Transactions
- Distributed
- Parallel
- Performance
- Interoperability
- Throughput
- Accountability
- Subscription
- Utility
- Business
- Open-source
- Grid
- Authorization
- Governance
- Virtualization
- SLA
- Management
- Software-as-a-service
- Multi-tenancy
- Loosely-coupled
- Integration
- Policies
- Privacy
- Applications

Myth & Facts

- Myths
 - Cloud computing will eliminate the need for IT personnel.
 - Cloud computing will eliminate IT expense
- Facts
 - Cloud technology is real
 - This technology should not be ignored
 - This presentation will assist you in understanding “The Cloud”

Cloud Computing Definition



Cloud Computing viewpoints

Executive

“A buyer centric view of technology where applications are available, through purchase, rental or even development, wherever and whenever.”

CFO

“An approach to consume technology in a pay-as-you-go model where consumers only pay for what they use.”

CIO

“A comprehensive virtualization model for technology from infrastructure through application delivery .”

Cloud Computing is all of these things!



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Cloud Services Features - Discussion

- Consumed over Internet/Cloud
- Anywhere - location Independent (?)
- Any Device - device Independent (?)
- provided by 3rd party (?)
- Shared infrastructure (multi-tenancy)
- **Little or no capital expenditure** as infrastructure is owned by the provider.
- **Massive scalability** is also common, though this is not an absolute requirement and many of the offerings have yet to achieve large scale.

5 Key Cloud Characteristics

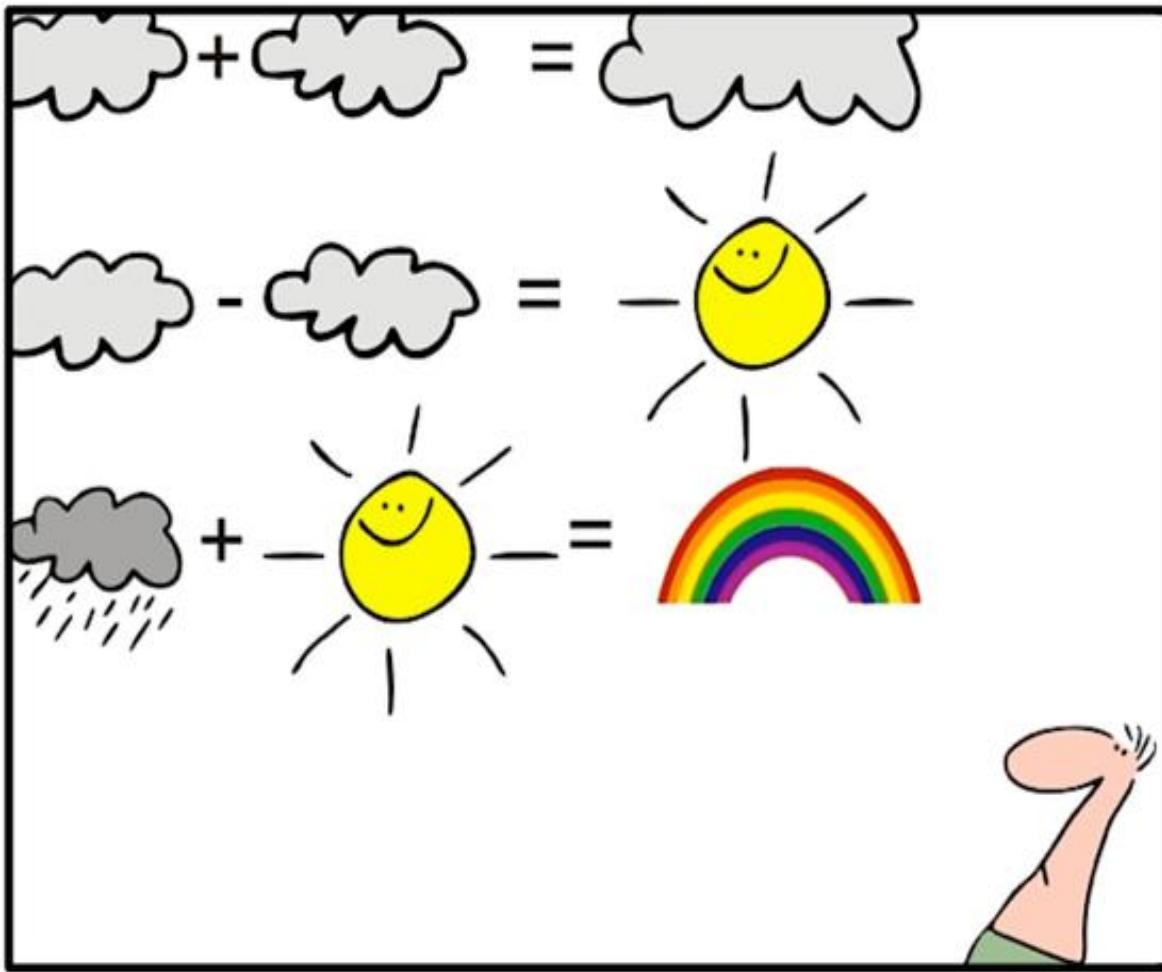
- On-demand self-service
- Ubiquitous network access
- Location independent resource pooling
- Rapid elasticity
- Pay per use

Source: NIST <http://csrc.nist.gov/groups/SNS/cloud-computing/index.html>

What Cloud Computing “IS NOT”?

- It is not Network Computing
 - Application and Data are not confined to any specific Company's Server
 - No VPN Access
 - Encompasses multiple companies, multiple servers and multiple networks
- It is not Traditional Outsourcing
 - Not a contract to host data by 3rd party Hosting Business
 - No subcontracting for computing services for specific outside firm

Cloud Definition



<http://geekandpoke.typepad.com/>

Definition

- Cloud computing is
- **Cloud computing** describes a new supplement, consumption and delivery model for **IT services** based on Internet, and it typically involves the provision of dynamically scalable and often virtualized resources as a service over the Internet

Alternative Definition

"Cloud computing is a buzzword..."

"The concept, quite simply, is that vast computing resources will reside somewhere out there in the ether (rather than in your computer room) and we'll connect to them and use them as needed."

- - Jonathan Weber (*The Times Online*)

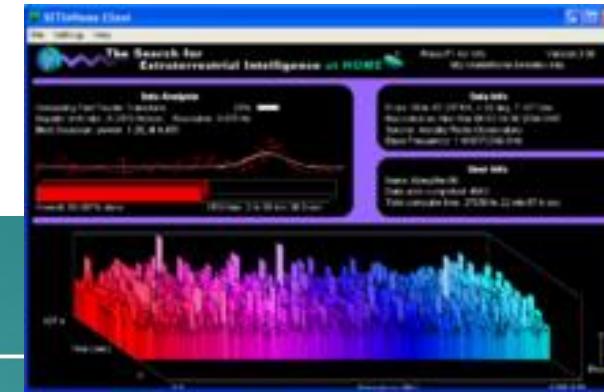
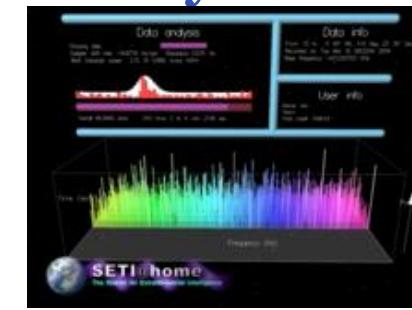
HISTORY & MARKET DRIVERS

- EVOLUTION MODELS
 - GRID
 - WEB 2.0
 - ISP
- TECHNOLOGY DRIVERS
- ECONOMIC DRIVERS

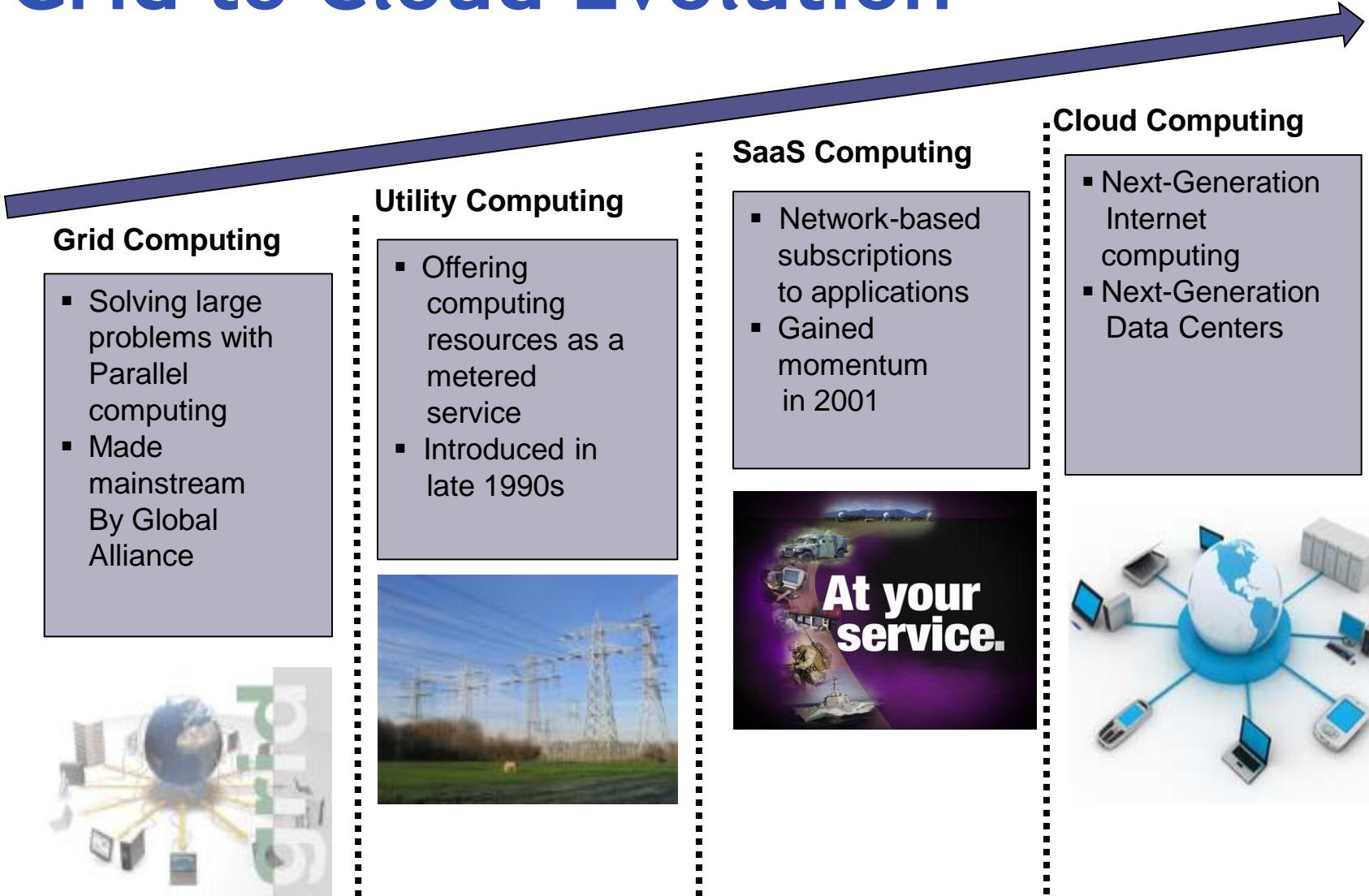
CPU Sharing example



- SETI – **Search for Extra-Terrestrial Intelligence**
- Initiative by Space Science Institute & Berkeley university
- Uses screen-saver CPU time for
 - analyze radio signals from space
 - present results as a very cool (geek oriented) screen-saver
- One of the first wide-spread examples of **distributing processing tasks** over the internet to simple users PCs



Grid to Cloud Evolution



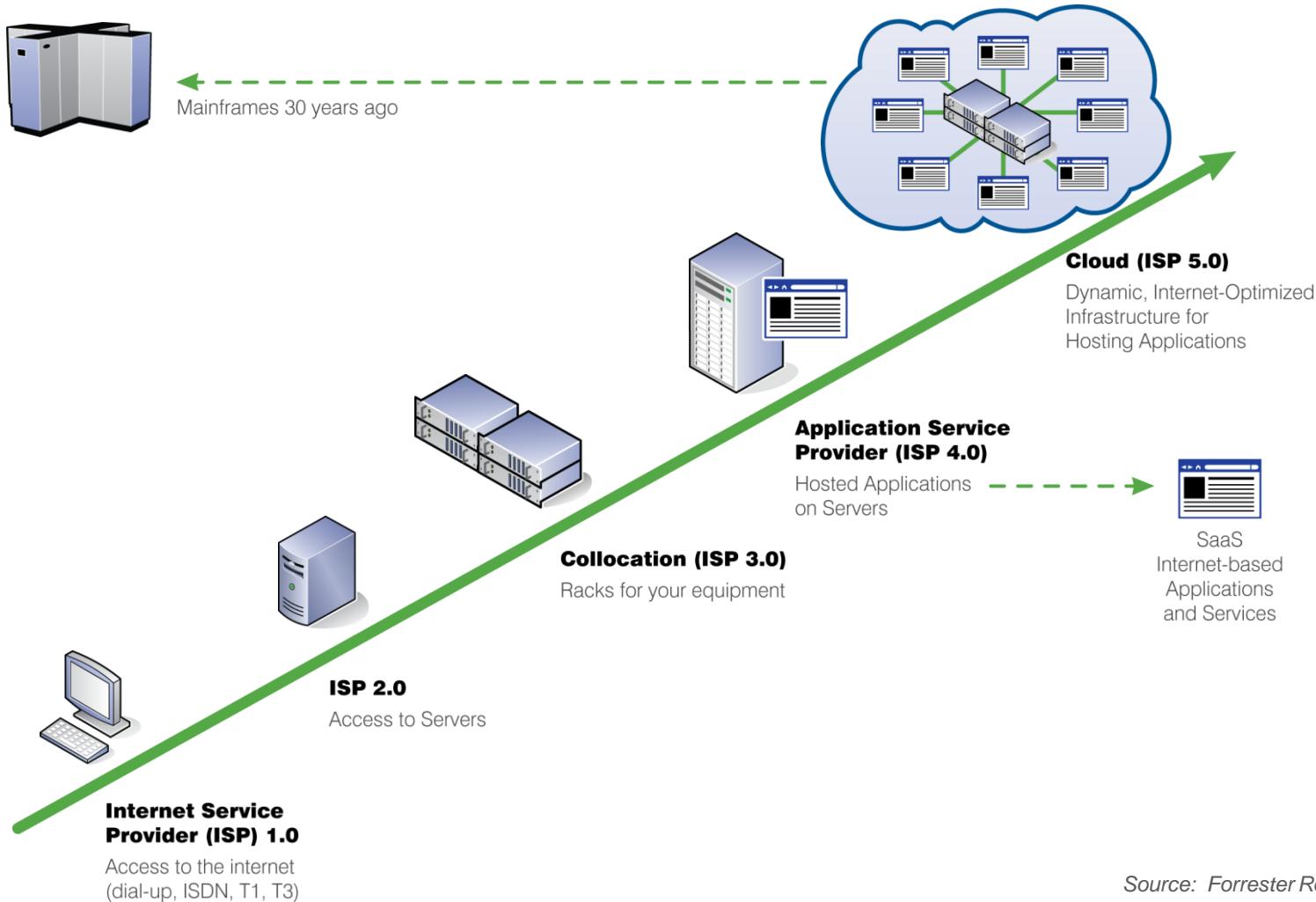
Grid vs. Cloud

	Grid	Cloud
Underlying concept	Utility Computing	Utility Computing
Main benefit	Solve computationally complex problems	Provide a scalable standard environment for network-centric application development, testing and deployment
Resource distribution / allocation	Negotiate and manage resource sharing; schedulers	Simple user <-> provider model; pay-per-use
Domains	Multiple domains	Single domain
Character / history	Non-commercial, publicly funded	Commercial

Web 2.0 & Clouds

- Web 2.0 concentrate on the private user and clouds are descendants of data centers which service the Enterprise.
- However Web 2.0 promoted SaaS which is part of the cloud
- Web 2.0 companies needed massive scaling technologies which promoted cloud (Amazon)
- User centric Web2.0 companies (Twitter, SlideShare) are relying on Cloud Service

ISP to Cloud Evolution



Source: Forrester Research, Inc.

Time-to-Market

- Time-to-Market forces developers to use 3rd party components and platforms
- Time-to-Market forces market standardization and interoperability while creating Ad-Hoc standards by leading vendors



Financial Drivers

- Cheaper, Better,
 - Efficiency in IT services
 - Economics of scale Cheaper:
 - Storage
 - Servers
 - CPU
- Pay as you go

CAAS - Car as a Service (Leasing)

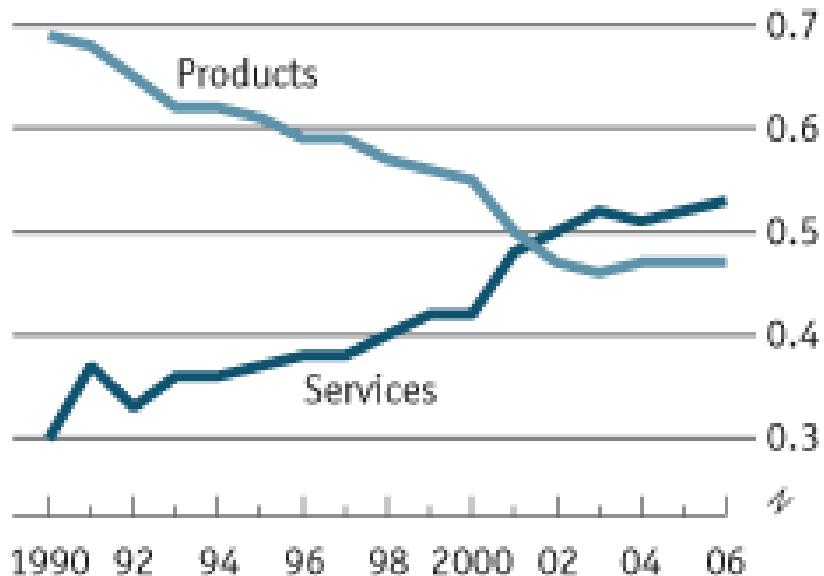
- Yes
 - It is provided as a service
- No
 - Private – no resource sharing / Multi-tenancy
 - No Virtualization
 - No Pay-Per-use

Maybe a private cloud
Car Pooling?



Service oriented sales

US-listed software-firms' sales, % of total



Source: Michael Cusumano,
Massachusetts Institute of Technology

- Commoditization of software and operating systems, shift to open source
- Software Business Model – tying to # of users of cores will be difficult, no up-front fees, no maintenance fees
- Usage based payment
- Possible user reduction of OS & Software licensing fees
- Need for recurring & safe Sales

Technology Drivers

- Web Services & SOA
- Demand for Mass Scalability Rapid User Growth
- Standard API
- Virtualization
- Converged / Meshups
- Faster networks



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Virtualization

- Virtualization is a term that refers to the abstraction of computer resources
- Virtual machine (VM), a software implementation of a machine (computer) that executes programs like a real machine

Other effecting trends

- Green
 - Don't Consume if you don't use
 - Conserve Energy

CLOUD SERVICES DEFINITIONS

XaaS - X AS A SERVICE



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XaaS/EaaS

- **Everything as a service** (*EaaS, XaaS, *aaS*) is a concept of being able to call up re-usable, fine-grained software components across a network. It is a subset of cloud computing. The most common and successful example is software as a service (SaaS), but the *as a service* moniker has been associated with many other functions including communication, infrastructure and platforms, most of which are core components of cloud computing.



Cloud Services Types

- Many service types try to “reuse” the success of cloud computing.
- In this course we focus on the main three major services:
 - IAAS
 - PAAS
 - SAAS
- Other services:
 - DAAS
 - NAAS
 - CAAS

Major Cloud Computing Services

Three primary models for Cloud Computing have emerged:

SaaS (Software as a Service)

Applications, typically available via the browser:

- Google Apps
- Salesforce.com

PaaS (Platform as a Service)

Hosted application environment for building and deploying cloud applications:

- Salesforce.com
- Amazon E2C
- Microsoft Azure

IaaS (Infrastructure as a Service)

Utility computing data center providing on demand server resources:

- HP Adaptive Infrastructure as a Service
- Rackspace
- Amazon E2C & S3

SaaS is the strongest Cloud trend and Service

SAAS

- SAAS – Software as a service
 - The major service given as part of Cloud-Computing services.
 - The first service
 - Most Known and used
- The application itself is provided by the service provider.
- Examples:
 - Enterprise: SalesForce.Com, Webex, OfficeLive
 - User Mail: Gmail, Hotmail
 - User Pics: Flickr, Picasa

IAAS

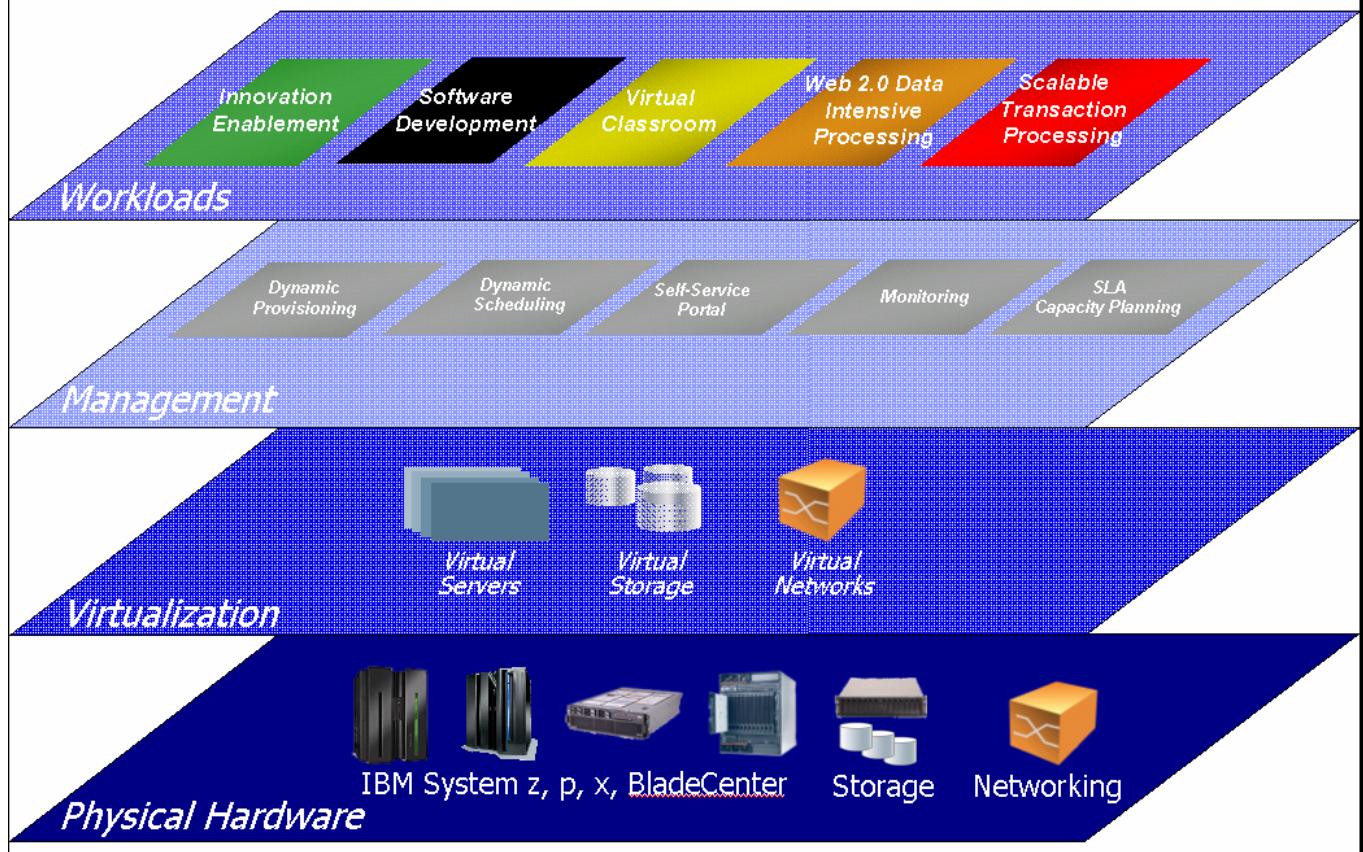
- IAAS – Service providers offers capacity for rent, basically hosted Data Centers & Servers
- An evolution of web site and server hosting services which provided servers and VPS
- Examples
 - Verizon's CAAS – Computing as a service
 - AT&T – Hosting & Storage

PAAS

- PAAS – Platform as a Service
- Platform enables application developers to host their services
- Examples:
 - Google's AppEngine

Services Framework at the Data Center

Infrastructure services framework of a new enterprise data center



Simple Service Map

amazon.com.



IAAS
Utility Computing

Windows Azure™



Platform as a Service
(PaaS)



force.com™
platform as a service

Windows Live™

Microsoft® Office Live

salesforce.com™
Success On Demand.™

flickr™

Cloud-based User
Applications

NAAS

- Network as a Service
- Provide a global network capability, CDNs for example
- Example, known video CDNs like:
 - Akamai
 - Limelight
 - L3
 - Amazon CloudFront (limited solution)

DAAS

- Data as a Service
- DaaS - A software as a service or web service offering that provides customers with access and analytics around a set of proprietary set of aggregated data.
- Example - Salary.com collects user data by offering individuals the ability to benchmark their compensation levels against others. Sell anonymized data to companies (HR managers) for hiring and compensation related usage.
Others D&B.

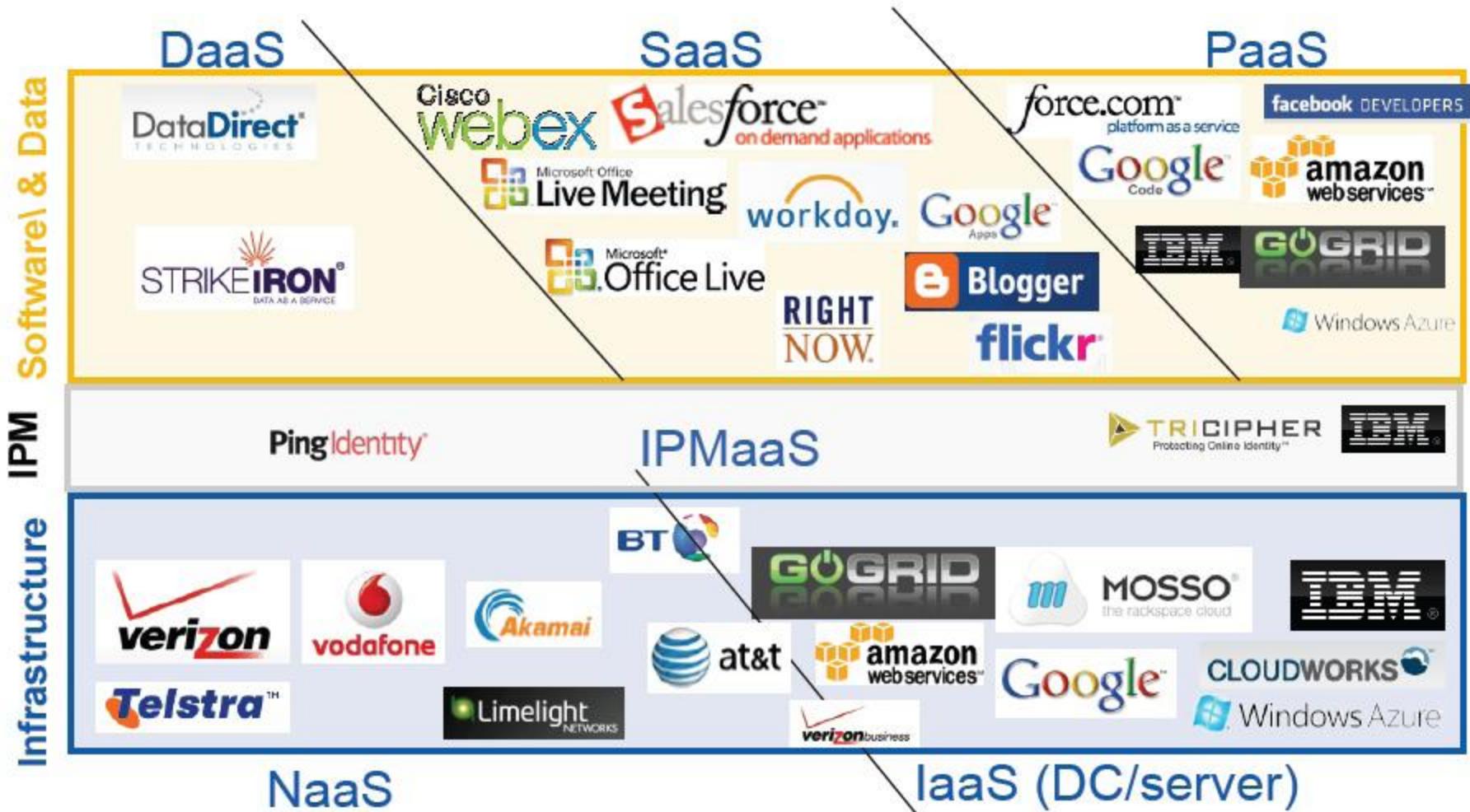


CAAS (Not Leasing)

- **Communications as a Service (CaaS)** is a type of outsourced enterprise communications solution where a third party vendor (known as CaaS vendor) is responsible for the management of hardware and software required for delivering Voice over IP (Voice as a Service), instant messaging, and video conferencing applications using fixed and mobile devices.
- Example: IP-Centrex, a remote PBX

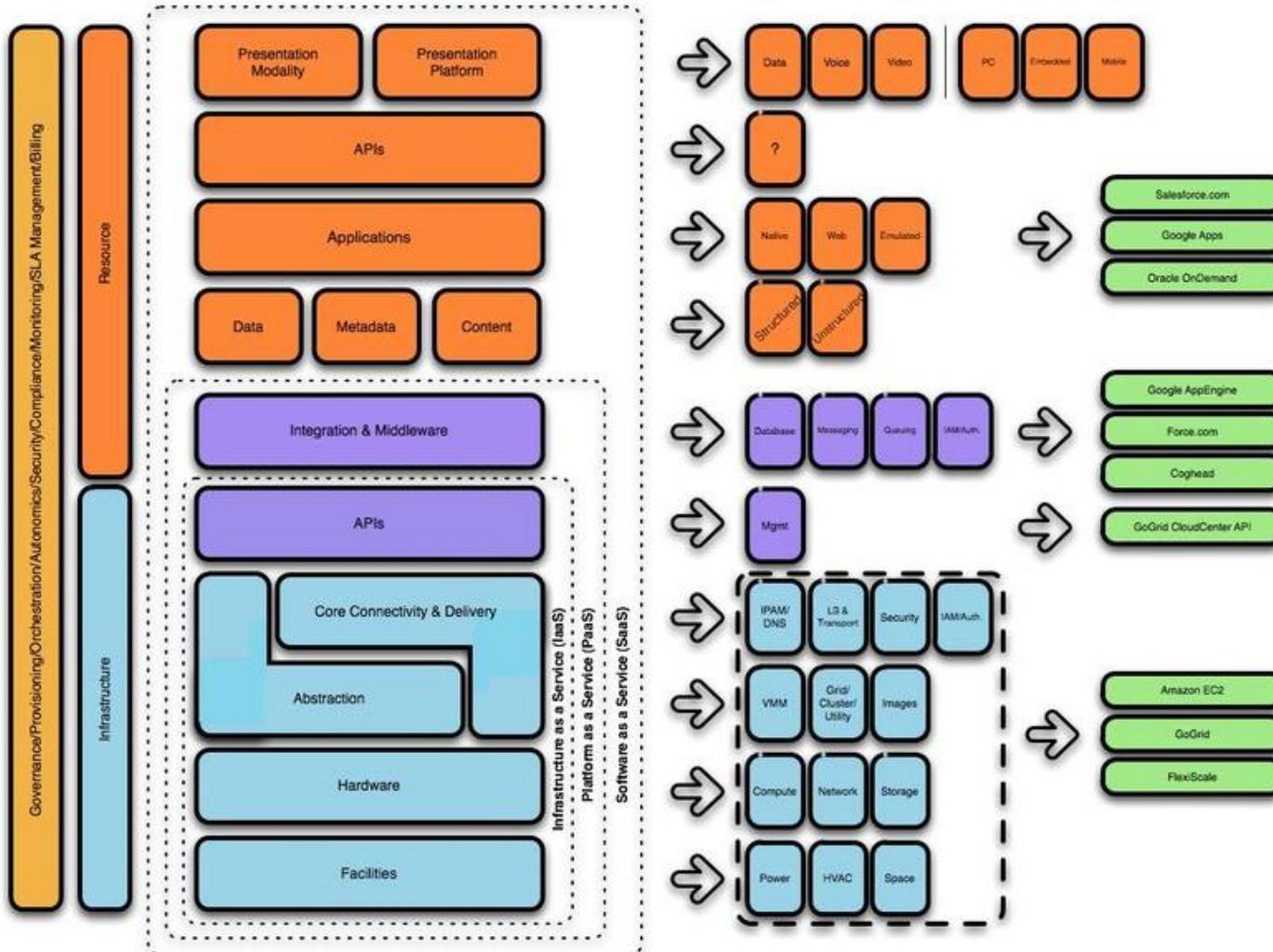


Service Maps



Cloud Taxonomy

Cloud Taxonomy & Ontology - Draft v1.4 - Hoff



<http://rationalsecurit.y.typepad.com/blog/2009/01/cloud-computing-taxonomy-ontology-please-review.html>

The background of the image is a vibrant blue sky filled with various types of white and grey clouds, ranging from wispy cirrus to puffy cumulus. A bright, horizontal band of light, likely representing the sun or a reflection on water, cuts across the bottom of the frame.

Questions?

CLOUD TYPES

- PRIVATE
- PUBLIC
- HYBRID

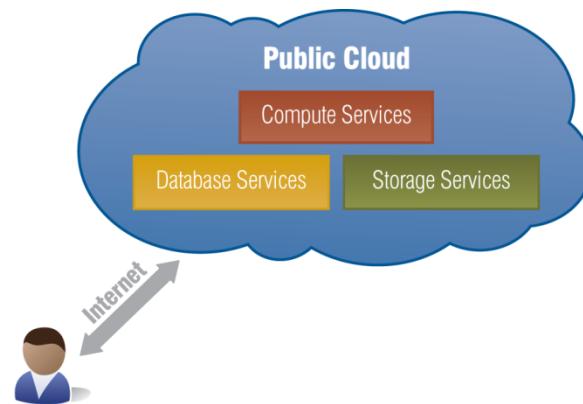


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Public Cloud

- **Public Cloud:** the services are delivered to the client via the Internet from a third party service provider.
- Example: Amazon



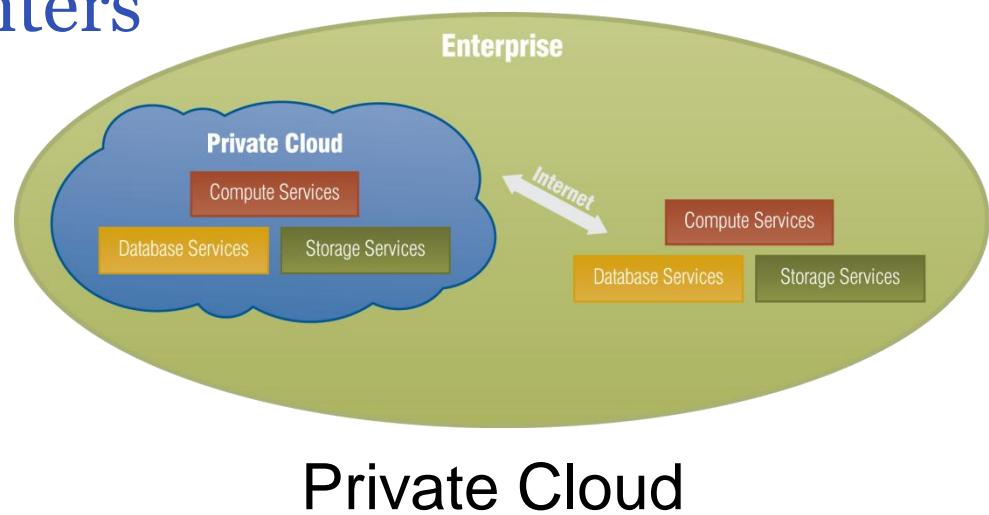
Public Cloud



Source: Cloud Computing Use Case Group. <http://opencloudmanifesto.org/resources.htm>

Private Cloud

- **Private Cloud:** these services are managed and provided within the organization. There are less restriction on network bandwidth, fewer security exposures and other legal requirements compared to the public Cloud.
- Example: HP Data Centers



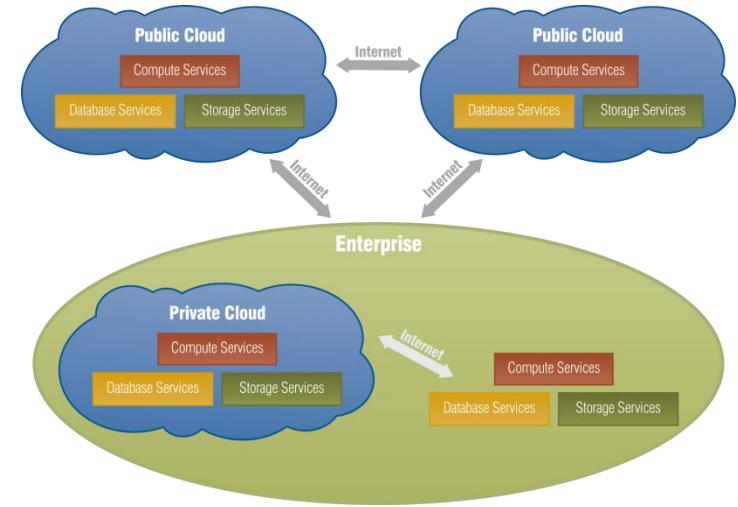
[CC BY-SA] Source: Cloud Computing Use Case Group. <http://opencloudmanifesto.org/resources.htm>

Public vs. Private clouds

Benefit	Public	Private
Illusion of infinite resources on-demand	Yes	Unlikely
Elimination of up-front commitment by users	Yes	No
True pay-as-you-go on short-term basis	Yes	No
Economy of scale	Yes	No
Better utilization through workload multiplexing	Yes	Depends on size
Better utilization & simplified operations through virtualization	Yes	Yes

Hybrid Cloud

- **Hybrid Cloud:** there is a combination of services provided from public and private Clouds.
- Example:
 - ERP in Private cloud
 - Sales & Email on public



Hybrid Cloud



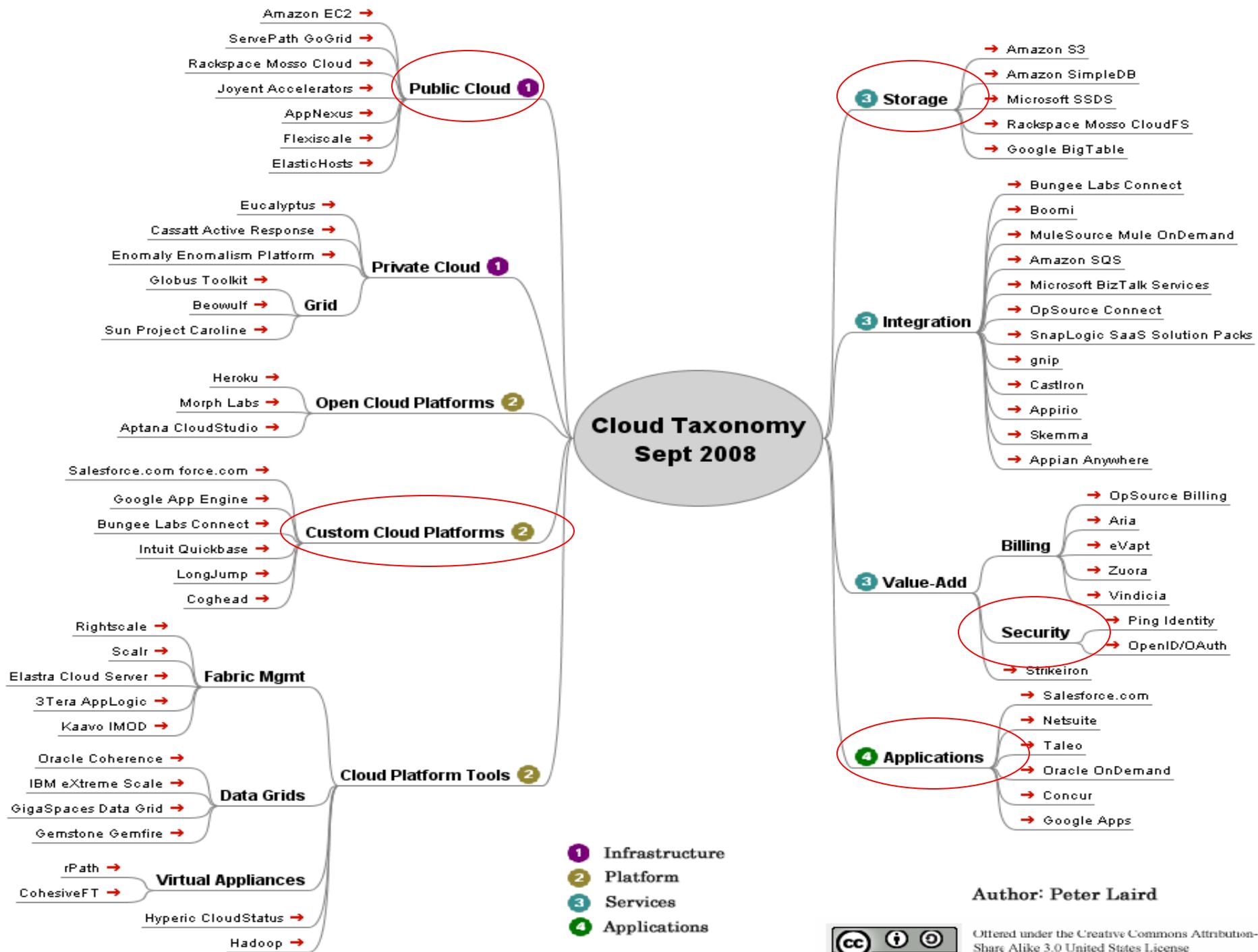
Source: Cloud Computing Use Case Group. <http://opencloudmanifesto.org/resources.htm>

WHAT'S LEFT TO TALK ABOUT?



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PRO & CONS

Short overview



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Advantages



Pros

- Scale
- Cost
 - CAPEX
 - OPEX
- Advance Architecture
- Agility
- Cost - Clouds are renowned for being dirt cheap for storage and burst-y processing.
- Elasticity - Growth and shrinkage

Challenges & Risks



Cons

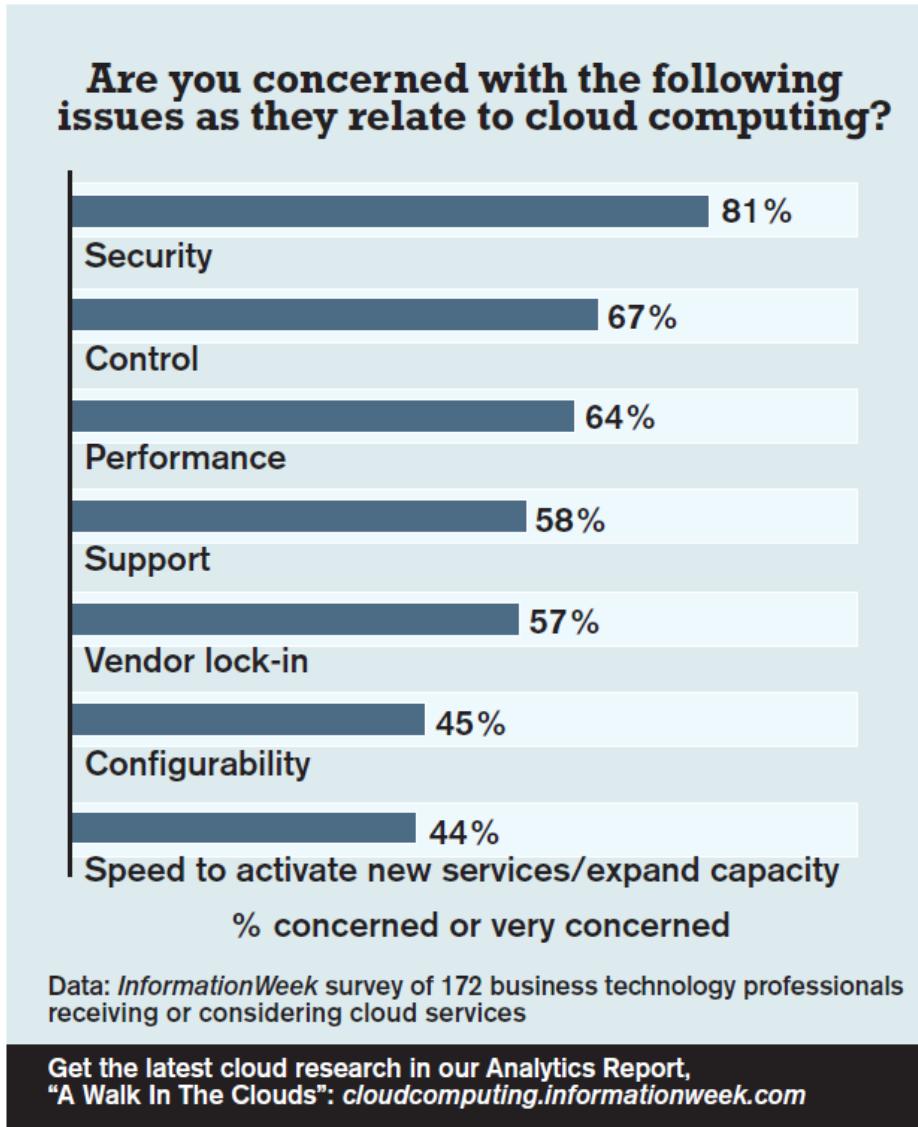
- Security & Privacy
 - Is it safe?
 - For Whom and at what level?
- Regulatory compliance: HIPPA, SOX etc
- Interoperability & Vendor Lock-In
- Lack of control
- Standardization

Challenges

- Organizational barriers
- Reliability (service outage)
- Definition of SLAs (Service Level Agreement)
- Service management (LCM), Monitoring
- Customization
- Integration with other applications
- Technology (limited languages & APIs)

Cloud Concerns

- Yep
- Security is No 1 !



Clouds Security



Security Risks & Challenges

- Conflicts with international privacy laws,
- Data ownership
- Service guarantees
- Securing virtual machines
- Massive outages
- Encryption needs & Standards
- Storing sensitive & personal information in clouds
- Contingency planning / disaster recovery for clouds

SaaS Pro & Cons

Benefits

- Speed
- Reduced up-front cost, potential for reduced lifetime cost
- Transfer of some/all support obligations
- Elimination of licensing risk
- Elimination of version compatibility
- Reduced hardware footprint

Challenges

- Extension of the security model to the provider (data privacy and ownership)
- Governance and billing management
- Synchronization of client and vendor migrations
- Integrated end-user support
- Scalability

Strong governance required to prevent lines of business from purchasing application services externally without IT involvement

PaaS Pro & Cons

Benefits

- Pay-as-you-go for development, test, and production environments
- Enables developers to focus on application code
- Instant global platform
- Elimination of H/W dependencies and capacity concerns
- Inherent scalability
- Simplified deployment model

Challenges

- Governance
- Tie-in to the vendor
- Extension of the security model to the provider
- Connectivity
- Reliance on 3rd party SLA's

Strong governance required to prevent lines of business from building applications without IT involvement

IaaS Pro & Cons

Benefits

- Systems managed by SLA should equate to fewer breaches
- Higher return on assets through higher utilization
- Reduced cost driven by
 - Less hardware
 - Less floor space from smaller hardware footprint
 - Higher level of automation from fewer administrators
 - Lower power consumption
- Able to match consumption to demand

Challenges

- Portability of applications
- Maturity of systems management tools
- Integration across Cloud boundary
- Extension of internal security models

IaaS is the onramp for corporate IT to Cloud Computing!

STANDARDIZATION LANDSCAPE



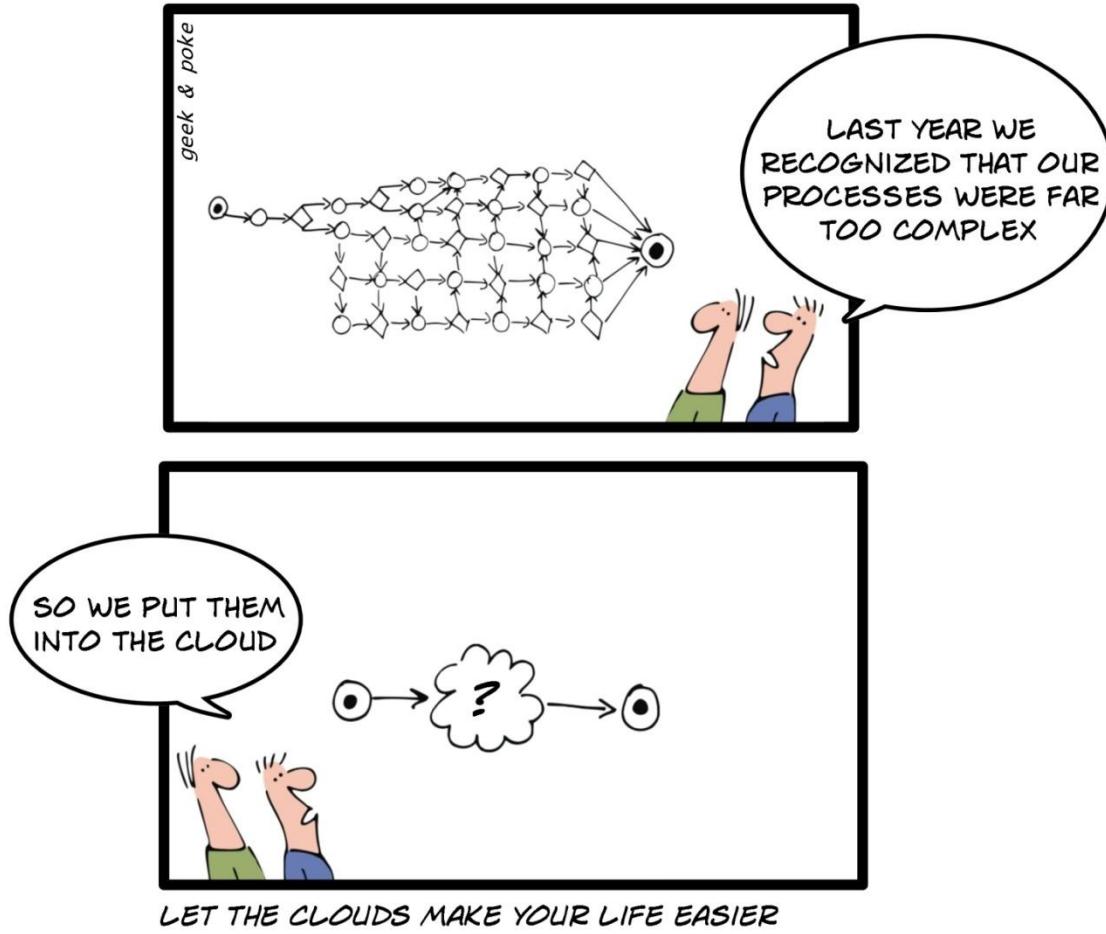
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Relevant Standardization Activity

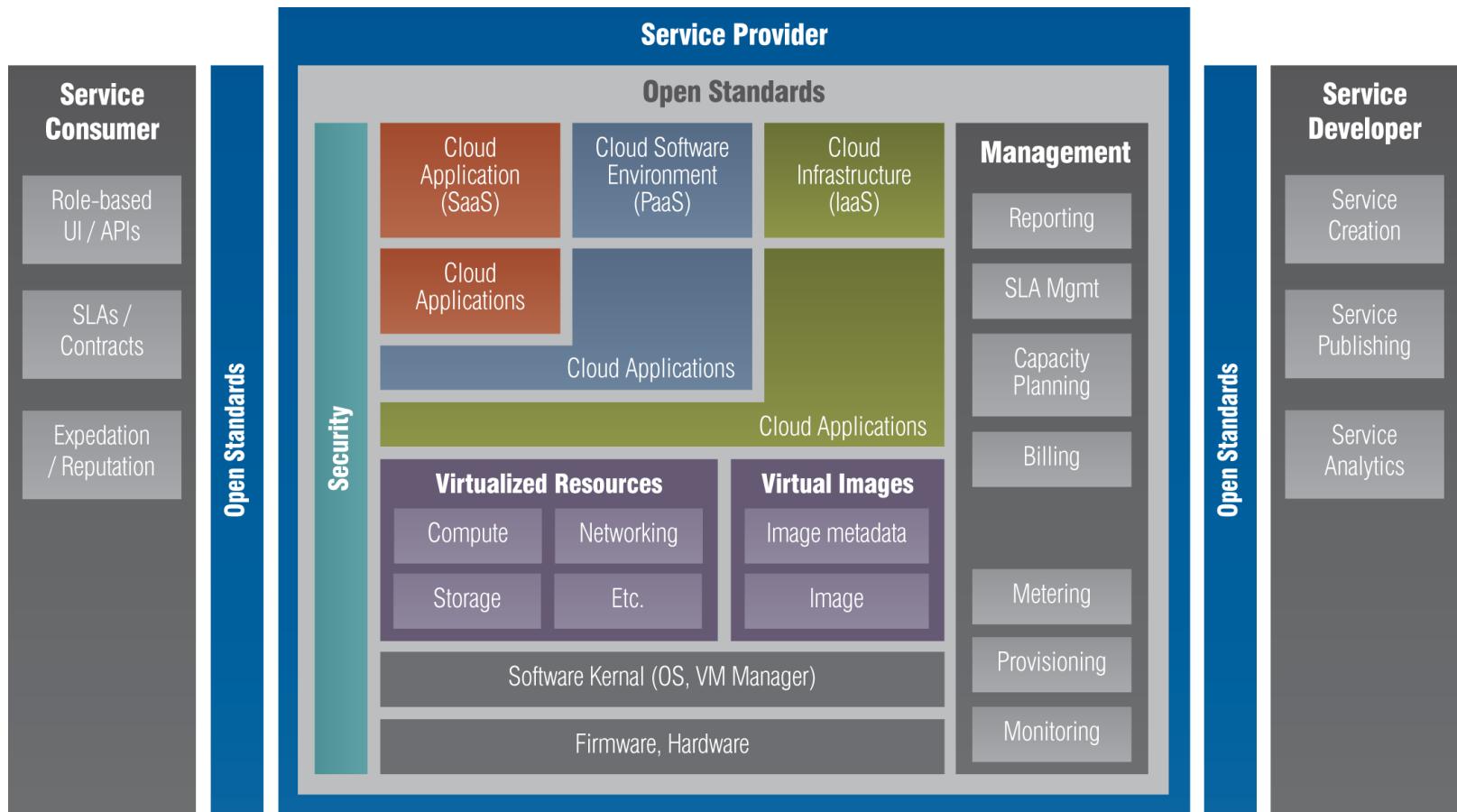
- Open Grid Forum (OGF)
- Cloud Computing Interoperability Forum (CCIF)
- Distributed Management Task Force (DMTF)
- Open Cloud Consortium (OCC)
- Cloud Security Alliance (CSA)
- ETSI
- OASIS
- Object Management Group (OMG)

Simplifying Cloud Computing



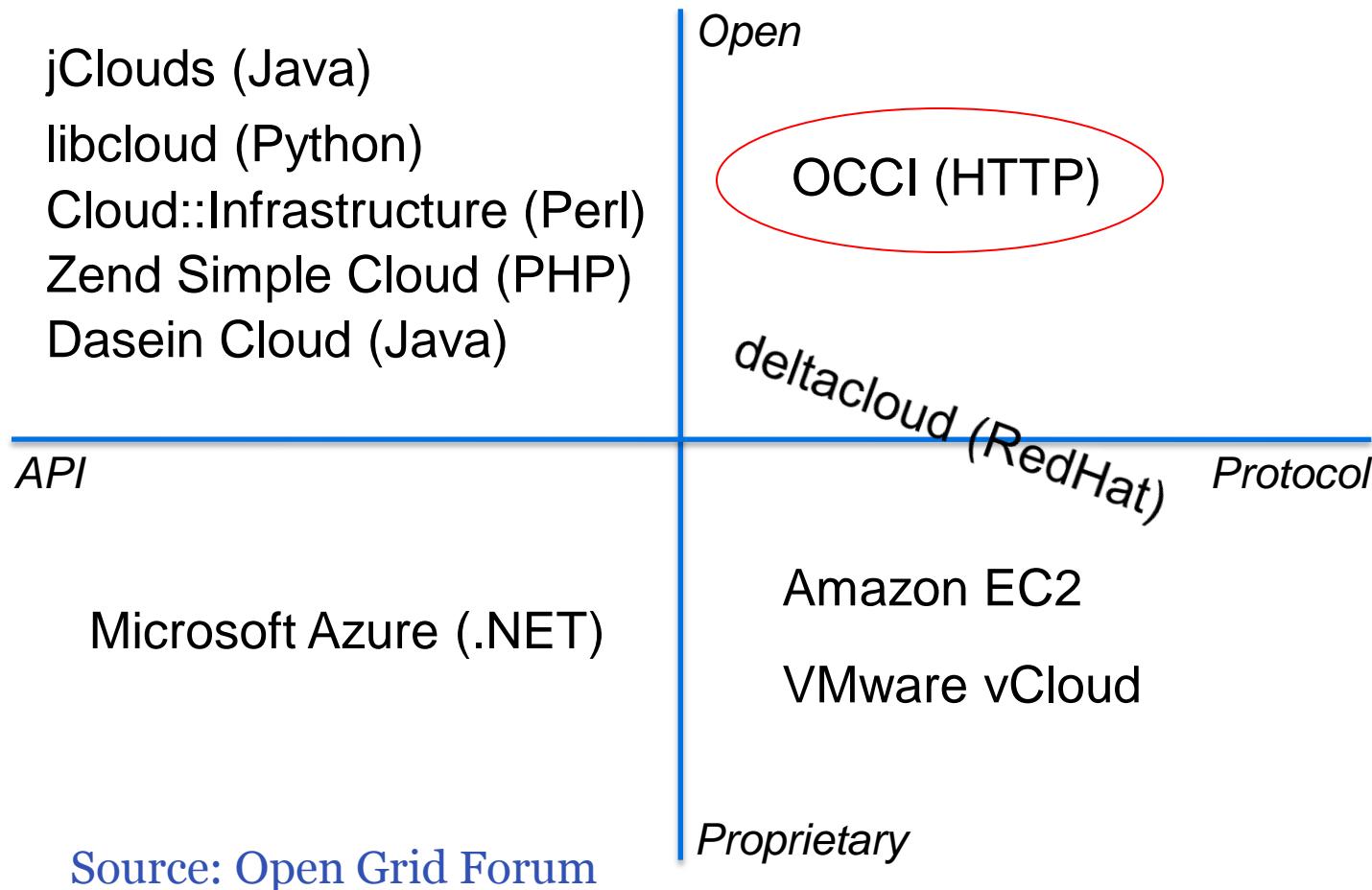
From <http://geekandpoke.typepad.com>

Standardization Issues

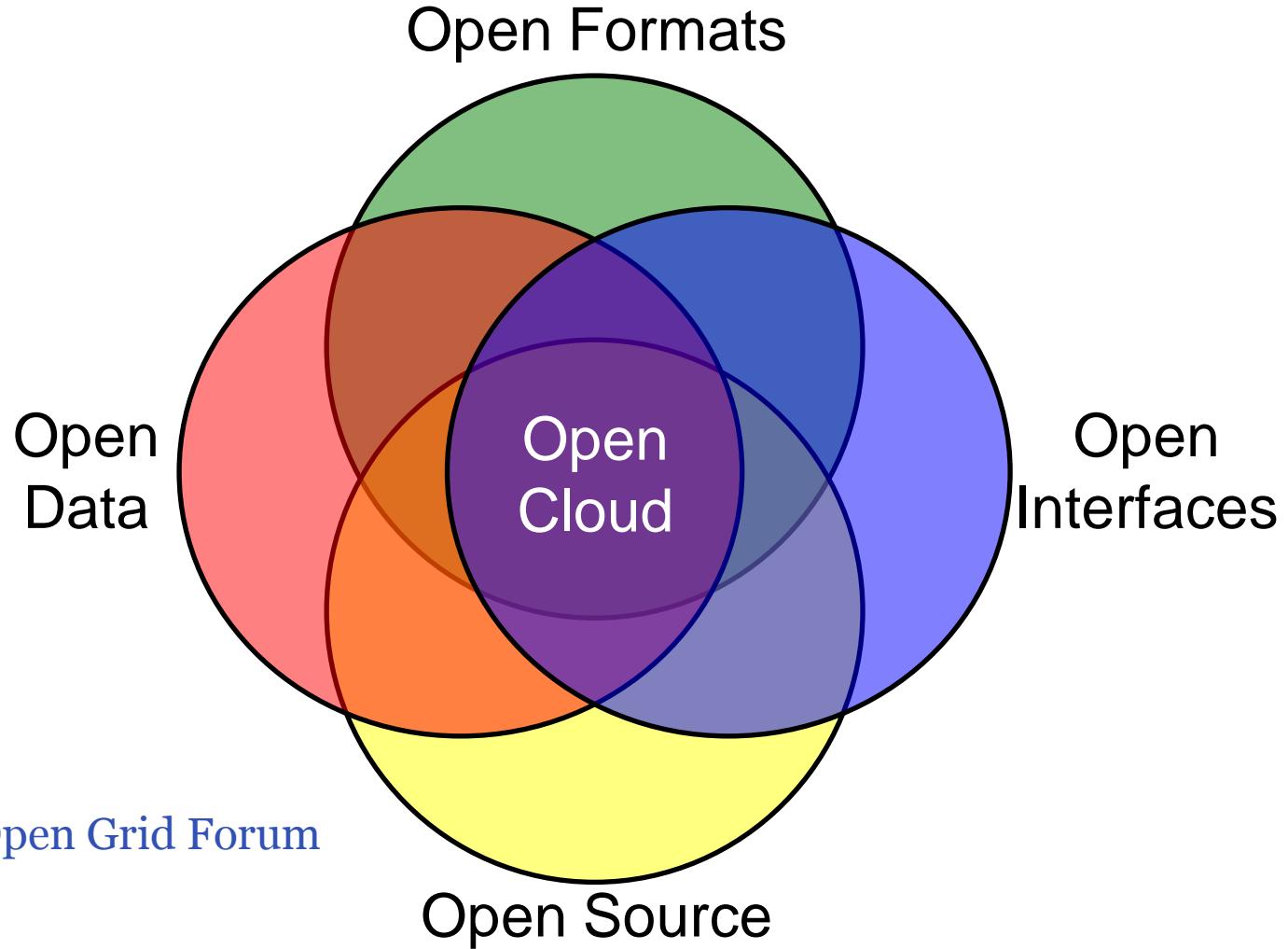


Source: Cloud Computing Use Case Group. <http://opencloudmanifesto.org/resources.htm>

APIs & Protocols Comparison



OGF- Open Cloud Ecosystem



Who is OCCI

- Open Grid Forum Working Group
 - OGF IP umbrella for copyrights, patents, trademarks
- More than 200 participants
 - Industry: Rackspace, GoGrid, Sun, RESERVOIR, ...
 - Academia: UCMadrid (OpenNebula), SLA@SOI w/Intel, ...
 - Service providers: CohesiveFT, RabbitMQ, ...
 - End users, developers

Overview of OCCI Standard

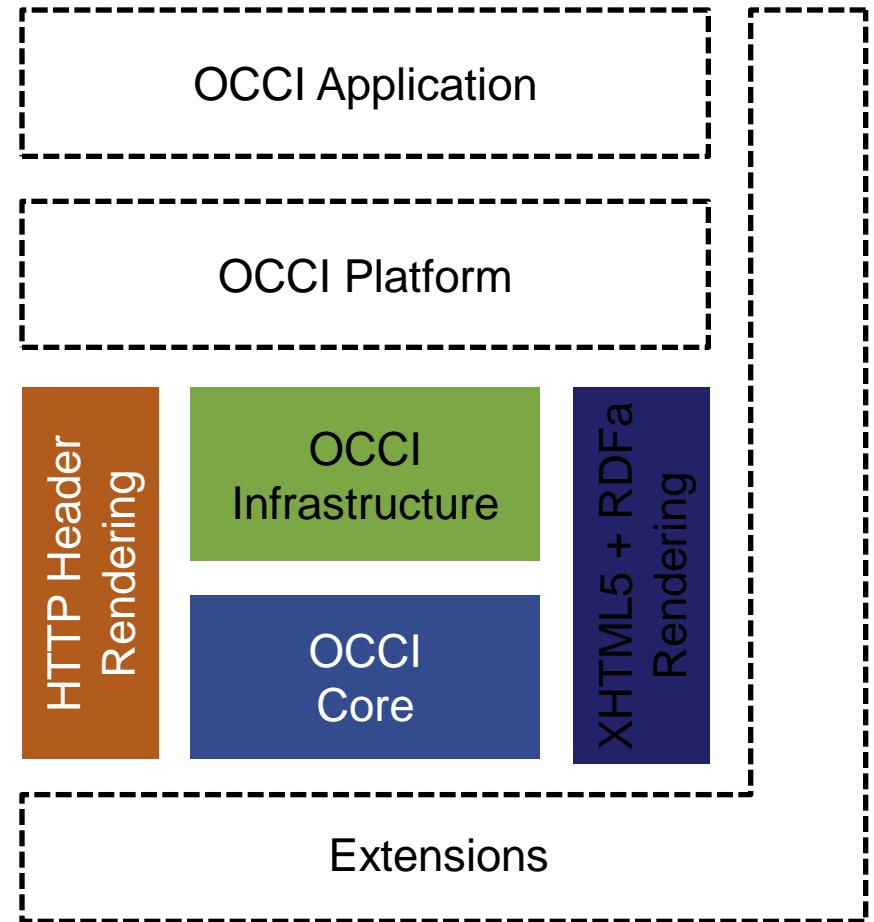
- Protocol
- Lightweight & extensible
- Format-agnostic
- Built on HTTP, RESTful

Create: HTTP POST

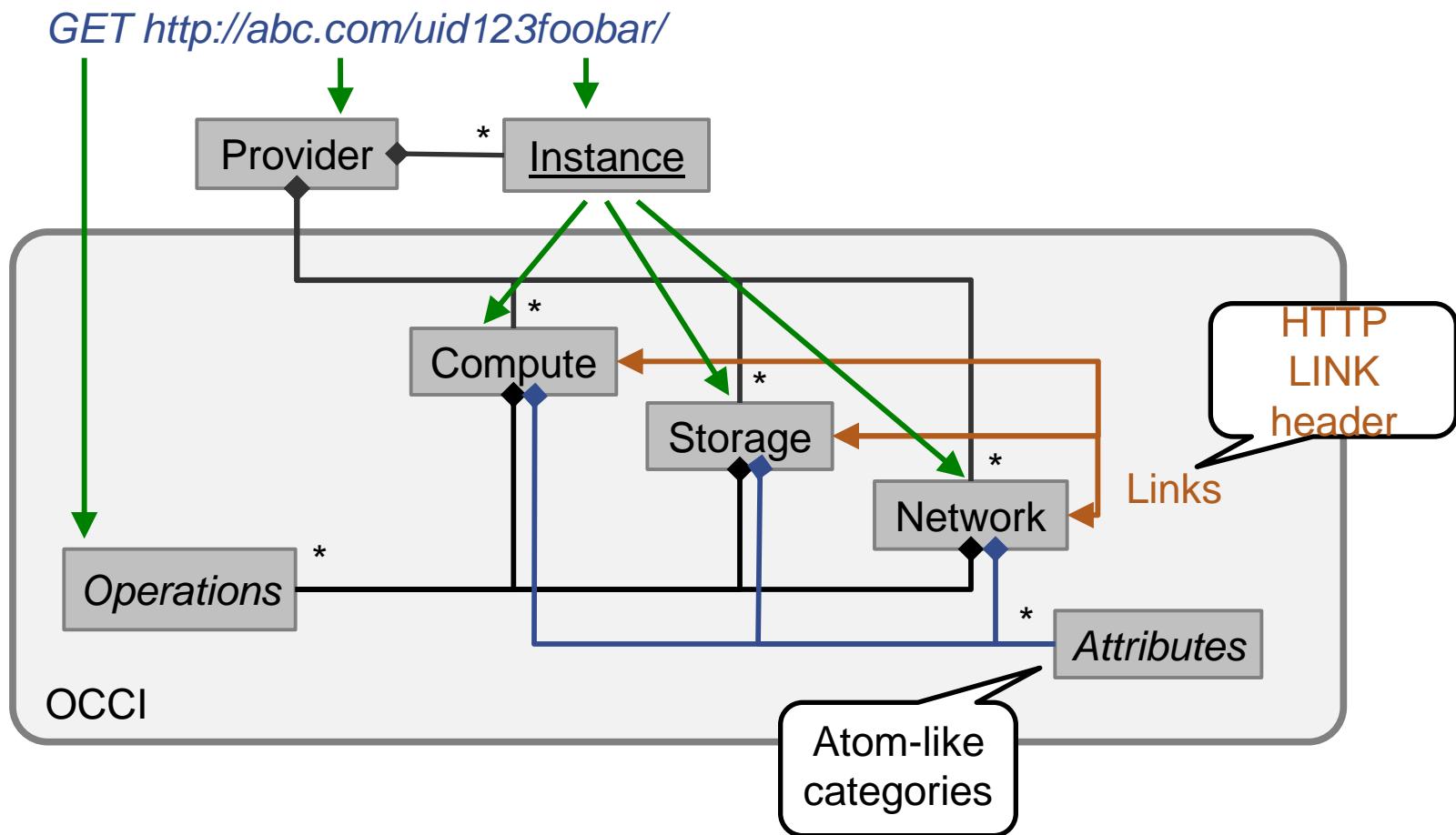
Retrieve: HTTP GET

Update: HTTP GET &
HTTP PUT

Delete: HTTP DELETE



Architect view OCCI



How it works

- **Create – HTTP POST**
- **Retrieve – HTTP GET**
- **Update – HTTP GET & HTTP PUT**
- **Delete – HTTP DELETE**



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Programmer level view of OCCI

REQUEST

```
> GET /us-east/webapp/vm01 HTTP/1.1  
> User-Agent: occi-client/1.0 (linux) libcurl/7.19.4 OCCI/1.0  
> Host: cloud.example.com  
> Accept: */*
```

Get the resource,
in whatever
format

RESPONSE

```
>  
< HTTP/1.1 200 OK  
< Date: Sat, 10 Oct 2009 12:56:51 GMT  
< Content-Type: application/ovf  
< Link: </us-east/webapp/vm01;start>;  
< rel="http://purl.org/occi/action/start";  
< title="Start"  
< Link: </us-east/webapp/build.pdf>;  
< rel="related";  
< title="Documentation";  
< type="application/pdf"  
< Category: compute;  
< label="Compute Resource";  
< scheme="http://purl.org/occi/kind/"  
< Server: occi-server/1.0 (linux) OCCI/1.0  
< Connection: close  
<  
< <?xml version="1.0" encoding="UTF-8"?>  
< <Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"  
<     xmlns:ovf="http://schemas.dmtf.org/ovf/envelope/1"  
<     xmlns="http://schemas.dmtf.org/ovf/envelope/1"
```

It's in OVF
format

You can
“start” it

Related
“documentation”

It's a
“compute”
resource

The OVF
payload

CLOUDS FOR THE IT

- WHY MIGRATE
- SHOULD WE MIGRATE?
- MIGRATE TO WHAT?



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So is this the right time to move?

- “It was too early to move our organization to VoIP”
 - COO/CFO of a medium hi-tech company
- So...Should we move ?
- Even if not, its definitely not too early to
 - Learn
 - Evaluate
 - Prepare
- Sample in the next slides

IT has fallen behind needs...

- Business Agility is Threatened:
 - Of 1,150 global CEO's, 76% say the ability to adapt will be a key source of strategic advantage in 2009*
- Complexity is growing:
 - CIO's see complexity as a threat to the very survival of their business
- Operation Costs Exceed HW Costs:
 - CEO's view growth as a key focus area
 - Operational costs far exceed the budgets for new hardware

* PricewaterhouseCoopers' 11th Annual Global CEO Survey

IT complexity is impacting the ability of companies to compete

IT state today...

- Many applications are proprietary, slow, siloed & exhibit single points of failure but are too expensive to remand
- Complex, heterogeneous infrastructure create resource & data silos and recovery nightmares
- Enterprise data is largely distributed and rife with errors
- Infrastructure resources are highly underutilized
 - PCs/Servers < 10%
 - Storage < 50%
- Change is a cost prohibitive and time consuming process

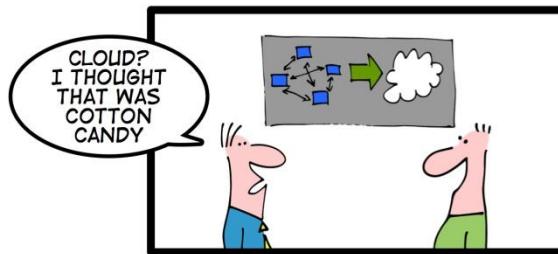
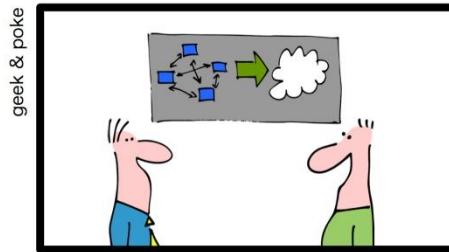
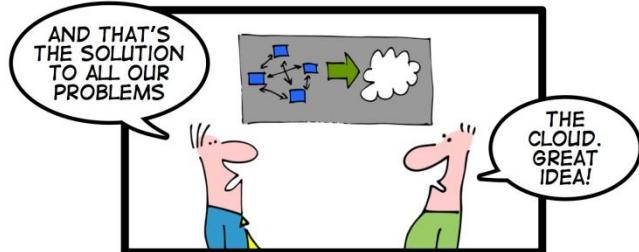
IT has been driven by cost instead of value!

Migration to Cloud Services



Cloud Computing purchasing process

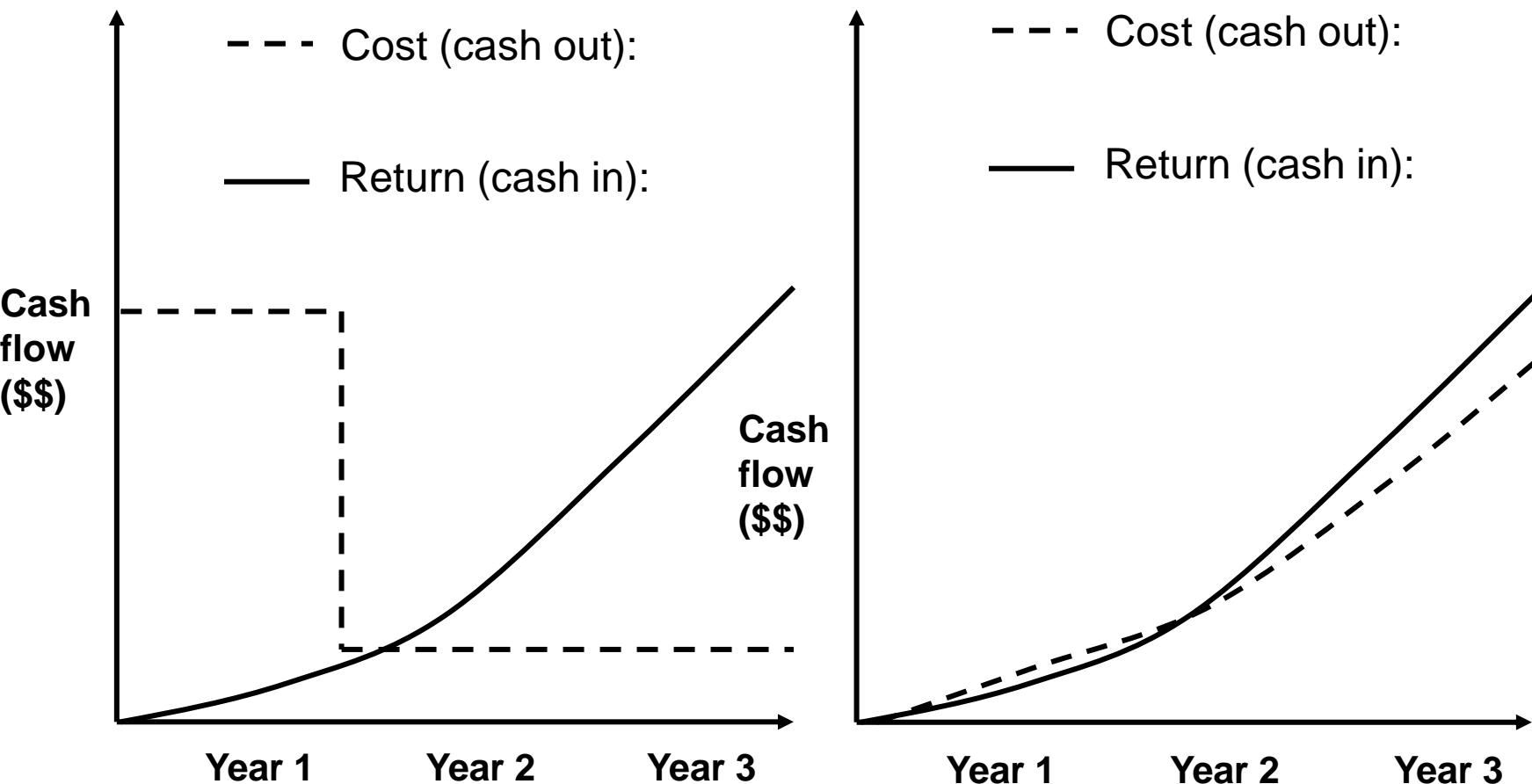
- Receive CEO approval before migrating to cloud service



CEOs LOVE THE CLOUD

<http://geekandpoke.typepad.com/>

Simplified cost Comparison



SaaS, PaaS, & IaaS migration

1) SaaS

- Easy first step to adopt alternative desktop office application
- Requires nothing more than a credit card to start with
- Will drive home the SOA value proposition

2) PaaS

- Aimed primarily at small & new companies but models apply to all
- Large companies will benefit as services scale up and model is driven into internal software development tools and processes

3) IaaS

- New approach to Utility Computing
- Scale using external provider to avoid cap-ex of peak demand
- Longer term play due to immature tools and resistance to change

Cloudbursting vs Bursting the Cloud

- Cloudbursting is to allow the cloud to act as overflow resources in the event your own infrastructure becomes overloaded
 - Critical tasks (revenue generating) in own datacentre
- Bursting in the cloud is applied to resources such as servers, application servers, application delivery systems, and other infrastructure required to provide on-demand computing environments

Bursting the cloud

- Automate the cloud's data centre
- Requires more than simple workflow systems
 - on-demand control and management over all devices in the delivery chain
 - from the storage to the application and web servers to the load-balancers and acceleration offerings that deliver the applications to end-users
 - “Data centre orchestration” – many moving parts and pieces be coordinated in order to perform a highly complex set of tasks

Application hosting options

Application runs **on-premises**

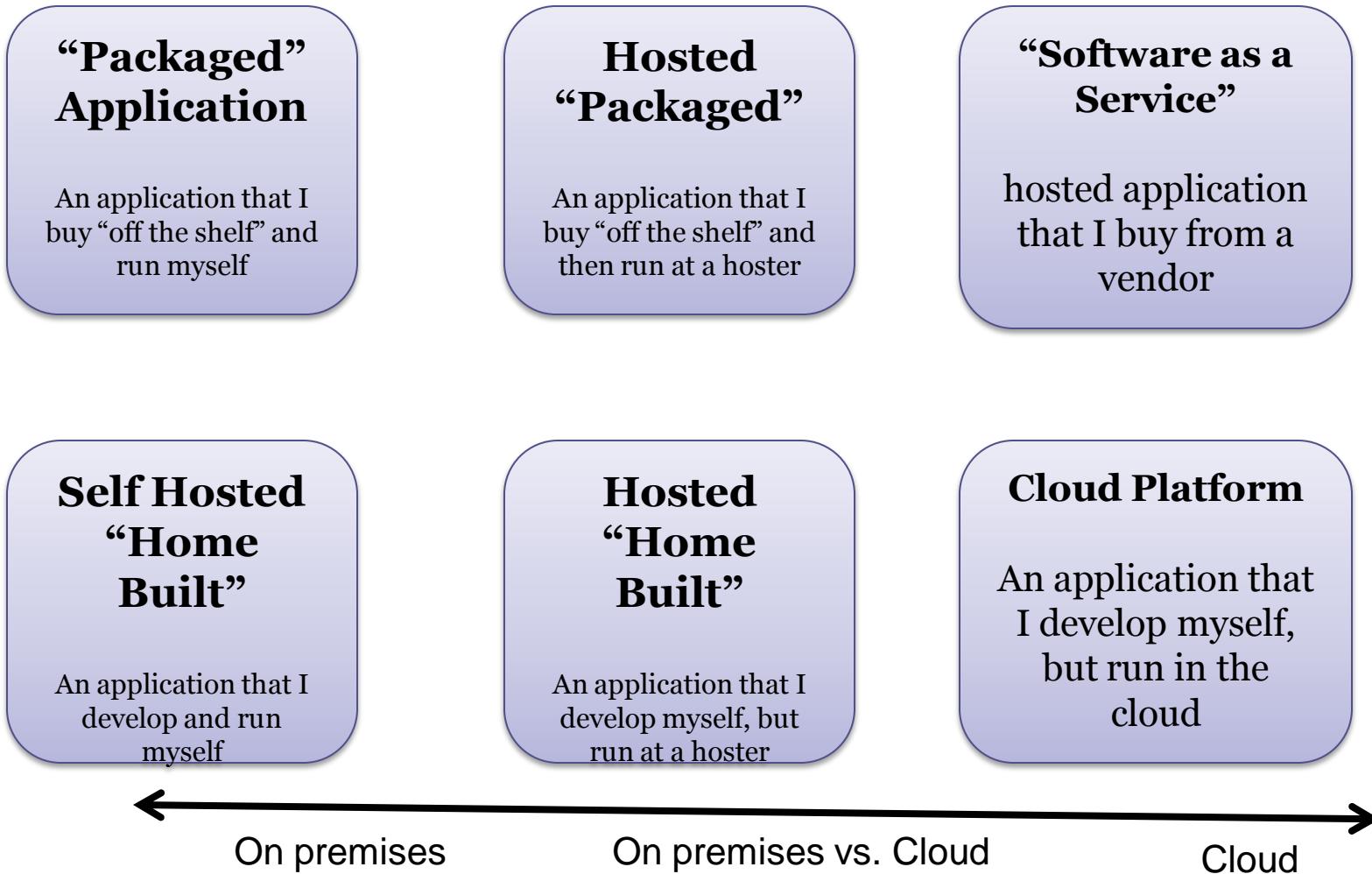
Buy my own hardware, and manage my own data center

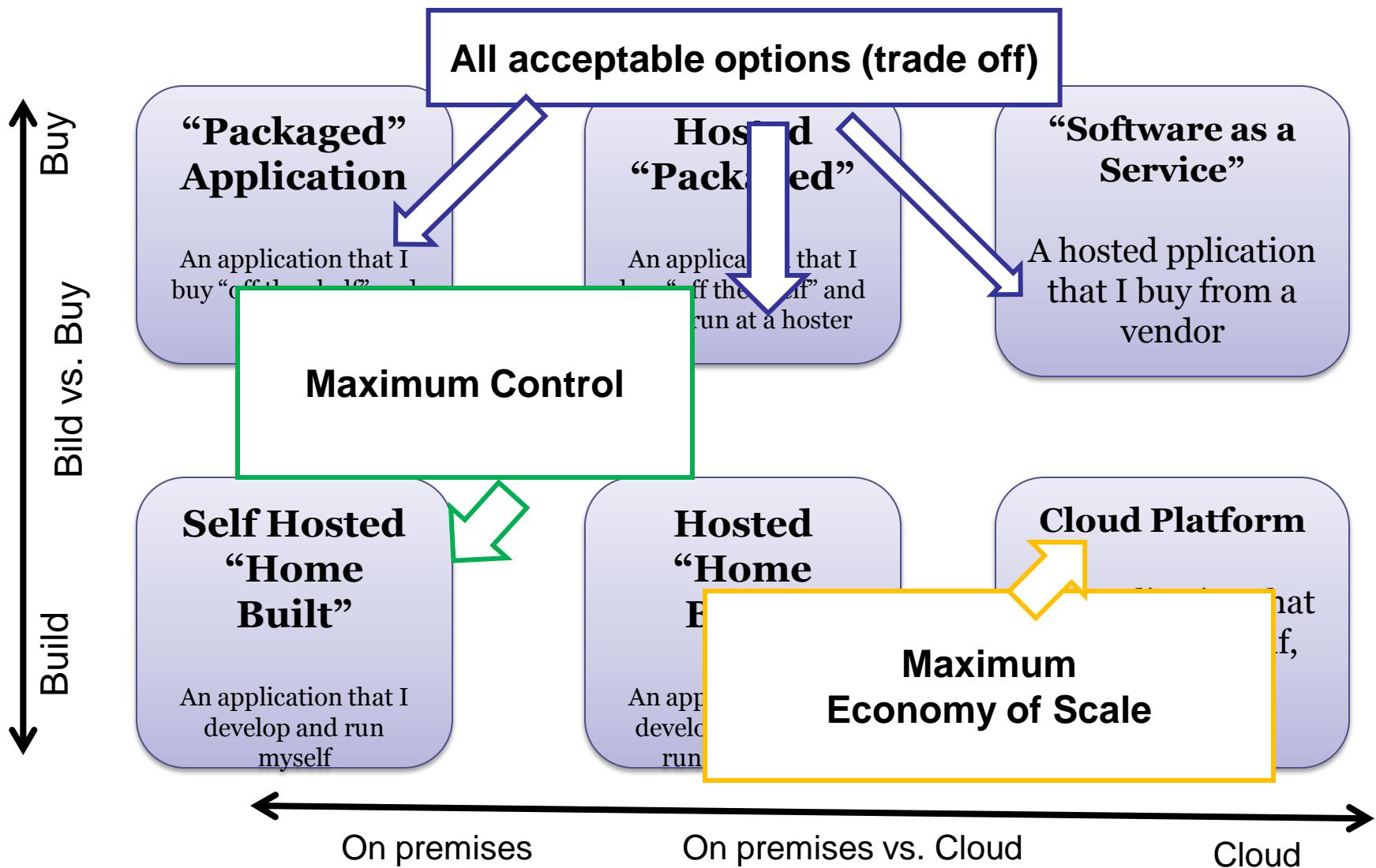
Application runs at a **hoster**

Co-location or
Managed servers

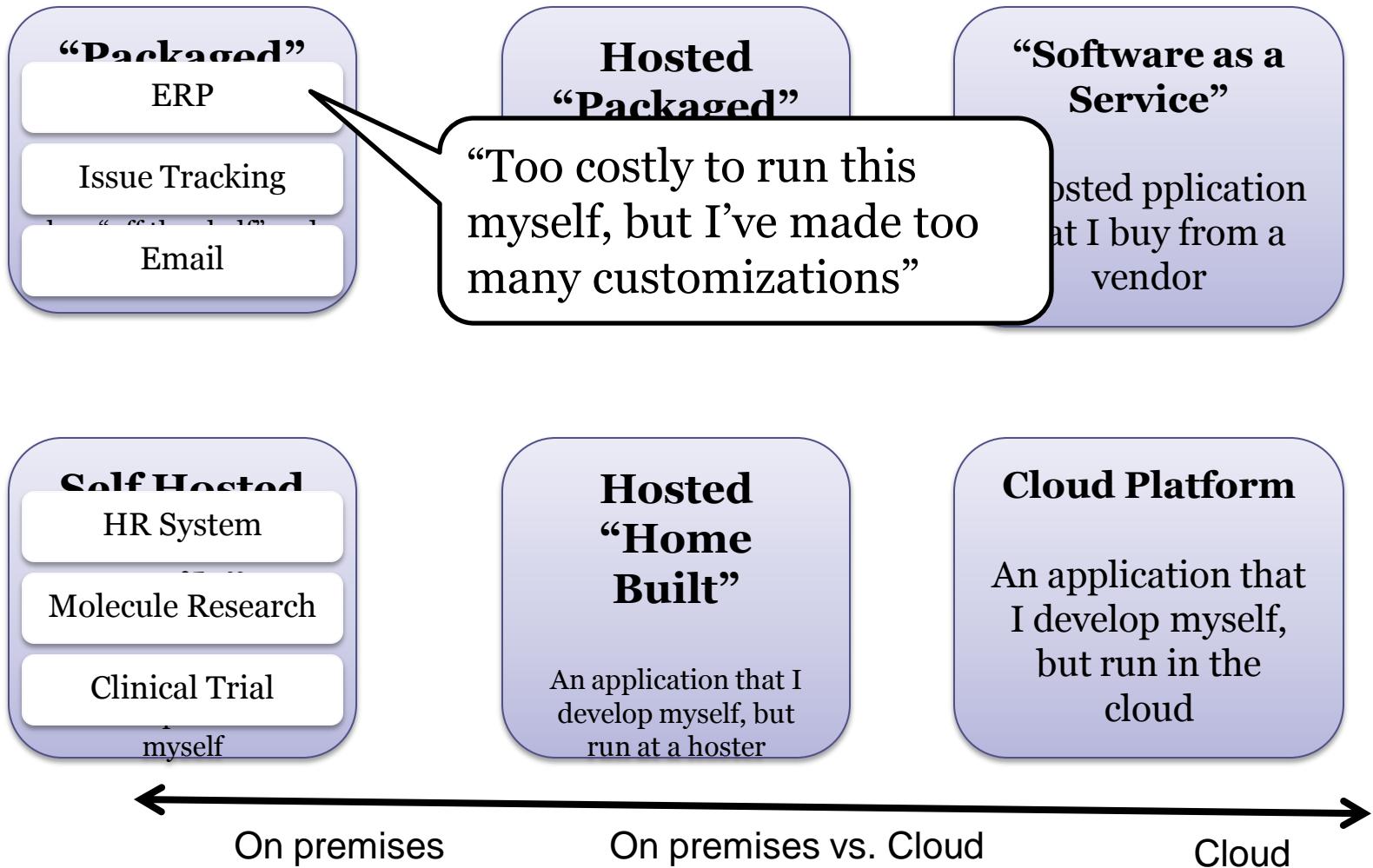
Application runs using **cloud** services
“cloud fabric”
(elastic, infini-scale)

↑ Buy
↓ Build

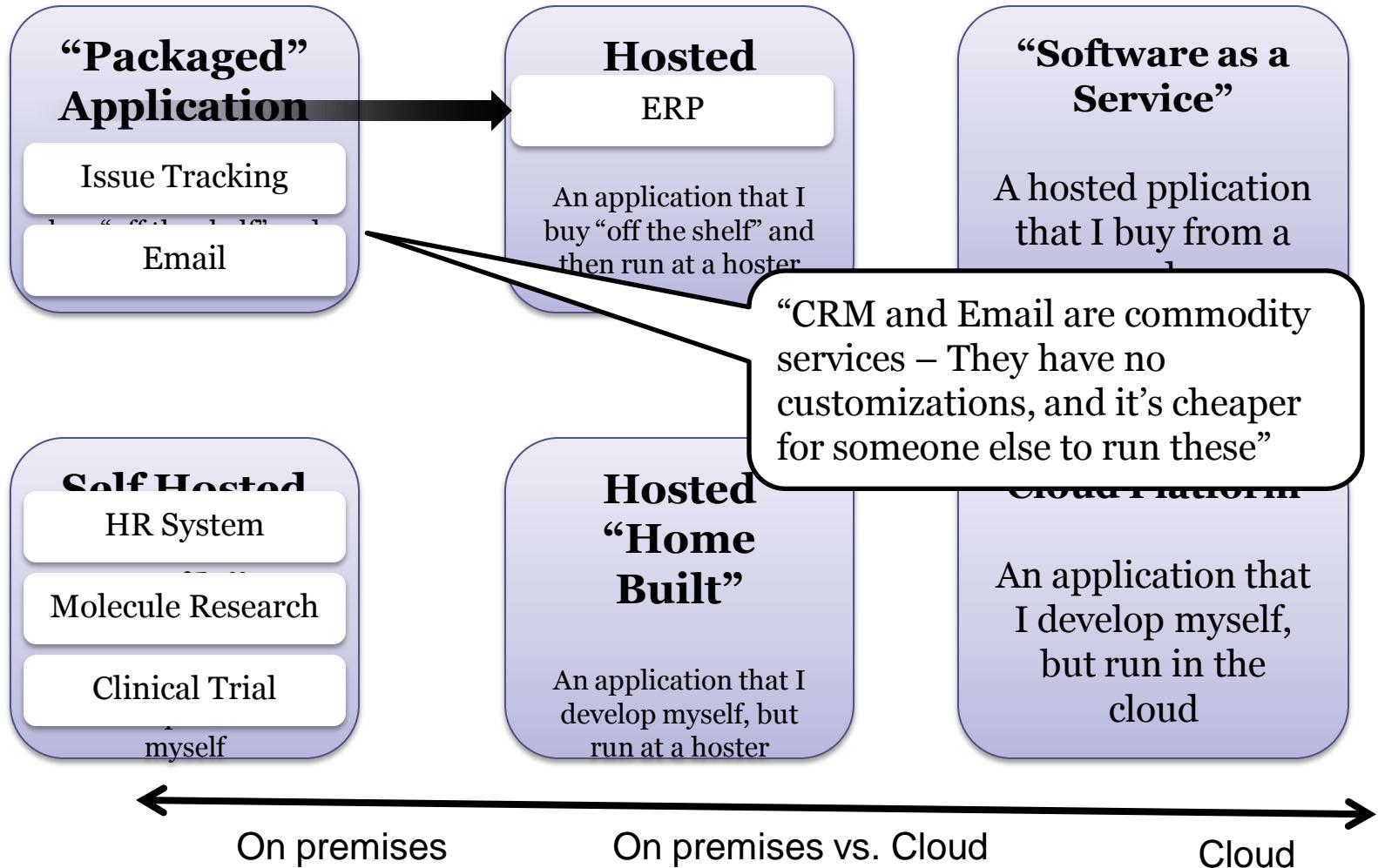




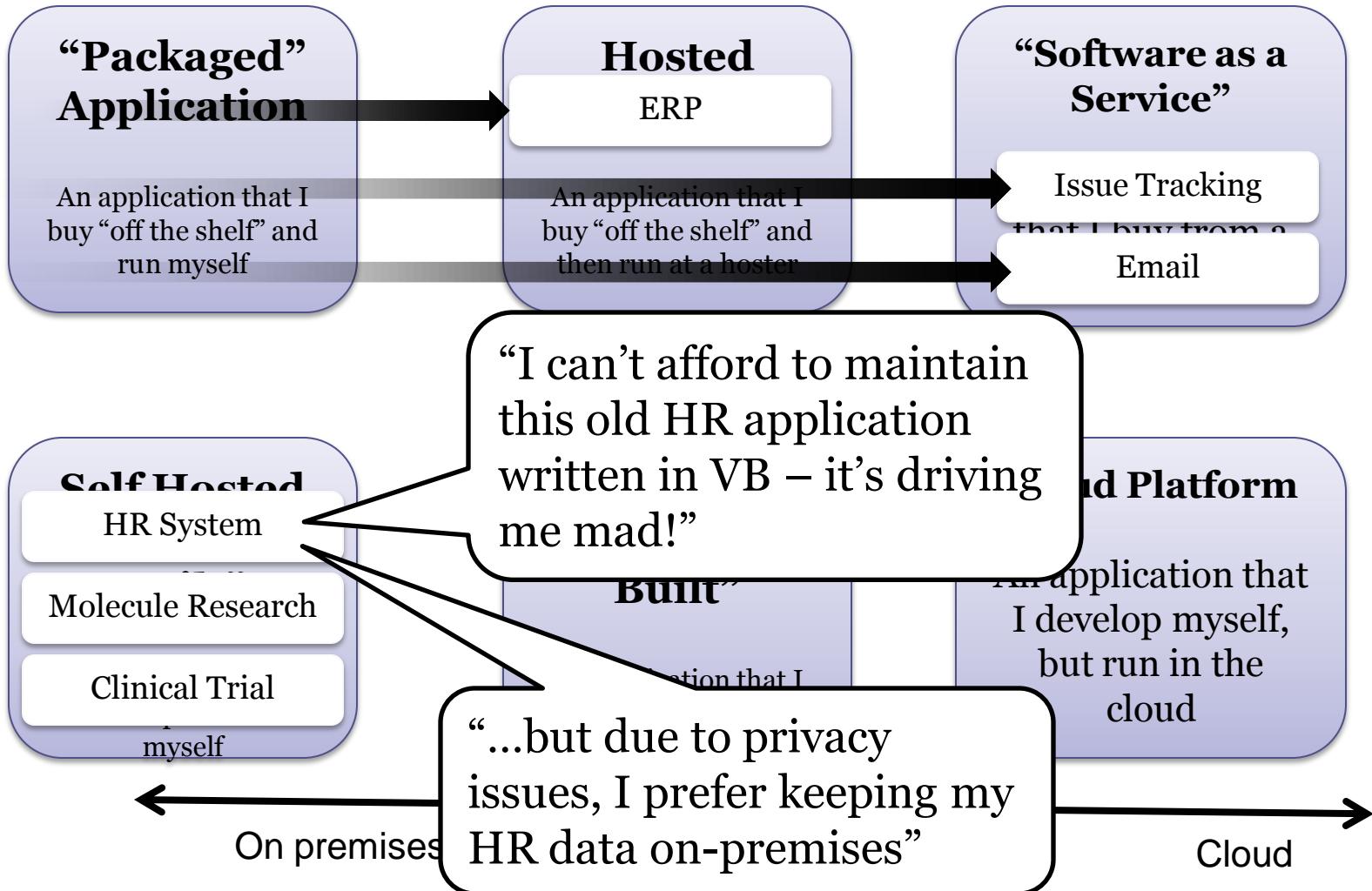
↑ Buy
↓ Build vs. Buy

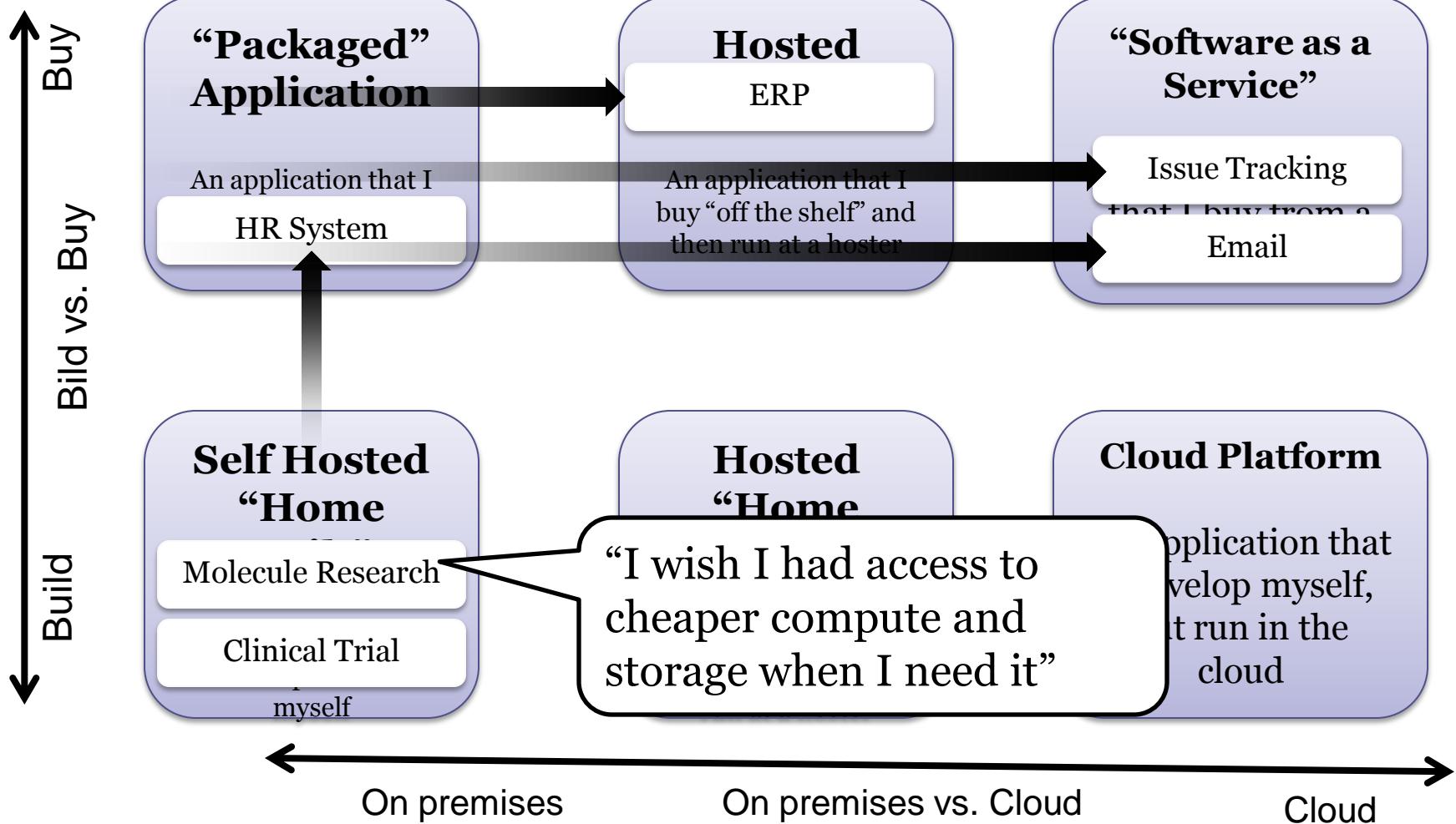


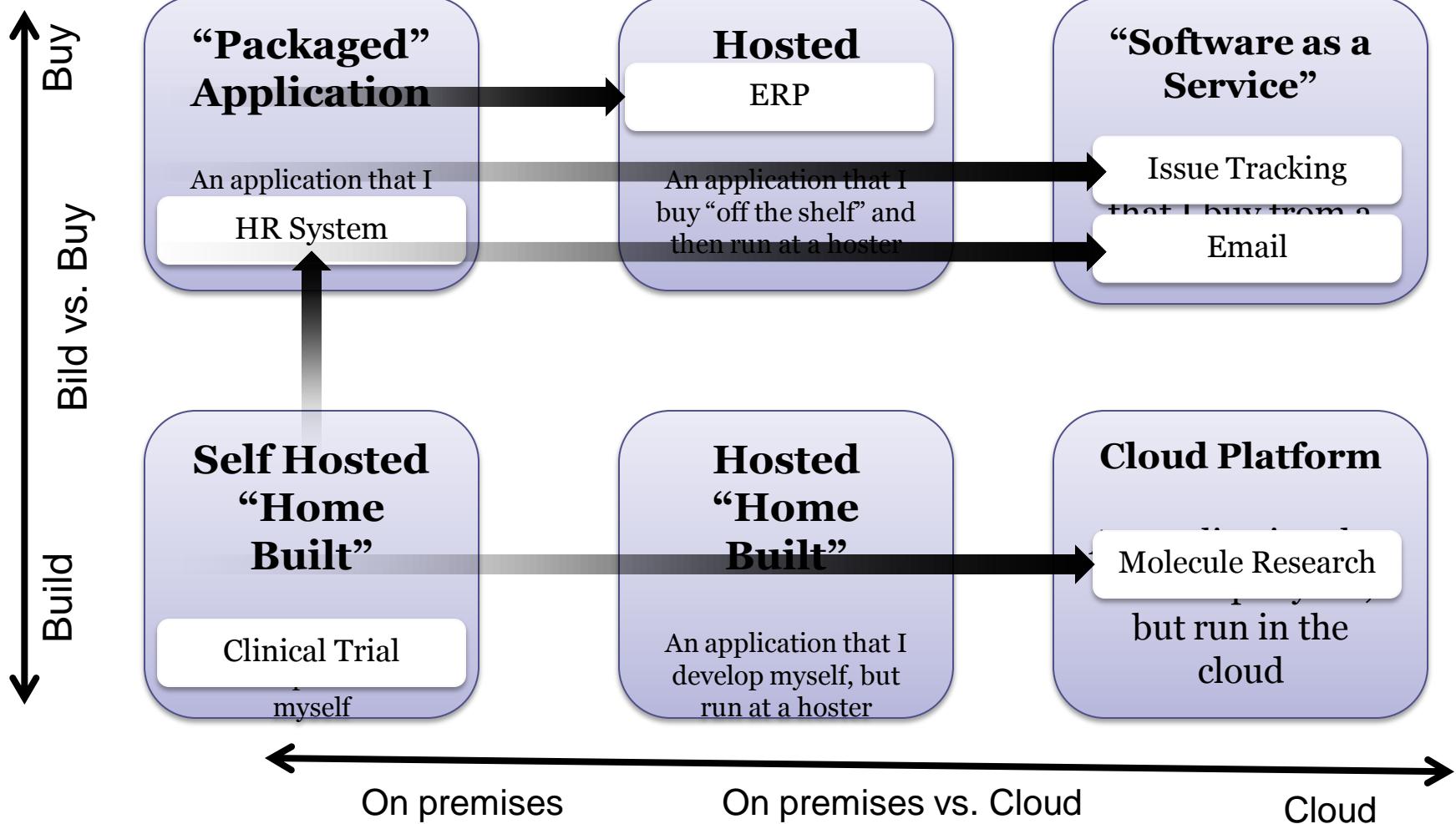
↑ Buy
Build vs. Buy
↓ Build

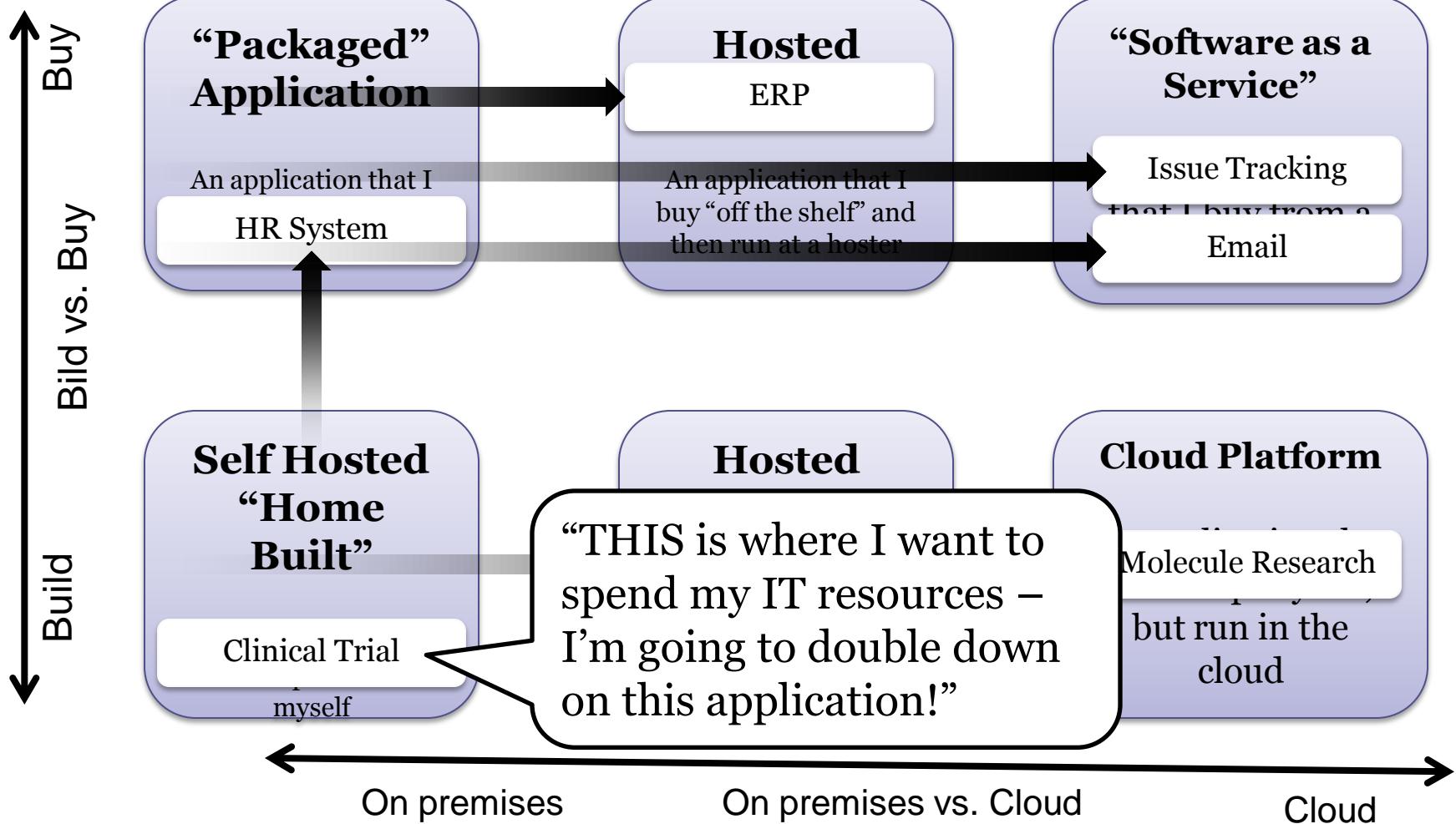


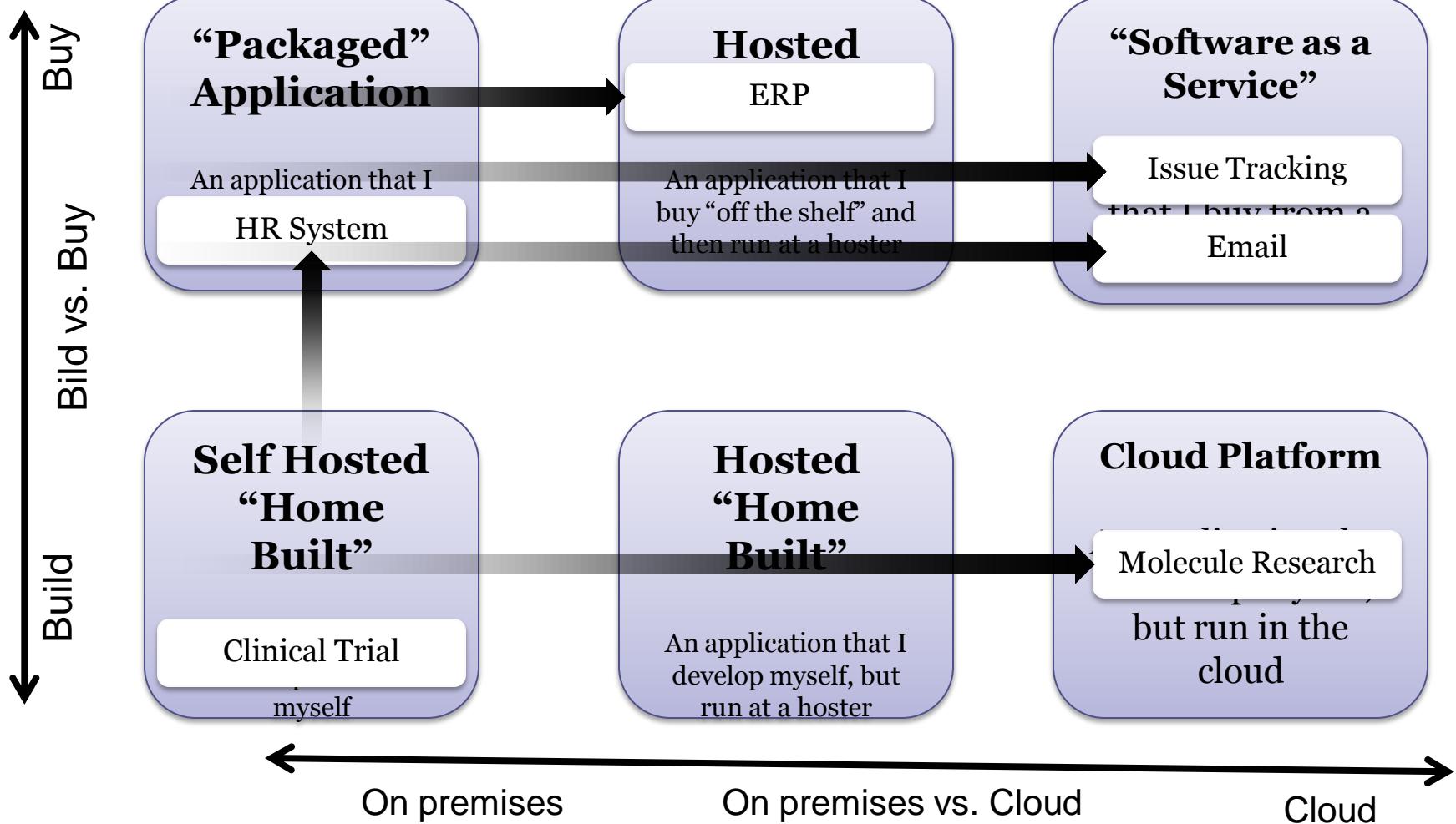
↑ Buy
Build vs. Buy
↓ Build



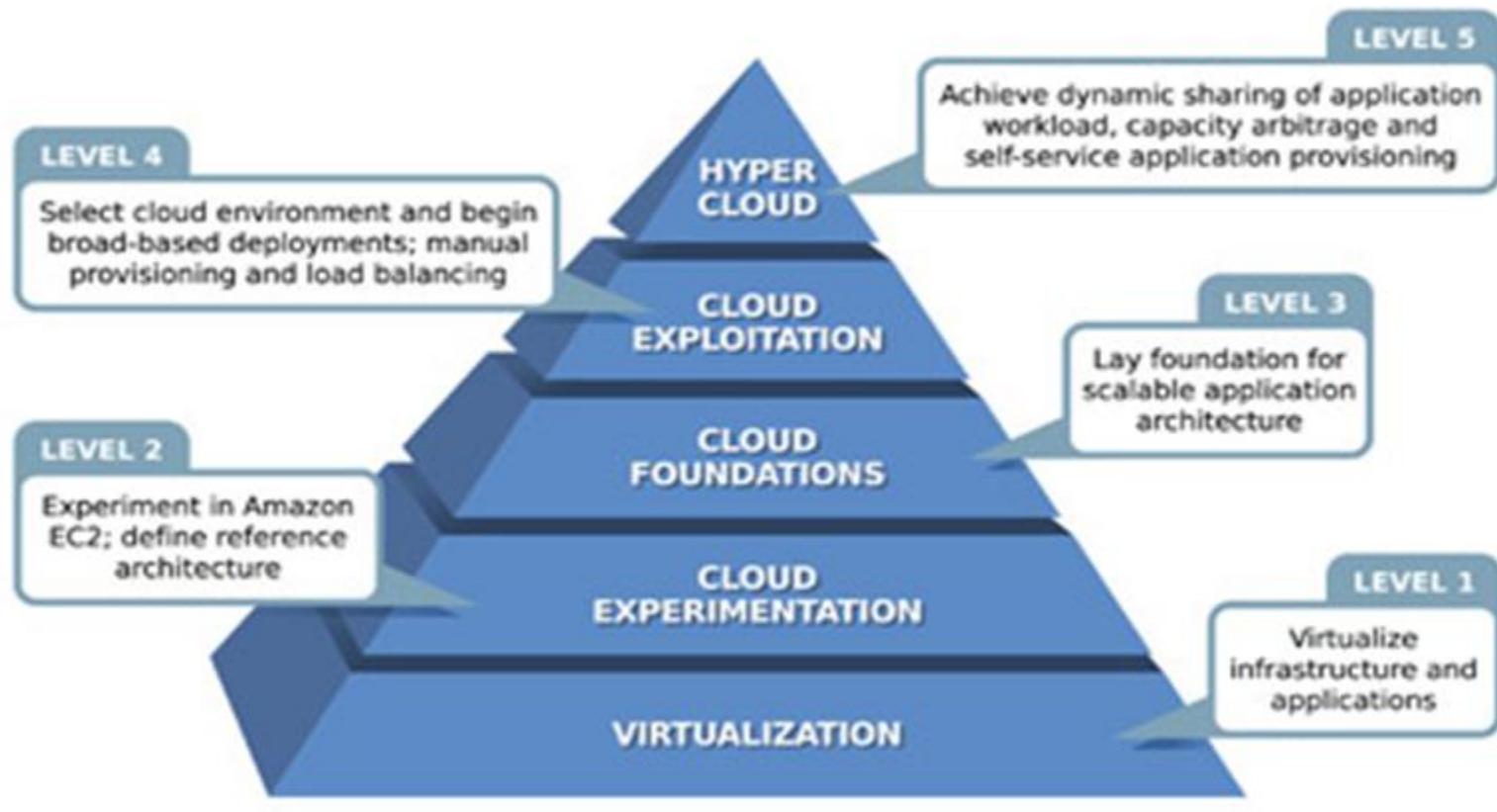








Suggested migration levels



Source: [eweek](#)

Challenges for Cloud Migration



Migrating Existing Applications



Integrating with Existing Enterprise Services and Data



Managing Risk and Perceived Risk



Addressing the Concept of SLAs



New Ways of Looking at Total Cost of Ownership



Service Management for Cloud Resources



Embracing Organisational Change



Adapting Licensing Models



How to Get Started

Cloud migration roadmap

1. Rationalize infrastructure & applications
 - Reduce the complexity by identifying redundant, outdated, or underperforming components and consolidate servers.
2. Define the cloud architecture
 - Create a cloud architecture leveraging SOA for applications, utility computing for infrastructure with appropriate standards, governance, and reference architectures
3. Build cost profiles for each application
 - Identify the costs to support, update, and operate each application on a per user basis
4. Identify and assess SaaS alternatives
 - Target SaaS alternatives offering a better economic model than internal hosting. If not available target SOA alternatives.

Cloud adaptation roadmap continues

- 5. Migrate infrastructure to a cloud bursting model
 - Further consolidate servers from just-in-case to average load provisioning using the internal pool of servers left over or an external IaaS provider to handle peak loads
 - Identify systems management gaps and discuss with vendors
- 6. Build new applications on a SOA foundation
 - Applications requiring significant development or new applications should be constructed on a SOA foundation with a particular focus on application virtualization
- 7. Create cloud enablement roadmap for retained applications
 - Define a development roadmap which migrates retained applications to a cloud model through outsourcing (SaaS), replacement (SaaS or SOA), or development (SOA).

VENDORS REVIEW

- INFRASTRUCTURE
- SOFTWARE
- SERVICES
- INTEGRATION
- LOCAL - ISP & TELCO

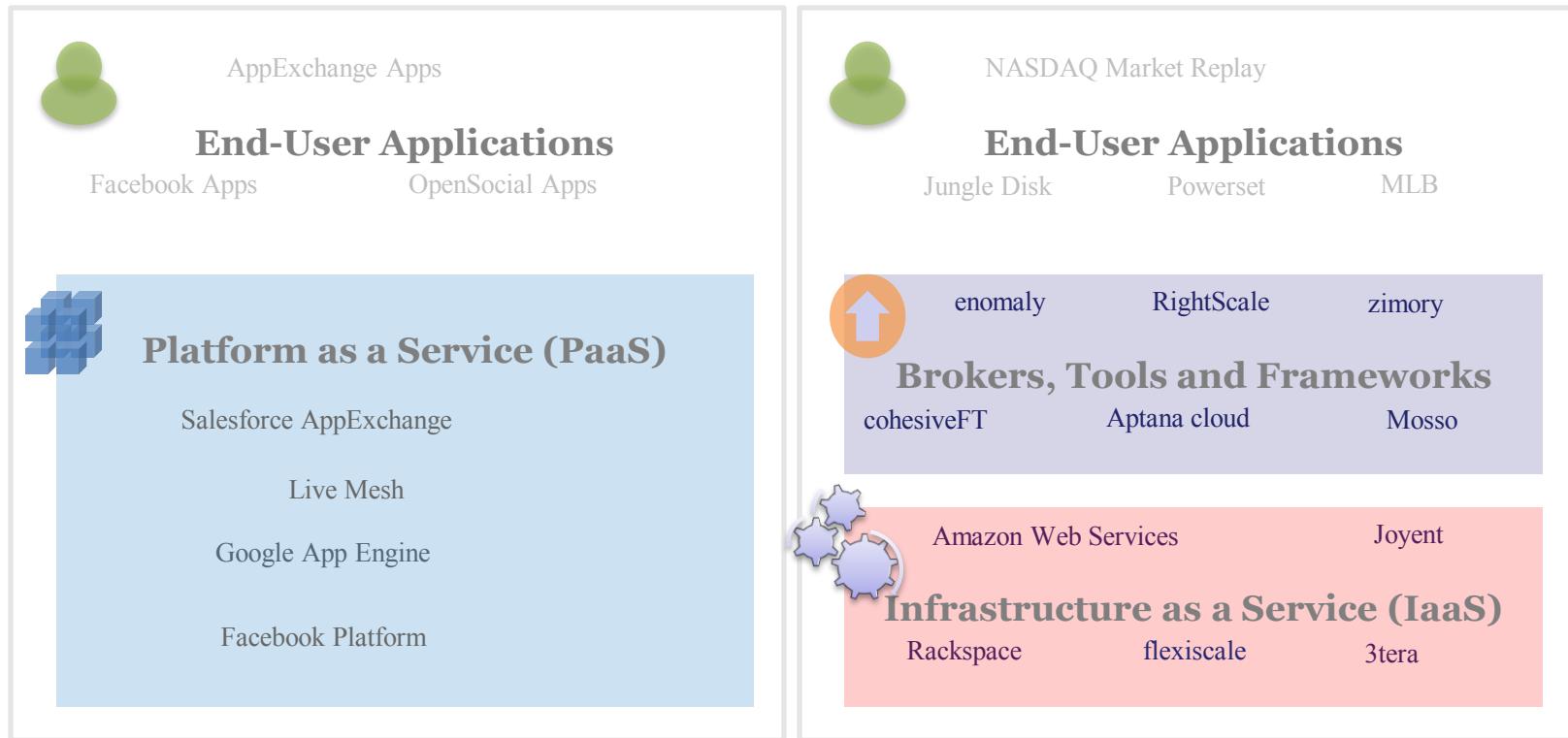


Fast Forward Your Development

www.dsp-ip.com

Cloud Ecosystem

- End-user applications, Software-as-a-Service (SaaS)
- Platform-as-a-Service (PaaS)
- Infrastructure-as-a-Service (IaaS)



The Cloud Vendors

- *The Public Cloud Vendors*
 - *Amazon*
 - *Google*
 - *Microsoft*
 - *Salesforce.com*
- *Private Cloud vendors (Data Centers)*
 - *IBM*
 - *Vmware*
 - *Sun/Oracle*
 - *3Tera*

Infrastructure Clouds

- **Private**
 - *3Tera, IBM, Vmware, Eucalyptus*
- **Public**
 - *Amazon, Rackspace, Gogrid, Joyent, Terramark*

Storage Based Clouds

- *EMC (Mozy)*
- *Nirvanix*
- *Amazon S3*
- *RackSpace Mosso Cloud Files*

AMAZON WEB SERVICES

- S3-SIMPLE STORAGE SERVICE
- EC2 - ELASTIC COMPUTE CLOUD
- MECHANICAL TURK
- SIMPLE QUEUE SERVICE

Amazon Web Services

Custom Applications and Services

Database
Amazon SimpleDB

Content Delivery
Amazon CloudFront

Messaging
Amazon Simple Queue Service (SQS)

Payments
Amazon Flexible Payments Service

On-Demand Workforce
Amazon Mechanical Turk

Compute

Amazon Elastic Compute Cloud (EC2)
Amazon Elastic MapReduce

Storage

Amazon Simple Storage Service (S3)

Amazon Web Services: proven Cloud Computing Infrastructure

▲ Infrastructure Services

- Amazon Elastic Compute Cloud (Amazon EC2)
- Amazon SimpleDB
- Amazon Simple Storage Service (Amazon S3)
- Amazon CloudFront
- Amazon Simple Queue Service (Amazon SQS)
- Amazon Elastic MapReduce
- AWS Premium Support

▲ Payments & Billing

- Amazon Flexible Payments Service (Amazon FPS)
- Amazon DevPay

▲ On-Demand Workforce

- Amazon Mechanical Turk

Online retail business

- Tens of millions of active customer accounts
- 7 countries: US, UK, Germany, Japan, France, Canada, China

Merchant Business

- Sell on Amazon.com as a merchant
- World-class logistics – multiple national fulfillment centers
- Online web presence

Technology Business (AWS)

- Access to Amazon's world class infrastructure
- Pay-per-use cost model
- 400,000 developers and businesses registered to use AWS

Amazon main services

Elastic Cloud
Service (EC2)

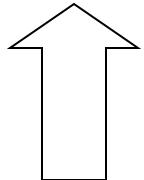
Simple Storage
Service (S3)

Simple Database
Service (SimpleDB)

Simple Queue
Service (SQS)

EC2 in a Nutshell

Cloud Platform



Machine
Image
(OS + Apps)

Usage:

- Create Machine Image
- Deploy the image to S3
- Start 1 or more instances
- Use it as regular machine(s)

Main Options:

- Dynamic/Static IPs
- Choose cores
- Choose locations
- Persistence via EBS

Sample EC2 Use Cases

Batch Processing

- All instances are configured with the same code.
- Each instance operates on a subset of data.
- Partitions are specified in configuration file.

Web Service

- All instances are configured with the same code.
- One or more instances are configured as load balancers (HAProxy for example).
- DNS Server distributes requests between load balancers.

EC2 vs. Web Hosting Company

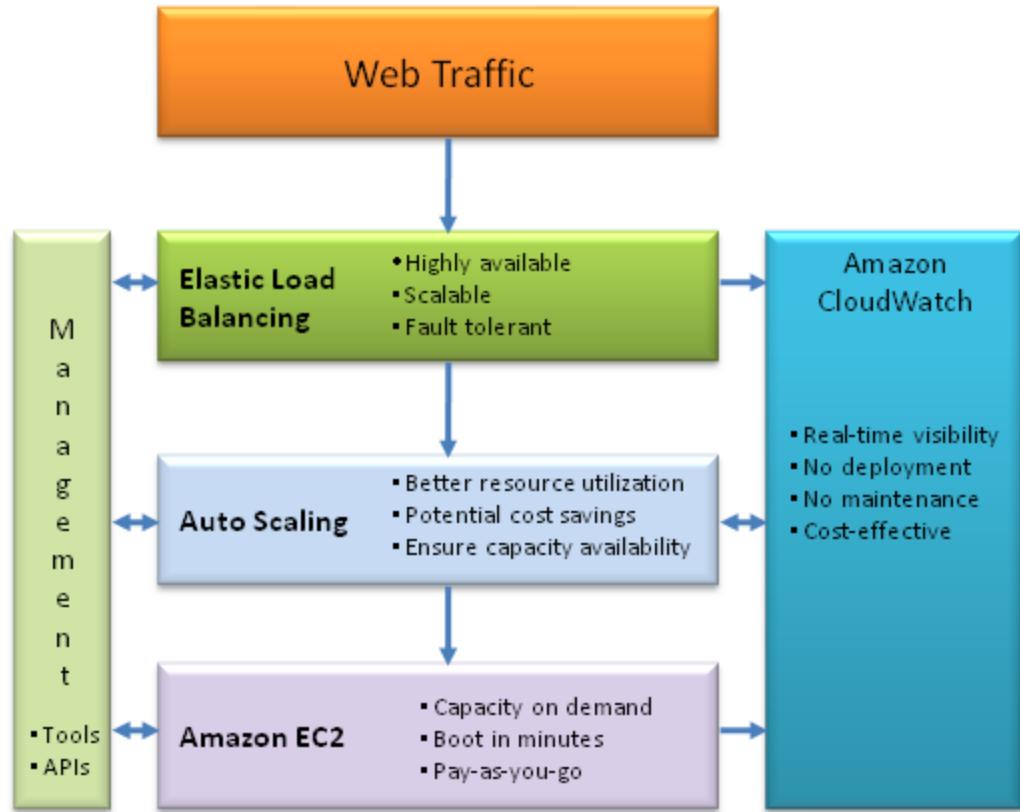
Good

- Instantly add new instances
- Full-control over the machines and choice of the environment
- Likely cheaper (but depends on your exact situation)

Bad

- Need to put the images together and manage instances
- No dedicated technical support
(but there is premium support and RightScale solutions)

Amazon EC2 services



Amazon EC2 Features

- Amazon Elastic Block store
- Multiple Locations
- Elastic IP Addresses
- Amazon Cloud Watch
- Auto scaling
- Elastic Load Balancing

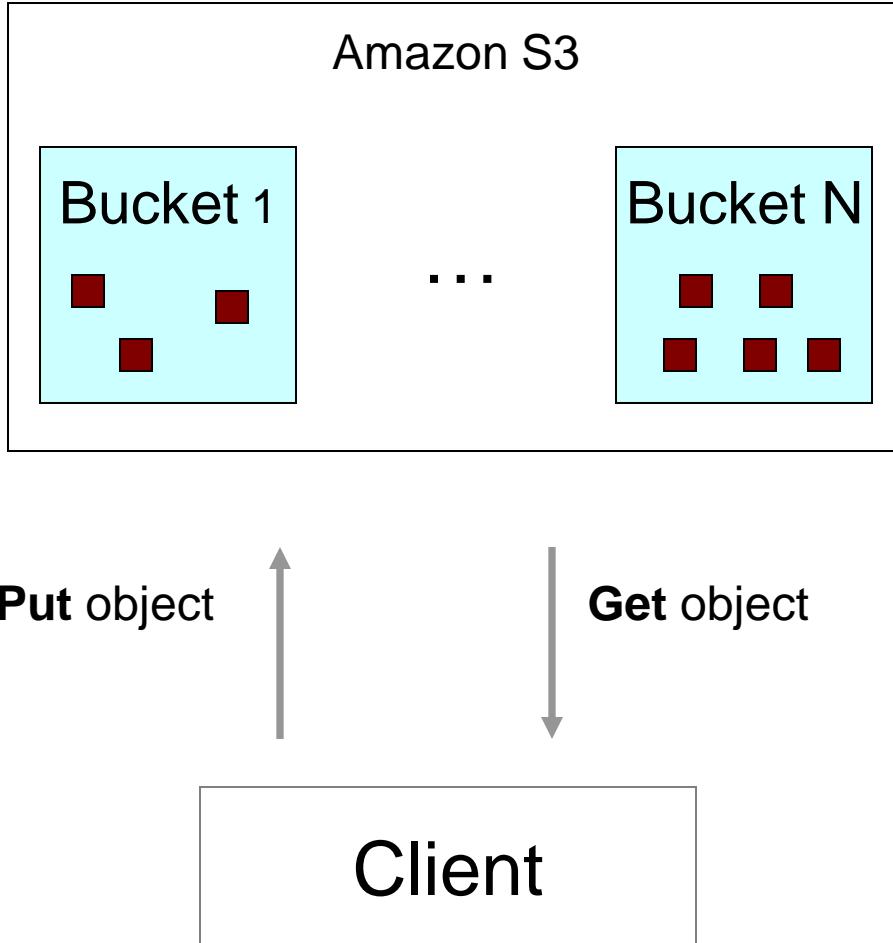
Amazon EC2 service highlights

- Elastic
- Completely controlled
- Flexible
- Designed for use with Amazon Web services
- Reliable
- Secure
- Inexpensive
- On Demand instances
- Reserved instances

Features - EC2

- Amazon Elastic Block Store (EBS) offers persistent storage for Amazon EC2 instances. Amazon EBS volumes provide off-instance storage that persists independently from the life of an instance.
- Amazon EBS volumes are highly available, highly reliable volumes that can be attached to a running Amazon EC2 instance and are exposed as standard block devices.
- Amazon EBS volumes offer greatly improved durability over local Amazon EC2 instance stores, as Amazon EBS volumes are automatically replicated on the backend (in a single Availability Zone).
- Amazon EBS provides the ability to create point-in-time consistent snapshots of your volumes that are then stored in Amazon S3, and automatically replicated across multiple Availability Zones. These snapshots can be used as the starting point for new Amazon EBS volumes, and can protect your data for long term durability.

S3 in a Nutshell



Idea:

Put/Get objects into buckets based on unique keys.

Main Features:

- Public/Private access.
- Support for large objects.

Sample S3 Use Cases

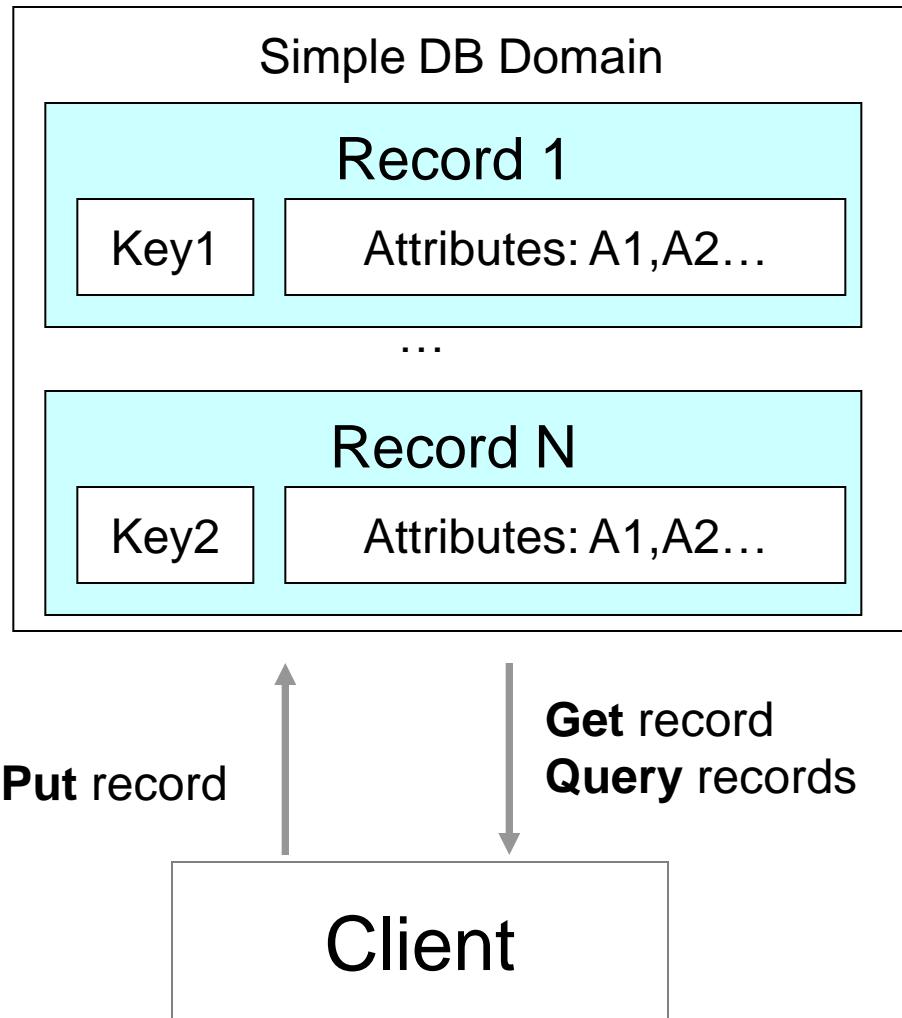
Image/Video storage

- Put your media once on S3 and then serve it up
- Reads are 10 times cheaper than writes!

Serialize your Java Objects

- Define unique key based on the object attributes
- Write out binary serialized version to a stream
- Write bytes to S3
- Read them back when needed

Simple DB in a Nutshell



Idea:

Create flat database with auto-indexed tables.

Main Features:

- Each attribute is indexed.
- Record structure is flexible.
- Basic operators in queries
- Supports sorting.

Sample SimpleDB Use Cases

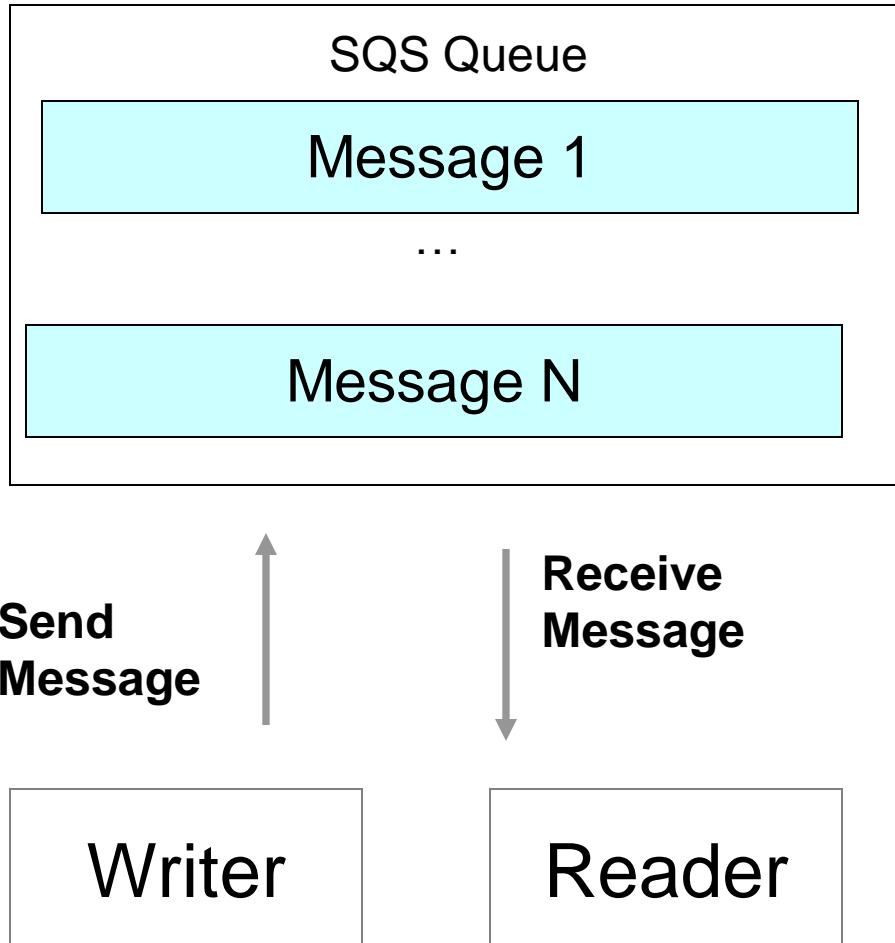
Index Media files stored on S3

- Use the same key as on S3
- Write the record with each metadata element as attribute

Store flat objects

- Use SimpleDB as a storage for non-nested data

SQS in a Nutshell



Idea:

Create an infinite asynchronous queue.

Main Features:

- Multiple queues
- Up to 4K messages
- Message Locking

Sample SQS Use Cases

Twitter Friend Update

- For each update generate a task to update friends
- Process updates in order

Publish/Subscribe

- Post messages to the queue to inform multiple subscribers

Process Pipeline

- Use different queues to put, for example, and order through a pipeline.

Amazon CloudFront Functionality

- CDN-like service, still limited in locations
- In Amazon CloudFront, objects are organized into distributions
- Distribution has a unique domain name (abc1.cloudfront.net) to reference the objects through the edge locations.
- To use Amazon CloudFront, you:
 - Store the original versions of your files in an Amazon S3 bucket.
 - Create a distribution via Amazon CloudFront API.
 - Use your distribution's domain name in your web pages or application.
 - Pay only for the data transfer and requests that you actually use.

Google AppEngine



- Write your web program in **Python** or VM based technologies including JAVA, JCS & Ruby and submit to Google. It will take care of the rest (is that good or bad?)
- How to use
 - Download AppEngine SDK
 - Develop your program locally
 - A set of python programs, input = requested url, output = return message
 - Debug locally
 - Register for an application id
 - Submit your application to Google

Google AppEngine - Hello world

- **Creating a Simple Request Handler**

Create a file `helloworld.py`:

```
print 'Content-Type: text/plain'  
print ''  
print 'Hello, world!'
```

- **Map url to handler**

Edit configuration file `app.yaml`

```
application: helloworld  
version: 1  
handlers:  
- url: /.*  
  script: helloworld.py
```

- **Data storage:**

- Distributed file system
- Store using AppEngine API, retrieve using GQL

- **Debug:** <http://localhost:8080/>

Google AppEngine

- **Register for an application ID**
 - <http://appengine.google.com>
 - Verification code sent to your mobile
- **Uploading the Application**
 - appcfg.py update helloworld/
 - Enter your Google username and password at the prompts
 - <http://application-id.appspot.com>
- **Manage using Administration Console**
 - Set up domain name
 - Invite other people to be developers
 - View error logs, traffic logs
 - Switch between different versions

128

Google AppEngine

- Characteristics
 - Easy to start, little administration
 - **Scale automatically**
 - Reliable
 - Integrate with Google user service: get user nickname, request login...
- Cost:
 - Can set daily quota
 - CPU hour: 1.2 GHz Intel x86 processor
 - Free quotas going to be reduced soon

Resource	Unit	Unit cost	Free (daily)
Outgoing Bandwidth	gigabytes	\$0.12	10GB
Incoming Bandwidth	gigabytes	\$0.10	10GB
CPU Time	CPU hours	\$0.10	46 hours
Stored Data	gigabytes per month	\$0.15	1GB (all)

EC2 vs AppEngine Comparison

- Its not a 1:1 comparison its for different needs

	Amazon	Google AppEngine
Computation model	<ul style="list-style-type: none">•x86 Instruction Set Architecture•Not scalable by default. Can use 3rd party service such as RightScale	<ul style="list-style-type: none">•Predefined 3-tiers Web app structure•Fixed language: Python•Automatic scaling up and down
Storage model	<ul style="list-style-type: none">•Scaling varies from none (EBS) to fully automatic (SimpleDB, S3)	<ul style="list-style-type: none">•Fixed API: BigTable•Automatic scaling
Networking model	<ul style="list-style-type: none">•Define network access policies•Choose availability zones, independent network failure•Elastic IP addresses, persistently routable name•Automatic scaling	<ul style="list-style-type: none">•Fixed topology to for 3-tier Web app structure•Automatic scaling



Microsoft®

Exchange Online

Microsoft®

SharePoint Online



Microsoft Dynamics

CRM Online

Azure™ Services Platform



Live Services



Microsoft® .NET Services



Microsoft® SQL Services



Microsoft® SharePoint Services



Microsoft Dynamics CRM Services



Windows® Azure™

A Look Inside Azure

Your Applications



Service Bus

Workflow

Access Control

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Microsoft SQL Services

Database

Analytics

Reporting

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Live Services

Identity

Contacts

Devices

...

...

Compute

Storage

Manage

...

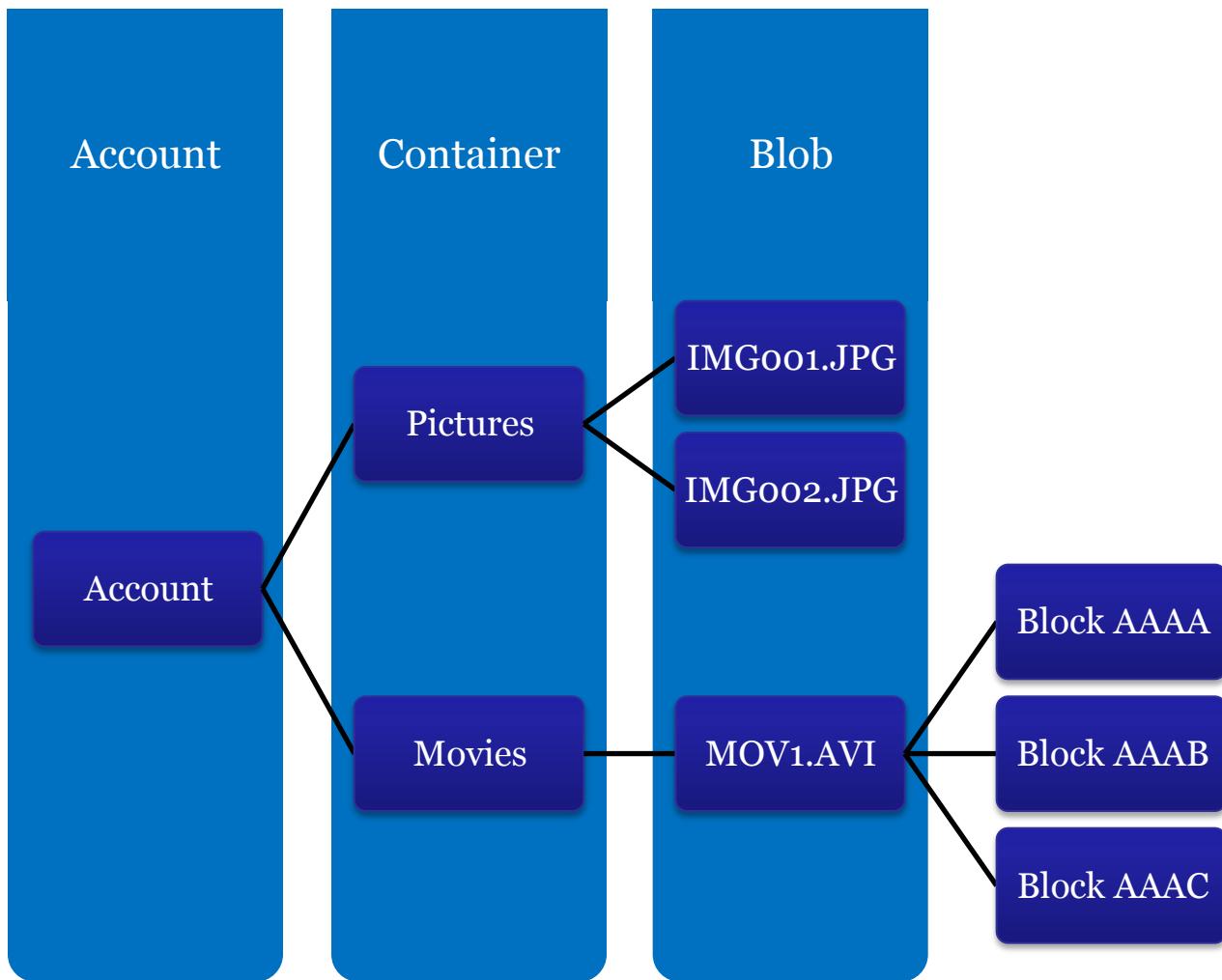


Windows Azure™

Windows Azure Storage Abstractions

- **Blobs** – provide a simple interface for storing named files along with metadata for the file
- **Tables** – provide structured storage. A table is a set of entities, which contain a set of properties
- **Queues** – provide reliable storage and delivery of messages for an application

Blob Storage Concepts



Queue Storage Concepts

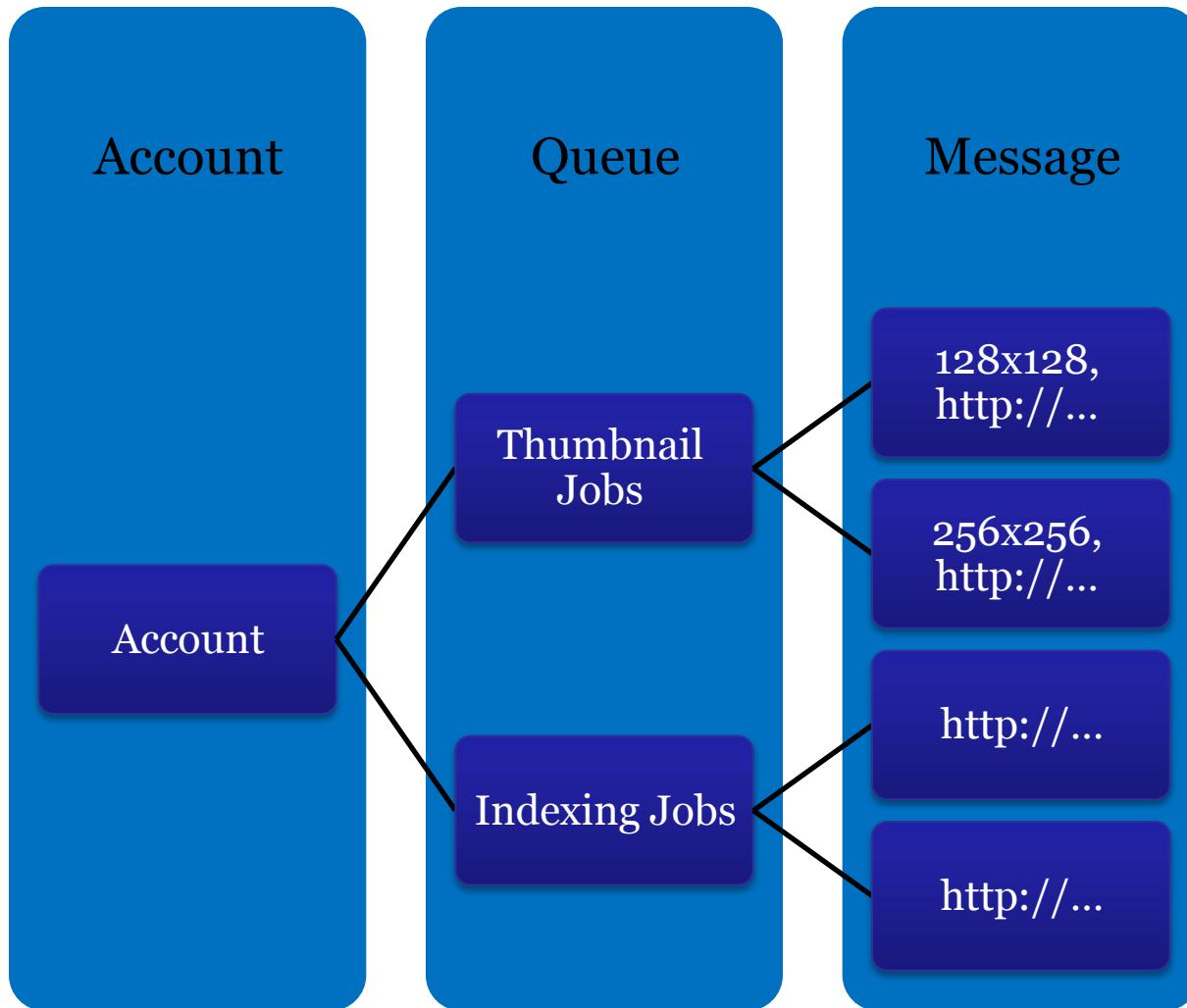
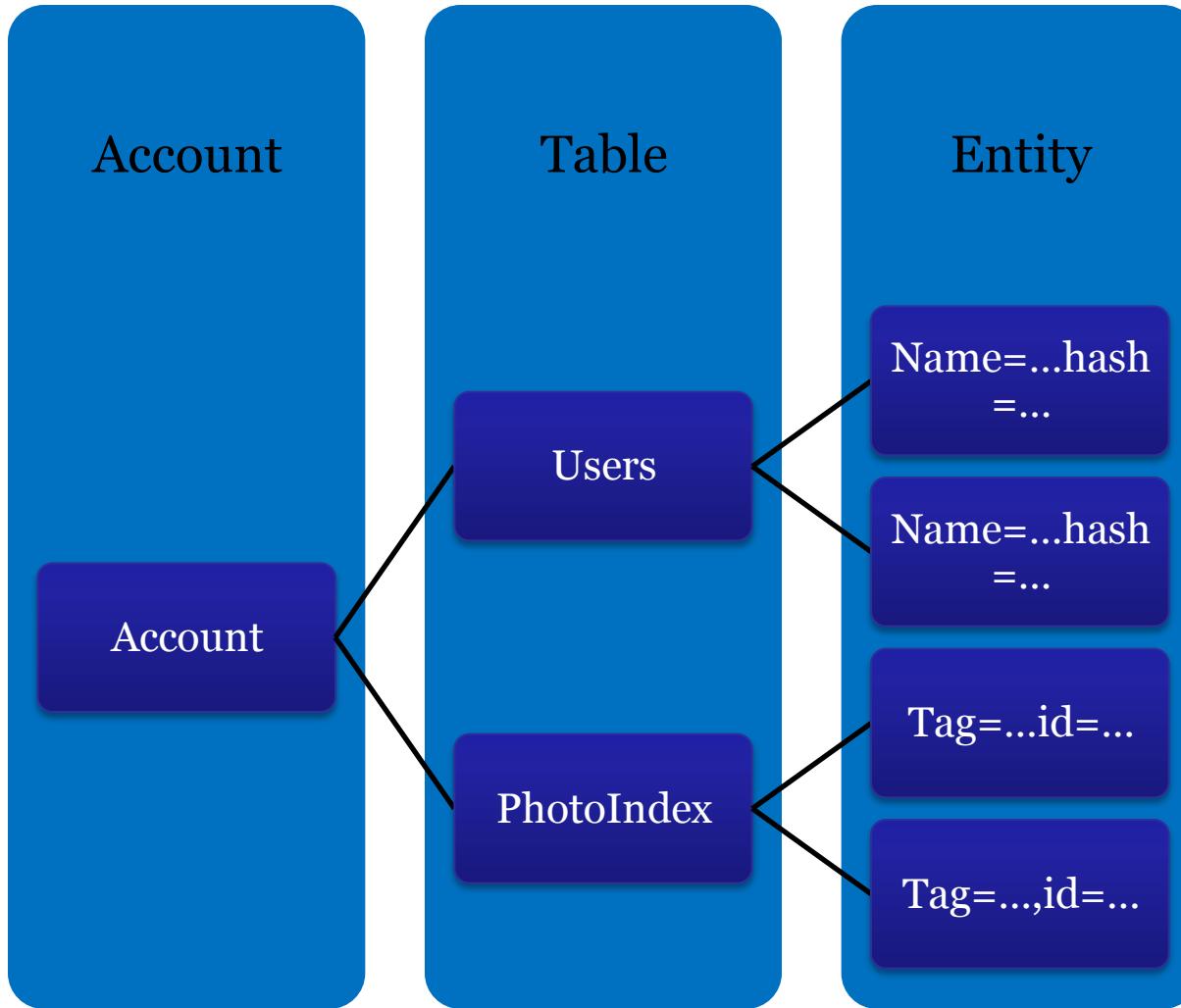
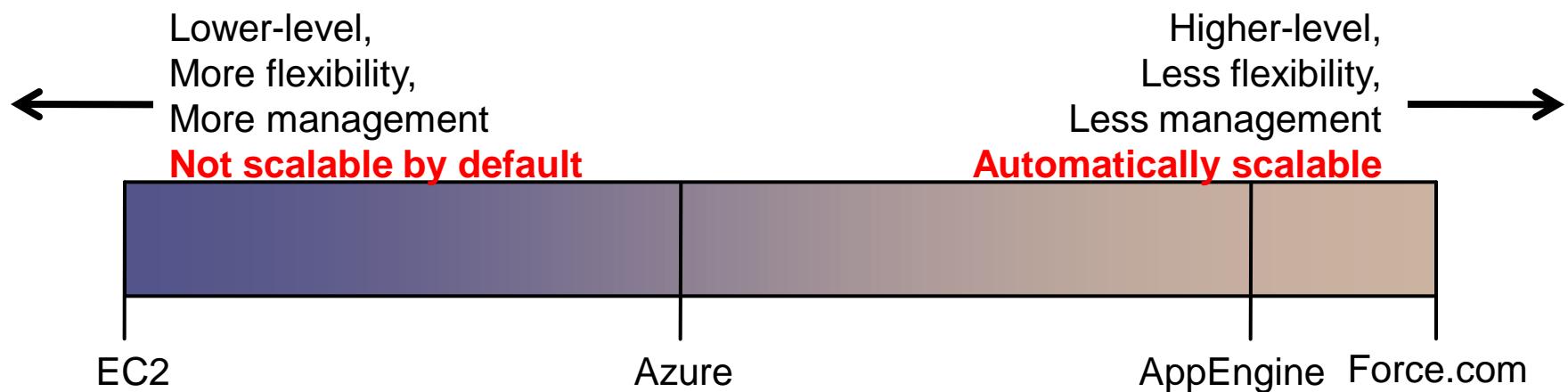


Table Storage Concepts



Spectrum of Abstractions

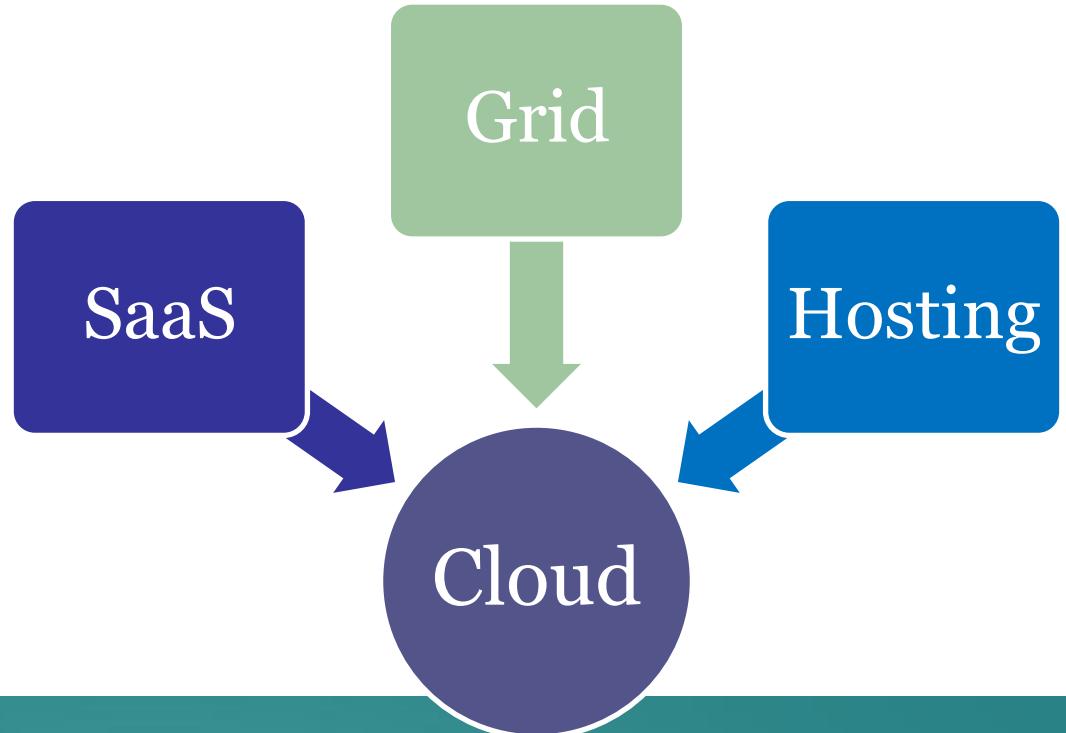
- Different levels of abstraction
 - Instruction Set VM: Amazon EC2
 - Framework VM: Google AppEngine
- Similar to languages
 - Higher level abstractions can be built on top of lower ones



Summary

Cloud Computing evolved from several technologies:

- SaaS service originating from SMB
- Grid & virtualization originating from enterprise D.C.
- Hosting and Server virtualization technologies from ISPs



Standardization

- Standardization holds a critical role in creating mass adoption of cloud computing:
 - Interoperability and vendor lock-in prevention
 - SLA definition
 - Monitoring definition
 - Security definition
 - Auditing definition

Migration and Adaptation

- IT are the business heart, don't cloud too fast
- Pay consideration to security and reliability
- Move to the cloud in steps
- Consider TCO
- Local Telcos might provide cloud services with support, consider using them

Cloud resources and useful links

- **The Open Cloud Consortium (OCC)**
 - <http://www.opencloudconsortium.org/index.html>
- **Open Cloud Manifesto**
 - <http://www.opencloudmanifesto.org/>
- **Distributed Management Task Force, Inc.**
 - <http://www.dmtf.org/home>
- **EUCALYPTUS (Open-Source website)**
 - <http://open.eucalyptus.com/>