

Services, Semantics, and Cloud

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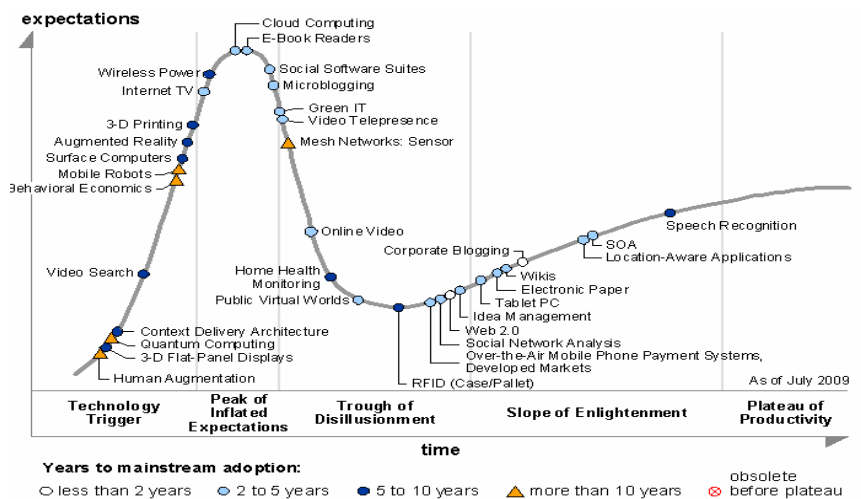
Digital Ecosystems and Business Intelligence Institute
Curtin University of Technology, Perth, Australia

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SOCA 2009

Gartner's Hyper Curve 2009

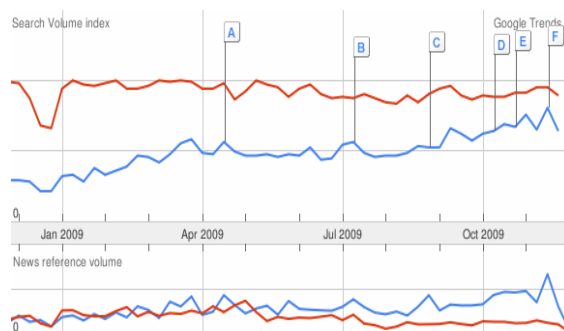


Gartner's top 10 technology areas in 2009

- Gartner identified Top 10 Technology areas for 2009
 - **Virtualization**
 - **Cloud Computing**
 - Servers: Beyond Blades
 - Web-Oriented Architectures
 - Enterprise Mashups
 - Specialized Systems
 - Social Software and Social Networking
 - Unified Communications
 - Business Intelligence
 - **Green Information Technology**

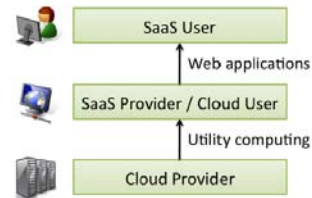
Google Trend: Cloud Computing vs. SOA

● Cloud Computing ● SOA

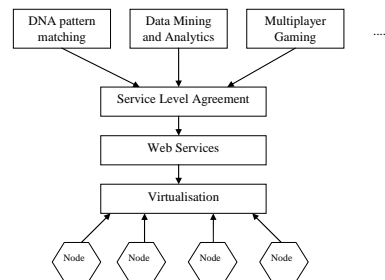
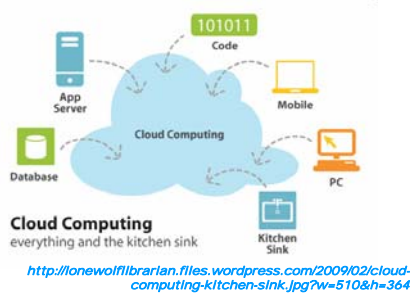


What is Cloud (Scope)?

- Service
- Platform
- Utility



Above the Clouds: A Berkeley View of Cloud Computing 2009



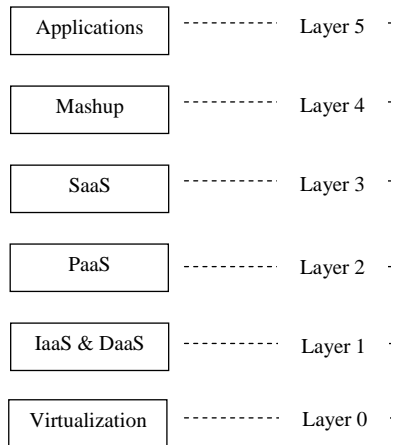
5

What is Cloud (Definition)?

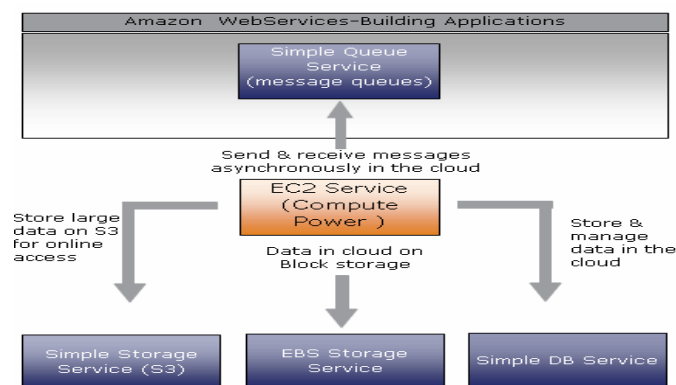
- *A Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resource(s) based on service-level agreements established through negotiation between the service provider and consumers*
(Buyya et al. 2009)
- *Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services*
- (Armbrust et al. 2009)
- So simply put
 - **Cloud** = Datacenter (Hardware + Software)
 - **Infrastructure** (hardware and middleware)
 - **Platform** (System software)
 - Cloud computing = **SaaS** + **Cloud**

6

Layered-architecture of Cloud



Amazon Cloud Realization



<http://www.telkte.com/images/amazon.gif>

SalesForce Cloud Realization



<http://www.salesforce.com>

9

Key characteristics in eyes of Cloud users

- Elasticity
 - No up-front commitment and contract – pay as you go
 - You use it whenever you want, and let it go once you finish
 - Scale up and down – computing on-demand
 - Scale horizontally – various services on-demand
 - Infinite, Immediate, and Invisible computing resources
- Service Level Agreement and QoS
 - Negotiation
- Robust and reliable
- Ubiquitous access
- Unawareness of which resources being used
- Availability

10

Key enabling technologies

- Virtualization
 - Virtual Machines
 - Virtual Clusters
 - Virtual Network overlays
- Parallelization
 - MapReduce
- Web services
 - WSDL, SOAP, and REST
- Distributed and Unlimited Storage
 - Google MegaStore/BigTable
 - Amazon EBS/SimpleTable
- Networking
 - VPN (for Private Cloud)

Cloud can benefit Service Computing research

- Service development on Cloud
 - Google AppEngine
 - Global Software Development with Cloud Platforms
- Service testing on Cloud
 - *Cloud-Testing@CloudIntelligence*
- Service deployment on Cloud (Service Cloud)
 - Amazon Machine Image
- Service integration/mashup/composition on Cloud
 - Yahoo Pipes
- Business process outsourcing through Cloud

Service can benefit Cloud Computing research

- ***WS- * may provide insight for cloud computing***
- Service Description for Cloud Service
 - WSDL is currently being used
 - More description languages will be used
- Service Discovery for Cloud Service
 - Various service discovery models can leveraged
 - More support for SLA, QoS, security (thru various WS-*)
- Service Composition for Cloud Service
 - Holy-grail of service-oriented computing
 - A great deal of research in this area can be applied
- Service Management for Cloud Service
 - SOA governance principles can be adapted

SOA

- Architectural style
 - standard interfaces
 - decoupled coupling
- A high level of abstraction: Integration/Process-oriented
- What's missing in SOA for SMEs?
 - No standard computation models (Computing-oriented)
 - How to run my services with minimum cost?
 - how to scale up/down my services applications?
 - How to maximize the utilization of my IT services in order to support my business services
- In our previous work
 - We propose the notion of SoftGrid, which
 - add services into computation models (SoftGrid)
 - Similar to OGSA, but add the notion of Space

Cloud and SOA

- Distributed computing paradigms
- How to see these two
 - Are they at the same technical/business level?
 - Do they aim to achieve the same goal?
 - Can they be employed at the same time?
 - If so, how?
- We believe that Cloud provides a practical approach for SMEs to accelerate and consolidate the realization of SOA through the facilitation of
 - Service development
 - Service testing
 - Service deployment
 - Service composition/mashup
 - Business process outsourcing

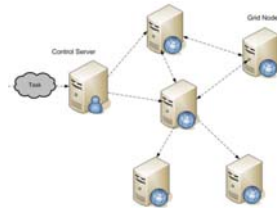
15

Cloud and Grid

- Similarity
 - Resource virtualization
- Differences
 - Grid emphasizes the “resource sharing” to form a virtual organization
Cloud is often owned by a single physical organization, who allocates resources to different running instances
 - Grid wants to provide the maximum computing capacity for a huge task through resource sharing
Cloud wants to suffice as many small-to-medium tasks as possible based on users' real-time requirements
 - Grid trades re-usability for (scientific) high performance computing
Cloud is pulled by business requirements in the first place
 - Grid asks for maximum computing
Cloud is after on-demand computing – Scale up and down

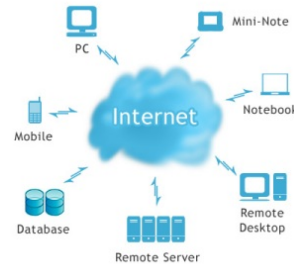
16

Grid Computing



- *Federation*
- *Single task*
- *Maximum capacity*
- *Virtual organization*

Cloud Computing



- *Logically Centralized*
- *multi tasks, multi-tenants*
- *Overall capacity*
- *Physical organization*

17

Cloud and High Performance Computing

- Scientific Applications vs. Business Applications
 - State dependency
 - Data dependency
- The current Cloud is not geared for HPC
 - not yet matured enough for HPC
 - like Cluster computing, Cloud infrastructure focuses on enhancing the overall system performance as a whole
 - HPC aims to enhance the performance of a specific scientific application using resources across multiple organizations
- The key difference lies in ***elasticity***
 - For cluster computing, the capacity is often **fixed**
 - For cloud computing, we often do not know a-prior how many processors do we need

18

Public Cloud

- IaaS

INFRASTRUCTURE AS A SERVICE



- PaaS

PLATFORM AS A SERVICE



- "Every day more than 3,000 businesses sign up for Google Apps and move to the cloud"

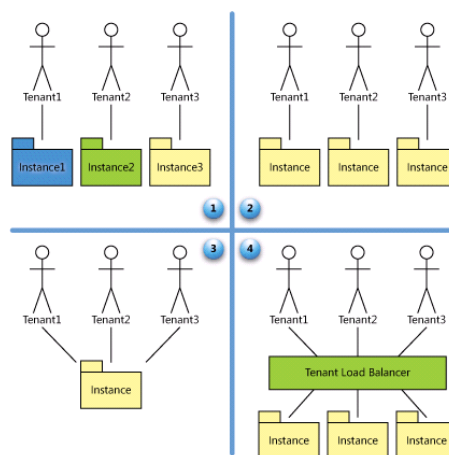
- SaaS

SOFTWARE AS A SERVICE



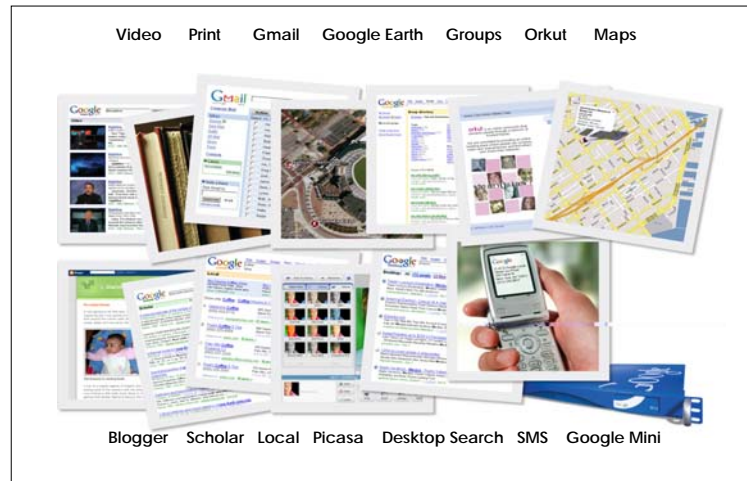
More on SaaS – Multi-tenancy

- Level 1:
 - Ad-Hoc/Custom
- Level 2:
 - Configurable
- Level 3:
 - Configurable
 - Multi-Tenant-Efficient
- Level 4:**
 - Scalable,
 - Configurable
 - Multi-Tenant-Efficient



Source: Microsoft MSDN Architecture Center

Google SaaS family



21

Apple SaaS Cloud – iTunes University

- A section of Apple's iTunes Store
- Designed for higher education to store and disseminate
 - institutional content,
 - course work, or
 - other multimedia materials



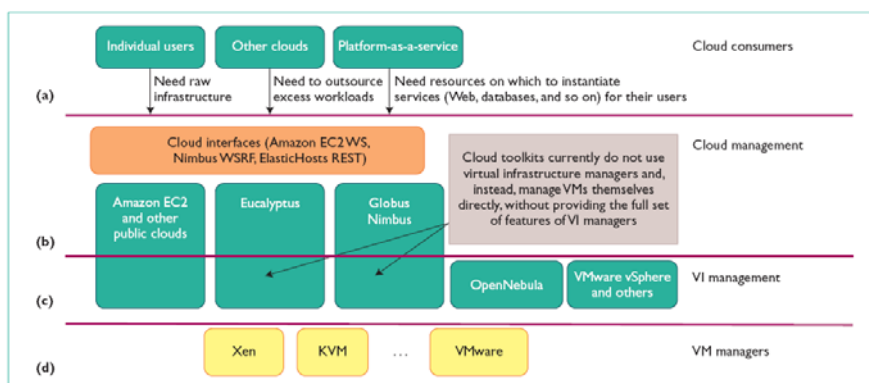
22

Private Cloud

- Why do we need private cloud ?
 - Security, Privacy & Trust
 - Data transfer cost
 - Fixed Cost vs. Variable Cost
 - Everything is under control
- Amazon Private Cloud

Hybrid Cloud

- Virtual Machine vs. Virtual Infrastructure



Sotomayor et al. 2008

Cloud: Outside-in

- Services
 - computational power
 - storage
 - business applications
 - **XaaS**
- Interface
 - SOAP and WSDL
 - RESTful
- Resource representation
 - Semantics for Cloud services and parameters
 - Dependencies

25

Cloud: Inside-out

- Virtualization
 - Virtualization saves Microsoft customers on average half a million per year
- Resource Management
- Metadata and Semantics
- Parallelization
 - Optimal parallelisation models for different types of applications/domain or programming styles
 - Internode communication
- Lifecycle management
- Testing, Monitoring, Diagonosis, and Verification

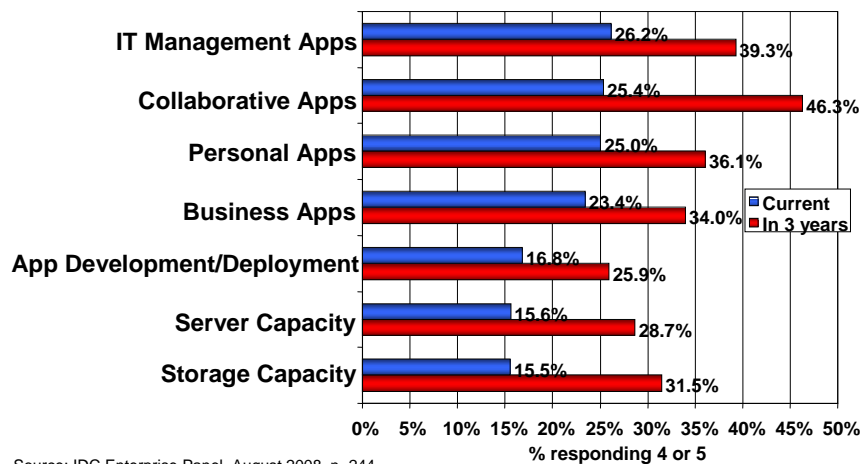
26

Cloud: Socio-Technical and Economical Impact

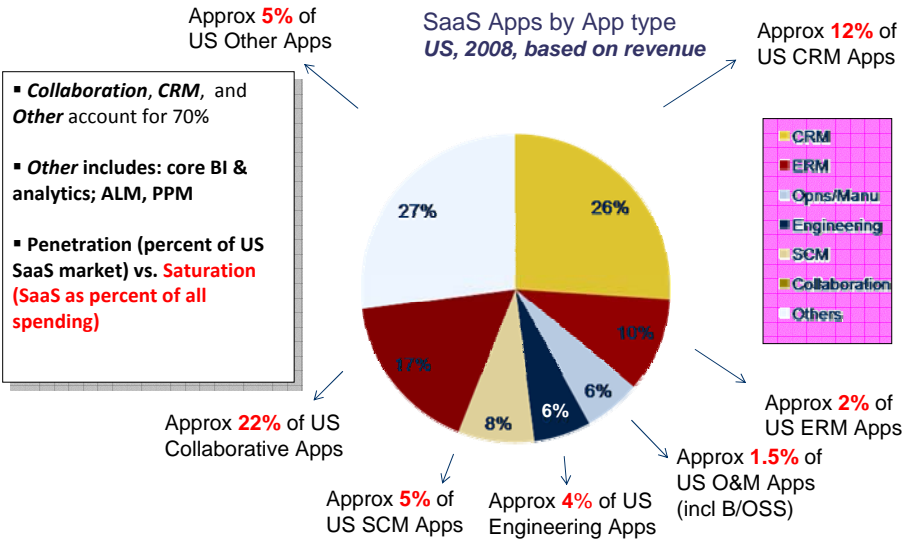
- Controllable vs. Uncontrollable
- Multi-tenant data architecture
 - Security
 - Privacy
 - Authentication
- Costing
 - basic load vs. peak load
 - Data transfer cost
- What types of applications are more suitable to be moved to cloud?
 - Website
 - CRM Systems
 - etc.

Moving to the cloud – What to move?

- Q: Current and future level use of cloud services in your organization? (1=none, 5=widespread)



US SaaS Market Composition & Penetration



Source: IDC SaaS Adoption Survey, November 2008. n= 200 US-based IT Director and above, and 200 LOB Director and above.

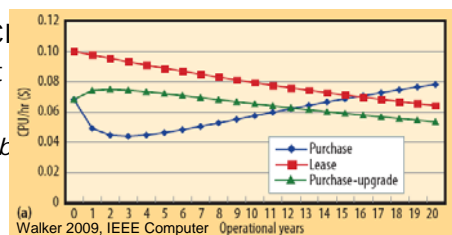
Moving to the cloud – Cost of moving

Amazon Public Cloud Cost

Instance T	Memory	Compute Units	Storage	Platform	Linux CPU/Hour	Windows CPU/Hour
Small	1.7GB	1	160GB	32-bit	\$0.10	\$0.125
Large	7.5GB	4	850GB	64-bit	\$0.40	\$0.50
Extra Large	15GB	8	1690GB	64-bit	\$0.80	\$1.00
High CPU, Medium	1.7GB	5	350GB	32-bit	\$0.20	\$0.30
High CPU, Large	7GB	20	1690GB	64-bit	\$0.80	\$1.20

Costing a plan

- Fixed cost (if using hybrid CI)
- Variable cost (Compute unit)
- Data Transfer cost
 - Application should always be...
- Long term value of CPUs



Open problems

- Decomposition
 - Data dependency makes it extremely complicated
 - Top-level decomposition to lower-level ones
 - How to estimate complexity of existing algorithms?
- Costing Optimization
 - Long-term costs of cloud development
- Vulnerability issues
 - Security of providers access to user data
 - Trustworthiness of providers (Amazon warrants 99.95% uptime)
 - Security of data placement
 - Security of data representation
 - Recoverability of data
 - Tracking of illicit activities on the cloud
 - "Vendor" lock-in

Some directions for SOA researchers

- Service Description and Discovery
- Service Level Agreement
- Security and Data privacy
- Service Composition/Integration
- Emergent Specification

Services and Cloud in Australia

- Cloud Computing at Peta-scale working group (since 2008)
- Australian Research Collaboration Service (2009 – 2013, \$ 97 million)
- Cooperative Research Centres (CRC)
 - A proposal on “Cloud-based Applications”

Cloud in the future

- Three possible scenarios (Nelson 2009)
 - Many cloud
 - Hazy cloud
 - Open cloud

M. Nelson, "Building an Open Cloud," *Science*, vol. 324, p. 1656, 2009

Thank you for your attention!