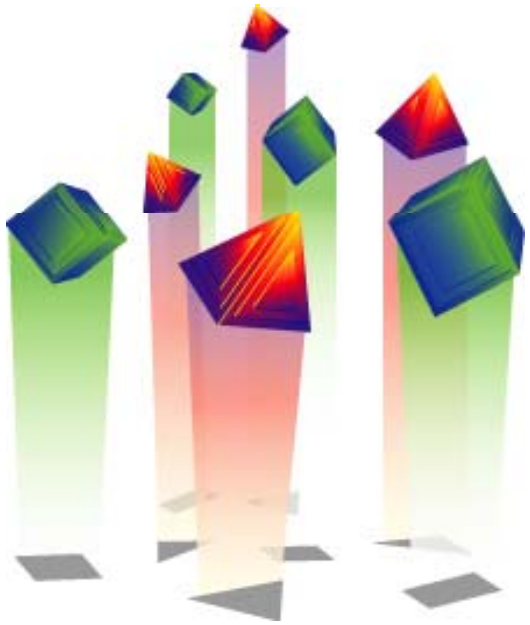
Cloud: Infrastructure

Share Session Boston



Laura Knapp
WW Business Consultant
Laurak@aesclever.com
650-617-2400

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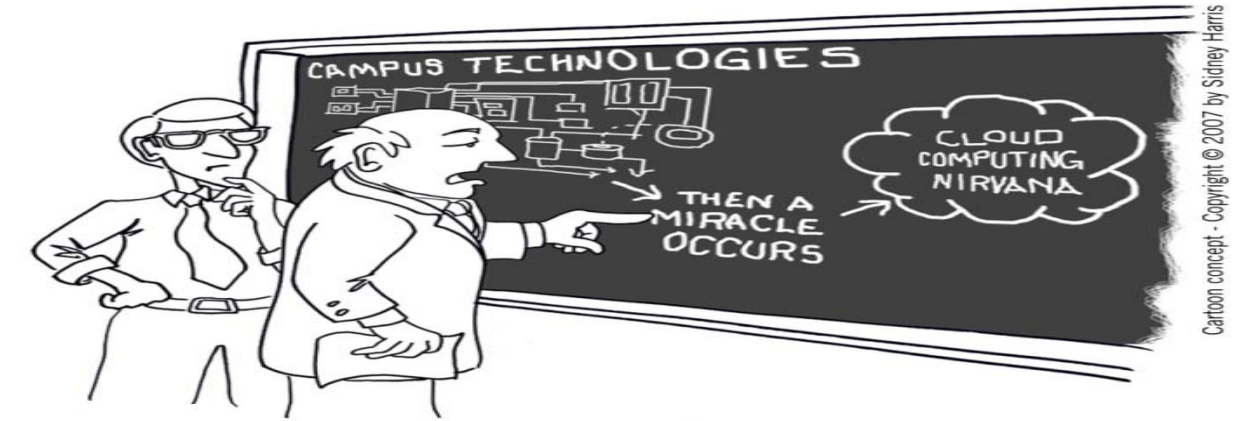
Cloud Computing Defined

Cloud Computing Model

Cloud Computing Security



"I think you should be more explicit here in step two."

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What is cloud computing?

- *I don't understand what we would do differently in the light of Cloud Computing other than change the wordings of some of our ads*

Larry Ellision, Oracle's CEO

- *I have not heard two people say the same thing about it [cloud]. There are multiple definitions out there of "the cloud"*

Andy Isherwood, HP's Vice President of European Software Sales

- *It's stupidity. It's worse than stupidity: it's a marketing hype campaign.*

Richard Stallman, Free Software Foundation founder

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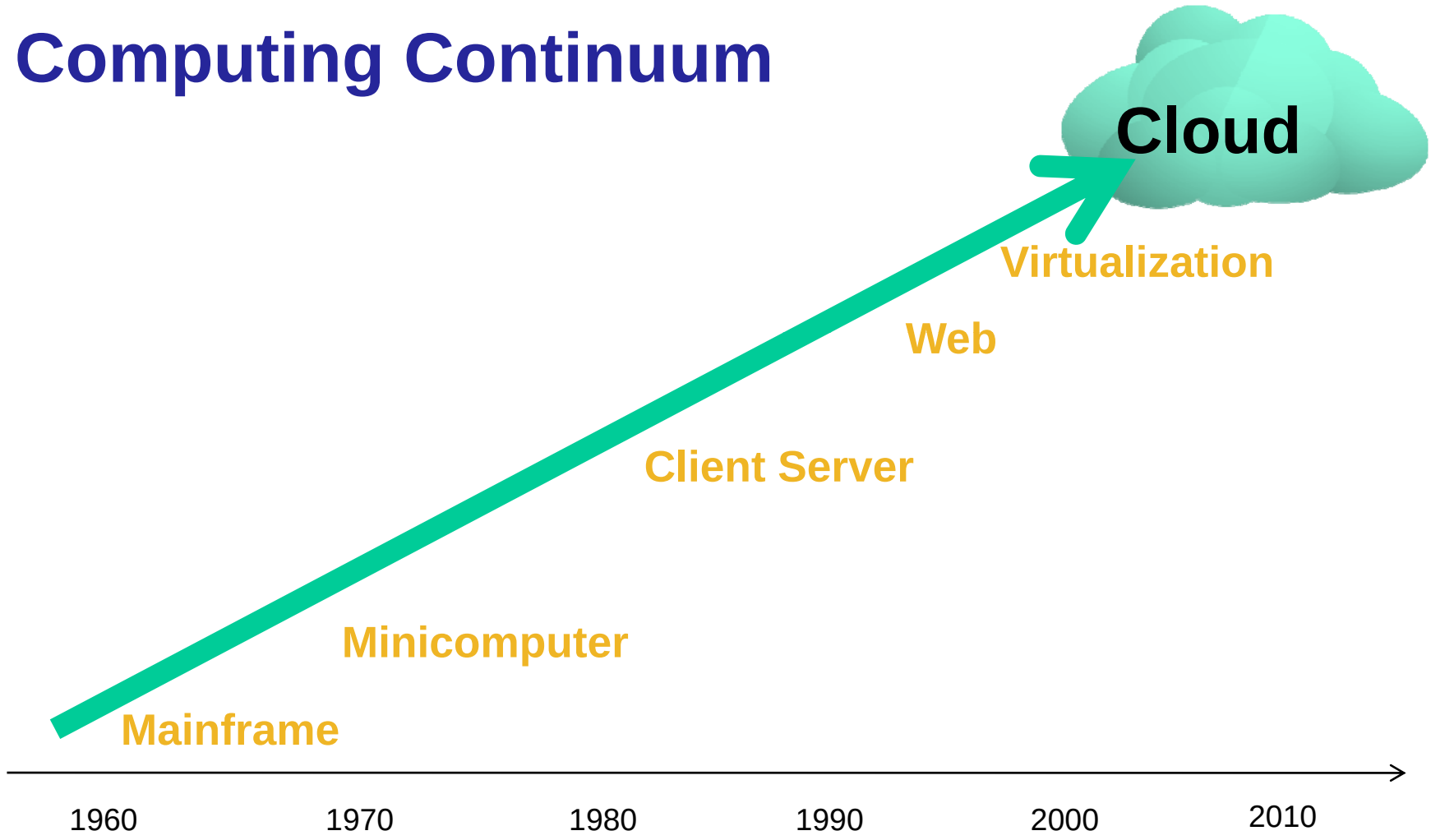
Computing Continuum



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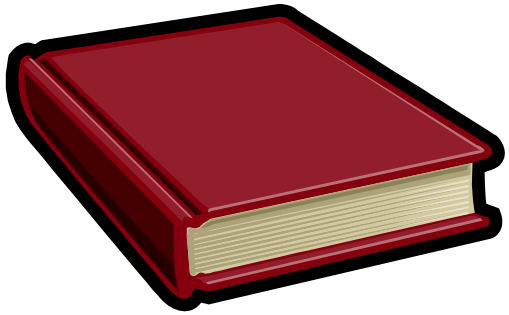
Definitions



From WikipediA:

"Cloud Computing is a style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet. Users need not have knowledge of, be expert in, or have control over the technology infrastructure in the "cloud" that supports them."

Resources and services that are abstracted from the underlying infrastructure and provided "on-demand" and "at scale" in a multi-tenant environment

Not to be confused with

- Grid Computing – a form of distributed computing
- Utility Computing – packaging of computing resources such as computing power, storage, also a metered services
- Autonomic computing – self managed

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Why Cloud

BENEFIT	COMMENT
Cost Savings	Organizations can reduce or eliminate IT capital expenditures and reduce ongoing operating expenditures by paying only for the services they use and, potentially, by reducing the size of their IT staffs.
Ease of Implementation	Without the need to purchase hardware, software licenses, or implementation services, an organization can implement cloud computing rapidly.
Flexibility	Cloud computing offers more flexibility (often called “elasticity”) in matching IT resources to business functions than past computing methods. It can also increase mobility of staff by allowing them to access business information and applications from a wider range of locations and/or devices.
Scalability	Organizations using cloud computing need not scramble to secure additional hardware and software when user loads increase, but can instead add and subtract capacity as the network load dictates.
Access to Top-End IT Capabilities	Particularly for smaller organizations, cloud computing can allow access to hardware, software, and IT staff of a caliber far beyond that which they can attract and/or afford for themselves.
Redeployment of IT Staff	By reducing or doing away with constant server updates and other computing issues, and eliminating expenditures of time and money on application development, organizations may be able to concentrate at least some of their IT staff on higher-value tasks.
Focusing on Core Competencies	Arguably, the ability to run data centers and to develop and manage software applications is not necessarily a core competency of most organizations. Cloud computing may make it much easier to reduce or shed these functions, allowing organizations to concentrate their efforts on issues central to their business such as (in government) the development of policy and design and delivery of public services.
Sustainability	The poor energy efficiency of most existing data centers, due to substandard design or inefficient asset utilization, is now understood to be environmentally and economically unsustainable. Cloud service providers, through leveraging economies of scale and their capacity to managing computing assets more efficiently, can consume far less energy and other resources than traditional data center operators.

Source: IBSG 2009

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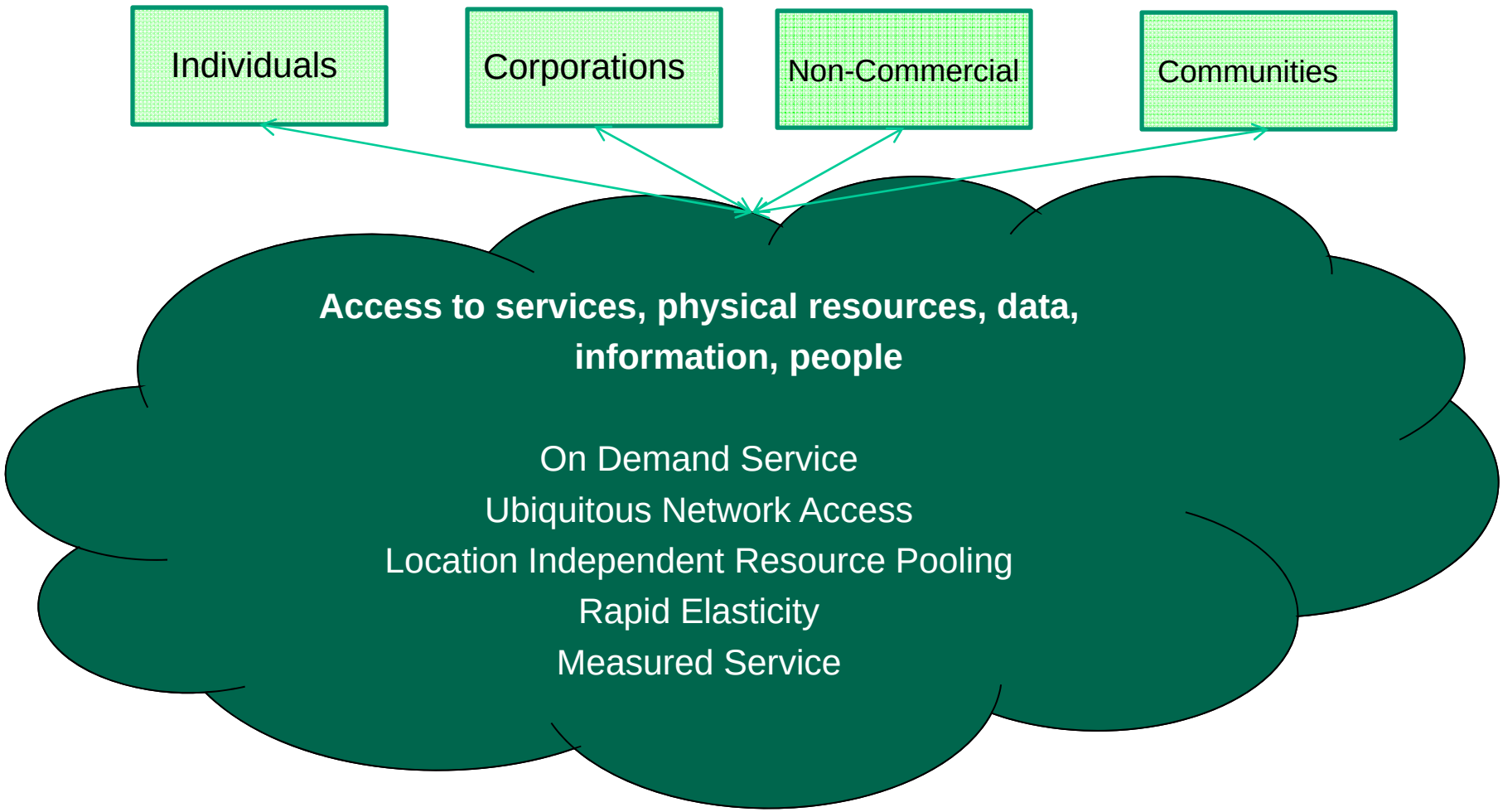
What is a Cloud?



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Common Cloud Models

Model	Capability Provided	Example Services
SaaS (End User)	To use the provider's applications running on a cloud infrastructure and accessible from various client devices through a thin client interface such as a Web browser	▪ Citizen Engagement (Wikis, Blogs, Data.gov) ▪ Government Productivity (Cloud based tools) ▪ Business Enablement (Salesforce.com) ▪ Enterprise Applications (Core Mission & Business Svcs
PaaS (Application Developers)	To deploy onto the cloud infrastructure consumer-created applications using programming languages and tools supported by the provider (e.g., java, python, .Net)	▪ Database and Database Management Systems ▪ Developer / Testing Tools ▪ Virtual Environments
IaaS (Network Architects)	To provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications	• Computing • Storage • Application hosting

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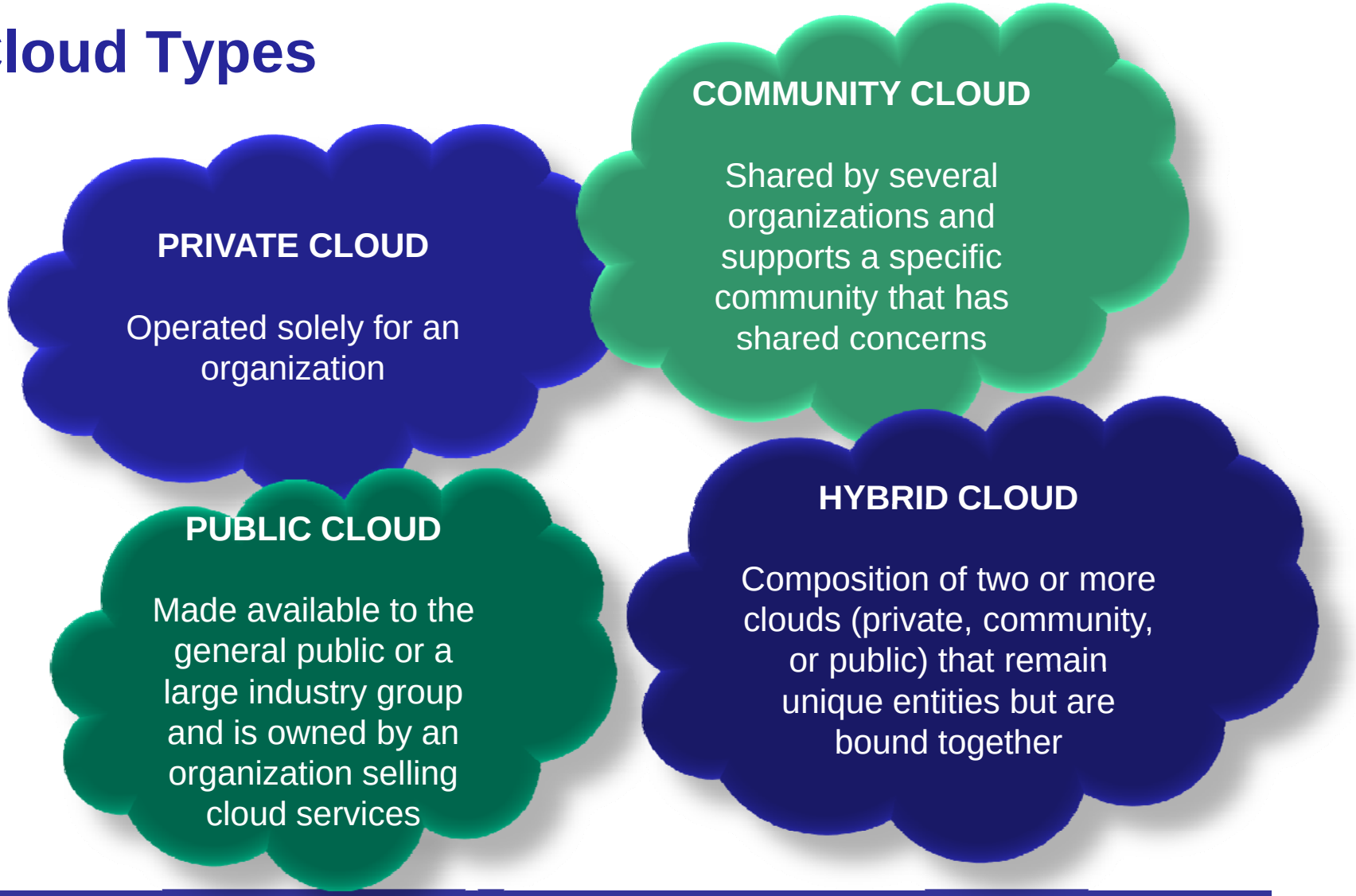
Cloud Types



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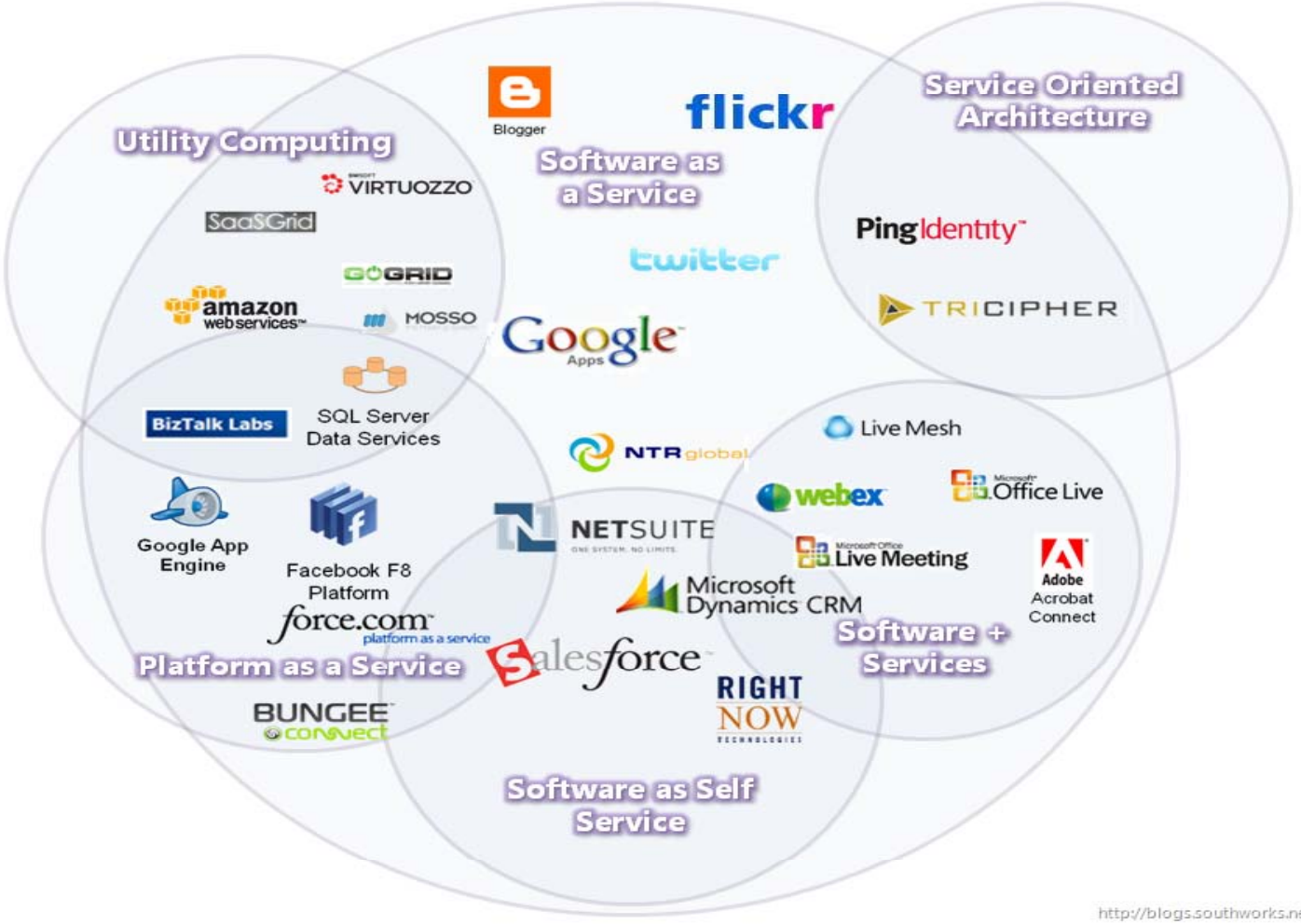
Commercial Clouds



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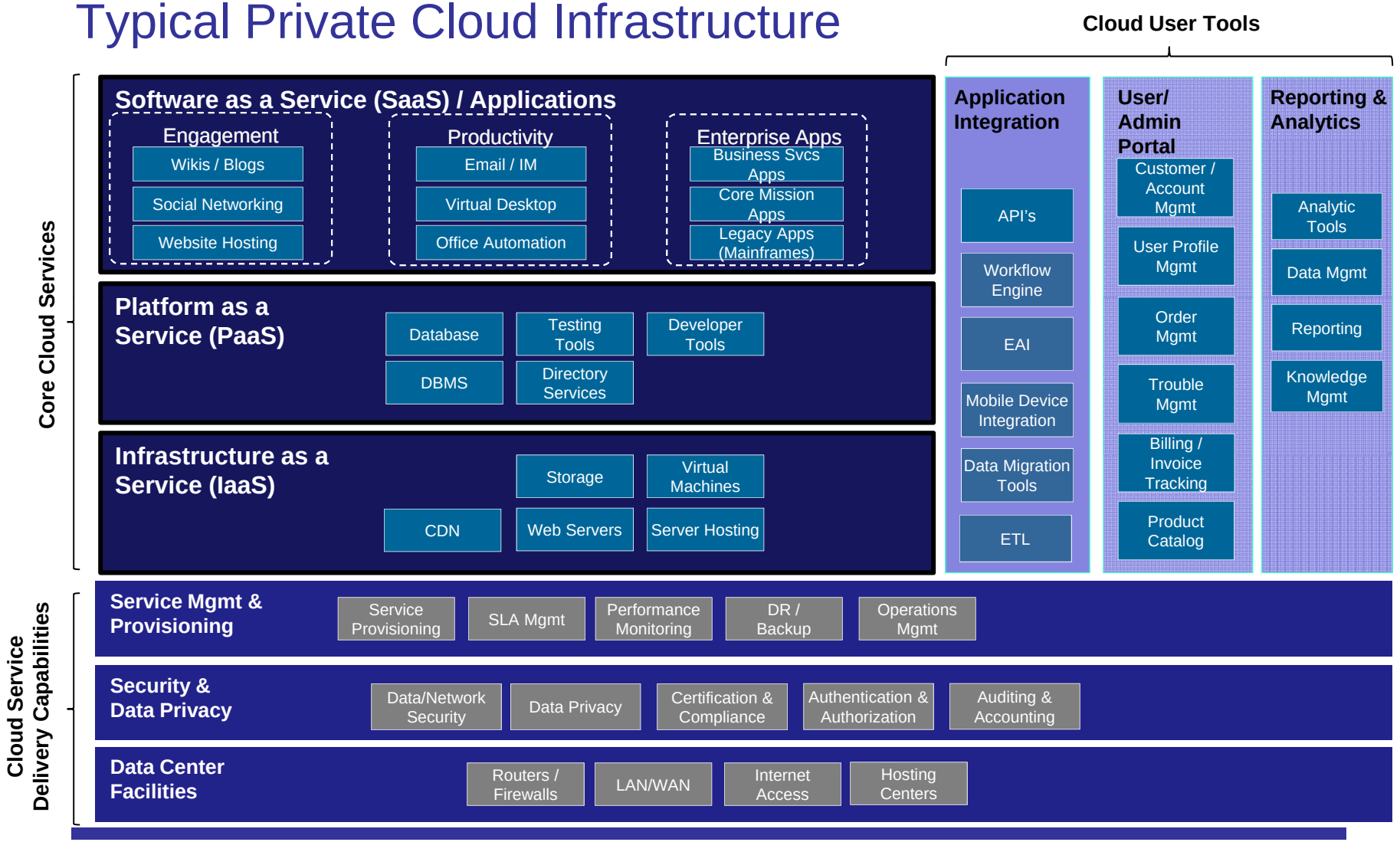
Typical Private Cloud Infrastructure



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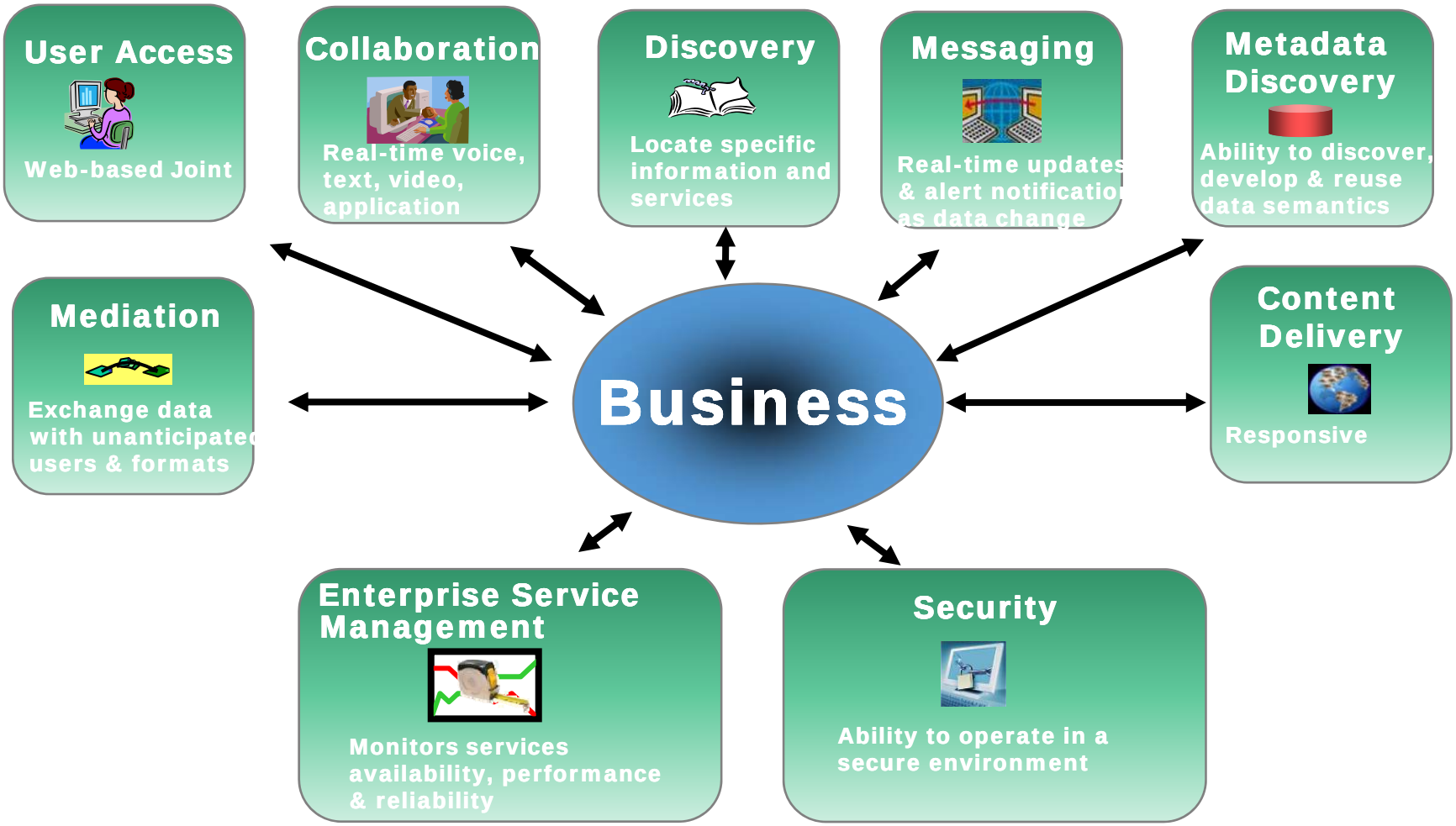
Core Business Services



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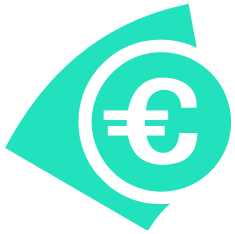
Should I move into a cloud

- Does it really save money?

$$\text{UserHours}_{\text{cloud}} \times (\text{revenue} - \text{Cost}_{\text{cloud}}) \geq \text{UserHours}_{\text{datacenter}} \times (\text{revenue} - \frac{\text{Cost}_{\text{datacenter}}}{\text{Utilization}})$$

  - $Cost_{cloud} > Cost_{datacenter}$, balance by *Utilization*
  - $UserHours_{cloud} > UserHours_{datacenter}$ (under-provisioning)

- Other factors
  - Re-implement programs
  - Move data into cloud
  - Regulatory compliance



- Example:
  - Upload rate 20Mbits / s. 500GB takes 55 hours
  - If can process locally in less than 55 hours → moving into a cloud would not save time

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Cloud Economics

- Estimates vary widely on possible cost savings
  - "If you move your data center to a cloud provider, it will cost a tenth of the cost." – Brian Gammage, Gartner Fellow
- Use of cloud applications can reduce costs from 50% to 90% - CTO of Washington D.C.
- IT resource subscription pilot demonstrated a 28% cost savings - Alchemy Plus cloud (backing from Microsoft)
- "Using Cloud infrastructure saves 18% to 28% before considering that you no longer need to buy peak capacity" – George Reese, founder Valtira and enStratus
- When implementing Cloud you must consider other costs which may not be apparent today

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Adoption Challenges

Challenge	Opportunity
Availability	Multiple providers
Data lock-in	Standardization
Data Confidentiality and Auditability	Encryption, VLANs, Firewalls

- Coghead, a cloud vendor closed its business in 2009
  - Customers need to rewrite their applications
- Online storage service The Linkup closed July 10, 2008
  - 20,000 paying subscribers lost their data

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Growth Challenges

Challenge	Opportunity
Data transfer bottlenecks	FedEx-ing disks, reuse data multiple times
Performance unpredictability	Improved VM support, flash memory
Scalable storage	Invent scalable storage
Bugs in large distributed systems	Invent debugger using distributed VMs
Scaling quickly	Invent auto-scaler

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Policy and business challenge

Challenge	Opportunity
Reputation Fate Sharing	Offer reputation-guarding services like those for email
Software Licensing	Pay-for-use licenses; Bulk use sales

- Reputation: Many blacklists use IP addresses and IP ranges
- Software licensing:
  - Open source software readily applicable
  - Microsoft and IBM software offered per hour for EC2

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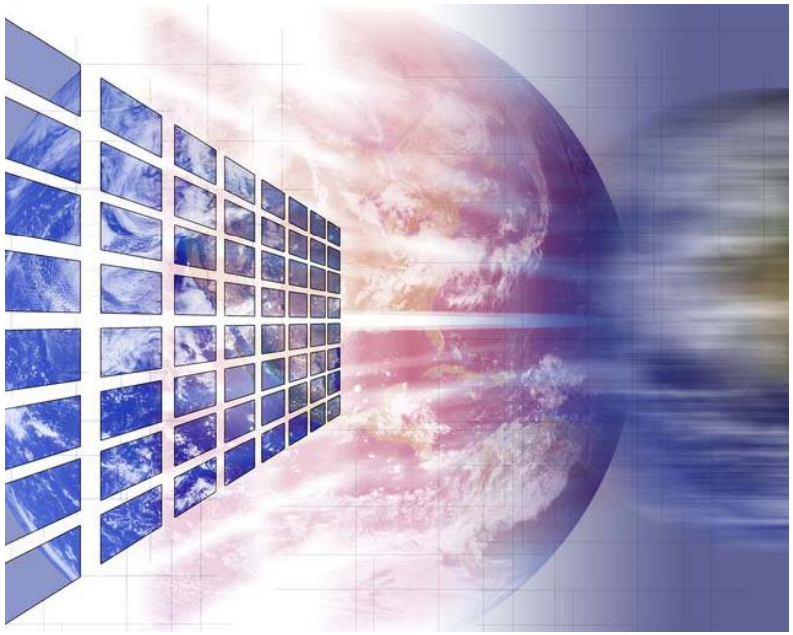
Cloud versus Hosting Services



Three distinct characteristics that differentiate clouds from traditional hosting

- Cloud is sold on demand
  - Typically by the minute or the hour
- Cloud is elastic
  - A user can have as much or as little of a service as they want at any given time
- A cloud service is fully managed by the provider
  - The consumer needs nothing but a personal computer and Internet access

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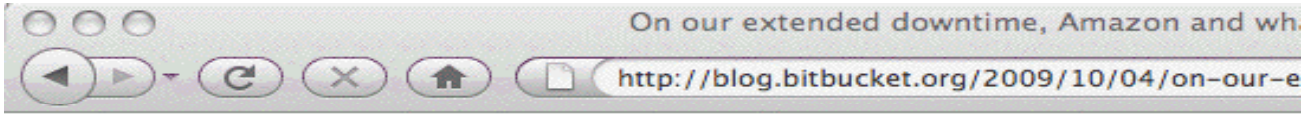
Amazon Off the Air



On our extended downtime, Amazon and what's coming

As many of you are well aware, we've been experiencing some serious downtime the past couple of days. Starting Friday evening, our network storage became virtually unavailable to us, and the site crawled to a halt.

We're hosting everything on Amazon EC2, aka. "the cloud", and we're also using their EBS service for storage of everything from our database, logfiles, and user data (repositories.)

Amazon EBS is a persistent storage solution for EC2, where you get high-speed (and free) connectivity from your instances, while it's also replicated. That gives you a lot for free, since you don't have to worry about hardware failure, and you can create periodic "snapshots" of your volumes easily.

While we were down, it was unknown to us what exactly the problem was, but it was almost certainly a problem with the EBS store. We've been working closely with Amazon the past 24 hours resolving the issue, and this post will outline what exactly went wrong, and what was done to remedy the problem.

Symptoms

What we were seeing on the server was high load, even after turning off anything that took up CPU. Load is a result of stuff "waiting to happen", and after reviewing iostat, it became apparent that the "iowait" was very high, while the "tps" (transactions per second) was very low for our

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Gmail Outage

More on today's Gmail issue

Tuesday, September 01, 2009 6:59 PM
Posted by Ben Treynor, VP Engineering and Site Reliability Czar

Gmail's web interface had a widespread outage earlier today, lasting about 100 minutes. We know how many people rely on Gmail for personal and professional communications, and we take it very seriously when there's a problem with the service. Thus, right up front, I'd like to apologize to all of you — today's outage was a Big Deal, and we're treating it as such. We've already thoroughly investigated what happened, and we're currently compiling a list of things we intend to fix or improve as a result of the investigation.

Here's what happened: This morning (Pacific Time) we took a small fraction of Gmail's servers offline to perform routine upgrades. This isn't in itself a problem — we do this all the time, and Gmail's web interface runs in many locations and just sends traffic to other locations when one is offline.

However, as we now know, we had slightly underestimated the load which some recent changes (ironically, some designed to improve service availability) placed on the request routers — servers which direct web queries to the appropriate Gmail server for response. At about 12:30 pm Pacific a few of the request routers became overloaded and in effect told the rest of the system "stop sending us traffic, we're too slow!". This transferred the load onto the remaining request routers, causing a few more of them to also become overloaded, and within minutes nearly all of the request routers were overloaded. As a result, people couldn't access Gmail via the web interface because their requests couldn't be routed to a Gmail server. IMAP/POP access and mail processing continued to work normally because these requests don't use the same routers.

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Sidekick Loses Data

T-Mobile: we probably lost all your Sidekick data

By Chris Ziegler posted Oct 10th 2009 3:45PM

BREAKING

Well, this is shaping up to be one of the biggest disasters in the history of cloud computing, and certainly the largest blow to Danger and the Sidekick platform: T-Mobile's now reporting that personal data stored on Sidekicks has "almost certainly has been lost as a result of a server failure at Microsoft/Danger." They're still looking for a way to recover it, but they're not giving users a lot of hope -- meanwhile, servers

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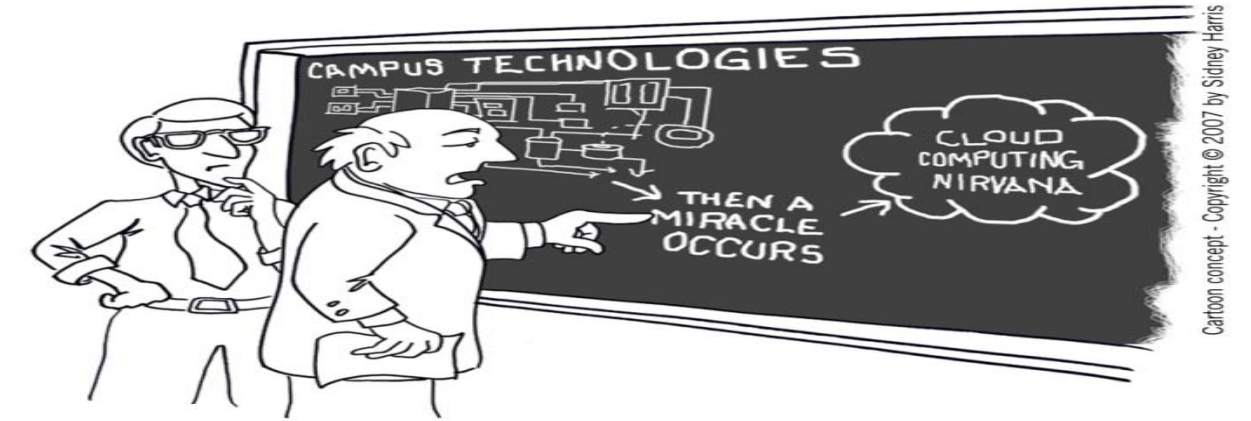
Cloud Computing Defined

Cloud Computing Model

Cloud Computing Security



"I think you should be more explicit here in step two."

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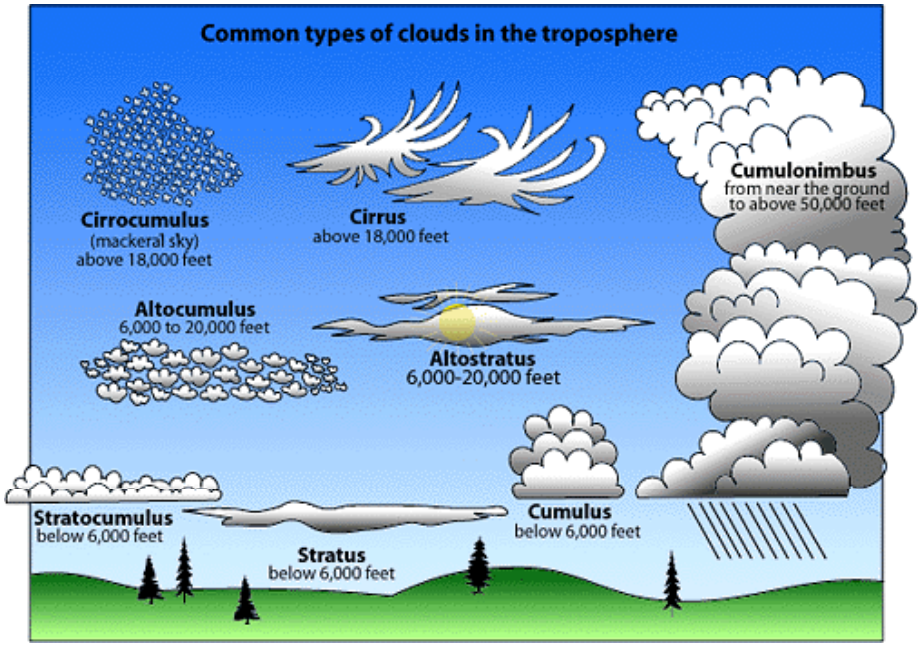
Enabling the Cloud

Infrastructure

- Consolidation
- Global information grid
- Capacity services
- Virtualization
- Rapid provisioning
- Facility analysis
- Infrastructure-as-a-Service
- Platform-as-a-Service



Software

Network-Centric services

Software-as-a-Service (Saas)

Processes

- ITIL
- Security (Certification & Accreditation)

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Cloud Physical Facility

Building site
Building controls
Electrical systems
Exterior structure
Operations & maintenance service management
Fire protection systems
Security system
HVAC systems & plumbing
Interior structures

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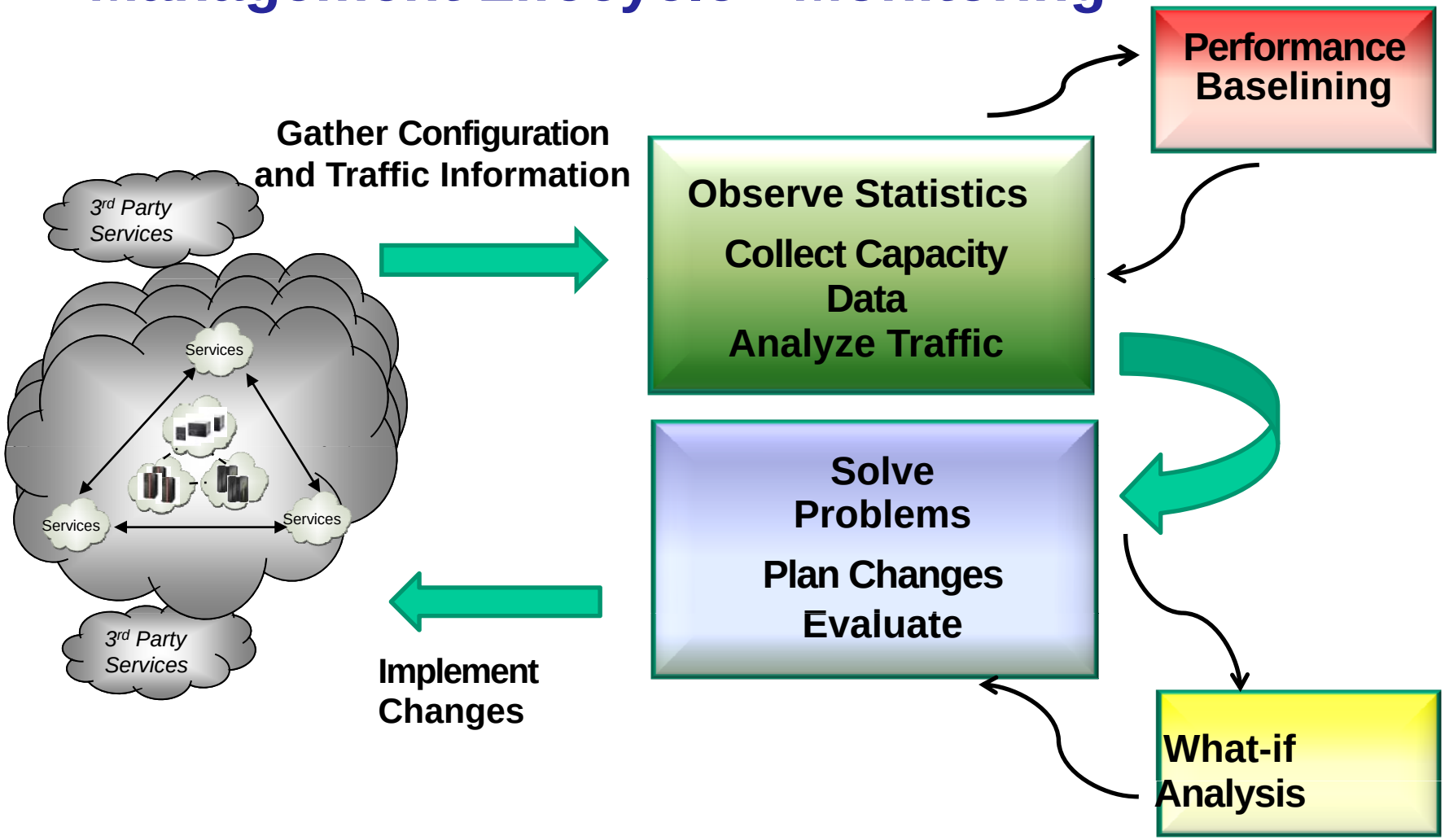
Management Lifecycle - Monitoring



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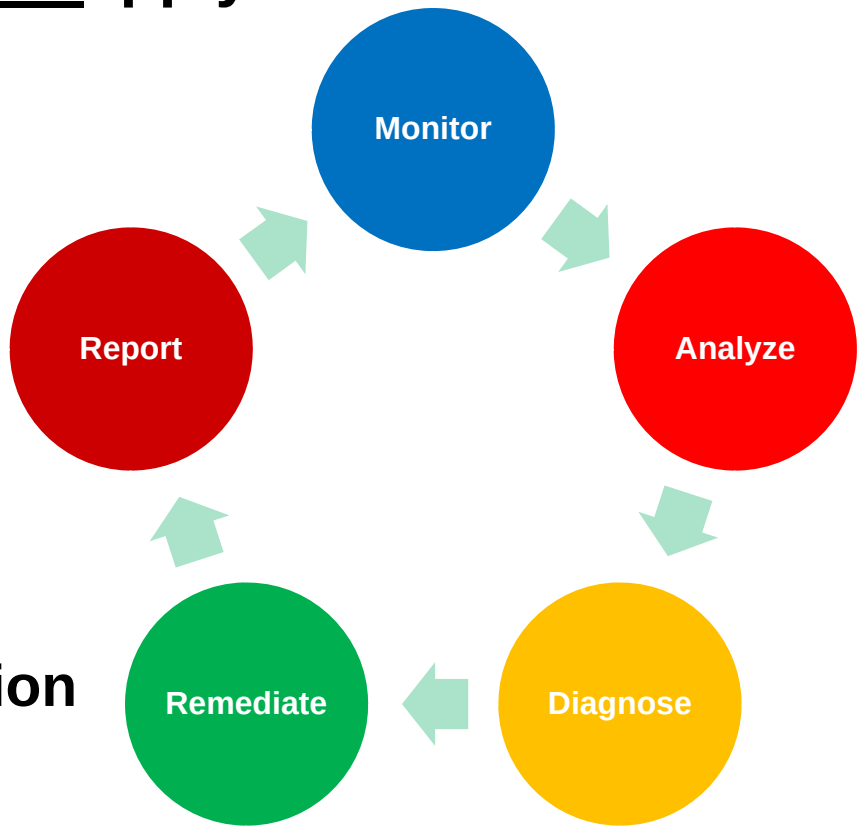
Managing Virtualized Data Center

- **Fundamentals of management apply FCAPS**
  - **Fault**
  - **Configuration**
  - **Availability**
  - **Performance**
  - **Security**
- **Leading to**
  - **Service Level Achievement**
  - **Optimum Resource Utilization**
  - **Highly available systems**
  - **High performing systems**



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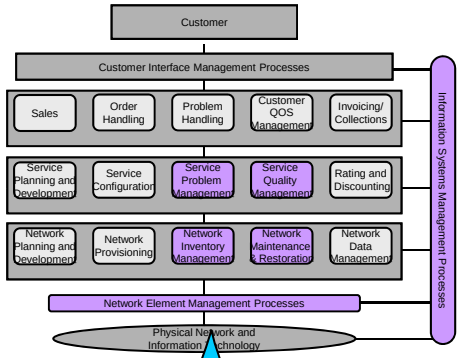
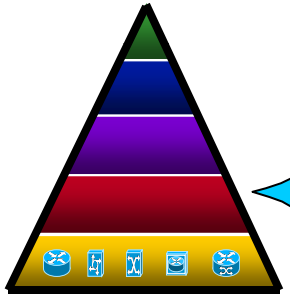
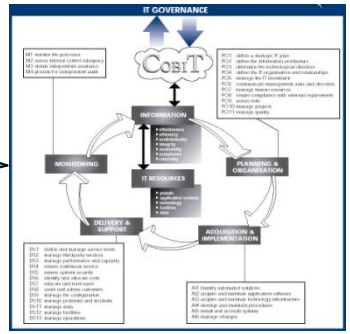
eTOM
- Extends M.3xxx
- Process & Functional Architecture
- Defines processes for providing services





ITU – M.3xxx
- Physical Focus
- Defines interfaces & functions
- M.3400 focuses on functions
- Recommended architecture for TMN
- Recommended interfaces Q_x CMIP

Integrated Service Management



COBIT
-IT Infrastructure management focus
-IT Governance
- Planning
- Investment
- Projects
- Quality
- Delivery
- Support

www.ITIL.org

ITIL
- Process Focus
- IT Service management
- Service level
- Equates to COBIT Dxxx processes

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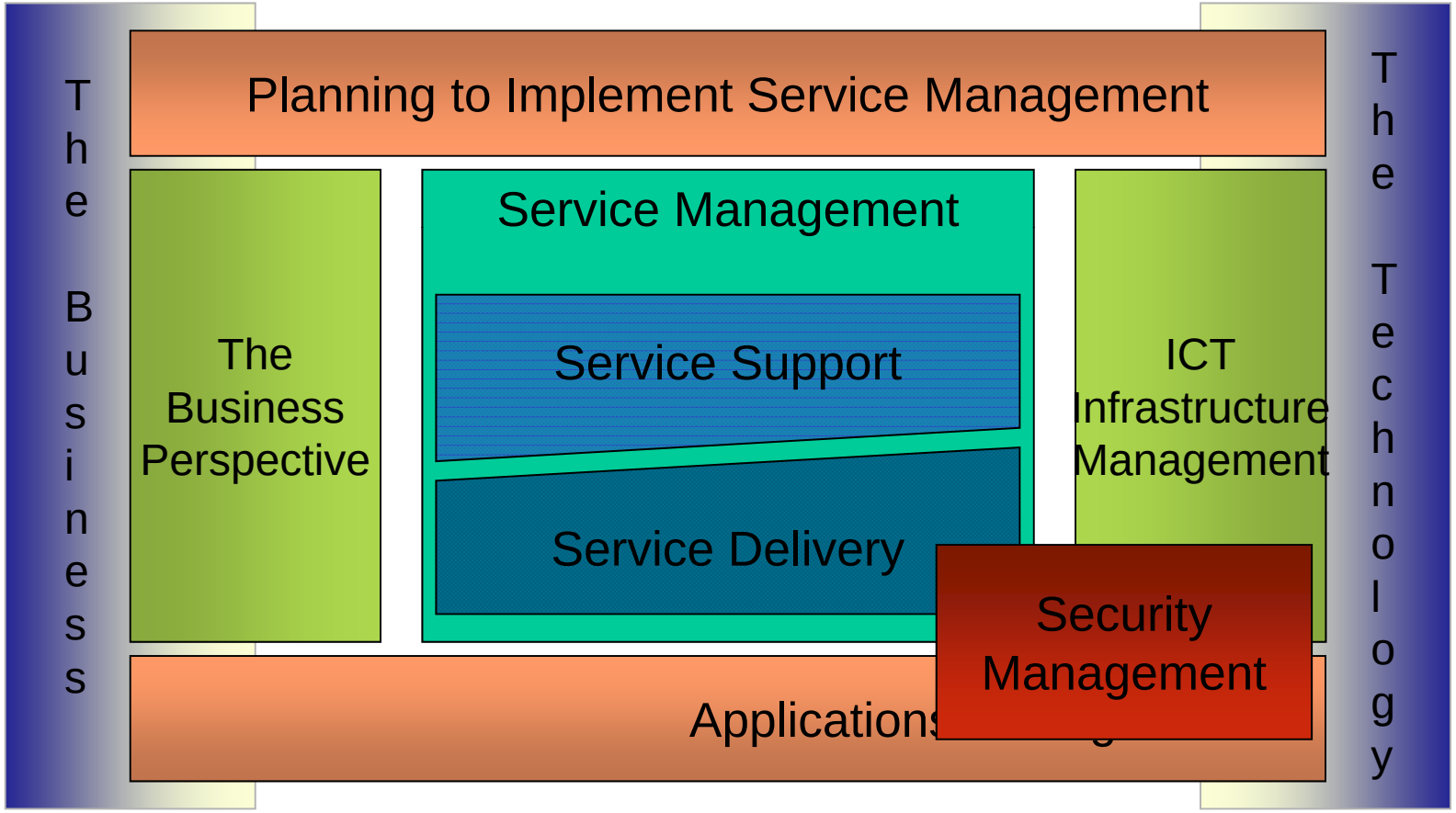
ITIL



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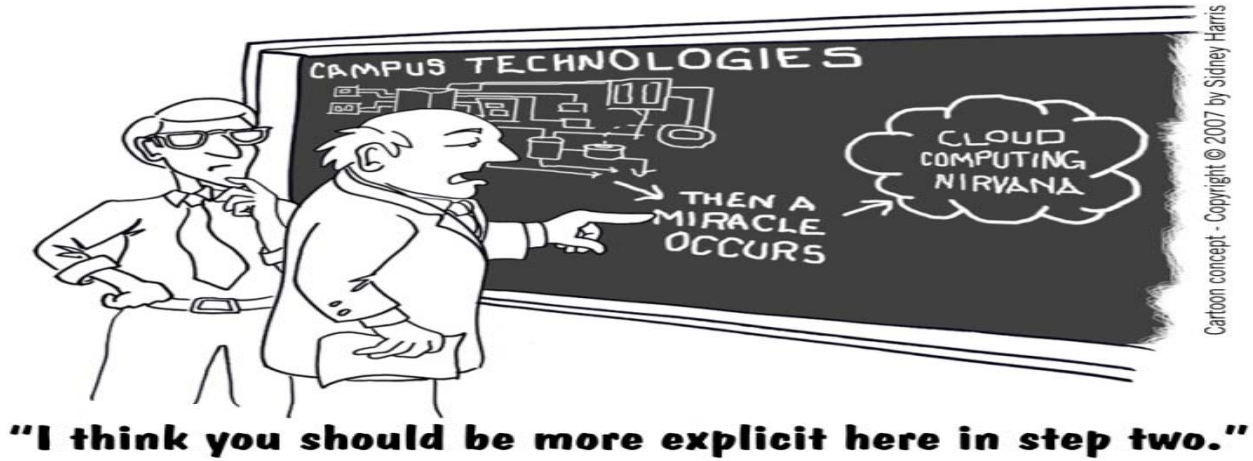
Cloud Computing Defined

Cloud Computing Model

Cloud Computing Security



"I think you should be more explicit here in step two."

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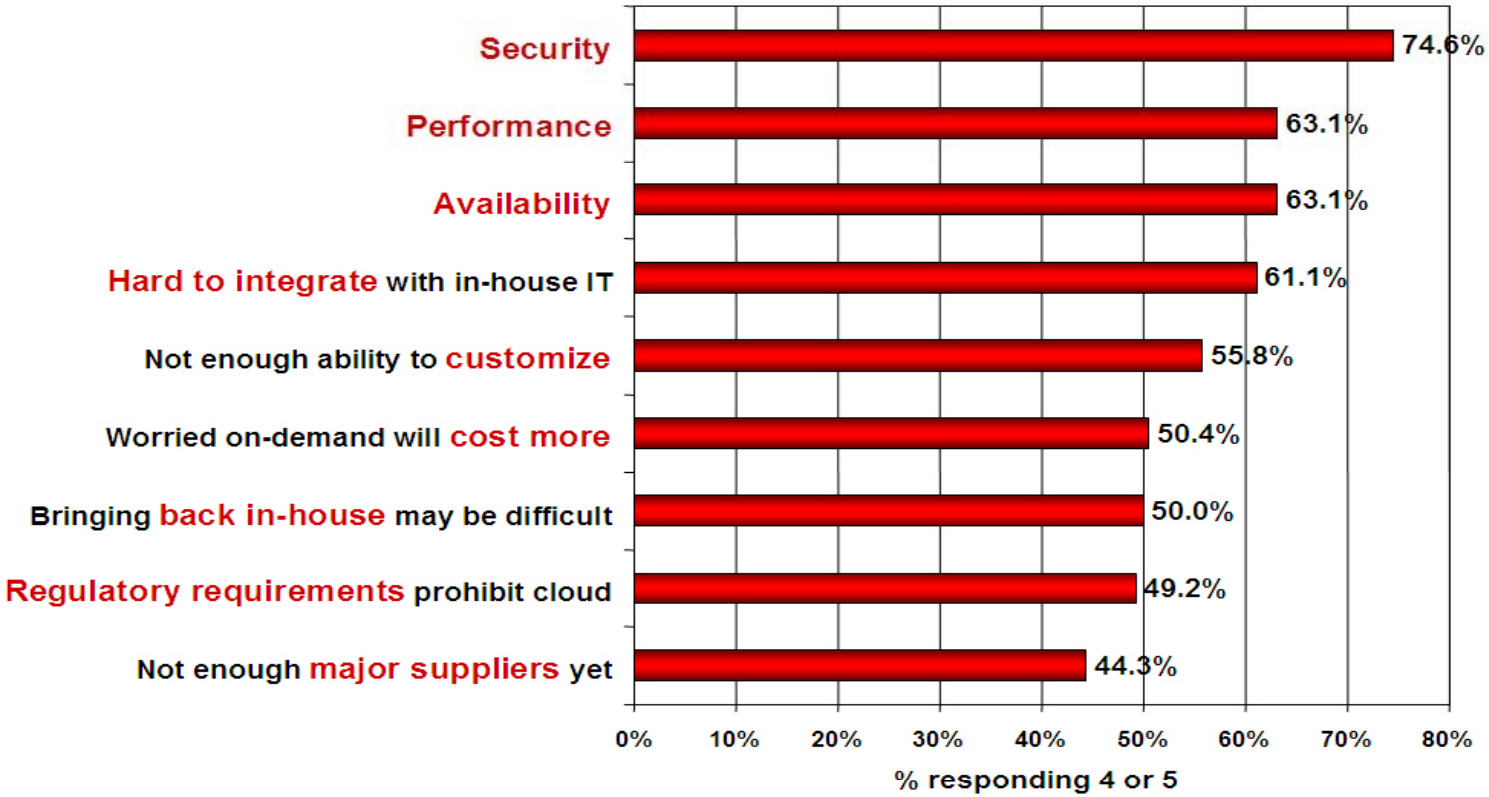
Cloud Issues

Q: Rate the challenges/issues ascribed to the 'cloud'/on-demand model

(1=not significant, 5=very significant)



Source: IDC Enterprise Panel, August 2008 n=244

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Cloud Security

- Clouds are massively complex systems that can be reduced to simple primitives that are replicated thousands of times
- These complexities create many issues related to security as well as all aspects of Cloud computing
- Clouds typically have a single security architecture but have many customers with different demands
- Cloud security issues may drive and define how we adopt and deploy cloud computing solutions
- Highly sensitive data is likely to be on private clouds where organizations have complete control over their security model

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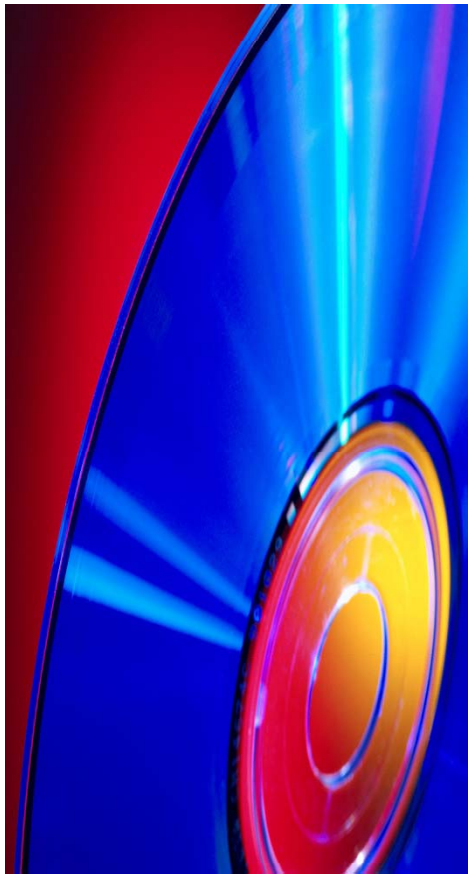
Security and Data

- Trusting vendor's security model
- Where is the data stored and who is securing it
- Inability to respond to audit requirements
- Indirect administrator accountability
- Loss of physical control
- Data retention / backup standards
- Redundancy / Disaster Recovery
- Handling Compliance
  - GLBA, HIPAA, SOX, PCY
  - State laws
  - International – EU Data Protection Directive
  - FTC Scrutiny
  - SAS 70 Audits



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Cloud Network and Perimeter Security

- Advantages
  - Distributed denial of service protection
  - VLAN capabilities
  - Perimeter security (IDS, firewall, authentication)
- Challenges
  - Virtual zoning with application mobility

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Cloud Security Advantages

- Data fragmentation and dispersal
- Dedicated security team
- Greater investment in security infrastructure
- Fault tolerance and reliability
- Greater resiliency
- Hypervisor protection against network attacks
- Simplification of compliance analysis
- Low-Cost disaster recovery and data storage solutions
- Real-Time detection of system tampering
- Rapid re-constitution of services
- Advanced honeypot capabilities

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Cloud Security Challenges Part 1

- Data dispersal and international privacy laws
  - EU Data Protection Directive and U.S. Safe Harbor program
  - Exposure of data to foreign government and data subpoenas
  - Data retention issues
- Need for isolation management
- Multi-tenancy
- Logging challenges
- Data ownership issues
- Quality of service guarantees

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Cloud Security Challenges Part 2

- Dependence on secure hypervisors
- Attraction to hackers (high value target)
- Security of virtual OSs in the cloud
- Possibility for massive outages
- Encryption needs for cloud computing
  - Encrypting access to the cloud resource control interface
  - Encrypting administrative access to OS instances
  - Encrypting access to applications
  - Encrypting application data at rest
- Public cloud vs internal cloud security
- Lack of public SaaS version control

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Additional Issues

- Issues with moving PII and sensitive data to the cloud
  - Privacy impact assessments
- Using SLAs to obtain cloud security
  - Suggested requirements for cloud SLAs
  - Issues with cloud forensics
- Contingency planning and disaster recovery for cloud implementations
- Handling compliance
  - FISMA
  - HIPAA
  - SOX
  - PCI
  - SAS 70 Audits

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World Privacy Forum

From: "Privacy in the Clouds: Risks to Privacy and Confidentiality from Cloud Computing," Released February 23, 2009, http://www.worldprivacyforum.org/cloudprivacy.html

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Cloud Computing…. It's a Journey

A Simple Idea

- User:
  - Builds a web application,
  - Using a standard platform
  - Using a standard database
  - Upload this application to a cloud provider
  - Only pays for what is used
  - Everything else is an implementation detail.
- Cloud provider automatically
  - Provisions the services
  - Scales the application and the database together

Clear Tenets

- Application Flexibility
  - Standardized
  - Increasing "click to run" services
  - Live in remote Internet data centers
  - Scalable to millions
- Procurement
  - Efficient
  - Rapid
  - Commoditized
  - "Pay by the sip"
- Security
  - Simplified
  - Streamlined

Multi-faceted Enablement

- Infrastructure
  - Consolidation
  - Global Information Grid
  - Capacity Services
  - Virtualization
  - Rapid Provisioning
  - Facility Analysis
- Software
  - Network-centric Services
  - Software-as-a-Service (Saas)
- Processes
  - ITIL
  - Security (Certification & Accreditation)

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Our other presentations:

Monday, 3:00 am - 4:00 am: Introduction to TCP/IP
Tuesday, 11:00 am – 12:00 pm: What every network manager needs to know about security
Tuesday 1:30 pm – 2:30 pm: Diagnosing Mainframe Network Problems with Packet Trace
Wednesday 11:00 am – 12:00 pm: Cloud Computing Environment
Wednesday 1:30 pm – 2:30 pm: Hot Topics in Networking and Security
Wednesday 4:30 pm – 5:30 pm: Wireless Security Challenges
Thursday 11:00 am – 12:00 pm: Virtualization – The Evolution of the Data Center

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Additional Key Security Studies

"AWS Security Whitepaper," http://s3.amazonaws.com/aws_blog/AWS_Security_Whitepaper_2008_09.pdf
"Cloud Computing Security: Raining On The Trendy New Parade," BlackHat USA 2009, www.isecpartners.com/files/Cloud.BlackHat2009-iSEC.pdf
“ENISA Cloud Computing Risk Assessment,” November 20th, 2009, www.enisa.europa.eu/act/rm/files/deliverables/cloud-computing-risk-assessment/at_download/fullReport
“Presentation on Effectively and Securely Using the Cloud Computing Paradigm v26,” 10/7/2009, NIST, http://www.csrc.nist.gov/groups/SNS/cloud-computing/cloud-computing-v26.ppt
“Security Guidance for Critical Areas of Focus in Cloud Computing, V2.1,” December 2009, Cloud Security Alliance, http://www.cloudsecurityalliance.org/csaguide.pdf

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