Government Cloud Computing Applications

Roger Smith
rdsmith@modelbenders.com

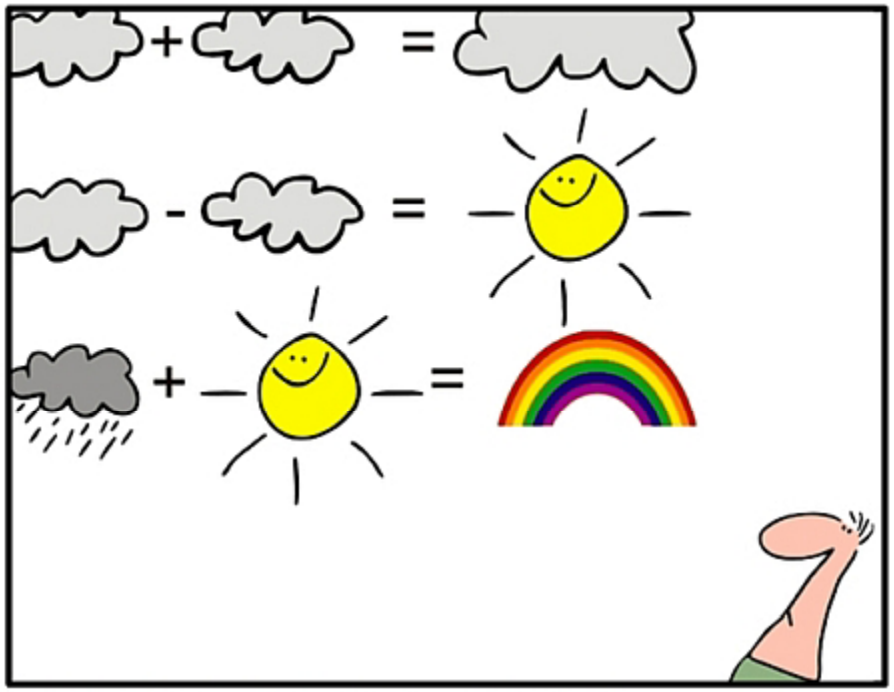
http://www.modelbenders.com/cloud.html

HPTi Technology Forum
March 19, 2010, Reston, VA

Outline

- Humor & Definitions
- Business Implications
- Technology & Architecture
- Systems Applications
- Simulation in the Cloud
- Additional Resources


LET'S IMPLEMENT CLOUD COMPUTING SO I HAVE SOMETHING TO TALK ABOUT AT THE EXECUTIVE MEETING.
DilbertCartoonist@gmail.com
Dilbert.com
TELL THEM WE'RE EVALUATING IT. THAT WAY NEITHER OF US NEEDS TO DO ANY REAL WORK.
11-08-09 © 2009 Scott Adams, Inc./Dist. by UFS, Inc.
I LIKE IT WHEN YOU DO REAL WORK.
SORRY. I THOUGHT YOU WERE LEADING BY EXAMPLE.



geek and poke

SIMPLY EXPLAINED - PART 17: CLOUD COMPUTING

"Wilber is probably taking this Cloud computering too seriously.

Cloud Computing

- *"A large-scale distributed computing paradigm that is driven by economies of scale, in which a pool of abstracted, virtualized, dynamically-scalable, managed computing power, storage, platforms, and services are delivered on demand to external customers over the Internet."* [1]

- **Cloud Computing is a distributed computing paradigm that focuses on providing a wide range of users with distributed access to virtualized hardware and/or software infrastructure over the Internet.**

[1] I. Foster, Y. Zhau, R. Ioan, and S. Lu. "Cloud Computing and Grid Computing : 360-Degree Compared." Grid Computing Environments Workshop, 2008.

Drivers for Cloud Computing Adoption

Scalability	Users have access to a large amount of resources that scale based on user demand.
Elasticity	The environment transparently manages a user's resource utilization based on dynamically changing needs.
Virtualization	Each user has a single view of the available resources, independently of how they are arranged in terms of physical devices.
Cost	The pay-per-usage model allows an organization to only pay for the resources they need with basically no investment in the physical resources available in the cloud. There are no infrastructure maintenance or upgrade costs.
Mobility	Users have the ability to access data and applications from around the globe.
Collaboration	Users are starting to see the cloud as a way to work simultaneously on common data and information.

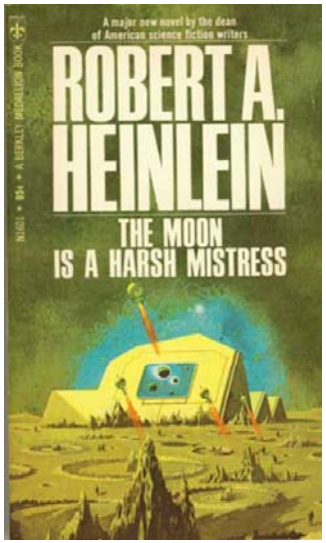
Barriers for Cloud Computing Adoption

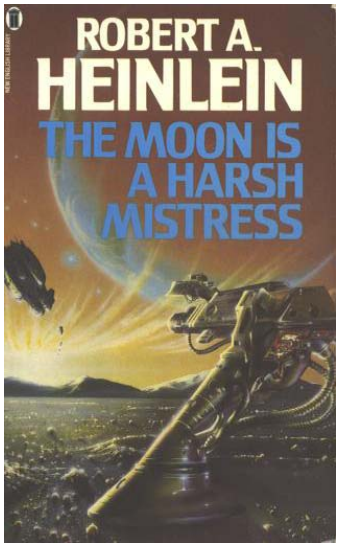
Security	The key concern is data privacy. Users do not have control of or know where their data is being stored.
Interoperability	A universal set of standards and/or interfaces have not yet been defined, resulting in a significant risk of vendor lock-in.
Control	The amount of control that the user has over the cloud environment varies greatly between vendors.
Performance	All access to the cloud is done via the internet, introducing latency into every communication between the user and the environment.
Reliability	Many existing cloud infrastructures leverage commodity hardware that is known to fail unexpectedly.

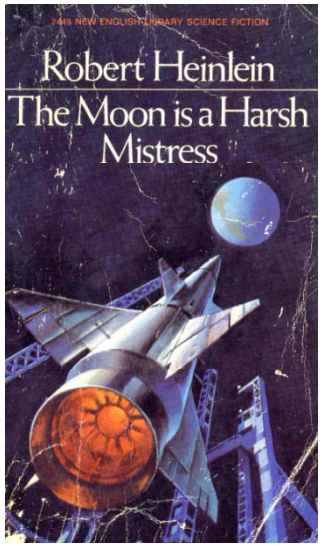
TANSTAAFL

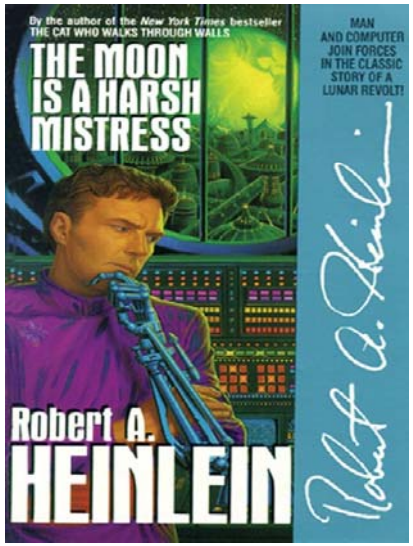
"There Ain't No Such Thing As A Free Lunch."

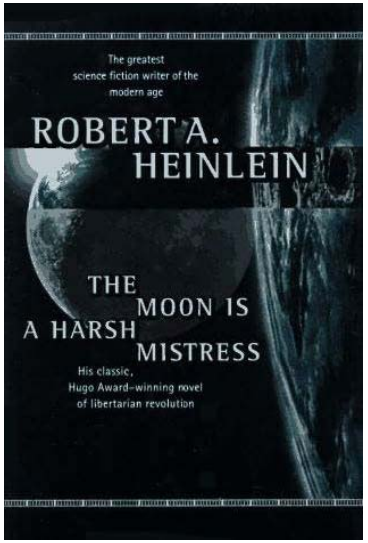
Robert Heinlein, 1966











Business Implications

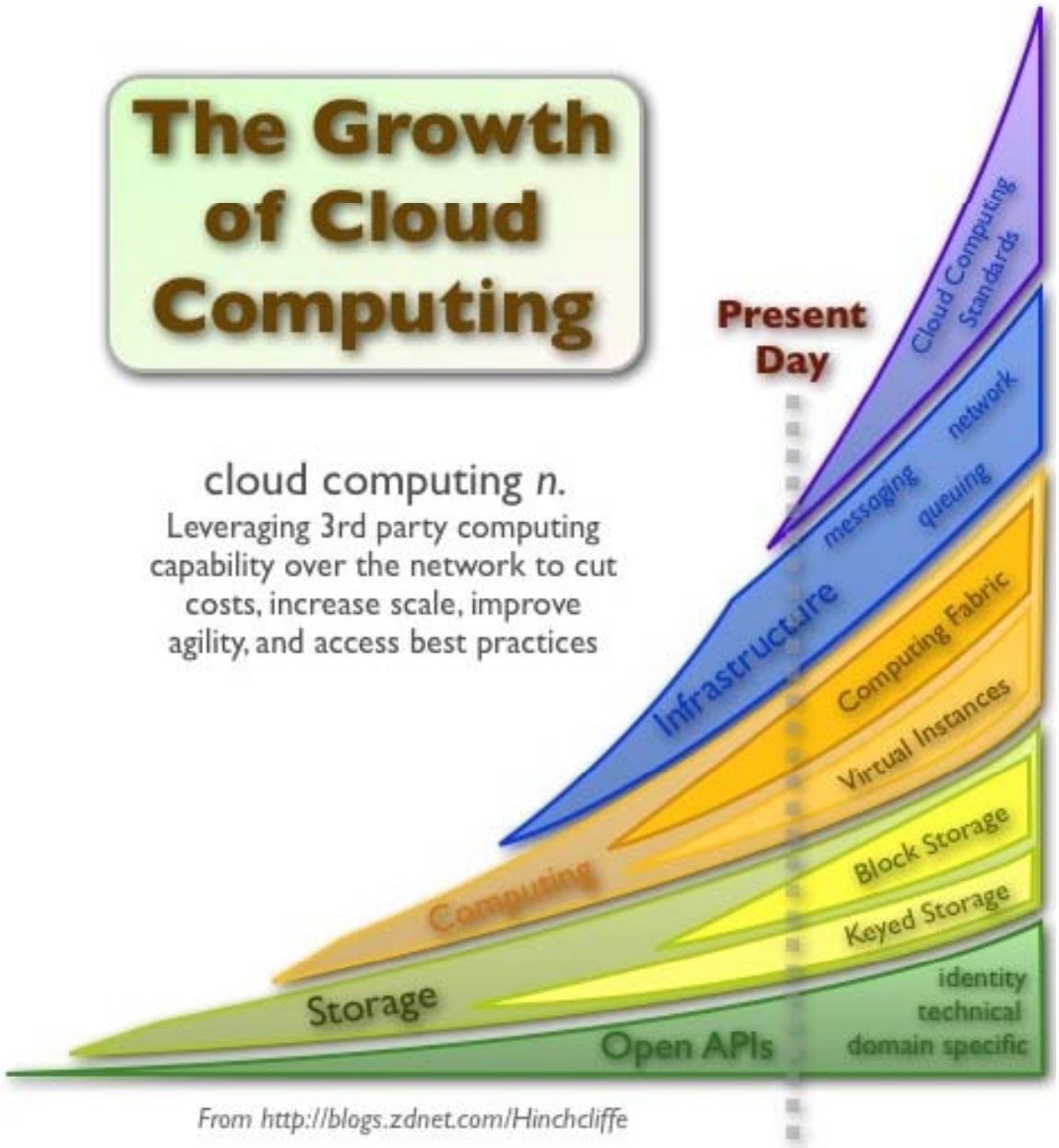
Big Players in the Cloud

Cloud Observations

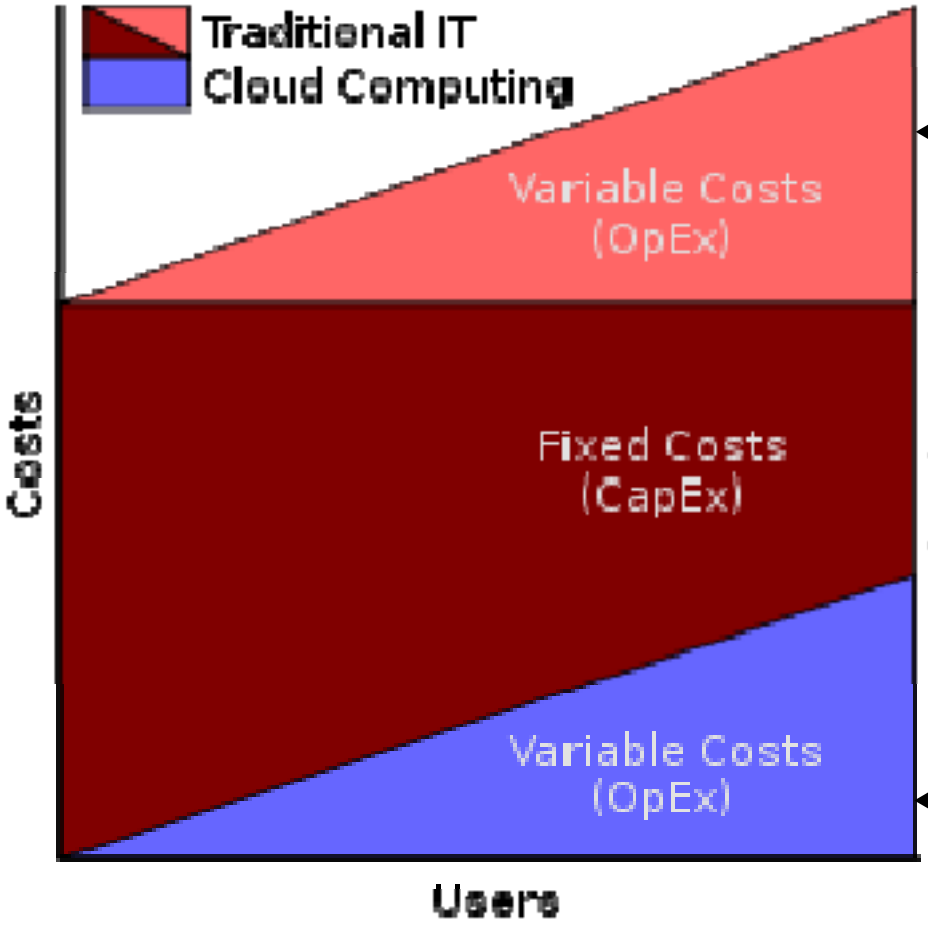
- "The great search tools available today are a direct result of easy access to data because the Web is already in the cloud"
  - Greg Badros, Google Engineering Director

- "We never defined the Internet, and it became extremely successful."
  - Geir Ramleth, Bechtel CIO

ZDnet's Vision of Growth



Controlling IT Costs



Cloud Computing Economics

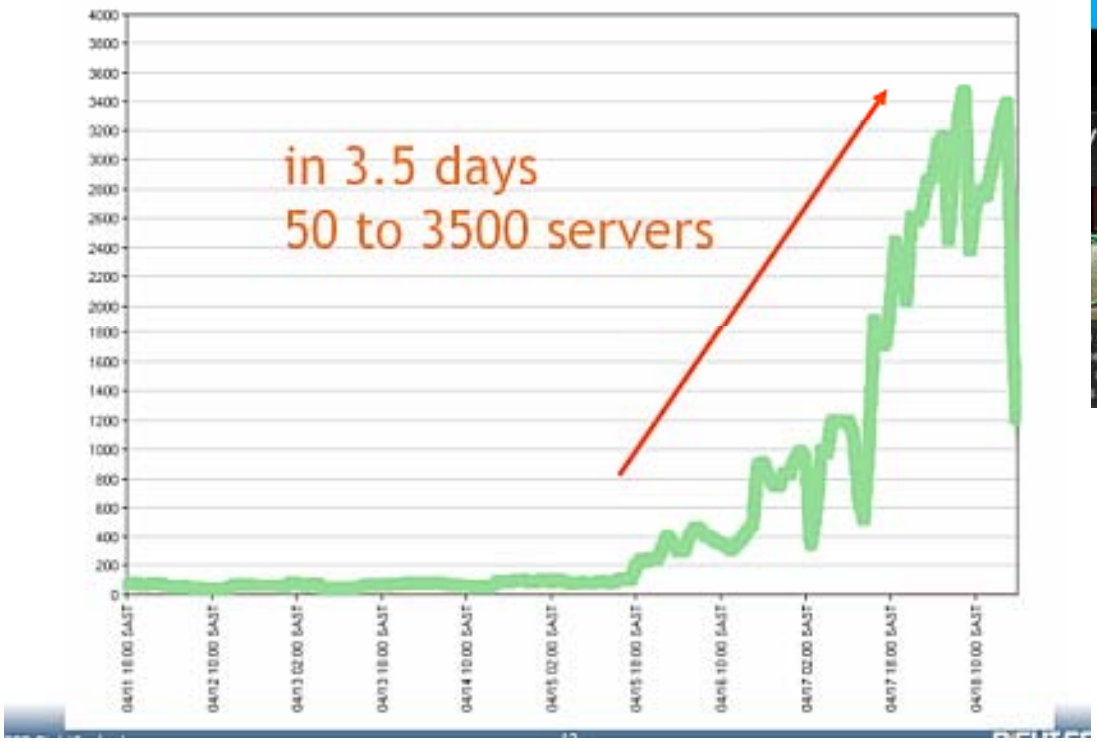
In an honest picture, the two instances of variable Costs should not be shown as equal in size.

Cloud: Larger or Smaller?

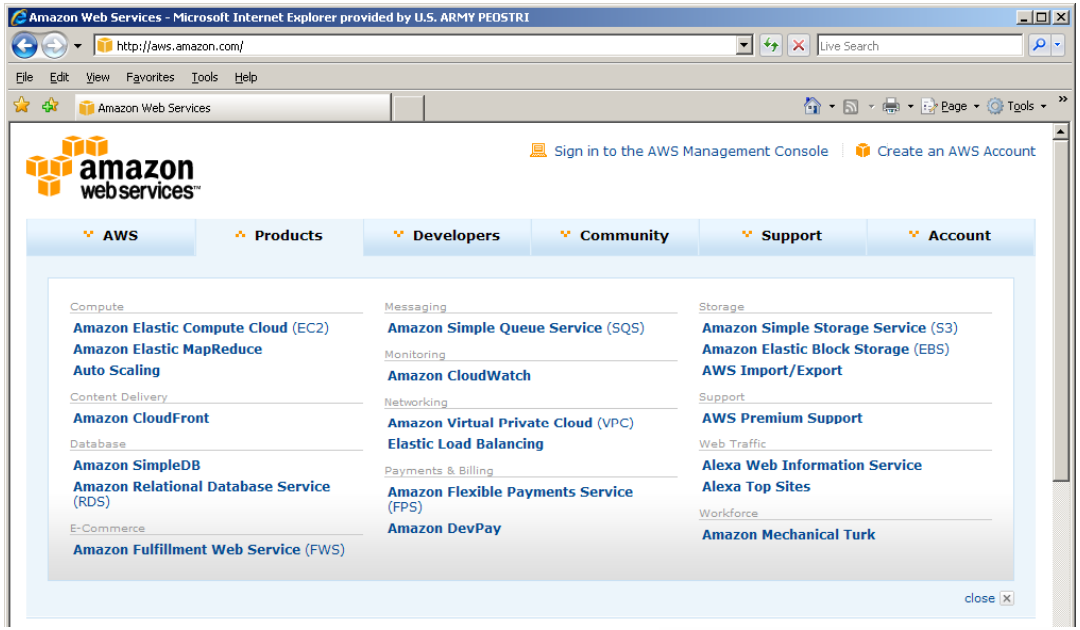
Animoto: Small Start-up

Turn your photos into a slideshow with transitions and music.

Animoto on Facebook

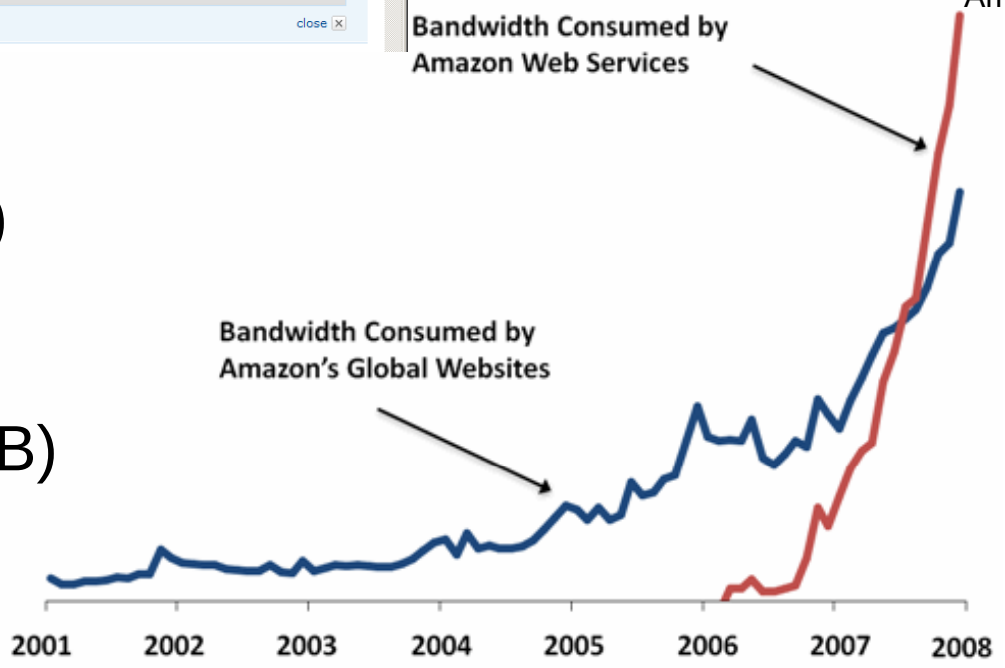


Amazon Web Services



Werner Vogels, CTO
Amazon.com

- Storage (S3 & EBS)
- Computation (EC2)
- Bandwidth
- Database (SimpleDB)
- … and others



Wall Street: Major IT User

- Where to perform computation and record keeping?
  - Have taken all office space available
  - Have maxed out electricity available
  - Have hit ceiling on cost of space
- Solution
  - Move daily operations into the cloud because they cannot build any more IT centers in the Wall Street area

Army G2: Military Cloud

Build systems without unnecessary barriers between customers, applications, and data.

e.g. Location, Hardware, O/S, Networks

Does not solve issues with data formats, incompatible APIs, and classification

Note: This slide is intentionally vague because of the applications and users.

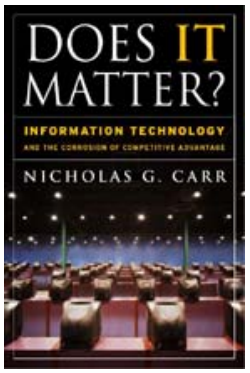
Commercial Cloud Companies

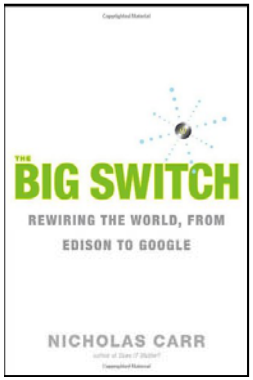
Amazon Elastic Compute Cloud (Amazon EC2) - *Beta*

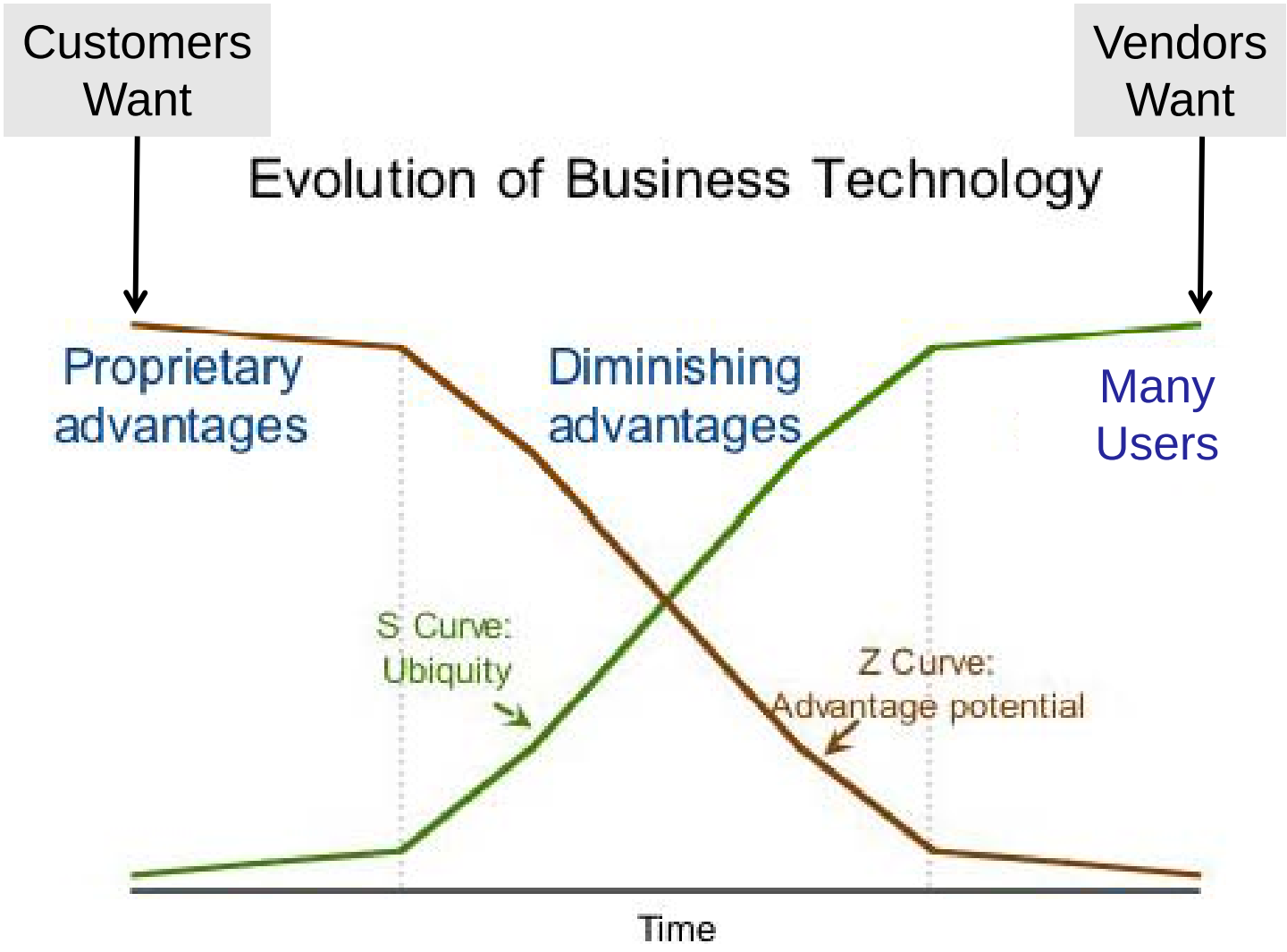
TAP INTO THE
POWER OF NETWORK.COM

MOSSO
the hosting cloud

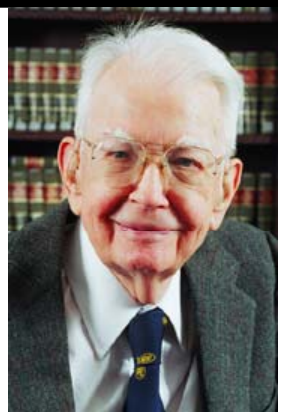
Technology Ubiquity vs. Advantage







Transaction Costs, 1937



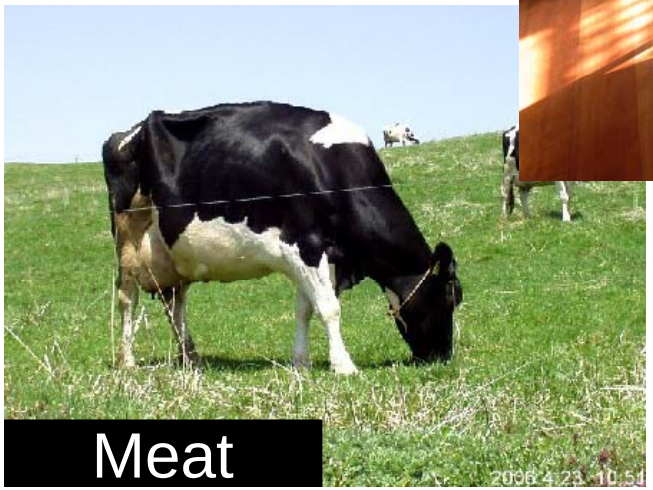
- "The Nature of the Firm" (1937), Ronald Coase, Nobel Prize in Economics, 1991
- Other things being equal, a firm will tend to be larger:
  - the less the costs of organizing and the slower these costs rise with an increase in the transactions organized.
  - the less likely the entrepreneur is to make mistakes and the smaller the increase in mistakes with an increase in the transactions organized.
  - the greater the lowering (or the less the rise) in the supply price of factors of production to firms of larger size.
- Technology changes that mitigate the cost of organizing transactions across space will cause firms to be larger—the advent of the telephone and cheap air travel, for example, would be expected to increase the size of firms.

Firms grow as long as the cost of adding additional internal capabilities is lower than the cost of purchasing from an outside supplier.

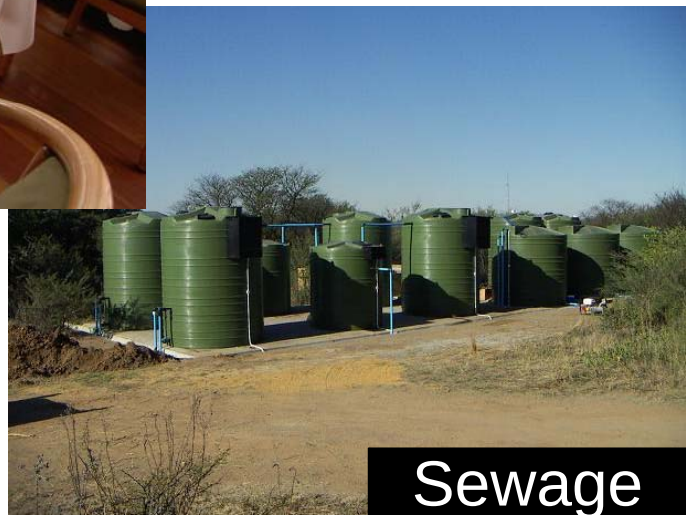
Restaurant Example

Fruit

Water

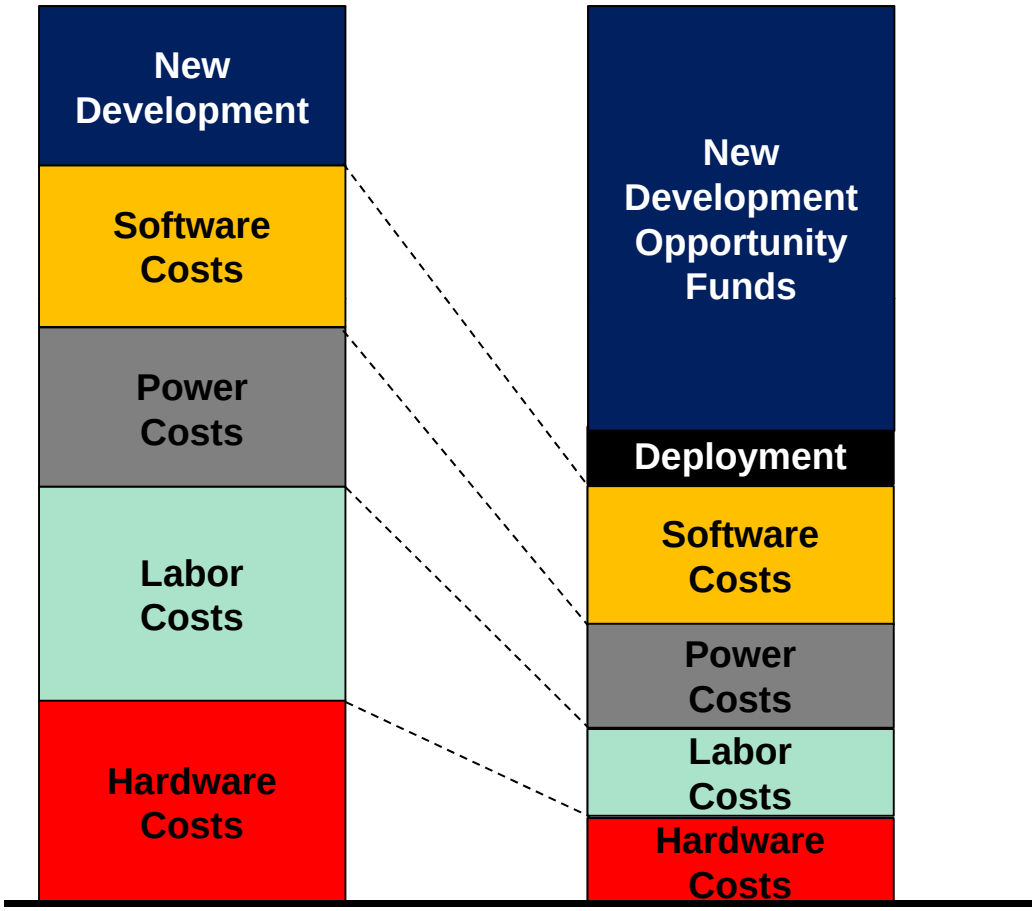


Meat



Sewage

IBM Case Study



- Reduced Capital Expenditure
- Reduced Operations Expenditure
- Reduced Risk of Startup
- Less Idle Time
- More Efficient Use of Energy
- Accelerate Innovation Projects
- Enhanced Customer Service

<u>Business Case Results:</u>
Annual savings $3.3M (84%)
(from $3.9M to $0.6M)

<u>Payback Period:</u>
73 days
NPV: $7.5M
IRR: 49%
ROI: 103%

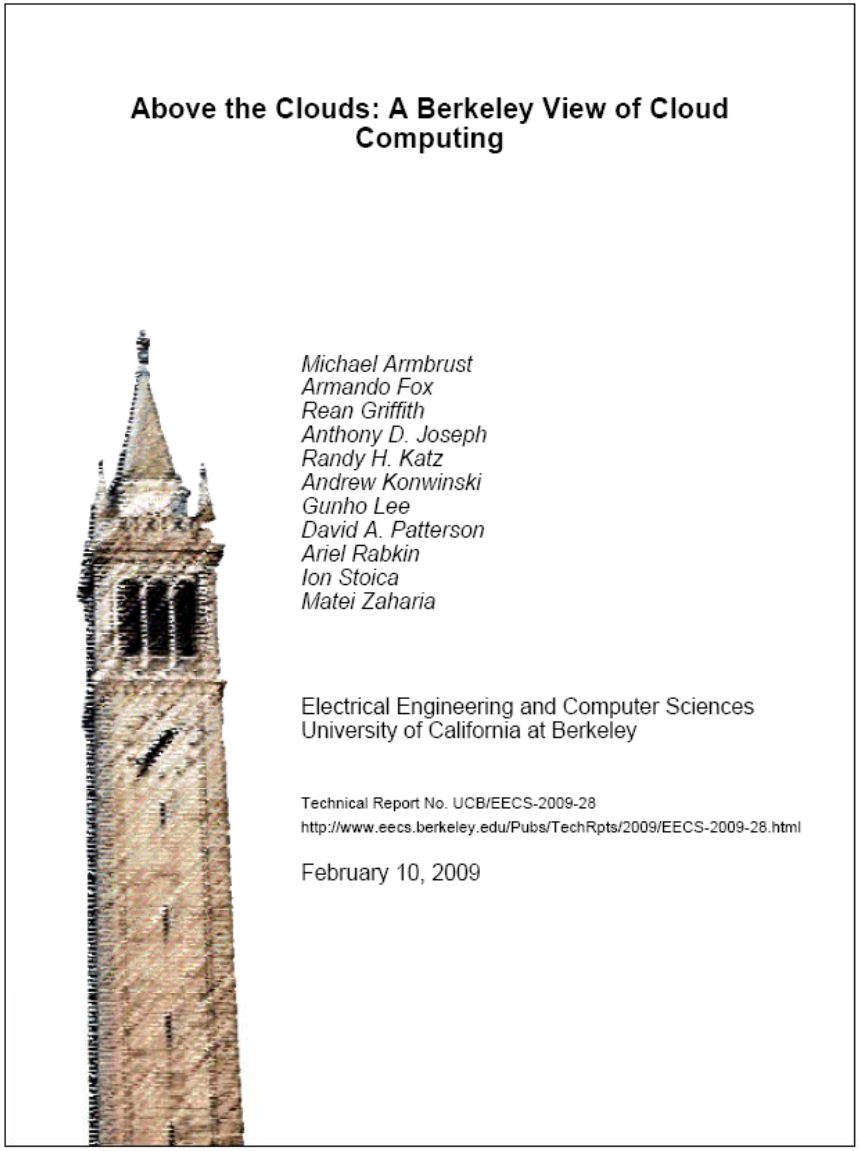
Bechtel IT Cost Evolution

- Geir Ramleth, CIO of Bechtel
- Measure IT Center Size and Efficiency:
- Original
  - 1998 = 35,000 sq.ft. running at 2% efficiency
- Consolidated Server/IT Center
  - 2002 = 20,000 sq.ft. running at 50% efficiency
- Virtualization of Servers
  - 2008 = 1,000 sq.ft. running at 80% efficiency
- Cloud Computing
  - 2010 = 0 sq.ft. running at 100% efficiency

Technology and Architecture

UC Berkeley View of Cloud Computing

- #1 Must-Read on the Subject
- Summary of Paper:
  1. Illusion of infinite compute resources on demand
  2. Ability to pay for resources as needed
  3. New term for an old idea (utility, cluster, grid)
  4. Top 10 obstacles to growth



Above the Clouds: A Berkeley View of Cloud Computing

Michael Armbrust
Armando Fox
Rean Griffith
Anthony D. Joseph
Randy H. Katz
Andrew Konwinski
Gunho Lee
David A. Patterson
Ariel Rabkin
Ion Stoica
Matei Zaharia

Electrical Engineering and Computer Sciences
University of California at Berkeley

Technical Report No. UCB/EECS-2009-28
http://www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.html

February 10, 2009

http://www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf

Berkeley: Top 10 Obstacles to Growth

(List from Feb 2009)

1. Availability of Service
2. Data Lock-in
3. Data Confidentiality & Auditability
4. Data Transfer Bottlenecks
5. Performance Unpredictability
6. Scalable Storage
7. Bugs in Large Distributed Systems
8. Scaling Quickly
9. Reputation Fate Sharing
10. Software Licensing

3 Cloud Service Models

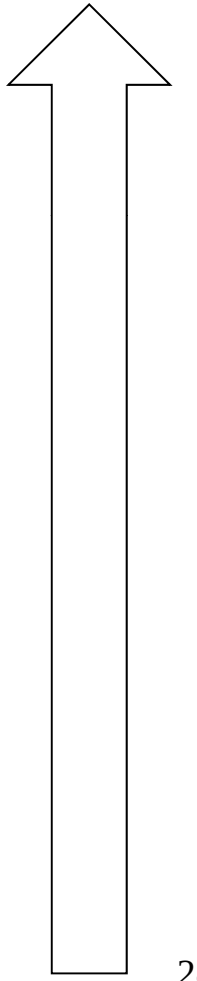
- Cloud Software as a Service (SaaS)
  - Use provider's applications over a network
  - Hot Mail, Google Docs, Ghost.cc
- Cloud Platform as a Service (PaaS)
  - Deploy customer-created applications to a cloud
- Cloud Infrastructure as a Service (IaaS)
  - Rent processing, storage, network capacity, and other fundamental computing resources
  - Amazon Web Services and Others

- To be considered "cloud" they must be deployed on top of cloud infrastructure

Cloud Related Service Offerings

Cloud Market Types	Types of Offerings	Examples
Software-as-a-Service	• Rich Internet application web sites • Application as Web Sites • Collaboration and email • Office Productivity • Client apps using cloud services	• Flikr • Myspace.com • Cisco WebEx office • Gmail • IBM Bluehouse
Application Components -as-a-Service	• APIs for specific service access for integration • Web-based software service than can combine to create new services, as in a mashup	• Amazon Flexible Payments Service and DevPay • Salesforce.com's AppExchange • Yahoo! Maps API • Google Calendar API • zembly
Software Platform-as-a-Service	• Development-platform-as-a-service • Database • Message Queue • App Servicer • Blob or object data stores	• Google App Engine and BigTable • Microsoft SQL Server Data Services • Engine Yard • Salesforce.com's Force.com
Virtual Infrastructure-as-a-Service	• Virtual servers • Logical disks • VLAN networks • Systems Management	• Akamai • Amazon EC2 and S3 • CohesiveFT • Mosso (from Rackspace) • Joyent Accelerators • Nirvanix Storage Delivery Network
Physical Infrastructure	• Managed Hosting • Collocation • Internet Service Provider • Unmanaged hosting	• GoDaddy.com • Rackspace • Savvis

Level of Abstraction



Adapted from Forrester Research Taxonomy

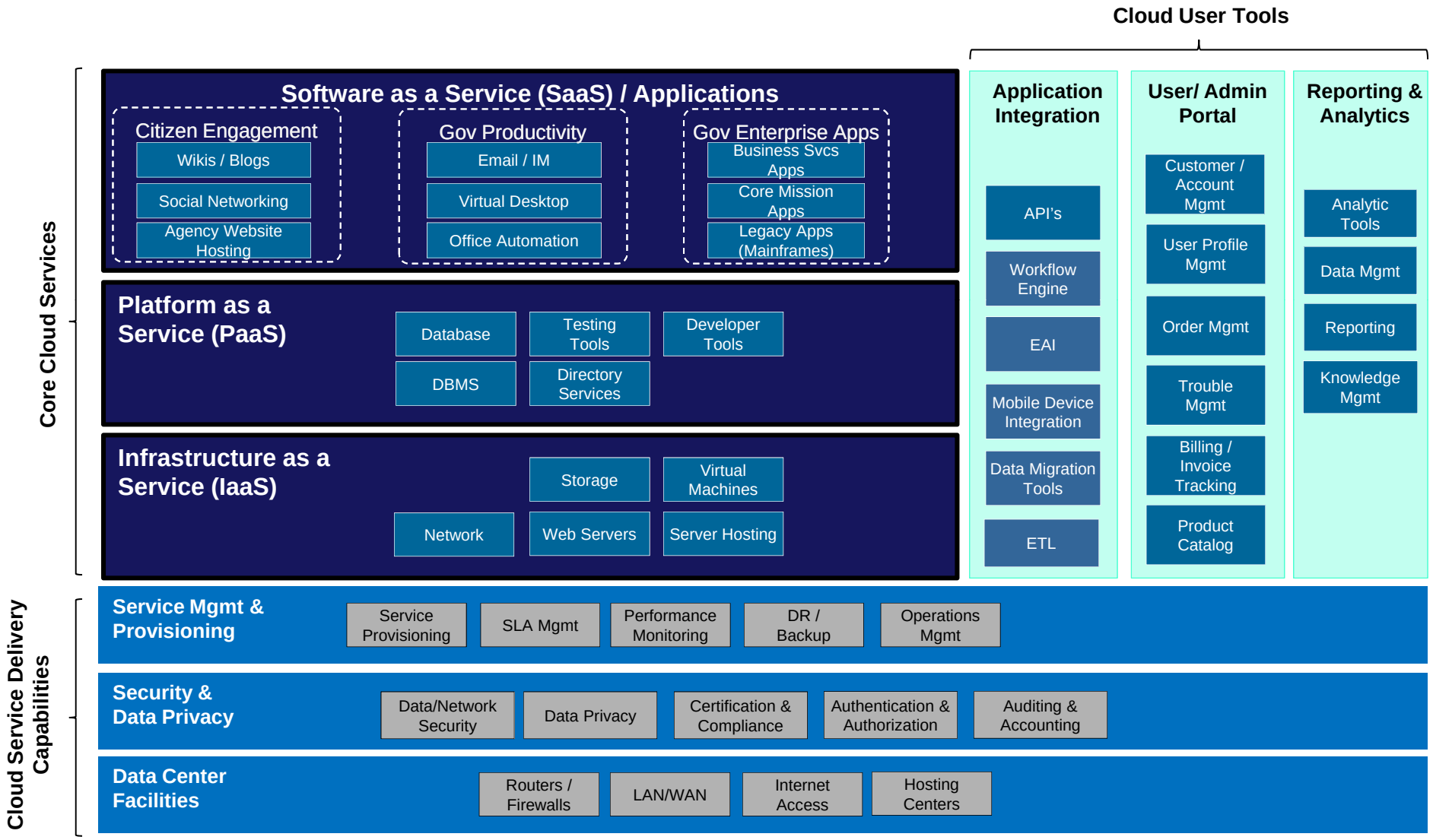
Examples of Cloud IaaS Environments

- **Amazon Elastic Compute Cloud (EC2)**
  - Provides users with a special virtual machine (AMI) that can be deployed and run on the EC2 infrastructure
- **Amazon Simple Storage Solution (S3)**
  - Provides users with access to dynamically scalable storage resources
- **IBM Computing on Demand (CoD)**
  - Provides users with access to highly configurable servers plus value-added services such as data storage
- **Microsoft Live Mesh**
  - Provides users with access to a distributed file system; targeted at individual use
- **Microsoft Azure Services Platform**
  - Provides users with on-demand compute and storage services as well as a development platform based on Windows Azure

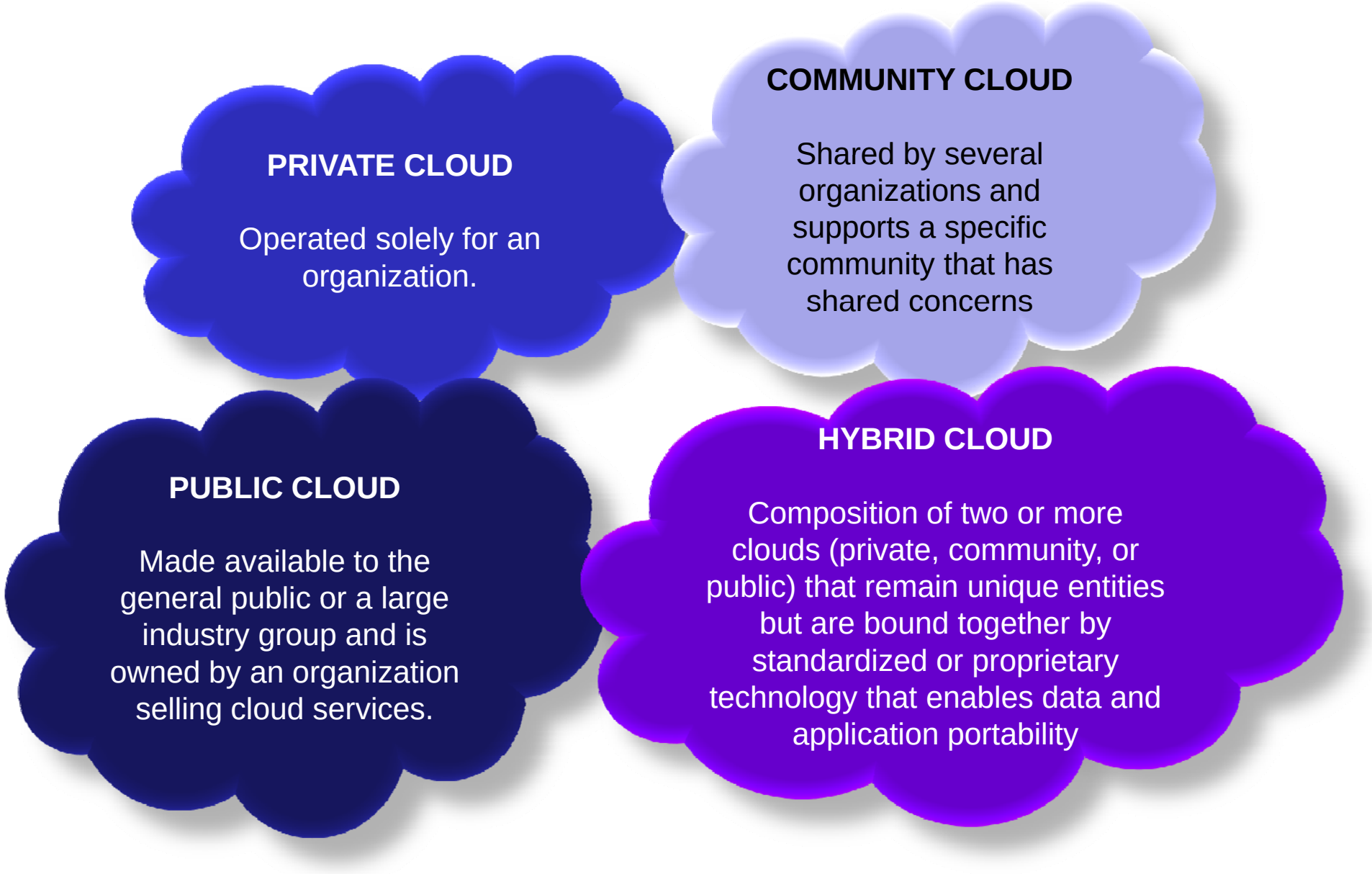
Examples of Cloud PaaS Environments

- **Google App Engine**
  - Provides users a complete development stack and allows them to run their applications on Google's infrastructure
- **Yahoo! Open Strategy (Y!OS)**
  - Provides users with a means of developing web applications on top of the existing Yahoo! platform, and in doing so leveraging a significant portion of the Yahoo! resources
- **Force.com**
  - From salesforce .com (SaaS leader), provides enterprise users a platform to build and run applications and components bought from AppExchange or custom applications
- **Zoho**
  - Provides a large suite of web-based applications, mostly for enterprise use
- **Akamai EdgePlatform**
  - Provides a large distributed computing platform on which organizations can deploy their web applications; large focus on analysis and monitoring

Government Cloud Computing Framework

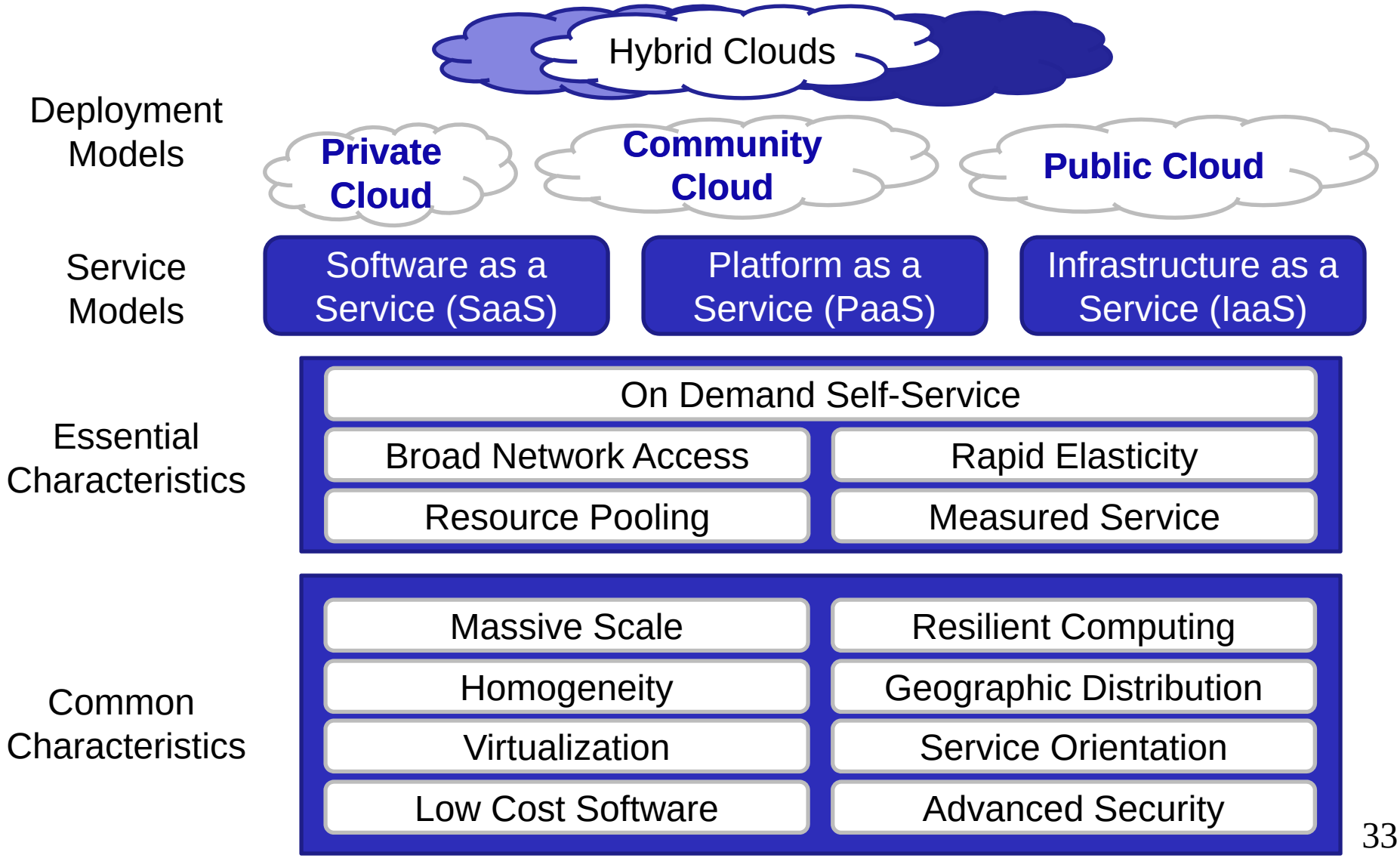


GSA Deployment Model



NIST National Institute of Standards and Technology U.S. Department of Commerce

Cloud Definition Framework



System Applications

DISA Components for the Cloud

- Platform-As-A-Service (PaaS)
  - Delivers a computing platform and/or solution stack as a service
  - Facilitates deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers

- Infrastructure-As-A-Service (IaaS)
  - The delivery of computer IaaS, typically platform virtualization
  - For example:
    - Virtual desktops
    - Grid computing

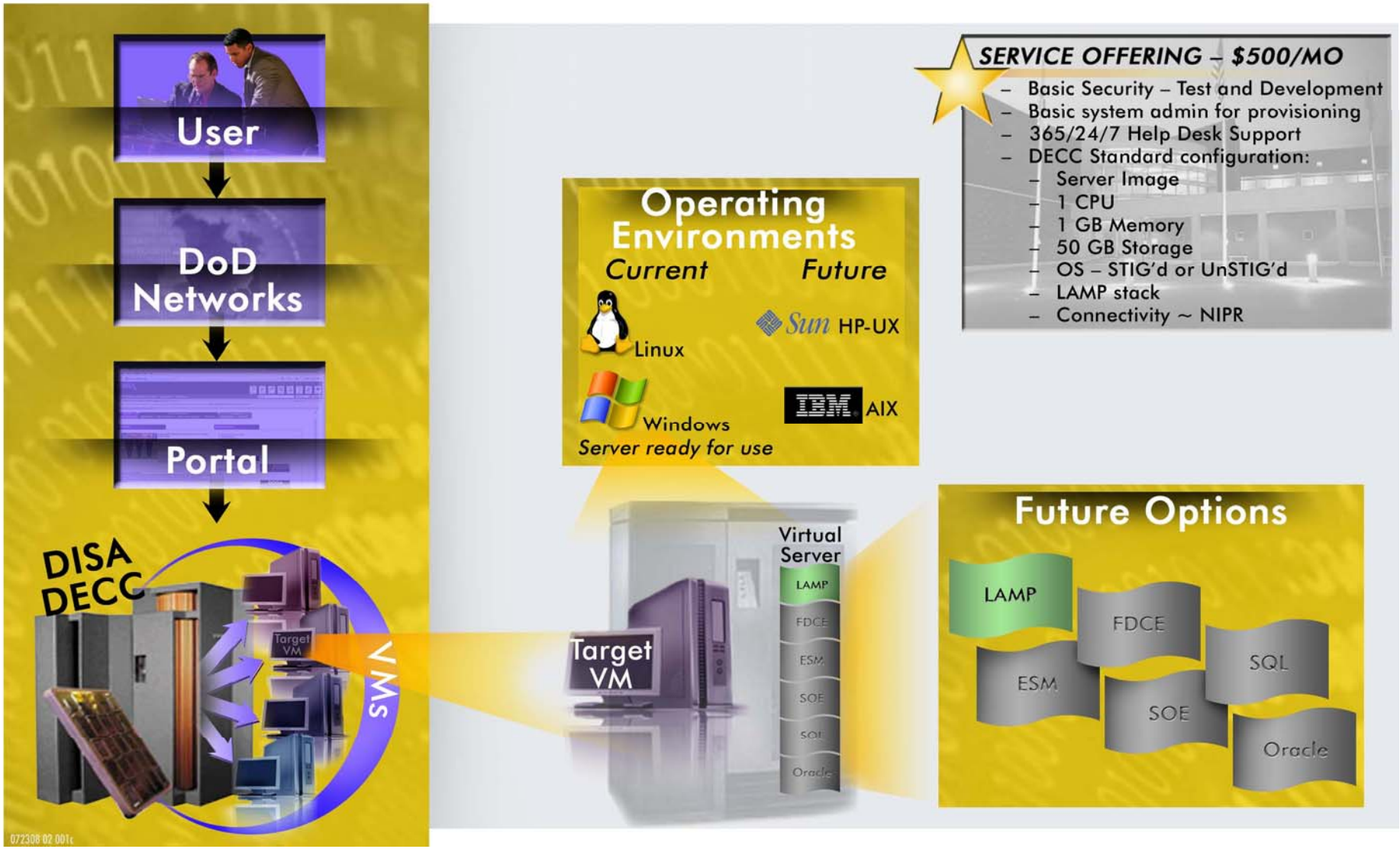
- Applications-As-A-Service (AaaS) /Software-As-A-Service (SaaS)
  - Leverages the Cloud in software architecture
  - Eliminates the need to install and run the application on the customer's own computer
  - Type:
    - Commercial
    - Government

Forge.mil

•Develops the SaaS Ecosphere
•Accelerates applications development

Independent But Complementary Activities

RACE – How it works



RACE – Benefits

Increased Speed

- 24 hour provisioning
- Online self service
- Credit card acquisition

Increased Scalability

- Increase capacity ~ 24 hours
- “Turn On / Turn Off” monthly
- Capacity on demand

Reduced Risk

- No capital $ needed
- DECC Infrastructure
- Develop under DoD IA standards

Reduced Cost

- Pay only for what you need
- Month-to-month service
- No annual maintenance fees

DISA Vision of Services

Plug-n-Fight

Enterprise Tactical Content Delivery Network

Device Clients

Fixed Geo-redundant Data Centers

SIPRNet

Deployable Data Center

Do for Computing what IP did for Networks
Cloud = default background resource

Technical Questions You Should Ask (1)

- What is performance overhead?
  - On individual CPU
  - On system including data and program transfer
- What is cost gain
  - From size efficiency; “green” location (rumor that Google has purchased the Niagara Falls including Canada!)
- Is Cloud Security adequate: can clouds be trusted?
- Can one can do parallel computing on clouds?
  - Looking at “capacity” not “capability” i.e. lots of modest sized jobs
  - Marine corps will use Petaflop machines – they just need ssh and a.out

Technical Questions Your Should Ask (2)

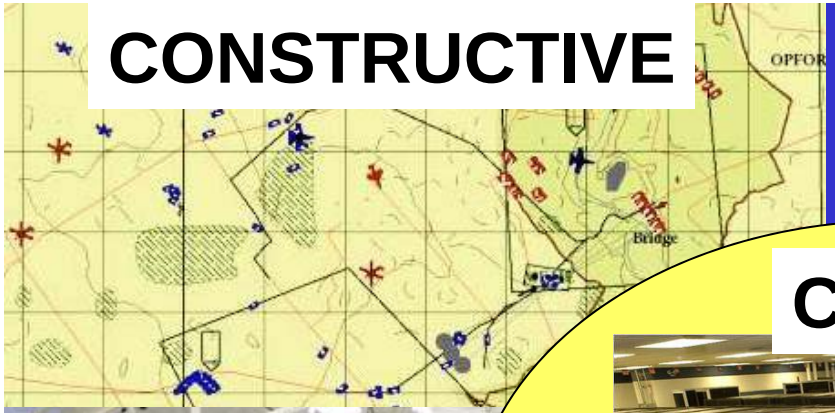
- How is data compute affinity tackled in clouds?
  - Co-locate data and compute clouds?
  - Lots of optical fiber i.e. “just” move the data?
- What happens in clouds when demand for resources exceeds capacity – is there a multi-day job input queue?
  - Are there novel cloud scheduling issues?
- Do we want to link clouds (or ensembles as atomic clouds); if so how and with what protocols
- Is there an intranet cloud e.g. “cloud in a box” software to manage personal (cores on my future 128 core laptop) department or enterprise cloud?

Simulation in the Cloud

Evolving the Simulation Center

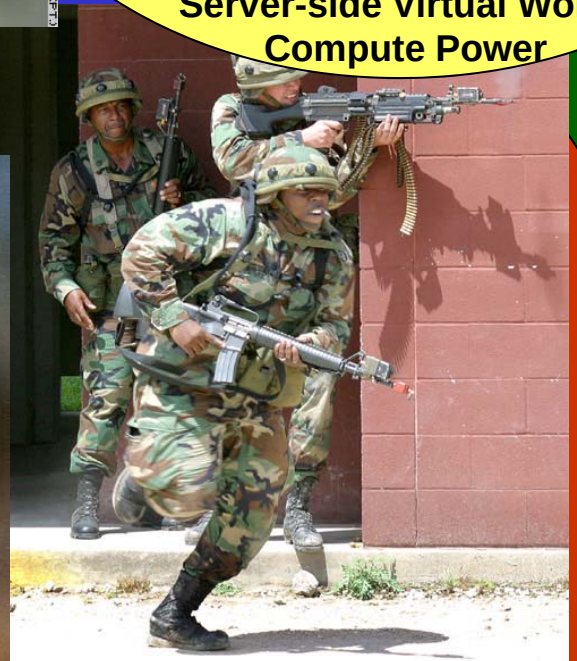
CONSTRUCTIVE

VIRTUAL



Cloud

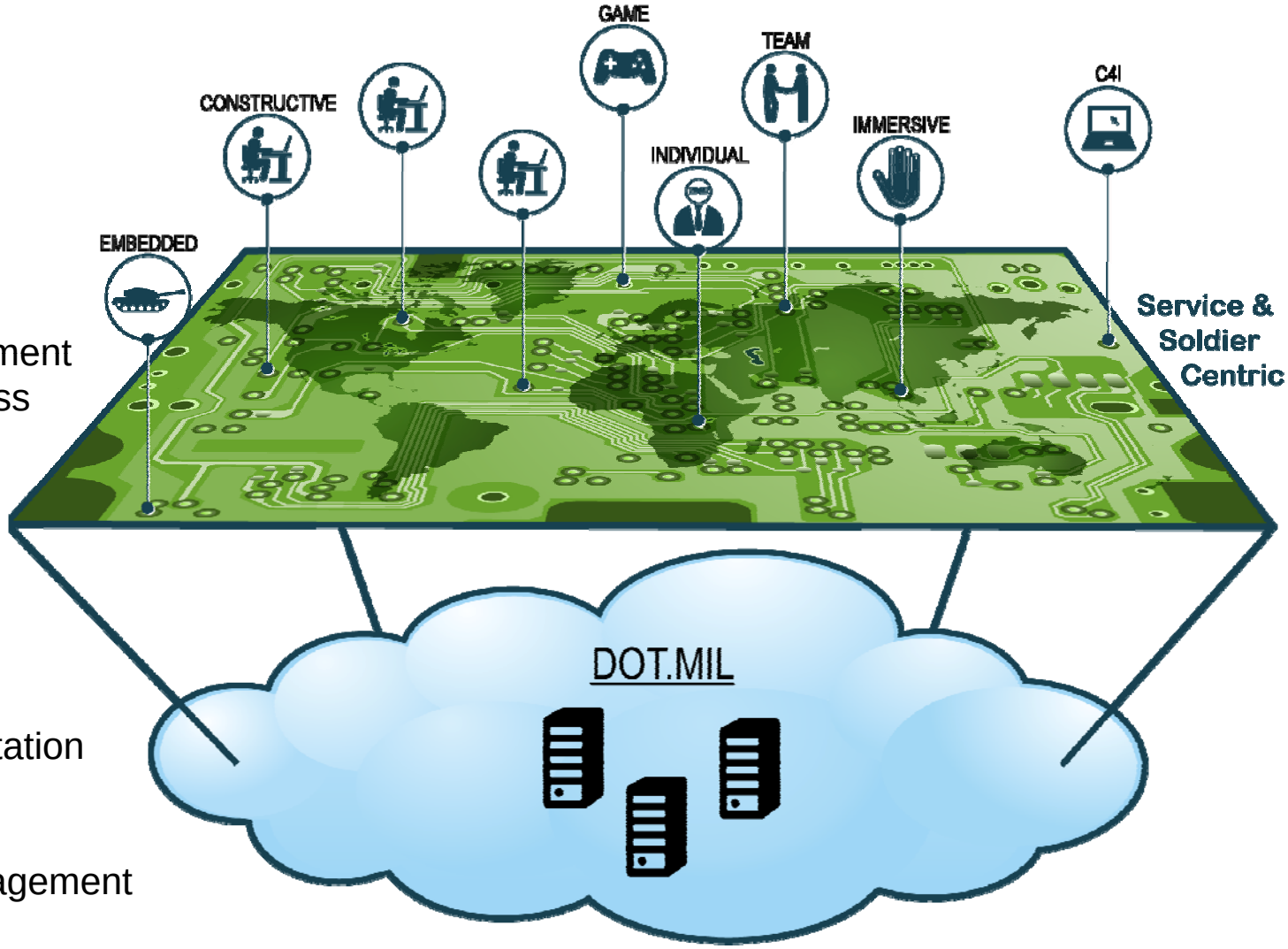
Server-side Virtual World Compute Power



LIVE

Simulation in the Cloud

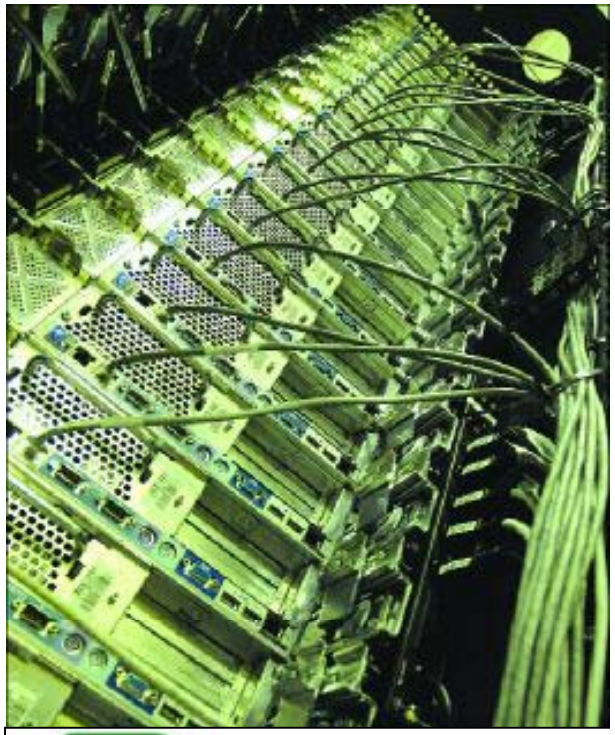
NEW WORLD
- Soldier-centric
- Desktop Equipment
- Universal Access



ENABLERS
- Massive Computation
- Global Networks
- Cloud Services
- Distributed Management

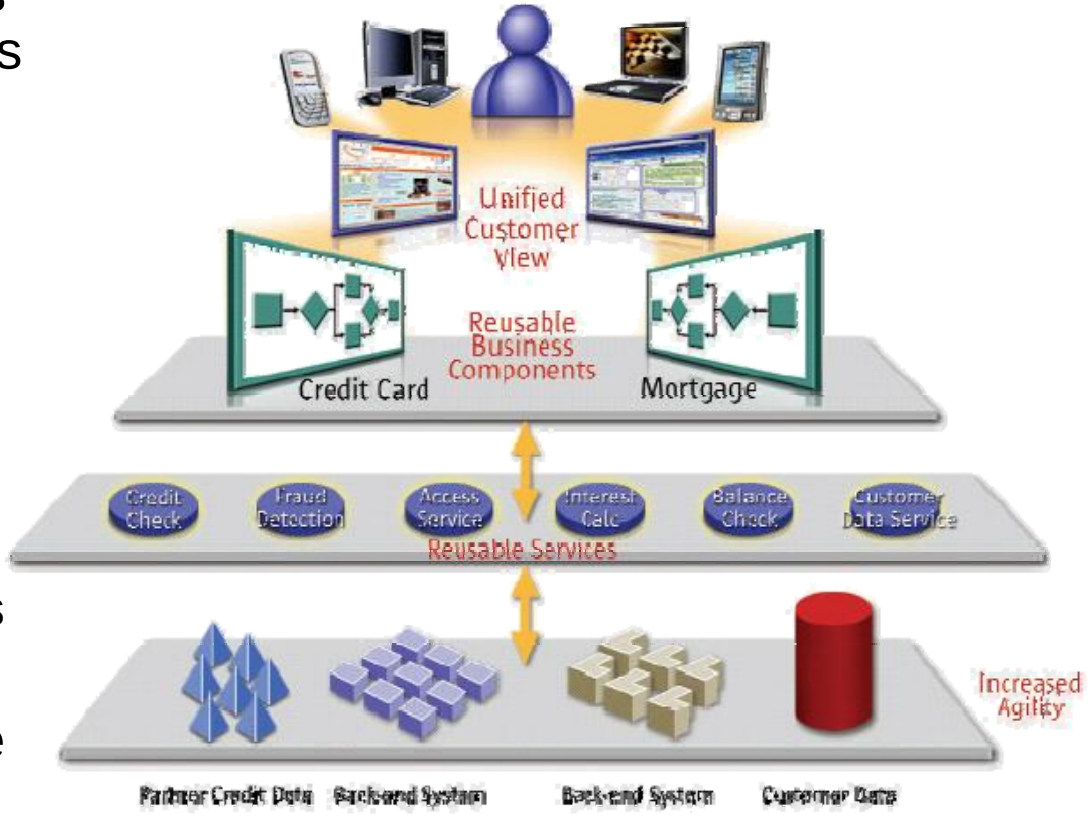
Training Event Servers in the Cloud

- High Compute Power in Professionally Managed Centers
  - Scalable to large exercises and large numbers of exercises
  - On-demand access to resources
- Power to Model
  - Finally put the “Reality” in “Virtual Reality”
  - Tighter system connections reduces lag
- Server-side Computing for LVC
  - Provide modeling for all types of exercises and experiments
  - Reduced sim-to-sim lag time
- Heterogeneous System-of-Systems
  - Multi-site collaboration



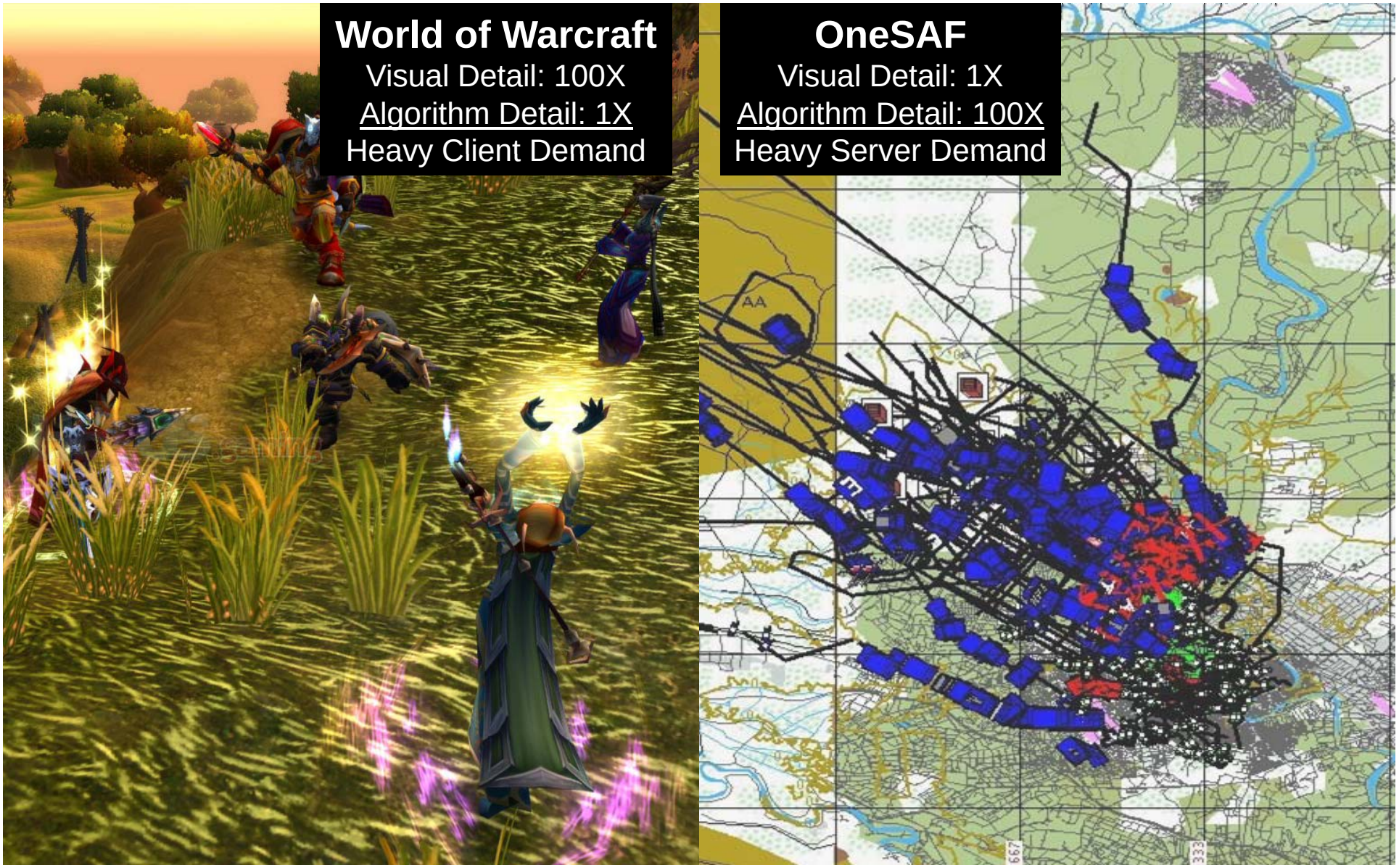
Simulation as a Cloud Service

- Scalable Simulation Services provided to remote customers on the customers' schedule
- Break the 1-to-1 relationship between equipment and events
- Light simulation client as an application on any military system
  - Browser-based
  - Generic Sim Engine & Tools
  - Flexible Game Engine
- Evolving Services at the core
  - Computation on Demand



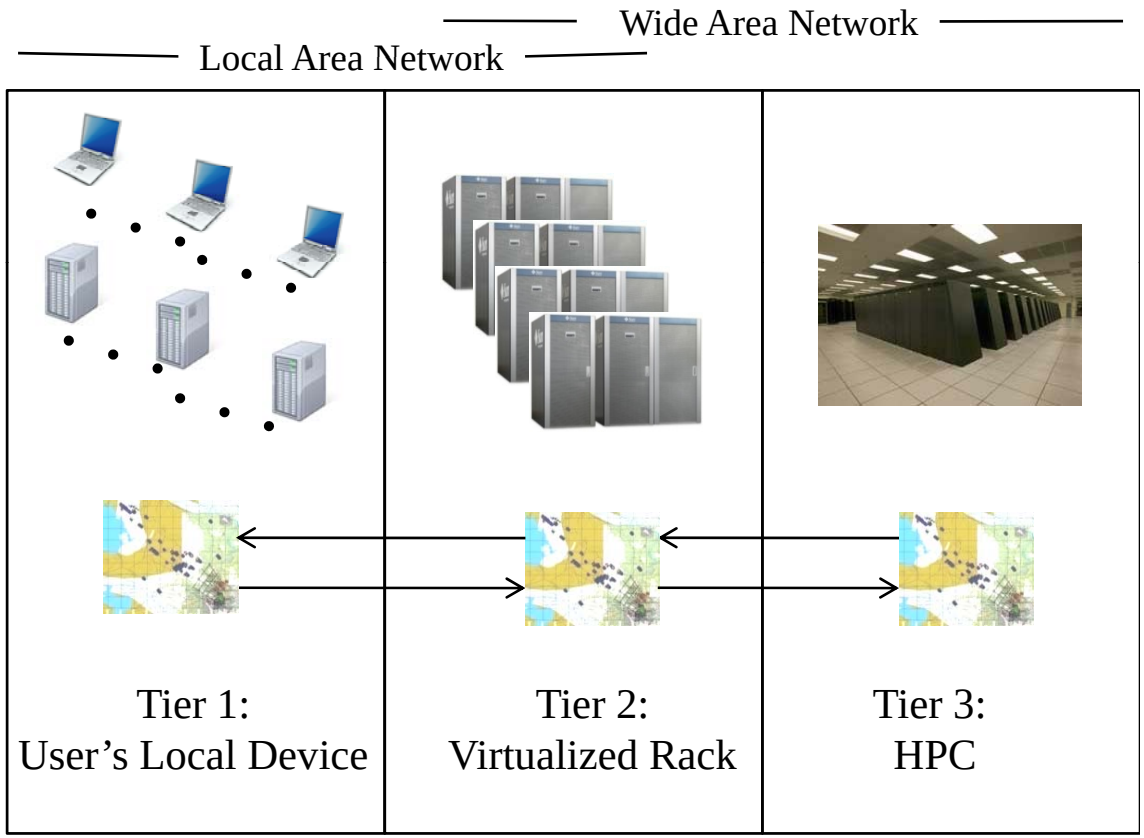
[Commercial SOA Diagram]

OneSAF vs. World of Warcraft



CloudSAF CONOPS

- Use Case 1
  - Many independent users within HPC environment
  - User needs large scenario (necessitating HPC) but only needs to control a subset of entities
  - System needs to provide “local” implementation (execution) of these entities for brief periods to support user interaction with minimal latencies
- Use Case 2
  - Many users cooperatively involved in federation of SAFs within HPC environment.
  - Each user needs to control a subset of entities
  - Optimization in this case simpler than optimization of case 1



Resources for HPTi

- Much more details and support than we covered today.
- Additional Resources are Available at:
  - Modelbenders.com
    - http://www.modelbenders.com/cloud.html

  - Slideshare.net
    - Search “Cloud Computing”