

# Cloud Computing Tutorial 1/2

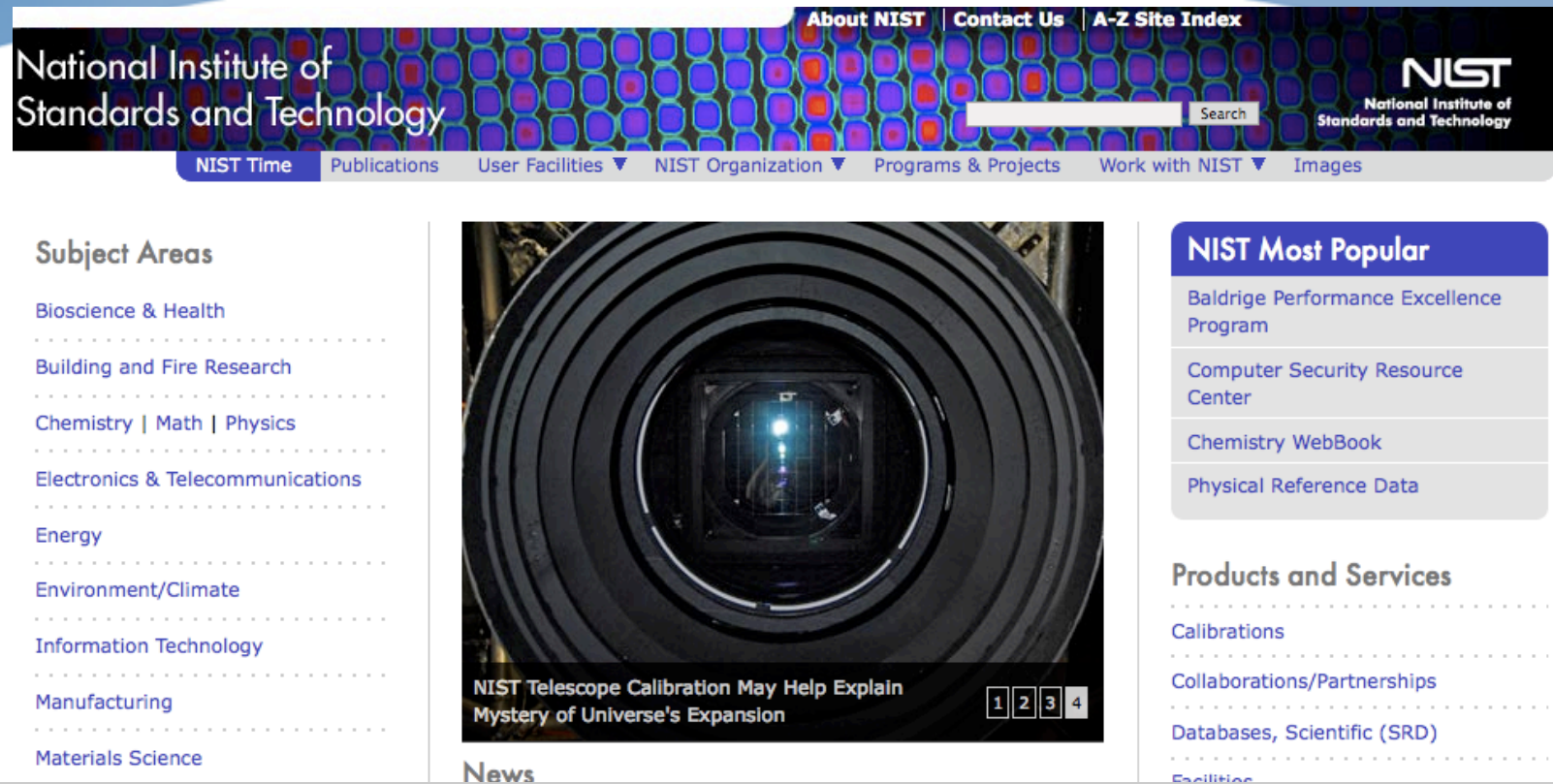
Peter Mell, Tim Grance

NIST, Information Technology Laboratory

Dongwon Lee, Ph.D.

Modified with the permissions from authors  
(pages with PSU logo)

# NIST View of Cloud Computing



The screenshot shows the NIST website homepage. At the top, there is a navigation bar with links for 'About NIST', 'Contact Us', and 'A-Z Site Index'. Below this is a large banner with the NIST logo and a search bar. The main content area is divided into three columns. The left column, titled 'Subject Areas', lists various research fields: Bioscience & Health, Building and Fire Research, Chemistry | Math | Physics, Electronics & Telecommunications, Energy, Environment/Climate, Information Technology, Manufacturing, and Materials Science. The middle column features a large image of a telescope lens with the headline 'NIST Telescope Calibration May Help Explain Mystery of Universe's Expansion' and a 'News' section below it. The right column, titled 'NIST Most Popular', lists several key resources: Baldrige Performance Excellence Program, Computer Security Resource Center, Chemistry WebBook, and Physical Reference Data. Below this is a 'Products and Services' section with links to Calibrations, Collaborations/Partnerships, Databases, Scientific (SRD), and Facilities.

**Subject Areas**

- Bioscience & Health
- Building and Fire Research
- Chemistry | Math | Physics
- Electronics & Telecommunications
- Energy
- Environment/Climate
- Information Technology
- Manufacturing
- Materials Science

**NIST Most Popular**

- Baldrige Performance Excellence Program
- Computer Security Resource Center
- Chemistry WebBook
- Physical Reference Data

**Products and Services**

- Calibrations
- Collaborations/Partnerships
- Databases, Scientific (SRD)
- Facilities

**News**

NIST Telescope Calibration May Help Explain Mystery of Universe's Expansion

NIST promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life.

# Origin of the term “Cloud Computing”

- “Comes from the early days of the Internet where we drew the network as a cloud... we didn’t care where the messages went... the cloud hid it from us” – Kevin Marks, Google
- First cloud around networking (TCP/IP abstraction)
- Second cloud around documents (WWW data abstraction)
- The emerging cloud abstracts infrastructure complexities of servers, applications, data, and heterogeneous platforms
  - (“muck” as Amazon’s CEO Jeff Bezos calls it)

# A Working Definition of Cloud Computing

- Cloud computing: A model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction
- This cloud model promotes availability and is composed of five essential **characteristics**, three **service models**, and four **deployment models**.

# Salesforce.com's CC Video



# 5 Essential Cloud Characteristics

- On-demand self-service
- Broad network access
- Resource pooling
  - Location independence
- Rapid elasticity
- Measured service

# 3 Cloud Service Models

- Cloud Software as a Service (**SaaS**)
  - Use provider's applications over a network
- 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
- To be considered “cloud” they must be deployed on top of cloud infrastructure that has the key characteristics



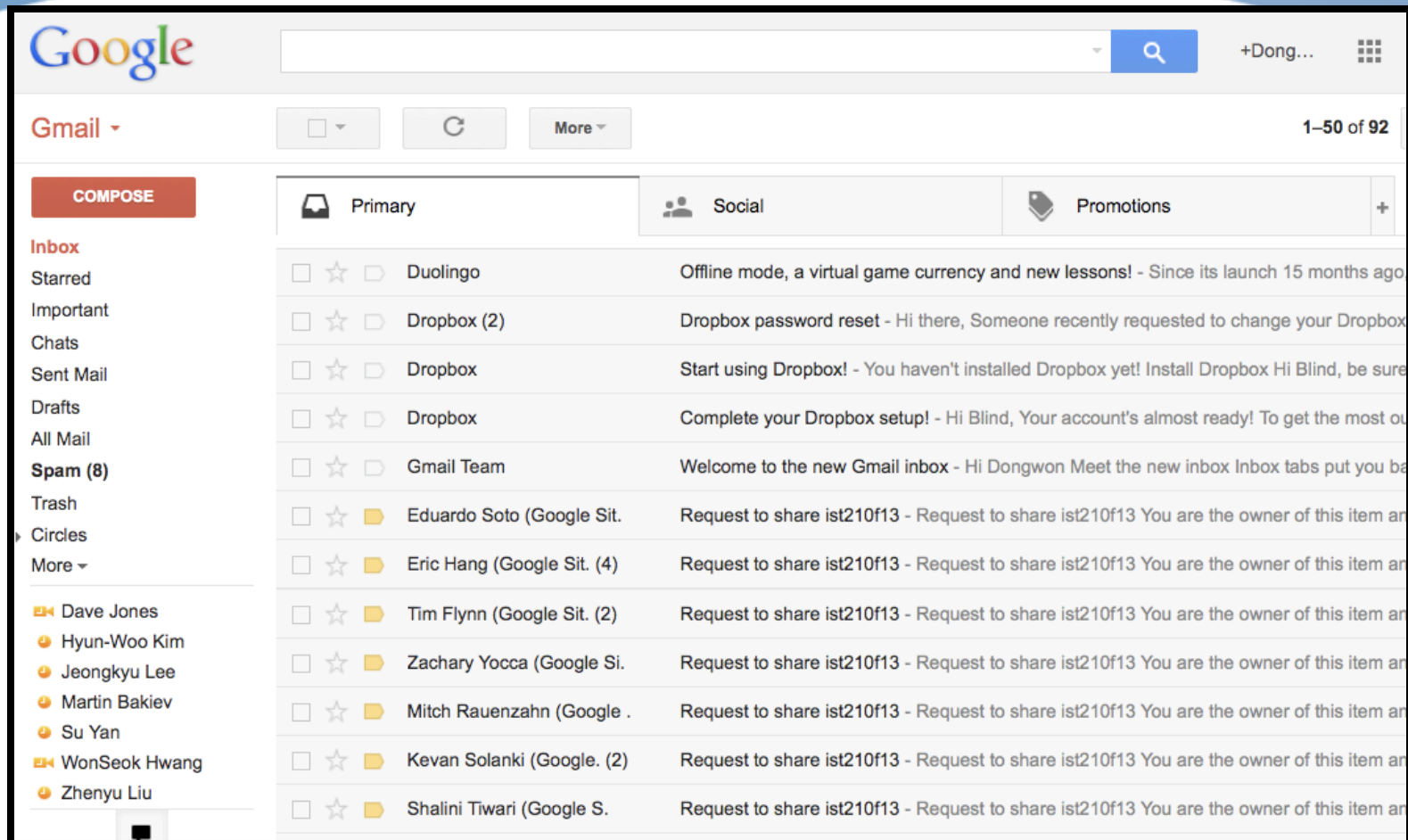
# Eg, SaaS

Apple  
iCloud







# Eg, SaaS



# Eg, PaaS

Search  
e.g. "templates" or "datastore"

★ **Google App Engine**Home [Docs](#) [FAQ](#)




## Run your web apps on Google's infrastructure

Easy to build, easy to maintain, easy to scale

Google App Engine enables you to build and host web apps on the same systems that power Google applications. App Engine offers fast development and deployment; simple administration, with no need to worry about hardware, patches or backups; and effortless scalability.

[Discover why](#) developers are choosing App Engine.



### Focus on your app, leave the rest to us

All the power of Google in one, simple platform.

- **Zero to sixty:** App Engine enables your application to scale automatically without worrying about managing machines.
- **Supercharged APIs:** The App Engine platform provides amazing services such as Task Queue, XMPP, and Prospective search, all powered by the same infrastructure that powers Google's applications.
- **You're in control:** The simple, web-based dashboard makes it easy to manage your application without having to babysit it.

# Google App Engine (GAE)

- Google's approach to CC
  - “Google as the web platform”
- A platform to deploy and host web applications in Google-managed data centers
- GAE delivers a platform and solution stack (as a service) → PaaS
- GAE virtualizes apps across multiple servers and data centers
- Beta service since 2008

<https://developers.google.com/appengine/>

# Eg, PaaS

The screenshot shows the Salesforce homepage with a blue header. The Salesforce logo is on the left, and a 'NO SOFTWARE' icon is overlaid on it. The header includes links for Feedback, Customer Login, Free Trial, and a search bar. The main navigation bar lists Products, Solutions, Services, Customers, Events, Resources, and About Us. The main content area features a section for Force.com, described as 'The leading cloud platform for business apps'. It lists features: 100% cloud (no hardware or software), Mobile (run on any platform or device), and Social (add collaboration features). A red button says 'Get started Free Force.com'. To the right is a video player with the text 'What can I build on Force.com?' and a play button. On the left, a sidebar lists other Salesforce products: Force.com, Appforce, Siteforce, VMforce, ISVforce, and Database.com.

1-800-NO-SOFTWARE – 1-800-6

salesforce

Feedback Customer Login Free Trial Search

Products Solutions Services Customers Events Resources About Us

**Force.com**

**The leading cloud platform for business apps**

Every business needs apps: HR apps, inventory apps, iPhone, iPad, Android, and BlackBerry apps. Now you can use the Force.com platform to build all of your apps—and websites—quickly and easily.

- 100% cloud—requires no hardware or software
- Mobile—run your apps on any platform or device
- Social—add collaboration features to every app

**Get started**  
Free Force.com

What can I build on Force.com?

Force.com

Appforce

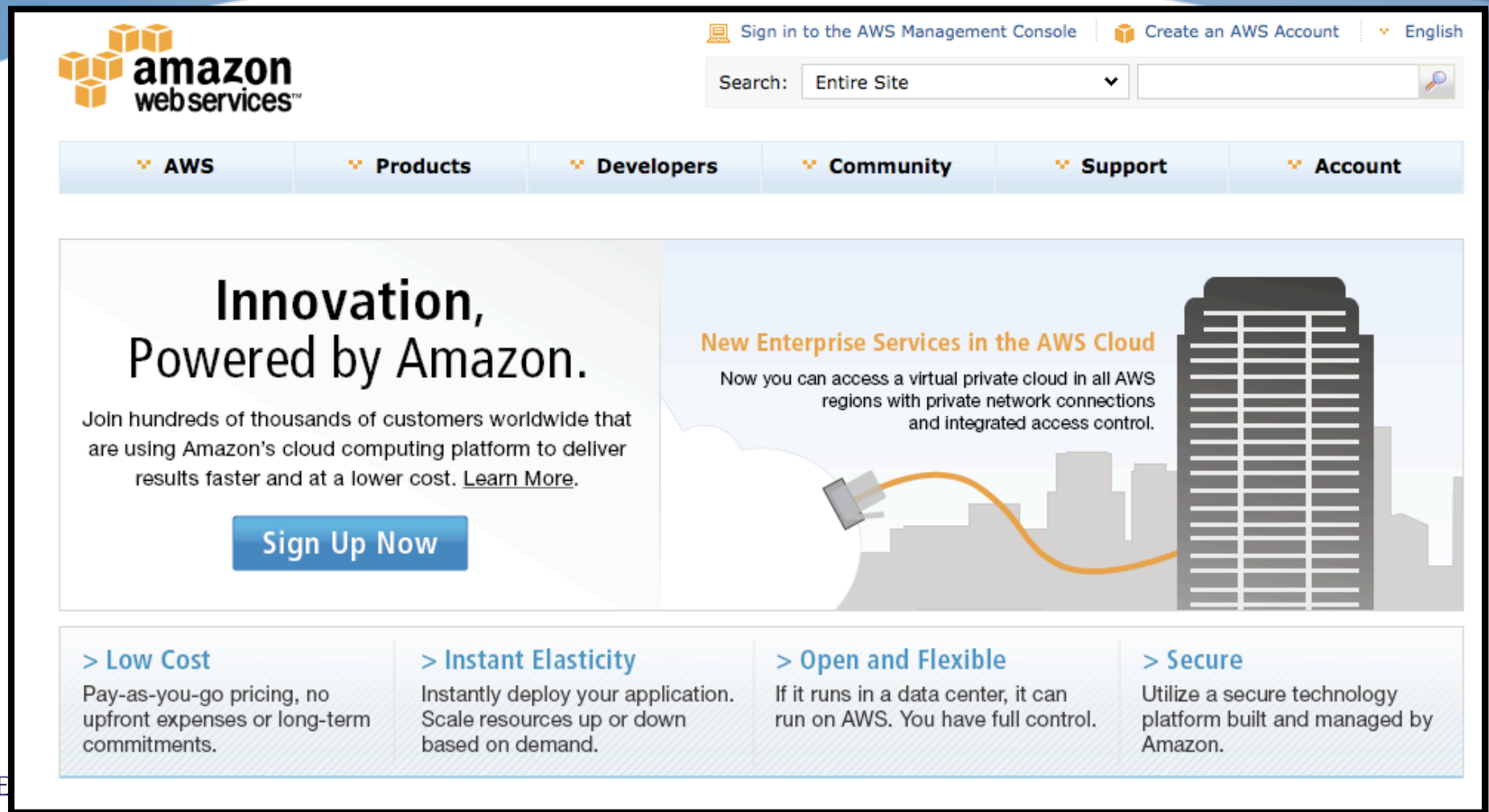
Siteforce

VMforce

ISVforce

Database.com

# Eg, IaaS



The screenshot shows the AWS homepage with a dark blue header. The AWS logo is on the left. On the right, there are links for 'Sign in to the AWS Management Console', 'Create an AWS Account', and 'English'. Below these is a search bar with 'Entire Site' selected. A navigation bar contains links for 'AWS', 'Products', 'Developers', 'Community', 'Support', and 'Account'. The main content area features a large section titled 'Innovation, Powered by Amazon.' with a 'Sign Up Now' button. To the right, a section titled 'New Enterprise Services in the AWS Cloud' describes virtual private cloud access. At the bottom, four columns highlight key benefits: Low Cost, Instant Elasticity, Open and Flexible, and Secure.

**amazon web services™**

Sign in to the AWS Management Console | Create an AWS Account | English

Search: Entire Site

**AWS** | **Products** | **Developers** | **Community** | **Support** | **Account**

## Innovation, Powered by Amazon.

Join hundreds of thousands of customers worldwide that are using Amazon's cloud computing platform to deliver results faster and at a lower cost. [Learn More.](#)

**Sign Up Now**

### New Enterprise Services in the AWS Cloud

Now you can access a virtual private cloud in all AWS regions with private network connections and integrated access control.

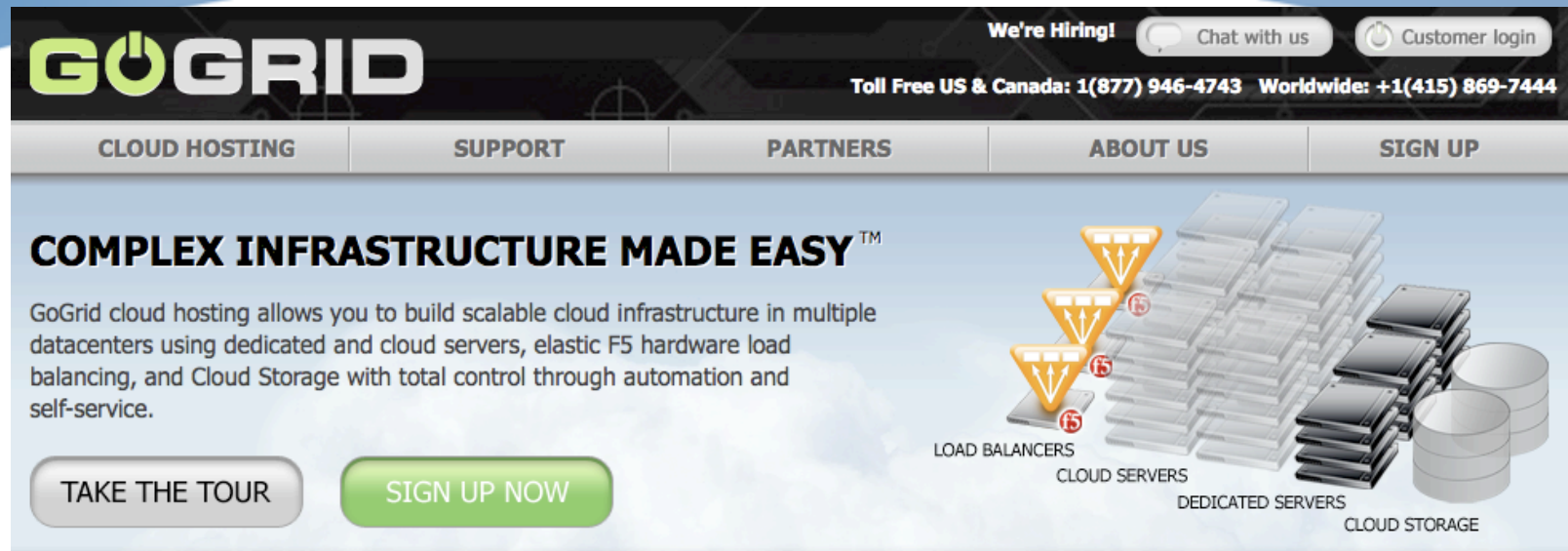
- > Low Cost**  
Pay-as-you-go pricing, no upfront expenses or long-term commitments.
- > Instant Elasticity**  
Instantly deploy your application. Scale resources up or down based on demand.
- > Open and Flexible**  
If it runs in a data center, it can run on AWS. You have full control.
- > Secure**  
Utilize a secure technology platform built and managed by Amazon.

# GAE vs. AWS

- GAE is **PaaS**
  - Abstract OS-independent platform is pre-built and provided
  - Users have to create a web app and deploy it to the abstract platform
- AWS is **IaaS**
  - Users can build their own platform within CC, called AMI  
→ “Infrastructure as a Service”
  - Users can create a web app and deploy it to their own platform (AMI)



# Eg, IaaS



The image shows the GoGrid website header and main banner. The header includes the GoGrid logo, navigation links for Cloud Hosting, Support, Partners, About Us, and Sign Up, and contact information including a toll-free number and a worldwide number. The main banner features the headline "COMPLEX INFRASTRUCTURE MADE EASY™" and a description of GoGrid's cloud hosting services. To the right of the text is a diagram illustrating the infrastructure components: Load Balancers, Cloud Servers, Dedicated Servers, and Cloud Storage. Below the text are two buttons: "TAKE THE TOUR" and "SIGN UP NOW".

**GOGRID**

We're Hiring! Chat with us Customer login

Toll Free US & Canada: 1(877) 946-4743 Worldwide: +1(415) 869-7444

CLOUD HOSTING SUPPORT PARTNERS ABOUT US SIGN UP

**COMPLEX INFRASTRUCTURE MADE EASY™**

GoGrid cloud hosting allows you to build scalable cloud infrastructure in multiple datacenters using dedicated and cloud servers, elastic F5 hardware load balancing, and Cloud Storage with total control through automation and self-service.

TAKE THE TOUR SIGN UP NOW

LOAD BALANCERS CLOUD SERVERS DEDICATED SERVERS CLOUD STORAGE

WHY GOGRID

FEATURES

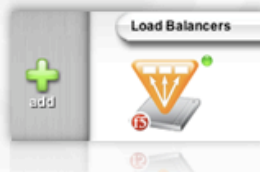
PRICING

COMPARE

**Powerful Tools**  
to manage your cloud



**Scale Easily**  
with real-time provisioning



**Expand your Cloud**  
with multiple datacenters



**Gartner.**

NEW!

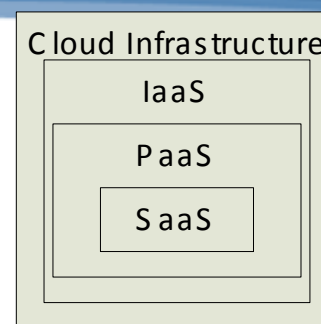
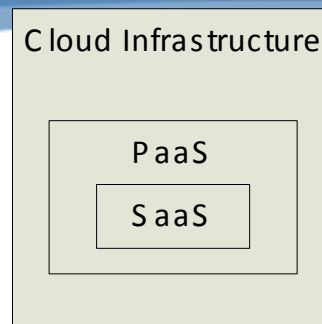
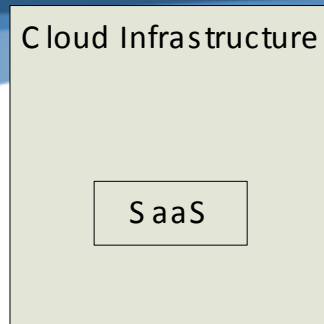
GoGrid positioned in the "Visionaries" Quadrant of the Magic Quadrant for Cloud Infrastructure as a Service and Web Hosting.

READ THE REPORT

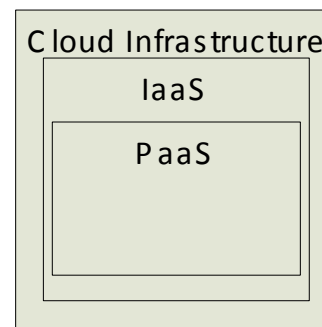
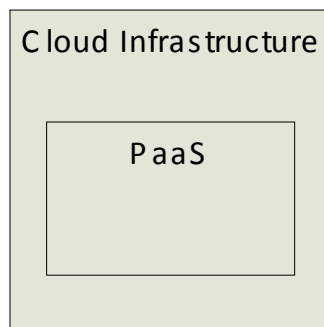




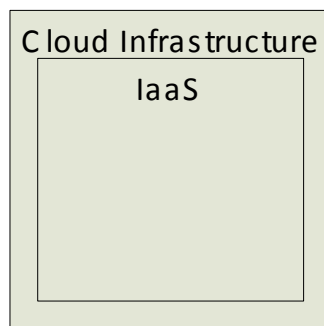
# Service Model Architectures



Software as a Service  
(SaaS)  
Architectures



Platform as a Service (PaaS)  
Architectures



Infrastructure as a Service (IaaS)  
Architectures

# 4 Cloud Deployment Models

- Private cloud
  - enterprise owned or leased
- Community cloud
  - shared infrastructure for specific community
- Public cloud
  - Sold to the public, mega-scale infrastructure
- Hybrid cloud
  - composition of two or more clouds

# Eg, Community Cloud

**Apps.Gov**  
A Service Provided by GSA

Welcome | Register | Log In  
0 Items in Cart \$0.00

Contact Us | Cloud FAQs | Vendor FAQs

Home | Business Apps | Productivity Apps | Cloud IT Services | Social Media Apps

 Wednesday, January 12, 2011

SEARCH FOR  IN All Categories



### What's Cool About the Cloud?

You've heard lots of talk about cloud computing, so what can it really do for you? Consider these benefits:

- Scalability: add and subtract capacity as your needs change. Pay for only what you use.
- Easy to implement: since you don't need to purchase hardware, software licenses or implementation services, you can get off the ground fast.
- Service quality: cloud service providers offer reliable services, large storage and computing capacity, and 24/7 service and up-time.
- Frees up resources: your in-house IT department can focus on business-critical tasks without having to incur additional costs in manpower.

### What is Cloud Computing?

Want to learn more?

Watch this brief video for an overview of Cloud Computing to gain a better understanding of what it is and its benefits.



Watch the video now »

[Video transcript »](#)

## What type of solution do you need?

### Business Apps


Your agency or service is complex and requires state-of-the-art software to get business done.



Cloud Business Apps has a solution!

### Cloud IT Services

Need a better solution to reduce cost and implement projects faster?



GSA Cloud IT Services has the answer!

Google's  
"Gov Cloud"

# Eg, Hybrid Cloud

## OpenNebula.org

The Open Source Toolkit for Cloud Computing

Commercial | Contact |    

Home

About

Documentation

Software

Support

Community

Cloud

Dev

Blog

### Most Flexible and Innovative Enterprise-class IaaS Cloud Software

Fully open source (not open core), thoroughly tested, customizable, extensible and with unique features and excellent performance and scalability to manage hundreds of thousands of VMs:

- Private cloud with **Xen**, **KVM** and **VMware**,
- Hybrid cloud (**cloudbursting**) with **Amazon EC2**, and other providers through **Deltacloud** (from **ecosystem**),
- Public cloud supporting **EC2 Query**, **OGF OCCI** and **vCloud** (from **ecosystem**) APIs,... and **much more**.



Designed to Implement Cloud Computing Use Cases from Leading IT Organizations

**1** Download OpenNebula

**2** Read the Documentation

**3** Engage the Community

### Quick links

- [About the Project](#)
- [What is OpenNebula?](#)
- [Who is behind?](#)
- [Who uses OpenNebula?](#)
- [Why OpenNebula?](#)
- [Key Features](#)

### Featured Quotes

"...out of the five researched platforms OpenNebula is best for SurfNet"

Cloud Computing Solutions, SURFnet

Meet Us at

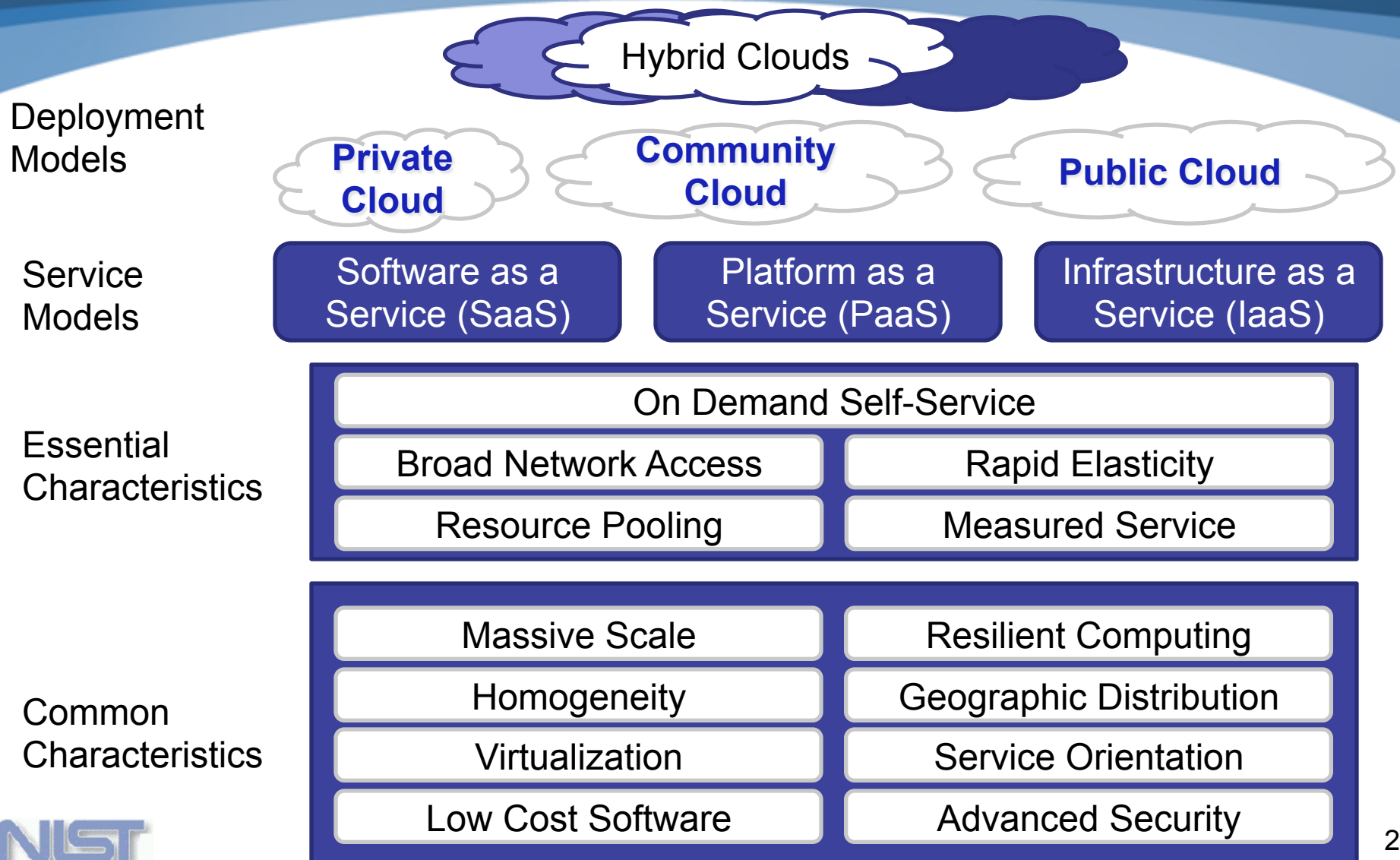
PENNSYLVANIA STATE



# Common Cloud Characteristics

- Cloud computing often leverages:
  - Massive scale
  - Homogeneity
  - Virtualization
  - Resilient computing
  - Low cost software
  - Geographic distribution
  - Service orientation
  - Advanced security technologies

# The NIST Cloud Definition Framework



# Putting All Together

- Most clouds will require very strong security controls
- All models of cloud may be used for differing tradeoffs between threat exposure and efficiency
- There is no one “cloud”. There are many models and architectures.
- How does one choose?



# Migration Paths for Cloud Adoption

- Use public clouds
- Develop private clouds
  - Build a private cloud
  - Procure an outsourced private cloud
  - Migrate data centers to be private clouds (fully virtualized)
- Build or procure community clouds
  - Organization wide SaaS
  - PaaS and IaaS
  - Disaster recovery for private clouds
- Use hybrid-cloud technology
  - Workload portability between clouds

# Eg, Using Public Cloud

The screenshot shows the Microsoft Student website interface. At the top left is a green banner with the text "/STUDENT". To its right is a search bar with the text "Section Title" and a "bing" search button. Below the search bar is a "Sign Up for Microsoft Student Newsletter" link. A horizontal navigation bar contains icons for Windows 7, Office 2010, Windows Live, Office Web Apps, Expression Studio, and Office for Mac. Below this is a "Navigation" section with the path "Home > Software > Live@edu". The main content area features the "Microsoft Live@edu" logo and a section titled "Free Hosted Email, Communication & Collaboration Services". This section describes the service as a free email, communication, and collaboration tool with 10 GB of mailbox space, 25 GB of free file storage on SkyDrive, and access to Office Web Apps, instant messaging, and video chat. To the right of this text is a yellow box containing the text "U. Washington", "U. Penn", and "...". Below the yellow box is a "Related Links" section with links to "SkyDrive Tips", "Office Web Apps", "PDF: Office Web Apps", "PDF: Office Web Apps", and "Microsoft Outlook". At the bottom right is a section titled "Microsoft Live@edu Services" with a link to "Microsoft Outlook Live".

/STUDENT

Section Title

Rate this page ☆☆☆☆☆

Search Microsoft/Student **bing** Microsoft

Sign Up for Microsoft Student Newsletter

Windows 7 Office 2010 Windows Live Office Web Apps Expression Studio Office for Mac

Navigation  
Home > Software > Live@edu

Microsoft Live@edu

**Free Hosted Email, Communication & Collaboration Services**

Microsoft Live@edu is a cool free email, communication and collaboration service that includes anywhere access to 10 GB mailboxes on the Outlook Live e-mail experience across the desktop, web and mobile devices, 25 GB of free file storage on SkyDrive, document sharing & editing through Office Web Apps, instant messaging, video chat, and a lot more that you can access with the same user ID & password.

Related Links

- SkyDrive Tips
- Office Web Apps
- PDF: Office Web Apps
- PDF: Office Web Apps
- Microsoft Outlook

Microsoft Live@edu Services

Microsoft Outlook Live

U. Washington  
U. Penn  
...

# Possible Effects of Cloud Computing



- Small enterprises use public SaaS and public clouds and minimize growth of data centers
- Large enterprise data centers may evolve to act as private clouds
- Large enterprises may use hybrid cloud infrastructure software to leverage both internal and public clouds
- Public clouds may adopt standards in order to run workloads from competing hybrid cloud infrastructures

# Potential Issues of Cloud Computing


- Privacy
- Security
- Legal Issue
- Compliance
- Availability
- Performance
- ...

# Eg, Security Problem

## Major University Dumps Gmail Over Security Concerns


 Tweet 11

 Share 499

 32


331  Digg ↑

 email

 share

### Do you like this story?

 Like

 499 likes. Sign Up to see what your friends like.

The University of California, Davis has [stopped using Gmail](#) for its 30,000-member staff and faculty body. The university was trying Gmail for faculty and staff with plans to roll out service to the entire campus. But school officials say the e-mail system isn't secure or private enough to meet their standards.

CIO Peter Siegel, Academic Senate IT Chair Niels Jensen and Campus Council IT Chair Joe Kiskis said the plug was pulled on Gmail because members of the faculty were concerned that it wouldn't keep their correspondence private enough. Many privacy experts also say that Gmail's social component, Google Buzz, is a source of privacy and security vulnerabilities.



# Eg, Availability Problem

## INVENOVATE

Your Online News Source

[Check Your Yahoo Mail](#)  
Check Your Yahoo Mail Now  
[www.alot.com](http://www.alot.com)  
[<](#) [>](#)

**HOME** **HEALTH** **WORLD** **MARKETING** **EDUCATION** **BUSINESS** **ENTERTAINMENT**

About Staff Privacy Policy Stay Connected

Tuesday, December 14th, 2010 | Posted by N Harrison

### Yahoo Account Yahoo Mail Sign In Server Goes Down

Do you own a business?  
Be found on Google for free  
Claim your free listing today  
Google places

places.google.com/business

Ads by Google

Many users of Yahoo services are taking notice of their email and other Yahoo products and services not functioning. The servers that Yahoo uses have been

#### Share It

- Digg It
- Del.icio.us
- Add to Facebook
- Google Bookmarks
- Stumble It
- Twitter
- Add to Reddit
- Print This Post

#### Archives

- ▶ January 2011
- ▶ December 2010
- ▶ November 2010
- ▶ October 2010



# Eg, Availability Problem

Google calendar

APR 20, 2011, 11:56AM

[Calendar Home](#)

[Overview](#)

[What's New](#)

[Event Publisher Guide](#)

[Privacy Information](#)

[For Work or School](#)

[Help Center](#)

## Server Error

Google Calendar is temporarily unavailable. Please try back later. In the meanwhile, you might find useful information on our [Help Group](#) and [Help Center](#). We apologize for any inconvenience.

Google カレンダーは一時的にご利用いただけません。しばらくしてから、もう一度試してみてください。また、[ヘルプセンター](#)および[ヘルプグループ\(英語\)](#)でも、問題の解決に役立つ情報を提供しております。ご不便をおかけしますが何卒ご了承ください。

Google Agenda est momentanément indisponible. Veuillez réessayer ultérieurement. En attendant, vous trouverez des informations utiles dans notre [Centre d'aide](#) et notre [Forum d'aide \(en anglais uniquement\)](#). Nous vous prions de nous excuser des désagréments occasionnés.

Der Google Kalender-Service ist vorübergehend nicht verfügbar. Versuchen Sie es später erneut. In der Zwischenzeit erhalten Sie nützliche Informationen in der [Google Kalender-Hilfe](#) und der [Google Kalender-Hilfegruppe \(nur auf Englisch verfügbar\)](#). Wir entschuldigen uns für eventuelle Unannehmlichkeiten.

Google Calendar no estará disponible temporalmente. Por favor, intenta acceder más tarde. Mientras tanto, puedes consultar el [Centro de Asistencia](#) y el [Grupo de Ayuda \(sólo en inglés\)](#), donde encontrarás información interesante. Disculpa las molestias.

Google Agenda is tijdelijk niet beschikbaar. Probeer het later nogmaals. In de tussentijd kun je nuttige informatie vinden in ons [Helpcentrum](#) en de [discussiegroep \(alleen in het Engels\)](#). Onze excuses voor het ongemak.

Google Calendar non è temporaneamente disponibile. Riprova più tardi. Nel frattempo prova a consultare il nostro [Centro assistenza](#) e il [Gruppo di assistenza \(solo in inglese\)](#) per trovare informazioni utili. Ci scusiamo per gli eventuali disagi causati.

O Google Agenda não está disponível no momento. Tente novamente mais tarde. Enquanto isso, você pode encontrar informações úteis na nossa [Central de Ajuda](#) e no [Grupo de ajuda \(apenas em inglês\)](#). Pedimos desculpas por qualquer inconveniente.

Google 日曆暫時無法使用。請稍後再試。在此期間，您可以在我們的[說明中心](#)和[協助團隊\(僅英文\)](#)中找到有用的資訊。對於造成您的任何不便，我們謹此致歉。

Google 日历暂时不可用。请稍后再试。在此期间，您可以在我们的[支持中心](#)和[支持论坛\(仅有英文版\)](#)查找有用的信息。对于由此带来的任何不便，我们深表歉意。

Kalendarz Google jest tymczasowo niedostępny. Spróbuj ponownie później. Tymczasem możesz znaleźć przydatne informacje



# Eg, Availability Problem

## Amazon says some data unrecoverable after restoring cloud service

April 27, 2011 | Dean Takahashi

2 Comments



2 people like this. Be the first of your friends.



Amazon said that about 0.07 percent of the data storage in its restored eastern cloud service isn't fully recoverable. The company's cloud-based web services suffered an outage that lasted for three-and-a-half days last week and service was restored for the most part on Monday.

But some of the data — 0.07 percent of the eastern region — hasn't been recovered, and the company is contacting the limited number of customers who have lost data. One of the lessons being learned here is that backup sometimes isn't enough, and customers who

web services may have to use multiple vendors in the future.



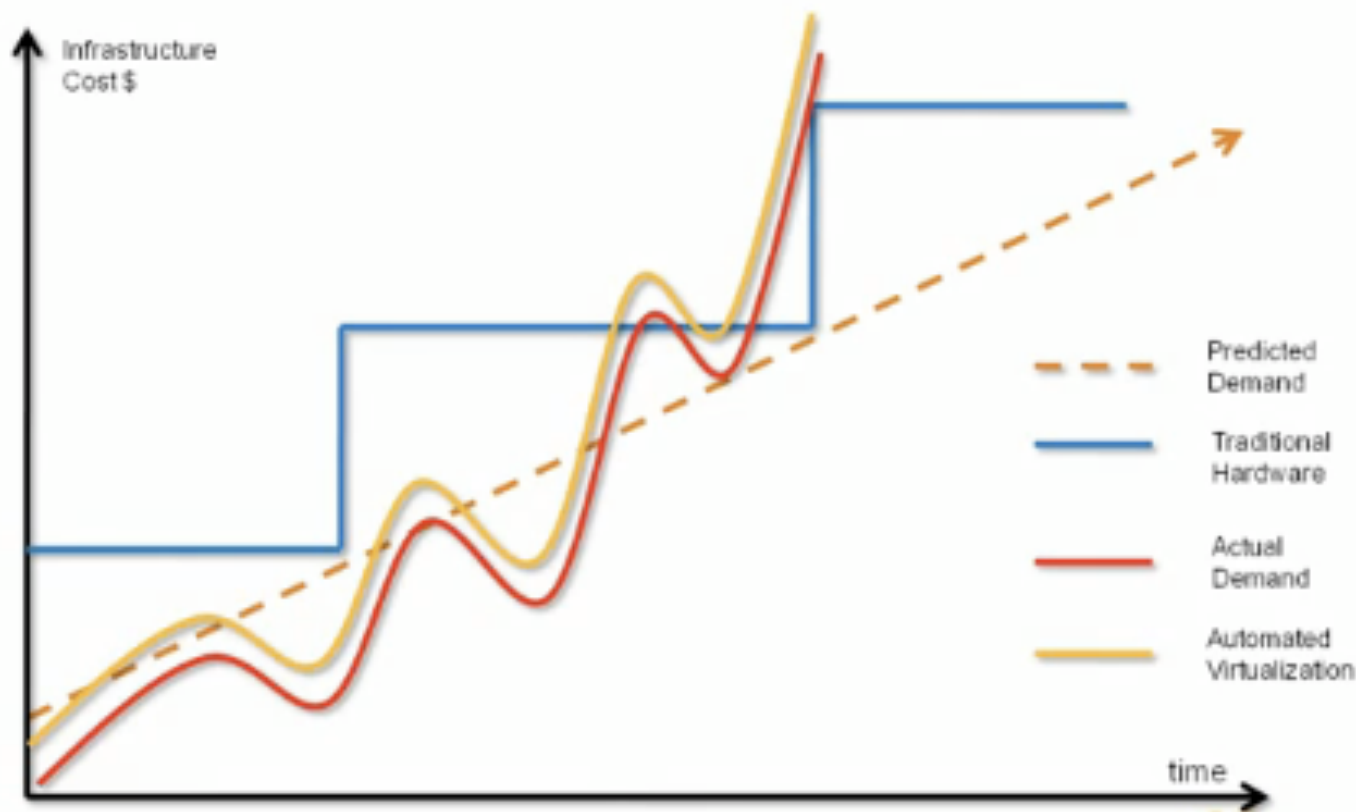
<http://venturebeat.com/>

# Thoughts on Cloud Computing

- Galen Gruman, InfoWorld Executive Editor, and Eric Knorr, InfoWorld Editor in Chief
  - “A way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software.”
  - “The idea of loosely coupled services running on an agile, scalable infrastructure should eventually make every enterprise a node in the cloud.”

# Meeting Demands using CC

## Elastic and Pay-Per-Use Infrastructure



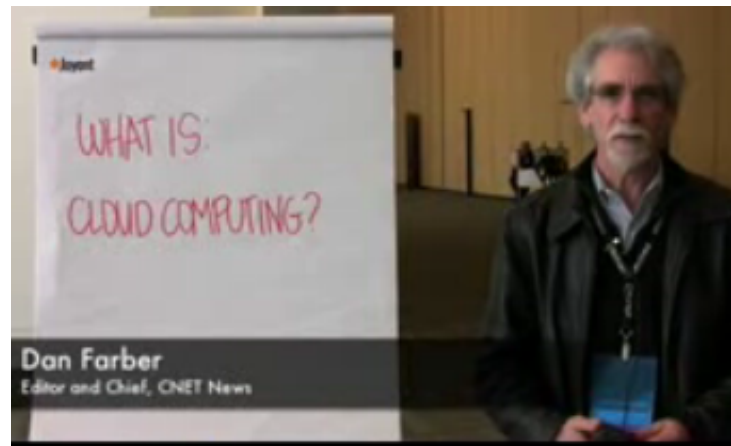
# Thoughts on Cloud Computing

- Tim O'Reilly, CEO O'Reilly Media
- “I think it is one of the foundations of the next generation of computing”
- “The network of networks is the platform for all computing”
- “Everything we think of as a computer today is really just a device that connects to the big computer that we are all collectively building”



# Thoughts on Cloud Computing

- Dan Farber, Editor in Chief CNET News
- “We are at the beginning of the age of planetary computing. Billions of people will be wirelessly interconnected, and the only way to achieve that kind of massive scale usage is by massive scale, **brutally efficient** cloud-based infrastructure.”



# Core objectives of Cloud Computing

- Amazon CTO Werner Vogels
- Core objectives and principles that cloud computing must meet to be successful:
  - Security
  - Scalability
  - Availability
  - Performance
  - Cost-effective
  - Acquire resources on demand
  - Release resources when no longer needed
  - Pay for what you use
  - Leverage others' core competencies
  - Turn fixed cost into variable cost



Amazon CTO Werner Vogels  
(Credit: Dan Farber)



# A “sunny” vision of the future

- Sun Microsystems CTO Greg Papadopoulos
  - Users will “trust” service providers with their data like they trust banks with their money
  - “Hosting providers [will] bring ‘brutal efficiency’ for utilization, power, security, service levels, and idea-to-deploy time” –CNET article
  - Becoming cost ineffective to build data centers
  - Organizations will rent computing resources



# Criticisms on Cloud Computing

- Richard Stallman (GNU, FSF, Emacs)
  - cloud computing was simply a trap aimed at forcing more people to buy into locked, proprietary systems that would cost them more and more over time
- Larry Ellison (Oracle CEO)
  - “everything that we already do” and that it will have no effect except to “change the wording on some of our ads”

# Case Study: Facebook's Use of Open Source and Commodity Hardware (8/08)

- Jonathan Heiliger, Facebook's vice president of technical operations
- 80 million users + 250,000 new users per day
- 50,000 transactions per second, 10,000+ servers
- Built on open source software
  - Web and App tier: Apache, PHP, AJAX
  - Middleware tier: Memcached (Open source caching)
  - Data tier: MySQL (Open source DB)
- Thousands of DB instances store data in distributed fashion (avoids collisions of many users accessing the same DB)
- “We don't need fancy graphics chips and PCI cards,” he said. “We need one USB port and optimized power and airflow. Give me one CPU, a little memory and one power supply. If it fails, I don't care. We are solving the redundancy problem in software.”

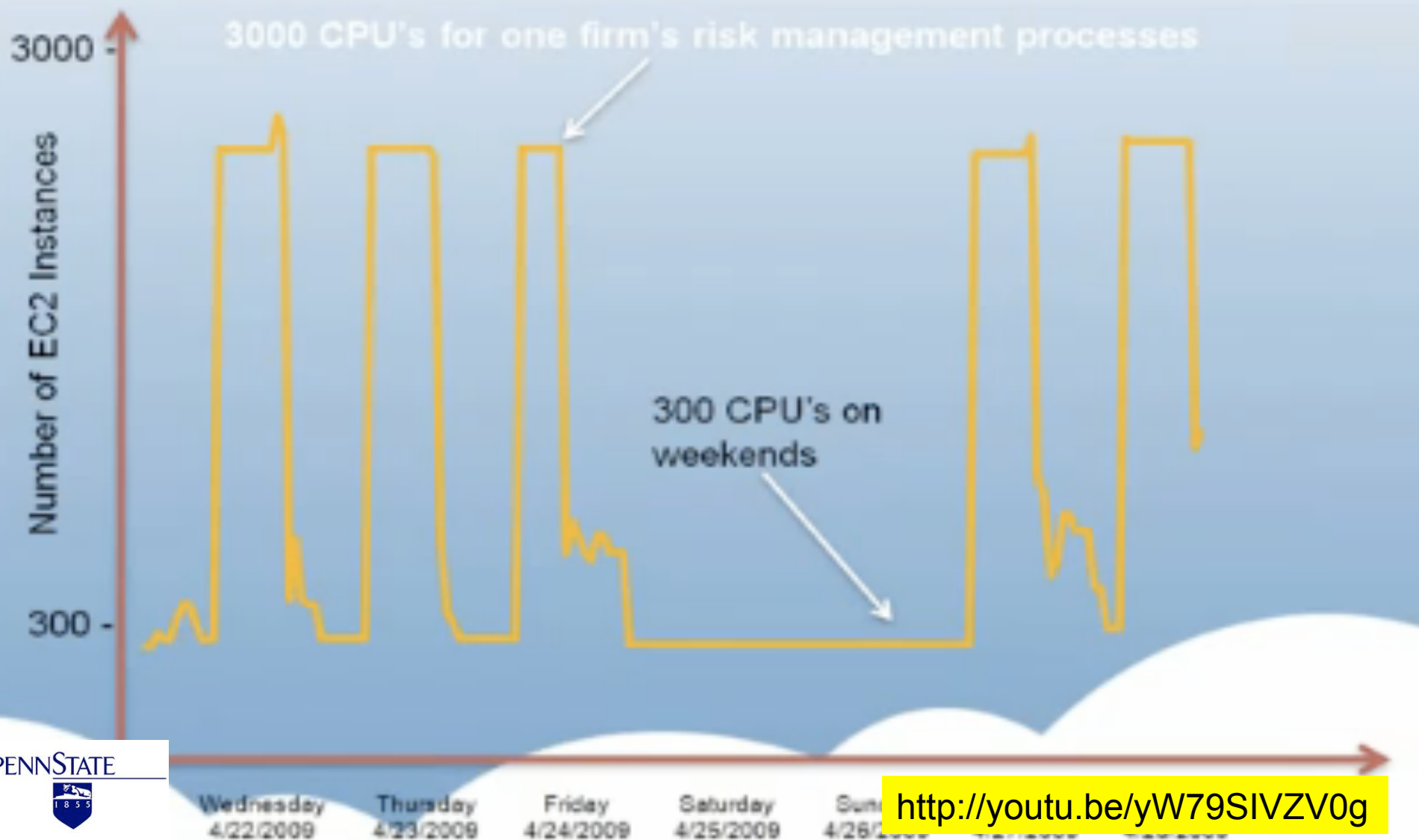
# Case Study: Amazon Cloud

- Amazon cloud components
  - Elastic Compute Cloud (EC2)
  - Simple Storage Service (S3)
  - SimpleDB
- New Features
  - Availability zones
    - Place applications in multiple locations for failovers
  - Elastic IP addresses
    - Static IP addresses that can be dynamically remapped to point to different instances (not a DNS change)

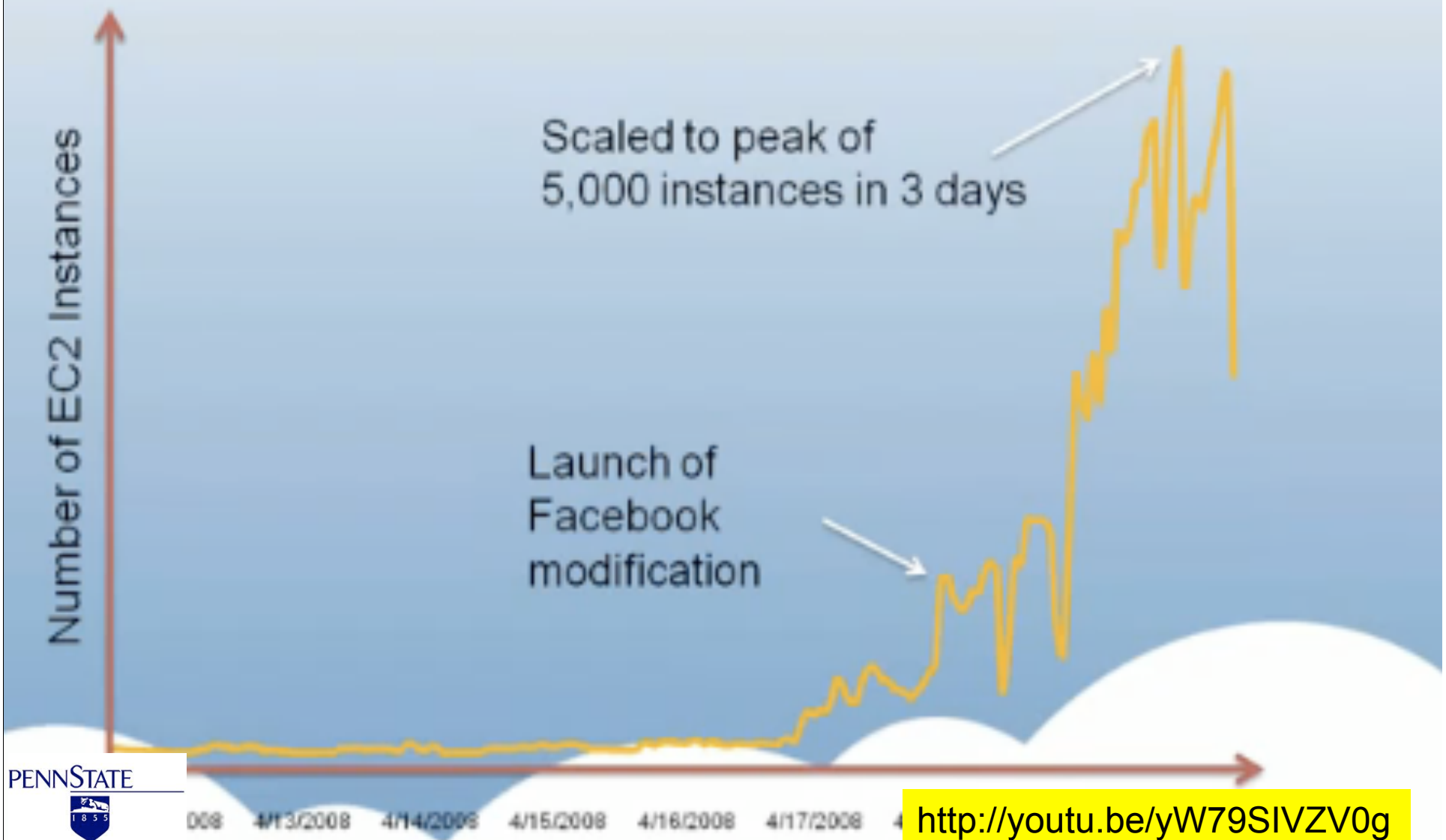
# Amazon Cloud Users: New York Times and Nasdaq (4/08)

- Both companies used Amazon's cloud offering
- New York Times
  - Didn't coordinate with Amazon, used a credit card!
  - Used EC2 and S3 to convert 15 million scanned news articles to PDF (4TB data)
  - Took 100 Linux computers 24 hours (would have taken months on NYT computers)
- Nasdaq
  - Uses S3 to deliver historic stock and fund information
  - Millions of files showing price changes of entities over 10 minute segments
  - “The expenses of keeping all that data online [in Nasdaq servers] was too high.” – Claude Courbois, Nasdaq VP
  - Created lightweight Adobe AIR application to let users view data

# Example: Wall Street App on Amazon EC2



# Example: Video App on Amazon EC2





# Case Study:

## Salesforce.com in Government

- **5,000+ Public Sector and Nonprofit Customers use Salesforce Cloud Computing Solutions**
- **President Obama's Citizen's Briefing Book Based on Salesforce.com Ideas application**
  - Concept to Live in Three Weeks
  - 134,077 Registered Users
  - 1.4 M Votes
  - 52,015 Ideas
  - Peak traffic of 149 hits per second
- **US Census Bureau Uses Salesforce.com Cloud Application**
  - Project implemented in under 12 weeks
  - 2,500+ partnership agents use Salesforce.com for 2010 decennial census
  - Allows projects to scale from 200 to 2,000 users overnight to meet peak periods with no capital expenditure

# Case Study:

## Salesforce.com in Government

- **New Jersey Transit Wins InfoWorld 100 Award for its Cloud Computing Project**
  - Use Salesforce.com to run their call center, incident management, complaint tracking, and service portal
  - **600%** More Inquiries Handled
  - **0** New Agents Required
  - **36%** Improved Response Time
- **U.S. Army uses Salesforce CRM for Cloud-based Recruiting**
  - U.S. Army needed a new tool to track potential recruits who visited its Army Experience Center.
  - Use Salesforce.com to track all core recruitment functions and allows the Army to save time and resources.

# Questions?



- Peter Mell
  - NIST, Information Technology Laboratory
  - Computer Security Division
- Tim Grance
  - NIST, Information Technology Laboratory
  - Computer Security Division
- Dongwon Lee, Ph.D.
  - Penn State University
  - All slides with PSU logo were newly added