Cloud Computing

IST 501
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Learning Objectives

● Understand what cloud computing is
● Be able to describe basic characteristics, service models, and deployment models
● Discuss examples of cloud computing
● Discuss potential issues with cloud computing
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.
Definition by NIST

- **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’s CC

http://youtu.be/ae_DKNwK_ms
5 Essential Cloud Characteristics

- On-demand self-service
- Broad network access
- Resource pooling
  - Location independence
- Rapid elasticity
- Measured service
Eg, Elasticity and Measurement

http://youtu.be/yW79SIVZV0g
Example: Wall Street App on Amazon EC2

3000 CPU's for one firm's risk management processes

300 CPU's on weekends

Number of EC2 Instances


http://youtu.be/yW79SiVZV0g
Example: Video App on Amazon EC2

Scaled to peak of 5,000 instances in 3 days

Launch of Facebook modification

http://youtu.be/yW79SIVZV0g
Measured Service: Utility Computing

- “Computing may someday be organized as a public utility” – John McCarthy, MIT, 1961
- “Packaging of computing resources, such as computation and storage, as a metered service similar to a traditional public utility, such as electricity”
  - A break in the clouds: towards a cloud definition, ACM SIGCOMM, 2009
- Hugh computational and storage capabilities available from utilities
- Metered billing “Pay-As-You-Go”
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, SaaS
Eg, PaaS

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
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

Yandex Cocaine

http://api.yandex.com/cocaine/
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
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 or internal cloud
  - enterprise owned/leases, for internal purpose
- Community cloud
  - shared infrastructure for community
- Public cloud
  - For general public, mega-scale infrastructure
- Hybrid cloud
  - composition of two or more clouds
Eg, Private Cloud
Eg, Community Cloud

Google’s “Gov Cloud”
Eg, Public Cloud
Eg, Hybrid Cloud

- Use multiple deployment models together
- Eg
  - Move enterprise level apps to **private** cloud and less critical apps to **public** cloud
New Deployment Model

- Personal Cloud ??
  - For individual or family usage

http://youtu.be/x_TcA7gBblc
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 Def. Framework

Deployment Models
- Private Cloud
- Community Cloud
- Public Cloud

Service Models
- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

Essential Characteristics
- On Demand Self-Service
- Broad Network Access
- Resource Pooling
- Measured Service
- Rapid Elasticity

Common Characteristics
- Massive Scale
- Homogeneity
- Virtualization
- Low Cost Software
- Resilient Computing
- Geographic Distribution
- Service Orientation
- Advanced Security
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?
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
Issues of Cloud Computing

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

...
Eg, Security Problem

Major University Dumps Gmail Over Security Concerns

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

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

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
Eg, Availability Problem

Google Calendar

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.

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Eg, Availability Problem

Amazon says some data unrecoverable after restoring cloud service

April 27, 2011 | Dean Takahashi

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 use web services may have to use multiple cloud vendors in the future.
Sunny Thoughts on CC

- 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”
Sunny Thoughts on CC

- 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: NYT and Nasdaq (4/08)

- **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
Case: Gov’s Use

- 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
Hype Cycle for CC (Gartner, 2010)

Over the course of the next five years, enterprises will spend $112 billion cumulatively on SaaS, PaaS and IaaS combined.
Pros of CC

- Lower-cost computers for end users
- Improved performance on users’ PC
- Lower IT infrastructure and software costs
- Fewer maintenance issues
- Instance software updates
- Unlimited storage capacity
- Increased data safety
- Easier group collaboration
- Universal access to data/documents
Cons of CC

- Requires a constant internet connection
- Doesn’t work well with low-speed connections
- Can be slower than using desktop software
- Features might be more limited
- Stored data might not be secure
- If the cloud loses your data, big problem
Who Benefits from CC?

- Collaborators
- Road warriors
- Cost-conscious users
- Cost-conscious IT departments
- Users with increasing needs
Who Shouldn’t be Using CC?

- The Internet-impaired
- Offline workers
- The security conscious
- Anyone married to existing applications
  - Eg, MS Office (now one can use MS Office in CC too)
Using CC Services (SaaS)

- Calendars, Schedules, & Task Management
- Event & Contact Management
- Email
- Project Management
- Word Processing, Spreadsheets, & Presentations
- Databases
- Storing & Sharing files
- Sharing digital photographs
- Sharing songs and videos
Presentation Services in CC

- Collaborating on presentations in CC
  - Web-based or Phone-based presentation app

- Pros
  - Users from multiple locations can co-work
  - No need to carry around presentation files
  - Cost-effective—free or nominal fee!

- Cons
  - Network access is critical
  - Don’t always have the same range of features
  - Compatibility issue with existing presentations
Sharing Presentations in CC

- Web-based services that aim at sharing (not editing) existing presentation files in CC
  - Upload existing presentation files for sharing
  - Supports formats like PPT, PDF, or ODP
  - Cannot edit existing files

- Eg,
  - AuthorStream.com
  - SlideBoom.com
  - SlideShare.net
Database Services in CC

- Dabbledb.com → acquired by Twitter (2010)
- Teamdesk.net
- Trackvia.com
- Baseportal.com
- Springbase.com
- Viravis.com
- Infodome.com
- Creator.zoho.com
- Quickbase.intuit.com
Reference

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