

# Security and Privacy in Cloud Computing

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Johns Hopkins University
en.600.412 Spring 2011

**Lecture 1**
01/31/2011

# Welcome to the class

## Administrative details

When? : Monday 3pm-3.50pm

Where?: Shaffer 302

Web: http://www.cs.jhu.edu/~ragib/sp11/cs412

Instructor: Ragib Hasan, 324NEB, rhasan7@jhu.edu

Office hours: Monday 4pm-5pm (more TBA)

# Introductions

Please tell us

- Your name
- What level (grad, undergrad, PhD/MS/BS) you are currently
- Your advisor
- Your research interests
- Anything fun/interesting about you

# Goals of the course

- **Identify** the cloud computing security issues
- **Explore** cloud computing security issues
- **Learn** about latest research

# Plan

**Each week**, we will

- Pick a different cloud computing security topic
- Discuss general issues on the topic
- Read one or two latest research paper on that topic

# Evaluations

Based on paper reviews

- Students taking the course for credit will have to submit 1 paper review per week

- The reviews will be short, 1 page discussion of the paper's pros and cons (format will be posted on the class webpage)

# Example Review

## Summary

Mention what problem the paper addresses. What is the approach, and what are the results.

## Pros

Advantages or features you liked. At least 3.

## Cons

Disadvantages or shortcomings. At least 3.

## Ideas

How can you improve the system? Short 2/3 sentence comment on your ideas.

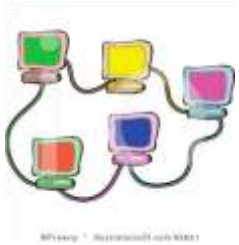
# Topics we will cover

Data and computation integrity and confidentiality

Infrastructure, topology

Data Privacy

Networking



Forensics

# What is **Cloud Computing**?

Let's hear from the "experts"

# What is **Cloud Computing**?


The infinite wisdom of the crowds (via **Google Suggest**)

# What is **Cloud Computing**?

We've redefined Cloud Computing to include everything that we already do. . . . I don't understand what we would do differently in the light of Cloud Computing other than change the wording of some of our ads.

**Larry Ellison**,
founder of Oracle

# What is **Cloud Computing**?

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

**Richard Stallman**
GNU

# What is **Cloud Computing**?

Cloud Computing will become a focal point of our work in security. I'm optimistic …

**Ron Rivest**
The **R** of RSA

# So, What really is **Cloud Computing**?

**Cloud computing** is a new computing paradigm, involving data and/or computation outsourcing, with

- Infinite and elastic resource scalability
- On demand "just-in-time" provisioning
- No upfront cost … pay-as-you-go

That is, use as much or as less you need, use only when you want, and pay only what you use,

# The real story

"Computing Utility" – holy grail of computer science in the 1960s. Code name: MULTICS

Why it failed?

•Ahead of time … lack of communication tech.
(In other words, there was NO (public) Internet)

•And personal computer became cheaper and stronger

# The real story

Mid to late ’90s, **Grid computing** was proposed to link and share computing resources

# The real story … continued

Post-dot-com bust, big companies ended up with large data centers, with low utilization

**Solution:** Throw in virtualization technology, and sell the excess computing power

And thus, **Cloud Computing** was born …

# Cloud computing provides numerous economic advantages

For clients:

- No upfront commitment in buying/leasing hardware
- Can scale usage according to demand
- Barriers to entry lowered for startups

For providers:

- Increased utilization of datacenter resources

# Cloud computing means **selling "X as a service"**

**IaaS:** Infrastructure as a Service

– Selling virtualized hardware

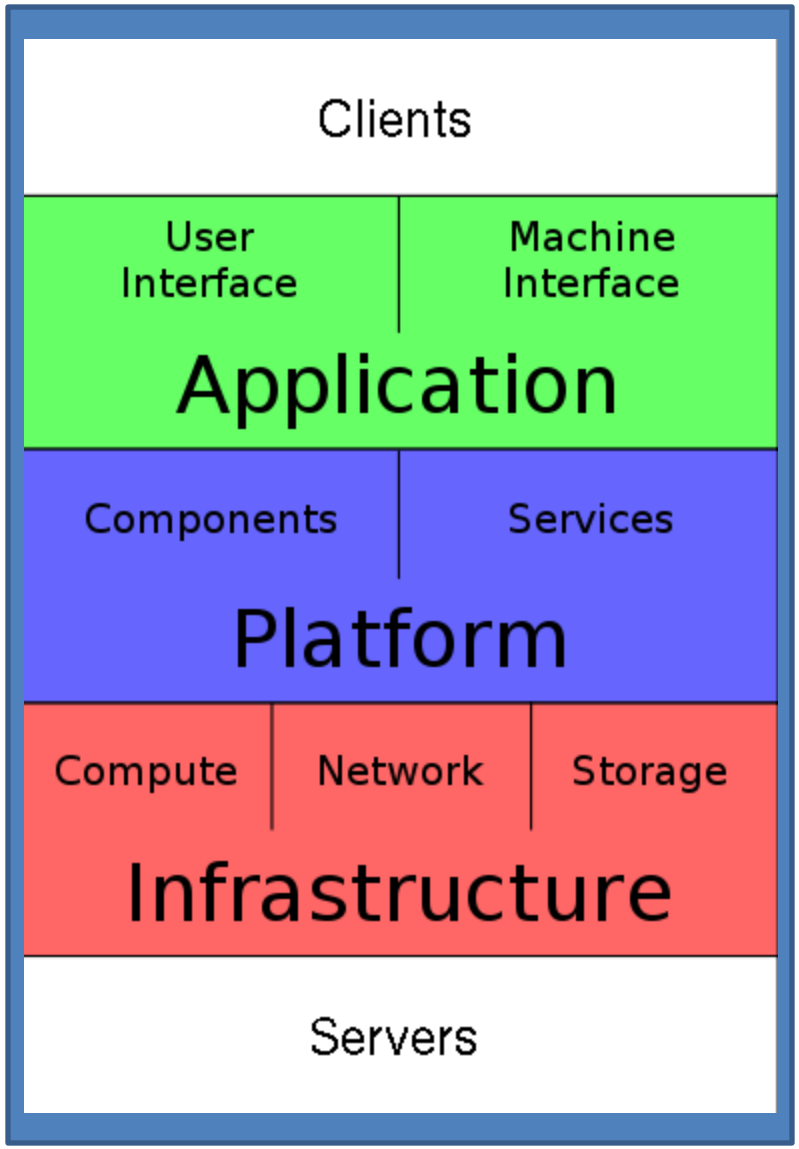
**PaaS**: Platform as a service

– Access to a configurable platform/API

**SaaS**: Software as a service

– Software that runs on top of a cloud

# Cloud computing architecture



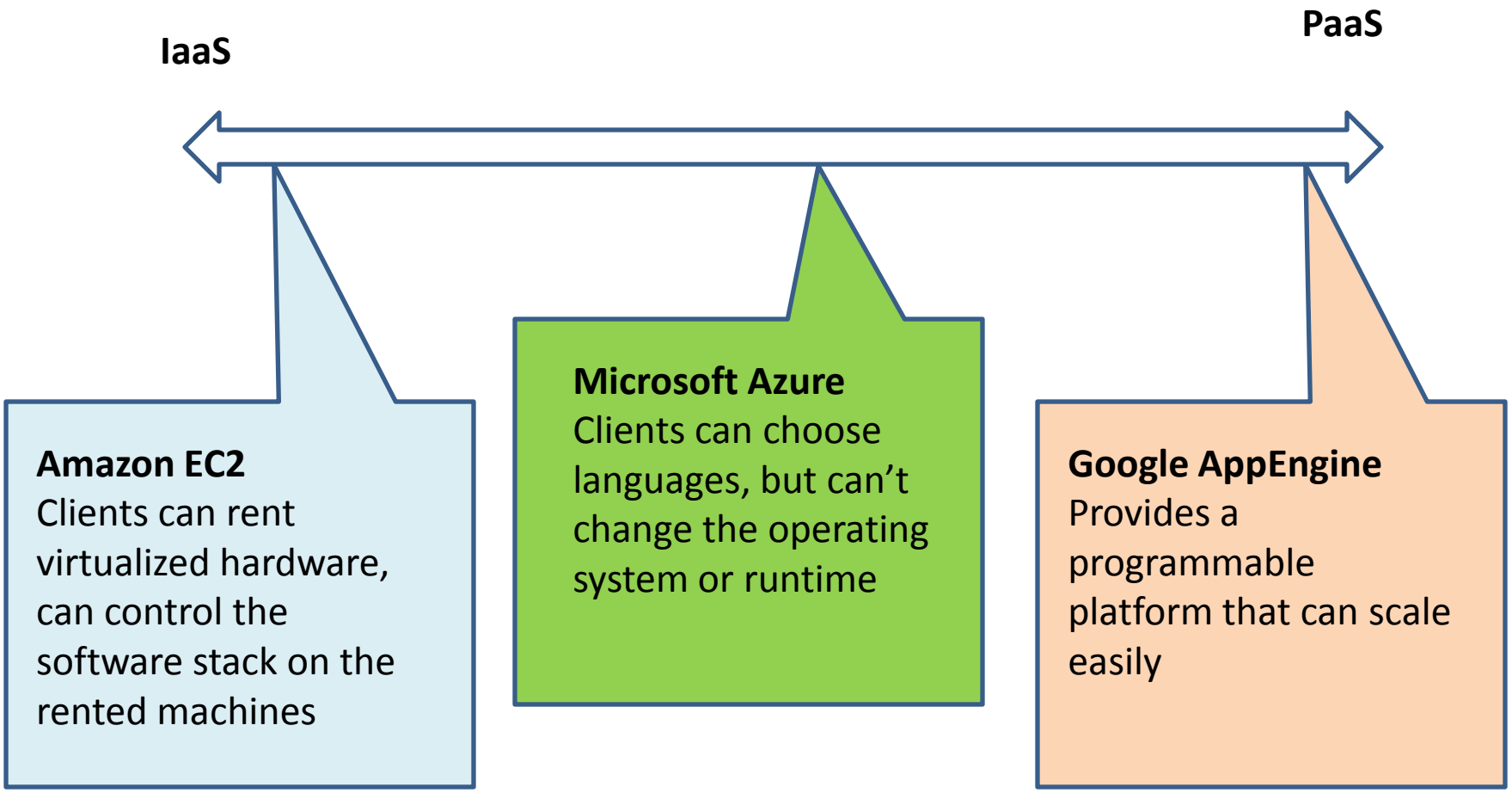

e.g., Web browser

**SaaS** , e.g., Google Docs

**PaaS**, e.g., Google AppEngine

**IaaS**, e.g., Amazon EC2

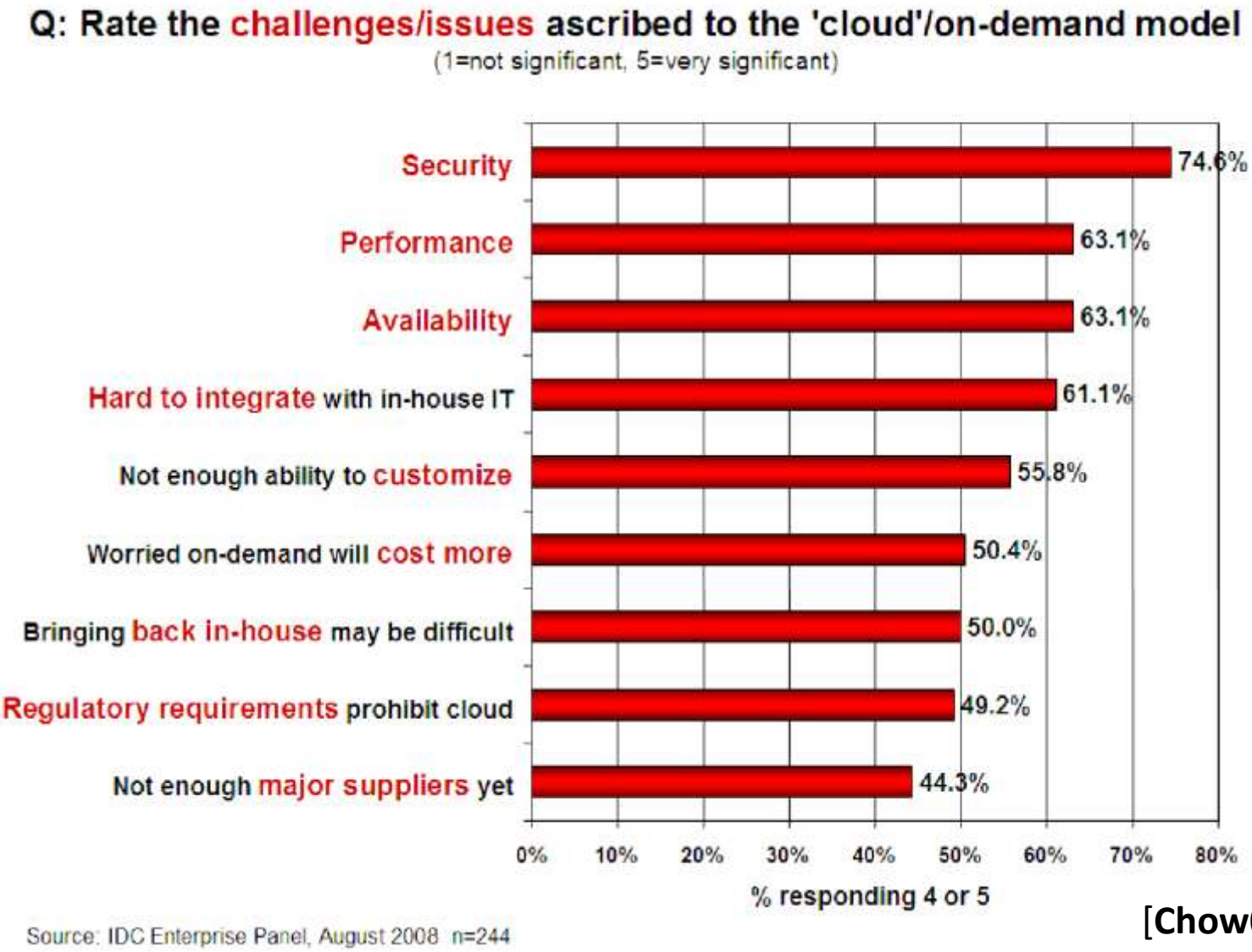
# Different types of cloud computing



# So, if cloud computing is so great, why aren't everyone doing it?

Clouds are still subject to traditional data confidentiality, integrity, availability, and privacy issues, plus some additional attacks

# Companies are still **afraid** to use clouds




[**Chow09ccsw**]

# Anatomy of **fear** …

**Confidentiality**

- Will the sensitive data stored on a cloud remain confidential? Will cloud compromises leak confidential client data (i.e., fear of loss of control over data)

- Will the cloud provider itself be honest and won't peek into the data?

# Anatomy of **fear** …

**Integrity**

- How do I know that the cloud provider is doing the computations correctly?
- How do I ensure that the cloud provider really stored my data without tampering with it?

# Anatomy of **fear** …

**Availability**

- Will critical systems go down at the client, if the provider is attacked in a Denial of Service attack?
- What happens if cloud provider goes out of business?

# Anatomy of **fear** …

**Privacy issues** raised via massive data mining

- Cloud now stores data from a lot of clients, and can run data mining algorithms to get large amounts of information on clients

# Anatomy of **fear** …

**Increased attack surface**

- Entity outside the organization now stores and computes data, and so
- Attackers can now target the communication link between cloud provider and client
- Cloud provider employees can be phished

# Anatomy of **fear** …

**Auditability and forensics**

- Difficult to audit data held outside organization in a cloud
- Forensics also made difficult since now clients don't maintain data locally

# Anatomy of **fear** …

**Legal** quagmire and transitive **trust** issues

- Who is responsible for complying with regulations (e.g., SOX, HIPAA, GLBA)?
- If cloud provider subcontracts to third party clouds, will the data still be secure?

# What we need is to …

- Adapt well known techniques for resolving some cloud security issues
- Perform new research and innovate to make clouds secure

# Final quote

[Cloud Computing] is a **security nightmare** and it can't be handled in traditional ways.

John Chambers
CISCO CEO

# Further Reading

Armbrust et al., Above the Clouds: A Berkeley View of Cloud Computing, UC Berkeley Tech Report UCB/EECS-2009-28, February 2009.

Chow et al., Cloud Computing: Outsourcing Computation without Outsourcing Control, 1st ACM Cloud Computing Security Workshop, November 2009.