# CLOUD COMPUTING

# Session 1 : Introduction

APROBAT

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# Objectives

Current context of the IT industry

Cloud technologies overview

Discussion about opportunities and impacts of using cloud

# Current Context of the IT Industry

# Software – A Must for Successful Organizations in the Digital Age

- Uber – 5 years old – $68B+ at peak
- Instagram – 4 years old - $35B+
- What's App – 5 years old - $19B+
- Airbnb – 6 years old - $25B+
- Twitch – 2 years old - $1B+
- Yo – 8 hours old - $10M+

Uber's Value Surges Past $50 Billion

By Douglas MacMillan And Telis Demos

ment in Delaware in May to a thorize the latest funding roun "We aren't commenting on add

GM CTO predicts cars will run on 100 million lines of code

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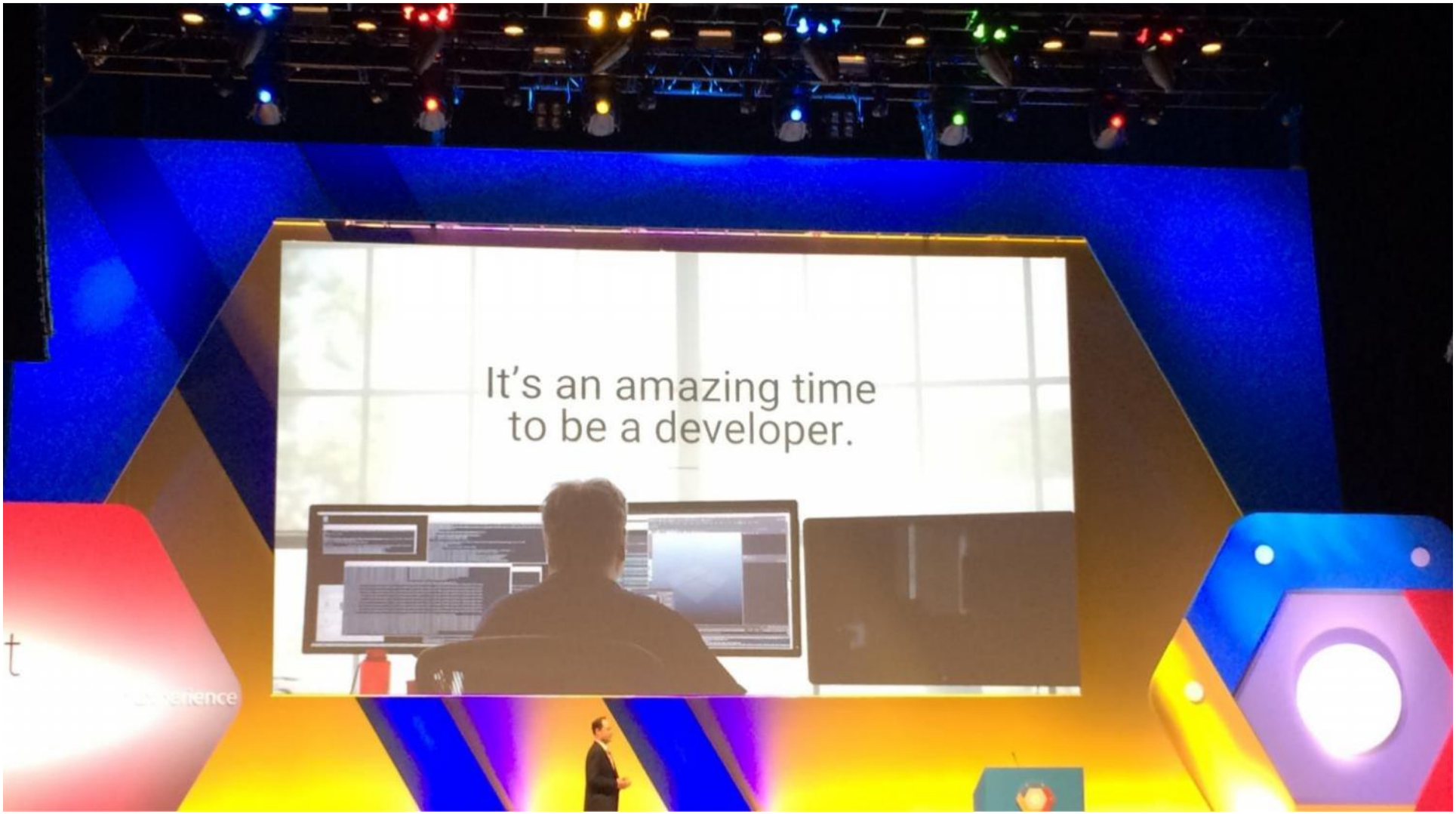
The relationship between General Motors (GM) and the software industry is set for some major changes over the next few years as software becomes a more important component of the automobile.

*Space shuttle was only 400,000 lines!*

- Many of the world's most valuable companies exist *because of* software: Apple, Microsoft, Google, Alibaba, Facebook, Oracle, IBM, Amazon, Tencent
- Same is true in India: TCS, Infosys, Wipro, HCL Technology, Tech Mahindra.
- Apple has been worth as much as $775 Billion … many of its hardware components are available to any company. The secret sauce is design and software.
- Software defined networks, software defined radios, software defined storage, software defined data centers, ….

"Software is where innovation is captured and codified" – Jeff Hammond

# From Google Cloud Conference



# Six Disruptive Forces in IT Industry

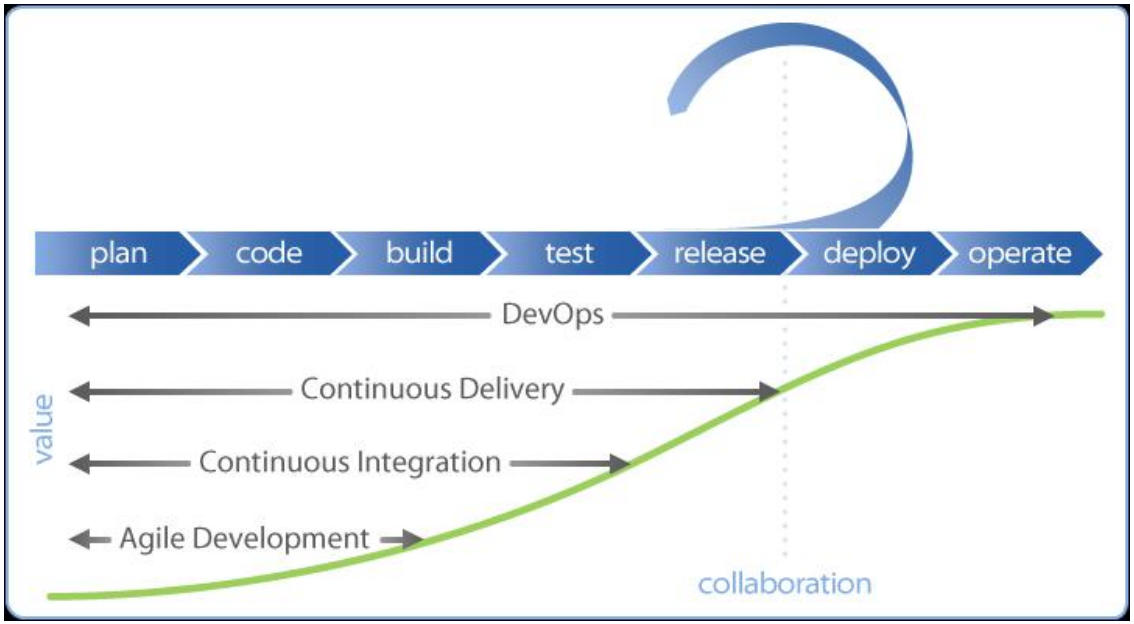



Image: CollabNet

## Methodology

- Agile Development
- Continuous Integration and Delivery
- DevOps

## Architecture

- Cloud Computing
- Microservices

## Platforms and Tools

- Open Source

*What are the actual problems to be addressed by each of these disruptive forces?*

# Cloud Computing

# One hour in the stock market: $100 billion

## The Cloud Is Here, Separating Disrupters From Disrupted

By QUENTIN HARDY OCTOBER 23, 2015 9:18 AM 5 Comments

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Tech historians will look at Oct. 22, as a watershed. Cloud computing is no longer on the way, just a contender, or even a competitor to traditional enterprise technology companies. Instead, it is here, full force, and all the signs are that it is about to get a lot bigger, fast.

Daily Report

A few data points: When the stock market closed on Thursday, Amazon, Google and Microsoft — arguably the three largest cloud businesses — declared their quarterly earnings. One hour later, their collective market capitalization had grown by more than $100 billion because

**Tech Stocks**

Tracking Amazon, Alphabet and Microsoft.


Digging in, Amazon had more operating income from Amazon Web Services, its business renting computing and software applications, than it did from combined sales of goods in the United States and internationally. At Microsoft, operating income from cloud and applications businesses were far better, as a percentage of sales, than the sector that includes the Windows operating system, long Microsoft's crown jewel.

# What is cloud computing?

**NIST definition of cloud computing**

*Cloud computing is 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.*

*The term "Cloud Computing" was first used by Google*

# With Cloud, you can…

**Lower the barrier of computing resource provisioning**

- No upfront cost

**Instant scalable up/down**

- Reduce operational costs

**Low maintenance cost**

- Service providers maintain the hardware/systems

**Highly scalable**

- enable big data processing

# Related Technologies (1)

**Utility Computing: pay-as-you-use computing**

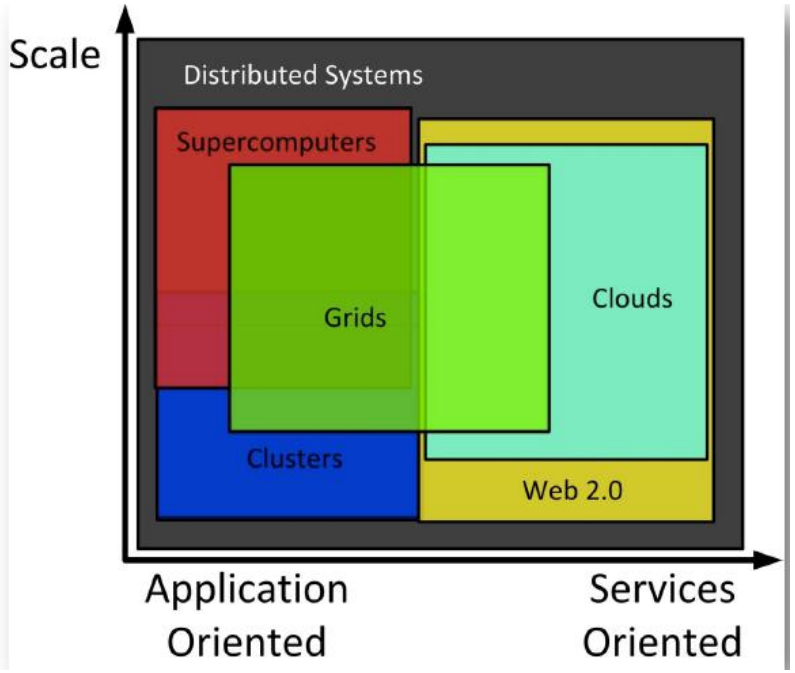
- First discussed in 1960s
- Illusion of infinite resources
- No up-front cost
- Fine-grained billing (e.g. hourly)

**Software as a Service (SaaS)**

- delivering applications over the Internet (services computing)

**Grid computing**

- Highly distributed resources
- Resource provisioning
- Load balancing
- Parallel/distributed processing




[GCE08] "Cloud Computing and Grid Computing 360-Degree Compared"

# Related Technologies (2)

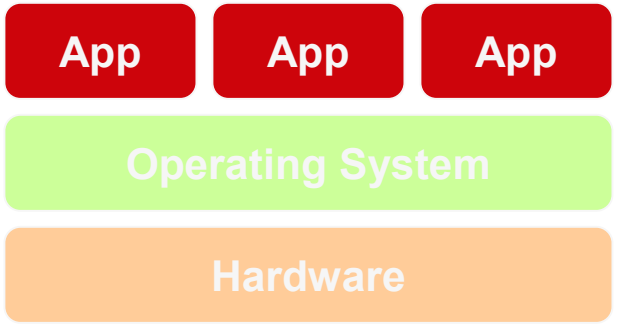
**Virtualization**

- Abstract away the details of physical hardware
- provide virtualized ones to applications
- Allow resource management much easier

  Pool all resources in the cluster

  Split resources to units (Virtual machines)

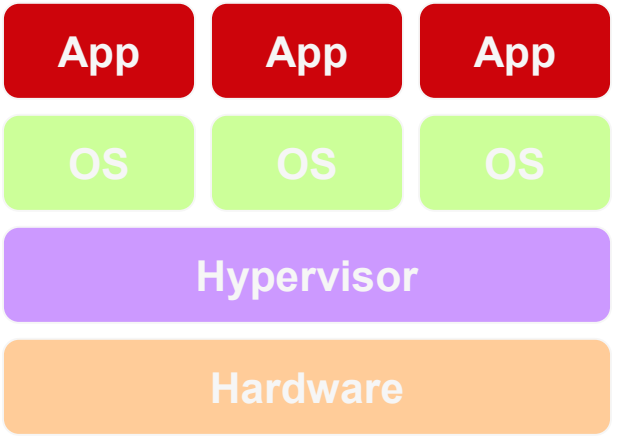
  Low costs of allocation and migration




**Traditional Stack**

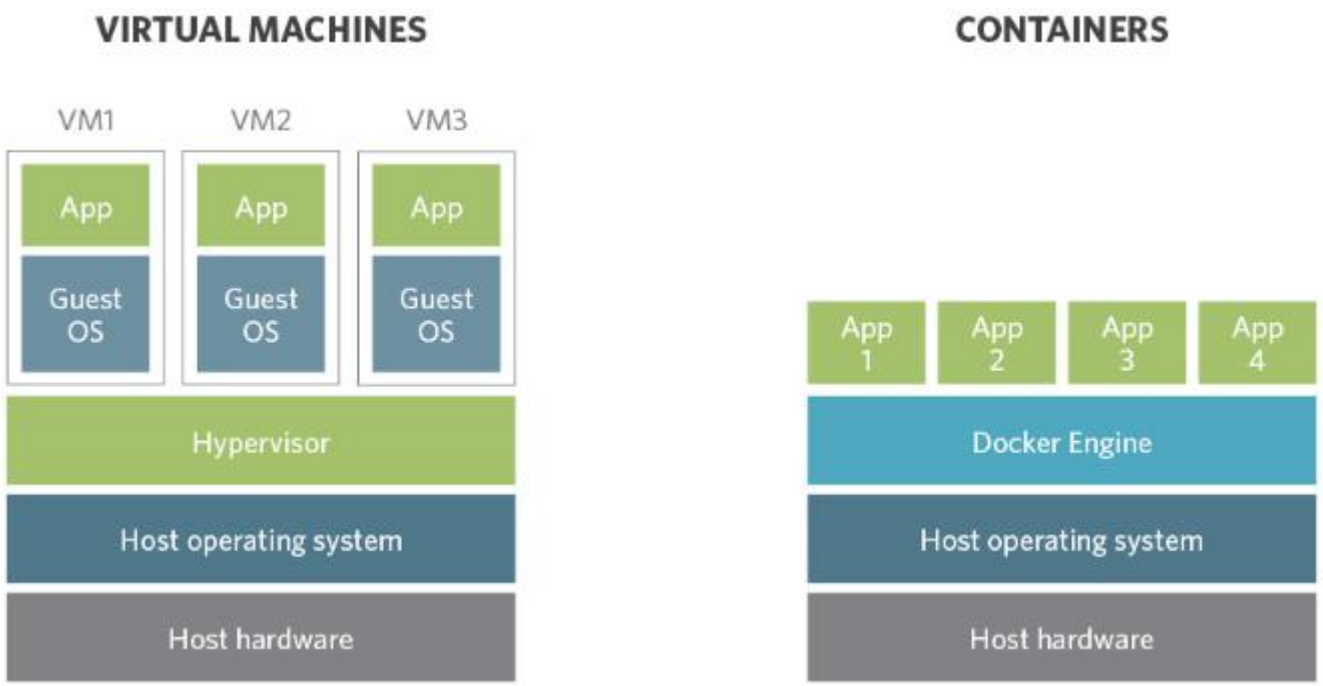
**Autonomic Computing**

- Definition: computer systems capable of self-management
- In cloud computing: automatic resource provisioning, consolidation



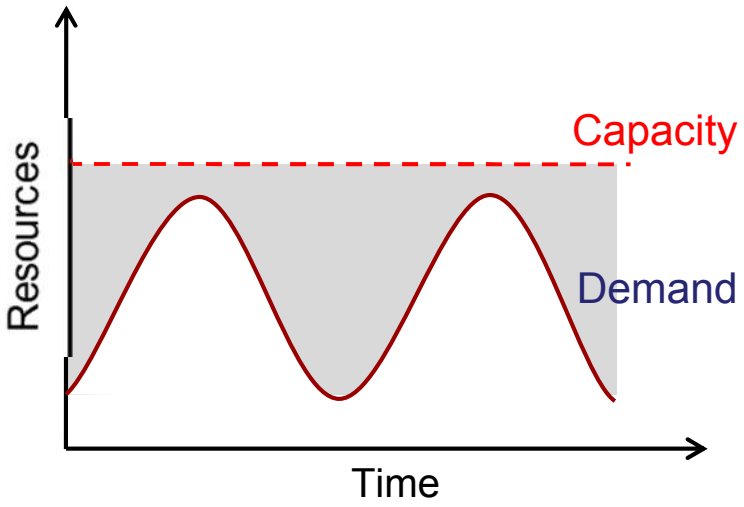

**Virtualized Stack**

# Virtual Machines vs Docker Containers

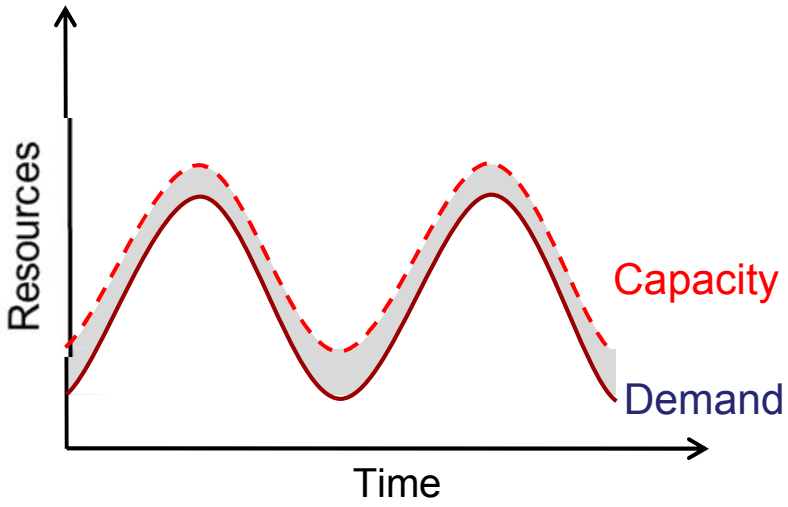


# Cloud Economics

- Pay by use instead of provisioning for peak




Static data center




Data center in the cloud

Unused resources

# Example

**Setup:**

- A peak period needs 10 servers to process requests
- Assume your service is going to run for 1 year

**Private cluster: one-time investment**

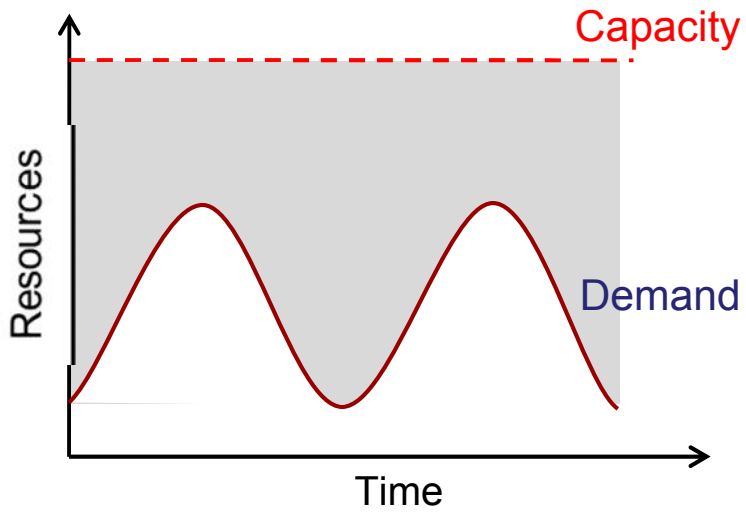
- Servers $1500 x 10 = $15000
- Power/AC costs about $200/year/server => $2000
- Administrator: $50000

**Public cloud:**

- Peak hours: 10 hours/day, which needs 10 nodes/hour
- Other hours: 14hours need 2 nodes/hour
- Total: 128 hour.nodes x $0.1/hour.node =$12.8/day
- One year cost = $4672

# Economics of Cloud Users

- Risk of over-provisioning: underutilization

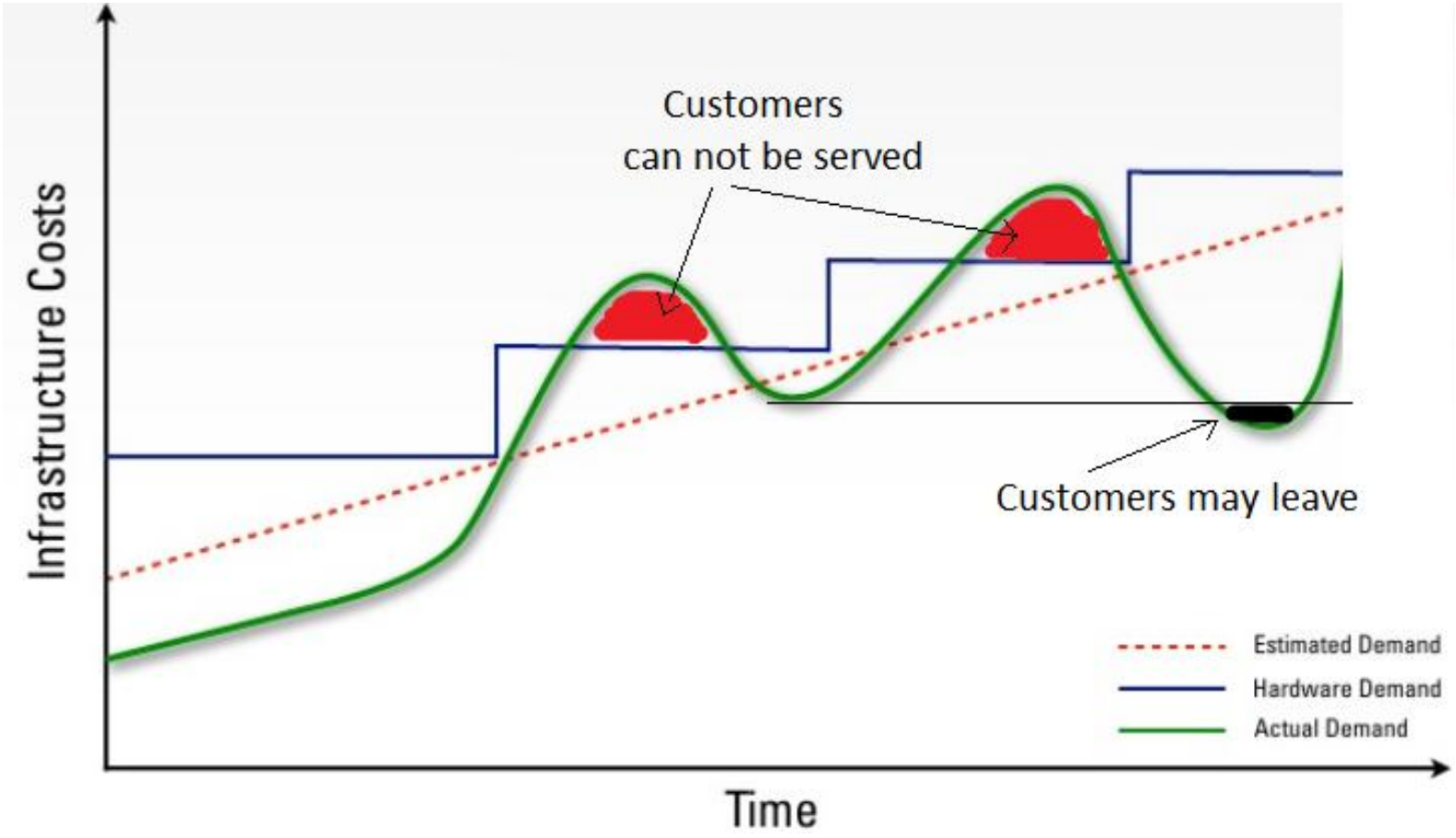



Unused resources

Static data center

# Economics of Cloud Users

- Heavy penalty for under-provisioning



# Cloud Economics for Cloud Providers

**5-7x economies of** scale **[Hamilton 2008]**

| Resource | Cost in Medium DC | Cost in Very Large DC | Ratio |
|---|---|---|---|
| **Network** | **$95 / Mbps / month** | **$13 / Mbps / month** | **7.1x** |
| **Storage** | **$2.20 / GB / month** | **$0.40 / GB / month** | **5.7x** |
| **Administration** | **≈140 servers/admin** | **>1000 servers/admin** | **7.1x** |

**Extra benefits**

- Amazon: utilize off-peak capacity
- Microsoft: sell .NET tools
- Google: reuse existing infrastructure

# Businesses benefit from the cloud

**What you need to do to startup an Internet company before the cloud computing :**

- Plan your computing resources
- Purchase the resources
- Hire people to setup a cluster
- Install software for development and production
- Hire people to maintain the cluster (software and hardware)

**Enterprises can take advantage of cloud to**

- Avoid capital costs for tech and data center refreshes
- Increase agility and better respond to market needs

# Cloud Service Models

## Infrastructure as a Service (IaaS)

- In this most basic cloud service model, cloud providers offer computers – as physical or more often as virtual machines; raw (block) storage, firewalls, load balancers, and networks.
- IaaS providers supply these resources on demand from their large pools installed in data centers..
- To deploy their applications, cloud users then install operating system images on the machines as well as their application software.
- In this model, it is the cloud user who is responsible for patching and maintaining the operating systems and application software.

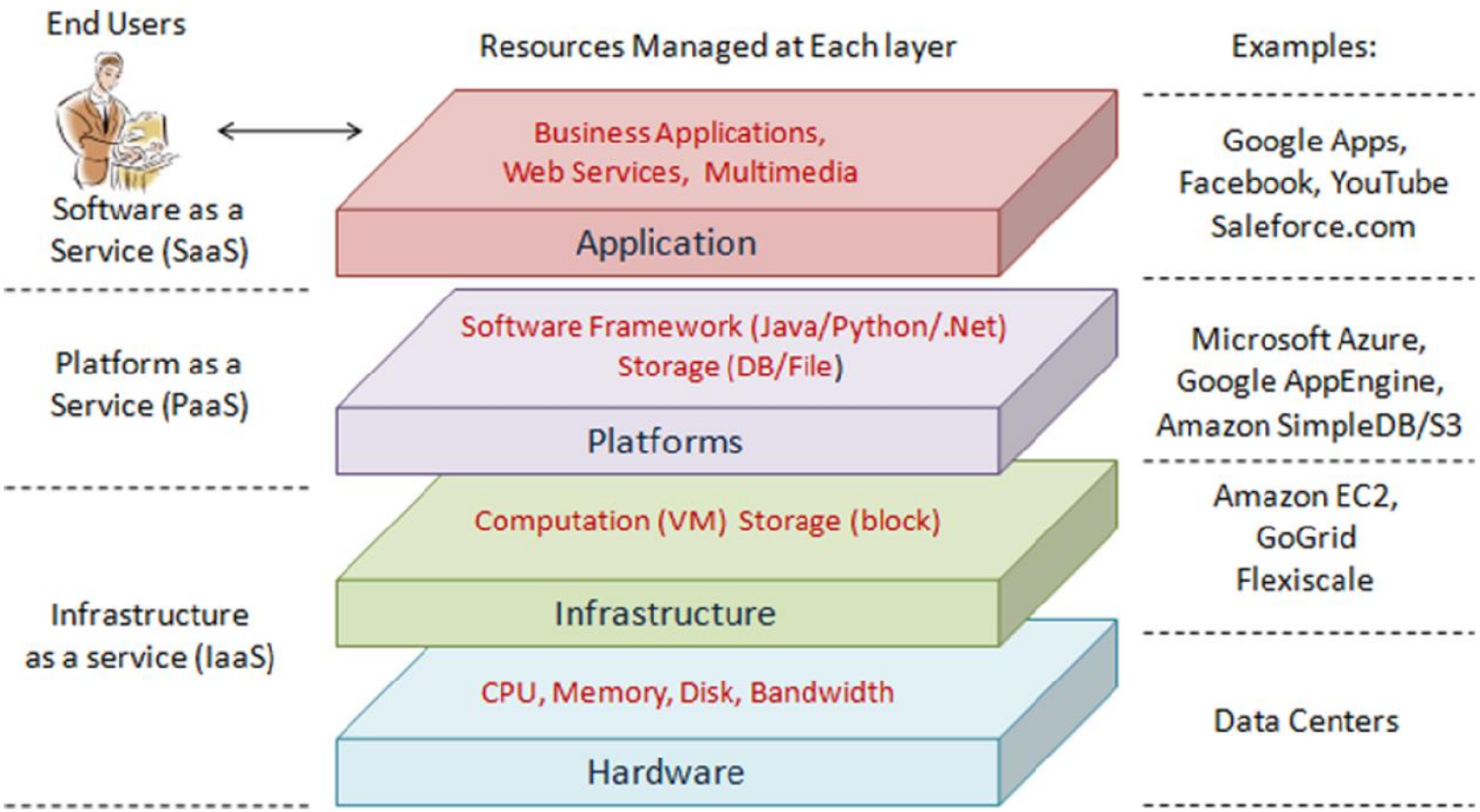
## Platform as a Service (PaaS)

- In the PaaS model, cloud providers deliver a computing platform and/or solution stack typically including operating system, programming language execution environment, database, and web server.
- Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers.

## Software as a Service (SaaS)

- In this model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients

# Achitecture: Layered cloud model



# Cloud Deployment Models

## Public cloud

- A public cloud is one based on the standard cloud computing model, in which a service provider makes resources, such as applications and storage, available to the general public over the Internet.
- Public cloud services may be free or offered on a pay-per-usage model.

## Community cloud

- Community cloud shares infrastructure between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally.
- The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the cost savings potential of cloud computing are realized.

## Hybrid cloud

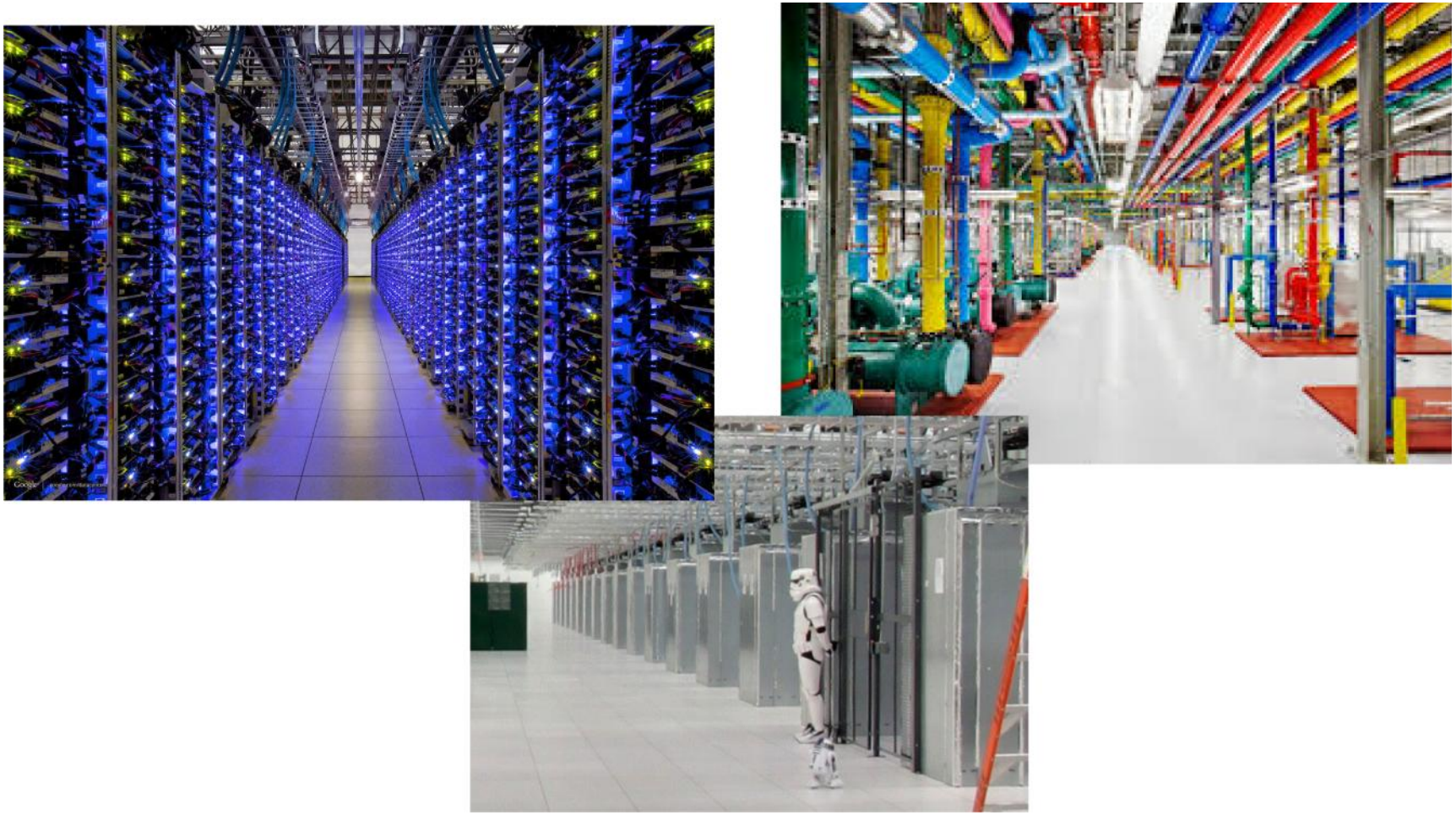
- Hybrid cloud is a composition of two or more clouds (private, community or public) that remain unique entities but are bound together, offering the benefits of multiple deployment models.
- It can also be defined as multiple cloud systems that are connected in a way that allows programs and data to be moved easily from one deployment system to another.

## Private cloud

- Private cloud is infrastructure operated solely for a single organization, whether managed internally or by a third-party and hosted internally or externally

# A typical cloud…

**Consists of multiple data centers**



# Application Use Cases

**Mobile and web applications**

**Batch processing / MapReduce**

- Data analytics (big data)
- E.g., OLAP, data mining, machine learning

**Research**

- Artificial Intelligence, deep learning, biotechnology

# Typical Challenges When Adopting Cloud

## Privacy

- Using a cloud service provider (CSP) can complicate privacy of data because of the extent to which virtualization for cloud processing (virtual machines) and cloud storage are used to implement cloud services.

## Security

- The effectiveness and efficiency of traditional protection mechanisms are being reconsidered as the characteristics of this innovative deployment model can differ widely from those of traditional architectures

## Compliance

- In order to obtain compliance with regulations including FISMA, HIPAA, and SOX in the United States, the Data Protection Directive in the EU and the credit card industry's PCI DSS, users may have to adopt *community* or *hybrid* deployment modes that are typically more expensive and may offer restricted benefits.

## Legal

- Certain legal issues arise; everything from trademark infringement, security concerns to the sharing of propriety data resources.

# Summary

– Can be public, private or hybrid

– A pool of virtualized resources

– You share resources with others (multi-tenancy)

- You can request at anytime, in any amount (within the bound)

– Automated provisioning

– Pay only for what you use

– Trades capital costs for expense

– Powerful tools for development and operations efficiency, but often proprietary

– API based services simplify development/integration

– Quickly scalable up and down

– Standard based

– Encourages portability

– Very low prices encourage experimentation

# Learning More About Cloud

**Adrian Cockcroft on Cloud Trends, DevOps and Microservices**

https://www.youtube.com/watch?v=FbuqMFOSVuw

**IBM DevOps and Cloud video**

https://www.youtube.com/watch?v=fVaJigwfNY4

**Open Stack**

https://www.slideshare.net/slideshow/embed_code/43160012

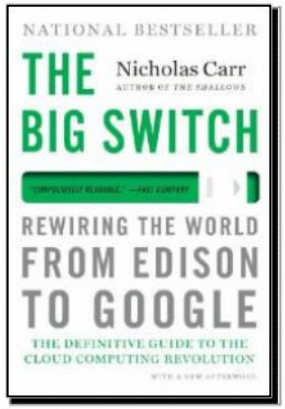
http://www.slideshare.net/mirantis/open-stack-architecture-overviewmeetup662013

**Amazon – What is Cloud?**

http://aws.amazon.com/what-is-cloud-computing/

**Google Cloud Live**

https://www.youtube.com/watch?v=0SU8-HJtYYc




Great book about big picture

# Q & A