# INTRODUCTION TO CLOUD COMPUTING



## OUTLINE

- Cloud Computing
  - Definition
  - Characteristics
  - History
- Cloud vs Conventional Computing
- Cloud Benefits
- Cloud Computing Enablers
  - Virtualization



#### CLOUD COMPUTING — NIST DEFINITION

A model for enabling convenient, on-demand network access to a shared pool of configurable computing and networking resources that can be rapidly provisioned and released with minimal management effort or service provider interaction



## 5 ESSENTIAL CLOUD CHARACTERISTIC











On-demand self-service

No human intervention needed to get resources

Broad network access

Access from anywhere Resource pooling

Provider shares resources to customers Rapid elasticity

Get more resources quickly as needed Measured service

Pay only for what you consume



#### WHAT IS CLOUD COMPUTING IN THE REAL WORLD

- "Cloud" refers to large Internet services running on 10,000s of machines (Amazon, Google, Microsoft, etc)
- "Cloud computing" refers to services by these companies that let external customers rent cycles and storage
  - Amazon EC2: virtual machines at 8.5¢/hour
  - Amazon S3: storage at 15¢/GB/month
  - Google Cloud AppEngine
  - Windows Azure



## WELL KNOWN CLOUD COMPUTING SERVICES

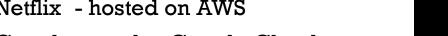
- Dropbox
- Google Drive
- Microsoft OneDrive
- Apple iCloud
- Netflix hosted on AWS
- Facebook
- Skype
- Twitter

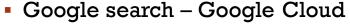


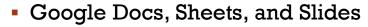


























## **Cloud History**

40s-Nowadays

1960 -1970s

1980s

limesharing and Data Processing Industry

Processing large amount of data (Kilobytes and Megabytes).

Data Processing Industry:

- 1960: \$70 million
- 1970: \$3.15 billion

1940 -1950s

> Distributed Systems

ENIAC and ORDVAC have similar architecture to distributed systems that we know today.

1990 -2000s

PCs and Clusters or workstations Grid Computing and Peer-to-Peer Systems



## EVOLUTION OF CLOUD COMPUTING — CONT'D

#### **Grid Computing**

- Solving large problems with parallel computing
- Made mainstream by Globus Alliance



#### **Utility Computing**

- Offering computing resources as a metered service
- Introduced in late 1990s



#### Software as a Service

Network-based subscriptions to applications

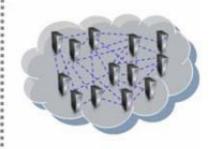
Gained momentum in 2001



#### **Cloud Computing**

Next-Generation Internet computing

Next-Generation Data Centers





## WHY CLOUD COMPUTING?

Expensive and wasteful IT infrastructure

#### IT-related capacity management challenges

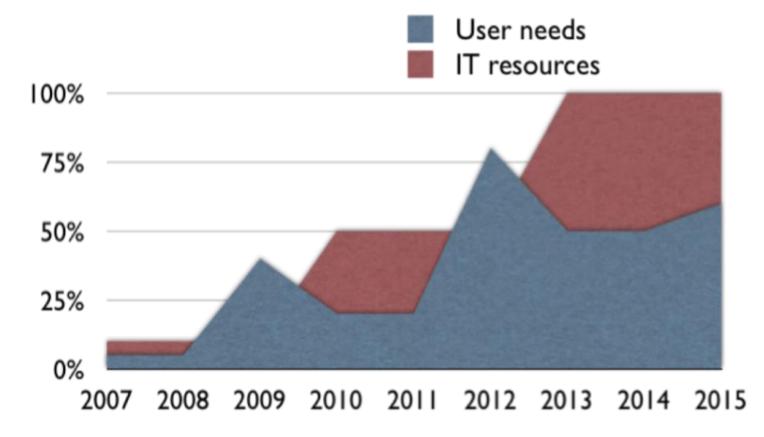


Source: 451 Research, November 2016, 500-plus IT decision-makers in the U.S.



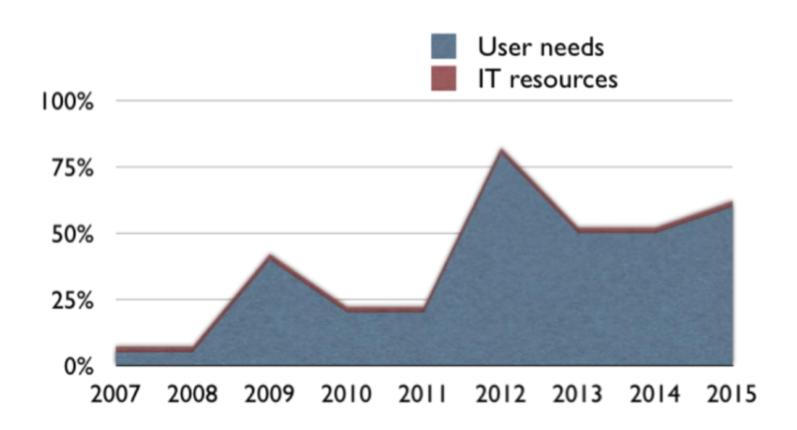
## CONVENTIONAL COMPUTING INFRASTRUCTURE "NEEDS VS IT RESOURCES"

- Moore's law
  - Storage Doubling Period: 12 months
  - Bandwidth Doubling Period: 9 months
  - CPU Computing Doubling Period: 18 months





# CLOUD COMPUTING INFRASTRUCTURE "NEEDS VS IT RESOURCES"





## CONVENTIONAL VS CLOUD

#### Conventional

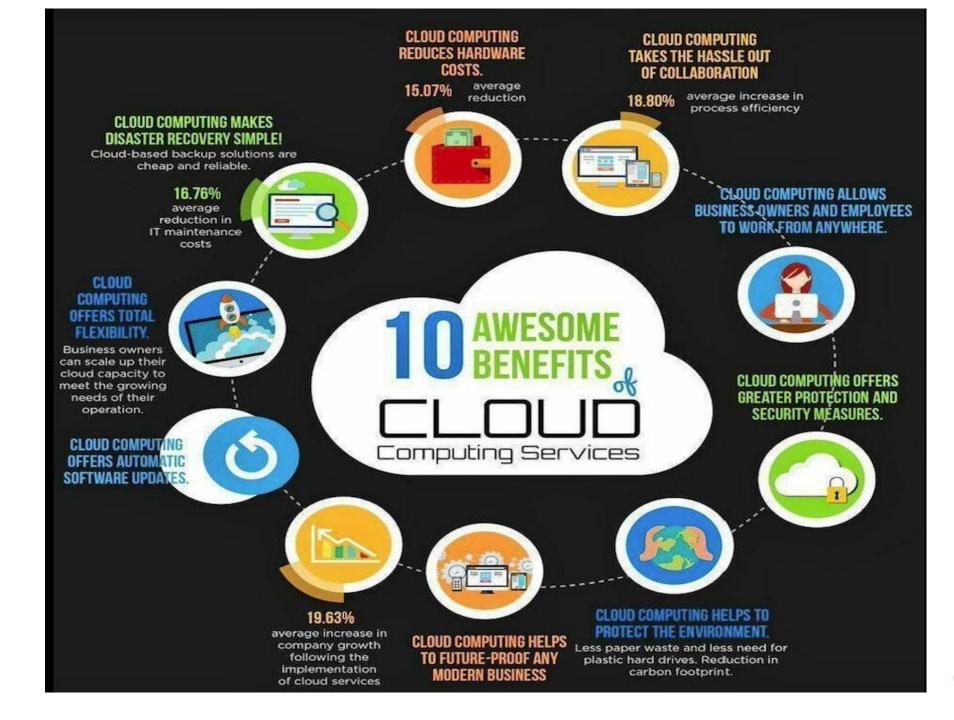
- Manually Provisioned
- Dedicated Hardware
- Fixed Capacity
- Pay for Capacity
- Capital & Operational Expenses
- Managed via System administrators

#### Cloud

- Self-provisioned
- Shared Hardware
- Elastic Capacity
- Pay per Use
- Operational Expenses
- Managed via APIs



## CLOUD BENEFITS







#### **Cloud Computing Enablers**

## **Cloud Computing = Data Center + Virtualization**

