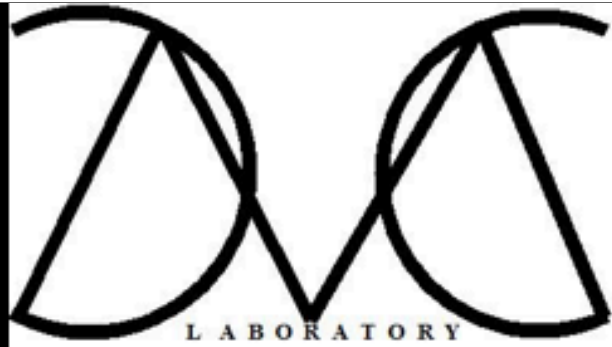


Distributed & Cloud Computing

kartick.mondal@jadavpuruniversity.in

Dr. Kartick Chandra Mondal
Assistant Professor
Department of Information Technology
Jadavpur University
Kolkata



CLOUD COMPUTING

Cloud Computing

Cloud Computing

1. Definition

Cloud Computing

1. Definition
2. Deployment Models

Cloud Computing

1. Definition
2. Deployment Models
3. Service Models

Cloud Computing

1. Definition
2. Deployment Models
3. Service Models
4. Speciality

Cloud Computing

1. Definition
2. Deployment Models
3. Service Models
4. Speciality
5. Advantages & Disadvantages

Cloud Computing

1. Definition
2. Deployment Models
3. Service Models
4. Speciality
5. Advantages & Disadvantages
6. Applications

Why Cloud Computing?

Why Cloud Computing?

- Information and Communication Technology (ICT) is generally accepted to mean
 - All TECHNOLOGIES (devices, networking components, applications and systems)
 - That combined, allow
 - People and organizations(I.e., businesses , nonprofit agencies, governments and criminal enterprises)
 - To interact in the digital world.

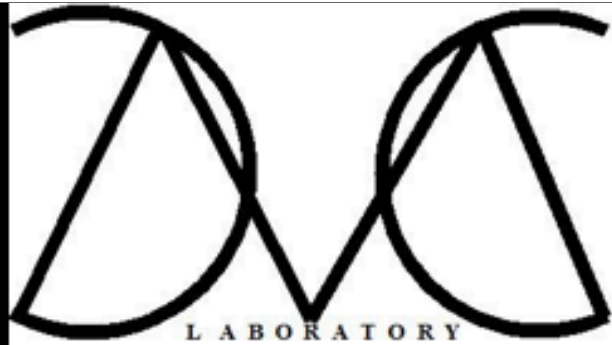
Why Cloud Computing?

Components of ICT

The term information and communications technology (ICT) is generally accepted to mean all technologies that, combined, allow people and organizations to interact in the digital world.



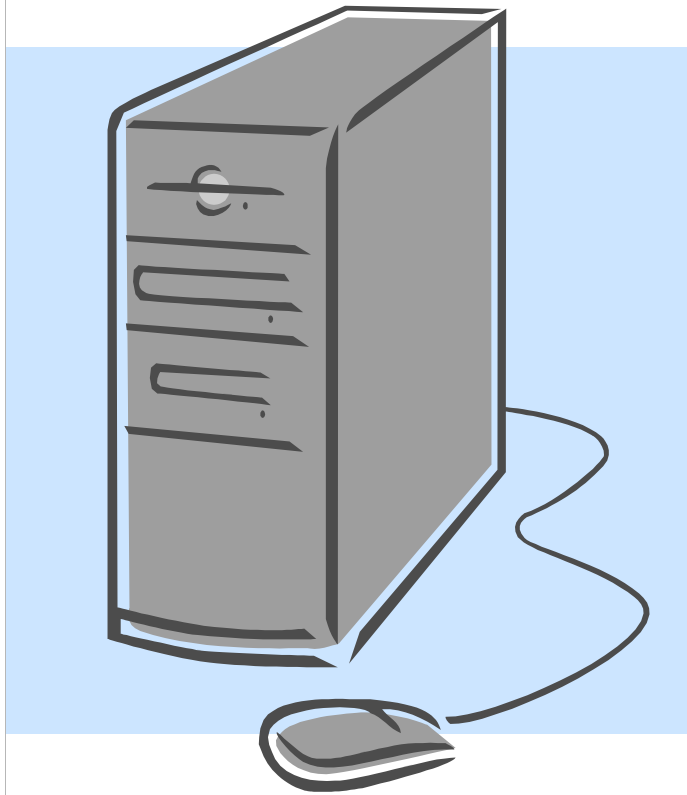
Why Cloud Computing?



Ground Reality

FROM GROUND TO CLOUD

Ground Reality



**Standard Computer Tower or
Central Processing Unit (CPU)**



Software

Storage



**Inside the
Computer**

Storage

Storage

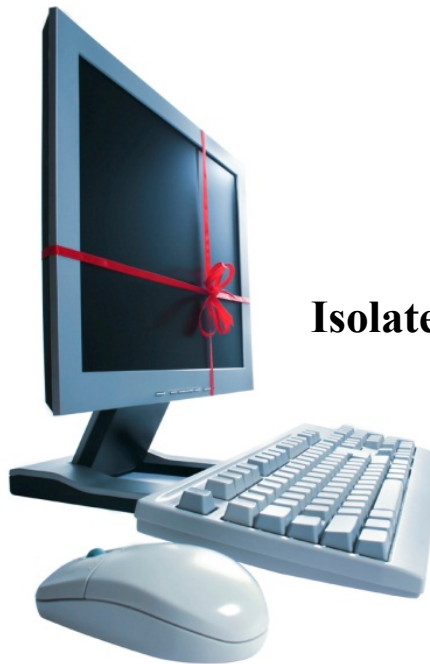
- To use content must return to THAT computer

Storage

- To use content must return to THAT computer
- Cannot access this content from another device or computer

Storage

- To use content must return to THAT computer
- Cannot access this content from another device or computer



Isolated Device

External Storage

External Storage

- Allows your content to become mobile

CD/DVD



Thumb Drive



External Storage

- Allows your content to become mobile
- Take device to any compatible computer

CD/DVD



Thumb Drive



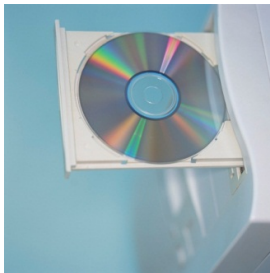
External Hard Drive



External Storage

- Allows your content to become mobile
- Take device to any compatible computer
- Open and use content

CD/DVD



Thumb Drive



SD Card



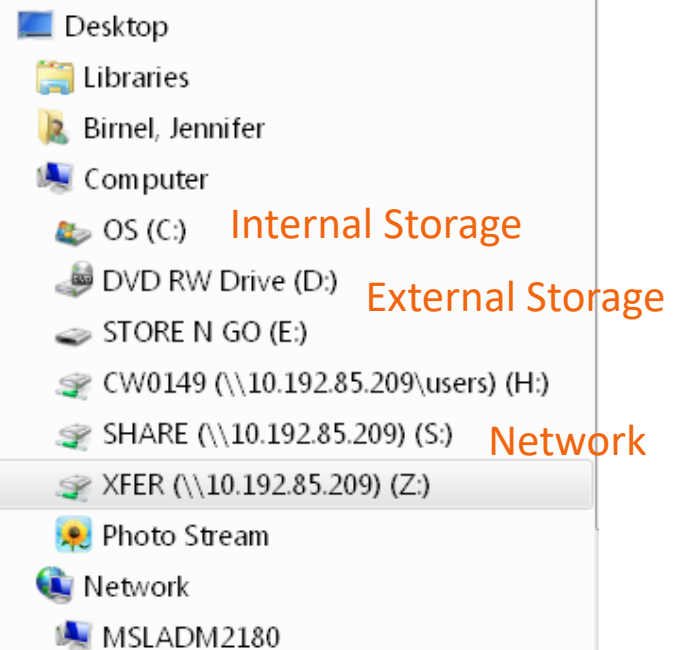
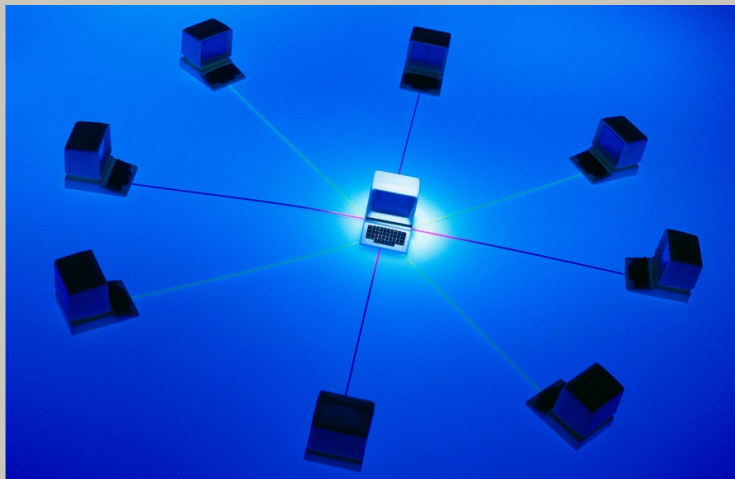
Micro SD Card



External Hard Drive

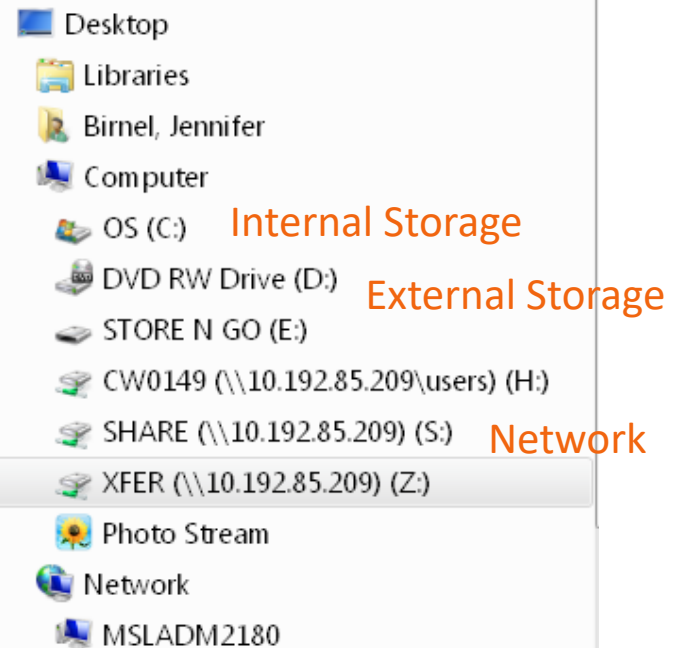
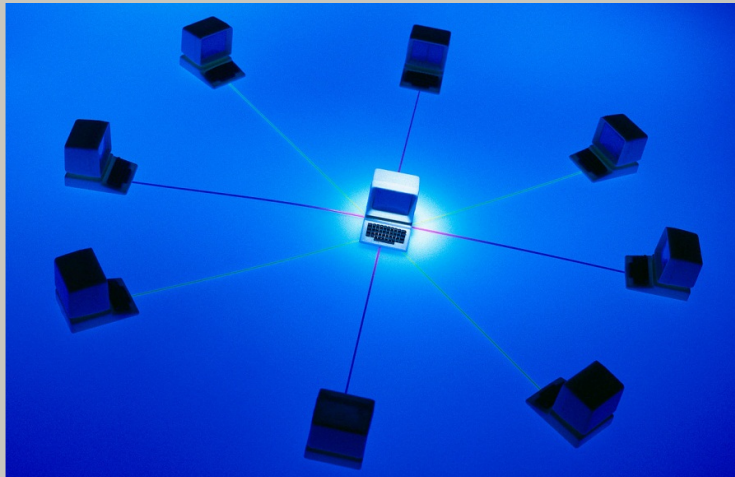


Network Storage



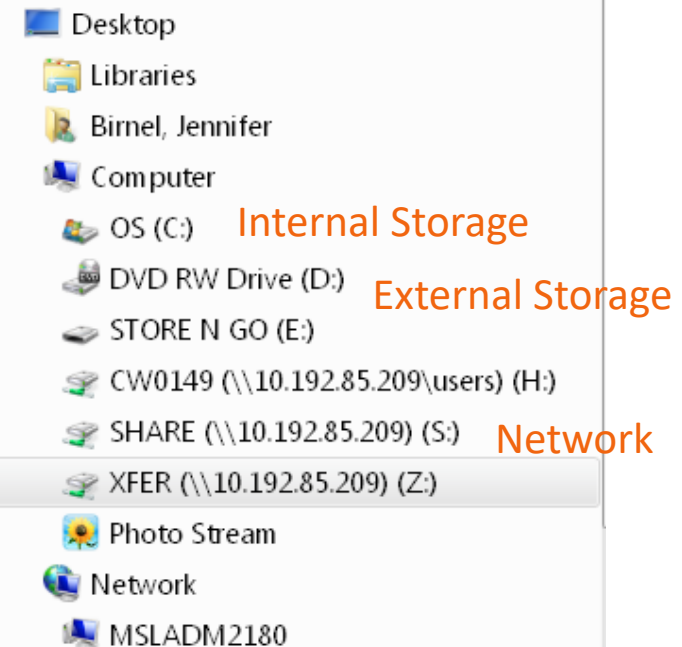
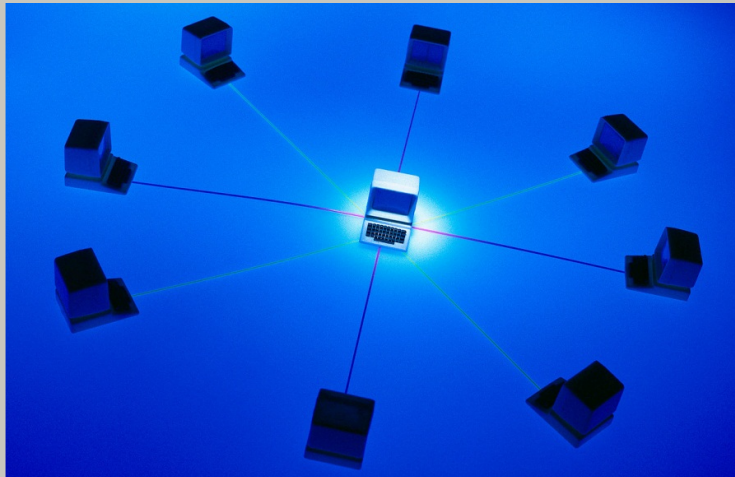
Network Storage

- Multiple work stations talk to one unit that stores information and data.



Network Storage

- Multiple work stations talk to one unit that stores information and data.
- Can retrieve the data stored to the network from any of the connected workstations.



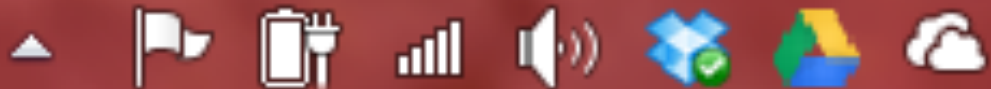
Cloud Storage

- Create an Account – User name and password
- Content lives with the account in the cloud
- Log onto any computer with Wi-Fi to find your content



Access Cloud Storage

- Download a cloud based app to a computer **you own**
- The app lives on your Computer
- Save files to and from the cloud through the app
- When connected to the Internet it will sync with the cloud
- The Cloud can be accessed from any Internet connection



Only Storage is Cloud?

Only Storage is Cloud?

- Software and applications

Only Storage is Cloud?

- Software and applications



Amazon Elastic Compute Cloud (Amazon EC2) - Beta



TAP INTO THE
POWER OF NETWORK.COM



info@3tera.com (040) 305.0050

CAREERS | SU

APPLIC | UTILITY COMPUTING | TECHNOLOGY | PARTNERS | GRID UNIVERSITY | COMPANY

Cloud Computing
Overview

Cloudware - Cloud Computing Without Compromise



MOSSO
the hosting cloud



VERIO
An NTT Communications Company

Only Storage is Cloud?



Infrastructure Services

Storage

- Amazon S3
- Amazon EBS
- CTERA Portal
- Mosso Cloud Files
- Nirvanix

Compute

- Amazon EC2
- Serve Path GoGrid
- Elastra
- Mosso Cloud Servers
- Joyent Accelerators
- AppNexus
- Flexiscale
- ElasticHosts
- Hosting.com CloudNine
- Terramark
- GridLayer
- ITRICITY
- LayeredTech

Services Management

- RightScale
- enStratus
- Scalr
- CohesiveFT
- Kaavo
- CloudStatus
- Ylastic
- Dynect
- CloudFoundry
- NewRelic
- Cloud42

Cloud Software

Data

- 10Gen MongoDB
- Oracle Coherence
- Gemstone Gemfire
- Apache CouchDb
- Apache HBase
- Hypertable
- TerraCotta
- Tokyo Cabinet
- Cassandra
- memcached

Compute

- Globus Toolkit
- Xeround
- Beowulf
- Sun Grid Engine
- Hadoop
- OpenCloud
- Gigaspace
- DataSynapse
- Xeround

Cloud Management

- 3Tera App Logic
- OpenNebula
- Open.ControlTier
- Enomaly Enomalism
- Altor Networks
- VMware vSphere
- OnPathTech
- CohesiveFT VPN Cubed
- Hyperic
- Eucalyptus
- Reductive Lbs Puppet
- OpenQRM
- Appistry

Appliances

- PingIdentity
- Symplified
- rPath
- Vordel

File Storage

- EMC Atmos
- ParaScale
- Zmamba
- CTERA

CLOUD TAXONOMY

Platform Services

General Purpose

- Force.com
- Etelos
- LongJump
- AppJet
- Rollbase
- Bungee Labs Connect
- Google App Engine
- Engine Yard
- Caspio
- Qrimp
- MS Azure Services Platform
- Mosso Cloud Sites

Business Intelligence

- Aster DB
- Quantivo
- Cloud9 Analytics
- Blink Logic
- K2 Analytics
- LogiXML
- Oco
- Panorama
- PivotLink
- Sterna
- ColdLight Neuron
- Infobright
- Vertica

Integration

- Amazon SQS
- MuleSource Mule OnDemand
- Boomi
- SnapLogic
- OpSource Connect
- Cast Iron
- Microsoft BizTalk Services
- gnip
- SnapLogic SaaS Solution Packs
- Appian Anywhere
- HubSpan
- Informatica On-Demand

Development & Testing

- Keynote Systems
- Mercury
- SOASTA
- SkyTap
- Aptana
- LoadStorm
- Collabnet
- Dynamsoft

Database

- Google BigTable
- Amazon SimpleDB
- FathomDB
- Microsoft SDS

Software Services

Desktop Productivity

- Zoho
- IBM Lotus Live
- Google Apps
- Desktoptwo
- Parallels
- ClusterSeven

Sales

- Xactly
- LucidEra
- StreetSmarts
- Success Metrics

Legal

- DirectLaw
- Advologix
- Fios
- Sertifi

Financials

- Concur
- Xero
- Workday
- Beam4d

Billing

- Aria Systems
- eVapt
- OpSource
- Redi2
- Zuora

CRM

- NetSuite
- Parature
- Responsys
- Rightnow
- Salesforce.com
- LiveOps
- MSDynamics
- Oracle On Demand

Backup & Recovery

- JungleDisk
- Mozy
- Zmanda Cloud Backup
- OpenRSM
- Syncplicity

Content Management

- Clickability
- SpringCM
- CrownPoint

Human Resources

- Taleo
- Workday
- iCIMS

Collaboration

- Box.net
- DropBox

Social Networks

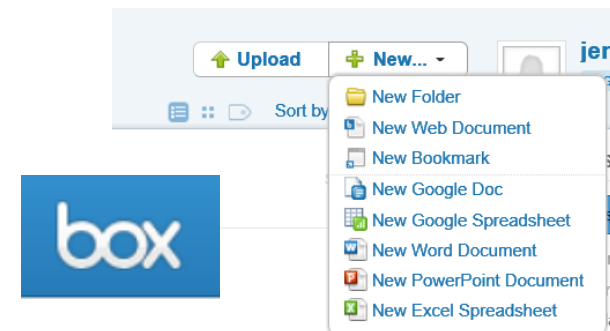
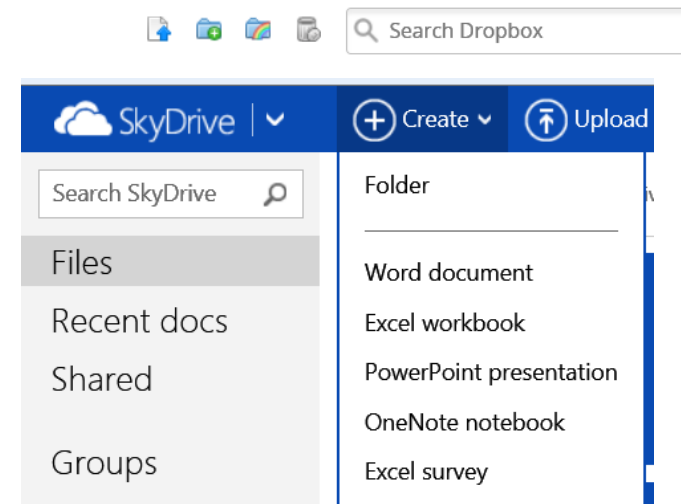
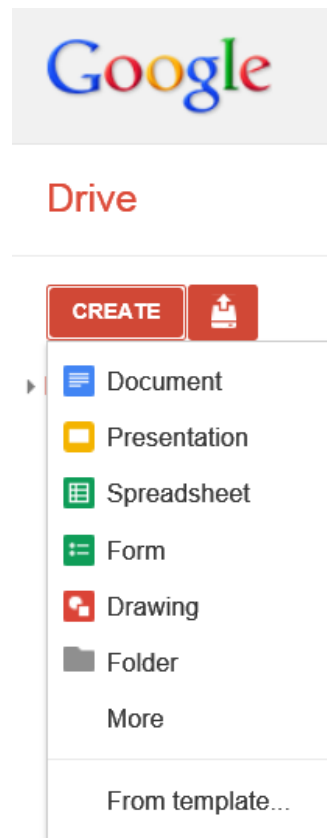
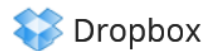
- Ning
- Zemby
- Amitive

Document Management

- NetDocuments
- Questys
- DocLanding
- Aconex
- Xythes
- Knowledge TreeLive
- SpringCM

Document Creation

- Google Docs
- DropBox
- SkyDrive
- Box

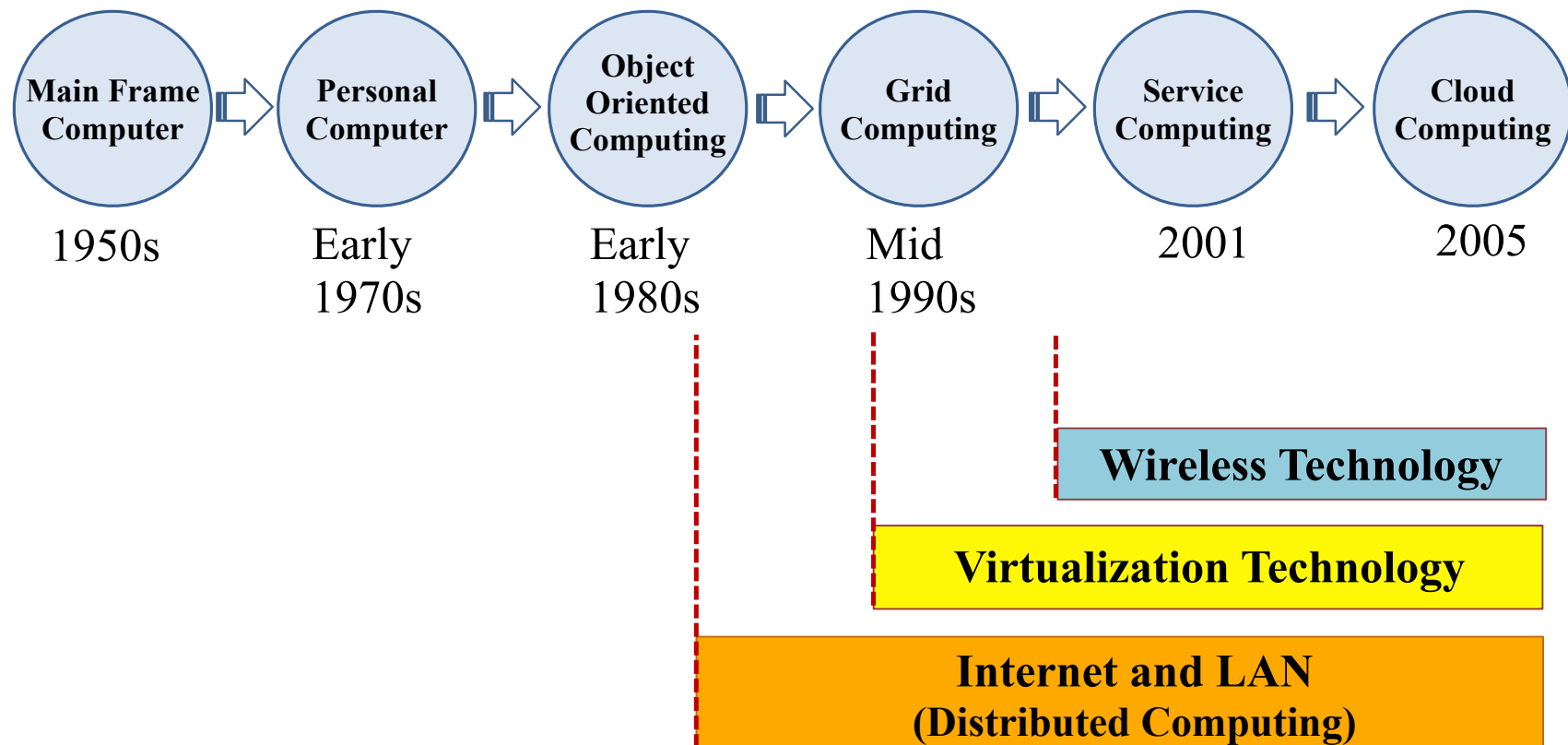


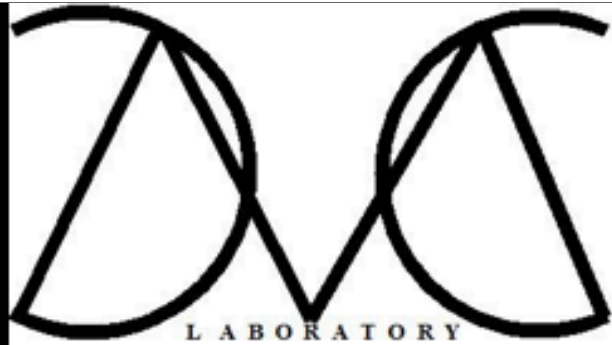
Other Software Services

- Photo Editing Software
- Online Banking Apps
- Social Media Apps
- Communication
- Library Specific Services
 - WorldCat
 - MSC
 - Ebsco
 - Discover It



Evolution of Computing Paradigms





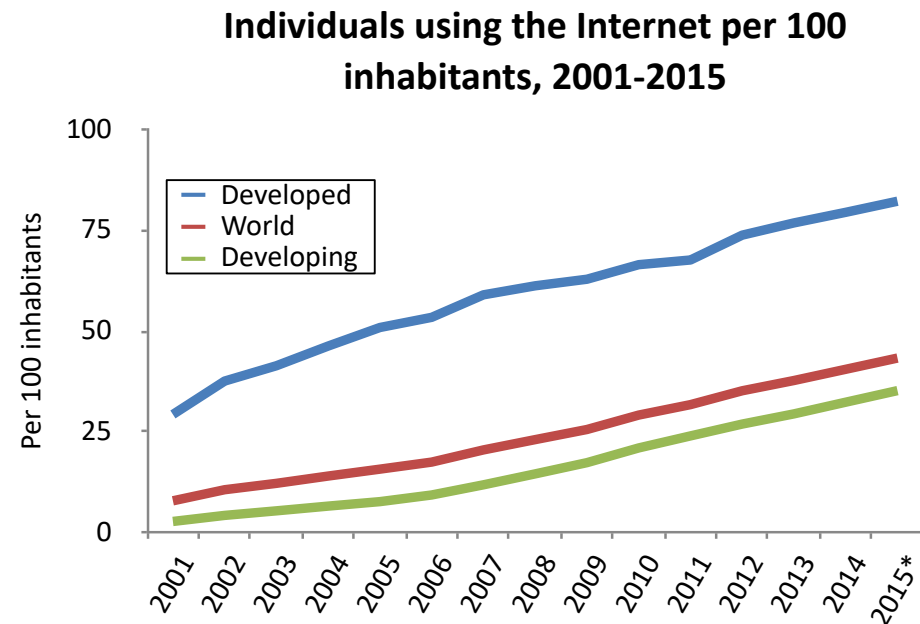
WHY SUDDEN SHIFT?

Internet Penetration

Source: ITU World Telecommunication /ICT Indicators database

Internet Penetration

The number of internet users globally will have attained almost 3 billions, two-thirds of the world internet users are from the developing world, in developing countries, the number of internet users will have doubled in 5 years, from 974 million in 2009 to 1,9 billion

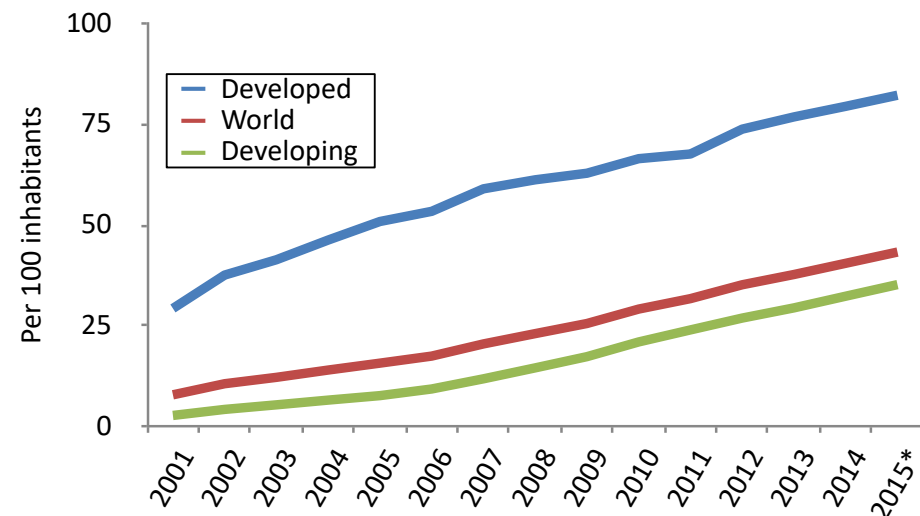


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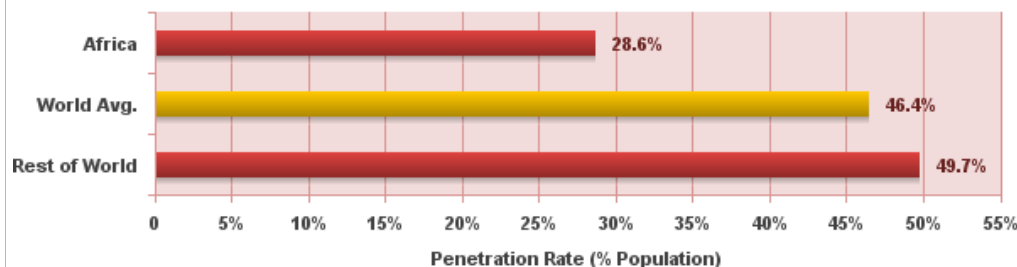
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Individuals using the Internet per 100 inhabitants, 2001-2015



Source: ITU World Telecommunication /ICT Indicators database

Internet Penetration in Africa
November 30, 2015



Source: Internet World Stats - www.internetworldstats.com/stats1.htm

The penetration remains is still low compared with other countries

Why adopt



Cloud Computing by Numbers

Cloud Computing by Numbers



Source: ¹IDC [Worldwide and Regional Public IT Cloud Services 2010 – 2014 Forecast, June 2010].

²Accenture ["Mind the Gap – Insights from the 3rd global High Performance IT research study, Nov, 2010]. ³Accenture [Cloudrise: Rewards and Risk at the Dawn of Cloud Computing" Nov, 2010], ⁴Center for Economics and Business Research [The cloud dividend, Dec, 2010]

Cloud Computing by Numbers

\$55 billion⁽¹⁾

forecasted worldwide revenue from
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44%⁽³⁾

of executives from global companies who believe cloud computing can provide their company with a lasting competitive advantage

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25% ⁽³⁾

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Cloud Computing by Numbers

\$55 billion ⁽¹⁾

forecasted worldwide revenue from public IT cloud services by 2014

33% ⁽²⁾

of global companies have deployed or are piloting the more mature layer of clouds, SaaS. 23% of high performing IT companies have already deployed SaaS

30% ⁽¹⁾

the rate at which cloud computing will grow in 2011, or more than 5 times the rate of IT industry as a whole

25% ⁽³⁾

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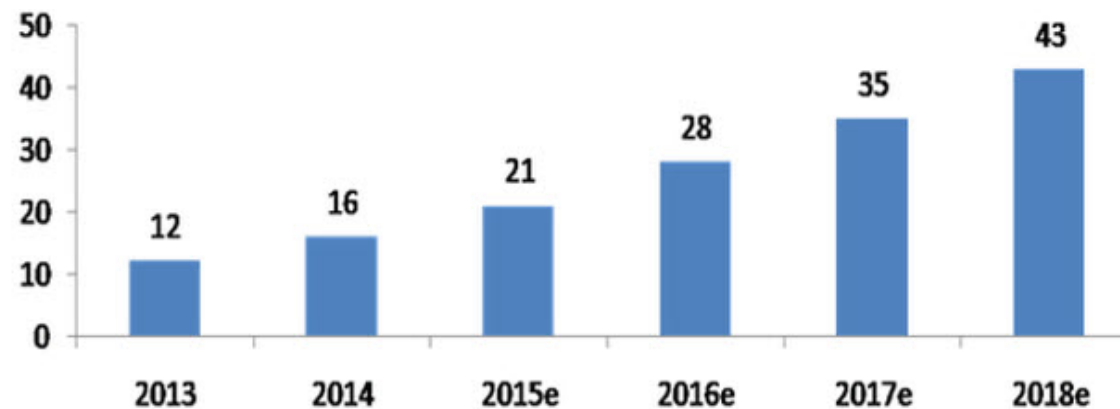
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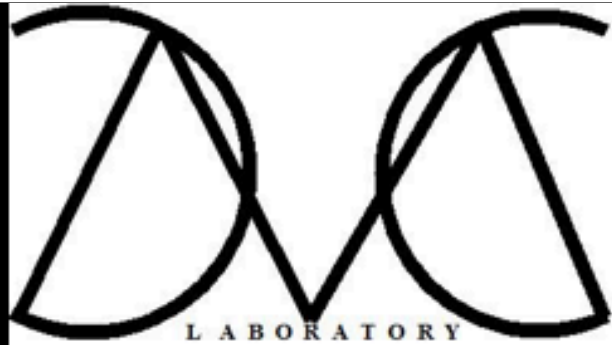
Cloud computing by the numbers

**Cloud Computing Infrastructure and Platform Market
(\$ Billions, 2013 – 2018e)**



Source : Goldman Sachs Research

<http://www.forbes.com/sites/louiscolumbus/2015/09/27/roundup-of-cloud-computing-forecasts-and-market-estimates-q3-update-2015/#11c433986c7a>



DEFINING SYSTEMS AND THEIR PROBLEMS

A System

A System

Software

- Moodle

Platform

- PHP
- MySQL
- Apache
- Ubuntu

Infrastructure

- IBM
BladeCenter
HS22
- Network
Connection

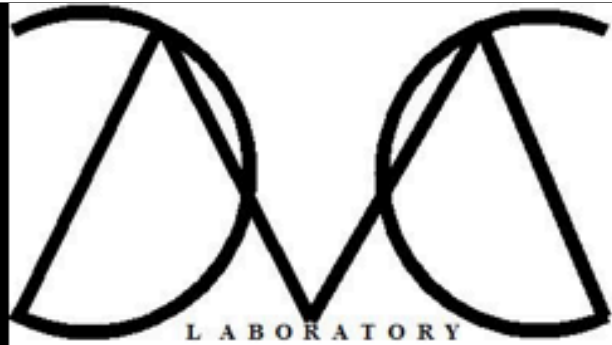
Problems with Systems

Problems with Systems

- Basic Assumptions When Creating Systems
 - Number of Users
 - Amount of Storage
 - Supporting Requirements
 - Amount of Computing Power

Problems with Systems

- Basic Assumptions When Creating Systems
 - Number of Users
 - Amount of Storage
 - Supporting Requirements
 - Amount of Computing Power
- Issues Faced with Maintaining Systems
 - Cost of Updating Systems
 - Scaling Systems



CLOUD COMPUTING: CHANGING THE WAY WE PROVIDE SYSTEMS

Defining The CLOUD

- National Institute of Standards and Technology
 - <http://csrc.nist.gov/groups/SNS/cloud-computing/>
- Cloud Computing is a model

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- Cloud Computing is a model
 - For enabling ubiquitous, convenient, on-demand network access
 - To a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services)

Defining The CLOUD

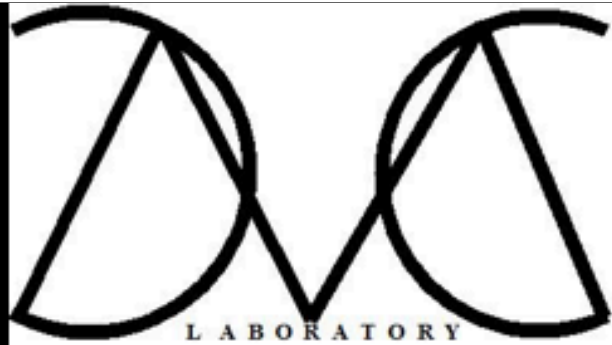
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Defining The CLOUD

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- Cloud Computing is a model
 - For enabling ubiquitous, 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.

Defining The CLOUD

- Cloud computing can be thought of as anything that involves delivering hosted services over the Internet.
- 5 Characteristics
- 4 Deployment Models
- 3 Service Models



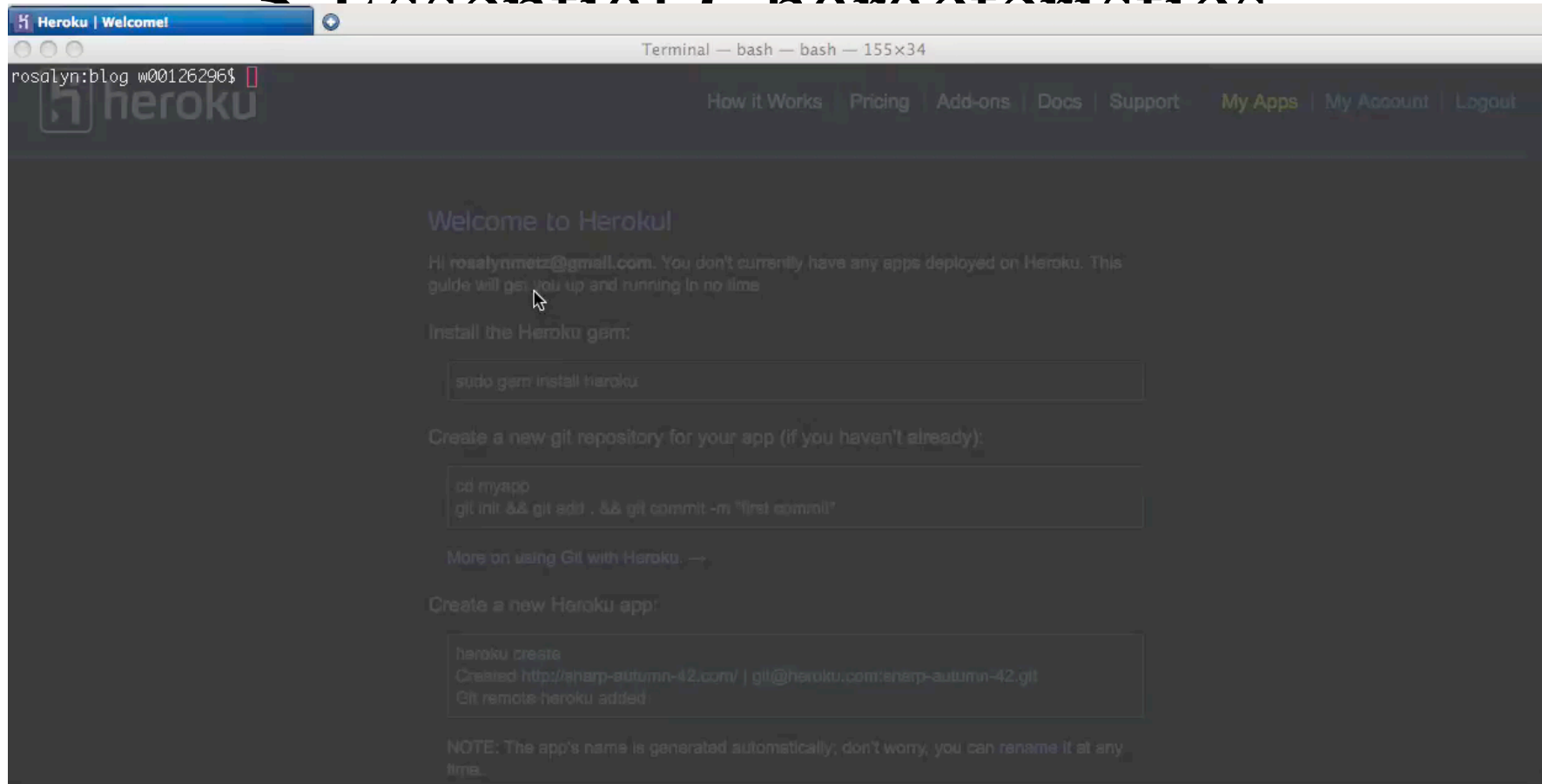
DEFINING THE CLOUD: 5 CHARACTERISTICS

5 Essential Characteristics

5 Essential Characteristics

- *On-demand self-service*
 - A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

5. Essential Characteristics



The screenshot shows a web browser window with the Heroku logo and navigation links. The main content area displays a welcome message and instructions for getting started with Heroku. The instructions include installing the Heroku gem, creating a new git repository, and creating a new Heroku app. A note at the bottom states that the app's name is generated automatically and can be renamed at any time.

Heroku | Welcome

Terminal — bash — bash — 155x34

rosalyn:blog w00126296\$

How it Works | Pricing | Add-ons | Docs | Support | **My Apps** | My Account | Logout

Welcome to Heroku!

Hi rosalynmetz@gmail.com. You don't currently have any apps deployed on Heroku. This guide will get you up and running in no time.

Install the Heroku gem:

```
sudo gem install heroku
```

Create a new git repository for your app (if you haven't already):

```
cd myapp  
git init && git add . && git commit -m "first commit"
```

More on using Git with Heroku. →

Create a new Heroku app:

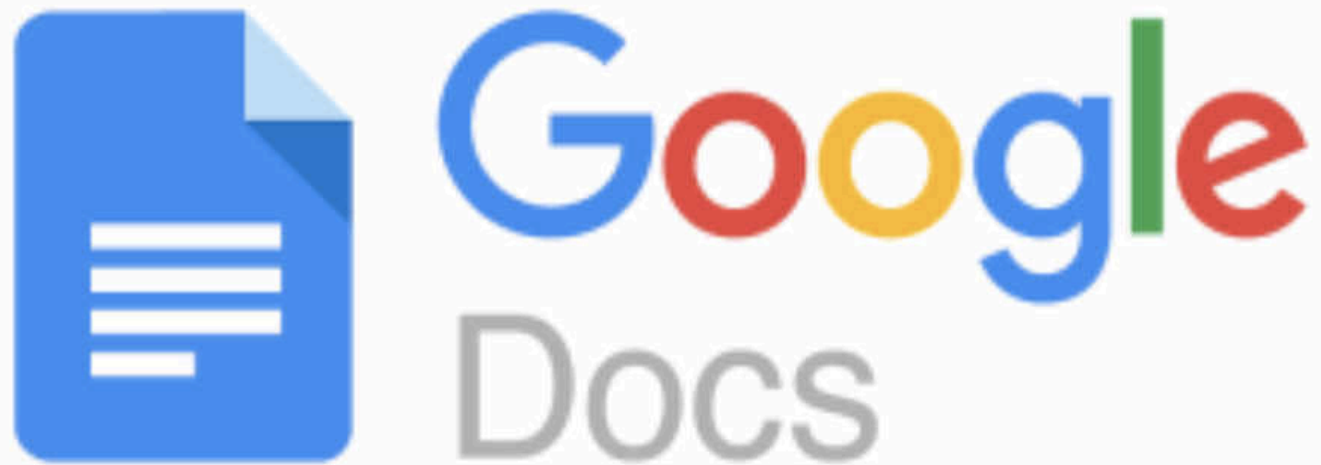
```
heroku create  
Created http://sharp-autumn-42.com/ | git@heroku.com:sharp-autumn-42.git  
Git remote heroku added
```

NOTE: The app's name is generated automatically; don't worry, you can rename it at any time.

5 Essential Characteristics

- *On-demand self-service*
 - A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
- *Broad network access*
 - Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

5 Essential Characteristics



5 Essential Characteristics

- *On-demand self-service*
 - A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
- *Broad network access*
 - Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
- *Resource pooling*
 - The provider's computing resources are pooled to serve multiple consumers. Resources can be dynamically assigned and reassigned according to customer demand. Customer generally may not care where the resources are physically located but should be aware of risks if they are located offshore

5 Essential Characteristics

- *On-demand self-service*

Amazon EC2

Amazon Elastic MapReduce

Amazon CloudFront

Navigation

Region: US East

> EC2 Dashboard

INSTANCES

> Instances

> Spot Requests

IMAGES

> AMIs

> Bundle Tasks

ELASTIC BLOCK STORE

> Volumes

> Snapshots

NETWORKING & SECURITY

> Elastic IPs

> Security Groups

> Key Pairs

> Load Balancers

Amazon EC2 Console Dashboard

Getting Started

To start using Amazon EC2 you will want to launch a virtual server, known as an Amazon EC2 instance.

Launch Instance

Note: Your instances will launch in the US East (Virginia) region.

Service Health

Current Status	Details
Amazon EC2 (US East - N. Virginia)	Service is operating normally

> View complete service health details

My Resources

You are using the following Amazon EC2 resources in the US East (Virginia) region:

Refresh

0 Running Instances

0 Elastic IPs

0 EBS Volumes

1 EBS Snapshot

2 Key Pairs

2 Security Groups

0 Load Balancers

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5 Essential Characteristics

- *On-demand self-service*
 - A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
- *Broad network access*
 - Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
- *Resource pooling*
 - The provider's computing resources are pooled to serve multiple consumers. Resources can be dynamically assigned and reassigned according to customer demand. Customer generally may not care where the resources are physically located but should be aware of risks if they are located offshore
- *Rapid elasticity*
 - Capabilities can be expanded or released automatically (i.e., more cpu power, or ability to handle additional users) to the customer this appears seamless, limitless, and responsive to their changing requirements

ELASTIC DEMAND

**ELASTICITY
OF DEMAND**

=

**% CHANGE
IN QUANTITY**

**% CHANGE
IN PRICE**

EXAMPLE:

Because there are so many housing options, it is easy for people to not have to pay more than they want to.



5 Essential Characteristics

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- *Measured service/Pay-as-you-go*
 - Customers are charged for the services they use and then amounts. There is a metering concept where customer resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service

Measured Service



Characteristics

Computing capabilities, such as server time and network requiring human interaction with each service

- *Broad network access*

- Capabilities promote laptops, etc.

- *Resource*

- The provider dynamically not care where located

- *Rapid elastic*

- Capabilities handle changing

- *Measured service*

- Customers customer provider



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Account Number 5777-1284-4344

Billing Statement: March 1, 2010

The billing cycle for this report is February 1 - February 28, 2010 .

Expand All Services Collapse All Services		Printer Friendly Version
		Totals
+ Amazon Elastic Compute Cloud View/Edit Service	Download Usage Report »	3.81
+ Amazon Simple Storage Service View/Edit Service	Download Usage Report »	0.01
Amazon Virtual Private Cloud View/Edit Service	Download Usage Report »	0.00
Taxes		0.00
Total Charges due on March 1, 2010		\$3.82

Measured Service



Characteristics

computing capabilities, such as server time and network requiring human interaction with each service

- *Broad network access*

- Capabilities promote laptops, etc.

- *Resource*

- The provider dynamically not care where located

- *Rapid elastic*

- Capabilities handle changing

- *Measured service*

- Customers customer provider

- *Low/No Maintenance*



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View/Edit Service		
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View/Edit Service		
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View/Edit Service		
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Taxes		0.00
Total Charges due on March 1, 2010		\$3.82