# Concepts of Cloud Computing

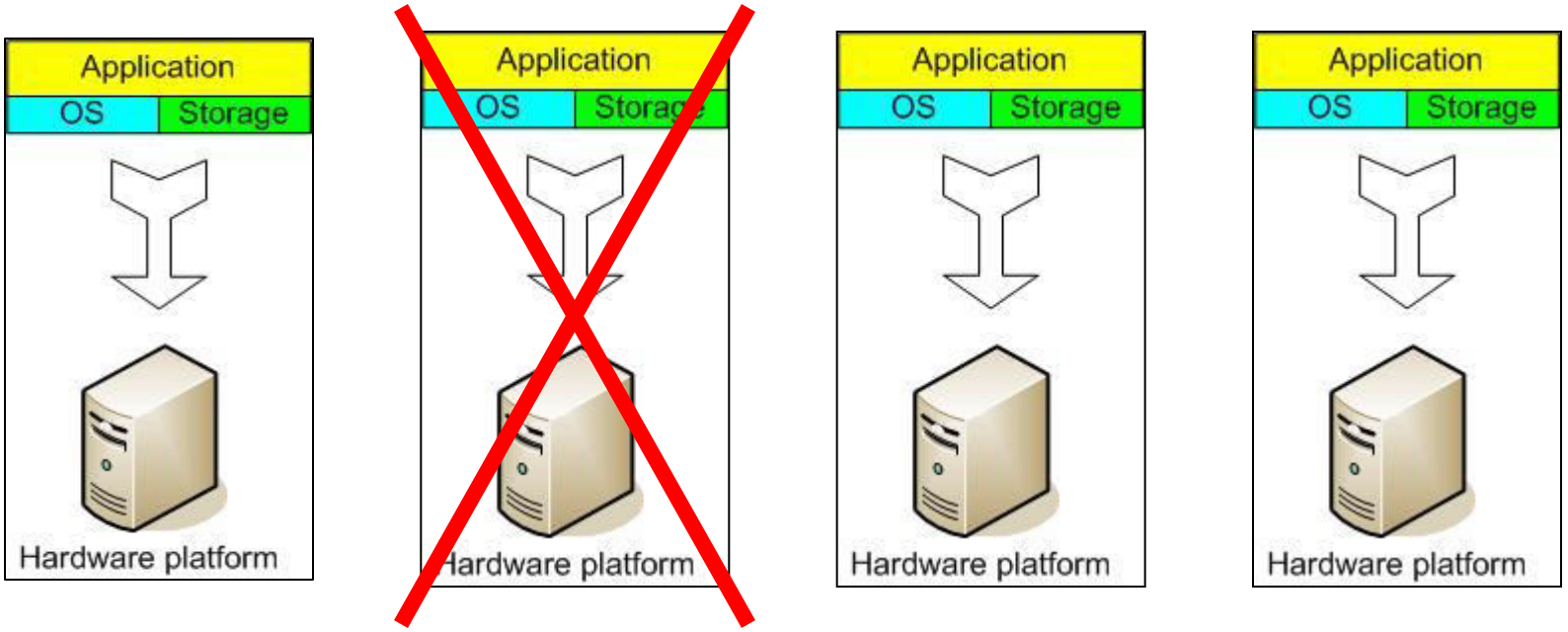
# Traditional Server Concept

- System Administrators often talk about servers as a whole unit that includes:
- Hardware, the OS, the storage, and applications.
- Servers are often referred to by their function:
- The Exchange server, SQL server, File server, etc.
- If the File server fills up, or the Exchange server becomes overtaxed, then…….
- System Administrators must add in a new server.

# Traditional Server Concept

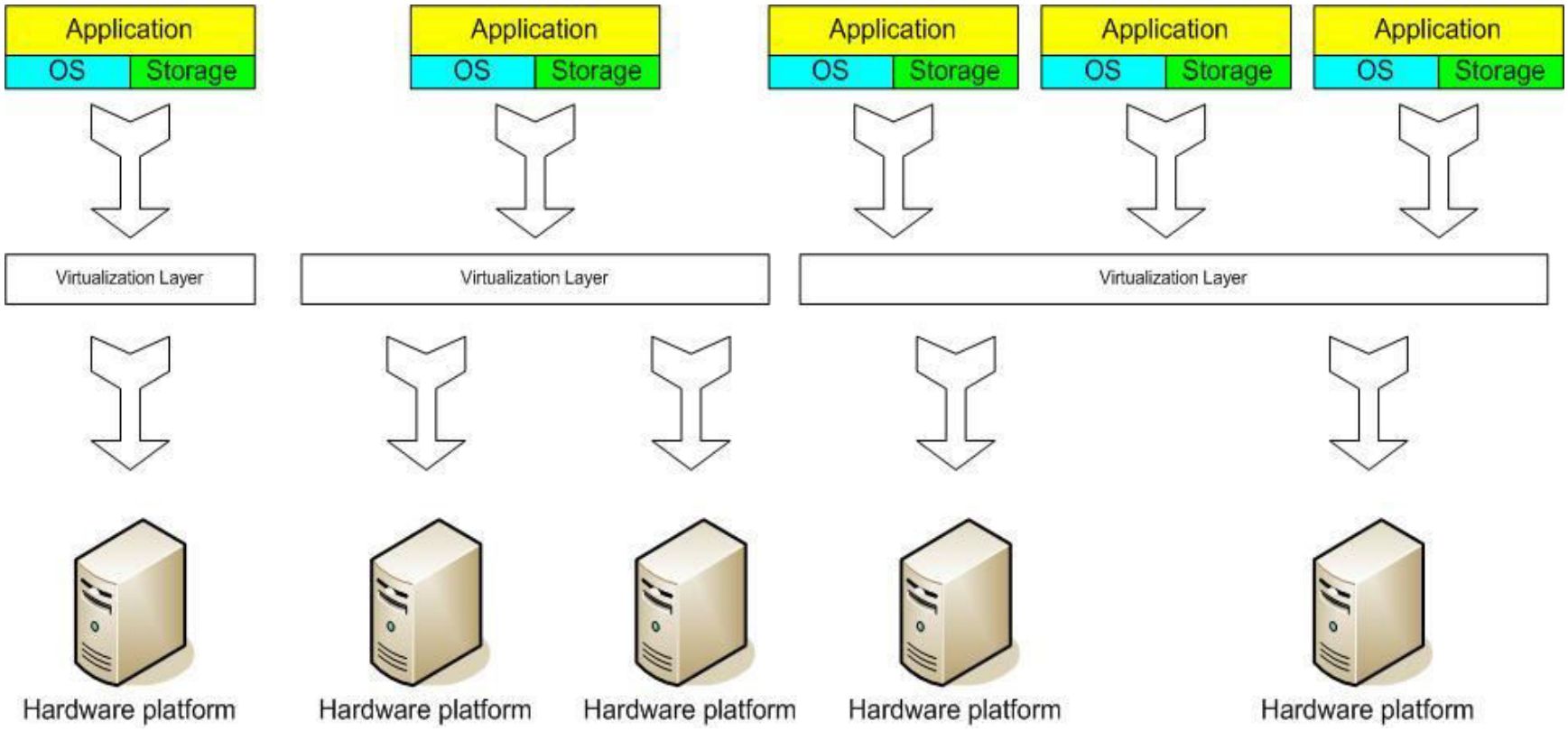
- Unless there are multiple servers, if a service experiences a hardware failure, then……
- The service is down.
- System Admins can implement clusters of servers:
- To make them more fault tolerant.
- However, even clusters have limits on their scalability, and not all applications work in a clustered environment.

# And if something goes wrong ...




| Web Server | App Server | DB Server | EMail |
|---|---|---|---|
| Windows | DOWN! | Linux | Windows |
| IIS | | MySQL | Exchange |

# The Virtual Server Concept

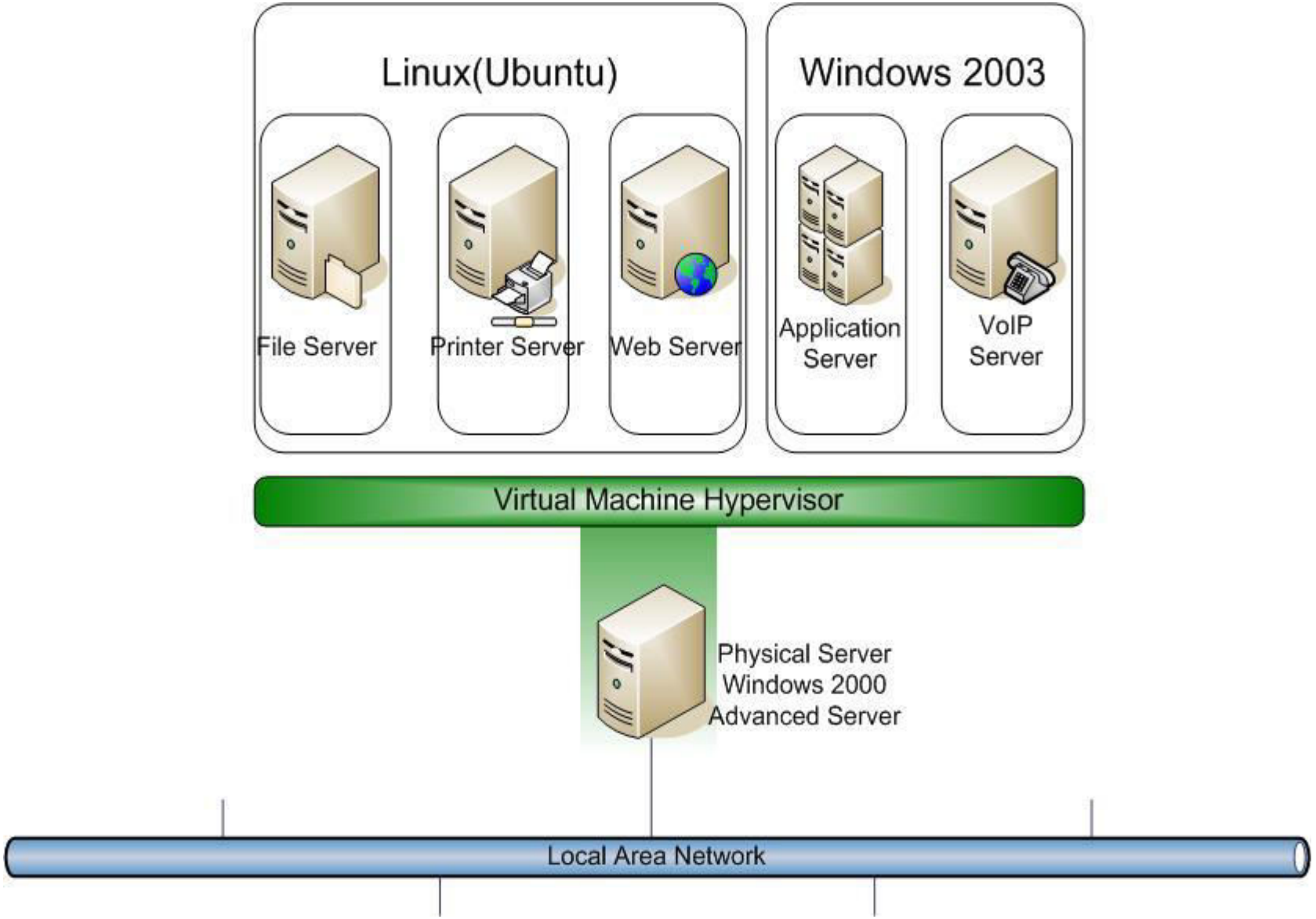



**Virtual Machine Monitor (VMM) layer between *Guest OS* and hardware**

# Virtual Server Concept

- Virtual servers seek to encapsulate the server software away from the hardware
  - This includes the OS, the applications, and the storage for that server.
- A virtual server can be serviced by one or more hosts,
- and one host may house more than one virtual server.

# Virtual Server



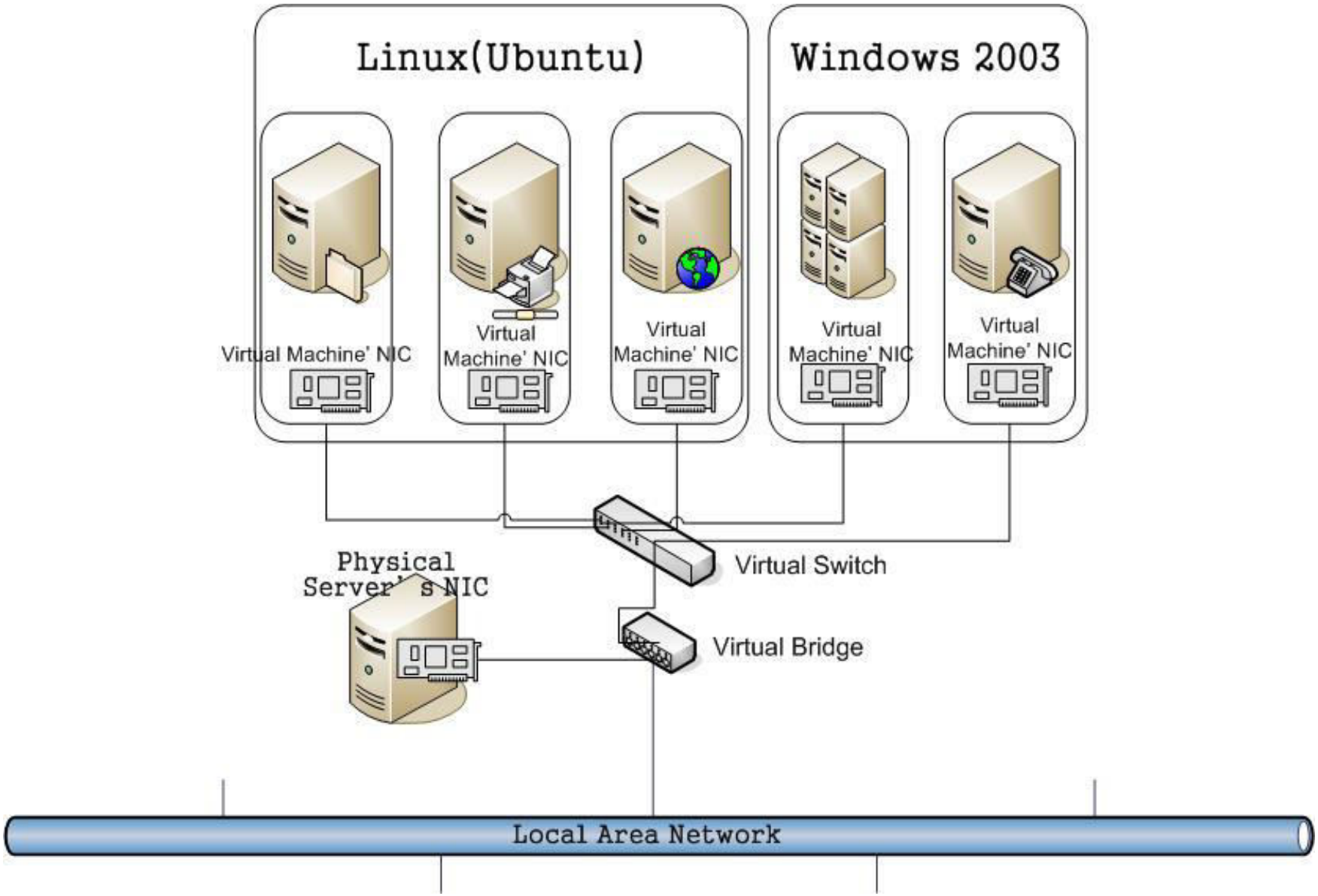
# Virtual Server Concept

- Virtual servers can still be referred to by their function
- i.e. email server, database server, etc.
- If the environment is built correctly, virtual servers will not be affected by the loss of a host.
- Hosts may be removed and introduced almost at will to accommodate maintenance.

# Virtual Server Concept

- Virtual servers can be scaled out easily.
  - If the administrators find that the resources supporting a virtual server are being taxed too much,
  - they can adjust the amount of resources allocated to that virtual server
- Server templates can be created in a virtual environment
- to be used to create multiple, identical virtual servers
- Virtual servers themselves can be migrated from host to host almost at will.

# Virtual Networking implementation



# What’s Cloud Computing?

# Cloud Computing

- **Cloud computing** is the next stage in evolution of the Internet.
- **Cloud computing** provides the means through which everything —
- from computing power to computing infrastructure, applications, business processes to personal collaboration
- Can be delivered to you as a service wherever and whenever you need.

# Client Server Computing

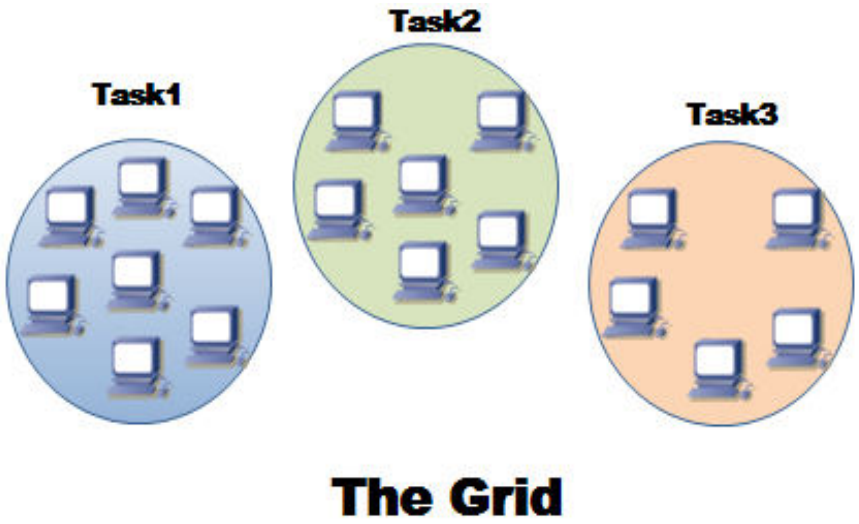
- Client-server application that was  popular is the mainframe and terminal application.
- At that time, storage and CPU was very expensive
- The mainframe pooled both types of resources and served them to thin-client terminals.
- With the advent of the PC revolution, which brought mass storage and cheap CPUs to the average corporate desktop,
- File server gained in popularity as way to enable document sharing and archiving.
- True to its name, the file server served up storage resources to clients in the enterprise,
- while the CPU cycles needed to do productive work with those resources were all produced and consumed within the confines of the PC client.

# Grid Computing

- In the early 1990s, Internet finally had enough computers attached to it
- that academics began thinking seriously about
- How to connect those machines together
- to create massive, shared pools of storage and compute power that would be much larger than what any one institution could afford to build.
- This is when the idea of "**the grid**" began to take shape.

# Grid Computing

- **Grid computing** requires the use of software that can divide and farm out pieces of a program as one large system image
- to several thousand computers.



# Problems

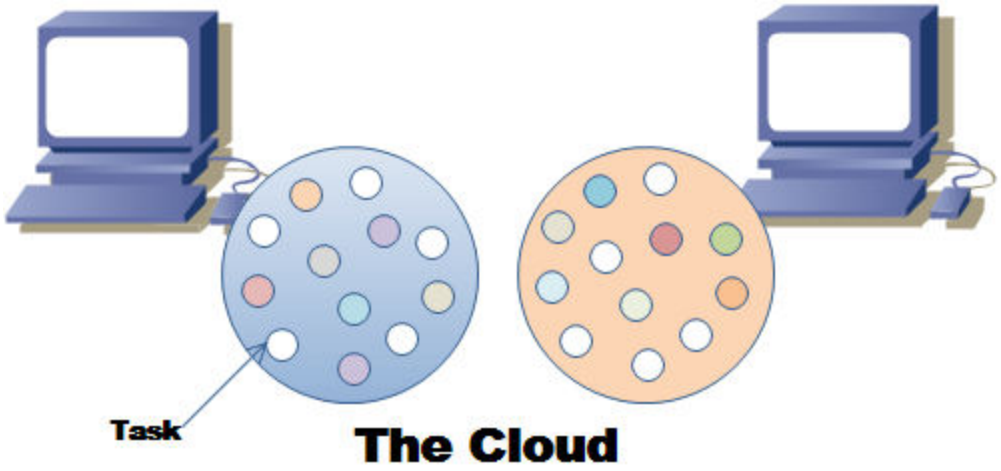
- If one piece of the software on a node fails, other pieces of the software on other nodes may fail.
- This is alleviated if that component has a failover component on another node,
- But problems can still arise if components rely on other pieces of software to accomplish one or more grid computing tasks.
- Large system images and associated hardware to operate and maintain them can contribute to large capital and operating expenses.

# Cloud Computing

- **Cloud computing** evolves from grid computing and provides on-demand resource provisioning.
- Grid computing may or may not be in the cloud depending on what type of users are using it.
- If the users are systems administrators and integrators,
- They care how things are maintained in the cloud.
- They upgrade, install, and virtualize servers and applications.
- If the users are consumers,
- They do not care how things are run in the system.

# Cloud Computing

- The **difference between grid computing and cloud computing** is hard to grasp
- Because they are not always mutually exclusive.
- In fact, they are both used to economize computing by maximizing existing resources.



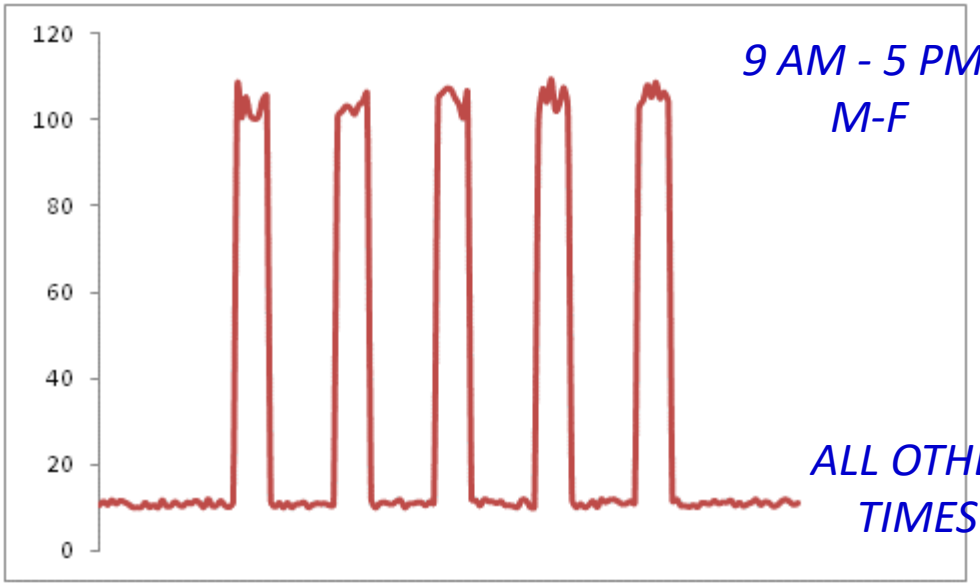
# Cloud Computing

- Cloud services include the delivery of software, infrastructure, and storage over the Internet
- Either as separate components or a complete platform based on user demand.

# Suppose you are Forbes.com

- You offer on-line real time stock market data
- Why pay for capacity weekends, overnight?

**Rate of Server Accesses**



# Forbes' Solution

- Host the web site in Amazon's EC2 *Elastic Compute Cloud*
- Provision new servers every day, and deprovision them every night
- Pay just $0.10* per server per hour
  - * more for higher capacity servers
- Let Amazon worry about the hardware!

# Cloud computing takes virtualization to the next step

- **You don't have to own the hardware**
- You "rent" it as needed from a cloud
- There are public clouds
  - e.g. Amazon EC2, and now many others (Microsoft, IBM, Sun, and others ...)
- A company can create a private one
  - With more control over security, etc.

# How it works ?

- Cloud Computing makes computer infrastructure and services available "on-need" basis.
- Computing infrastructure could include hard disk, development platform, database, computing power or complete software applications.
- To access these resources from the cloud vendors, organizations do not need to make any large scale capital expenditures.

# How it works ?

- Organization need to "pay per use"
- i.e. organization need to pay only as much for the computing infrastructure as they use.
- Billing model of cloud computing is similar to the electricity payment that we do on the basis of usage.
- Cloud vendors provide appearance of infinite computing infrastructure availability.
- This is available to organizations on need basis.

# How it works ?

- Sports site gets extremely high traffic in the two weeks when the championship happens.
- For this two weeks period this site will have high server usage.
- For rest of the year the site will need to only pay for the reduced usage.
- In general organizations do not need to bear the cost of computing infrastructure for their peak loads.
- The usage of computing resources can be increased or reduced on need basis, is called elastic computing.

# How it works ?

- Cloud computing typically does not involve long-term commitment to use the computing infrastructure.
- The vendor does not enforce long-term usage of services.
- Cloud computing does not involve any significant capital expenditure for the organization.
- **Unlike traditional IT infrastructure, in cloud computing organizations just use the computing services without procuring it.**
- In some sense cloud computing involves renting the computing resources instead of buying them.

# How it works ?

- Since the cloud computing vendor provides services over the web, these are available from any location.
- Cloud computing can be ordered online without detailed formal contracts.
- Cloud traditionally depicts the internet. Since cloud computing is built using internet

# Examples

- Hotmail.com was launched in 1996,
- It is widely considered as the first cloud computing application.
- The data is stored at the vendor servers, and users could pay incrementally to increase disk space usage.
- Many other services have emerged in the last decade that allows users to store information (or perform processing) without paying any upfront charges.
- These are typically consumer oriented services.
- Twitter, myspace, Wikipedia, youtube, facebook, linkedin, Google docs and blogger all are examples of cloud computing.
- Companies that provide Hosting services for diskspace storage, images, emails are all examples of cloud computing

# Examples

- Salesforce.com, founded in 1999,
- the first successful example of providing software as a service in the business to business domain.
- Salesforce is a CRM tool for sales executives providing features like managing customer details, running promotions etc

# Examples

- Google and Microsoft provide development platforms that can be accessed with "pay-per-use" billing model.
- Amazon.com was one of the first vendors to provide storage space and computing resources following the cloud computing model.
- All these services are examples of Cloud computing.

# Types of Cloud Computing

- there are mainly three forms of cloud computing:
- **Public Cloud:** IT resources offered as a service and shared across multiple organizations, managed by an external service provider
- **Private Cloud:** IT resources dedicated to a single organization and offered on demand
- **Hybrid Cloud:** a mix of private and public clouds managed as a single entity to extend capacity across clouds as needed

# PRIVATE/ENTERPRISE CLOUD

A proprietary computing architecture that provides hosted services to a limited number of people behind a firewall, and is typically for organizations that needs or wants more control over their data than they can get by using a third-party hosted service.

OTHER COMPANIES: EMC² FalconStor Software FUSION-IO NetApp

## HP/3PAR

EST. 1939

In September 2010, HP announced the acquisition of 3PAR Inc., a provider of utility storage, for $2.35 billion, to expand HP's storage portfolio into enterprise-class cloud computing environments.

## ORACLE

EST. 1977

In 2009, Larry Ellison railed on the cloud, calling it "water vapor." In 2010, Ellison laid out his cloud vision of using Oracle's software on a third party cloud and renting Oracle apps in a SaaS model on a subscription basis.

## IBM

EST. 1911

IBM has announced its launch of the Federal Community Cloud, a private cloud program aimed at government organizations.

## CISCO

EST. 1984

The name "Cisco" is not an acronym, but an abbreviation of San Francisco. According to John Morgridge, employee 34 and the company's first president, the founders hit on the name and logo while driving to Sacramento to register the company — they saw the Golden Gate Bridge framed in the sunlight.

## VMWARE

EST. 1998

VMware products have reached Common Criteria certification at Evaluation Assurance Level 4, the highest globally recognized security features certification

KEY

# PUBLIC CLOUD

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.

OTHER COMPANIES: Salesforce flickr YAHOO!

## TWITTER

EST. 2006

**Total assets:** $162.1 million*

**Alexa ranking*****: 9

**CEO compensation:** Unavailable; Twitter co-founder Evan Williams has stepped down from his role as CEO of the company

**Monthly uniques******:** 96 million

Jack Dorsey thought of the idea for Twitter while sitting in a park on a children's slide and eating Mexican food, introducing the idea of an individual using an SMS service to communicate with a small group.

## GOOGLE

EST. 1998

**Total assets:** $40.5 billion

**Alexa ranking:** 1

**CEO compensation:** $557,466 *(compensation in 2006)*

**Monthly uniques:** 146 million

Larry Page and Sergey Brin started Google together in their friend's garage.

## MICROSOFT AZURE

EST. 1975

**Total assets:** $86.1 billion

**Alexa ranking:** 23

**CEO compensation:** $1.28 million

**Monthly uniques:** 57 million

When the program was known by its code name of "Red Dog" in 2008, its working team of about 150 included Microsoft heavyweight Dave Cutler, semi-retired lead developer on Windows NT.

NOTE: Statistics are for Microsoft, of which Azure is a small part.

## AMAZON

EST. 1994

**Total assets:** $24.5 billion

**Alexa ranking:** 15

**CEO compensation:** $1.78 million

**Monthly uniques:** 75 million

CEO Jeff Bezos changed the name Cadabra.com to Amazon.com because it sounded too much like "cadaver."

## FACEBOOK

EST. 2004

**Total assets:** $1.5 billion**

**Alexa ranking:** 2

**CEO compensation:** Unavailable

**Monthly uniques:** 131 million

Facebook had allowed users to deactivate their accounts but not actually remove account content from its servers.

*A New York Times* article noted the issue, and also raised a concern that emails and other private user data remain indefinitely on Facebook's servers. Facebook subsequently began permanently deleting accounts on special request.

*Based on estimates from Search Engine Land, Sharespost, and Techcrunch

***Alexa is popular destination for free traffic metrics and search analytics

**Figure represents net worth; total assets unavailable

****Monthly unique visitors to company website — each visitor is counted only once


HYBRID CLOUD
The use of both private and public clouds to provide an organization's computing needs. Two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology.
verizon
$10.3 mil
rackspace
$6.7 mil

## NRE Alliance

A coalition of newScale, rPath and Eucalyptus Systems focused on self-service private and hybrid cloud, with a goal helping enterprise IT organizations transform into internally managed versions of a public cloud service.

## VERIZON

EST. 1983

**Total assets:** $227.2 billion

**Alexa ranking:** 590

**Monthly uniques:** 11 million

In September 2010, Verizon and VMware unveiled an enterprise-class hybrid cloud solution that promises to enable enterprises to move their applications to the cloud more quickly without compromising security or performance.

222,900 employees

91.64 bil (Verizon)

## RACKSPACE

EST. 1998

**Total assets:** $668.6 million

**Alexa ranking:** 2,386

**Monthly uniques:** 186,953

Rackspace pushes a hybrid approach that tightly couples dedicated and cloud computing resources. The theory: Customers will begin toggling between hosted data centers and cloud computing resources as standard operating procedure.

3.45 bil (Rackspace)

799.08 mil (Terremark)

## TERREMARK

EST. 2002

**Total assets:** $1.1 billion

**Alexa ranking:** 144,743

**Monthly uniques:** 12,350

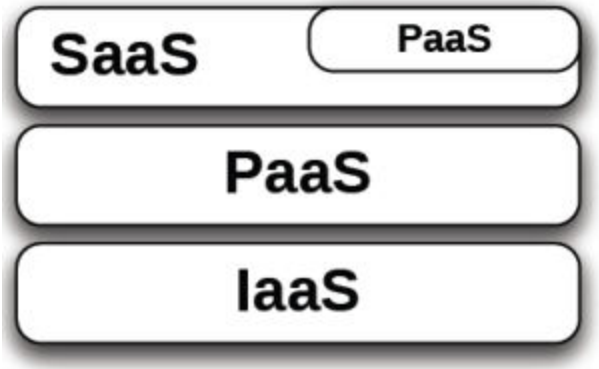
Terremark offers a broad spectrum of offerings from more traditional hosted infrastructure to cloud and on-demand services.

Wikibon

INFO GRAPHI WORLD

# Types of Cloud Computing

- **Which areas of the IT can you leverage with cloud computing ?**
- basically three areas, which are known as the cloud models :



# IaaS

- **Infrastructure as a Service (IaaS)** is the delivery of computer hardware
- servers,networking technology, storage, and data center space as a service.
- It may also include the delivery of operating systems and virtualization technology to manage the resources.
- Benefits: makes the acquisition of hardware easier. Makes instant provisioning of hardware resources in a cheap way.


amazon.com
web services


vmware

# PaaS

- **The Platform as a Service layer (Paas)**
- offers development environments that IT organizations can use to create cloud-ready business applications.
- A PaaS is ultimately a contract between an hosted environment and user-provided extensions.

# SaaS & IaaS

- **The Software as a Service (Saas)** layer offers
- Purpose-built business applications
- In practical terms, this is the piece of cloud you are likely to build.
- You might wonder if it's possible that some services can be both defined as **Platform** and as **Software**:
- the answer is, of course yes!
- Take for example Facebook.
- We might define Facebook both as Platform where various services can be delivered and also as business applications (Facebook Api) which are developed by the end user.