Cloud Computing:

MOD 1:

Definition:

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.

Essential Characteristics:

On-demand self-service

A consumer can unilaterally provision computing capabilities 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 using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.

Measured Service

Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service .

Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Rapid elasticity

Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand.

To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

Cost Model

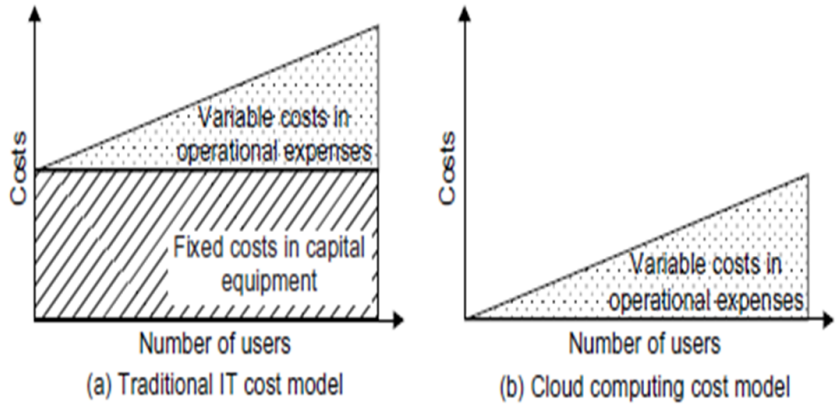


FIGURE 4.3

Computing economics between traditional IT users and cloud users.

Traditional:

- Users must acquire their own computer and peripheral equipment as capital expenses.
- The operational costs may increase sharply with a larger number of users.
- Therefore, the total cost escalates quickly with massive numbers of users.

Cloud:

- Cloud computing applies a pay-per-use business model, in which user jobs are outsourced to data centers.
- To use the cloud, one has no up-front cost in hardware acquisitions.
- Only variable costs are experienced by cloud users

Design Objectives:

1. **Shifting computing from desktops to data centers**

Computer processing, storage, and software delivery is shifted away from desktops and local servers and toward data centers over the Internet.

2. **Service provisioning and cloud economics**

Providers supply cloud services by signing SLAs with consumers and end users.Pricing is based on a pay-as-you-go policy.

3. **Scalability in performance**

The cloud platforms and software and infrastructure services must be able to scale in performance as the number of users increases.

4. **Data privacy protection**

Can you trust data centers to handle your private data and records? This concern must be addressed to make clouds successful as trusted services.

5. **High quality of cloud services**

The QoS of cloud computing must be standardized to make clouds interoperable among multiple providers.

6. **New standards and interfaces**

This refers to solving the data lock-in problem associated with data centers or cloud providers.

Universally accepted APIs and access protocols are needed to provide high portability and flexibility of virtualized applications.

Advantages of Cloud Computing:

- **Lower computer costs:**

  –No need of a high-powered and high-priced computer to run cloud computing's web-based applications.

- **Improved performance:**

  –With few large programs hogging your computer's memory, you will see better performance from your PC.

- **Reduced software costs:**

  Instead of purchasing expensive software applications, you can get most of what you need for free.

- **Instant software updates**

  –Another advantage to cloud computing is that you are no longer faced with choosing between obsolete software and high upgrade costs.

  –When the application is web-based, updates happen automatically available the next time you log into the cloud.

- **Improved document format compatibility.**

–You do not have to worry about the documents you create on your machine being compatible with other users' applications or OS.

–There are less format incompatibilities when everyone is sharing documents and applications in the cloud.

- **Unlimited storage capacity**

  –Cloud computing offers virtually limitless storage.

- **Increased data reliability**

  –Unlike desktop computing, in which if a hard disk crashes and destroy all your valuable data, a computer crashing in the cloud should not affect the storage of your data.

- **Universal information access**

  –That is not a problem with cloud computing, because you do not take your documents with you.

  –Instead, they stay in the cloud, and you can access them whenever you have a computer and an Internet connection

- **Latest version availability**

  –When you edit a document at home, that edited version is what you see when you access the document at work.

- **Easier group collaboration**

–Many users do this as it is an important advantages of cloud computing multiple users can collaborate easily on documents and projects

- **Device independence**

–You are no longer tethered to a single computer or network.

—Move to a portable device, and your applications and documents are still available.

Disadvantages of Cloud Computing:

- **Requires a constant internet connection**

–Cloud computing is impossible if you cannot connect to the Internet.

- **Does not work well with low-speed connections**

  –Similarly, a low-speed Internet connection, such as that found with dial-up services, makes cloud computing painful at best and often impossible.

- **Features might be limited**

  –This situation is bound to change, but today many web-based applications simply are not as full-featured as their desktop-based applications.

- **Can be slow**

  –Even with a fast connection, web-based applications can sometimes be slower than accessing a similar software program on your desktop PC.

- **Stored data might not be secured**

  –With cloud computing, all your data is stored on the cloud.

  –Can unauthorized users gain access to your confidential data ?

- **Stored data can be lost!**

  –Theoretically, data stored in the cloud is safe, replicated across multiple machines.

  –But on the off chance that your data goes missing, you have no physical or local backup.

- **HPC Systems**

  –Not clear that you can run compute-intensive HPC applications that use MPI/OpenMP!

- **General Concerns**

  –Each cloud systems uses different protocols and different APIs

  may not be possible to run applications between cloud based systems

  Service models:

- **X as a Service (XaaS) is a generalization for cloud-related services**
- **XaaS stands for "anything as a service" or "everything as a service“**
- **XaaS refers to an increasing number of services that are delivered over the Internet rather than provided locally or on-site**

- SaaS - Software-as-a-Service
- Where the business subscribes to an application it accesses over the Internet.
- SaaS is defined as software that is deployed over the internet
- With SaaS, a provider licenses an application to customers

- a service on demand,
- Either through a subscription, in a “pay-as-you-go” model

- PaaS - Platform-as-a-Service
- Where a business can create its own custom applications for use by all in the company.
- Rather than being software delivered over the web, it is a platform for the creation of software, delivered over the web.

- IaaS - Infrastructure-as-a-Service

  Where players like Amazon, Microsoft, Google, and Rackspace provide a backbone that can be "rented out" by other companies.

  •Infrastructure as a Service (IaaS) is a way of delivering Cloud Computing infrastructure – servers, storage, network and operating systems – as an on-demand service.

- DaaS - Desktop-as-a-Service

  DaaS is a cloud service where the back-end of a virtual desktop is hosted by a cloud provider.

- **Applications where SAAS is used:**

  •Applications that have need for web or mobile access.

  E.g. mobile sales management software.

  •Software that is only to be used for a short term need.

  •Software where demand spikes significantly.

- **Applications where SAAS is not the best option:**
- Applications where extremely fast processing of real time data is needed
- Applications where an existing on-premise solution fulfills all of the organization’s needs

- **Applications where PAAS is used:**
- multiple developers will be working on a development project
- Or where other external parties need to interact with the development process .
- PaaS is useful where developers wish to automate testing and deployment services.

- **Applications where PAAS is not the best option:**
- Where proprietary languages or approaches would impact on the development process
- Where application performance requires customization of the underlying hardware and software

- **Applications where IAAS is used:**
- Where demand is very volatile – any time there are significant spikes and troughs in terms of demand on the infrastructure
- For new organizations without the capital to invest in hardware
- Where the organization is growing rapidly and scaling hardware would be problematic
- trial or temporary infrastructural needs

- **Applications where IAAS is not the best option:**
- Where the highest levels of performance are required, and on-premise or dedicated hosted infrastructure has the capacity to meet the organization's needs

- **Public Cloud**
- Cloud infrastructure is provisioned for open use by the general public.
- It may be owned, managed, and operated by a business, academic, or government organization, or some combination of the**m.**
- the provider's computing and storage resources are potentially large;
- the communication links can be assumed to be implemented over the public Internet

Examples of Public Cloud:

- **Google App Engine**
- **Microsoft Windows Azure**

- **IBM Smart Cloud**
- **Amazon EC2**

- **Private Cloud**
- **The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units).**
- **It may be owned, managed, and operated by the organization, a third party, or some combination of them**

  •On-site Private Cloud

  –Applies to private clouds implemented at a customer's premises.

  •Outsourced Private Cloud

  –Applies to private clouds where the server side is outsourced to a hosting company.

  Examples:

  Eucalyptus

  –Ubuntu Enterprise Cloud - UEC

  –Amazon VPC (Virtual Private Cloud)

  –VMware Cloud Infrastructure Suite

  –Microsoft ECI data center.

- **Community Cloud**
- **Cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns**
- **It may be owned, managed, and operated by the organization, a third party, or some combination of them, and**
- **Examples of Community Cloud:**

  Google Apps for Government

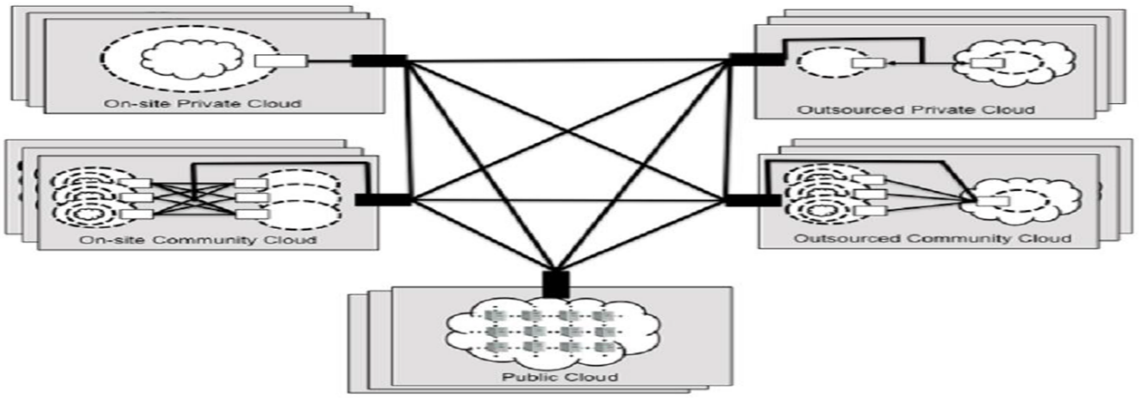
  Microsoft Government Community Cloud

- **Hybrid Cloud**
- **The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities,**

- **but are bound together by standardized technology that enables data and application portability**
- **A hybrid cloud can be extremely complex**
- **A hybrid cloud may change over time with constituent clouds joining and leaving.**
- **Examples of Hybrid Cloud:**

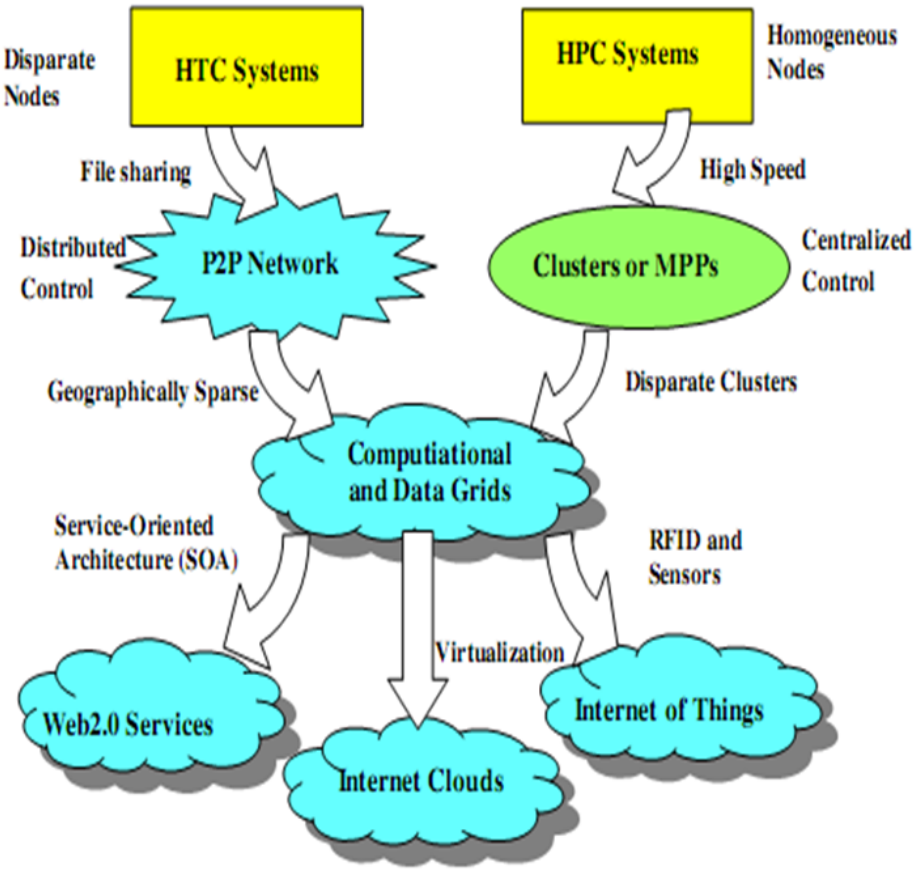
  –Windows Azure (capable of Hybrid Cloud)

  –VMware vCloud (Hybrid Cloud Services)



- **Cloud Bursting for load balancing**
- **Cloud bursting is a configuration which is set up between a private cloud and a public cloud to deal with peaks in IT demand.**
- **If an organisation using a private cloud reaches 100 percent of its resource capacity,**
- **the overflow traffic is directed to a public cloud so there is no interruption of services.**

HPC AND HTC:



- HPC systems emphasize the raw speed performance
- Massively Parallel Processors(MPP)
- High Throughput Computing.
- HTC pays more attention to High flux computing.
- HPC tasks are characterized as needing large amounts of computing power for short periods of time,
- HTC tasks also require large amounts of computing, but for much longer times (months and years, rather than hours and days).
- HPC environments are often measured in terms of FLOPS.
- The HTC community, however, is not concerned about operations per second, but rather operations per month or per year.

- On the HPC side, Supercomputers or MPPs (Massively Parallel Processors) are gradually replaced by clusters of Co-operative computers out of desire to share computing resources.(in close range connection)
- P2P is built over many client machines and are globally distributed in nature.
- Clustering and P2P lead to development of Computational and data grids.
- GRID Computing:
- Grid computing is especially useful when different subject matter experts need to collaborate on a project but
- do not necessarily have the means to immediately share data and computing resources in a single site.
- By joining forces despite the geographical distance,
- the distributed teams are able to leverage their own resources that contribute to a bigger effort.
- **Web Service**
- Web service is a means by which computers talk to each other over the web using HTTP and other universally supported protocols.
- A web service is any piece of software that makes itself available over the internet and uses a standardized XML messaging system.
- For example, a client invokes a web service by sending an XML message, then waits for a corresponding XML response.
- As all communication is in XML, web services are not tied to any one operating system or programming language—Java can talk with Perl; Windows applications can talk with Unix applications.
- Web Services is based on:

- HTTP (Hypertext Transport Protocol)
- SOAP (Simple Object Access Protocol)
- UDDI (Universal Description, Discovery and Integration)
- WS-POLICY (Web Services Policy)

Most Web services expect their Web methods to be invoked using

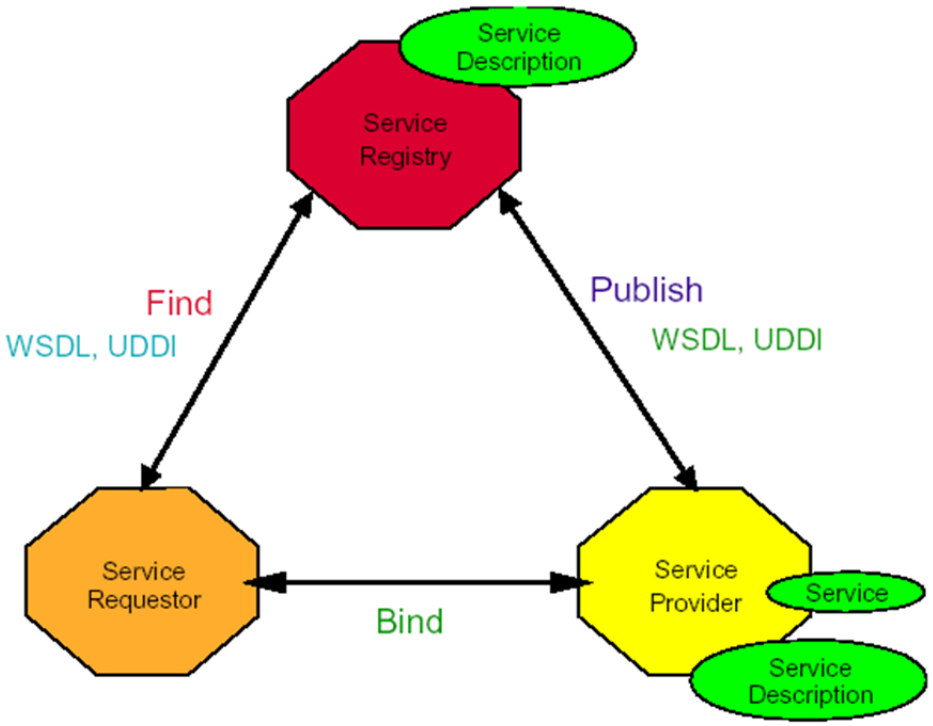
- HTTP requests containing SOAP messages.
- SOAP is an XML-based vocabulary for performing remote procedure calls using HTTP and other protocols.

	Web Service	Website
1.	A web service doesn't have a user interface	A website has a user interface or GUI
2.	Web services are meant for other applications to be interacted with over internet	Websites are meant for use by humans
3.	Web services are platform independent as they use open protocols	Websites are cross platform as they require tweaking to operate on different browsers, operating systems etc.

4.	Web services are accessed by HTTP methods - GET, POST, PUT, DELETE etc	Websites are accessed by using their GUI components - buttons, text boxes, forms etc.
5.	E.g. Google maps API is a web service that can be used by websites to display Maps by passing coordinates to it	E.g. ArtOfTesting.com is website that has collection of related web pages containing tutorials

- **Service Oriented Architecture**

IBM has created a model to show Web services interactions which is referred to as a Service-Oriented Architecture (SOA)



Roles in Web Service architecture

•Service provider –

Owner of the service

Platform that hosts access to the service

•Service requestor

Business that requires certain functions to be satisfied

Application looking for and invoking an interaction with a service

•Service registry

Searchable registry of service descriptions where service providers publish their service descriptions

Operations in a Web Service Architecture

•Publish

Service descriptions need to be published in order for service requestor to find them

•Find

Service requestor retrieves a service description directly or queries the service registry for the service required

•Bind

Service requestor invokes or initiates an interaction with the service at runtime

Steps of Operation

1.Client queries registry to locate service.

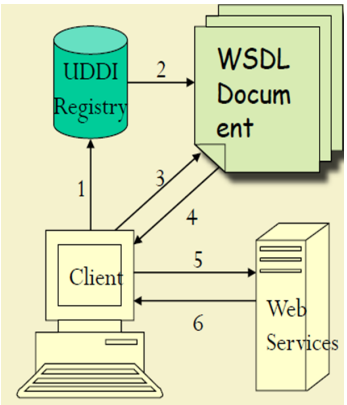
2.Registry refers client to WSDL document.

3.Client accesses WSDL document.

4.WSDL provides data to interact with Web service.

5.Client sends SOAP-message request.

6.Web service returns SOAP-message response.



AWS

- Amazon web services (AWS) AWS offers comprehensive cloud IaaS services ranging from virtual
- compute, storage, and networking to complete computing stacks
- AWS is mostly known for its compute and storage-on demand services, namely
- Elastic Compute Cloud (EC2)

  EC2 (Elastic Compute Cloud) provides the virtualized platforms to the host VMs where the cloud application can run.

  It is possible to choose from a large variety of virtual hardware configurations, including GPU and cluster instances.

- Simple Storage Service (S3)

REFER FIGURE FROM PPT