EMERGING TECHNOLOGIES

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FAITH • INTEGRITY • EXCELLENCE

OBJECTIVES

1. Understand the impact that emerging technologies will have in the future.
2. Define the use of emerging technologies –
   a) Cloud Computing,
   b) Big data concept and analytics,
   c) Data Centre and virtualization,
   d) internet of things,
   e) 4G/5g Mobile technologies,
   f) optical computing,
   g) quantum computing and quantum cryptography,
   h) virtual reality and wearable computing.
4. Define the ways in which certain technologies will impact homes of the future.
5. Describe some emerging technologies and their uses that are extreme.

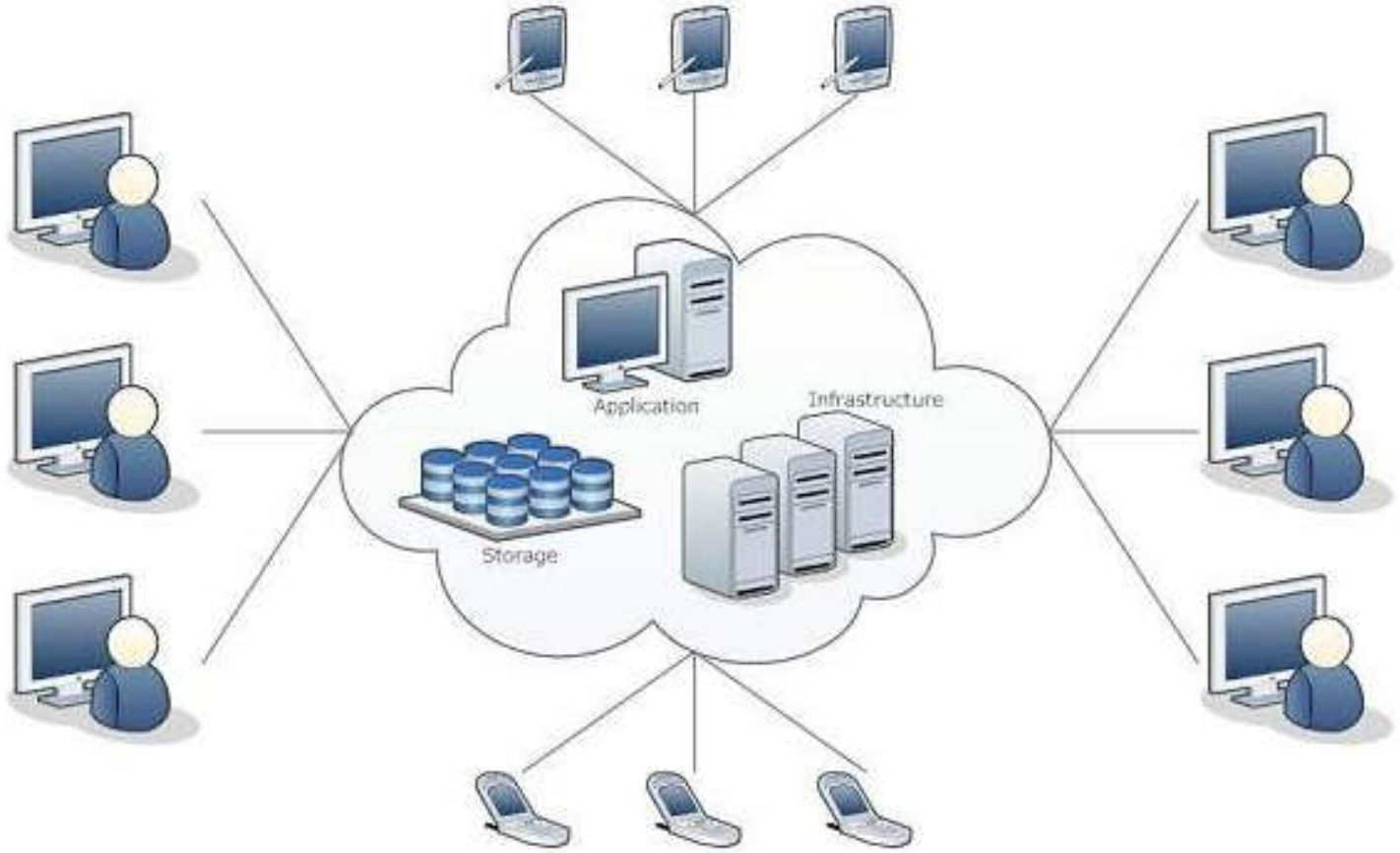
CLOUD COMPUTING

What is Cloud Computing?

- It is a general term used to describe a new class of network-based computing that takes place over the Internet.
  - *Basically a step on from Utility Computing*
  - *A collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform).*
  - *Using the Internet for communication and transport provides hardware, software and networking services to clients*
- Cloud computing is the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer."
- These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API (Applications Programming Interface).

CLOUD COMPUTING

- refers to **manipulating, configuring,** and **accessing** the hardware and software resources remotely.
  - *It offers online data storage, infrastructure, and application.*



Basic Concepts

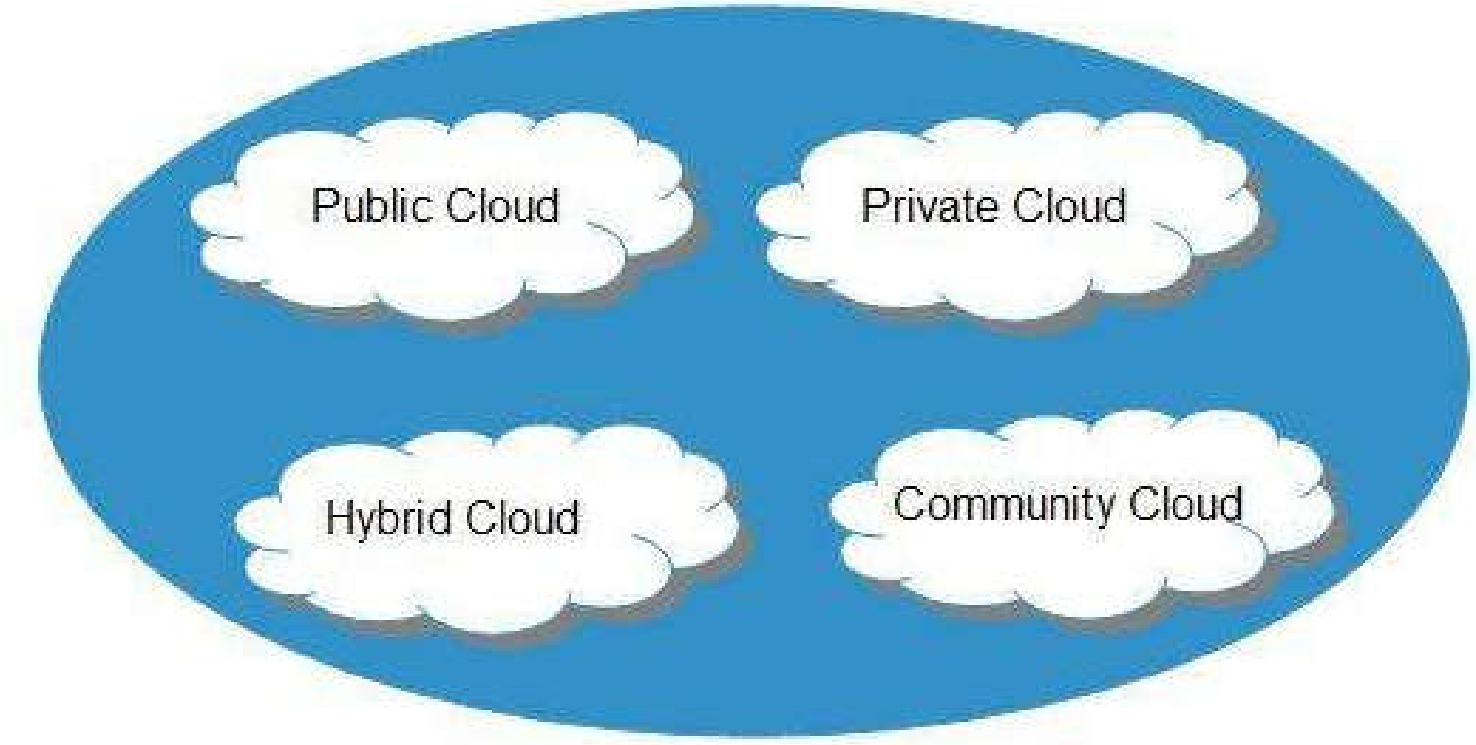
There are certain services and models working behind the scene making the cloud computing feasible and accessible to end users.

working models for cloud computing:

- Deployment Models
- Service Models

Deployment Models

- define the type of access to the cloud, i.e., how the cloud is located?
- Cloud can have any of the four types of access: Public, Private, Hybrid, and Community.



Deployment Models

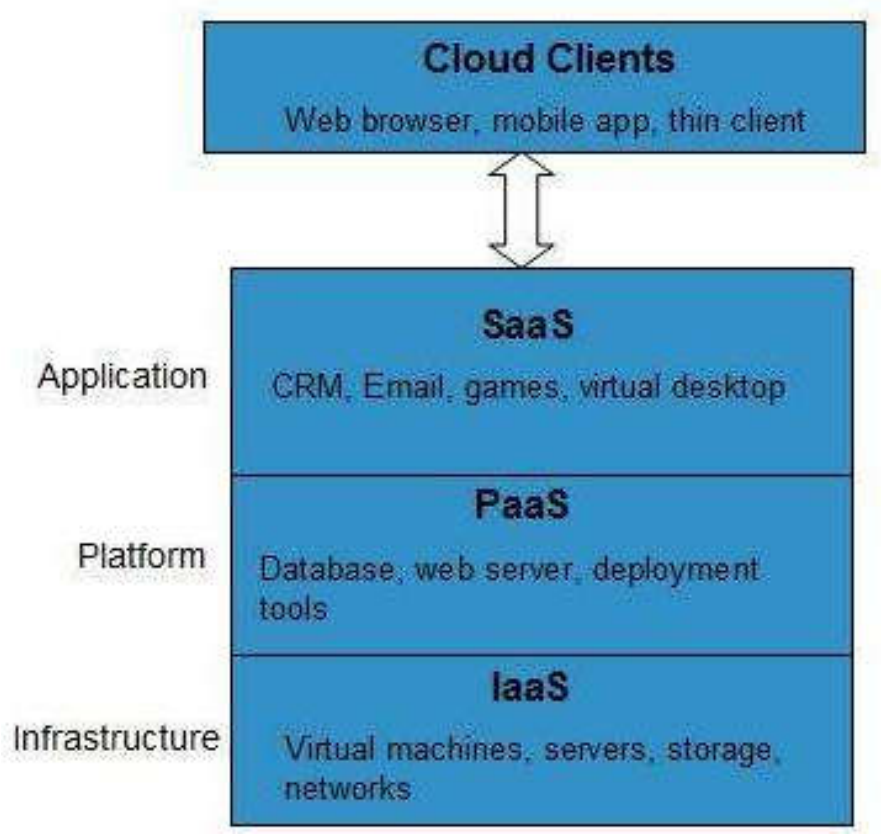
- The **public cloud** allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness.
- The **private cloud** allows systems and services to be accessible within an organization. It is more secured because of its private nature.
- The **community cloud** allows systems and services to be accessible by a group of organizations.
- The **hybrid cloud** is a mixture of public and private cloud, in which the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

Service Models

- Cloud computing is based on service models. These are categorized into three basic service models which are –
  - *Infrastructure-as–a-Service (IaaS)*
  - *Platform-as-a-Service (PaaS)*
  - *Software-as-a-Service (SaaS)*
- **Anything-as-a-Service (XaaS)** is yet another service model, which includes Network-as-a-Service, Business-as-a-Service, Identity-as-a-Service, Database-as-a-Service or Strategy-as-a-Service.

CLOUD SERVICES

- The **Infrastructure-as-a-Service (IaaS)** is the most basic level of service. Each of the service models inherit the security and management mechanism from the underlying model, as shown in the following diagram:.



CLOUD SERVICES

- Infrastructure-as-a-Service (IaaS)

  IaaS *provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc.*

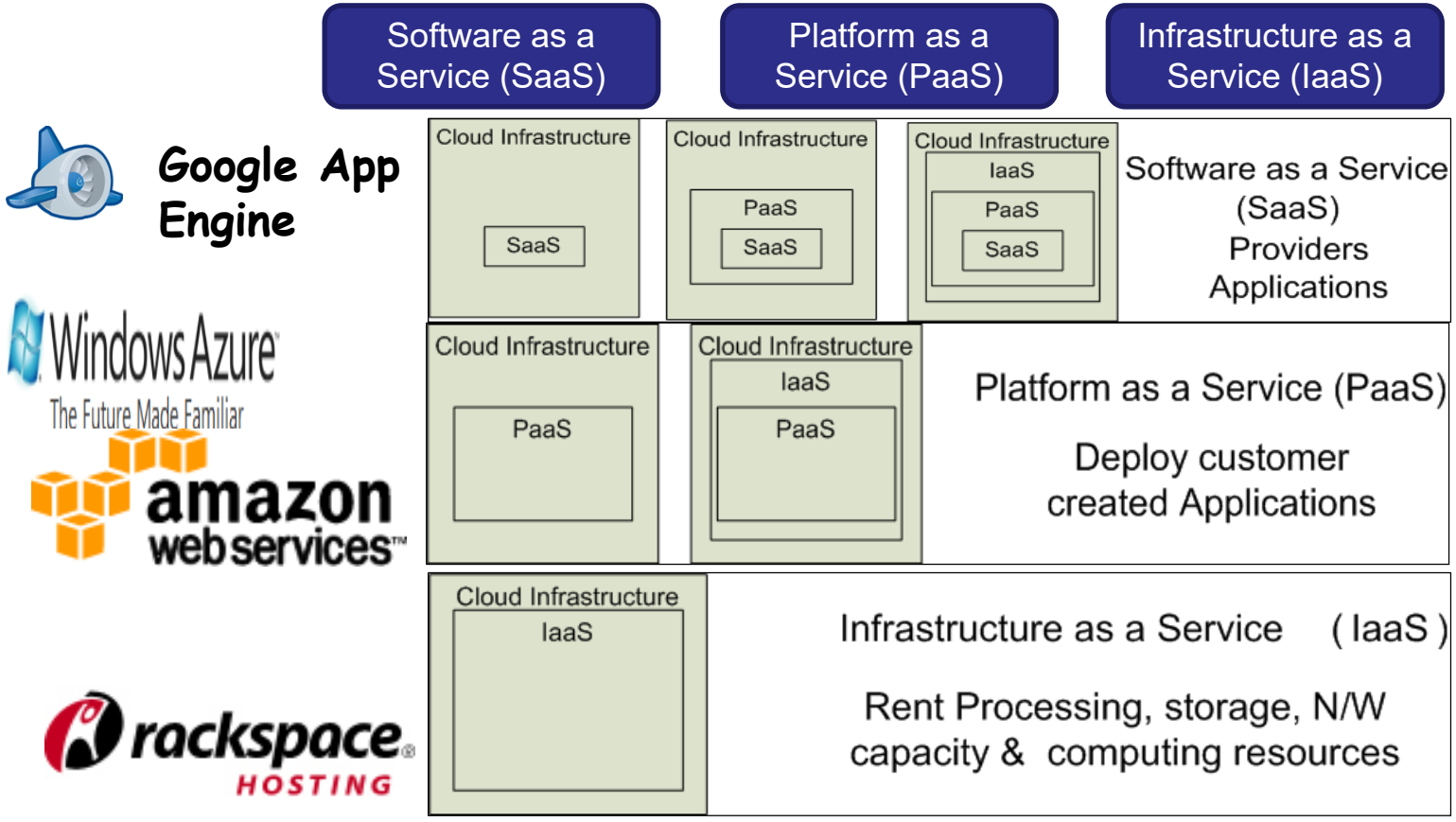
- Platform-as-a-Service (PaaS)

  PaaS *provides the runtime environment for applications, development and deployment tools, etc.*

- Software-as-a-Service (SaaS)

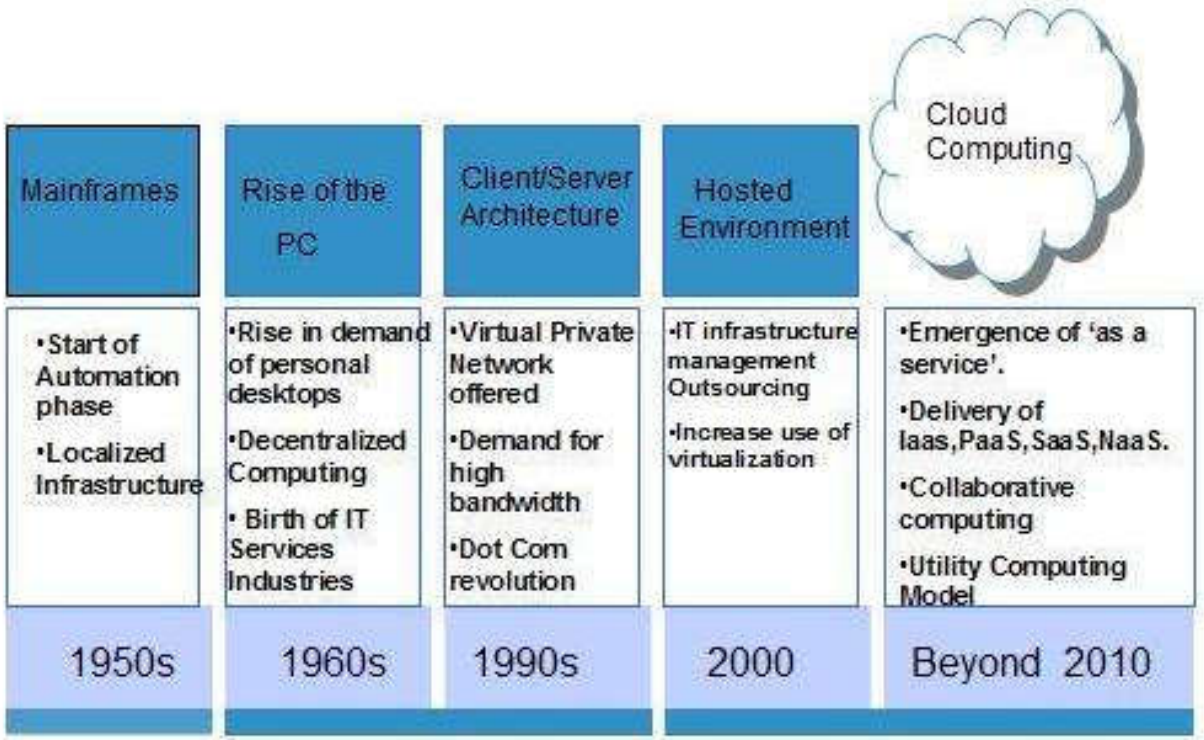
  SaaS *model allows to use software applications as a service to end-users.*

CLOUD SERVICE MODELS



History of Cloud Computing

- The concept of **Cloud Computing** came into existence in the year 1950 with implementation of mainframe computers, accessible via **thin/static clients.** Since then, cloud computing has been evolved from static clients to dynamic ones and from software to services. The following diagram explains the evolution of cloud computing:

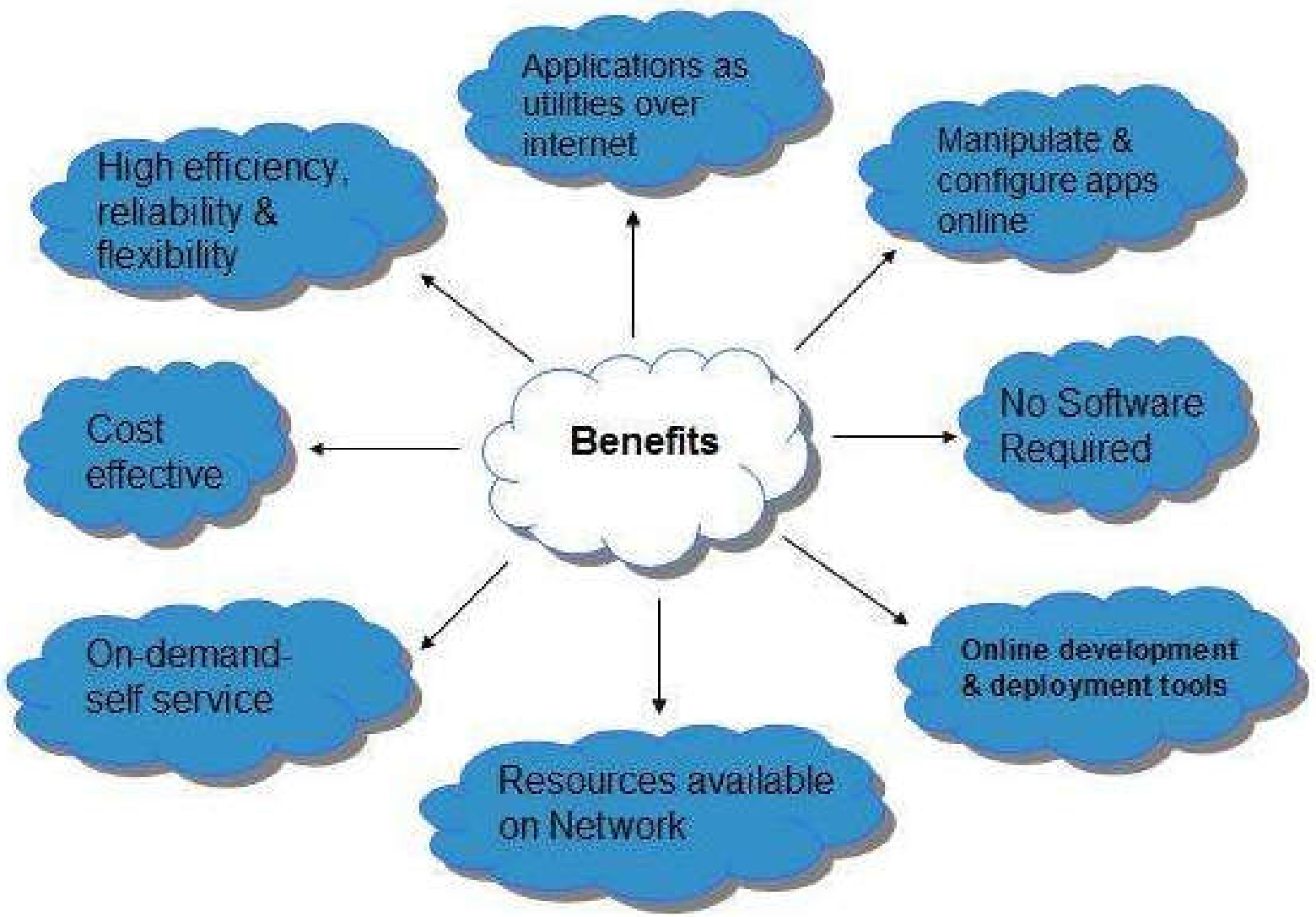


MERITS OF CLOUD COMPUTING

Cloud Computing has numerous advantages. Some of them are listed below -

- One can access applications as utilities, over the Internet.
- One can manipulate and configure the applications online at any time.
- It does not require to install a software to access or manipulate cloud application.
- Cloud Computing offers online development and deployment tools, programming runtime environment through **PaaS model.**
- Cloud resources are available over the network in a manner that provide platform independent access to any type of clients.
- Cloud Computing offers **on-demand self-service.** The resources can be used without interaction with cloud service provider.
- Cloud Computing is highly cost effective because it operates at high efficiency with optimum utilization. It just requires an Internet connection
- Cloud Computing offers load balancing that makes it more reliable.

MERITS OF CLOUD COMPUTING



MERITS OF CLOUD COMPUTING

- **Lower computer costs:**
  - *You do not need a high-powered and high-priced computer to run cloud computing's web-based applications.*
  - *Since applications run in the cloud, not on the desktop PC, your desktop PC does not need the processing power or hard disk space demanded by traditional desktop software.*
  - *When you are using web-based applications, your PC can be less expensive, with a smaller hard disk, less memory, more efficient processor...*
- **Improved performance:**
  - *With few large programs hogging your computer's memory, you will see better performance from your PC.*
  - *Computers in a cloud computing system boot and run faster because they have fewer programs and processes loaded into memory.*

MERITS OF CLOUD COMPUTING

- **Reduced software costs:**
  - *Instead of purchasing expensive software applications, you can get most of what you need for free*
    - Most cloud computing applications today, such as the Google Docs suite.
  - *Better than paying for similar commercial software*
    - which alone may be justification for switching to cloud applications.
- **Universal document 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*
  - *Documents are instantly available from wherever you are*

DEMERITS OF CLOUD COMPUTING

- **Requires a constant Internet connection:**
  - *Cloud computing is impossible if you cannot connect to the Internet.*
  - *Since you use the Internet to connect to both your applications and documents, if you do not have an Internet connection you cannot access anything, even your own documents.*
  - *A dead Internet connection means no work and in areas where Internet connections are few or inherently unreliable, this could be a deal-breaker.*
- **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.*
  - *Web-based applications require a lot of bandwidth to download, as do large documents*

DEMERITS OF CLOUD COMPUTING

- **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.*
    - For example, you can do a lot more with Microsoft PowerPoint than with Google Presentation's web-based offering
- **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.*
  - *Everything about the program, from the interface to the current document, has to be sent back and forth from your computer to the computers in the cloud.*
  - *If the cloud servers happen to be backed up at that moment, or if the Internet is having a slow day, you would not get the instantaneous access you might expect from desktop applications*

DEMERITS OF CLOUD COMPUTING

- **Security and Privacy**
  - *It is the biggest concern about cloud computing. Since data management and infrastructure management in cloud is provided by third-party, it is always a risk to handover the sensitive information to cloud service providers.*
  - *Although the cloud computing vendors ensure highly secured password protected accounts, any sign of security breach may result in loss of customers and businesses.*
- **Lock In**
  - *It is very difficult for the customers to switch from one **Cloud Service Provider (CSP)** to another. It results in dependency on a particular CSP for service.*
- **Isolation Failure**
  - *This risk involves the failure of isolation mechanism that separates storage, memory, and routing between the different tenants*

DEMERITS OF CLOUD COMPUTING

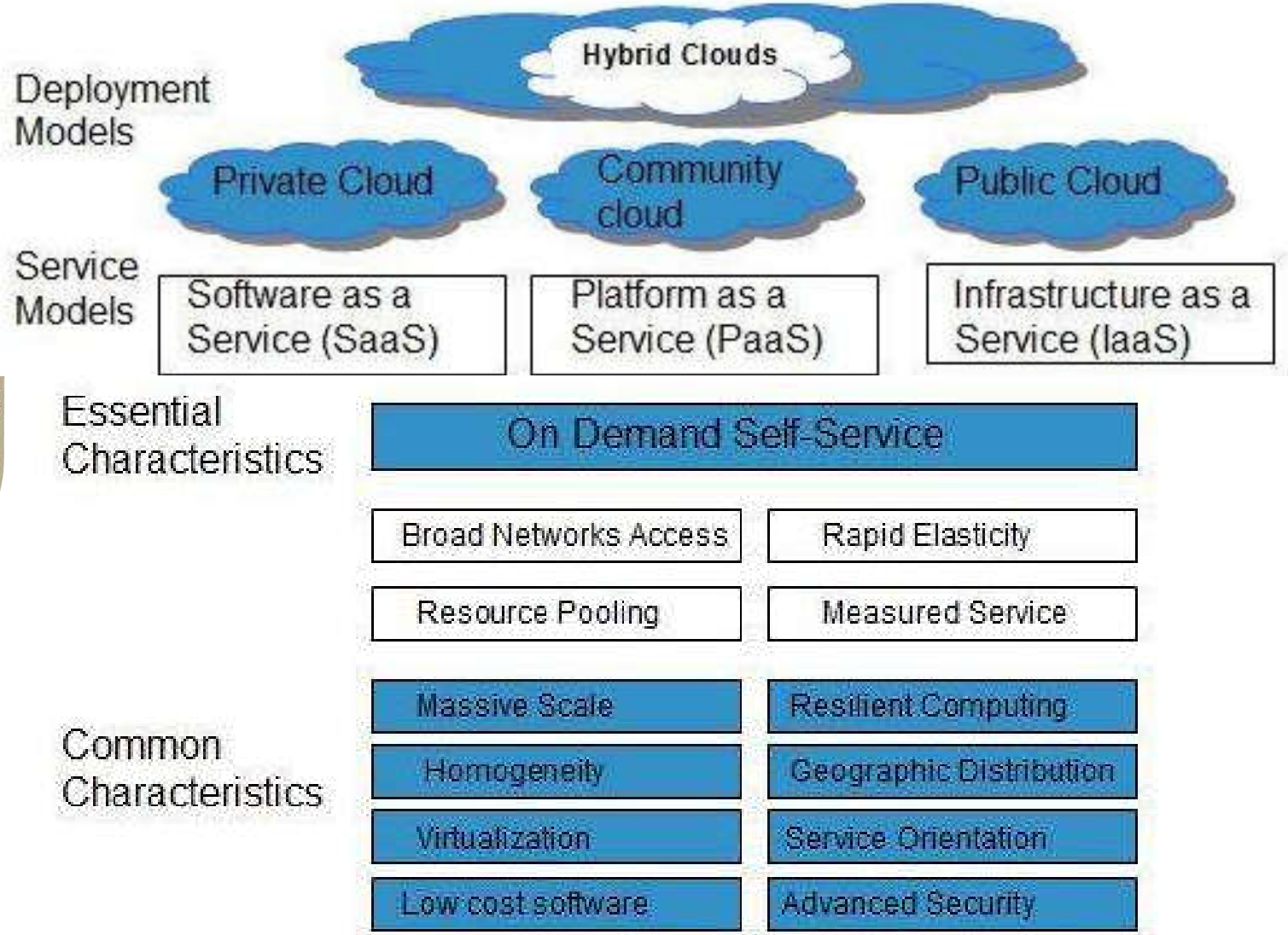
- **Management Interface Compromise**
  - *In case of public cloud provider, the customer management interfaces are accessible through the Internet.*
- **Insecure or Incomplete Data Deletion**

It is possible that the data requested for deletion may not get deleted. It happens because either of the following reasons

  - *Extra copies of data are stored but are not available at the time of deletion*
  - *Disk that stores data of multiple tenants is destroyed.*

Characteristics of Cloud Computing

There are four key characteristics of cloud computing.



Characteristics of Cloud Computing

- **On Demand Self Service**
  - *CC allows the users to use web services and resources on demand. One can logon to a website at any time and use them.*
- **Broad Network Access**
  - *Since cloud computing is completely web based, it can be accessed from anywhere and at any time.*
- **Resource Pooling**
  - *CC allows multiple tenants to share a pool of resources.*
  - *One can share single physical instance of hardware, database and basic infrastructure.*
- **Rapid Elasticity**
  - *It is very easy to scale the resources vertically or horizontally at any time.*
  - *Scaling of resources means the ability of resources to deal with increasing or decreasing demand.*
  - *The resources being used by customers at any given point of time are automatically monitored.*
- **Measured Service**
  - *In this service cloud provider controls and monitors all the aspects of cloud service. Resource optimization, billing, and capacity planning etc. depend on it.*

THE FUTURE

- Almost everything in the digital world is connected to the cloud in some way or another — unless it's specifically kept in local storage for security reasons.
- Many of the activities loosely grouped together under cloud computing have already been happening and centralised computing activity is not a new phenomena
- Grid Computing was the last research-led centralised approach
- However there are concerns that the mainstream adoption of cloud computing could cause many problems for users
- Many new open source systems appearing that you can install and run on your local cluster
  - *Should be able to run a variety of applications on these systems.*

THE FUTURE by IT Gaints

- “The future of cloud computing will most likely represent a combination of cloud based software products and on premises compute to create a hybrid IT solution that balances the scalability and flexibility associated with cloud and the security and control of a private data center.
  - *By Michael Corrado, World Wide Marketing Manager with HP Ent.*
- A decade from now, every business will be operating primarily from the cloud, making way for more flexible — yet more productive and efficient — ways of working. Hardware won’t be the problem in a decade — software will.
  - *Matt Riley, CEO & Co-founder of Swiftype*
- “The future of the cloud is a radically different hybrid cloud computing model in which isolated workloads can flex up or down, span multiple public clouds, be moved at any time, and be managed with a single set of controls.
  - *Tom Gillis, Founder & CEO of Bracket Computing*

THE FUTURE

- **The software will be separated from the hardware**
  - *Even today, cloud applications are often used to automate business using CRM, ERP, PSA and HR systems stored on remote servers. All these tendencies are growing every year. So, in the future the software that we'll use will be somewhere "far beyond the horizon", and information from it will pass through several filters before starting to interact with the user's computer.*
- **Low-power processors will stimulate the decline in prices for services of cloud providers**
  - *Today low-power chips are available on the market. They allow to use processors with low power consumption for data processing.*
- **Data security will continue to be superior**
  - *Due to constantly increasing security requirements, physical access to the data center will also be severely limited, and to enter the protected premises you will need not only an electronic key, but also a procedure for biometric scanning.*

THE FUTURE

- **Clouds will make people richer**
  - *Over time, the software is becoming more standardized: leading companies are working on the compatibility of web applications. To open a PDF file, you do not need to install Acrobat, and Word 2013 is able to work with files of dozens of different types. This will allow companies to interact with each other easily. After all, cloud computing will lead to changes in the production cycle. All this will force manufacturers to produce better products at a lower price.*