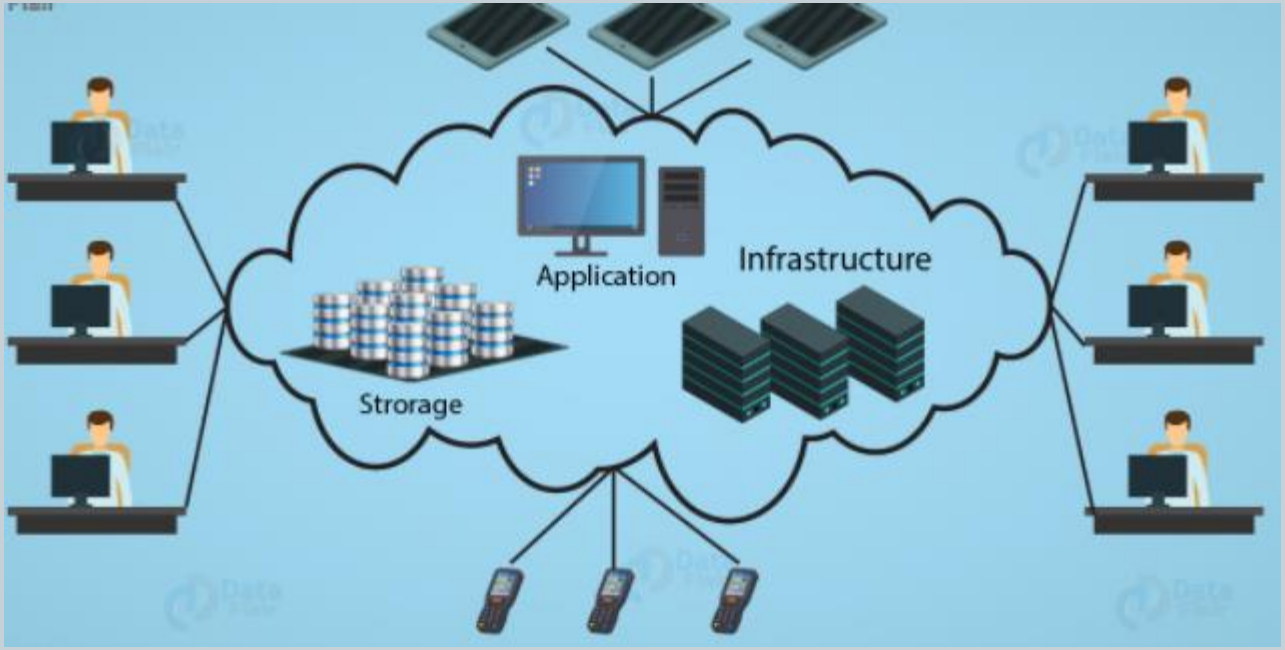
Basics of Cloud Computing

Cloud computing

Storing and accessing the data and programs over the internet rather than the computer's hard disk.



History of Cloud computing

- Client/server computing
- Centralized storage
- In which all the data, software applications and all the controls reside on the server side.
- Then in 1961, John McCarthy delivered a speech at MIT in which he suggested that computing can be sold like a utility like electricity and food.
- The idea was great but it was much ahead of its time and despite having an interest in the model, the technology at that time was not ready for it.

History of Cloud computing

- In 1999, Salesforce.com became the 1st company to enter the cloud arena, excelling the concept of providing enterprise-level applications to end users through the Internet.
- Then in 2002, **Amazon** came up with Amazon Web Services, providing services like computation, storage, and even human intelligence.
- *In 2009,* **Google Apps** and **Microsoft's Windows Azure** also started to provide cloud computing enterprise applications.
- Other companies like HP and Oracle also joined the stream of cloud computing, for fulfilling the need for greater data storage.

Cloud computing

- Definition of cloud computing has been developed by the U.S. National Institute of Standards and Technology (NIST):
- *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.*
- *This cloud model promotes availability and is composed of*
  - *five essential characteristics,*
  - *three service models, and*
  - *four deployment models.*

Essential Characteristics of the Cloud

On-demand self-service

- resources (e.g., server time, network storage) are automatically provided to a customer when required

Broad network access

- capabilities are available worldwide over standard network mechanisms

Resource pooling

- resources are provided/assigned dynamically in a multi-tenant way

Rapid elasticity

- underlying infrastructure is able to adapt to changing requirements
  - (e.g., number of concurrent users)
- → allows for dynamic up-/down-scaling

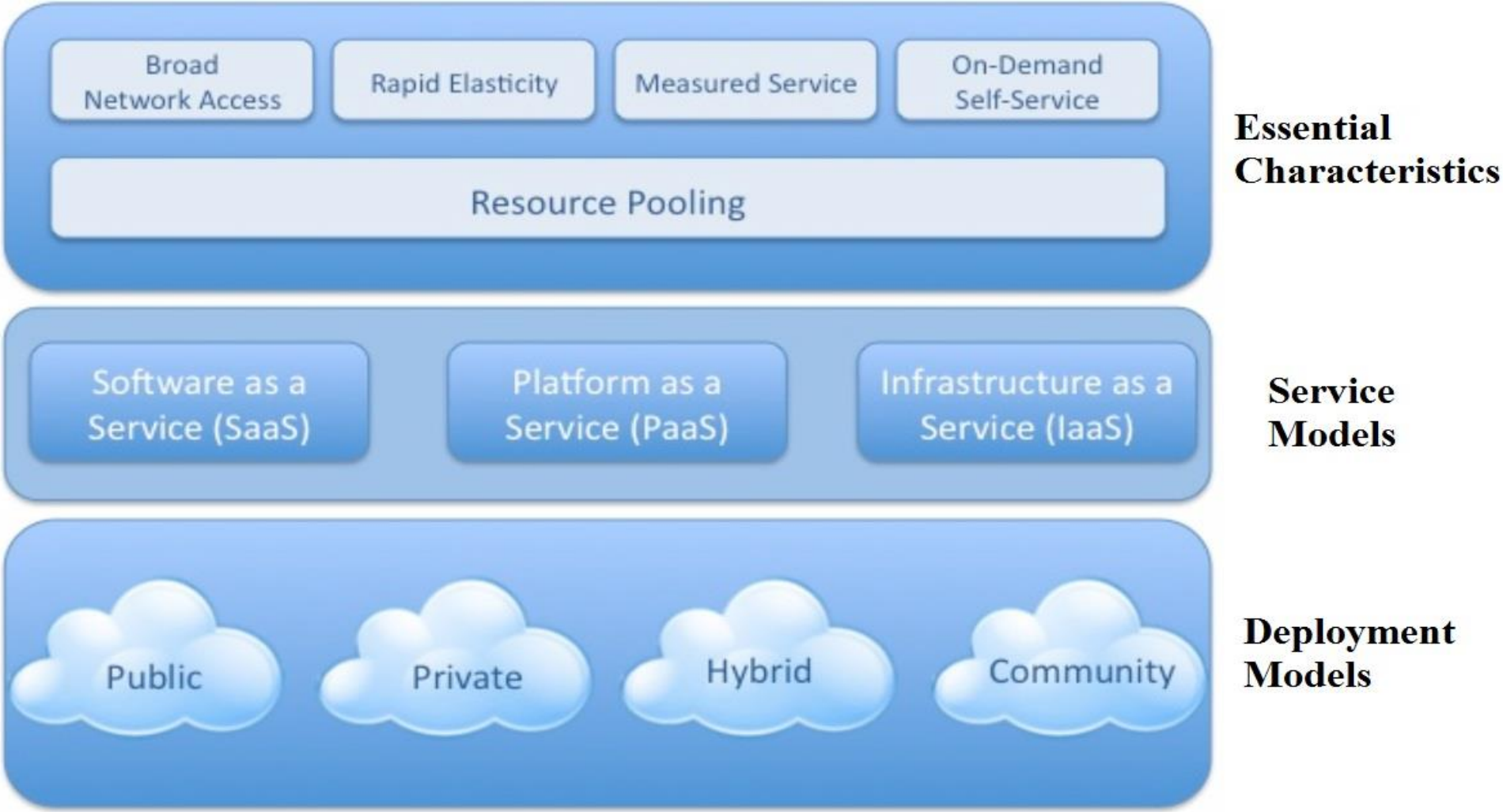
Measured Service

- metering of resource and service consumption to provide elastic pricing and billing models
- e.g., pay-per-use

Components of Cloud Computing

- Cloud computing is a virtualized pool of infrastructure resources with applications and services that can be used directly through self-service portal. For end user, cloud computing consists of:
  - Client
    - Mobile Clients
    - Thin Clients
    - Thick Clients
  - Cloud Network
    - Connecting link between the users and the cloud services-Internet
    - Encryption, Compression are the advanced services that can be employed during transit .
  - Cloud Application Programming Interfaces
    - A set of programming instructions and tools that provide abstractions over a specific provider cloud.
    - For instance, a unique provider call, for enhancing the amount of control over the cloud implementation.

Architecture



NIST Visual Model of Cloud Computing Definition

Cloud Types

- Most people separate cloud computing into two distinct sets of models:
- **Deployment models:** This refers to the location and management of the cloud's infrastructure.
- **Service models:** This consists of the particular types of services that you can access on a cloud computing platform. This is a very useful demarcation that is now widely accepted.

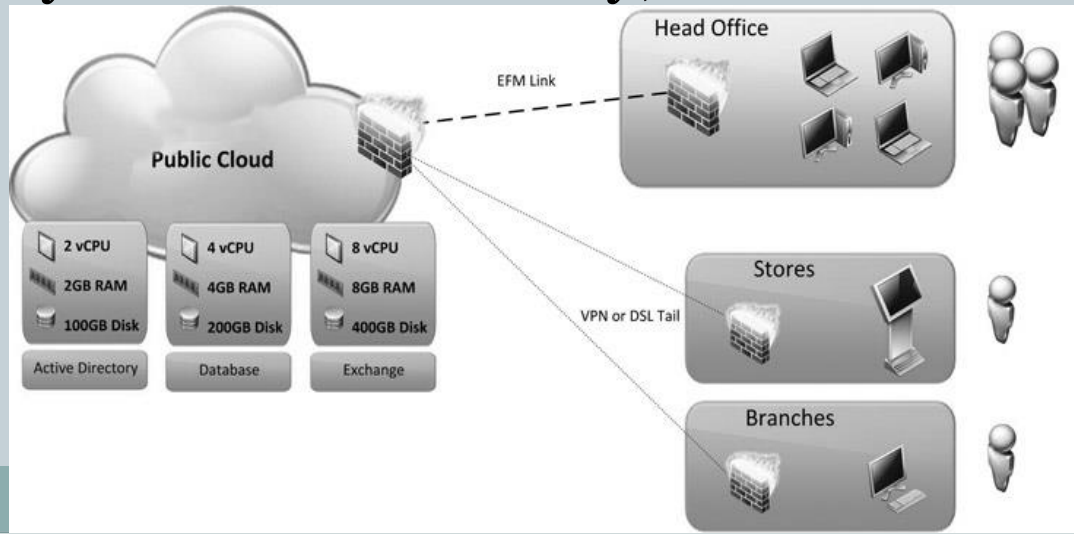
Deployment Models in Cloud

- 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,
  - Community.

Public Cloud

- 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, e.g., e-mail.
- Public clouds are owned and operated by third parties
- deliver superior economies of scale to customers
- Pay-as-you-go
- Public cloud may be larger than an enterprises cloud, thus providing the ability to scale seamlessly, on demand.

- Examples of Public Cloud:
  - Google App Engine
  - IBM Smart Cloud
  - Amazon EC2



Private Cloud

- Accessible within an organization. It offers increased security because of its private nature.
- Private clouds are built exclusively for a single enterprise.
- They aim to address concerns on data security and offer greater control, which is typically lacking in a public cloud.
- There are two variations to a private cloud:
  - On-premise Private Cloud
  - Externally hosted Private Cloud

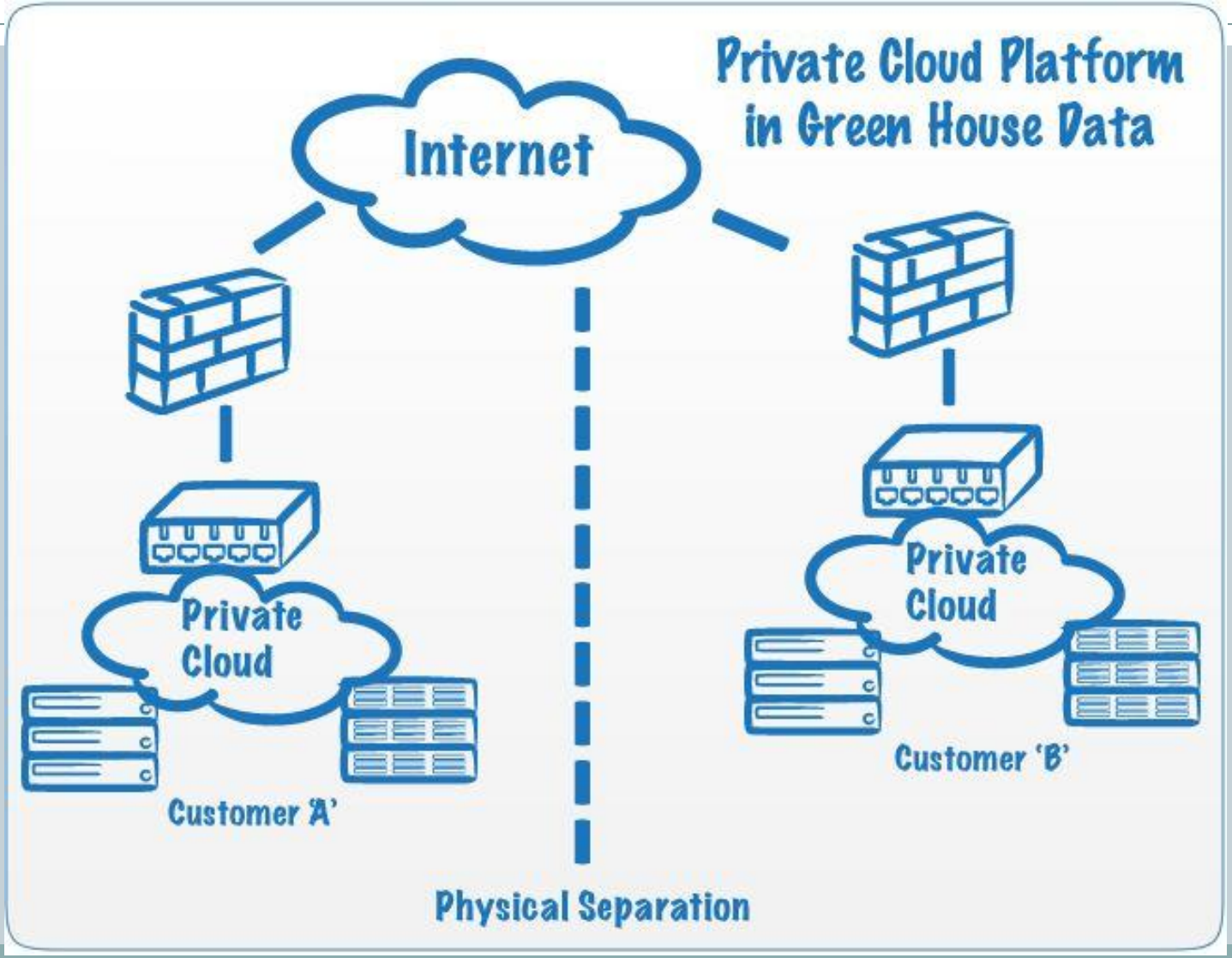
Private Cloud

- On-premise Private Cloud:
  - On-premise private clouds, also known as internal clouds are hosted within one's own data center. This model provides a more standardized process and protection, but is limited in aspects of size and scalability. *IT departments would also need to incur the capital and operational costs for the physical resources.*
  - This is best suited for applications which require complete control and configurability of the infrastructure and security.
- Externally hosted Private Cloud:
  - This type of private cloud is hosted externally with a cloud provider, where the provider facilitates an exclusive cloud environment with full guarantee of privacy.
  - This is best suited for enterprises that don't prefer a public cloud due to sharing of physical resources.

Private Cloud

- Examples of Private Cloud:
  - Eucalyptus
  - Ubuntu Enterprise Cloud - UEC (powered by Eucalyptus)
  - Amazon VPC (Virtual Private Cloud)
  - VMware Cloud Infrastructure Suite
  - Microsoft ECI data center.

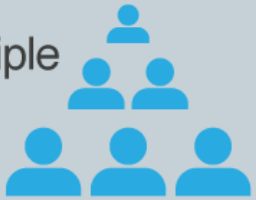
Private Cloud



VS

Publically Shared
Virtualised Resources

Supports multiple
customers



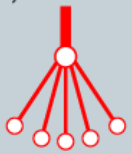
Supports connectivity
over the internet

Suited for less
confidential information

Privately Shared
Virtualised Resources

Cluster of dedicated
customers

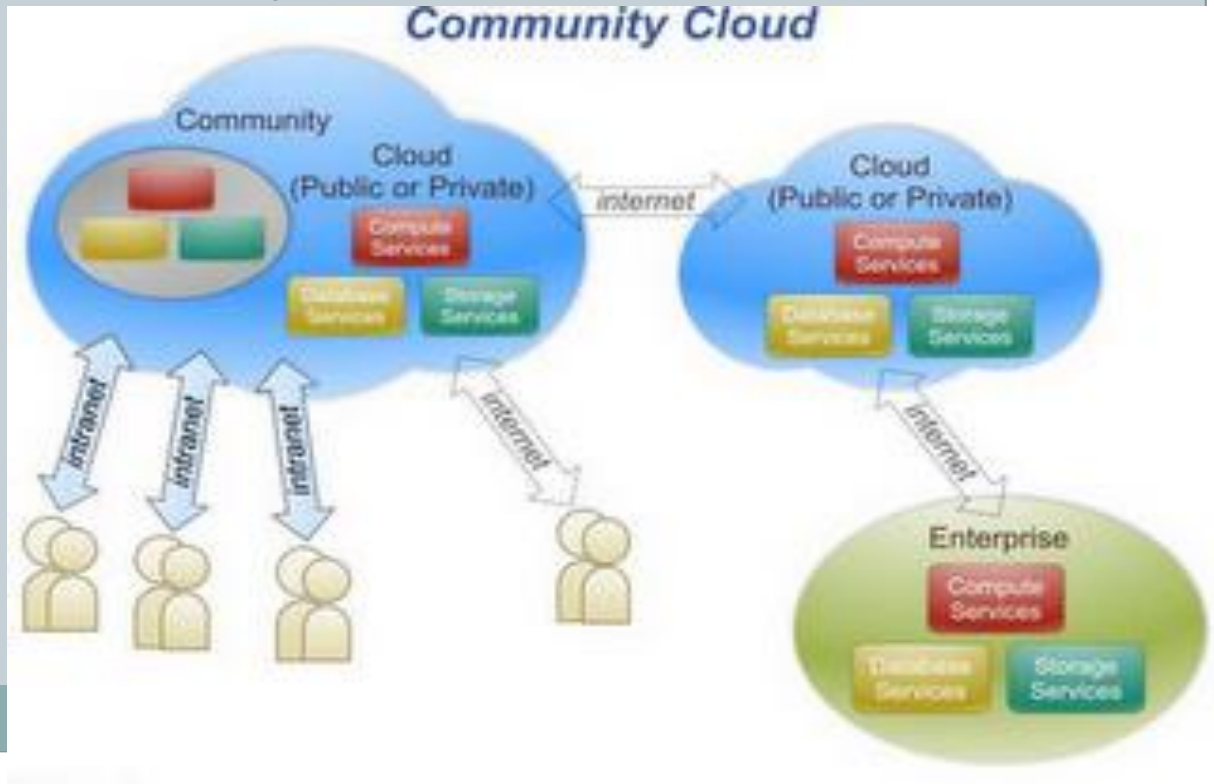
Connectivity over
internet, fibre and private network



Suited for secured
confidential information
& core systems

Community cloud

- The Community Cloud allows systems and services to be accessible by group of organizations.
- Examples of Community Cloud:
  - Google Apps for Government
  - Microsoft Government Community Cloud

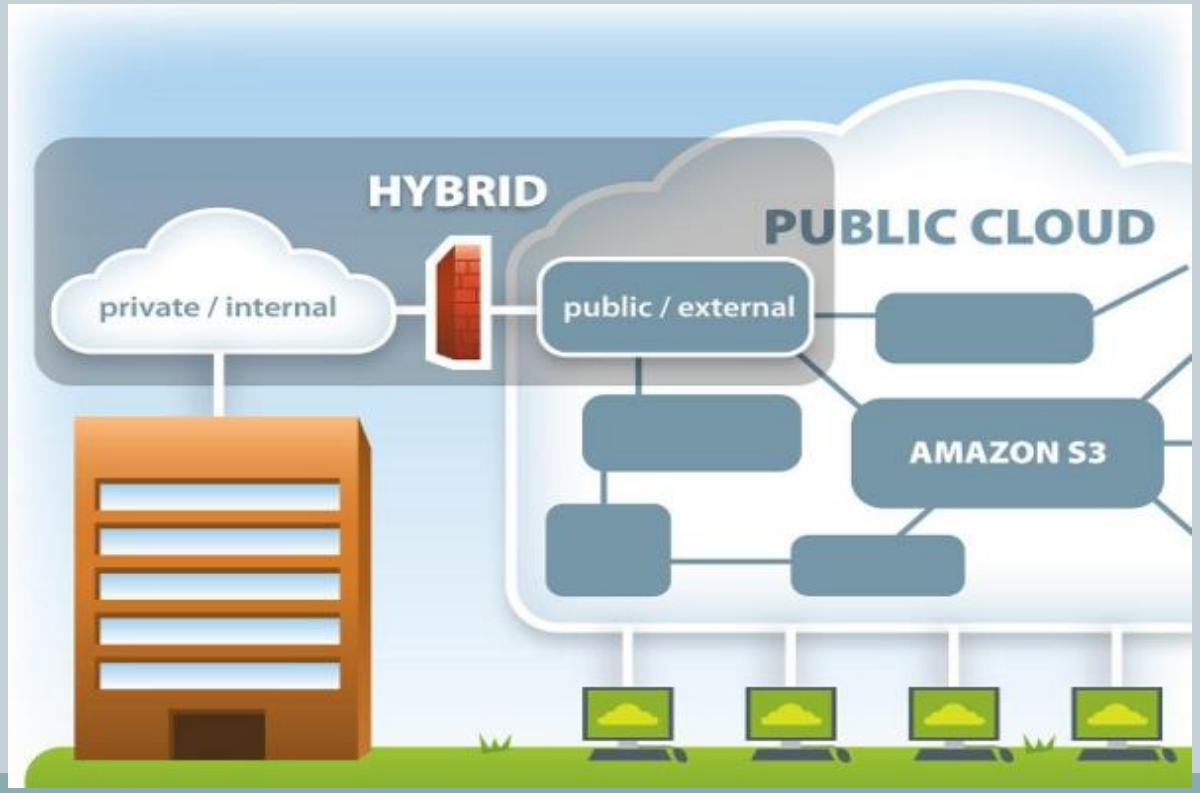


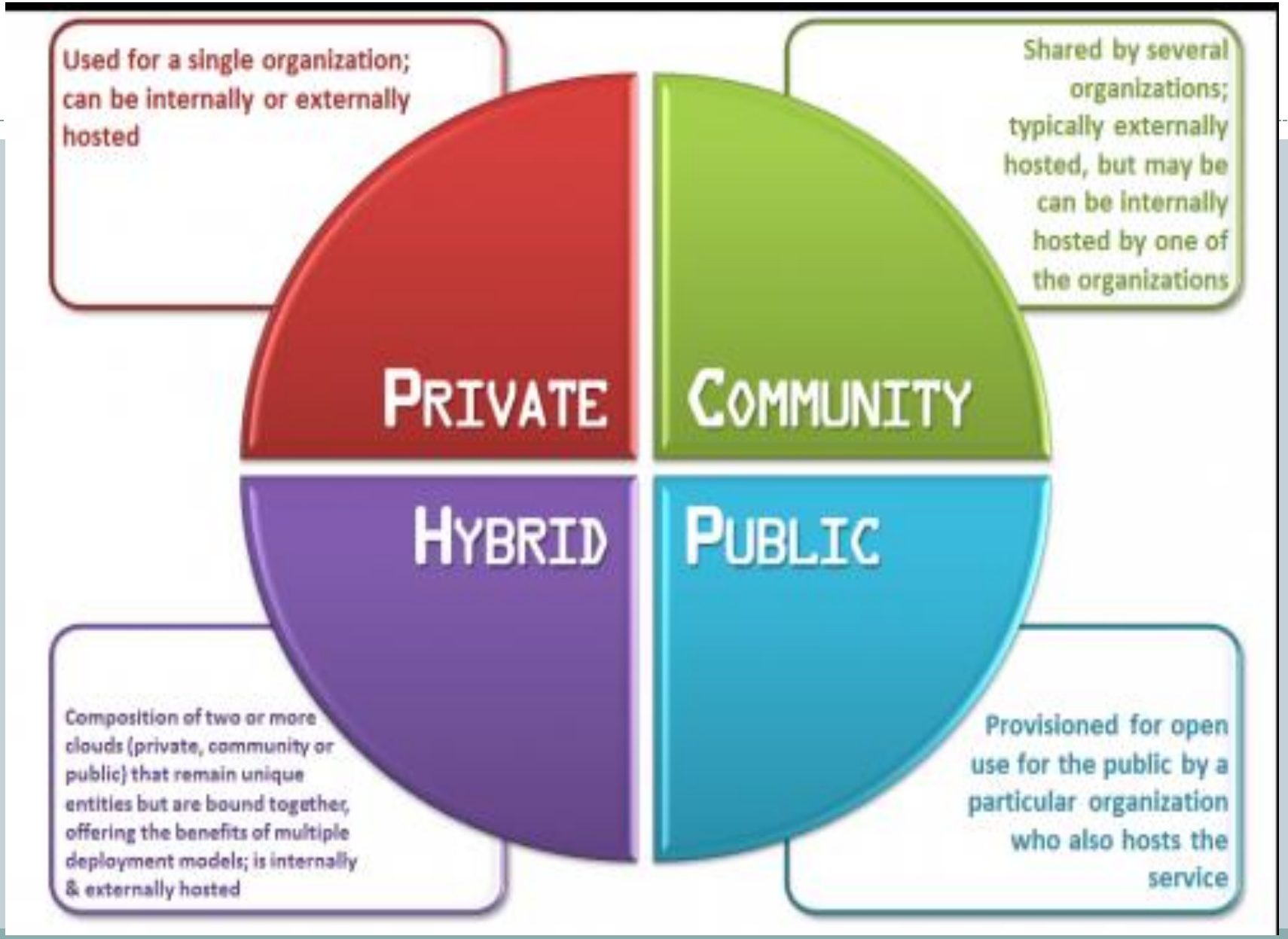
Hybrid Cloud

- The Hybrid Cloud is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.
  - With a Hybrid Cloud, service providers can utilize 3rd party Cloud Providers in a full or partial manner thus increasing the flexibility of computing.
  - The Hybrid cloud environment is capable of providing on-demand, externally provisioned scale. The ability to augment a private cloud with the resources of a public cloud can be used to manage any unexpected flows in workload.

Hybrid Cloud

- Example of Hybrid Cloud:
  - VMware vCloud (Hybrid Cloud Services)



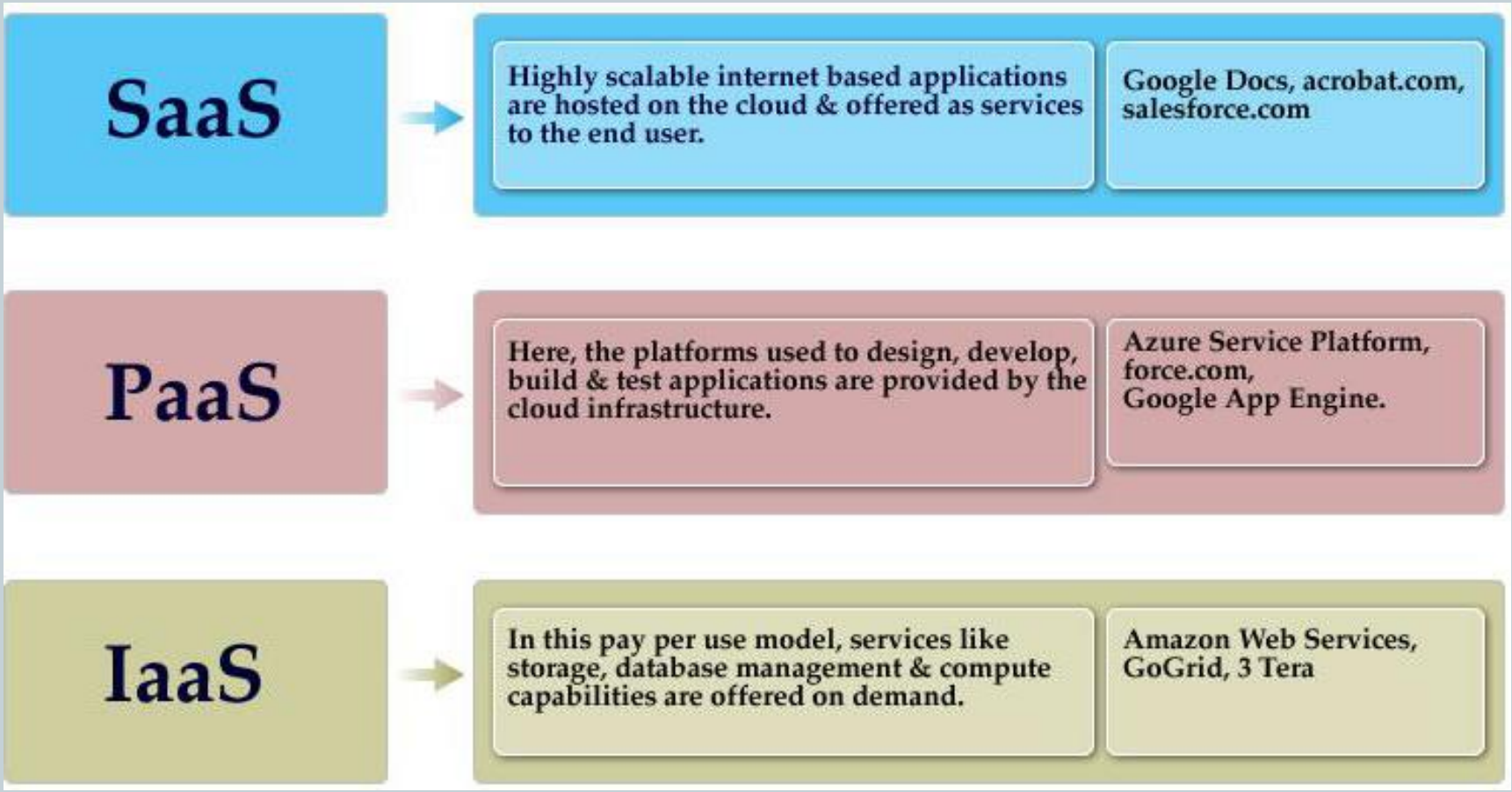

Used for a single organization; can be internally or externally hosted
Shared by several organizations; typically externally hosted, but may be can be internally hosted by one of the organizations
PRIVATE
COMMUNITY
HYBRID
PUBLIC
Composition of two or more clouds (private, community or public) that remain unique entities but are bound together, offering the benefits of multiple deployment models; is internally & externally hosted
Provisioned for open use for the public by a particular organization who also hosts the service

Cloud Computing Service Delivery Models

- Service Models are the reference models on which the Cloud Computing is based. These can be categorized into three basic service models as listed below:
- Software as a Service (SaaS):
  - In this model, a complete application is offered to the customer, as a service on demand.
  - A single instance of the service runs on the cloud & multiple end users are serviced.
  - On the customer's side, there is no need for upfront investment in servers or software licenses, while for the provider, the costs are lowered, since only a single application needs to be hosted & maintained.
  - Today SaaS is offered by companies such as Google, Salesforce, Zoho, etc.

Cloud Computing Service Delivery Models

- Platform as a Service (PaaS):
  - A layer of software, or development environment is encapsulated & offered as a service, upon which other higher levels of service can be built.
  - The customer has the freedom to build his own applications, which run on the provider's infrastructure.
  - To meet manageability and scalability requirements of the applications, PaaS providers offer a predefined combination of OS and application servers, such as LAMP platform (Linux, Apache, MySql and PHP), restricted J2EE,Ruby etc.
  - Google's App Engine, Force.com, etc. are some of the popular PaaS examples.
- Infrastructure as a Service (IaaS):
  - Physically, the pool of hardware resource is pulled from a multitude of servers and networks usually distributed across numerous data centers, all of which the cloud provider is responsible for maintaining.
  - IaaS provides a layer of virtualized hardware that delivers the computing power and data centers required for applications to run.
  - Amazon Elastic Cloud Compute (Amazon EC2), Rackspace Cloud Servers, GoGrid, Joyent, and AppNexus


SaaS
Highly scalable internet based applications are hosted on the cloud & offered as services to the end user.
Google Docs, acrobat.com, salesforce.com
PaaS
Here, the platforms used to design, develop, build & test applications are provided by the cloud infrastructure.
Azure Service Platform, force.com, Google App Engine.
IaaS
In this pay per use model, services like storage, database management & compute capabilities are offered on demand.
Amazon Web Services, GoGrid, 3 Tera

Important questions

- What is cloud computing? Explain essential characteristics and components of cloud computing.
- Explain different deployment models of cloud computing.
- Explain architecture of cloud computing.
- Explain the difference between public and private cloud.
- Explain different cloud computing service delivery models.
- Explain the situations where public cloud can not be used.
- Explain following terms in detail:
  - Software as a Service (SaaS)
  - Platform as a Service (PaaS)
  - Infrastructure as a Service (IaaS)