Principle of Cloud Computing

Chapter 1:
Cloud Computing fundamentals

Principle of Cloud Computing

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Chapter 1:
Cloud Computing fundamentals
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Outline

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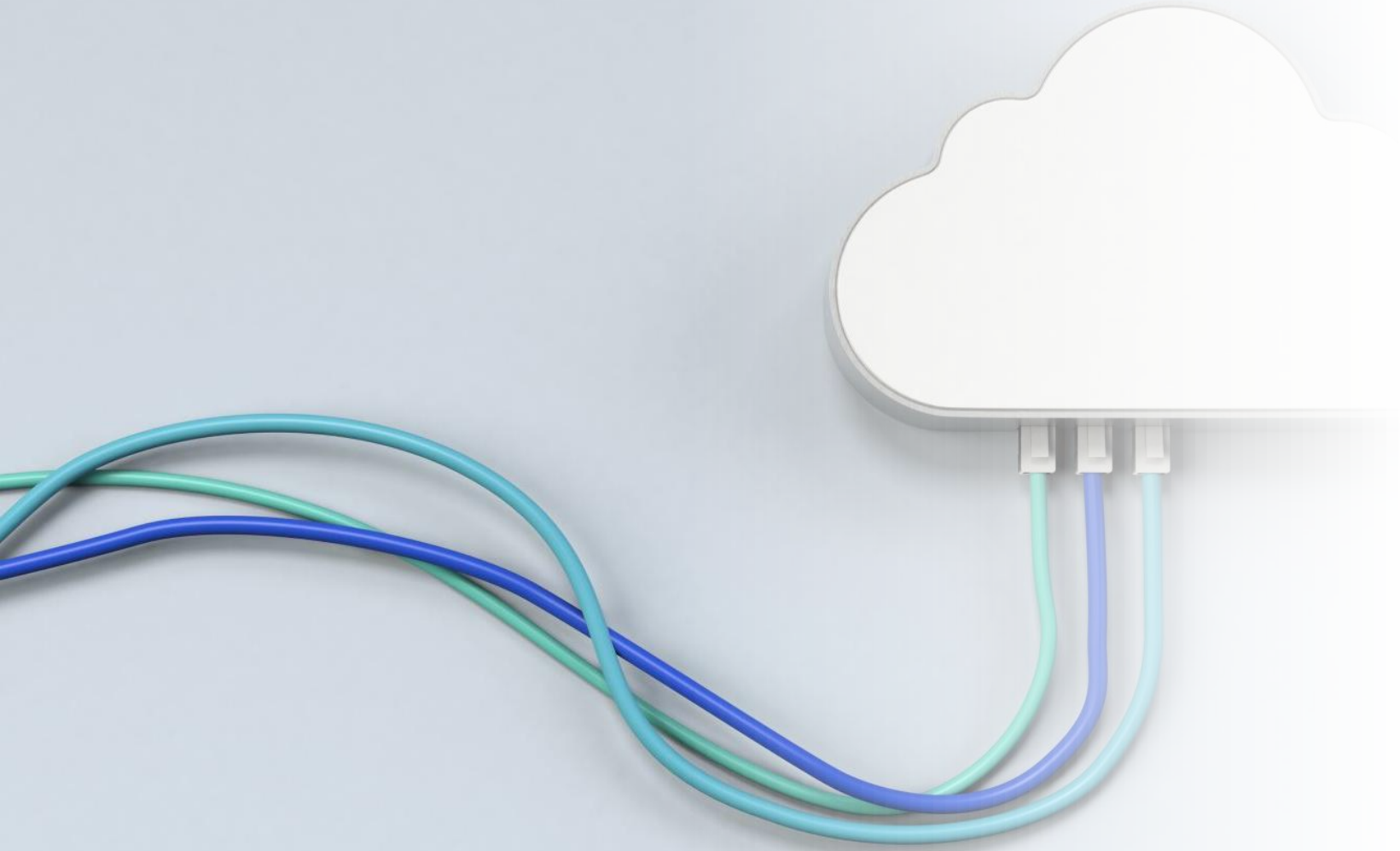
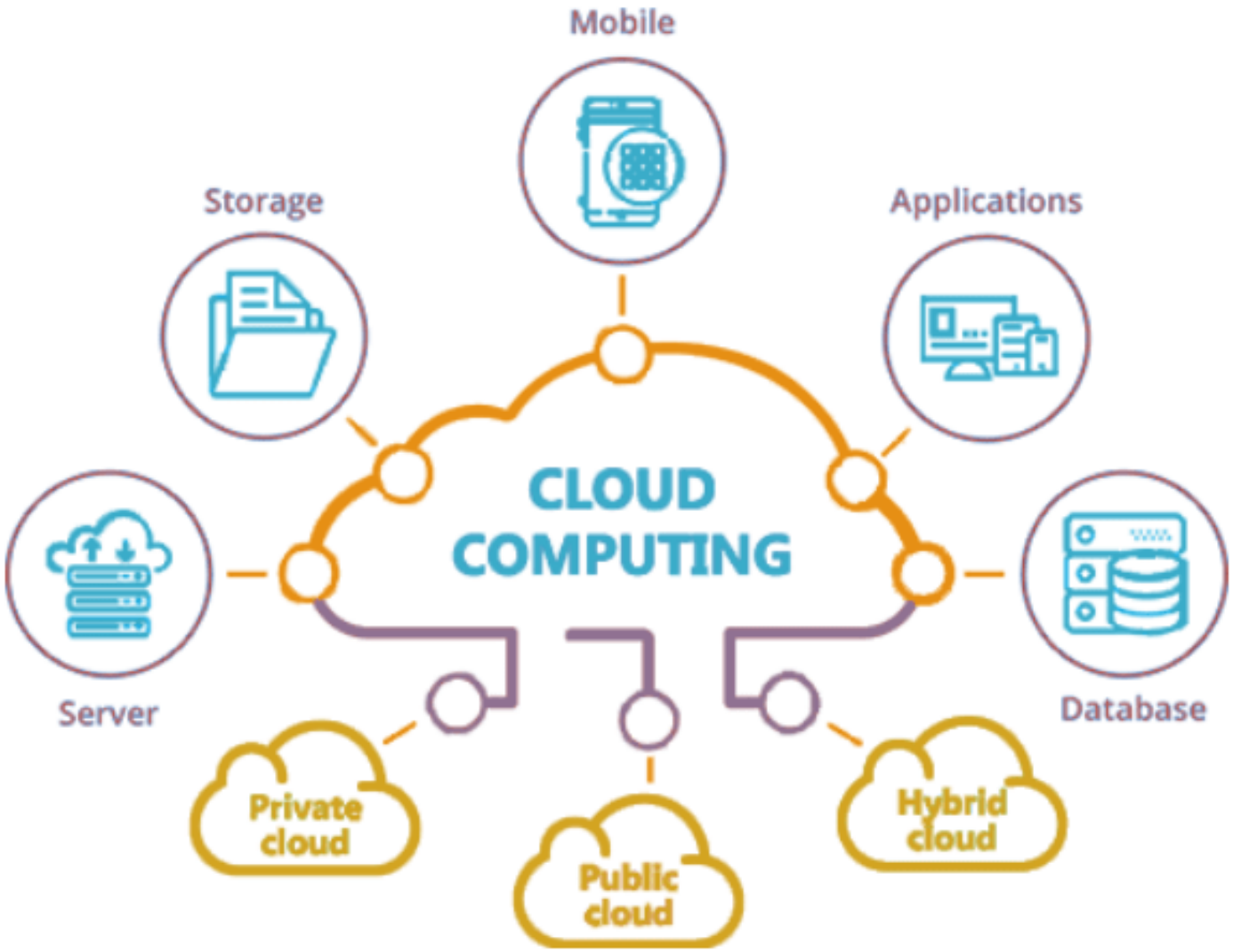


What is the definition of Cloud Computing ?

Give us your opinion

What is The Cloud Computing?



What is Cloud Computing?

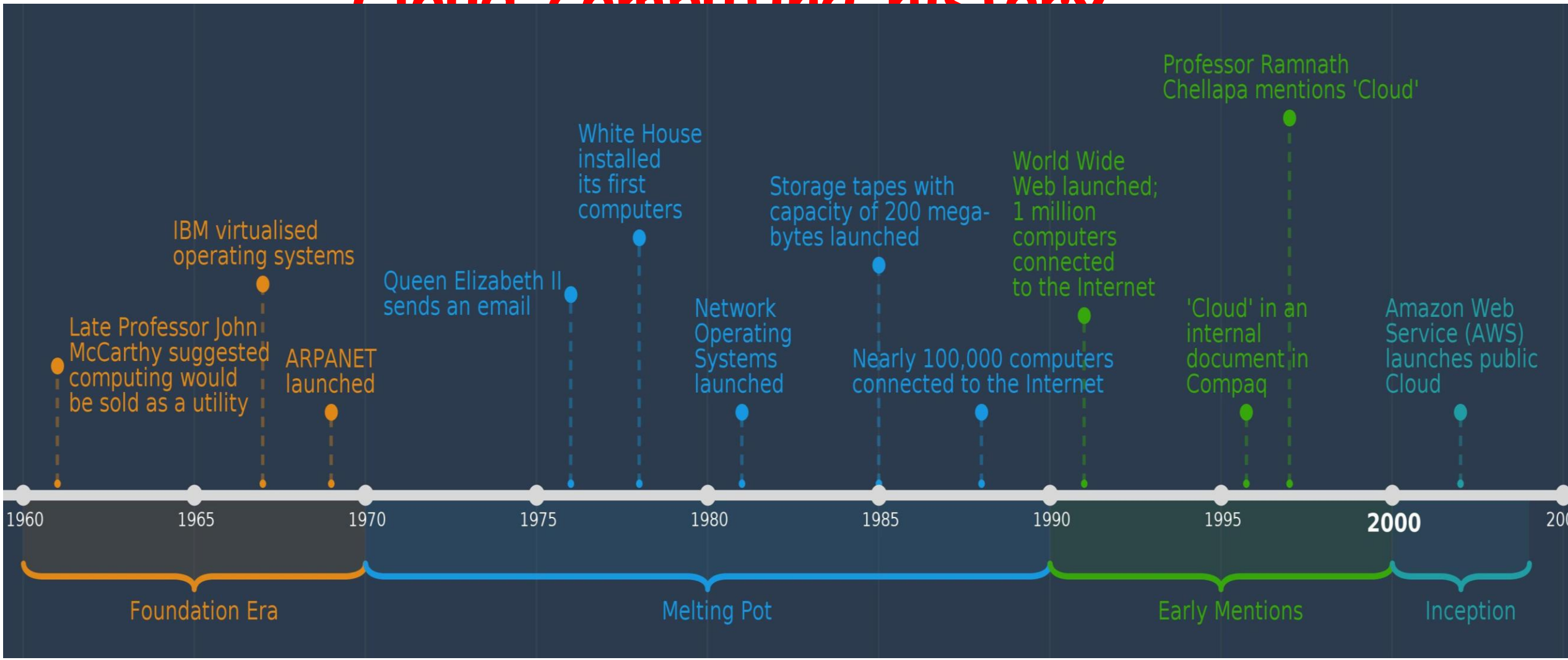
What is Cloud Computing

- **Cloud Computing** is a general term used to describe a new class of network-based computing that takes place over the Internet, It is a technology that uses remote servers on the internet to store, manage, and access data online rather than local drives. The data can be anything such as files, images, documents, audio, video, and more.
- Or Cloud computing is using internet-connected remote computers to store, manage, and access your data and run programs, instead of using your own device. These remote computers (called "servers") can handle many types of data including files, images, documents, audio, and video.

Cloud computing history

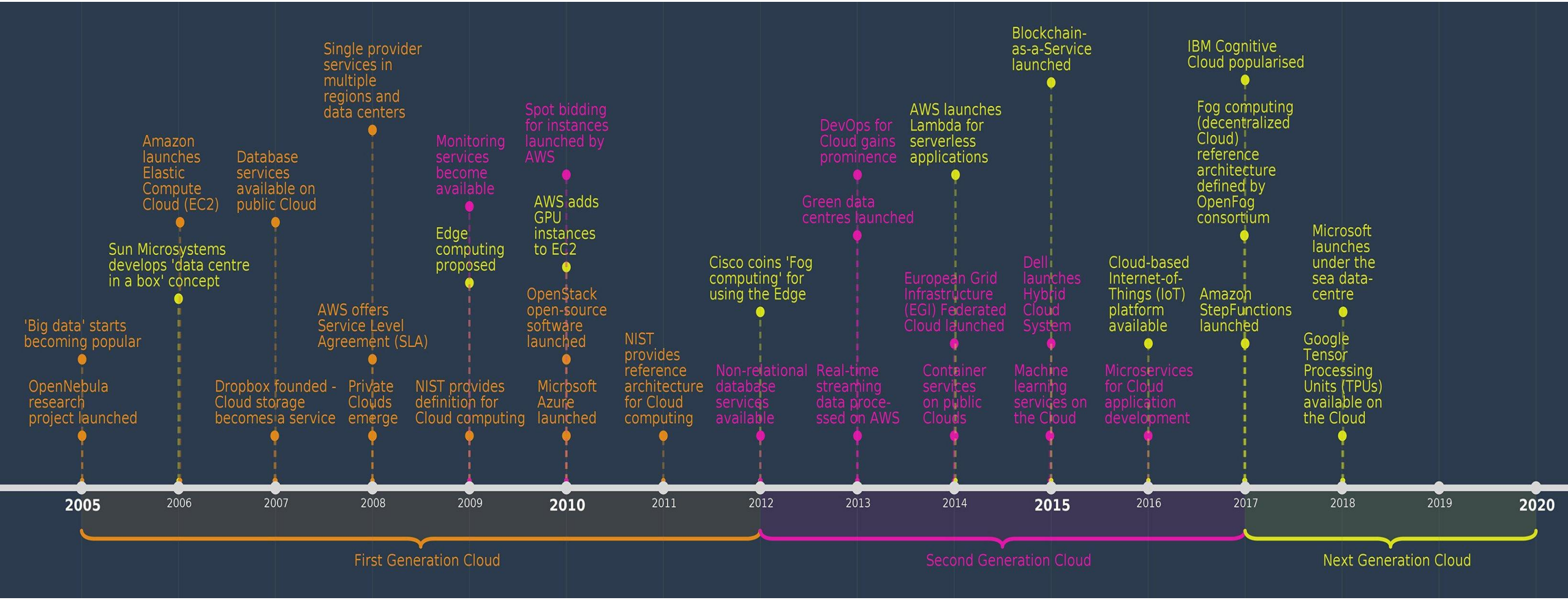
The cloud has become essential to our digital lives today, but this wasn't always the case. Just a decade ago, the vast array of cloud services we now take for granted simply didn't exist. Today, nearly everything we do online connects to cloud technology - from downloading apps to storing our photos and videos. When cloud services are unavailable, our frustration reveals just how dependent we've become on this technology. But how did cloud computing evolve from a novel concept to the backbone of our digital world? Let's explore the journey of how cloud technology developed into the critical infrastructure we rely on daily.

Cloud computing history



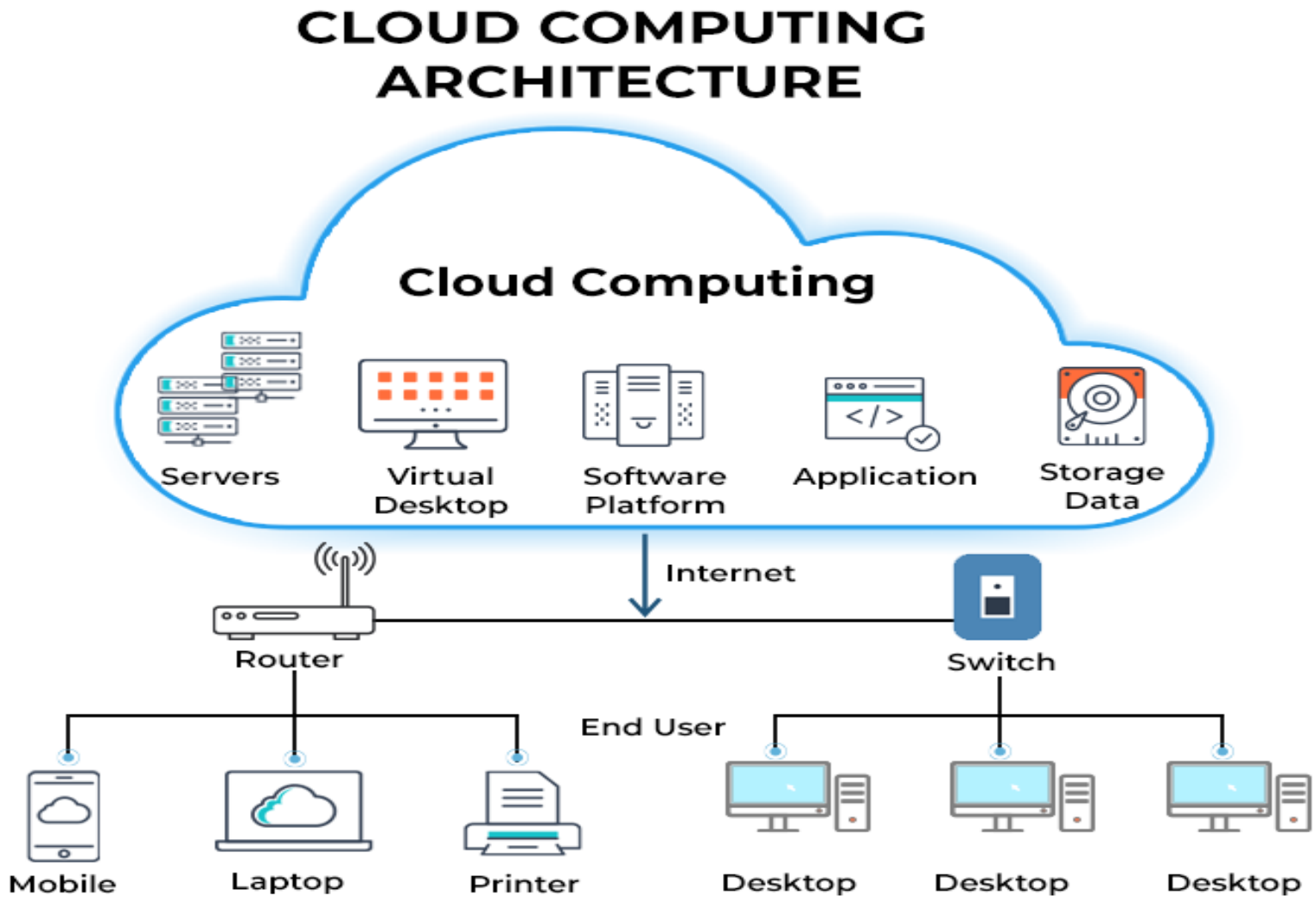
Cloud timeline 1960-2005

Cloud computing history



Cloud timeline 2005-2022

Cloud computing architecture



Cloud computing architecture

Cloud computing architecture is divided into the following two parts

Front End

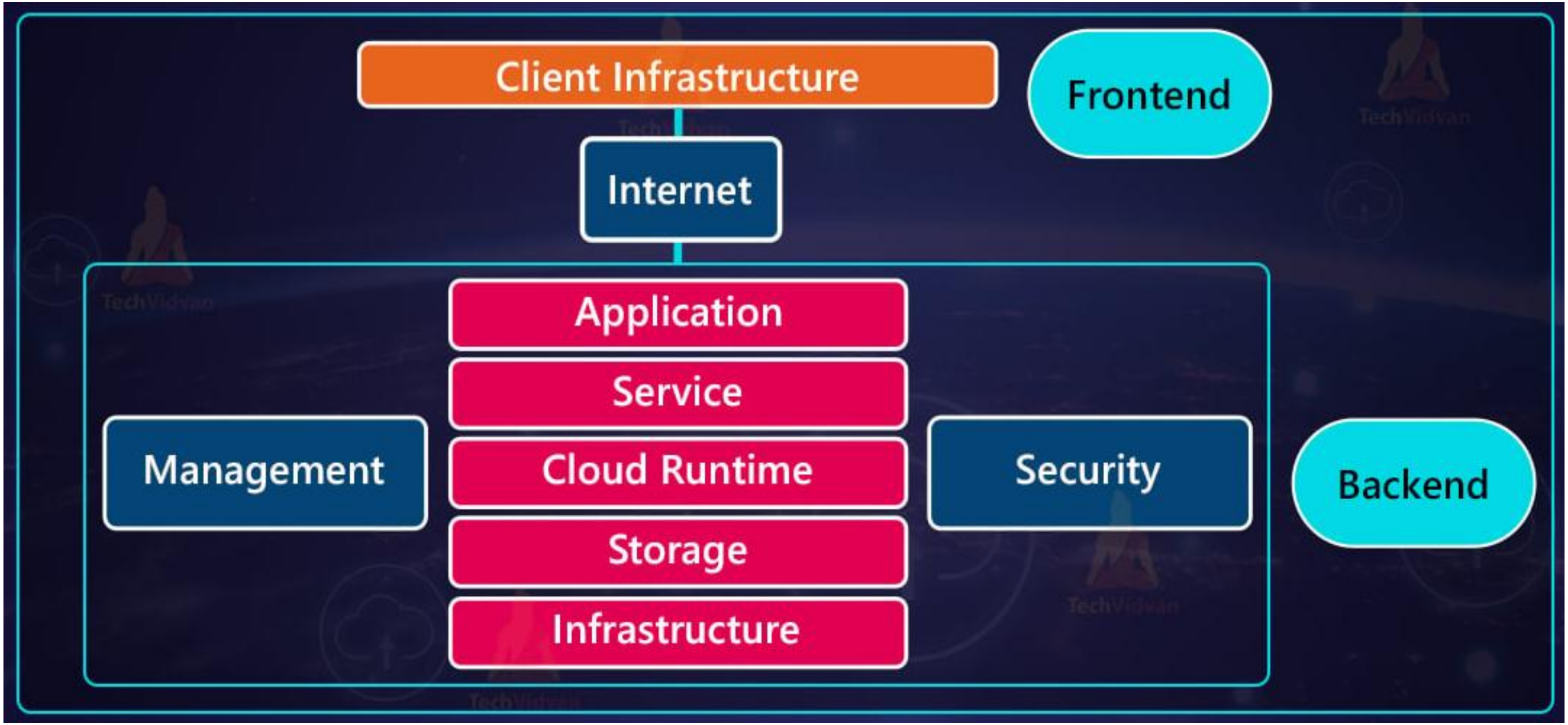
- The front end is used by the client. It contains client-side interfaces and applications that are required to access the cloud computing platforms. The front end includes web servers (including Chrome, Firefox, internet explorer, etc.), thin & fat clients, tablets, and mobile devices.

Back End

- The back end is used by the service provider. It manages all the resources that are required to provide cloud computing services. It includes a huge amount of data storage, security mechanism, virtual machines, deploying models, servers, traffic control mechanisms, etc.

- Functionality that uses internet-based resources
- Only the **interface** dealt with on the client side.

Cloud Computing Architecture



Components of Cloud Computing Architecture

There are the following components of cloud computing architecture -

1. **Client Infrastructure**

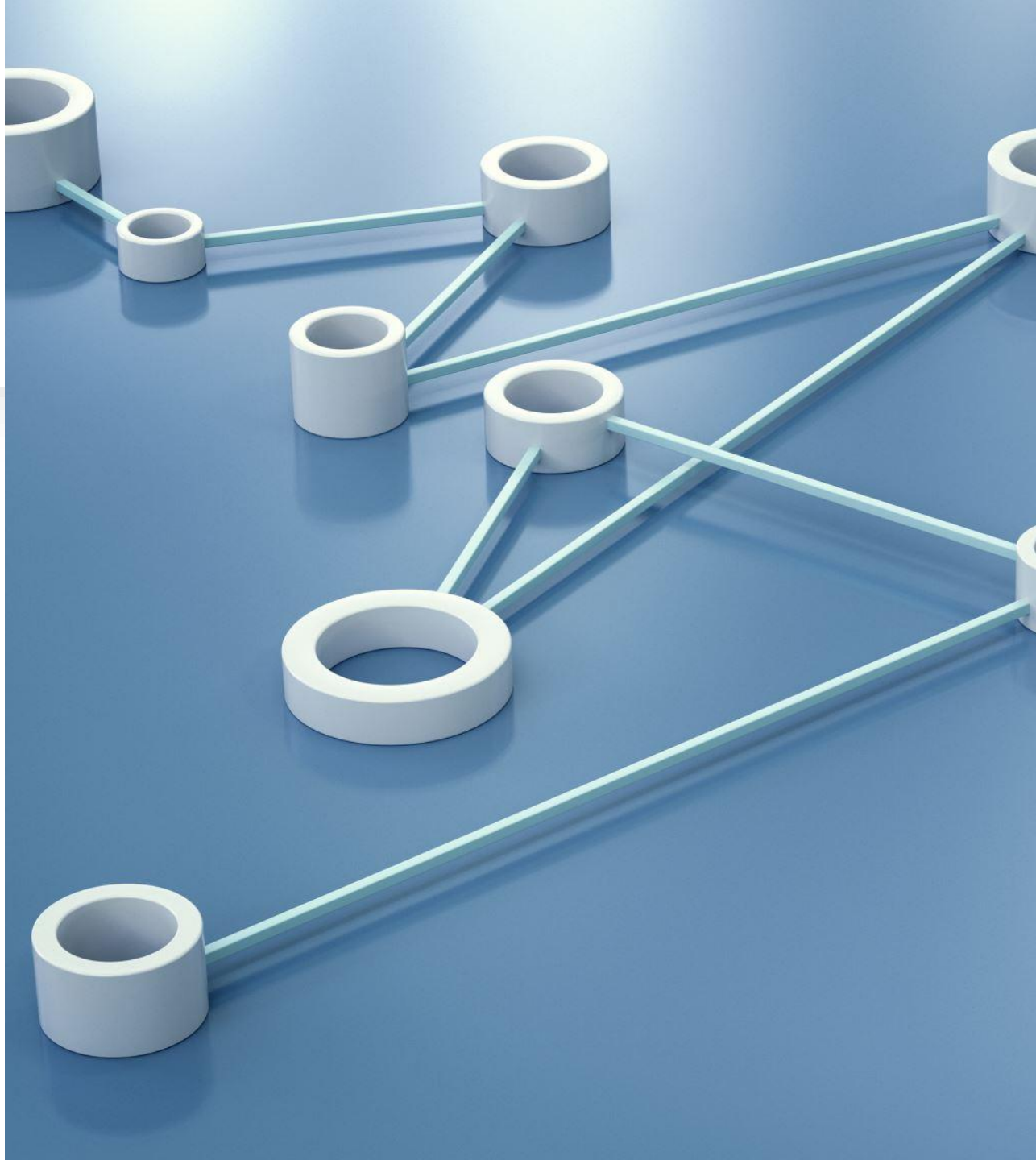
Client Infrastructure is a Front end component. It provides GUI (Graphical User Interface) to interact with the cloud.

2. **Application**

The application may be any software or platform that a client wants to access.

3. **Service**

A Cloud Services manages that which type of service you access according to the client's requirement.



Cloud Computing Operations

There are the following operations that we can do using cloud computing:

- Developing new applications and services
- Storage, back up, and recovery of data
- Hosting blogs and websites
- Delivery of software on demand
- Analysis of data
- Streaming videos and audios

What It cloud computing Provides

Cloud computing provides shared services as opposed to local servers or storage resources

Enables access to information from most web-enabled hardware

Allows for cost savings – reduced facility, hardware/software investments, support

Service Level Agreement

- Definition
  - A service-level agreement (SLA) is a contract between a network service provider and a customer that specifies, usually in measurable terms (QoS), what services the network service provider will furnish

- Common content in contract
  - Performance guarantee metrics
    - Up-time and down-time ratio
    - System throughput
    - Response time
  - Problem management detail
  - Penalties for non-performance
  - Documented security capabilities

Some Commercial Cloud Provider

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

Essential Characteristics

- *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

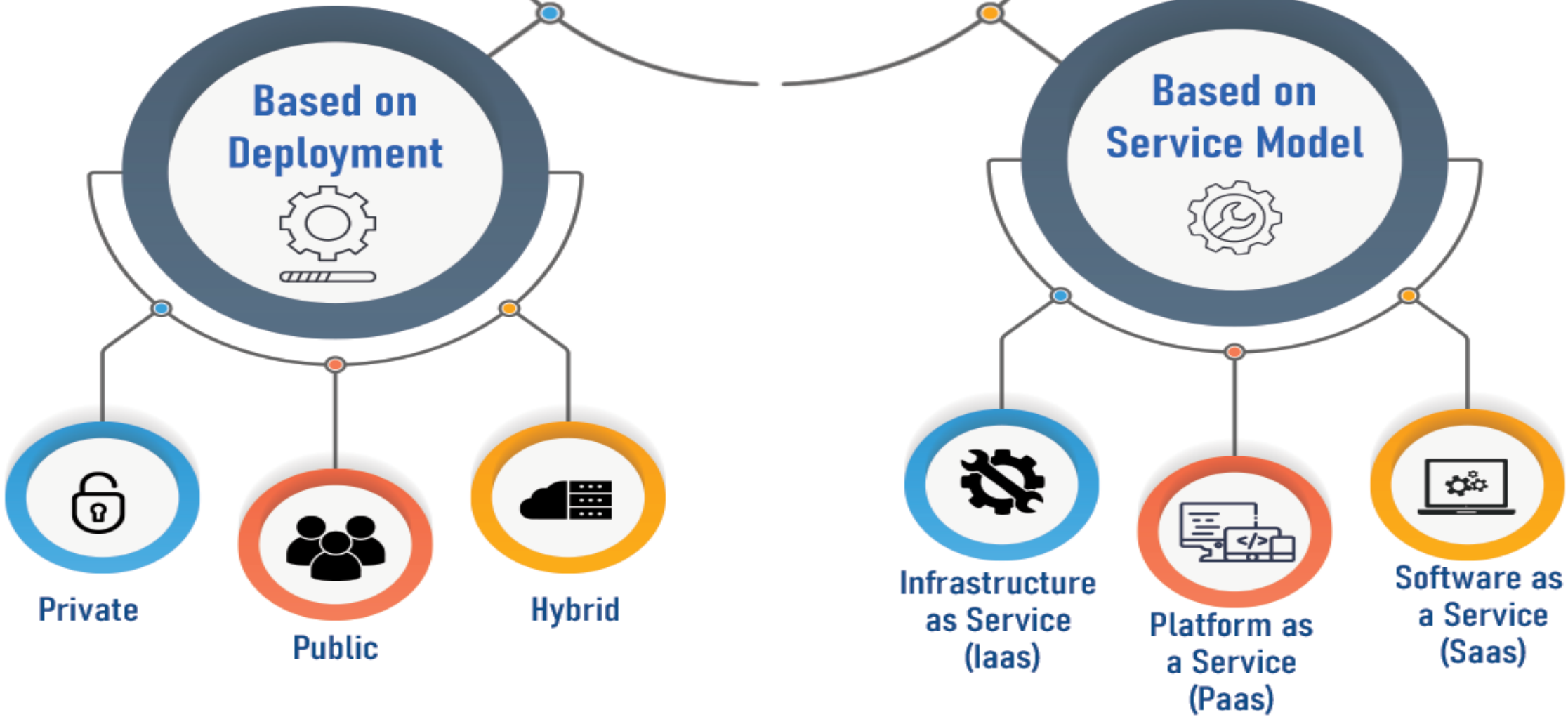
- *Measured service*

Customers are charged for the services they use and the 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

Where Is My Data?

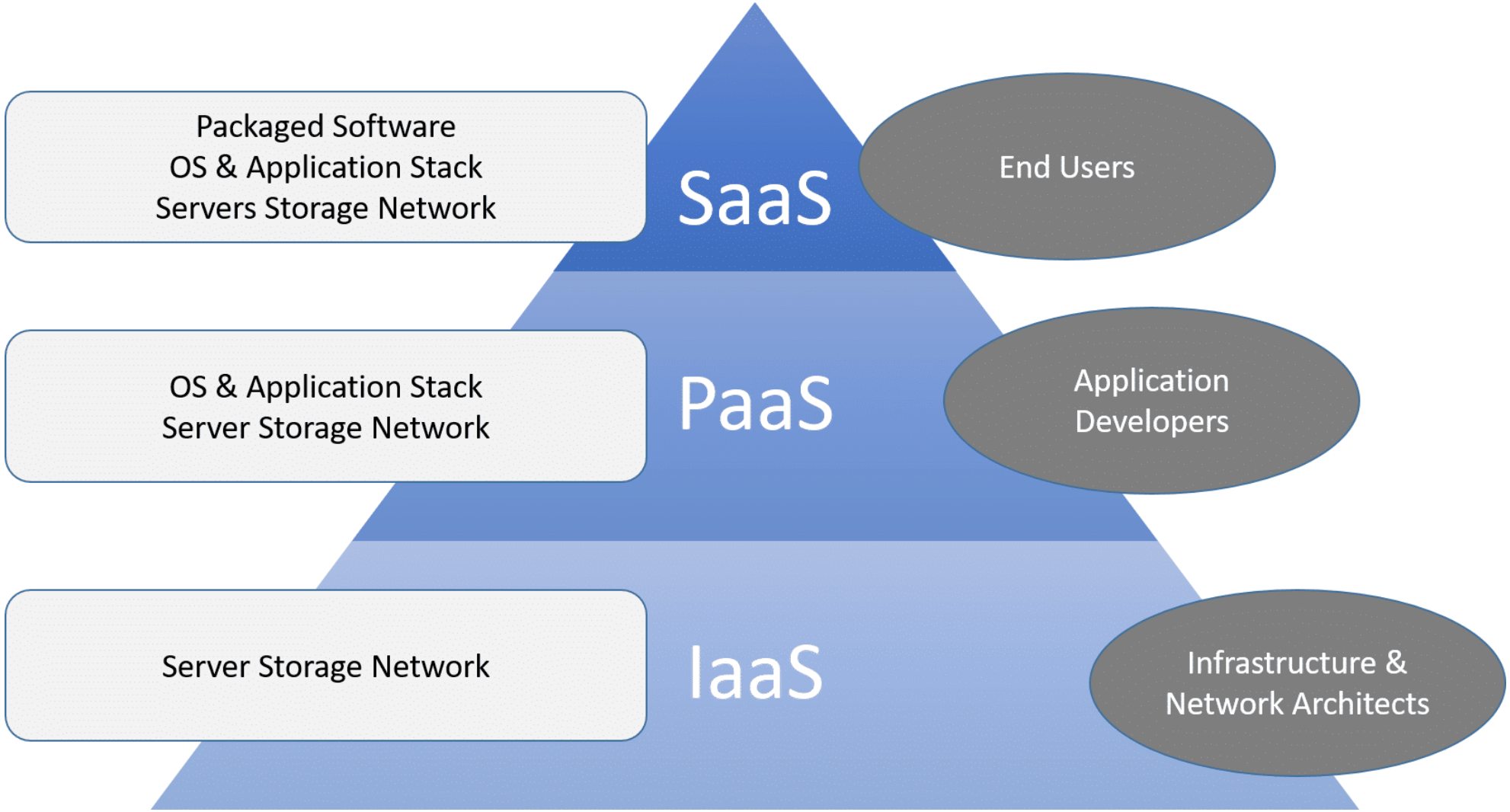
- Data resides on servers that the customer cannot physically access
- Vendors may store data anywhere at lowest cost if not restrained by agreement

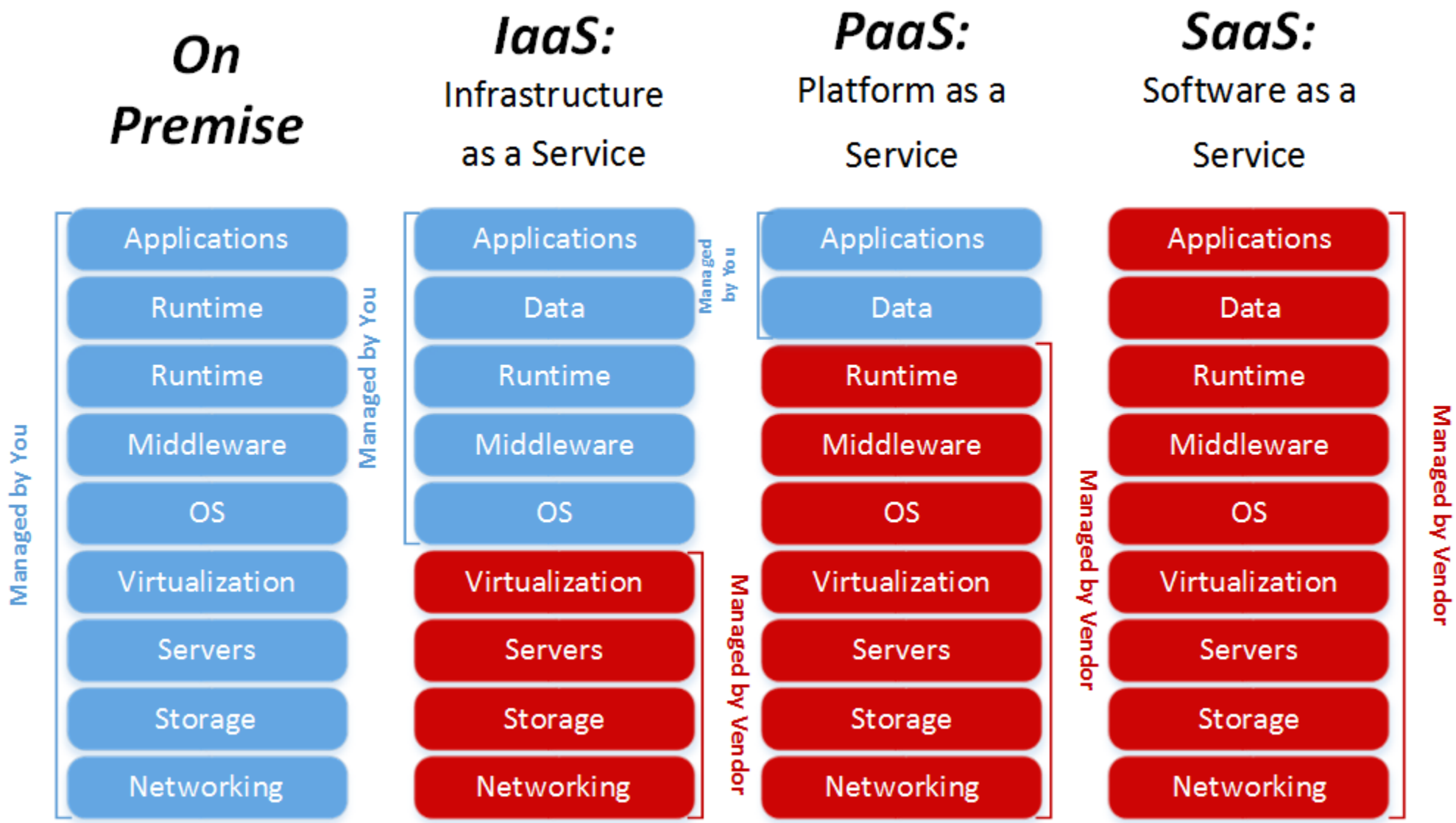
TYPES OF CLOUD COMPUTING



Service Models

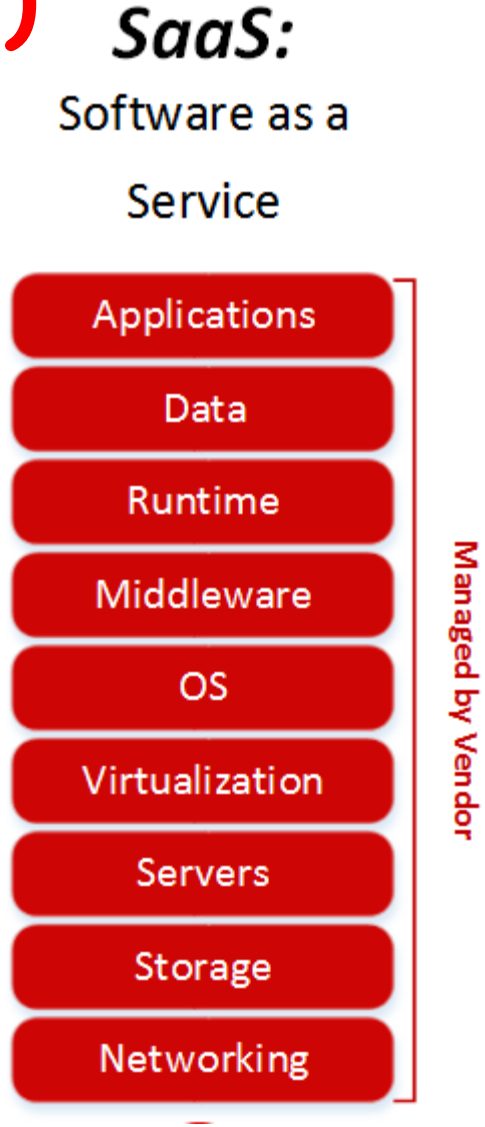
Cloud Service Models




On Premise
IaaS: Infrastructure as a Service
PaaS: Platform as a Service
SaaS: Software as a Service
Applications
Runtime
Runtime
Middleware
OS
Virtualization
Servers
Storage
Networking
Data
Managed by You
Managed by Vendor

Service Models
Software-as-a-Service (SaaS)

- Software-as-a-Service (SaaS) Also referred to as "software on demand," this service model involves outsourcing the infrastructure, platform, and software/applications.
- Typically, these services are available to the customer for a fee, pay-as-you-go, or a no charge model.
- The customer accesses the applications over the internet.

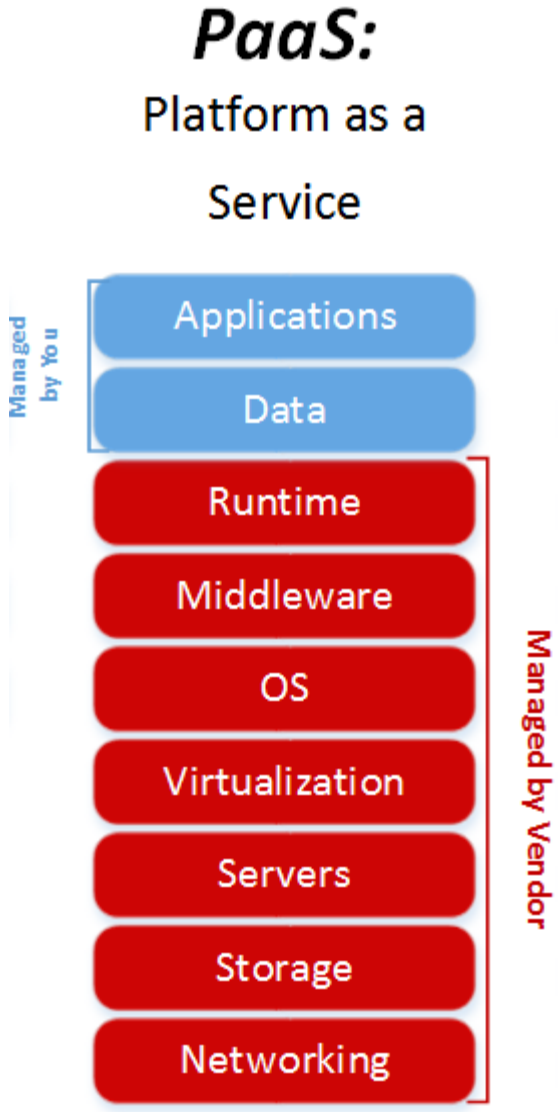


Service Models
Platform-as-a-Service (PaaS)

- Platform-as-a-Service (PaaS) A service model that involves outsourcing the basic infrastructure and platform (Windows, Unix)

- PaaS facilitates deploying applications without the cost and complexity of buying and managing the underlying hardware and software where the applications are hosted.

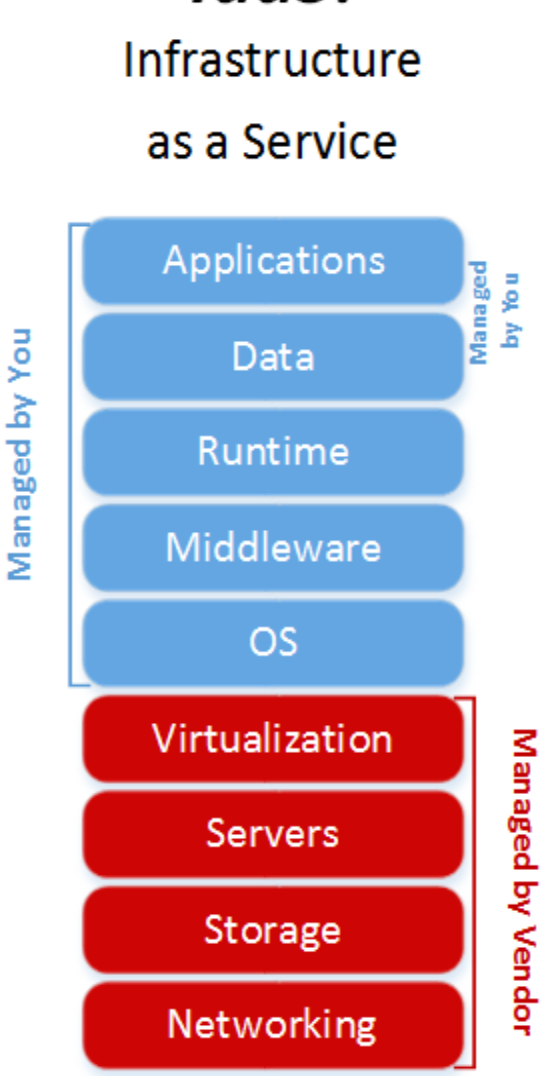
- **The customer uses their own applications**



Service Models
Infrastructure-as-a-Service (IaaS)

Infrastructure-as-a-Service (IaaS)

- A service model that involves outsourcing the basic infrastructure used to support operations--including storage, hardware, servers, and networking components.
- The service provider owns the infrastructure equipment and is responsible for housing, running, and maintaining it. The customer typically pays on a per-use basis.
- **The customer uses their own platform (Windows, Unix), and applications**



Cloud Service Models

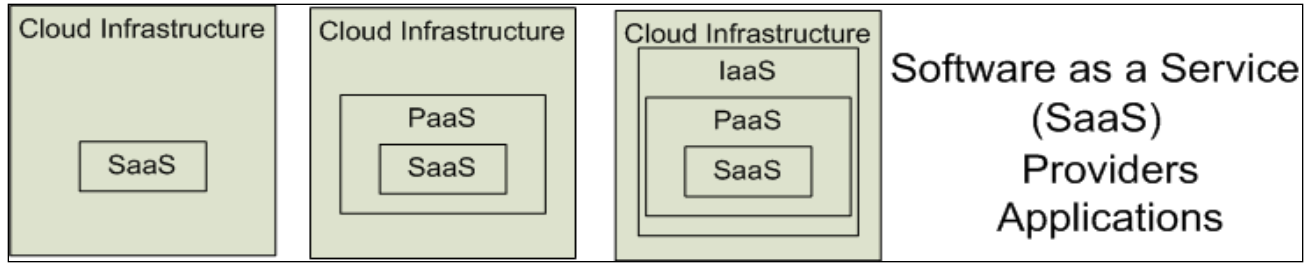
Software as a Service (SaaS)

Platform as a Service (PaaS)

Infrastructure as a Service (IaaS)

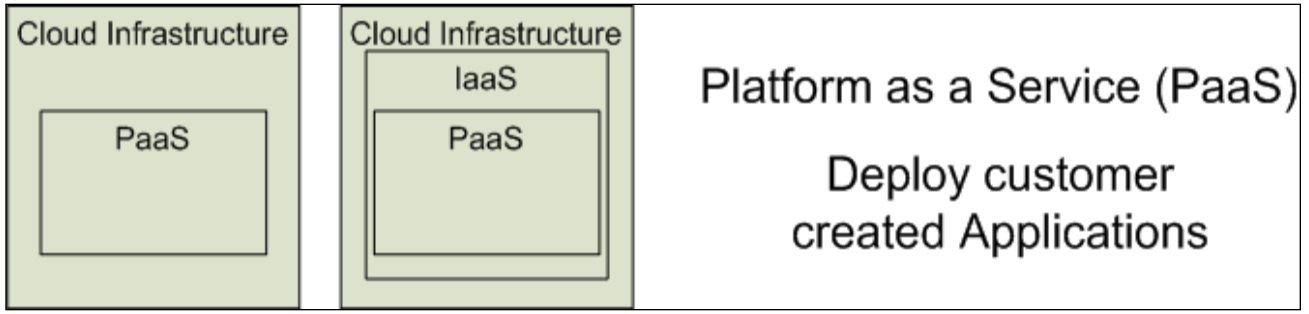
SalesForce CRM

LotusLive



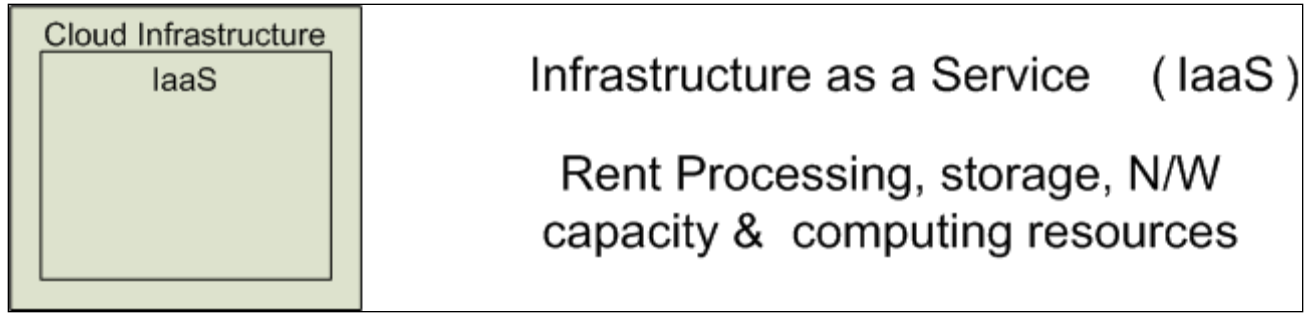
Google App

Windows Azure
The Future Made Familiar



amazon web services™

rackspace HOSTING



Deployment Model

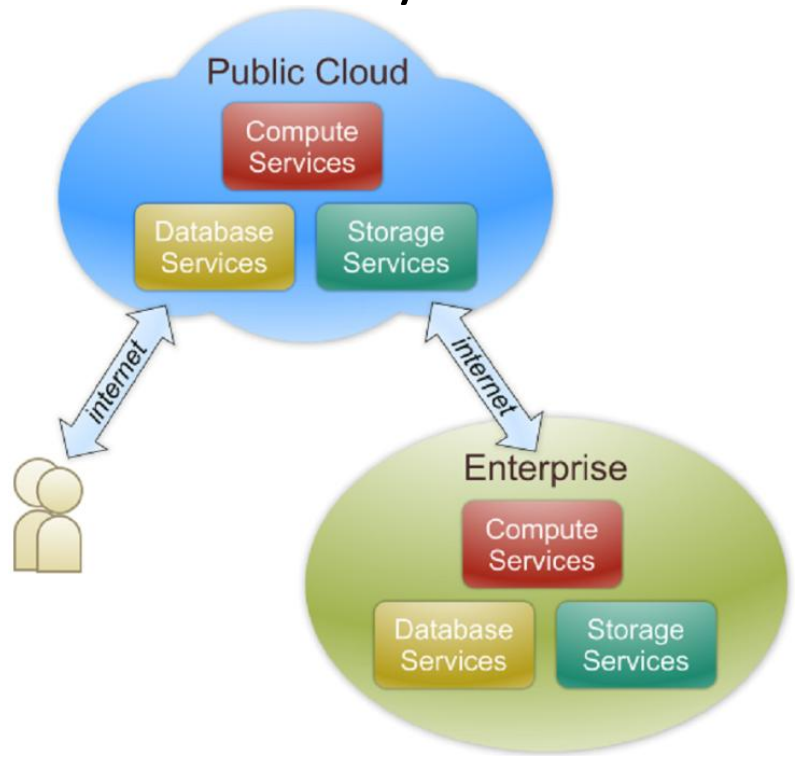
There are four primary cloud deployment models :

- Public Cloud
- Private Cloud
- Community Cloud
- Hybrid Cloud

Each can exhibit the previously discussed characteristics; their differences lie primarily in the scope and access of published cloud services, as they are made available to service consumers.

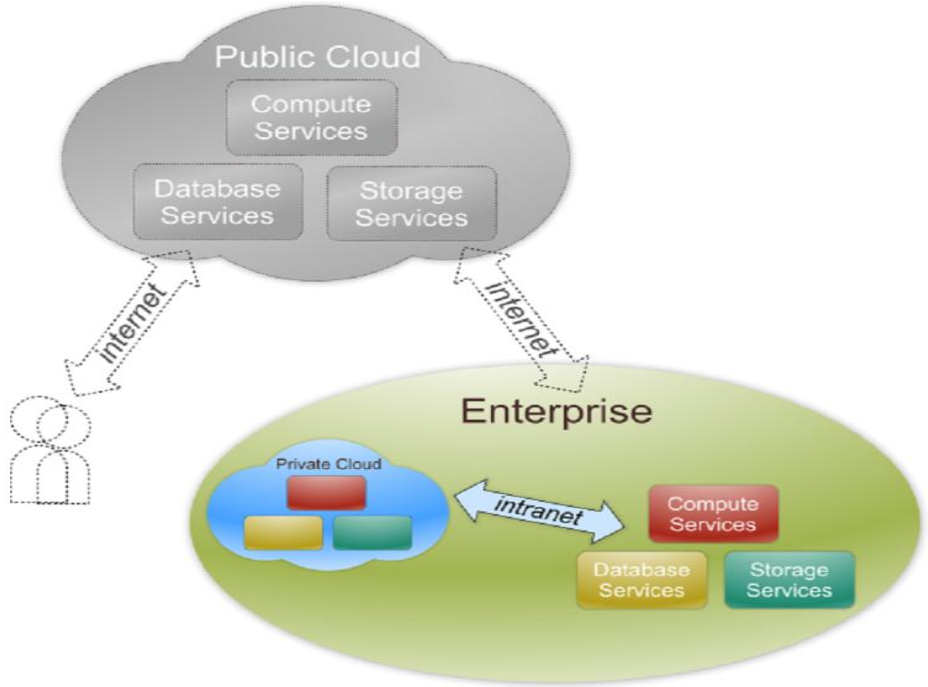
Public Cloud

- Public cloud definition
  - The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.
  - Also known as external cloud or multi-tenant cloud, this model essentially represents a cloud environment that is openly accessible.
  - Basic characteristics :
    - Homogeneous infrastructure
    - Common policies
    - Shared resources and multi-tenant
    - Leased or rented infrastructure
    - Economies of scale



Private Cloud

- Private cloud definition
  - The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.
  - Also referred to as internal cloud or on-premise cloud, a private cloud intentionally limits access to its resources to service consumers that belong to the same organization that owns the cloud.
  - Basic characteristics :
    - Heterogeneous infrastructure
    - Customized and tailored policies
    - Dedicated resources
    - In-house infrastructure
    - End-to-end control



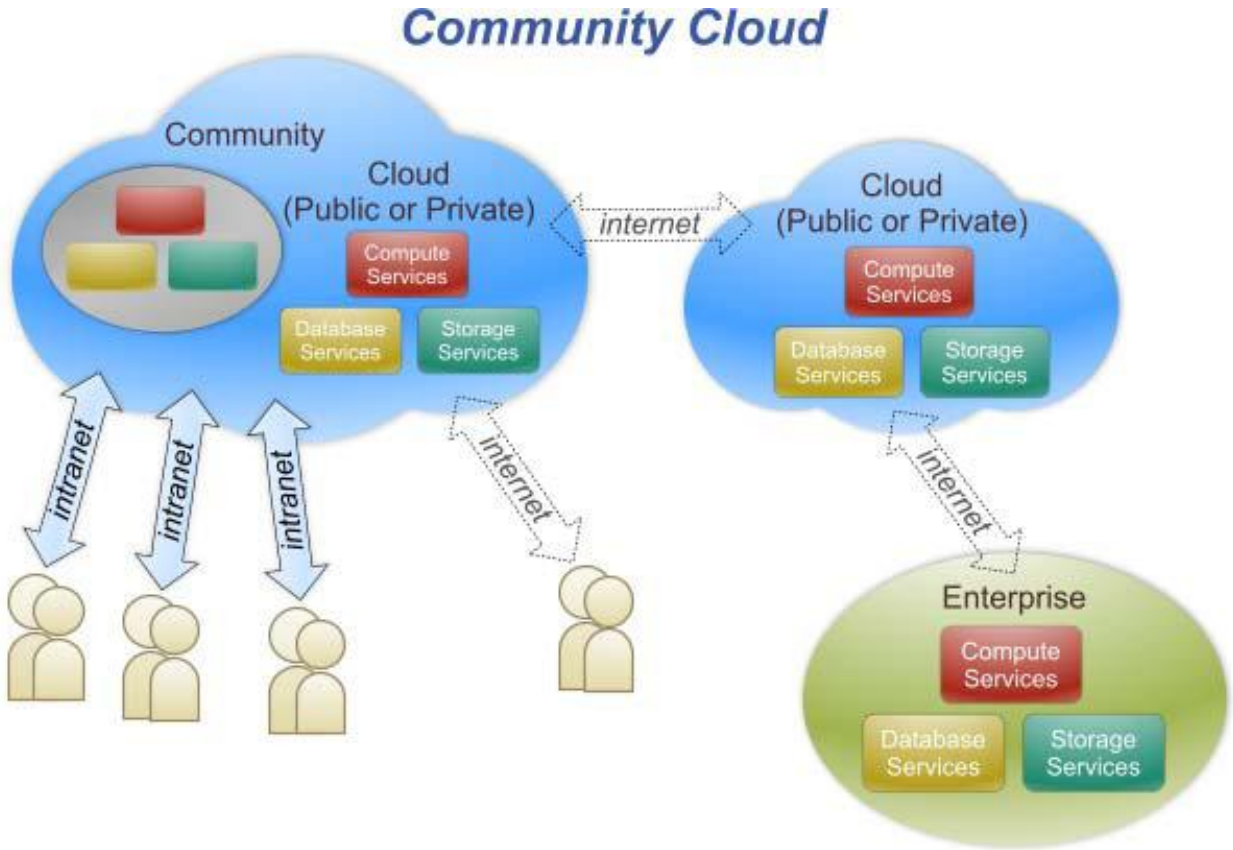
Public vs. Private

- Comparison :

	Public Cloud	Private Cloud
Infrastructure	*Homogeneous*	*Heterogeneous*
Policy Model	*Common defined*	*Customized & Tailored*
Resource Model	*Shared & Multi-tenant*	*Dedicated*
Cost Model	*Operational expenditure*	*Capital expenditure*
Economy Model	*Large economy of scale*	*End-to-end control*

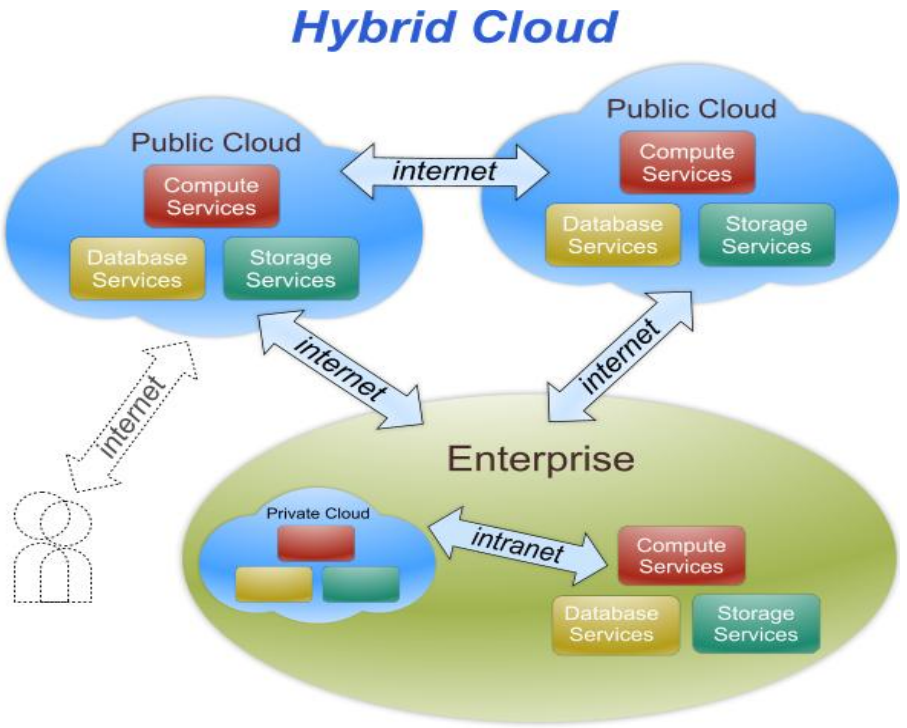
Community Cloud

- Community cloud definition
  - The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations).

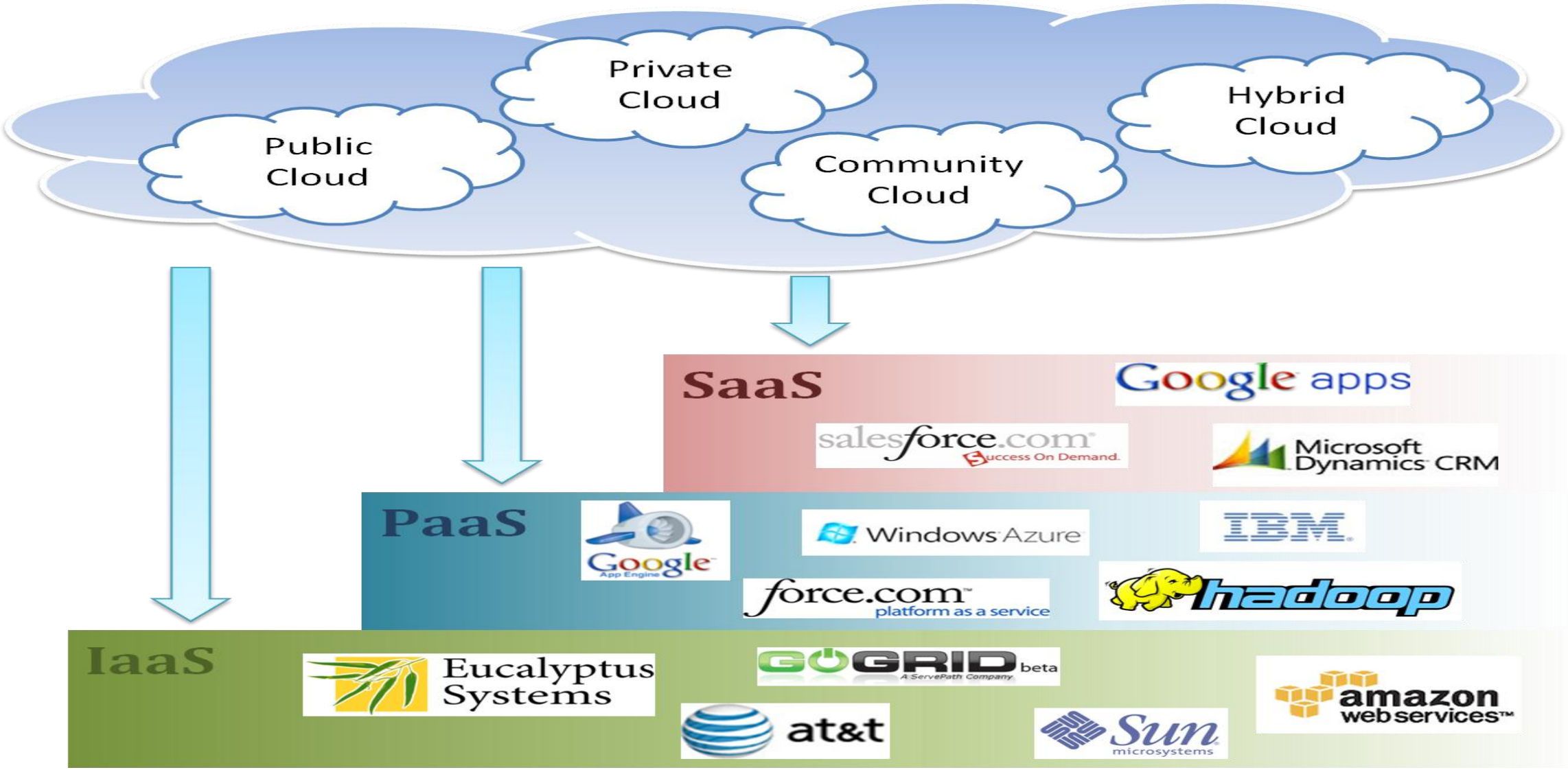


Hybrid Cloud

- Hybrid cloud definition
  - The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).



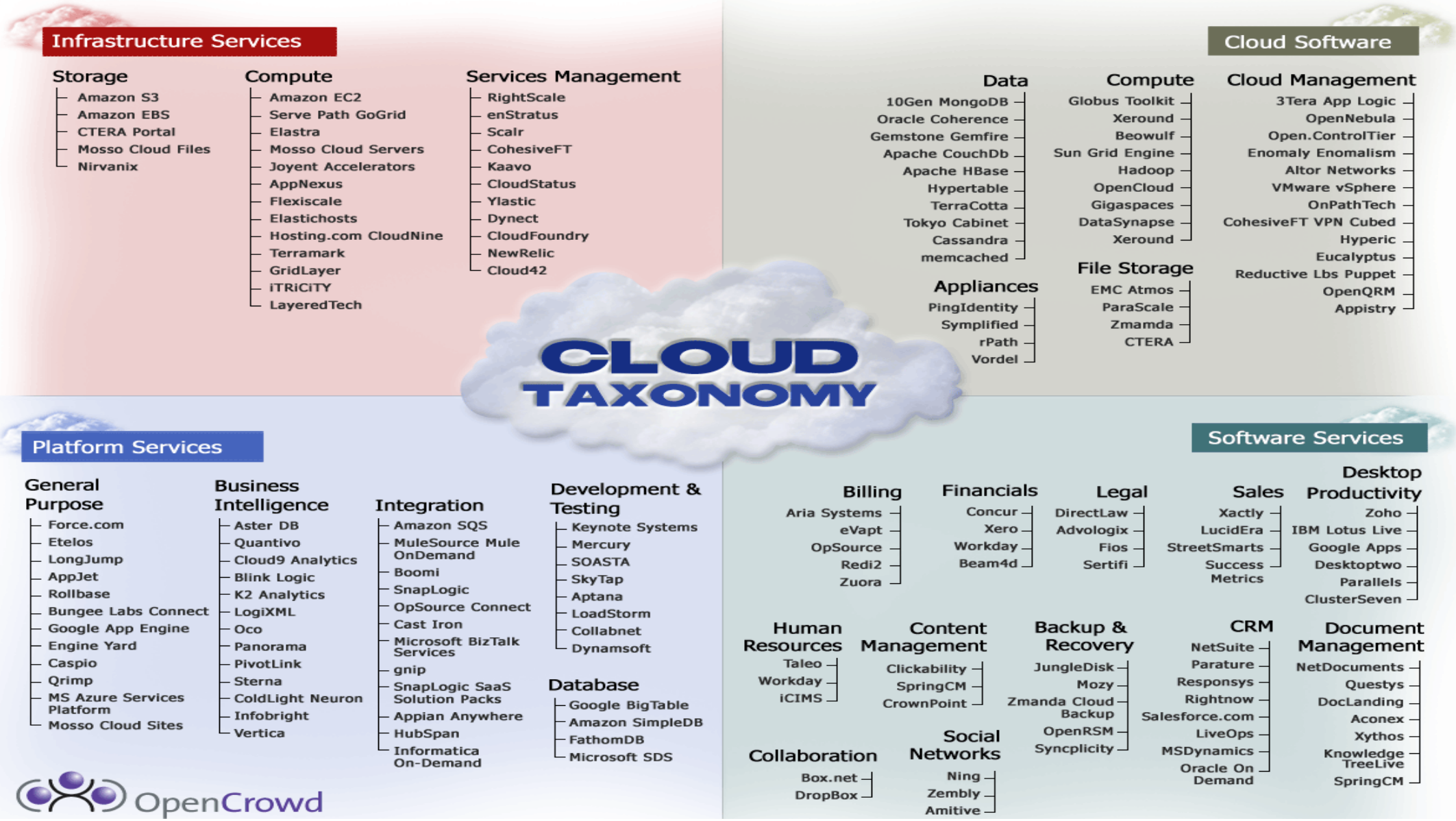
Cloud Ecosystem



Other Deployment models

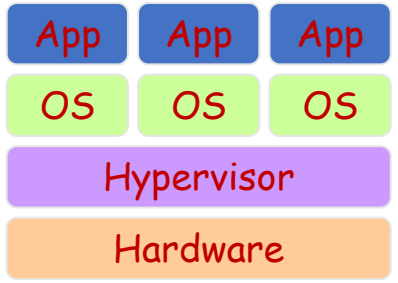
- **Distributed cloud:** Computing done by distributed set of machines that are running at different locations and they are connected to a single network. Examples
- BOINC and Folding@Home. Example: voluntarily shared resources.
- **Multicloud:** When multiple cloud vendors provides service together in heterogeneous architecture.This will help in reducing reliance on single vendors, increase flexibility through choice, mitigate against disasters, etc.
- **Intercloud** is an interconnected cloud i.e. "cloud of clouds" similar to Interconnected network (Internet) "network of networks". Mainly inter cloud helps in interoperability between public cloud service providers (as is the case for hybrid- and multi- cloud).

Cloud Taxonomy



Virtualization

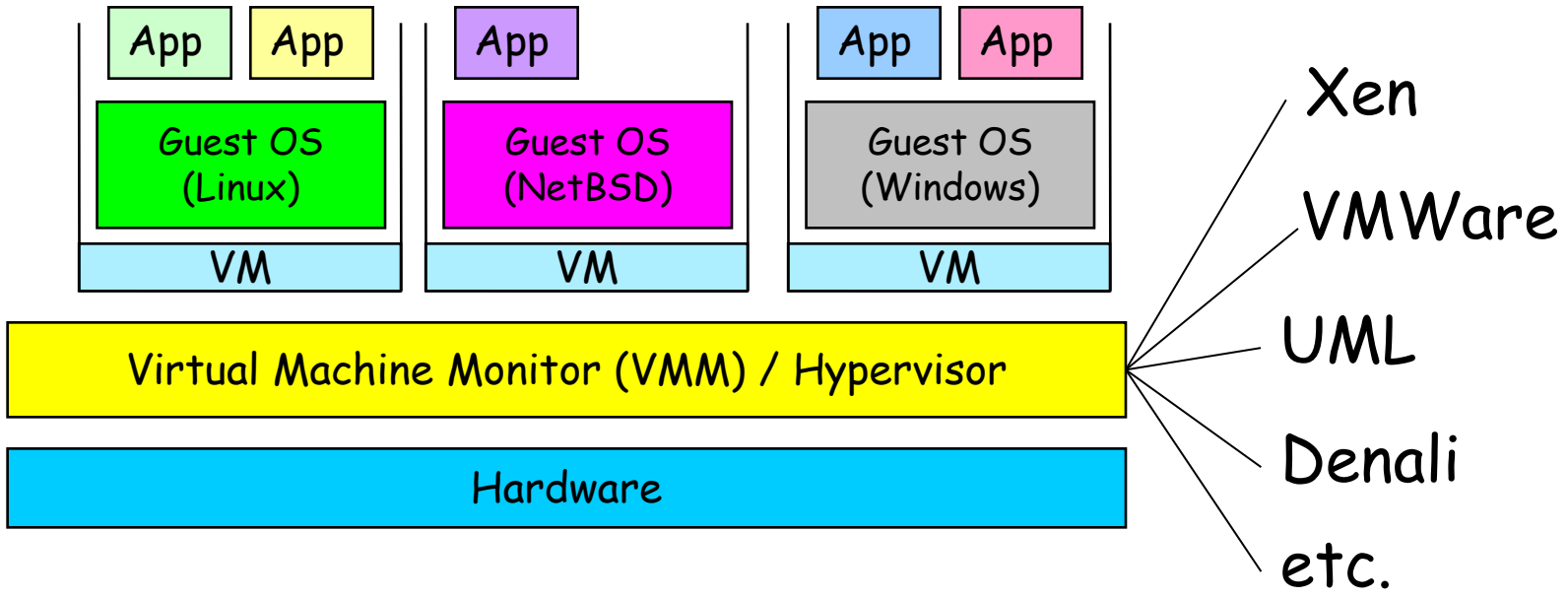
- Virtual workspaces:
  - An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols,
  - Resource quota (e.g. CPU, memory share),
  - Software configuration (e.g. O/S, provided services).
- Implement on Virtual Machines (VMs):
  - Abstraction of a physical host machine,
  - Hypervisor intercepts and emulates instructions from VMs, and allows management of VMs,
  - VMWare, Xen, etc.
- Provide infrastructure API:
  - Plug-ins to hardware/support structures



Virtualized Stack

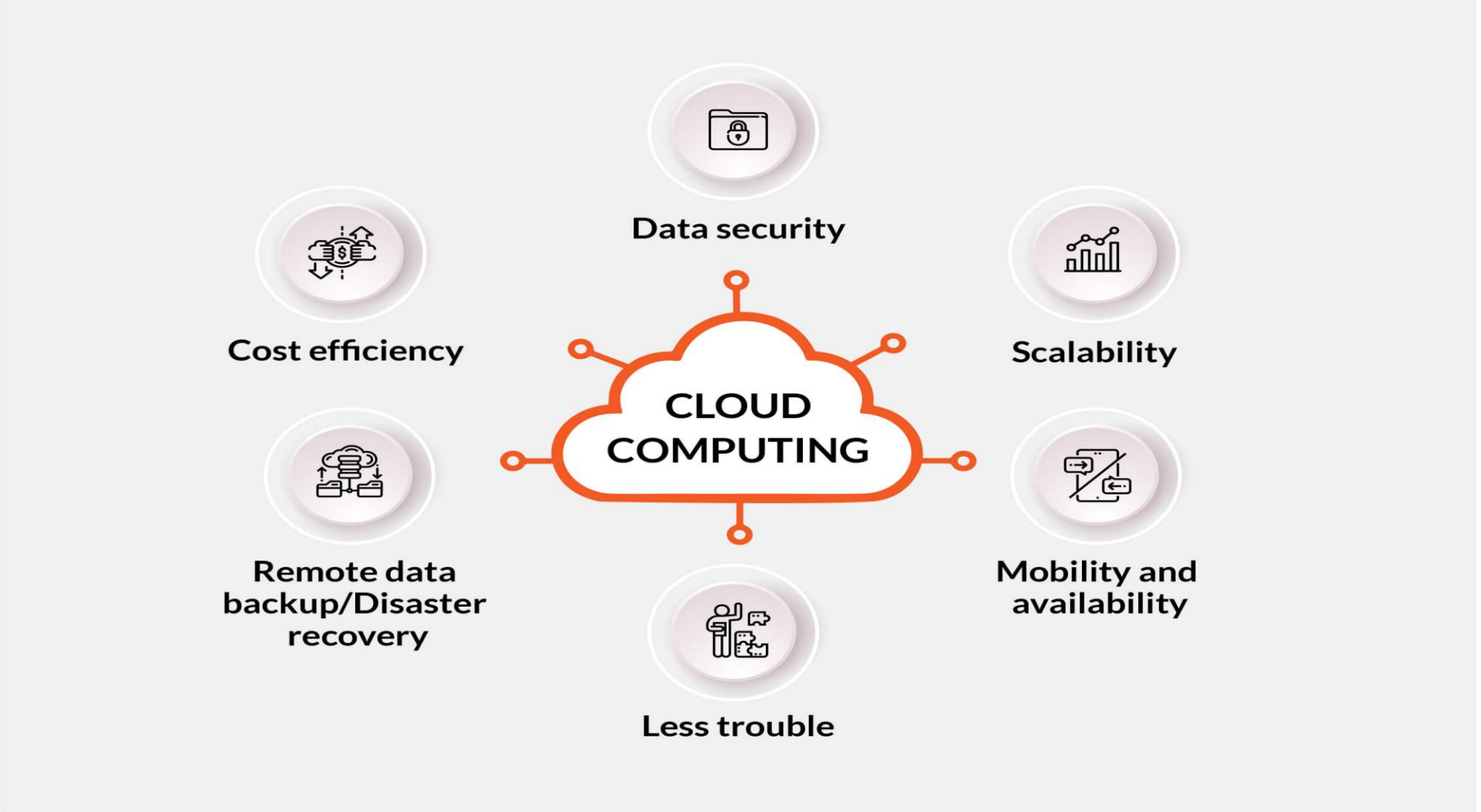
Virtual Machines

- VM technology allows multiple virtual machines to run on a single physical machine.



Performance: Para-virtualization (e.g. Xen) is very close to raw physical performance!

THE ADVANTAGES OF CLOUD COMPUTING



DATA SECURITY

- A number of security measures are taken by the cloud hosting vendors to prevent data loss and ensure a safe computing environment in the multi-tenant infrastructure. These include access restrictions to apps and system resources, logging, monitoring and control of access and use of apps and systems, employment of security architecture models with app-level configurations, as well as the implementation of baseline protections like user authentication, encryption, SSO, API controls contracts and so on..

MOBILITY AND AVAILABILITY

- The cloud service providers take care to make your personal or corporate data available for you 24/7 provided you remember your credentials and have access to any computer device with a stable Internet connection (which is really not a problem these days). This way, you can stay up-to-date on important issues instantly, easily store, retrieve, recover and process your data anytime and anywhere. Also, remote data access gives the opportunity for teams and colleagues to collaborate on a single shared project, without creating multiple copies of any document, no matter which part of the world each of them is located in. And you don't need to have files in your device memory any more to share them with people - just send data as web links to your target recipients to download from.

SCALABILITY

- Using the on-premise server collection can be like buying clothes you'll never wear: first, you thought you'd need it but it turned out to be unfitting. And now you don't know what to do with it. Or, in case of rapid growth, you suddenly realize you need some extra storage and capacity right now, but you have to take extra time and effort to build and set up a new server infrastructure. This problem can be easily eliminated due to cloud services.
- Whenever you need flexibility in computer capacity and storage, moving to the cloud will be an ideal choice. On-demand cloud computing platforms providing their services on a pay-as-you-go basis allow their customers to use as many resources as needed at a particular moment. This is also a great benefit for small businesses that are planning to grow quickly or aren't sure exactly how many resources they might need for their functioning.

LESS TROUBLE

- If you are using any in-house hardware that looks at least a bit more advanced than a regular laptop, you definitely need a team of IT professionals to handle all the possible issues arising from it.
- Unlike using the physical servers, cloud computing, from the admin point of view, is fairly easy to manage and, the best part about it, cloud service providers take the responsibility for maintaining their systems, ensuring the proper levels of performance, security and control, as well as managing all the forthcoming updates and potential threats off-sight. Isn't it amazing?

REMOTE DATA BACKUP/DISASTER RECOVERY

- Everybody knows how it feels when important information is lost due to possible malware, hardware crashes or deterioration, a simple user error or a lame power cut, and even a natural disaster. That's what you may be expecting when using physical on-premise servers to store your own or your client's data. Such troubles may cost you your company revenues, brand positioning, customer loyalty and trust.
- With the cloud services, however, you can be pretty certain about your data backup and disaster retrieval opportunities. On the remote servers, the data is arranged and stored on multiple servers in the network. A reserve copy of your files is made instantly and transferred to a secondary, off-site location regularly by the provided settings or as soon as data updates take place.

COST EFFICIENCY

- Compared to having your own physical servers, using cloud services might seem more expensive. Although having taken into account everything said before, the benefits of cloud computing significantly outweigh the costs. In addition, moving to the cloud helps companies to avoid some extra expenses like capital investment in hardware, IT staff salary, rent for a bigger office with a server room, and even electricity bills (yes, physical servers and air conditioners for them are pretty power-hungry).

Disadvantages of Cloud Computing

A list of the disadvantage of cloud computing is given below -

1) **Internet Connectivity**

- As you know, in cloud computing, every data (image, audio, video, etc.) is stored on the cloud, and we access these data through the cloud by using the internet connection. If you do not have good internet connectivity, you cannot access these data. However, we have no any other way to access data from the cloud.

2) Vendor lock-in

- Vendor lock-in is the biggest disadvantage of cloud computing. Organizations may face problems when transferring their services from one vendor to another. As different vendors provide different platforms, that can cause difficulty moving from one cloud to another.

Disadvantages of Cloud Computing

3) Limited Control

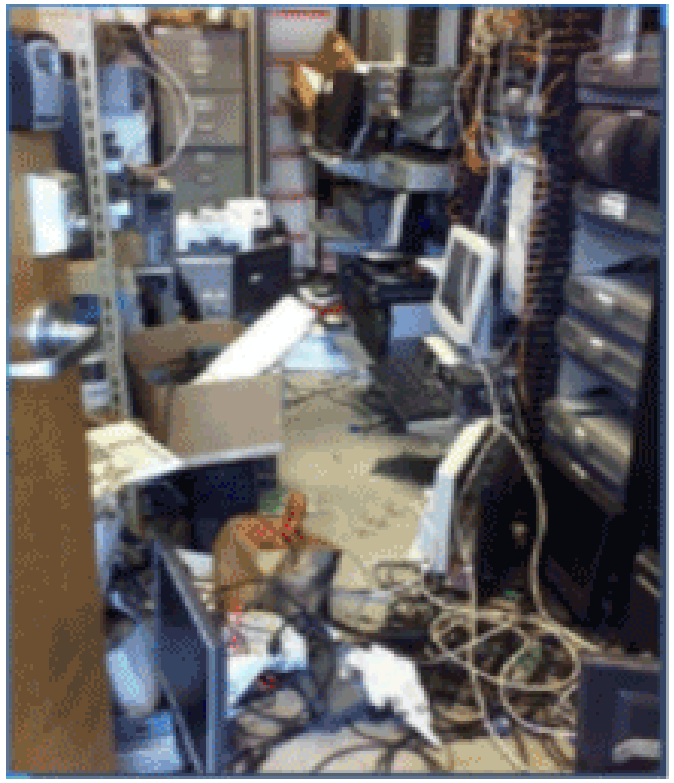
- As we know, cloud infrastructure is completely owned, managed, and monitored by the service provider, so the cloud users have less control over the function and execution of services within a cloud infrastructure.

4) Security

- Although cloud service providers implement the best security standards to store important information. But, before adopting cloud technology, you should be aware that you will be sending all your organization's sensitive information to a third party, i.e., a cloud computing service provider. While sending the data on the cloud, there may be a chance that your organization's information is hacked by Hackers.

CLOUD COMPUTING

Before
Cloud Computing



After
Cloud Computing