Cloud Computing - 19CSE445

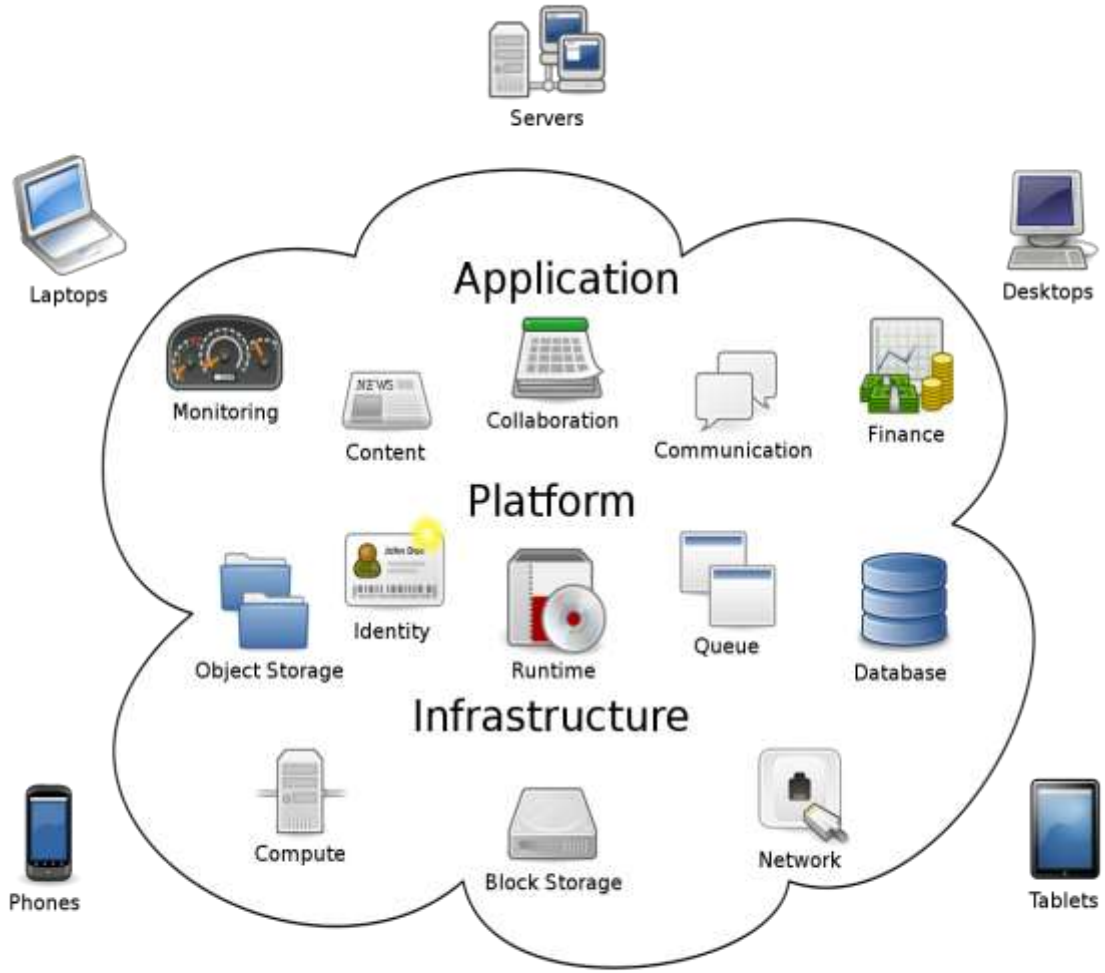
Pre-Requisite(s):19CSE102 Computer Programming, 19CSE301 Computer Networks

Course Objectives

- This course introduces the basic principles of cloud computing, cloud native application development and deployment, containerization principles, micro-services and application scaling.
- It will also equip the students to understand major industry players in the public cloud domain for application development and deployment.

Course Outcomes

- CO 1: Understand the basic principles of cloud computing.
- CO 2: Apply cloud native application development for containerization and container orchestration.
- CO 3: Analyse different types of cloud services – Delivery models, Deployment models.
- CO 4: Implement different solution approaches in Cloud – containers in public cloud, setting up private cloud and convert monolithic applications to containers


Servers
Laptops
Desktops
Application
Monitoring
Content
Collaboration
Communication
Finance
Platform
Identity
Object Storage
Runtime
Queue
Database
Infrastructure
Compute
Block Storage
Network
Phones
Tablets


Mobile
Storage
Applications
CLOUD
COMPUTING
Server
Database
Private
cloud
Public
cloud
Hybrid
cloud

What is Computing?

- The utilization of computers to complete a task.
- It involves both hardware & software functions performing some sort of task with a computer.
- Examples of computing being used in everyday life:

  sending an email, swiping credit/debit cards etc.
- Computing is any activity that uses computers from designing and building software and hardware to analyse data, process data, communicate and solving complex problems to help push humanity

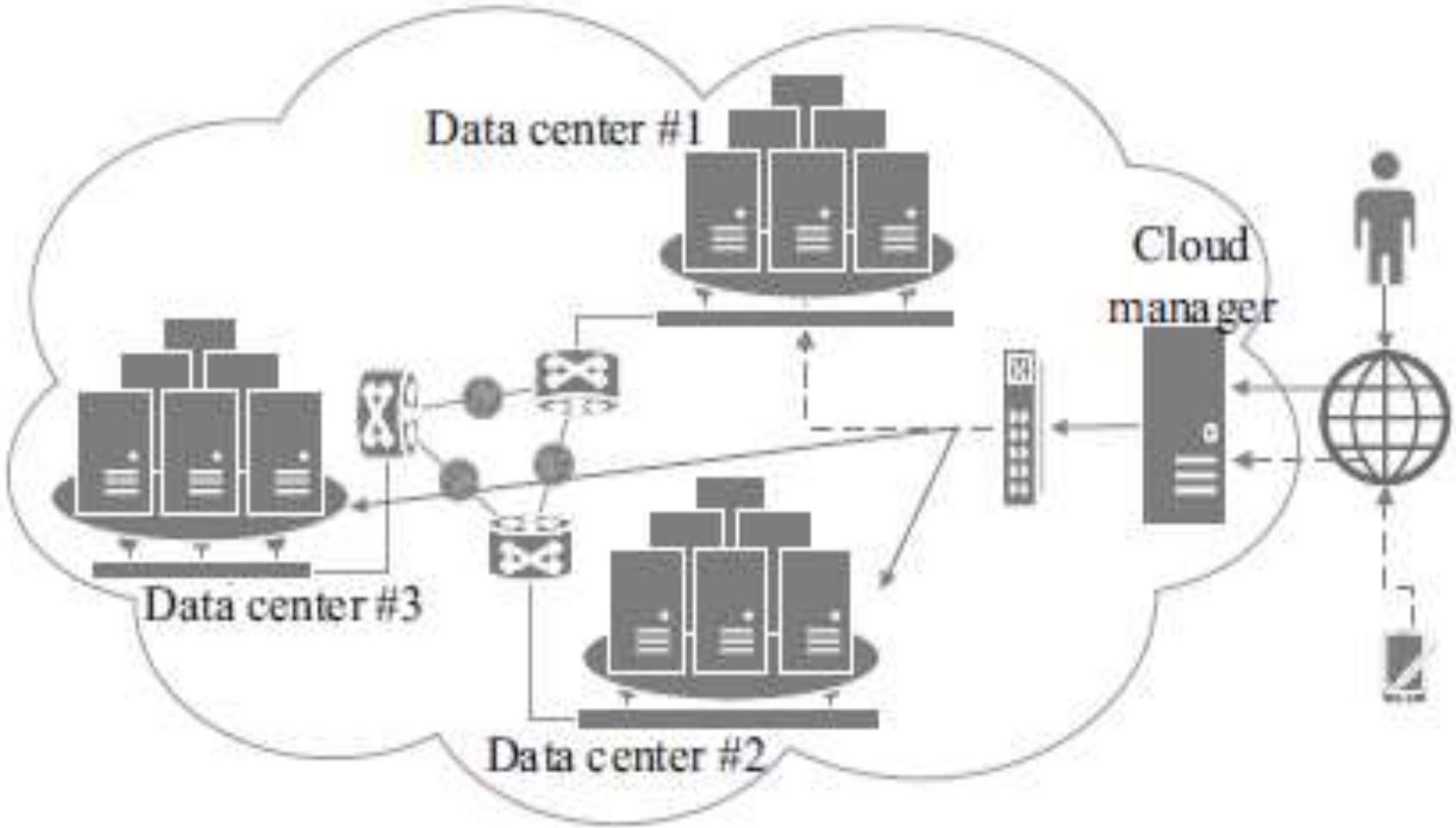
Cloud Computing

- You can connect to computers from a web browser (Internet).
- Interfaces (**services)** that help you get your work done more easily.

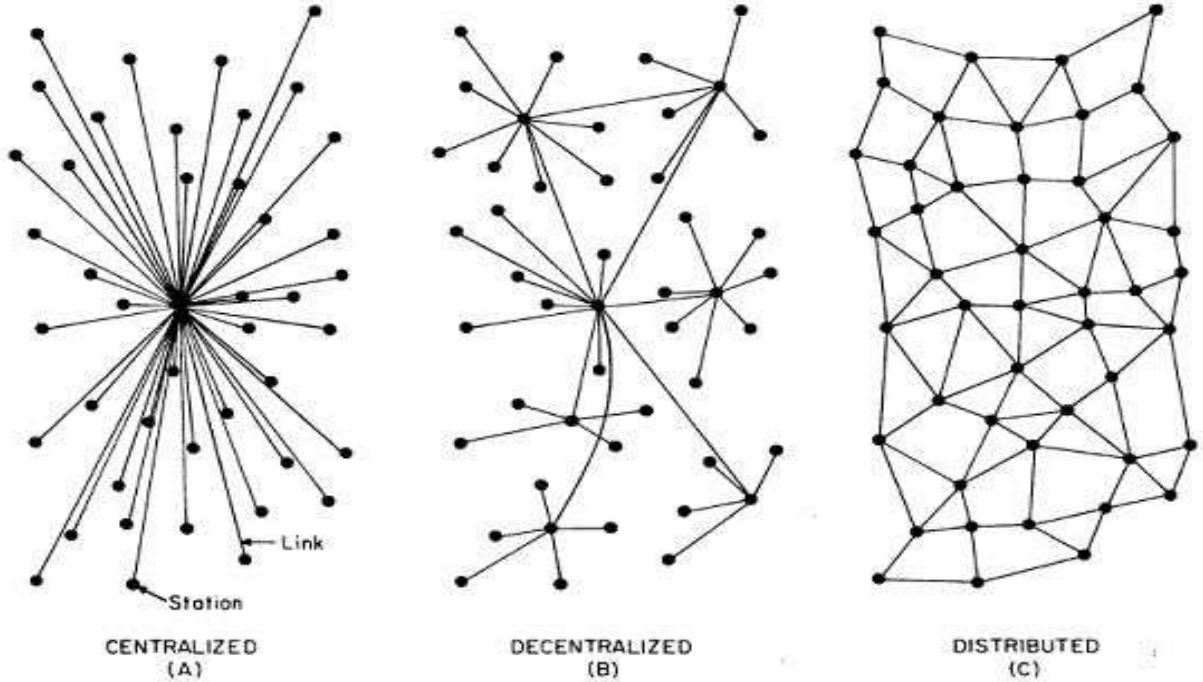
Cloud Computing

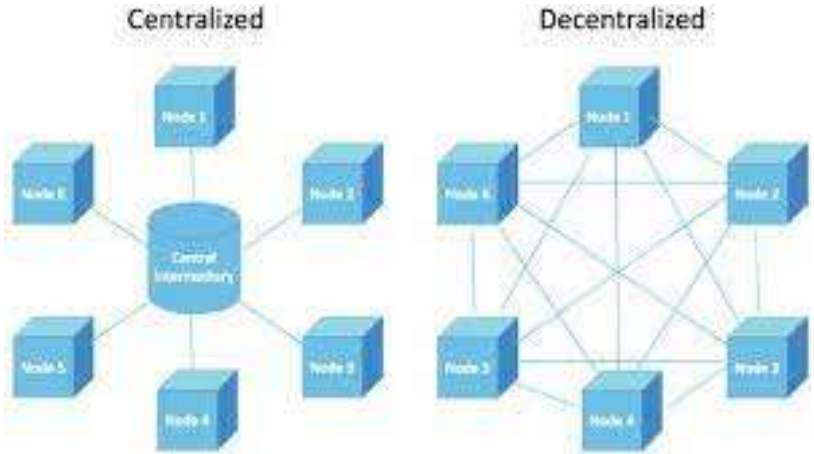
- Cloud computing is the delivery of computing services—servers, storage, databases, networking, software, analytics and more—**over the Internet** (“the cloud”).

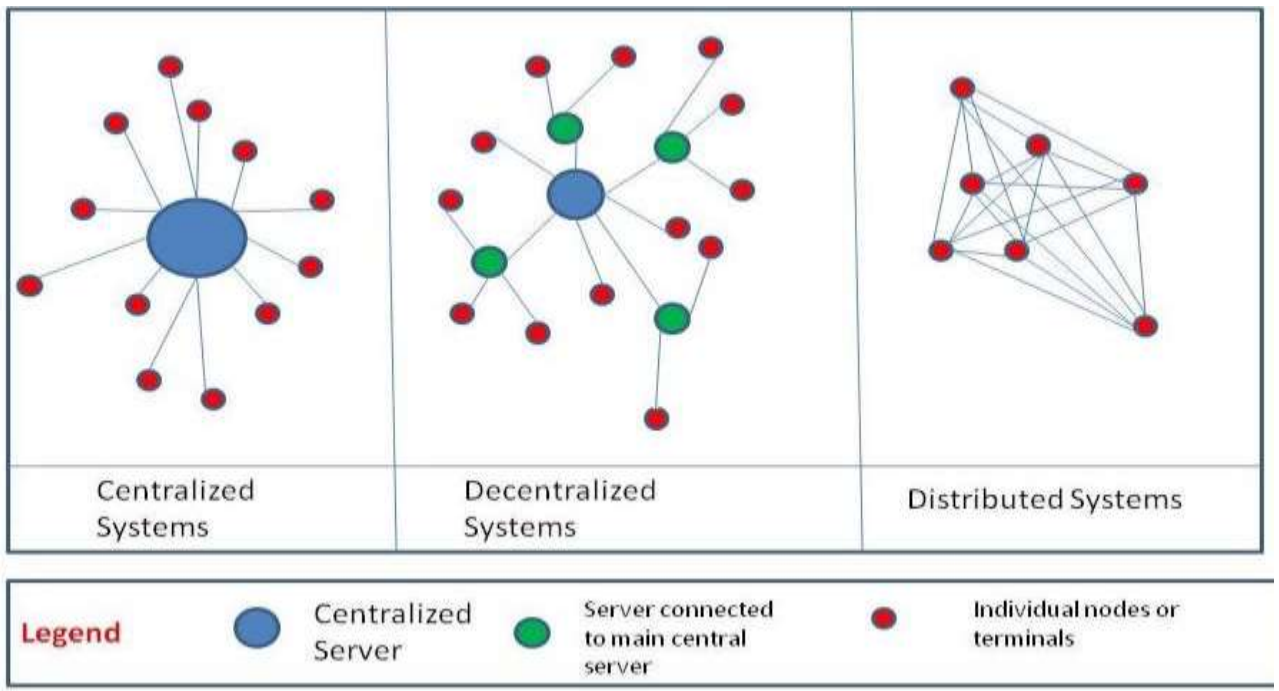
- Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage, similar to how you are billed for water or electricity at home



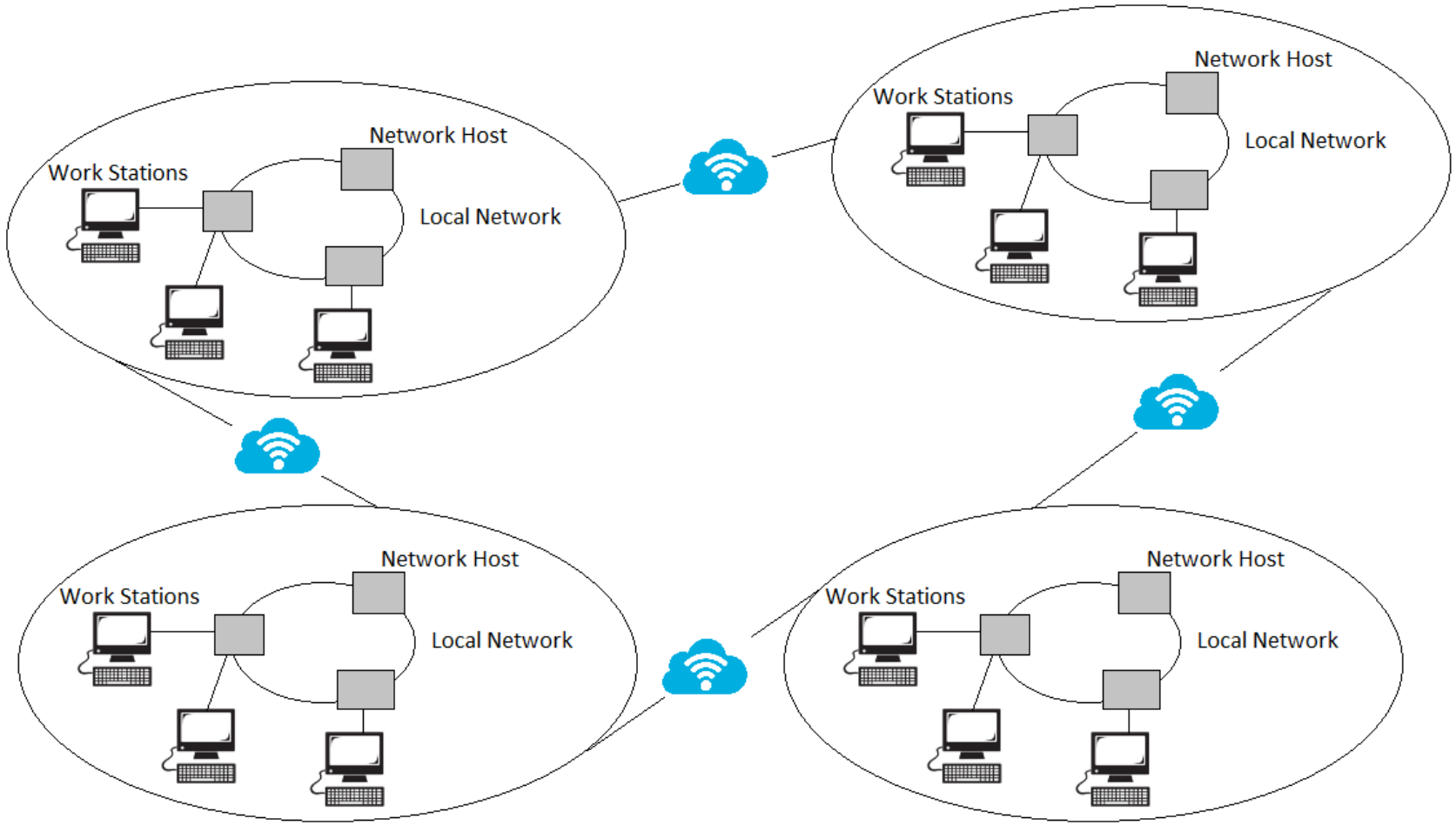
Cloud Computing Architecture


Link
Station
CENTRALIZED
(A)
DECENTRALIZED
(B)
DISTRIBUTED
(C)

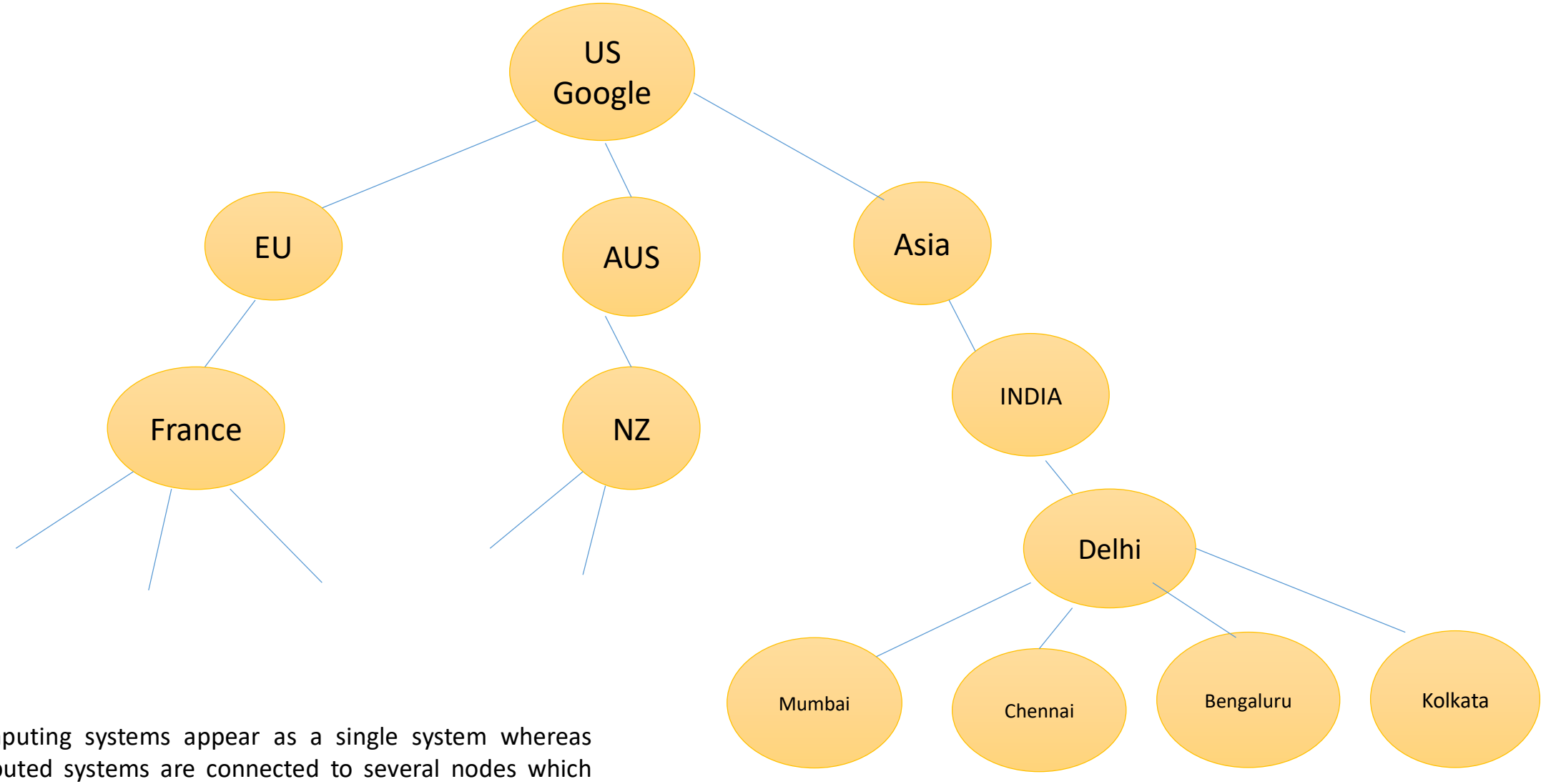

Centralized
Decentralized


Centralized Systems
Decentralized Systems
Distributed Systems
Legend
Centralized Server
Server connected to main central server
Individual nodes or terminals

Distributed Computing



Distributed Computing



Distributed computing systems appear as a single system whereas internally distributed systems are connected to several nodes which perform the designated computing tasks.

Distributed Computing…

1. "A distributed system is a collection of independent computers that appears to its users as a single coherent system"

2. solve a single large problem by breaking it down into several tasks where each task is computed in the individual computers of the distributed system.

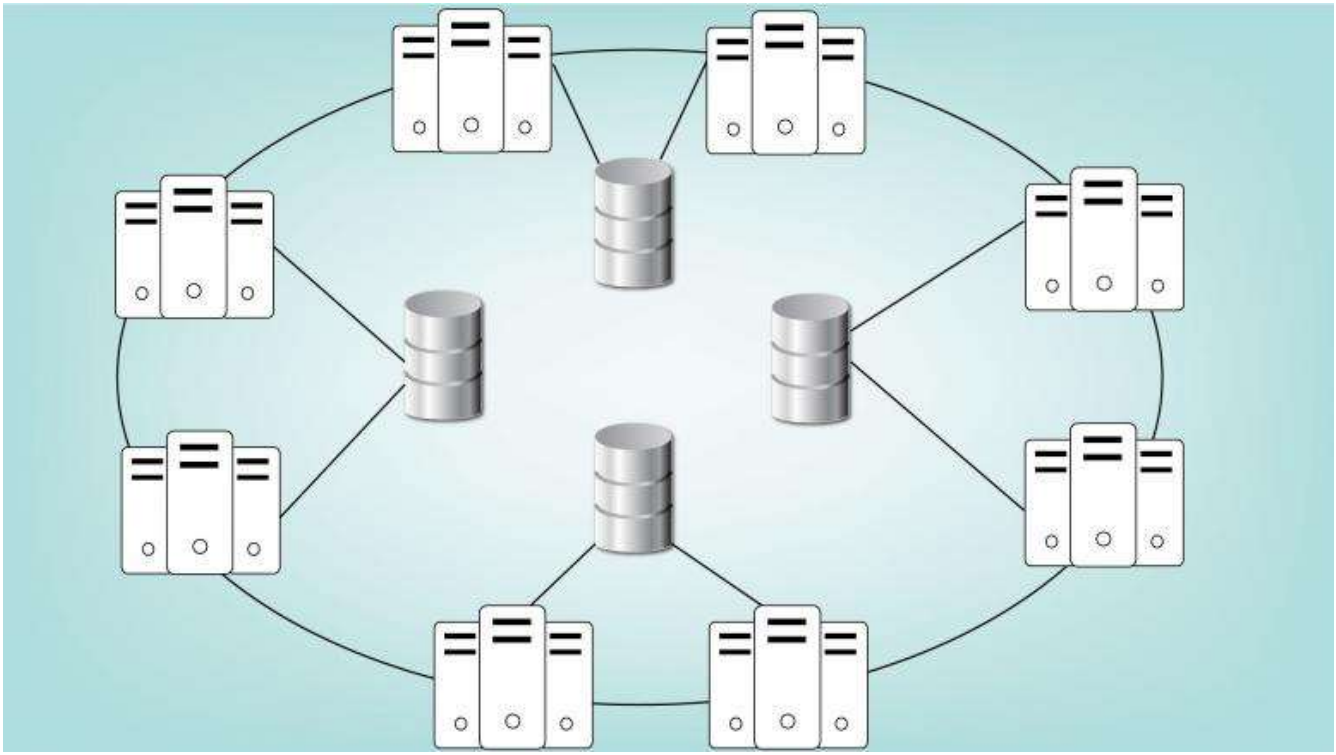
3. A distributed system consists of more than one self directed computer that communicates through a network.

4. All the computers connected in a network communicate with each other to attain a common goal by making use of their own local memory.

5. Different users of a computer possibly might have different requirements and the distributed systems will tackle the coordination of the shared resources by helping them communicate with other nodes to achieve their individual tasks.

6. Supports Fault Tolerance mechanism

Distributed System…



- Composed of multiple independent components and are perceived as a single entity by users
- **The primary purpose of distributed systems is to share resources and utilize them better**.

Distributed Computing System - Examples

1. World Wide Web
2. Social Media Giant Facebook
3. Hadoop's Distributed File System (HDFS)
4. ATM
5. Cloud Network Systems(Specialized form of Distributed Computing Systems)
6. Google Bots, Google Web Server, Indexing Server
7. Netflix, Amazon Prime….

Need for Distributed Computing

- Distributed computing systems provide a better price/performance ratio when compared to a centralized computer because adding microprocessors is more economic than mainframes.

- Distributed Computing Systems have more computational power than centralized (mainframe) computing systems. Distributed Computing Systems provide incremental growth so that organizations can add software and computation power in increments as and when business needs.

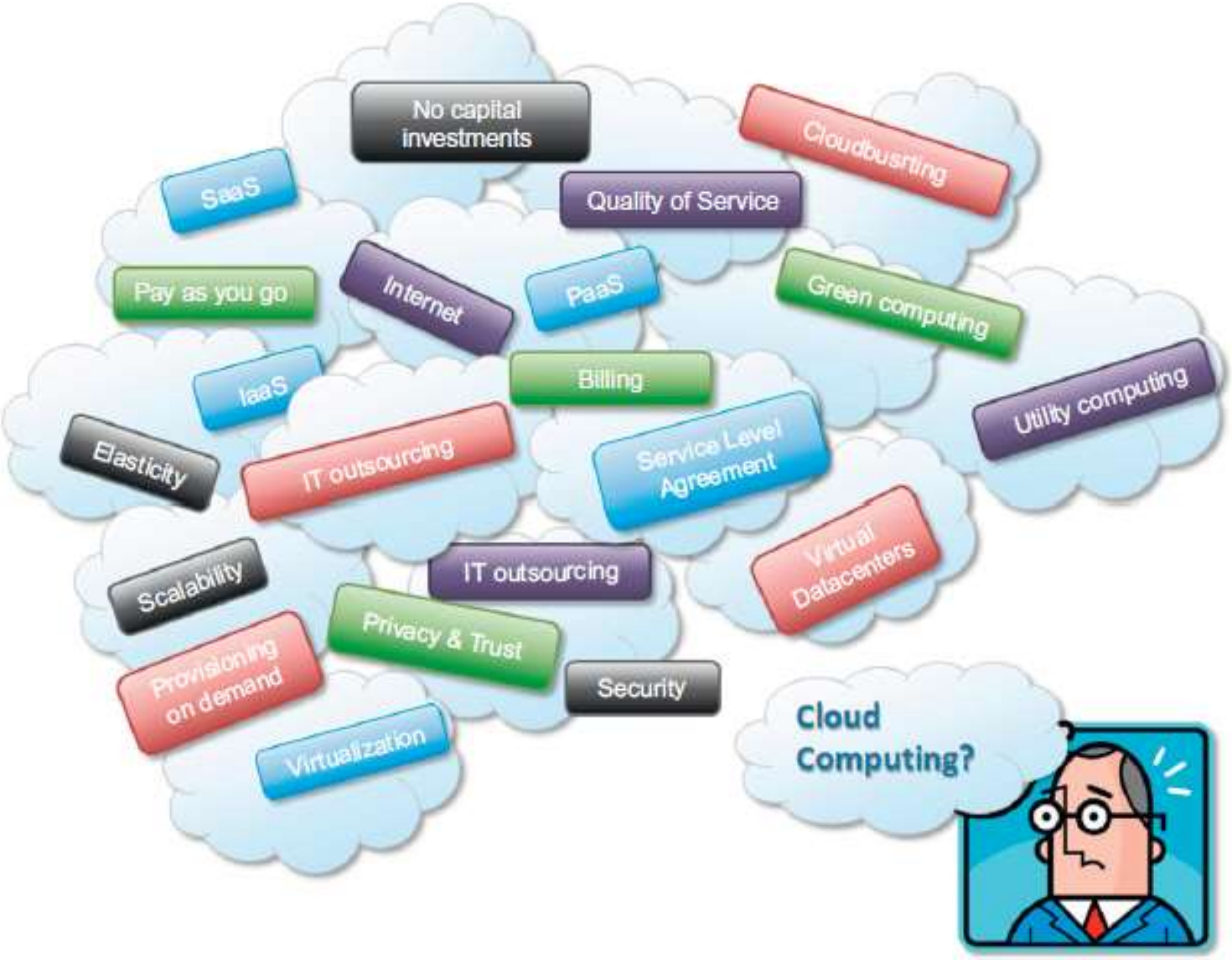
Advantages of Distributed Computing

Distributed computing (distributed processing) is the technique of linking together multiple computer servers over a network into a cluster, to share data and to coordinate processing power. Such a cluster is referred to as a “distributed system.”

Distributed computing makes all computers in the cluster work together as if they were one computer.

1. **Scalability.** The system can easily be expanded by adding more machines as needed. Higher loads can be handled by simply adding new hardware (versus replacing existing hardware).
2. **Performance.** Through parallelism in which each computer in the cluster simultaneously handles a subset of an overall task, the cluster can achieve high levels of performance through a divide-and-conquer approach.
3. **Redundancy**. Duplication of critical resources to improve system reliability. Several machines can provide the same services, so if one is unavailable, work does not stop
4. **Resilience.** How well a system recovers from failure. Distributed computing clusters typically copy or “replicate” data across all computer servers to ensure there is no single point of failure.
5. **Cost-effectiveness.** Distributed computing typically leverages low-cost, commodity hardware, making initial deployments as well as cluster expansions very economical.
6. **High availability**
7. **Reliability -** The probability that a system will function as expected
8. **Transparency**
9. **Fault tolerance:** Able to continue providing a service in the event of a failure

Different notions included in current definitions of cloud computing



Cloud computing technologies, concepts, and ideas.

Distributed computing refers to solve a problem over distributed autonomous computers and they communicate between them over a network

A computing technique which allows to multiple computers to communicate and work to solve a single problem

It is classified into 3 different types such as Distributed Computing Systems, Distributed Information Systems and Distributed Pervasive Systems

There are many benefits of distributed computing like flexibility, reliability, improved performance etc.

Distributed computing helps to achieve computational tasks more faster than using a single computer as it takes a lot of time

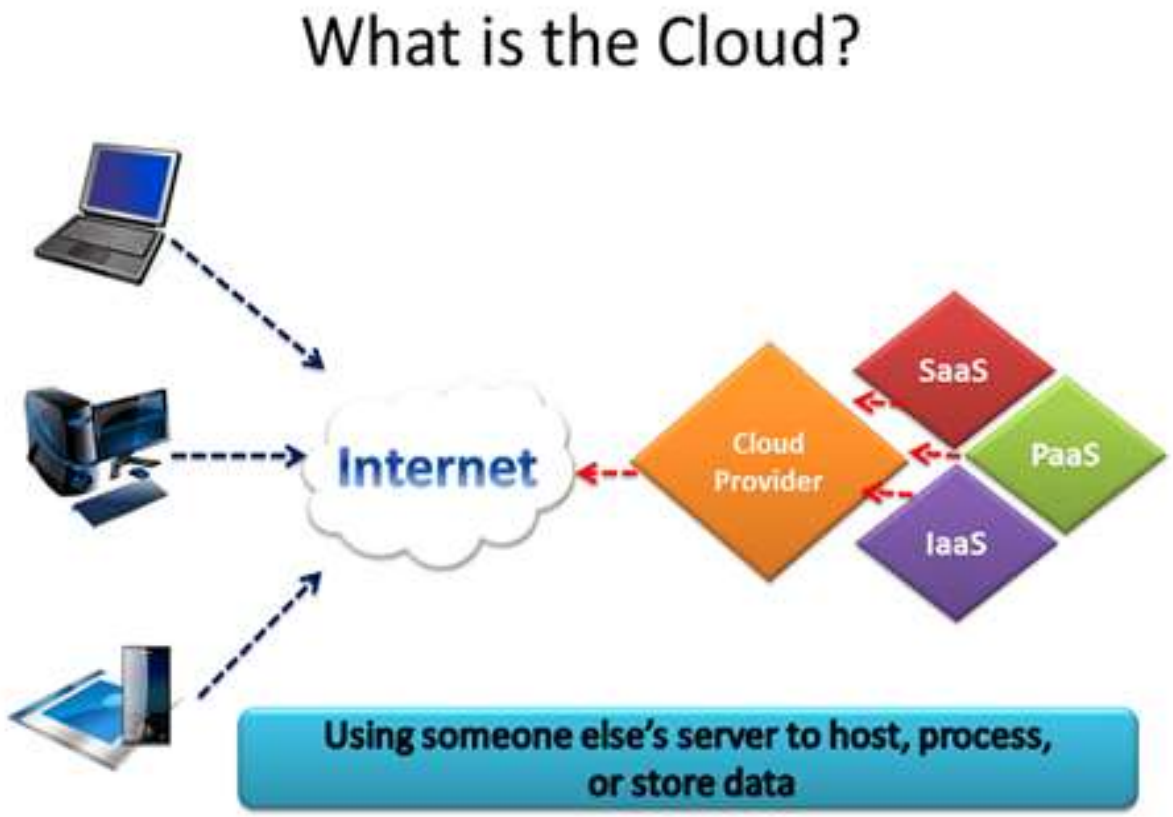
The goal of distributed computing is to distribute a single task among multiple computers and to solve it quickly by maintaining coordination between them

Switch from Distributed computing to Cloud Computing

1. There is no installation required
2. Lower cost structure.
3. Increased mobile access
4. The control and flexibility available.
5. It integrates with everything

Cloud computing (Cloud Distributed Computing)

- Cloud computing is a style of computing where massively scalable and flexible IT-related capabilities are delivered as a service to the users using Internet technologies, services may include: infrastructure, platform, applications, and storage space. The users pay for these services, resources they actually use. They do not need to build infrastructure of their own.



Cloud computing …

- An Internet-centric way of computing. The Internet plays a fundamental role in cloud computing, since it represents either the medium or the platform through which many cloud computing services are delivered and made accessible.

- Cloud computing refers to both the applications delivered as services over the Internet and the hardware and system software in the data centres that provide those services

- Everything as a service, mostly referred as XaaS2 IT infrastructure, development platforms, databases, and soon—can be delivered, measured, and consequently priced as a service.

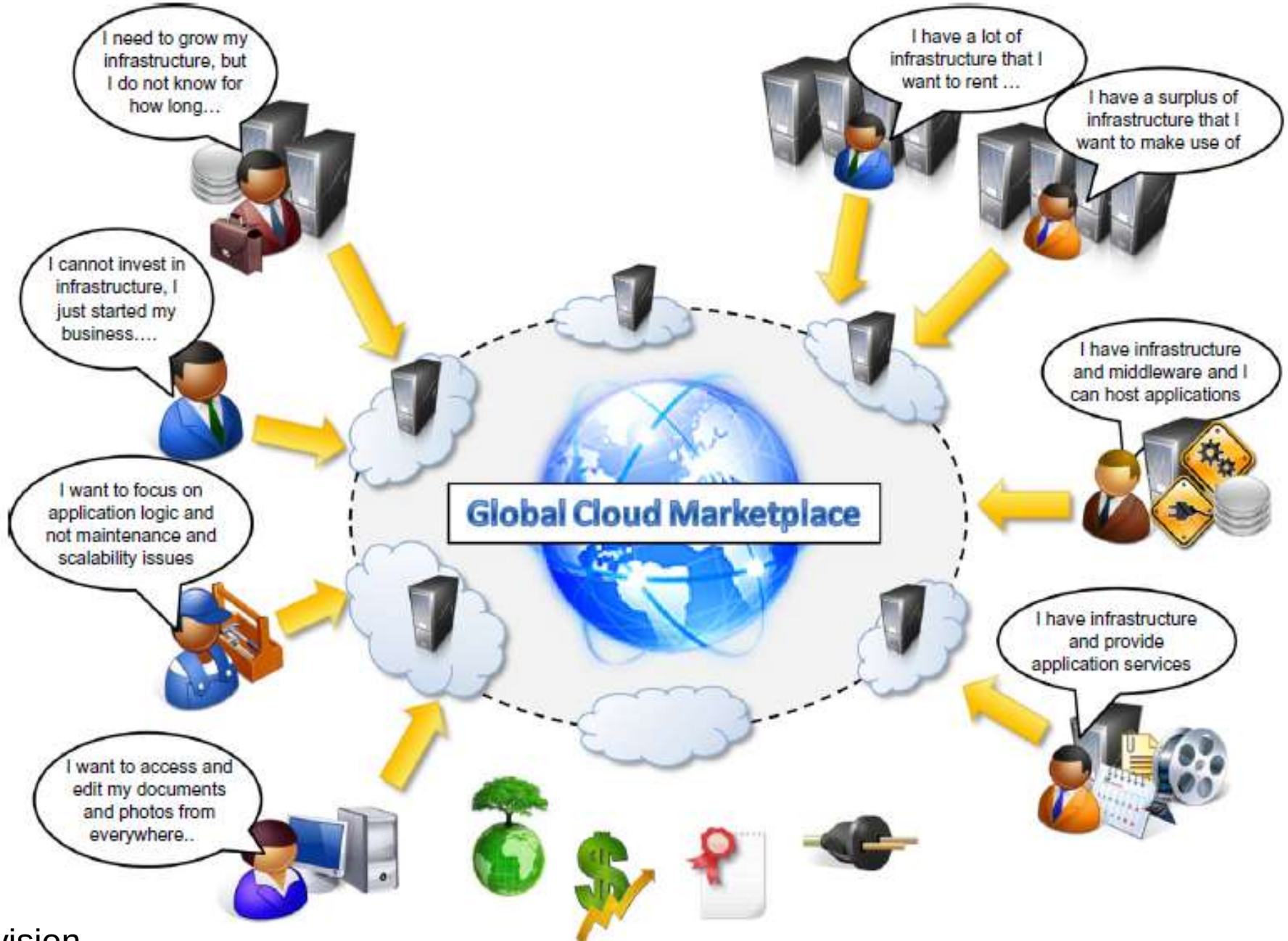
- Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

- Definition proposed by the U.S.National Institute of Standards and Technology (NIST):

- *Cloud computing is a model for enabling ubiquitous, 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.*

- It is a utility-oriented approach, cloud computing focuses on delivering services with a given pricing model, in most cases a “pay-per-use” strategy. It makes it possible to access online storage, rent virtual hardware, or use development platforms and pay only for their effective usage, with no or minimal up-front costs. All these operations can be performed and billed simply by entering the credit card details and accessing the exposed services through a Web browser.

- clouds hide the complex architecture they rely on and provide a single interface to users.



Cloud computing vision.

Practical examples of cloud systems across all market segments:

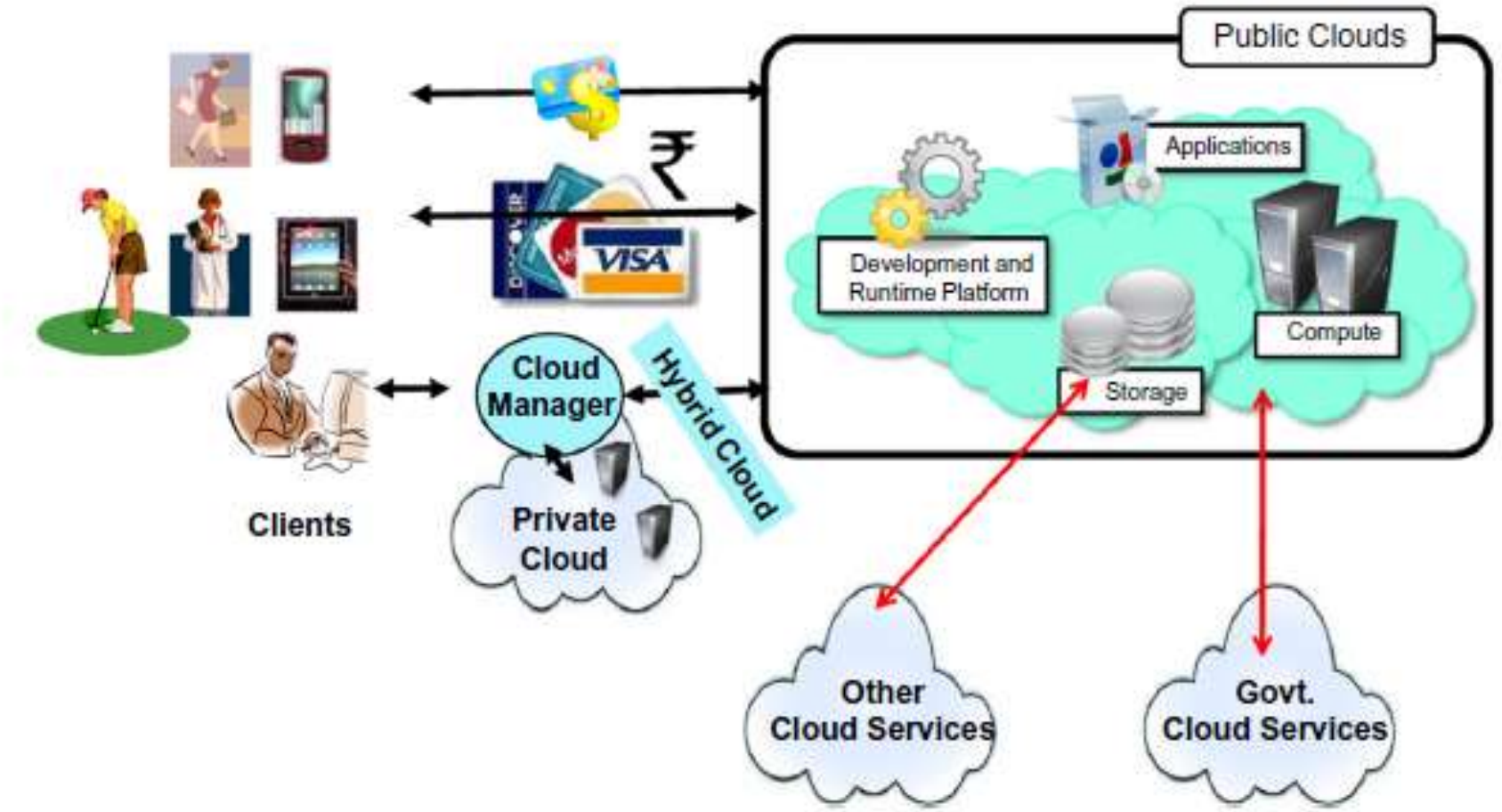
1. Large enterprises can offload some of their activities to cloud-based systems.

2. Small enterprises and start-ups can afford to translate their ideas into business results more quickly, without excessive up-front costs.

3. System developers can concentrate on the business logic rather than dealing with the complexity of infrastructure management and scalability.

4. End users can have their documents accessible from everywhere and any device.

Subscription - Oriented Cloud Services:
X{compute, apps, data, ..}as a Service (..aaS)



A bird’s-eye view of cloud computing

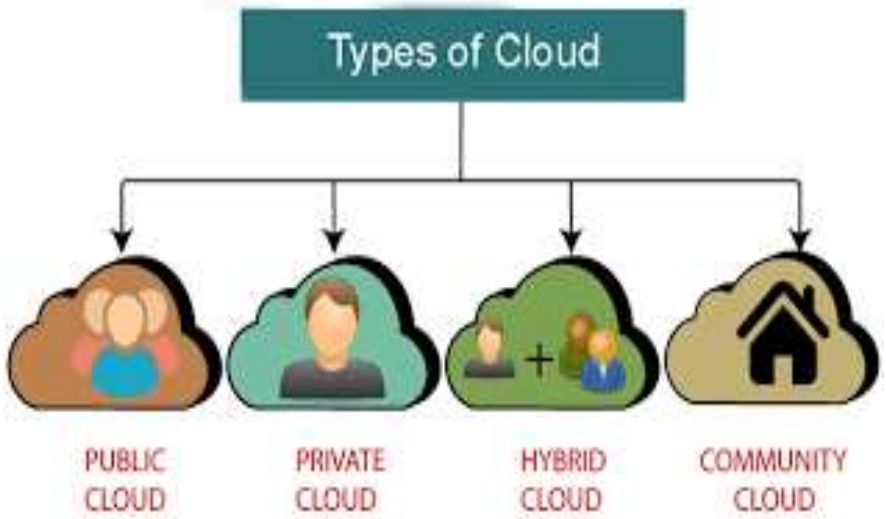
How does cloud computing work?

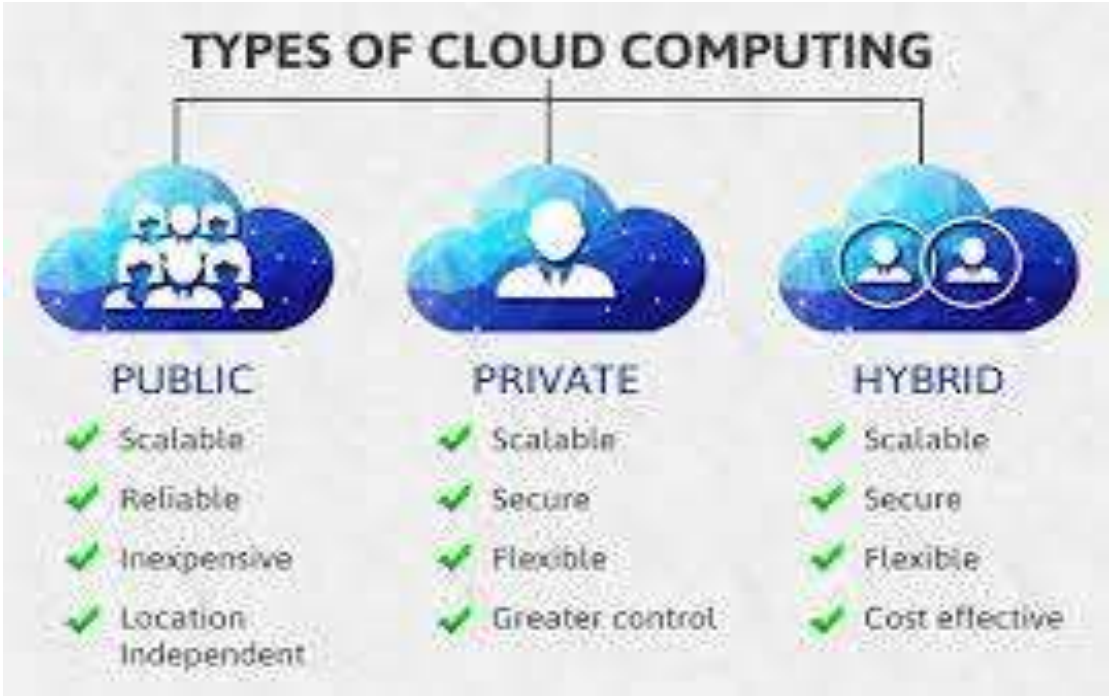
- Access data and cloud applications over the internet from remote physical servers, databases and computers
- Communications between the front and back ends are managed by a central server
- Relies heavily on virtualization and automation technologies

Cloud Computing …

- Cloud computing refers to providing on demand IT resources/services like server, storage, database, networking, analytics, software etc. over internet.
- a computing technique that delivers hosted services over the internet to its users/customers.
- It is classified into 4 different types such as Public Cloud, Private Cloud, Community Cloud and Hybrid Cloud.
- There are many benefits of cloud computing like cost effective, elasticity and reliable, access to the global market etc.
- Cloud computing provides services such as hardware, software, networking resources through internet.
- **The goal of cloud computing is to provide on demand computing services over internet on pay per use model.**
- Some characteristics of cloud computing are providing shared pool of configurable computing resources, on-demand service, pay per use , provisioned by the Service Providers etc.
- Some disadvantage of cloud computing includes less control especially in the case of public clouds, restrictions on available services may be faced and cloud security.

Types of cloud computing





Types of cloud

1. Public cloud: Public clouds are cloud environments typically created from IT infrastructure not owned by the end user.

   Alibaba Cloud, Amazon Web Services (AWS), Google Cloud, IBM Cloud, and Microsoft Azure.

2. Private clouds

   Private clouds are dedicated to a single end user or group, where the environment usually runs behind that user or group's firewall. All clouds become private clouds when the underlying IT infrastructure is dedicated to a single customer with completely isolated access

3. Hybrid clouds = Public + Private

Utility computing / On demand computing

- Utility computing is a service-providing paradigm in which a service provider makes computer resources and infrastructure management available to customers as needed, charging them on a per-use basis rather than a set fee.

- The user can only pay for what they use using utility computing. It is a plug-in that is administered by an organization that determines what kind of cloud services must be deployed. The majority of businesses prefer a hybrid strategy.

Three major milestones have led to cloud computing

1. Mainframe computing - Mainframes
2. Cluster computing - Clusters
3. Grid computing - Grids

1. Mainframes

A mainframe is the **central data repository**, or hub , in a corporation's data processing center, linked to users through less powerful devices such as workstations or terminals. The presence of a mainframe often implies a centralized form of computing, as opposed to a distributed form of computing

1. Mainframes

- Centralized control of resources.
- A style of operation, applications, and operating system facilities.
- Businesses use to host the commercial databases, transaction servers, and applications that require a greater degree of security and availability than is commonly found on smaller-scale machines.
- Hardware and operating systems that can share access to disk drives with other systems, with automatic locking and protection against destructive simultaneous use of disk data.
- A style of operation, often involving dedicated operations staff who use detailed operations procedure books and highly organized procedures for backups, recovery, training, and disaster recovery at an alternative location.
- Hardware and operating systems that routinely work with hundreds or thousands of simultaneous I/O operations.

Mainframes …

- used by large organizations for bulk data processing tasks such as online transactions, enterprise resource planning, and other operations involving the processing of significant amounts of data.

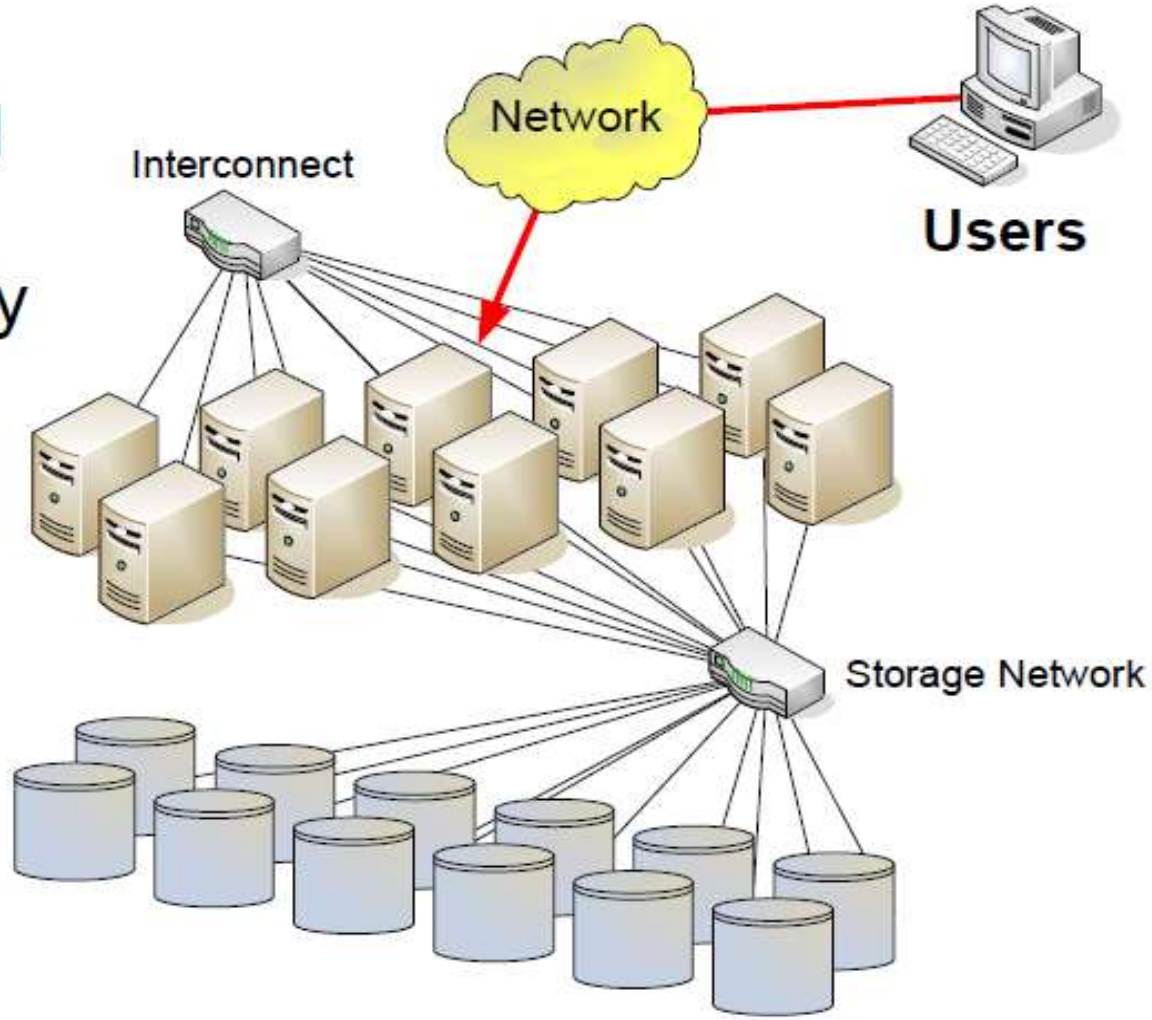
- offer large computational power by using multiple processors, presented as a single entity to users. Have the ability to be highly reliable computers that were “always on” and capable of tolerating failures transparently

- mainframes are now frequently used in combination with networks of smaller servers in a multitude of configurations. The ability to dynamically reconfigure a mainframe's hardware and software resources (such as processors, memory, and device connections), while applications continue running, further underscores the flexible, evolving nature of the modern mainframe.

- *Mainframes cannot scale up to meet the mission critical business requirements of processing huge structured and unstructured datasets*

2. Clusters

- A group of independent, but interconnected, computers that act as a single system
- Usually deployed to increase availability and performance or to balance a dynamically changing workload



Clusters…

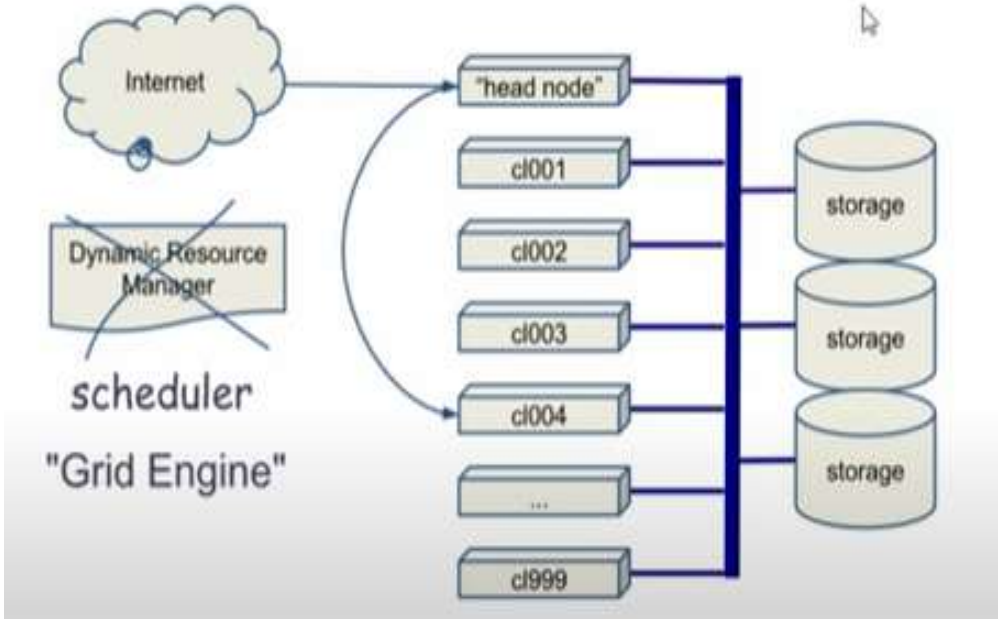
- A cluster consists of two or more independent, but interconnected, servers. A cluster is a group of independent servers that cooperate as a single system.

- Provides high availability by allowing work to be transferred to a secondary node if the active node fails.

- Appears to an application as if it were a single server. Several servers are managed as single server. The cluster management software provides transparency.

- For the nodes to act as if they were a single server, files must be stored in such a way that they can be found by the specific node that needs them. There are several different cluster topologies that address the data access issue, each dependent on the primary goals of the cluster designer.

Clusters…



- A computer cluster is a group of two or more computers/servers, or nodes, that act like a single system and enable high availability, load balancing and parallel processing
- Nodes run in parallel to achieve a common goal.
- A cluster functions as if it were a single system. A user accessing the cluster should not need to know whether the system is a cluster or an individual machine. A cluster should be designed to minimize latency and prevent bottlenecks in node to node communication.

Grid

- A computer network consisting of a number of computer systems connected in a grid topology
- access large computational power, huge storage facilities, and a variety of services.
- Users can “consume” resources in the same way as they use other utilities such as power, gas, and water.
- geographically dispersed clusters by means of Internet connections. These clusters belonged to different organizations, and arrangements were made among them to share the computational power.
- a computing grid is a dynamic aggregation of heterogeneous computing nodes, and its scale was nationwide or even worldwide

Edge computing

- Edge computing is computing that's done at or near the source of the data, instead of relying on the cloud servers
- Edge computing is a distributed information technology (IT) architecture in which client data is processed at the periphery of the network, as close to the originating source as possible
- Edge computing is the computational processing of sensor data away from the centralized nodes and close to the logical edge of the network, toward individual sources of data.
- Enables mobile computing for data produced locally
- **Edge computing is the practice of capturing, storing, processing and analyzing data near the client, where the data is generated, instead of in a centralized data-processing warehouse.**
- Edge computing moves some portion of storage and compute resources out of the central data centre and closer to the source of the data itself. Rather than transmitting raw data to a central data center for processing and analysis, that work is instead performed where the data is actually generated
- Running AI on a user's device instead of all in the cloud seems to be a huge focus

Edge Computing

There are three main cloud service delivery models:

1. Infrastructure as a service (IaaS)
2. Software as a service (SaaS)
3. Platform as a service (PaaS)

Infrastructure as a Service (IaaS)

- Offers essential compute, storage and networking resources on demand
- A cloud service provider manages the infrastructure for you—the actual servers, network, virtualization, and data storage—through an internet connection.
- IaaS offers administrators more direct control over operating systems.
- IaaS provides users access to computing resources such as networking, processing power and data storage capacity.
- Examples: Amazon EC2, Windows Azure, Rackspace, Google Compute Engine.
- VM's are IAAS (Infrastructure as a service) because on a VM you can manage what operation system runs and what software is installed

Platform as a Service (PaaS):

- The hardware and an application-software platform are provided and managed by an outside cloud service provider, but the user handles the apps running on top of the platform and the data the app relies on.

- PaaS offers users greater flexibility and ease of operation.

- PaaS, or platform as a service, is on-demand access to a complete, ready-to-use, cloud-hosted platform for developing, running, maintaining and managing applications.

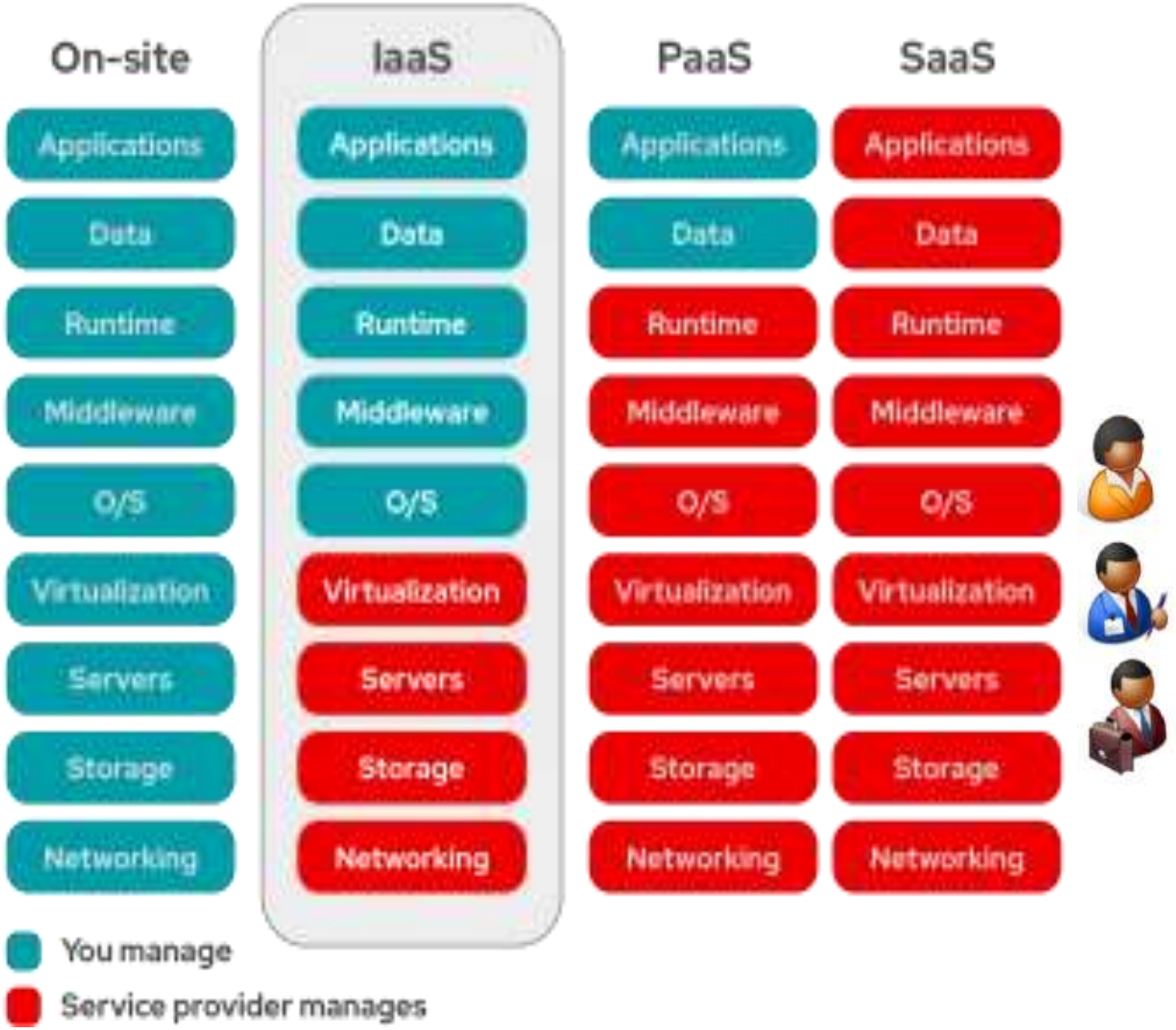
- Ex: Microsoft Azure, AWS Elastic Beanstalk, Force.com. by Salesforce, Google App Engine, Rackspace Cloud Sites, OpenShift, and Apache Stratos

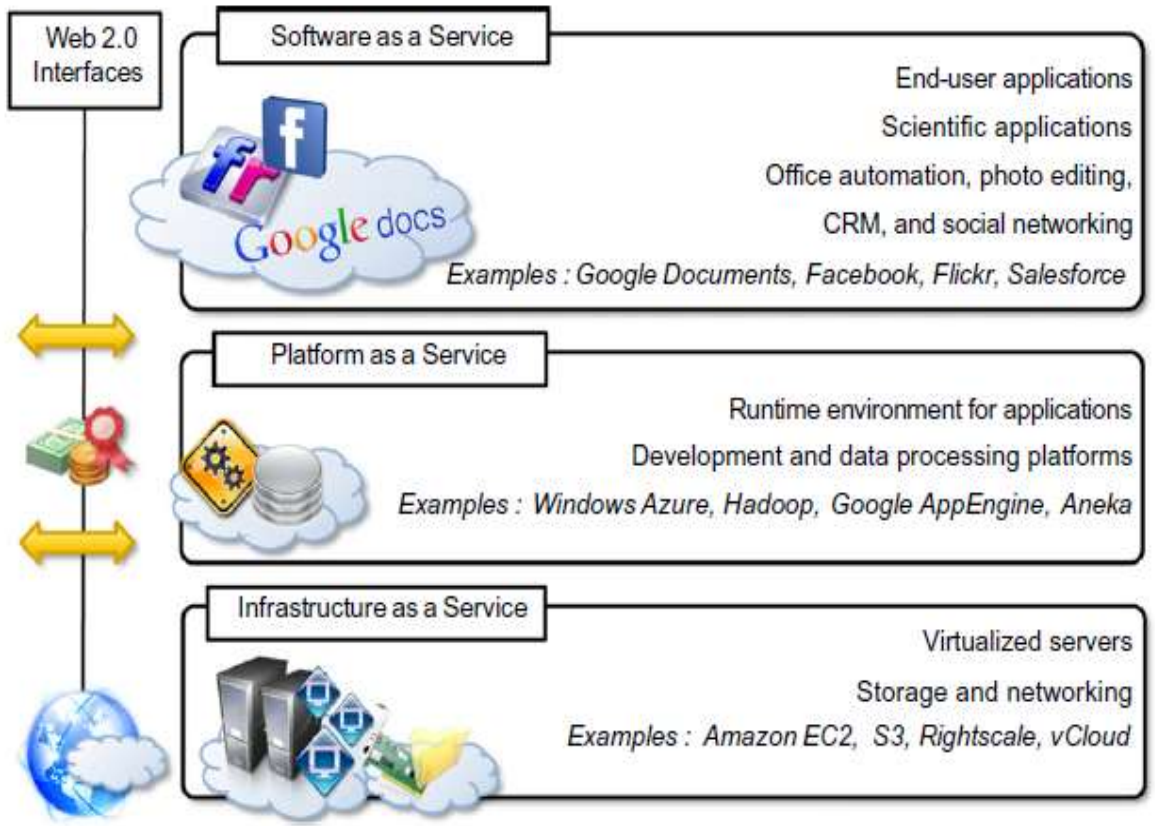
- Facebook. Developers can create specific applications for the Facebook platform using proprietary APIs and make that application available to any Facebook user

Software as a Service (SaaS)

- Delivers a software application—which the cloud service provider manages to its users.
- SaaS, or software as a service, is on-demand access to ready-to-use, cloud-hosted application software
- SaaS apps are web applications or mobile apps that users can access via a web browser.
- Software updates, bug fixes, and other general software maintenance are taken care of for the user, and they connect to the cloud applications via a dashboard or API.
- Ex: Google, Edge, Mozilla, Zoom, Messaging applications like WhatsApp, Facebook messenger
- Netflix is a SaaS company that sells software to watch licensed videos on demand. It follows a subscription-based model whereby the customer chooses a subscription plan and pays a fixed sum of money to Netflix monthly or annually
- Allows users to connect to and use cloud-based apps over the Internet. Common examples are email, calendaring, and office tools (such as Microsoft Office 365)

Types of cloud computing services



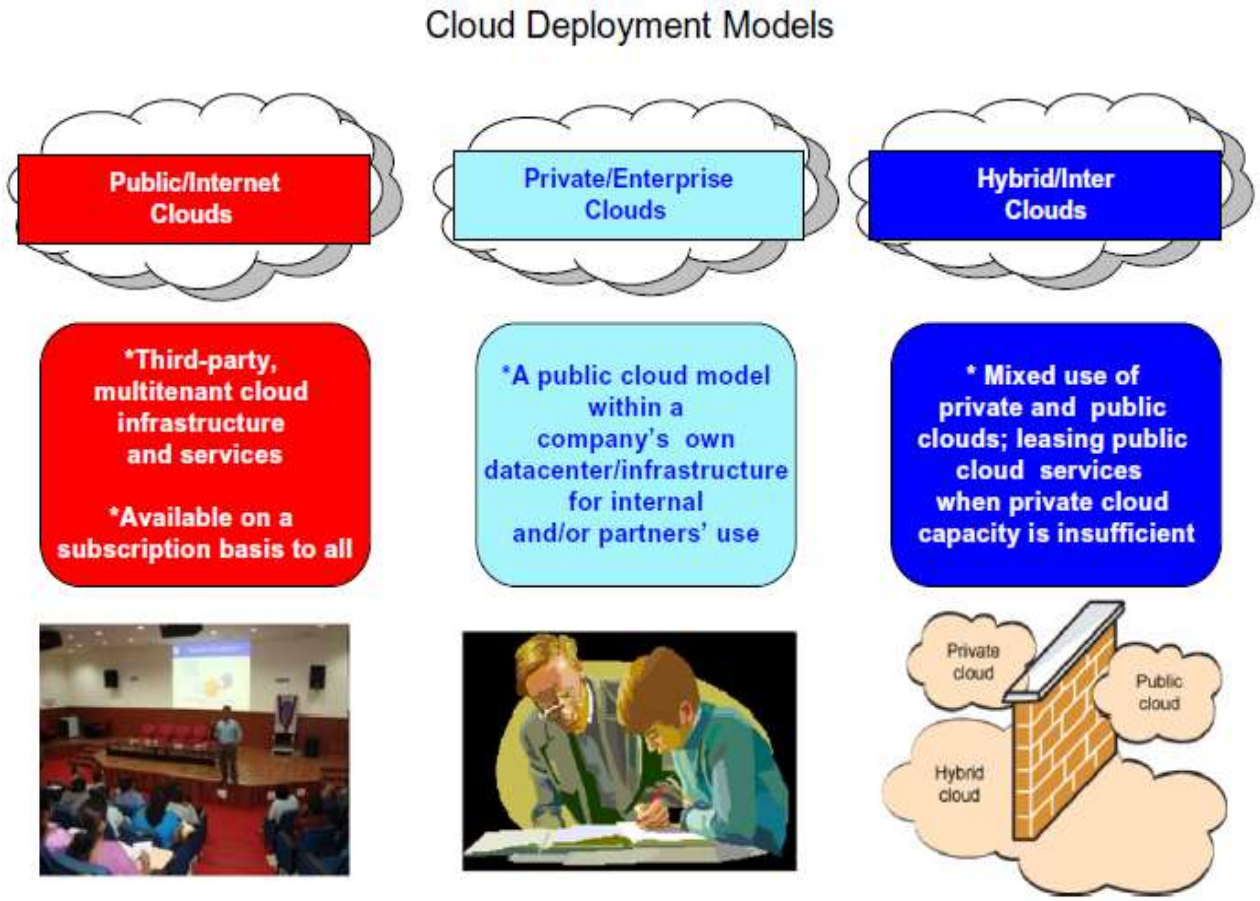


Cloud Deployment Models

- Access to a shared pool of computer resources (servers, storage, programs, and so on) in the cloud.
- Request additional resources when you require them , getting resources up and running quickly with the clouds.
- Release resources that are no longer necessary. This method allows you to just pay for what you use.
- Your cloud provider is in charge of all upkeep. It functions as a virtual computing environment with a deployment architecture that varies depending on the amount of data you want to store and who has access to the infrastructure.

Cloud Deployment Models …

1. Public cloud
2. Private cloud
3. Hybrid cloud
4. Community cloud
5. Multi-cloud



1. Public Cloud

- The public cloud makes it possible for anybody to access systems and services.
- The public cloud may be less secure as it is open for everyone.
- The public cloud is one in which cloud infrastructure services are provided over the internet to the general people or major industry groups.
- The infrastructure in this cloud model is owned by the entity that delivers the cloud services, not by the consumer.
- It is a type of cloud hosting that allows customers and users to easily access systems and services.
- In this arrangement, storage backup and retrieval services are given for free, as a subscription, or on a per-use basis.
- Example: Google App Engine etc.

Advantages of the public cloud model:

1. Minimal Investment
2. No setup cost
3. Infrastructure Management is not required
4. No maintenance
5. Dynamic Scalability
6. To fulfill company’s needs, on-demand resources are accessible.

2. Private Cloud

- The private cloud deployment model is the exact opposite of the public cloud deployment model.
- It’s a one-on-one environment for a single user (customer). There is no need to share your hardware with anyone else.
- Private hardware.
- It is also called the “internal cloud” & ability to access systems and services within a given border or organization.
- The cloud platform is implemented in a cloud-based secure environment that is protected by powerful firewalls and under the supervision of an organization’s IT department.
- The private cloud gives the greater flexibility of control over cloud resources

Advantages - Private Cloud model

- Better Control
- Data Security and Privacy
- Supports Legacy Systems
- Customization

3. Hybrid cloud

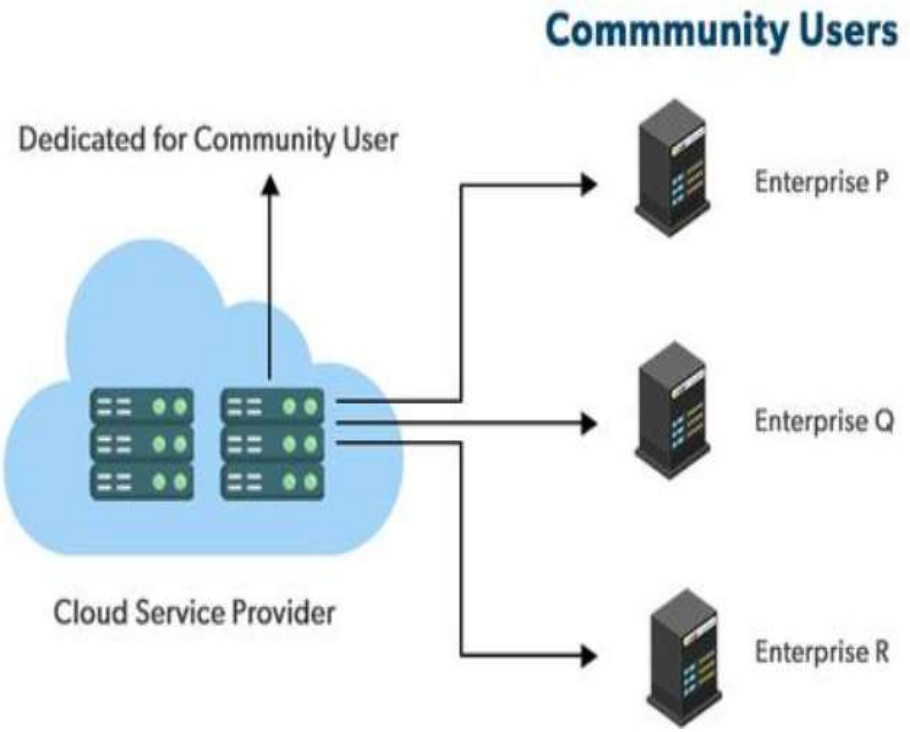
- Bridging the public and private worlds with a layer of proprietary software
- With a hybrid solution, you may host the app in a safe environment while taking advantage of the public cloud’s cost savings.
- Organizations can move data and applications between different clouds using a combination of two or more cloud deployment methods, depending on their needs.

Advantages - hybrid cloud model

- Flexibility and control
- Cost
- Security

4. Community cloud

- It allows systems and services to be accessible by a group of organizations.
- Created by integrating the services of different clouds to address the specific needs of a community, industry, or business.
- The infrastructure of the community could be shared between the organization which has shared concerns or tasks.
- Managed by a third party or by the combination of one or more organizations in the community.



Advantages - community cloud model

- Cost Effective
- Security
- Shared resources
- Collaboration and data sharing

- Community cloud is cost-effective because the whole cloud is being shared by several organizations or communities.
- Community cloud is suitable for organizations that want to have a collaborative cloud with more security features than the public cloud.
- It provides better security than the public cloud.
- It provides collaborative and distributive environment.
- Community cloud allows us to share cloud resources, infrastructure, and other capabilities among various organizations.

Disadvantages of Community Cloud

- Community cloud is not a good choice for every organization.
- Security features are not as good as the private cloud.
- It is not suitable if there is no collaboration.
- The fixed amount of data storage and bandwidth is shared among all community members.

5. Multi-cloud

- Similar to the hybrid cloud deployment approach, which combines public and private cloud resources.
- Uses many public clouds
- Improves the high availability of your services even more.
- Multicloud is the use of multiple cloud computing services from different providers, which allows organizations to use the best-suited services for their specific needs and avoid vendor lock-in.
- This allows organizations to take advantage of the different features and capabilities offered by different cloud providers.

Advantages – Multi-Cloud model

- Mix and match the best features of each cloud provider's services to suit the demands of your apps, workloads, and business by choosing different cloud providers.
- Reduced Latency
- High availability of service
- Flexibility: Using multiple cloud providers allows organizations to choose the best-suited services for their specific needs, and avoid vendor lock-in.
- Cost-effectiveness: Organizations can take advantage of the cost savings and pricing benefits offered by different cloud providers for different services.
- Improved performance: By distributing workloads across multiple cloud providers, organizations can improve the performance and availability of their applications and services.
- Increased security: Organizations can increase the security of their data and applications by spreading them across multiple cloud providers and implementing different security strategies for each.

Disadvantages

- Complexity: Managing multiple cloud providers and services can be complex and require specialized knowledge and expertise.
- Increased costs: The cost of managing multiple cloud providers and services can be higher than using a single provider.
- Compatibility issues: Different cloud providers may use different technologies and standards, which can cause compatibility issues and require additional resources to resolve.
- Limited interoperability: Different cloud providers may not be able to interoperate seamlessly, which can limit the ability to move data and applications between them.

In which cloud multiple users rely on a common cloud?

In which cloud multiple users rely on a common cloud?

Public Cloud

In which Cloud Data Security is very high?

In which Cloud Data Security is very high?

Private Cloud

For which Cloud maintenance cost is high?

For which Cloud maintenance cost is high?

Private Cloud, Hybrid, Multi-Cloud

Which Cloud do you recommend?

For fintech, legal, healthcare, and other companies that store and process sensitive information and personal data

Which Cloud do you recommend?

For fintech, legal, healthcare, and other companies that store and process sensitive information and personal data

Private Cloud

Which Cloud do you recommend?

Large-scale organizations that process massive amounts of data on a regular basis and focus on tech innovations should choose ---------- Cloud

Which Cloud do you recommend?

Large-scale organizations that process massive amounts of data on a regular basis and focus on tech innovations should choose multi-clouds.

Multi-Cloud

Which Cloud is Safest?

Which Cloud Costs the Most? The Least?

Characteristics of Cloud

1. Self-service provisioning
2. Elasticity
3. Pay per use
4. Workload resilience
5. Migration flexibility
6. Broad network access
7. Multi-tenancy and resource pooling
8. Cost management
9. Data and workload mobility
10. Business continuity and disaster recovery (BCDR)

Disadvantages of cloud computing

1. Cloud security
2. Cost unpredictability
3. Lack of capability and expertise
4. IT governance
5. Compliance with industry laws
6. Management of multiple clouds
7. Cloud performance
8. Building a private cloud
9. Cloud migration
10. Vendor lock-in

Cloud computing examples

- Google Docs, Microsoft 365
- Email, Calendar, Skype, WhatsApp
- Zoom , MS Teams
- AWS Lambda

Cloud computing service providers

The three largest public CSPs that have established themselves as dominant fixtures in the industry are the following:

AWS

GCP

Microsoft Azure

Other major CSPs include the following:

Apple

Citrix

IBM

Salesforce

Alibaba

Oracle

VMware

SAP

Joyent

Rackspace

Cloud Computing Security Issues and Challenges

1. Misconfiguration
2. Cyberattacks
3. Malicious Insiders
4. Lack of Visibility
5. Data Leakage
6. Inadequate Staff
7. Data Privacy

Cloud-Native Applications

Cloud native applications—or native cloud applications (NCAs)—are programs designed for a cloud computing architecture

These applications are run and hosted in the cloud and are designed to capitalize on the inherent characteristics of a cloud computing software delivery model.

Cloud-native applications use a microservice architecture

Cloud native is an approach to building and running applications that exploits the advantages of the cloud computing delivery model.

Enables you to build and to run your scalable app in a dynamic environment: a public, private, or hybrid cloud.

Is a design methodology that utilizes cloud services such as EC2, S3, Lambda from AWS, etc to allow dynamic and agile application development techniques that take a modular approach to building, running, and updating software.

A native app

A native app is software that is developed for use on a specific platform or device. An application written to work on a specific device platform

a native app is built for use on a particular device and its OS, it has the ability to use device-specific hardware and software.

Native apps can provide optimized performance and take advantage of the latest technology, such as a GPS, compared to web apps or mobile cloud apps developed to be generic across multiple systems.

Uses a microservice architecture. This architecture efficiently allocates resources to each service that the application uses, making the application flexible and adaptable to a cloud architecture.

The term native app is used to refer to platforms such as Mac and PC, with examples such as the Photos, Mail or Contacts applications that are preinstalled and configured on every Apple computer

The two main mobile OS platforms are Apple's iOS and Google's Android.

Examples: A cloud native app

With the ability to tap into specific resources, native apps can quickly access multiple services on a device, such as the microphone, accelerometer or push notifications.

- Examples of native applications range from navigation programs, social apps, such as Twitter, or games, such as Pokémon Go.
- Kubernetes, Docker, Containers, Microservices
- AWS Lambda and Azure Functions
- A app that ships with built-in self-healing (Resilient to Failures)
- Cloud native is a way to increase the velocity of your business and a method to structure teams to take advantage of the automation and scalability that cloud native technologies like Kubernetes offer.

Examples: A cloud native app

- Docker. The Docker platform is open source. It creates, deploys and manages virtualized application containers using a common operating system (OS). It isolates resources allowing multiple containers to use the same OS without contention.

- Kubernetes. The Kubernetes platform is used to manage and orchestrate Linux containers, determining how and where the containers will run.

- Terraform. Designed for implementing IaC, Terraform defines resources as code and applies version control so users can see when and where resources were altered.

- GitLab CI/CD. This continuous integration/continuous development (CI/CD) software lets users automate software testing and deployment. GitLab can be used for security analysis, static analysis and unit tests.

- Node.js. This JavaScript runtime is useful for creating real-time applications like chat, news feeds and other microservices. For example, Node.js can create virtual servers and define the routes that connect microservices to external APIs.

Difference between a application on cloud and on Native?

- Cloud-native: Applications are flexible and built to scale and because of the microservice architecture, areas of an app can be upgraded without disruption.

- Cloud-based: Applications are tightly integrated, and upgrades may be needed for the entire stack, causing downtime
- cloud computing providers: Amazon Web Services (AWS) or Google Cloud Platform (GCP)

- Cloud-native applications are developed using every modern tool and technology, including DevOps, Agile methodology, cloud platforms (AWS, GCP, Azure), microservices, containers (like Docker, Kubernetes), and continuous delivery

microservices

- Cloud-native applications use a microservice architecture. This architecture efficiently allocates resources to each service that the application uses, making the application flexible and adaptable to a cloud architecture.

- An approach to application development in which a large application is built from modular components or services.

- Each module supports a specific task or business goal and uses a simple, well-defined interface, such as an application programming interface (API), to communicate with other sets of services.

Cloud Native Applications on AWS

1. Amazon Simple Storage Service (S3)
2. Amazon CloudFront CDN
3. AWS Lambda
4. Amazon Elastic Load Balancing (ELB)
5. Amazon Simple Notification System (SNS)
6. Amazon Simple Queue Service (SQS)
7. Amazon Simple Email Service (SES)
8. Amazon Cognito
9. 9. Amazon Route 53
10. 10. Amazon Machine Learning

The Top 10 Most Used AWS Services

1. Amazon EC2
2. Amazon RDS
3. Amazon Simple Storage Service (S3)
4. Amazon CloudFront
5. Amazon VPC
6. Amazon SNS
7. AWS Beanstalk
8. AWS Lambda
9. AWS Autoscaling
10. AWS IAM

Building Cloud Native Applications on AWS

- Amazon Web Services (AWS) is a cloud computing platform that offers a mix of infrastructure as a service (IaaS), platform as a service (PaaS), and packaged software as a service (SaaS) services.
- AWS has more than 1 million active customers in 190 countries, with a revenue of $6.1 billion.
- It offers a wide range of services, solutions, and training programs that enables development teams to stay product focused, rather than investing time on infrastructure to support an application.
-
- To build a cloud-native application on AWS, these are some of the best services that can help to boost application performance

microservices

microservices

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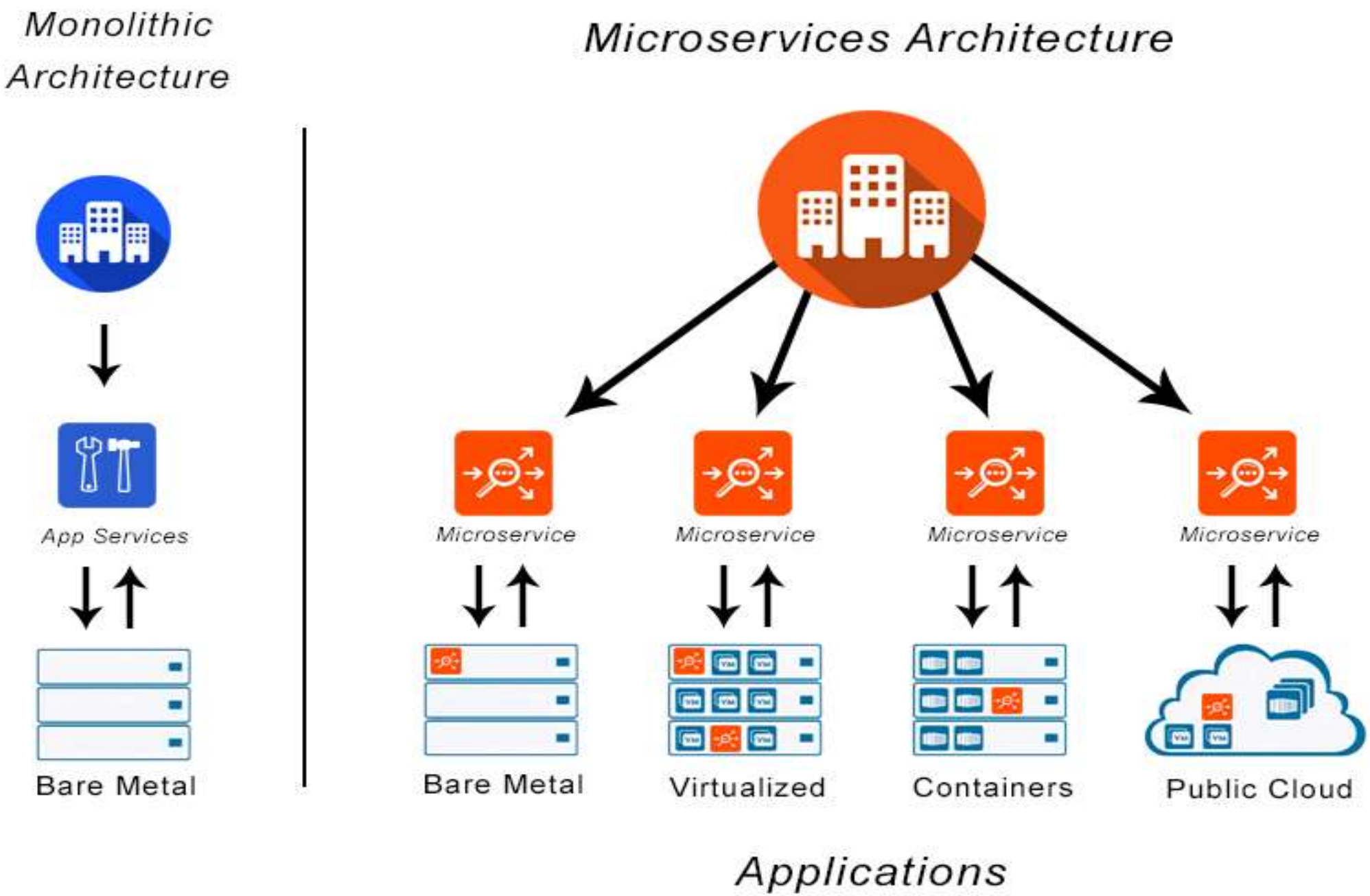
- Each module supports a specific task or business goal and uses a simple, well-defined interface, such as an application programming interface (API), to communicate with other sets of services.

- Microservices are loosely coupled application services, each independently built and maintained. Collectively and working together, they form an application. They are usually organized to align individually to business functions, such as a payment or a messaging service.

Microservices

- Is an architectural design for building a distributed application using containers.
- Each function of the application operates as an independent service.
- Architecture allows for each service to scale or update without disrupting other services in the application.
- Framework creates a massively scalable and distributed system, which avoids the bottlenecks of a central database and improves business capabilities, such as enabling continuous delivery/deployment applications and modernizing the technology stack.


Monolithic Architecture
Microservices Architecture
App Services
Bare Metal
Microservice
Microservice
Microservice
Microservice
Bare Metal
Virtualized
Containers
Public Cloud
Applications

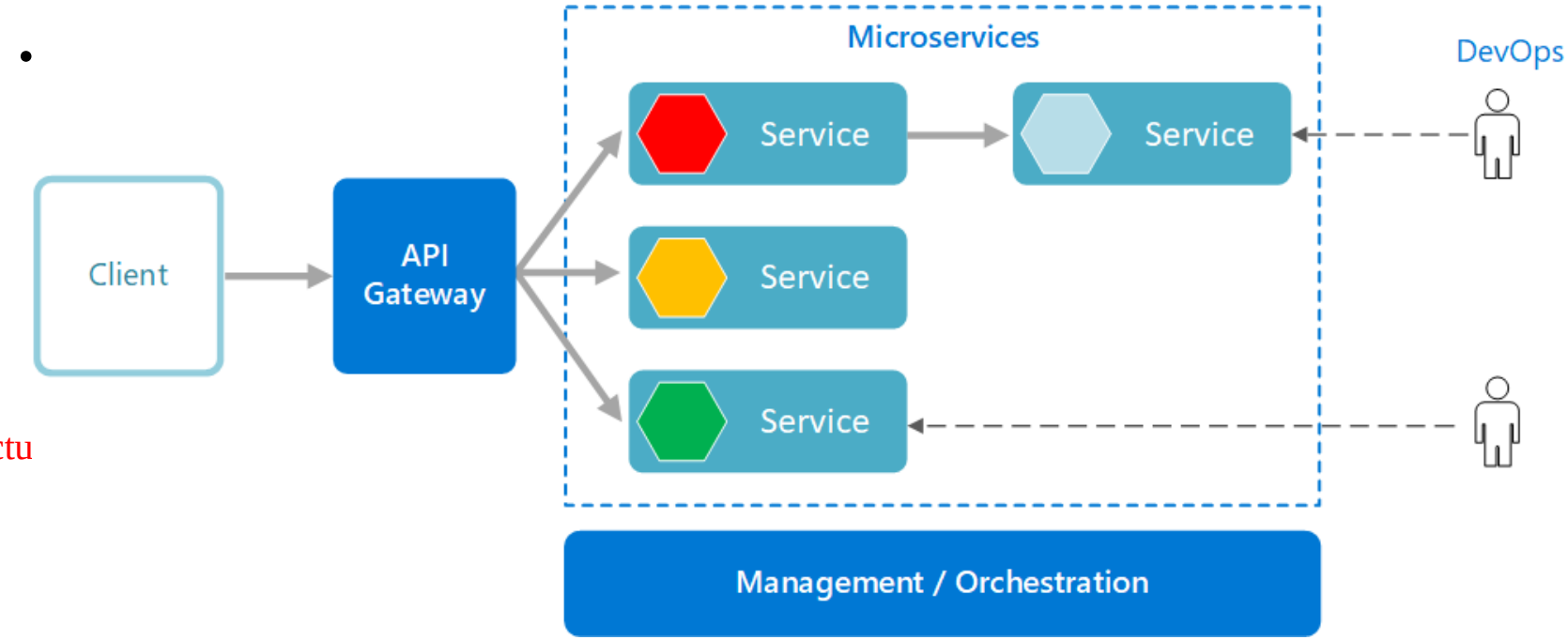
Microservices versus monolithic architecture

- A monolithic application is a software application that is built as a single code package, compared to a microservices-based application, which comprises individual code components.

- The tight coupling of a monolithic application's components requires that the code package is replaced in its entirety, when an update needs to be made. This increases potential risk both from a code and infrastructure perspective, while reducing feature velocity and change

- A microservices-based application can be updated more frequently and with less risk, as the changes to its individual components (microservices) can be rolled out independent of each other.

microservices …



https://docs.microsoft.com/en-us/azure/architectu

An architectural style that structures an application as a collection of services that are

- Highly maintainable and testable
- Loosely coupled
- Independently deployable
- Organized around business capabilities
- Owned by a small team
- The microservice architecture enables the rapid, frequent and reliable delivery of large, complex applications. It also enables an organization to evolve its technology stack

Microservices ..

Microservices are an architectural approach to creating cloud applications.

Each application is built as a set of services, and each service runs in its own processes and communicates through APIs.

Microservices are decentralized and run on different servers, but they still work together for an application

Benefits of microservices architecture

- Microservices-based architecture is a popular option for development teams that embrace a DevOps philosophy. Breaking an application into individual components facilitates agile development with rapid and more frequent deployments.

- Microservices can drive better infrastructure efficiencies, as they can scale up and down as required, compared to monolithic architectures.

What is Docker?

Docker is a software platform that allows you to build, test, and deploy applications quickly.

Docker packages software into standardized units called containers that have everything the software needs to run including libraries, system tools, code, and runtime.

Containers and Kubernetes

Microservices are typically packaged in containers, including their application code and dependencies. This offers a lightweight, standardized application deployment and delivery model, abstracted from physical infrastructure.

In order to manage containers at scale, Kubernetes has become the de facto standard for how containers are orchestrated and deployed.

Containers

- Containers are a form of operating system virtualization.
- Containers provide a standard way to package your application's code, configurations, and dependencies into a single object. Containers share an operating system installed on the server and run as resource-isolated processes, ensuring quick, reliable, and consistent deployments, regardless of environment
- A single container might be used to run anything from a small microservice or software process to a larger application.
- Inside a container are all the necessary executables, binary code, libraries, and configuration files. Compared to server or machine virtualization approaches, however, containers do not contain operating system images. This makes them more lightweight and portable, with significantly less overhead.
- *container clusters can be managed by Kubernetes*

Common containers use cases

1. Microservices: Containers provide process isolation that makes it easy to break apart and run applications as independent components called microservices.

2. Batch processing: Package batch processing and ETL jobs into containers to start jobs quickly and scale them dynamically in response to demand.

3. Machine learning: Use containers to quickly scale machine learning models for training and inference and run them close to your data sources on any platform.

4. Hybrid applications: Containers let standardize how code is deployed, making it easy to build workflows for applications that run between on-premises and cloud environments.

5. Application migration to the cloud: Containers make it easy to package entire applications and move them to the cloud without needing to make any code changes.

6. Platform as a service: Use containers to build platforms that remove the need for developers to manage infrastructure and standardize how your applications are deployed and managed.

Kubernetes

Kubernetes (also spelled “K8s”) is an open-source software platform used to manage containers. Using automation, it takes care of the manual engineering effort in deploying container-based applications at scale

Kubernetes offers great value for DevOps and IT Operations teams, as it enables them to maintain a common and consistent environment throughout an application's lifecycle.

Kubernetes is an open source container management and orchestration system. On AWS, you can choose to run and manage Kubernetes infrastructure with Amazon EC2, or use Amazon EKS for a managed, automatically provisioned Kubernetes control plane.