UNIT-6

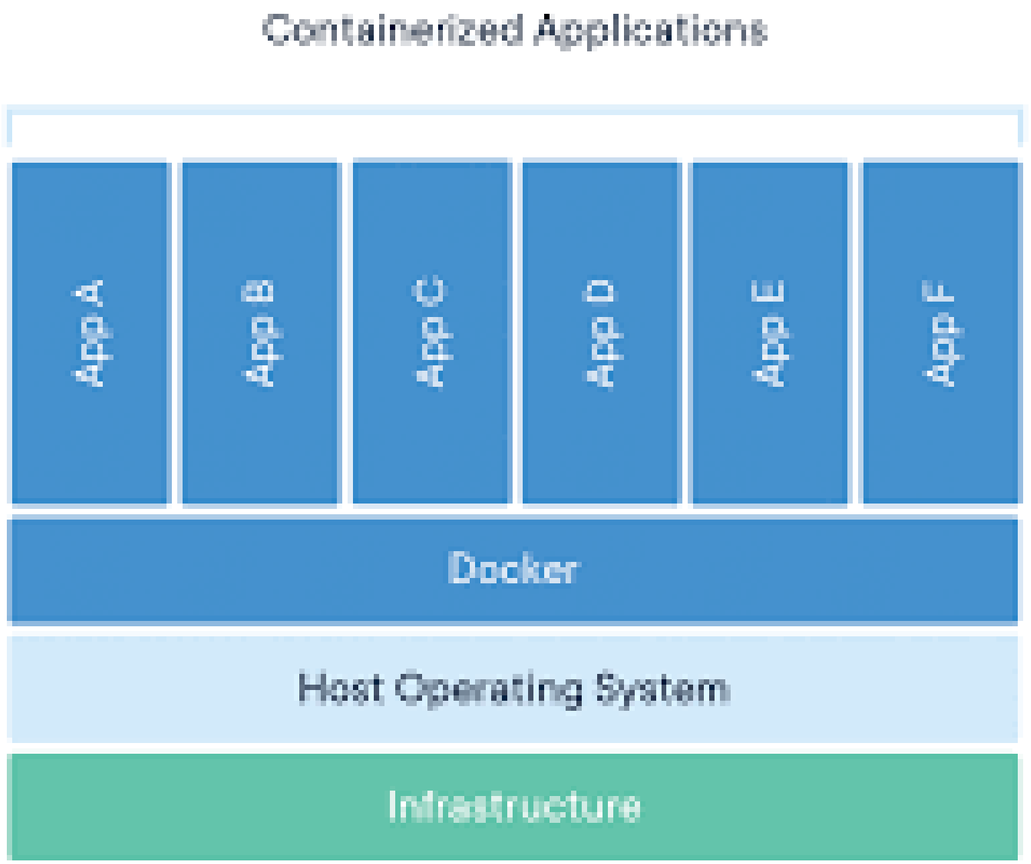
Contents

Introduction to Containers

- A container is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another.
- A Docker container image is a lightweight, standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries and settings.
- Container images become containers at runtime and in the case of Docker containers - images become

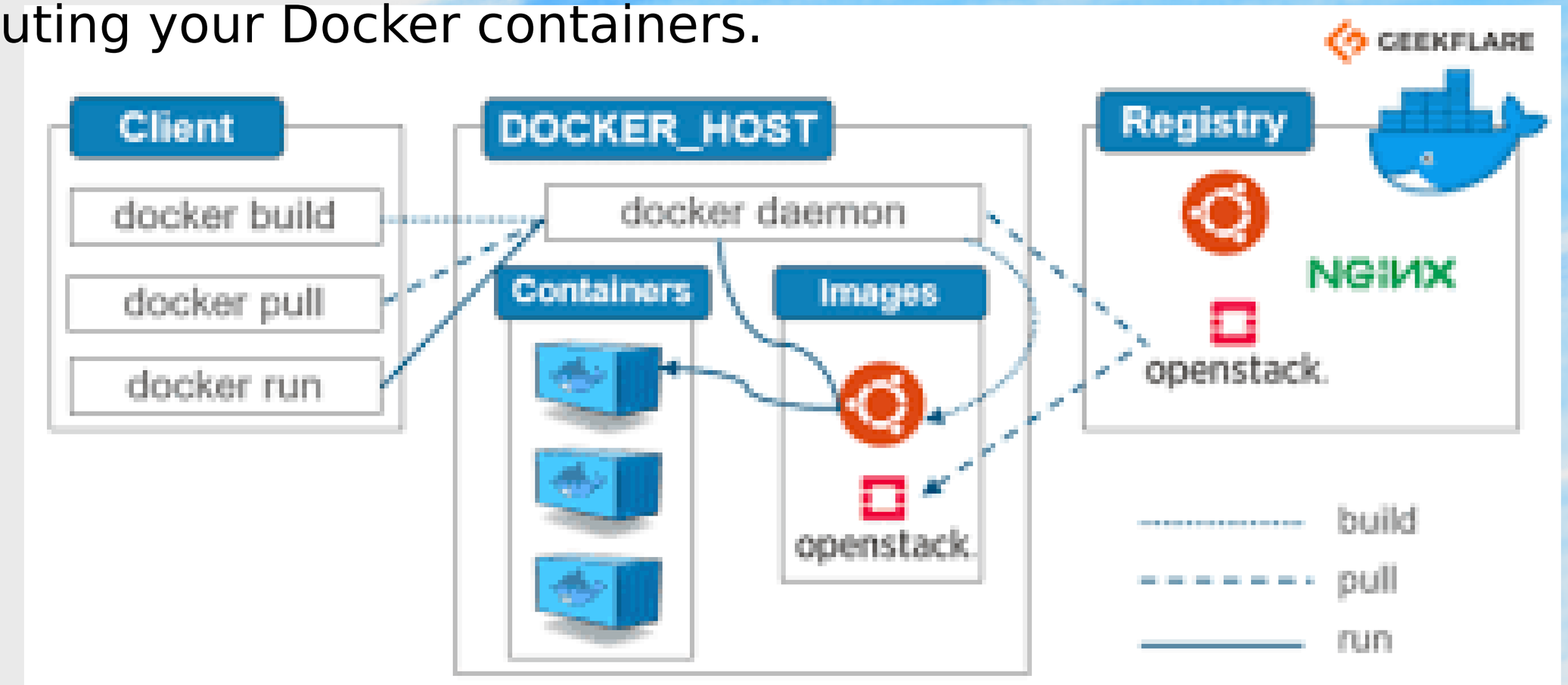
Containers isolate software from its environment and ensure that it works uniformly despite differences for instance between development and staging.

Docker is an open platform for developing, shipping, and running applications. Docker enables you to separate your applications from your infrastructure so you can deliver software quickly.



INTRODUCTION TO DOCKERS

Docker uses a client-server architecture. The Docker client talks to the Docker daemon, which does the heavy lifting of building, running, and distributing your Docker containers.



- **The Docker client and daemon can run on the same system, or you can connect a Docker client to a remote Docker daemon. The Docker client and daemon communicate using a REST API, over UNIX sockets or a network interface.**

- The Docker daemon

The Docker daemon (dockerd) listens for Docker API requests and manages Docker objects such as images, containers, networks, and volumes.

- The Docker client

The Docker client (docker) is the primary way that many Docker users interact with Docker. When you use commands such as docker run, the client sends these commands to dockerd, which carries them out. The docker command uses the Docker API. The Docker client can communicate with more than one

- **Docker registries**
  - A Docker registry stores Docker images. Docker Hub is a public registry that anyone can use, and Docker is configured to look for images on Docker Hub by default. When the docker pull or docker run commands, the required images are pulled from your configured registry.
- Docker objects
  - When you use Docker, you are creating and using images, containers, networks, volumes, plugins, and other objects. This section is a brief overview of some of those objects.
- Images & containers
  - An image is a read-only template with instructions for creating a Docker container. Often, an image is based on another image, with some additional customization.
- A container is a runnable instance of an image. You can create, start, stop, move, or delete a container using the Docker API or CLI. You can connect a

- **Services**
  - Services allow you to scale containers across multiple Docker daemons, which all work together as a swarm with multiple managers and workers. Each member of a swarm is a Docker daemon, and the daemons all communicate using the Docker API.
- Docker Engine
  - Docker Engine is a client-server application with these major components:
- **A server which is a type of long-running program called a daemon process (the dockerd command).**
- **A REST API which specifies interfaces that programs can use to talk to the daemon and instruct it what to do.**
- **A command line interface (CLI) client (the docker**

Monolithic Application

Recruitment Website

Job Applicants

Job Vacancies

Recruiters

Transition to Microservices

Recruitment Website

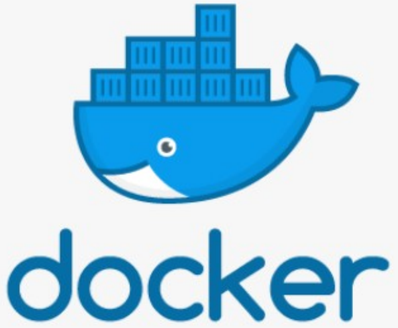
Recruiters

Job Applicants

Job Vacancies

Docker

Create containers for your application



Kubernetes

Launch your containerised application in K8s

Kubernetes

Kubernetes (K8s) is an open-source system for automating deployment, scaling, and management of containerized applications.

- Containerization helps package software to serve these goals, enabling applications to be released and updated in an easy and fast way without downtime.
- Kubernetes helps you make sure those containerized applications run where and when you want, and helps them find the resources and tools they need to work.
- Kubernetes is a production-ready, open source platform designed with Google's accumulated experience in container orchestration, combined with best-of-breed ideas from the community.
- A container orchestrator is essentially an administrator in charge of operating a fleet of containerized applications. If a container needs to be restarted or acquire more resources, the

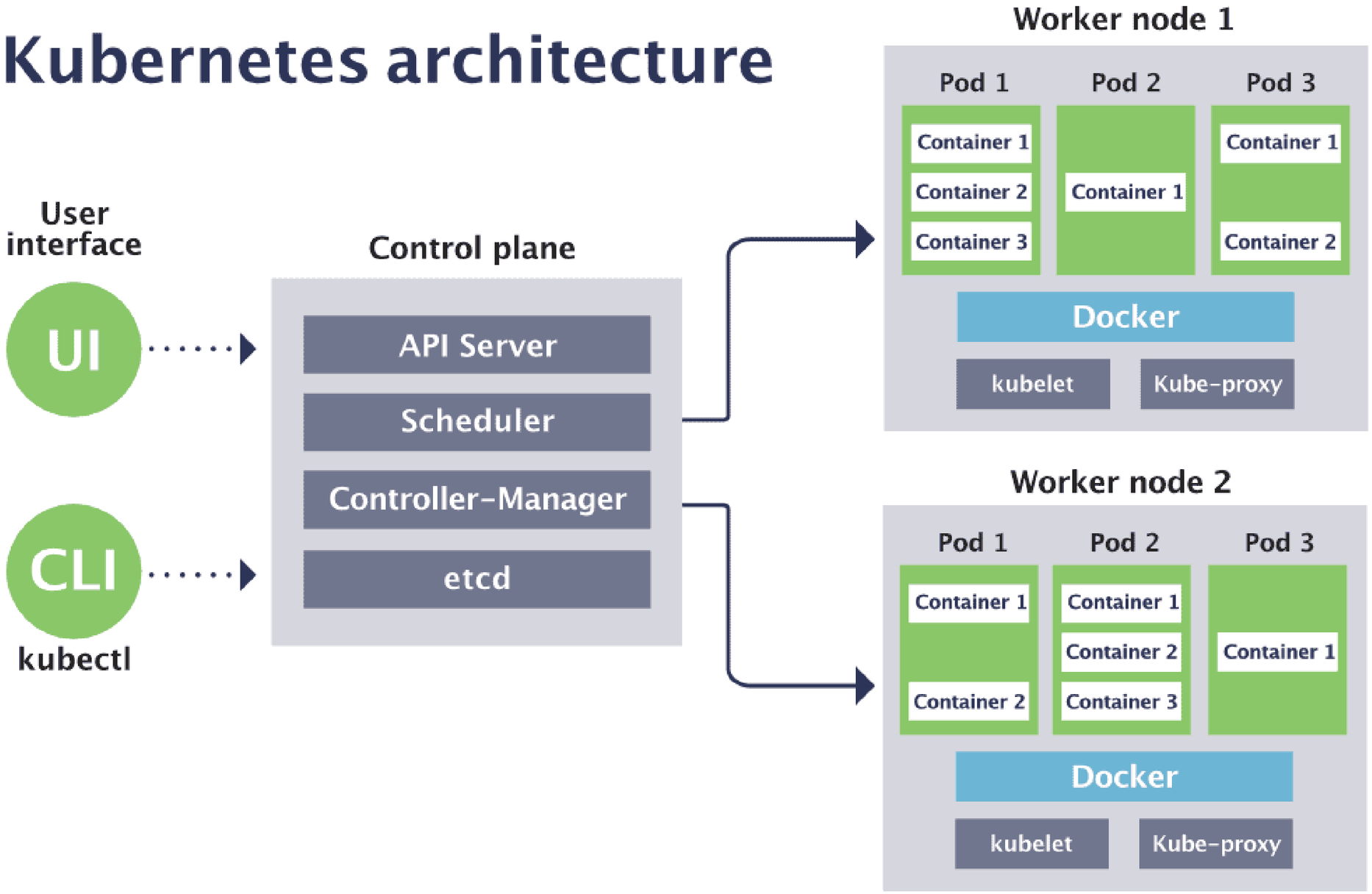
WHAT IS KUBERNETES USED FOR?

Kubernetes keeps track of your container applications that are deployed into the cloud. It restarts orphaned containers, shuts down containers when they’re not being used, and automatically provisions resources like memory, storage, and CPU when necessary.

How does Kubernetes work with Docker?

Actually, Kubernetes supports several base container engines, and Docker is just one of them. The two technologies work great together, since Docker containers are an efficient way to distribute packaged applications, and Kubernetes is designed to coordinate and schedule those applications.

Kubernetes architecture



Pods

- A Kubernetes pod is a group of containers, and is the smallest unit that Kubernetes administers.
- Pods have a single IP address that is applied to every container within the pod. Containers in a pod share the same resources such as memory and storage.
- It is common to have a pod with only a single container, when the application or service is a single process that needs to run.
- For example, if you were working on an image-processing service that created GIFs, one pod might have several containers working together to resize images.
- The primary container might be running the non-blocking microservice application taking in requests, and then one or more auxiliary (side-car) containers running batched background processes or cleaning up data artifacts in the storage volume as part of managing overall application performance.

Deployments

- Kubernetes deployments define the scale at which you want to run your application by letting you set the details of how you would like pods replicated on your Kubernetes nodes. Deployments describe the number of desired identical pod replicas to run and the preferred update strategy used when updating the deployment. Kubernetes will track pod health, and will remove or add pods as needed to bring your application deployment to the desired state.

Services

- A service is an abstraction over the pods, and essentially, the only interface the various application consumers interact with. As pods are replaced, their internal names and IPs might change. A service exposes a single machine name or IP address mapped to pods whose underlying names and numbers are unreliable. A service ensures that, to the outside network, everything appears to be unchanged.

Nodes

- A Kubernetes node manages and runs pods; it’s the machine (whether virtualized or physical) that performs the given work. Just as pods collect individual containers that operate together, a node collects entire pods that function together. When you’re operating at scale, you want to be able to hand work over to a node whose pods are free to take it.

Control plane

- The Kubernetes control plane is the main entry point for administrators and users to manage the various nodes. Operations are issued to it either through HTTP calls or connecting to the machine and running command-line scripts. As the name implies, it controls how Kubernetes interacts with your applications.

Cluster

- A cluster is all of the above components put together as a single unit.

API server

- The API server exposes a REST interface to the Kubernetes cluster. All operations against pods, services, and so forth, are executed programmatically by communicating with the endpoints provided by it.

Scheduler

- The scheduler is responsible for assigning work to the various nodes. It keeps watch over the resource capacity and ensures that a worker node’s performance is within an appropriate threshold.

Controller Manager

- The controller-manager is responsible for making sure that the shared state of the cluster is operating as expected. More accurately, the controller manager oversees various controllers which respond to events (e.g., if a node goes down).

Kubelet

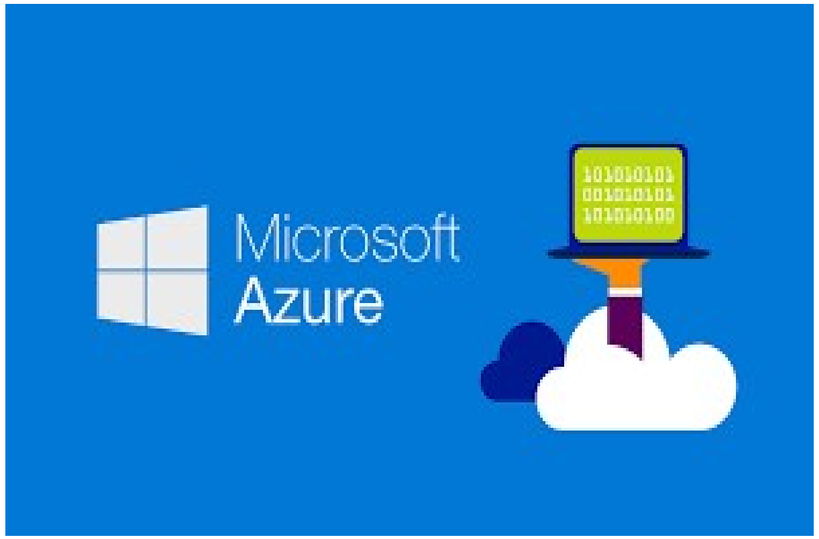
- A Kubelet tracks the state of a pod to ensure that all the containers are running. It provides a heartbeat message every few seconds to the control plane. If a replication controller does not receive that message, the node is marked as unhealthy.

Kube Proxy

- The Kube proxy routes traffic coming into a node from the service. It forwards requests for work to the correct containers.

Cloud Platforms in Industry
(Microsoft Azure)

(Microsoft Azure)



What is Microsoft Azure ?

- Microsoft Azure, often referred to as Azure, is a cloud computing platform operated by Microsoft that provides access, management, and development of applications and services via globally-distributed data centers.
- It provides a broad range of cloud services, including compute, analytics, storage and networking.
- Users can pick and choose from these services to develop and scale new applications or run existing applications in the public cloud.

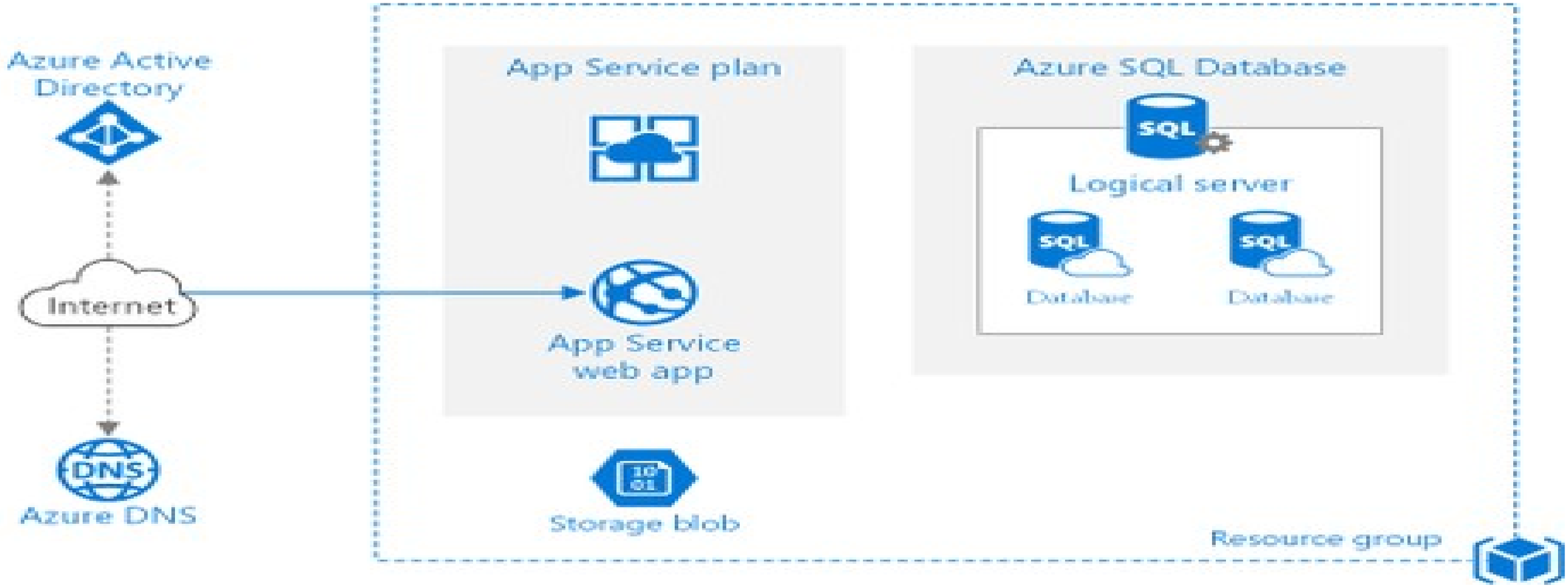
What is Microsoft Azure Used For?

- Microsoft Azure is a cloud computing service that provides virtual servers and storage.
- It allows you to quickly deploy applications and run them in the cloud, while also giving you access to a large network of other users.
- You can use Azure to run web apps, mobile apps, and more. Azure is available in several different subscription plans, so you can choose what’s right for your needs.
- It’s commonly used for things like building websites and running databases, among other things. With Microsoft’s recent launches of Azure Kubernetes Service (AKS) and Azure Container Service (ACS), microservice adoption has gained momentum in enterprises

What is Microsoft Azure Architecture?

- Microsoft Azure is a cloud computing platform that lets you create, deploy and manage applications and services. It provides tools such as machine learning, mobile app development, and IoT solutions. This service can be used to run any type of application or service.
- The Azure platform is available on multiple devices like PCs, laptops, smartphones, and tablets. It supports many programming languages including HTML5, JavaScript, PHP, Python, C# and more.

Diagram of AZURE.



Microsoft Azure Features.

- Improved Backup and Disaster Recovery-

  Microsoft Azure offers flexibility, advanced site recovery, and built-in integration. The cloud-based nature of Azure makes it innately flexible, allowing you to backup your data in virtually any programming language, operating system, or location. Azure also allows you to set backup schedules daily, weekly, monthly, or whatever schedule you please.

- Develop and Host Web and Mobile Apps -

  Azure is an ideal platform for developing, hosting, and managing web and mobile apps, making them autonomous and adaptive through features like automatic patch management, AutoScale, and integration for on-premise apps.

- Integration with Active Directory –

  Microsoft Azure can integrate with your Active Directory, supplementing your existing access and identity capabilities. It also gives your DNS improved security, worldwide reach, and centralized management.

Cloud Platforms in Industry
(Case studies)
Company name – Deloitte

Cloud Platforms in Industry (Case studies)

Company Name - Deloitte Touche Tohmatsu Limited, a UK private company.

- Explore case studies to learn how Deloitte create Cloud is helping clients design and realize the future of their business.

- Discover how Deloitte helped a global chemical company deploy a cloud-based enterprise integration platform and modernize its technology.

Case Study of cloud platforms.

- A global chemical company planned a multiyear integration program to implement (Systems, Applications & Products which **provides multiple business functions**)SAP 4 /HANA (High-performance Analytic Appliance) which is multi-model database that stores data in its memory in the cloud, with the aim of folding not only IT but also plant operational technologies into the outcome. The company had to align operations across six continents and needed to be operational on an abbreviated two-year timetable—a tight deadline with its current resources.

- As part of this program, the company had to modernize its integration platform required to process a high-volume of messages, spanning across multiple business domains, to be interchanged between diverse systems—on-premises and on the cloud—and trading partners.

- The company worked with Deloitte to conduct an integration platform as a service

Cloud Platforms in Industry

(Amazon Web services and Google App Engine)

What is Amazon Web services?

- Amazon web service is an online platform that provides scalable and cost-effective cloud computing solutions.

- AWS is a broadly adopted cloud platform that offers several on-demand operations like compute power, database storage, content delivery, etc., to help corporates scale and grow.

How Does AWS Work?

- AWS usually works in several different configurations depending on the user's requirements. However, the user must be able to see the type of configuration used and the particular server map with respect to the AWS service.

- Amazon Web Services (AWS) is a highly available, secure cloud services platform that offers more than 100 cloud applications. It helps in controlling, auditing, and managing identity, configuration, and usage.

What types of Services offers by the AWS?

- AWS services are divided into these domains:

- Amazon Web Services offers a broad set of global cloud-based products including **compute , storage , databases , analytics , networking , mobile , developer tools , management tools , IoT , security , and enterprise applications** . These services help organizations move faster, lower IT costs, and scale.

What are the Benefits of AWS ?

- **User-friendly –**

- This tops the list of the Amazon Web Services benefits. AWS is easy to use as the platform is specially designed for quick and secure access. Users can modify their data whenever they want, wherever they want.
- Most companies find starting with AWS as their cloud provider much easier than using other providers, namely, Azure or Google Cloud Platform. AWS provides you with all the information, documentation, and video instructions to help you learn how to use all of its services.

2. Flexible

- **Flexible**
- Flexibility is also the reason why many companies prefer AWS. It always lets you use those operating systems, programming languages, and web application platforms that you are comfortable with. With a service like AWS EC2, you can build your virtual computing environment by setting up your preferable operating systems and applications.
- AWS benefits provide all the best services that your application requires to function seamlessly. It can also ease the migration process, and you can work on new solutions simultaneously.

3. Secure :

- **Secure**
- Security is one of the best benefits of AWS cloud computing. As we know, security is the uppermost priority for any company that is data-driven. AWS provides a highly secure infrastructure to ensure the privacy of your data. Security professionals at AWS follow different layers of data surveillance such as:
- Data protection
- Identity and access management
- Infrastructure protection
- Threat detection and continuous monitoring
- Compliance and data privacy

4. Cost-effective

- **Cost-effective**
- If you follow traditional methods, then you should build your own servers for storing your data and applications, which consumes a good amount of both your time and money.
- So instead of building your own expensive servers, you can use AWS where you need to pay only for the tools and services that you use. AWS offers a pay-as-you-go pricing method, which means that a company will only pay for the services that it needs and has used for a period of time. It is the same as paying your electricity bill; you only pay for the units you have consumed. These AWS services are unique and cheaper than the traditional computing method.

5. Reliable

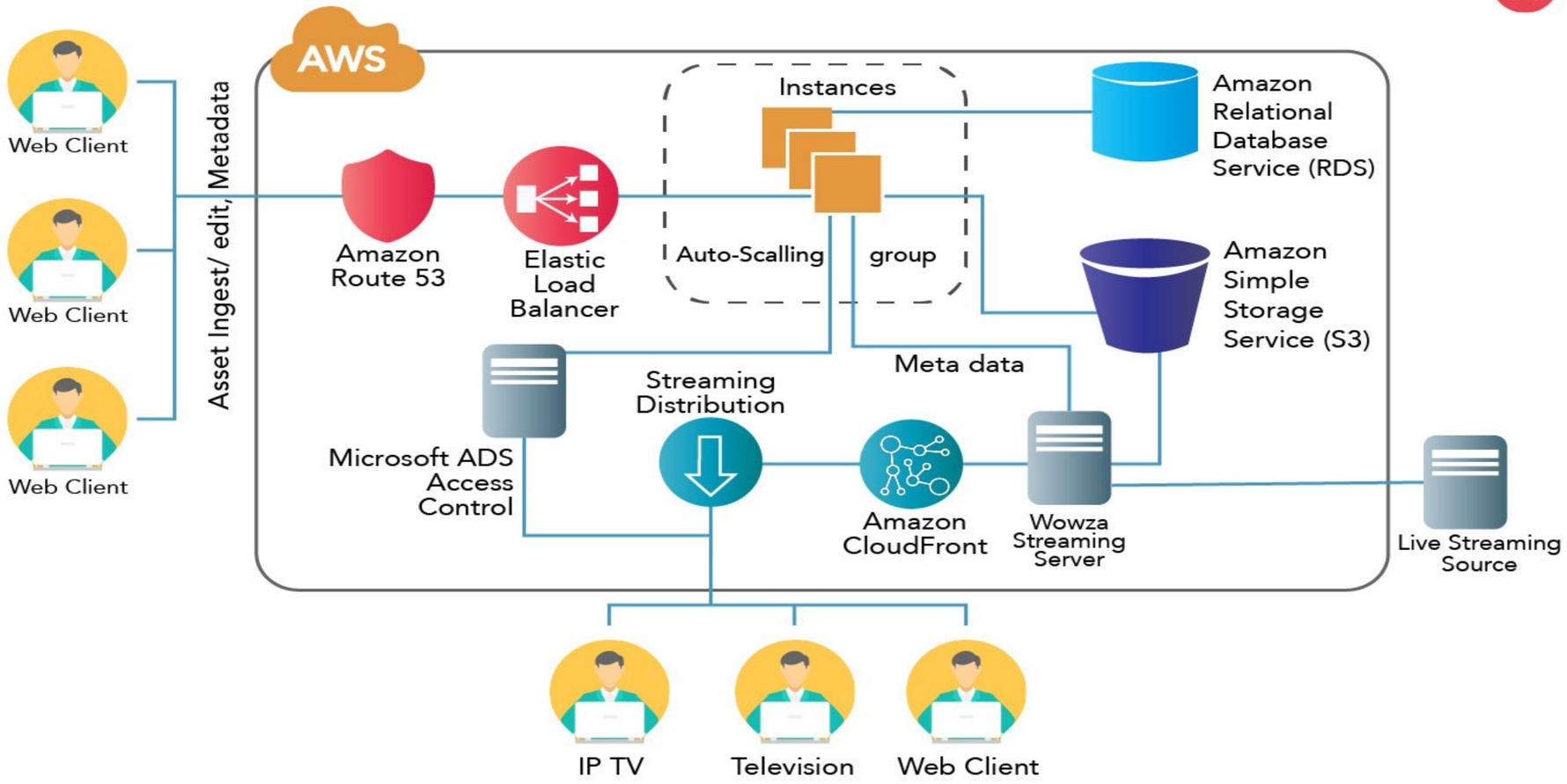
- Amazon offers the highest reliability for its customers. AWS serves over a million active clients in more than 200 nations all over the world. An ultimate team of tech professionals is working on data security.

- AWS performs its tasks accurately when it is required and offers many services that make it more reliable like the capability to automatically recover from failure. Also, services such as Amazon DynamoDB and Amazon S3 store the data in three different availability zones so that even if two of them fail to work, the users will still have their data intact. Therefore, AWS benefits are trustworthy in terms of the services and security it provides.

Drawbacks or disadvantages of AWS .

- Amazon Web Services may have some common cloud computing issues when you move to a cloud. For example, downtime, limited control, and backup protection.
- AWS sets default limits on resources which vary from region to region. These resources consist of images, volumes, and snapshots. You can launch the limited number of instance per area.
- Hardware-level changes happen to your application which may not offer the best performance and usage of your applications.
- Security Limitations: As security is one of the main features so AWS limits some of its features which cannot be changed at all are.

What is AWS Architecture Diagram?



Function of AWS.

- It is considered as the basic structure of AWS architecture or AWS EC2. Simply, EC2 is also called Elastic Compute cloud which will allow the clients or else the users of using various configurations in their own project or method as per their requirement.
- There are also different amazing options such as pricing options, individual server mapping, configuration server, etc. S3 which is present in the AWS architecture is called Simple Storage Services. By using this S3, users can easily retrieve or else store data through various data types using Application Programming Interface calls. There will be no computing element for the services as well.

What are the Key Components of AWS Architecture?

- **1. Load Balancing:**
- The load balancing is a component of the AWS architecture which helps to enhance the application and the server’s efficiency in the right way. According to the diagrammatic representation of AWS architecture, this Hardware load balancer is mostly used as the common network appliance and helps to perform skills in the architectures of the traditional web applications.
- It also makes sure to deliver the Elastic Load Balancing Service, AWS takes the traffic gets distributed to EC2 instances across the various available sources. Along with this, it also distributes the traffic to dynamic addition and the Amazon EC2 hosts removals from the load-balancing rotation.

2.Elastic Load Balancing: -

- This load balancing can easily shrink and increase the capacity of load balancing by tuning some of the traffic demands and supporting sticky sessions to have advanced routing services.

3. Amazon Cloud Front:

- Amazon Cloud Front is mostly used for the delivery of content that is directly used for website delivery. The content in the Amazon Cloud Front can also be the type of content such as static, dynamic as well as streaming content that can also take the usage of global network locations as well. From the user end, the content can be requested in an automatic way based on the nearest location that also shows the diverse effect on the performance which will be enhanced in the right way. There will be no commitments in the monthly wise and the contracts.

4.Elastic Load Balancer:

- Elastic Load Balancer is mainly used to deliver the required traffic to the web servers and it also helps to improve the performance in a large manner. This Elastic Load Balancing can easily have growth in a dynamic way and also the load-balancing capacity can be shrunk based on certain traffic conditions.

5. Security Management:

- It also makes sure to provide a security feature namely known as security groups. It will also work the same as the inbound network firewall and will also have to specify the ports, protocols, and also source IP ranges where all these can be reached to the EC2 instances. With the help of specific subnets or else IP addresses, the security groups can be configured that can also limit the access to EC2 instances effectively.

6. Elastic Cache:

- Amazon Elastic Cache is an efficient web service where the memory cache can be managed in the cloud with ease. This cache plays a vital role in terms of memory management and will also help to reduce the service's load in a reliable manner. It also makes sure to enhance the performance along with the scalability on the tier of the database by caching the information which is used in a frequent manner.

7. Amazon RDS:

- Amazon Relational Database Service helps to deliver the same access that is similar to the MySql, Microsoft SQL Server database engine or else Microsoft SQL. These applications, queries, and tools will be useful in the Amazon RDS as well.

What is the Importance of AWS Architecture?

- AWS Architecture also makes sure to provide incredible services based on the web technologies, uploading and unloading of virtual servers, the selection service and the service of transferring messages, etc. Moreover, the resources of AWS can be available worldwide and can also be able to deploy solutions exactly where the customers are required of them.

Top 5 Pillars of AWS Well-Architected Framework.

- **1. Security –**

- Security is the basic thing that matters a lot in AWS Technology. It is entirely an infra design that can easily serve complete data protection, infrastructure protection, privilege Management of all AWS accounts and identifying the security breach with certain detective controls reliably. Basically, it follows certain design principles that are:-

- One can apply security at every level
- Implementation of Principle of Least Privilege
- Enable Traceability
- Secured System Applications, data, and OS Level
- Automate Security Best practices

2. Reliability

- AWS is a good architecture that has come up with well-planned foundations and monitoring in place with various mechanism rates to handle demand rates as per requirements. The system can easily detect the failure and must come out with an optimized solution. The design principles are in the given way like

- Test Recovery Procedures.
- Usage of Horizontal Scalability in an increment of system availability.
- Recovery from failure in an automatic way.
- Add or else Removing resources.
- Manage Changes in the automation.

3. Performance Efficiency

- Performance Efficiency is kept the focus on the efficient use of computing resources to meet the given requirements in a reliable manner. It is also to maintain efficiency as demand changes and technology evolves. The design principles go in the given way.
- Democratize advanced Technologies
- Globally Deploying of the given system at a minimal cost of lower latency
- To keep aside of operational burden, use a serverless architecture
- Various comparative testing and configurations for better performance

4. Cost Optimization

- It is one of the main pillars of AWS Architecture that is completely optimizing costs, unused, elimination or else sub-optimal resources. It is most probably considered with the matching supply with demand and being aware of expenditure and optimizes over costs.
- The following design principles are delivered in the cost optimization are
- Adopting of consumption model.
- High benefits values from economies of scale.
- Stop investing in Data Center Operations.
- Analyzing and Attribute Expenditure.
- Usage of Well Managed services for reducing some cost of ownership.

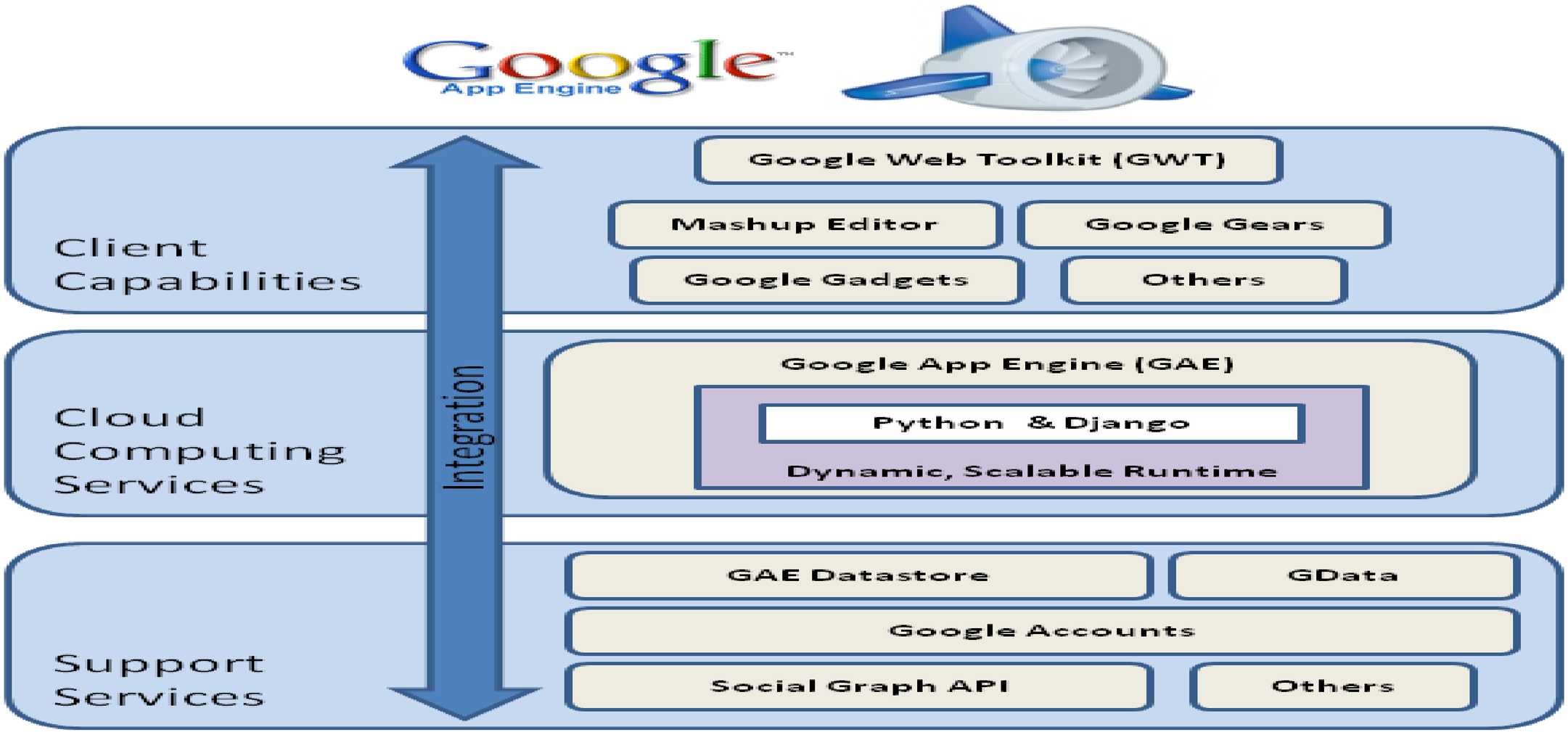
What is Google App Engine ?

- Google App Engine is **a fully managed, serverless platform for developing and hosting web applications at scale**.

or

- Google App Engine is a cloud computing platform as a service for developing and hosting web applications in Google-managed data centers.

Architecture of google app engine.



Major Features of Google App Engine.

- **Language support: -**
  Google App Engine lets users' environment to build applications in some of the most popular languages, including Java, Python, Node.js, C#, and PHP.
- **Flexibility: -**
  Google App Engine offers the flexibility to import libraries & frameworks through Docker containers.

Features of Google app engine.

- **Traffic splitting:**

  Google App Engine automatically routes the incoming traffic to different application versions as a part of A/B testing. This enables users to easily create environments for developing, staging, production and testing.

- **Security:**

  Google App Engine enables users to define access rules in Engine’s firewall and utilize SSL/TLS certificates on custom domains for free.

Advantages of Google App Engine

- **Easy to build and use the platform:-**
  GAE is fully managed which lets developers lay focus on writing code with zero configuration and server management. It handles traffic management by automatic monitoring, patching and provisioning.

- **Scalability:-**
  Google App Engine handles the workload fluctuations through scaling the infrastructure, by adding or removing instances or application resources as needed.

Advantages of google app engine.

- **Various API sets:**
- Google App Engine has many built-in APIs and services which allows developers to build robust and versatile apps. These features include:
- 1) Application log Accessibility
- 2) Blobstore- serve large data objects
- 3) GAE Cloud Storage
- 4) SSL Support
- 5) Google Cloud Endpoint for mobile application

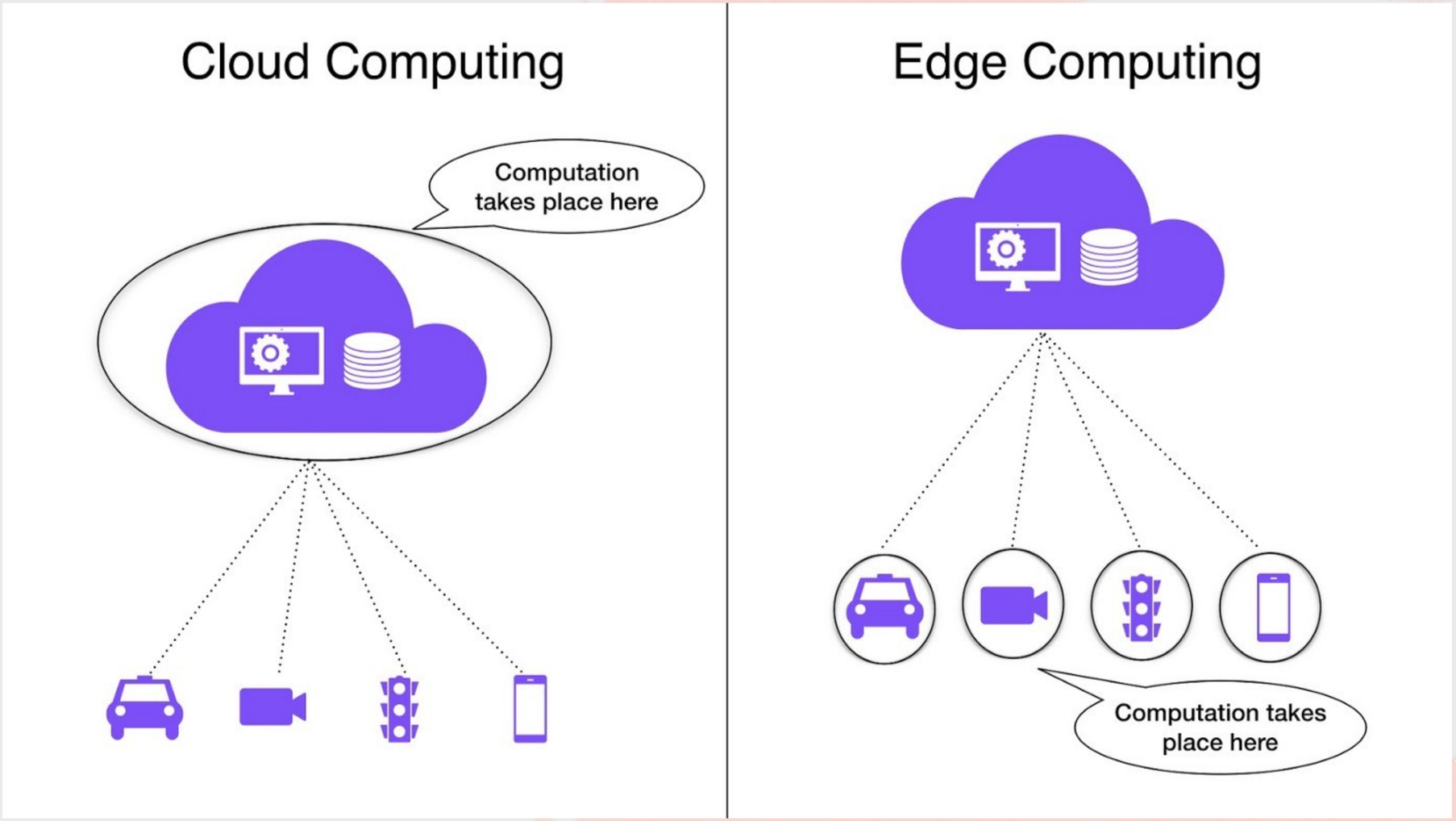
Example of Google app engine.

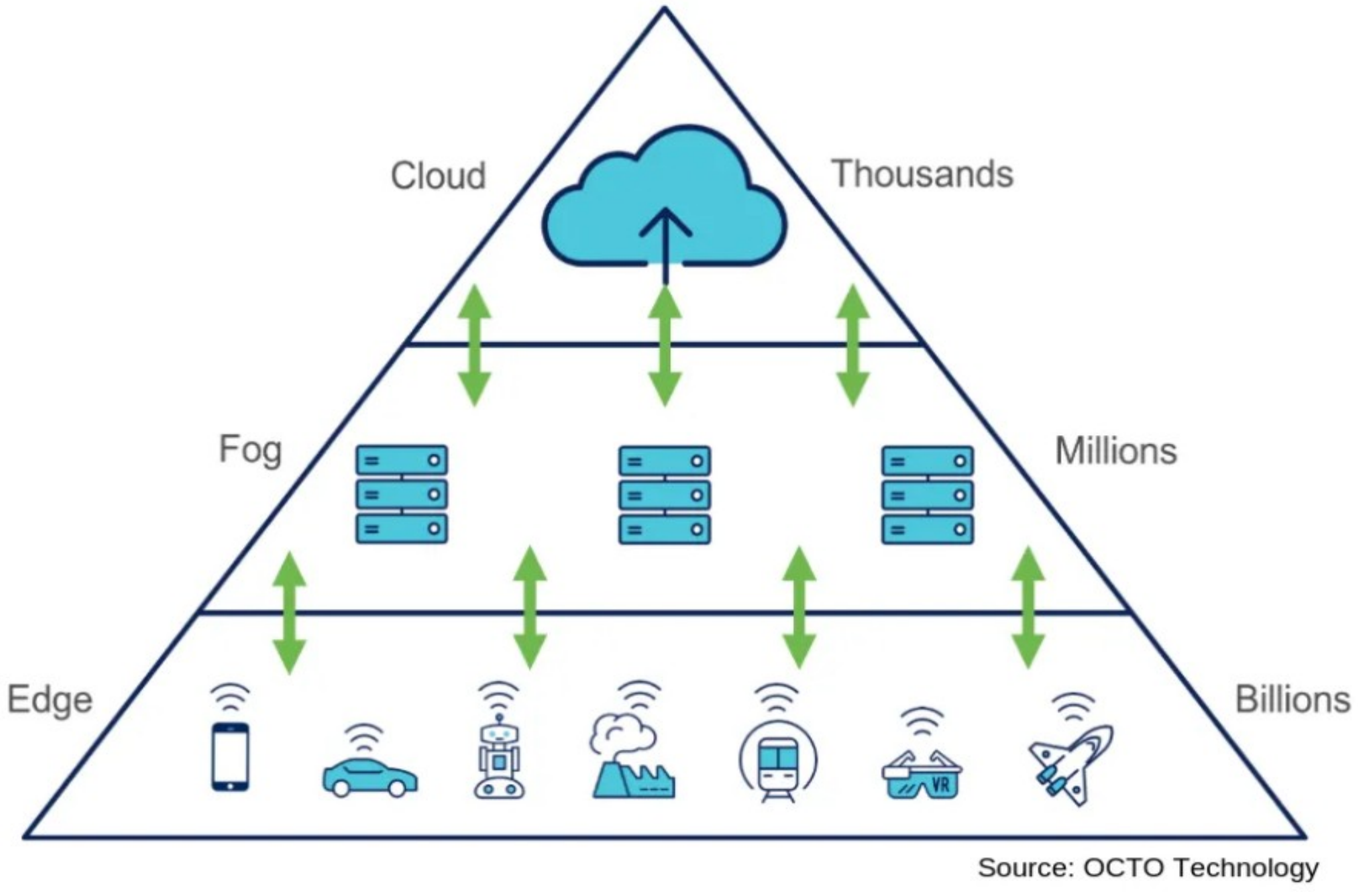
- Examples of Google App Engine:-

  One example of an application created in GAE is an Android messaging app which is use to store user log data. The app can store user messages and write event logs to the Firebase Realtime Database and use it to automatically synchronize data across devices.

Edge Computing

- A part of a distributed computing topology in which information processing is located close to the edge – where things and people produce or consume that information.”
- Edge computing brings computation and data storage closer to the devices where it’s being gathered, rather than relying on a central location that can be thousands of miles away. In addition, companies can save money by having the processing done locally, reducing the amount of data that needs to be processed in a centralized or cloud-based location.
- Edge computing was developed due to the exponential growth of IoT devices, which connect to the internet for either receiving information from the cloud or delivering data back to the cloud. And many IoT devices generate enormous


Cloud Computing
Computation takes place here
Edge Computing
Computation takes place here



Source: OCTO Technology

Edge v/s Cloud

Edge and cloud computing have distinct features and most organizations will end up using both. Here are some considerations when looking at where to deploy different workloads.

Cloud Computing	Edge Computing
Non-time-sensitive data processing	**Real-time data processing**
Reliable internet connection	**Remote locations with limited or no internet connectivity**
Dynamic workloads	**Large datasets that are too costly to send to the cloud**
Data in cloud storage	**Highly sensitive data and strict data laws**

Fog Computing

- Fog computing can be perceived both in large cloud systems and big data structures, making reference to the growing difficulties in accessing information objectively.
- This results in a lack of quality of the obtained content. The effects of fog computing on cloud computing and big data systems may vary.
- However, a common aspect is a limitation in accurate content distribution, an issue that has been tackled with the creation of metrics that attempt to improve accuracy.
- Fog networking consists of a control plane and a data plane. For example, on the data plane, fog computing enables computing services to reside at the edge of the network as opposed to servers in a data-center.

Specialty	Cloud Computing	fog computing
Delay	Cloud computing has higher latency than fog computing	Fog computing has low latency
Capacity	Cloud computing does not provide any reduction in data while sending or converting data.	Fog computing reduces the amount of data sent to cloud computing.
Responsiveness	The response time of the system is low.	The response time of the system is high.
Security	Cloud computing has less Security compared to Fog Computing	Fog computing has high Security.
Speed	Access speed is high depending on the VM connectivity.	High even more compared to Cloud Computing.
Data Integration	Multiple data sources can be integrated.	Multiple Data sources and devices can be integrated.
Mobility	In cloud computing, mobility is Limited.	Mobility is supported in fog computing

POINTS OF DIFFERENCE	Cloud Computing	Fog Computing	Edge Computing
LOCATION OF DATA PROCESSING	Central cloud server	Within an IoT gateway or fog nodes that are located in the LAN network.	Device itself
PURPOSE	Long term in-dept analysis	Quick analysis and real time response	Quick analysis and real time response
LATENCY	High	Low	Very Low
SECURITY	Less secure	High Security	High Security
GEOGRAPHICAL DISTRIBUTION	Centralized	Distributed	Distributed

IIOT

- The Industrial Internet of Things (IIoT) is a methodology, a practice, an implementation sweeping through businesses and industries worldwide. On a basic level, IIoT is a way of congregating data that was previously inaccessible and locked within inflexible data streams. This provides all stakeholders with a more complete and comprehensive view of operations.

- Imagine smart TVs and watches or security cameras - devices that were historically lacking in internet connection but now have that capability. This is IoT, the Internet of Things. IIoT is used to refer to industrial equipment and plant assets that are now integrated.

- Developments in technology are ushering in the age of Industry 4.0, where real-time data is captured and made available within integrated digital ecosystems. Similarly, software is now increasingly platform-agnostic, this means that plant floor information won't be originating from a single platform, but there will be a multitude of systems that needs to feed into a companies digital

IIOT

- The concept behind cloud computing is a computer processor placed at remote location runs a specific application or software rather than running it on each user’s computer. User can interact with the system via a network on the cloud. Most of the times this network is Internet.

- Since the storage and processing capacity of the cloud is unlimited, it provides more economic, convenient and secure storage alternatives. The growing storage capacity can also be met as the cloud is expandable.

- In connected IIoT, data is expected to flow to and from the connected devices. These streams of data usually get larger with time and that is when Big Data comes in existence. Integration of Big Data into Industrial IoT can help to generate, access and gather the huge amount of data.

Lecture 40
GREEN CLOUD COMPUTING

Definition of Green cloud computing.

- Green cloud computing refers to the potential environmental benefits cloud-based services can offer society. The term combines two words: green, which means environmentally friendly, and cloud computing, which is the delivery of IT services over the internet.

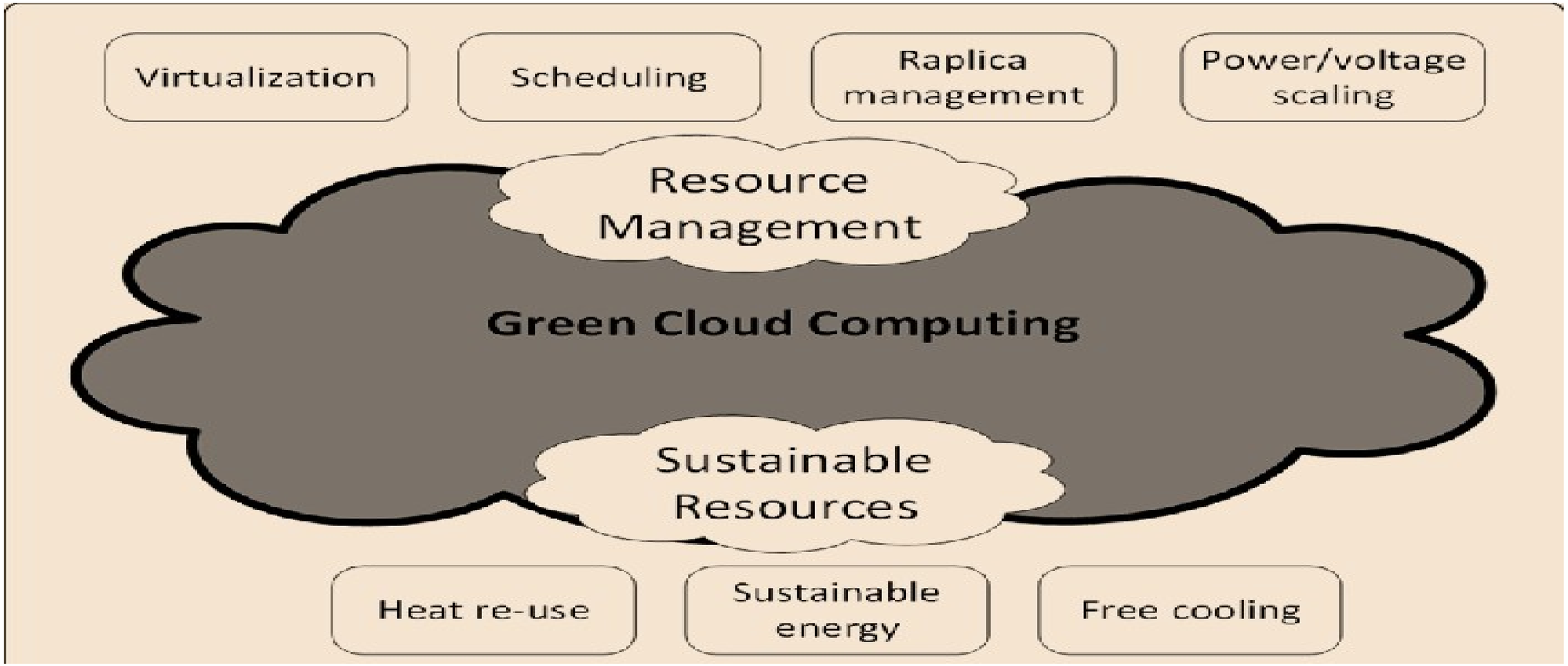
OR

- Green cloud computing is a coined term that means making the practices and approaches of using technological advances like computing and other IT resources sustainable for potential environmental benefits.

OR

- Green cloud computing allows users to utilize the benefits of cloud storage while decreasing its adverse effects on the environment, ultimately affecting human well-being. It includes the following practices:

Diagram of green cloud computing – suitable way to use cloud .



Benefits or advantages of Green Computing

Following are the benefits or **advantages of Green Computing**:

➡Telecommuting techniques help in increases profit margins, increases worker satisfaction and reduces greenhouse gas emissions (by avoiding travelling requirements of employees/customers).

➡Virtualization of IT helps in running two or more computer systems on single set of physical hardware. This reduces operating costs for energy and cooling. This ultimately helps in saving money.

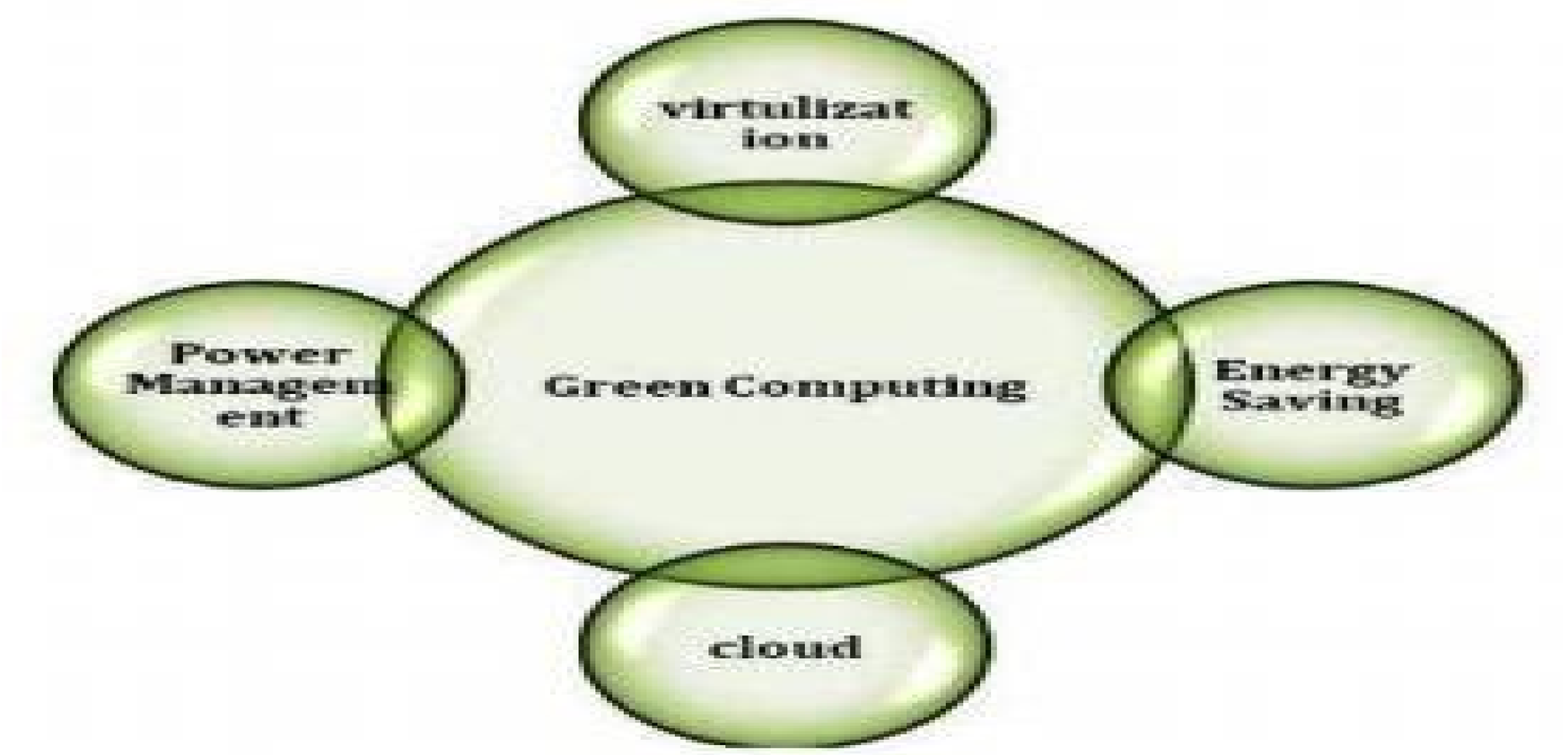
➡It reduces usage of paper and other consumables in IT industry.

➡Green manufacturing makes use of bamboo for computers and peripherals. Moreover computers are constructed using recyclable plastics. Hence it will have less impact on the environment.

➡It minimizes equipment disposal requirements by adopting reuse, refurbish and recycle methods.

Advantages of green cloud computing.

Advantages



Drawbacks or disadvantages of Green Computing

Following are the drawbacks or **disadvantages of Green Computing**:

➨Implementation of green computing requires higher start up cost.
➨The green computing systems sacrifies performance to improve battery life.
➨Adoption and success of green computing system requires years of efforts by consumers and organizations.
➨It is not available for everyone at affordable cost.

Green cloud computing

- With Green cloud computing, world is looking forward to higher energy efficient mechanism, managed security services, cloud security solutions at one place by offering equivalent and cloud management platform benefits with enormous environmental impact!
- Cloud computing, is an important facet for any IT operations of any organization, continuous attempts have been made to make it- much “greener”.
- “The green cloud”- certainly a superior marketing label, is employed by organizations for handling environmental considerations and concerns effectively. With contribution, towards the critical business operational goals and reduced costs across the servers, green cloud is most environment friendly initiative.

Factors for Green Computing

- Product longevity
  - Gartner maintains that the PC manufacturing process accounts for 70% of the natural resources used in the life cycle of a PC. More recently, Fujitsu released a Life Cycle Assessment (LCA) of a desktop that show that manufacturing and end of life accounts for the majority of this desktop's ecological footprint.
- Data center design
  - Energy efficient data center design should address all of the energy use aspects included in a data center: from the IT equipment to the HVAC equipment to the actual location, configuration and construction of the building.

FACTORS OF GREEN COMPUTING

- Resource allocation
  - Algorithms can also be used to route data to data centers where electricity is less expensive. .Larger server centers are sometimes located where energy and land are inexpensive and readily available. Local availability of renewable energy, climate that allows outside air to be used for cooling, or locating them where the heat they produce may be used for other purposes could be factors in green siting decisions.
- Power management
  - The Advanced Configuration and Power Interface (ACPI), an open industry standard, allows an operating system to directly control the power-saving aspects of its underlying hardware. This allows a system to automatically turn off components such as monitors and hard drives after set periods of inactivity. In addition, a system may hibernate, when most components (including the CPU and the system RAM) are turned off. ACPI is a successor to an earlier Intel-Microsoft standard called Advanced Power Management

- Materials recycling
  - Recycling computing equipment can keep harmful materials such as lead, mercury, and hexavalent chromium out of landfills, and can also replace equipment that otherwise would need to be manufactured, saving further be given for recycling, and they typically sign a non-disclosure agreement.
- Algorithmic efficiency
  - The efficiency of algorithms has an impact on the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs. Algorithm changes, such as switching from a slow (e.g. linear) search algorithm to a fast (e.g. hashed or indexed) search algorithm can reduce resource usage for a given task from substantial to close to zero.

THANKS

Green Cloud Computing

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