What is kubernetes ?

Kubernetes (also known as K8s) is an open-source container **orchestration platform** designed to **automate the deployment, scaling, and management of containerized applications**. It was originally developed by Google and is now maintained by the Cloud Native Computing Foundation (CNCF).

- Containers are a technology that allows you to package an application and its dependencies together in a consistent environment, ensuring that the application runs consistently across different computing environments. **Kubernetes builds upon this concept by providing a way to manage these containers at scale**

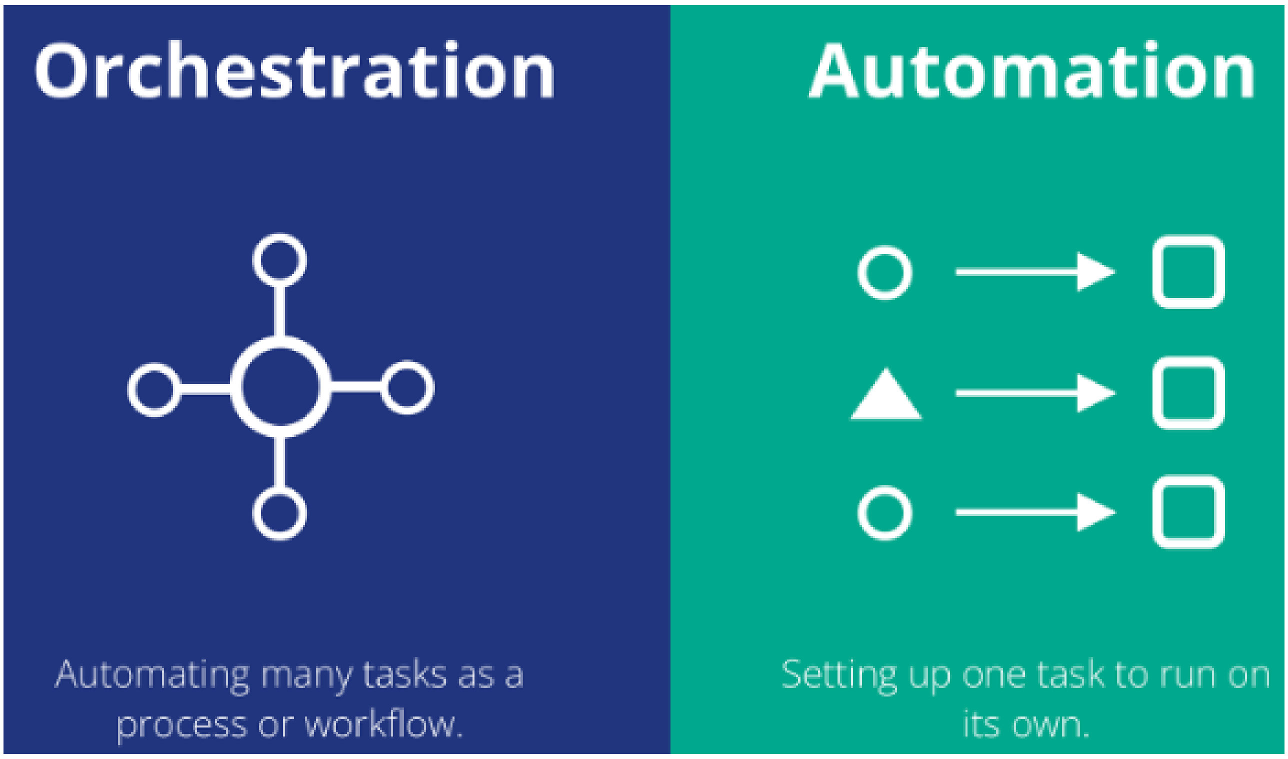
What does orchestration mean?

Orchestration in the context of containers and Kubernetes refers to the **automated arrangement, coordination, and management of computer systems, middleware, and services**.

Here are some key points about orchestration:

- It involves automating the deployment, management, scaling, networking, and availability of containerized applications.
- The orchestrator (like Kubernetes) acts as the conductor, controlling and coordinating services and infrastructure.
- It handles container lifecycle management actions like provisioning, starting, stopping, scaling up/down, load balancing, health monitoring etc.
- It enables declaring the desired state (e.g. number of container replicas, resources per container) and the orchestrator maintains it.

container orchestration **automates the deployment, scaling, networking, availability and entire lifecycle of containers across clusters of hosts** - providing the tools and abstractions to simplify container management. Kubernetes is the most widely used orchestrator today.


Orchestration
Automating many tasks as a process or workflow.
Automation
Setting up one task to run on its own.

Real Time Example :

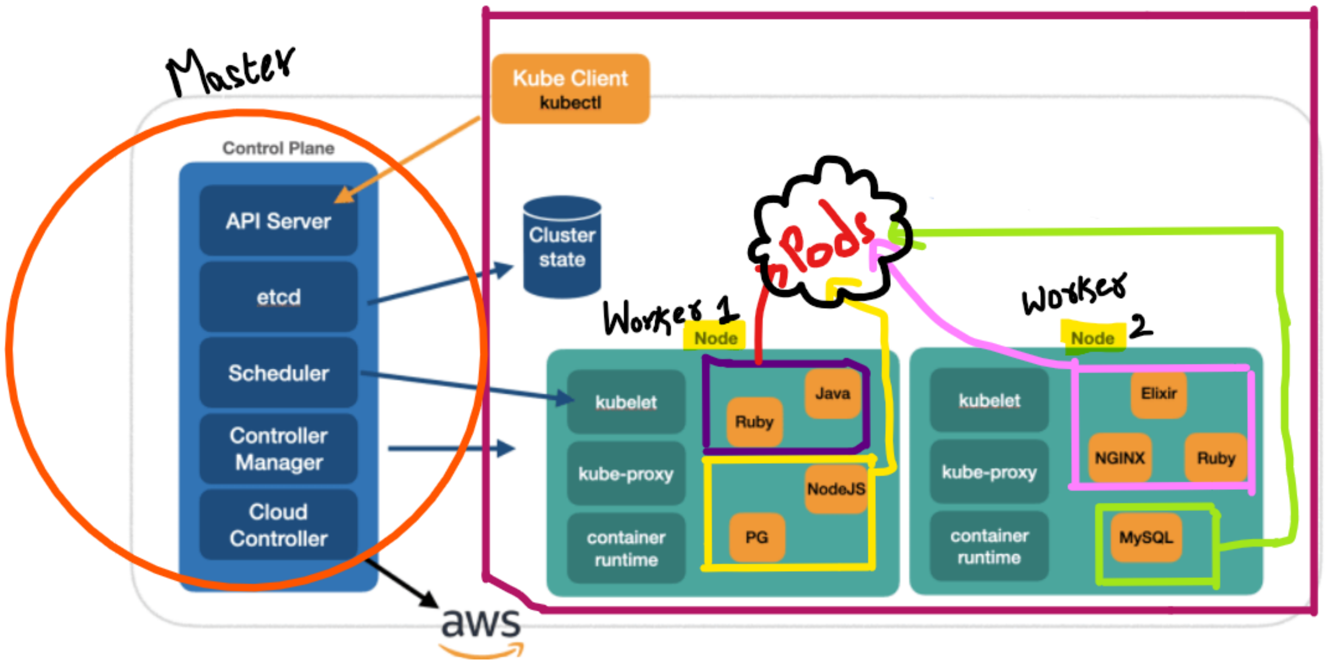
Think of orchestration like conducting an orchestra. An orchestra has many musicians playing different instruments, and they need to work together to create beautiful music. The conductor is like the orchestrator. They guide when each musician plays, how loud or soft they play, and when to stop. They make sure everything sounds harmonious.

In the same way, in computing, orchestration is like having a conductor for your software applications. When you have many pieces (like services or components) working together, an orchestrator helps them start, stop, and work together smoothly. It makes sure they have the right resources, communicate well, and can handle more work when needed.

Just as a conductor makes music sound great without musicians worrying about each other, an orchestrator makes your software run well without you having to worry about all the technical details.

Describe the architecture and components of Kubernetes?

The architecture of Kubernetes is designed to provide a scalable and flexible platform for deploying, managing, and orchestrating containerized applications. It consists of several key components that work together to achieve these goals.



The key components found in Kubernetes master and worker nodes:

Master Node Components:

- **kube-apiserver** - The API server that exposes the Kubernetes API for management and deployment.
- **etcd** - Distributed key-value store that stores cluster config and state.
- **kube-scheduler** - Scheduler that selects the best node for pod deployment.

- **kube-controller-manager** - Controller for cluster management functions like replication, endpoints, etc.
- **cloud-controller-manager** - Handles cloud provider integration like load balancers.

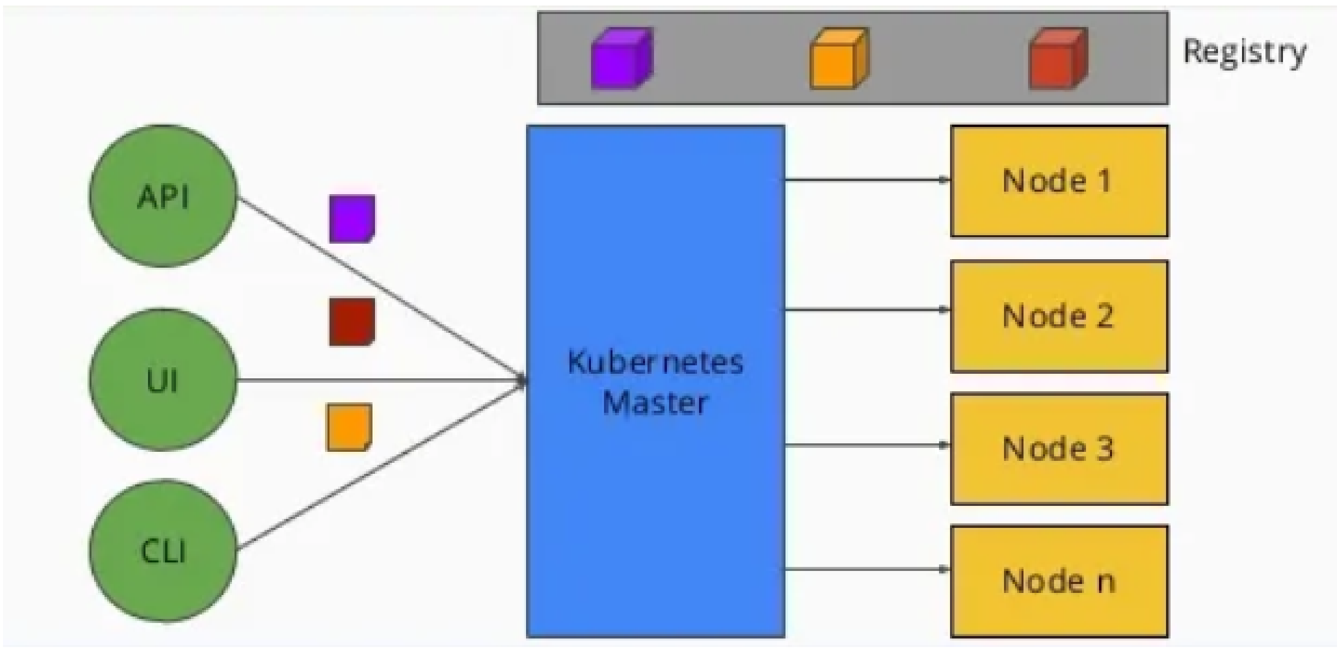
Worker Node Components:

- **kubelet** - The primary "node agent" that interacts with the API server to manage pod lifecycle and containers.
- **kube-proxy** - A network proxy and load balancer for services on each node.
- **Container runtime** - Software like Docker that runs and monitors containers.
- **PODs** - The basic deployable units that encapsulate one or more containerized apps.
- **kubectl** - The Kubernetes command line tool to manage the cluster.

The master handles cluster management while nodes run applications and workloads. Components like kubelet, kube-proxy, kubectl are present on both master and worker nodes.

Explain Master Node in detail ?

The master node components work in tandem to **manage, control, and ensure the stability of the Kubernetes cluster**. They provide a **centralized control plane that orchestrates the behavior of the entire system**, from resource allocation and scheduling to maintaining desired states and responding to changes in the cluster's configuration or load. The optional **Cloud Controller Manager further enhances Kubernetes' capabilities** when operating in cloud environments by integrating with cloud provider-specific services and resources.



- **API Server**:

The **API Server** is the central control point for the entire Kubernetes cluster. It exposes the Kubernetes API, which serves as a frontend for managing the cluster's resources and performing administrative actions. **Users, developers, and various Kubernetes components interact with the API Server** to create, update, and delete resources. It validates and processes API requests, then communicates with other components to ensure the desired state of the cluster is maintained. The API Server also **enforces authentication, authorization, and admission control policies** to ensure secure access to the cluster.

- **etcd**:

etcd is a distributed and consistent key-value store that acts as the Kubernetes cluster's primary source of truth. It **stores all configuration data, metadata, and the current state of the cluster's objects**. The data stored in etcd includes information about **Pods, Services, Nodes, and more**. The etcd cluster maintains **high availability and consistency** to ensure that the entire cluster's components are aware of the same state. Both the Master Node components and Worker Nodes use etcd to **read and write configuration and state data**, making it crucial for maintaining the overall health and consistency of the cluster.

- **Controller Manager**:

The **Controller Manager** includes a collection of controllers, each responsible for ensuring a specific aspect of the cluster's desired state. **Controllers continuously monitor the state of the cluster and work to reconcile any differences between the desired state and the actual state**. For instance, the **Replication Controller maintains the correct number of replicas for each ReplicaSet**, ensuring high availability. The **Endpoint Controller populates the Endpoints resource**, enabling communication between different services. Controllers run **periodic checks and take corrective actions** as needed, making sure that the cluster remains in the desired state even in the face of failures or changes.

- **Cloud Controller Manager**:

The **Cloud Controller Manager** is a specialized component that enhances Kubernetes' capabilities when deployed on cloud providers. In cloud environments, different **cloud services and resources are available that Kubernetes can leverage for managing the cluster and applications**. The **Cloud Controller Manager interacts with the cloud provider's APIs** to manage these cloud-specific resources. For example, it can handle **node management, creating and managing load balancers, provisioning storage volumes, and other cloud-related tasks**. By offloading these tasks to the Cloud Controller Manager, Kubernetes maintains a more **modular and extensible architecture**.

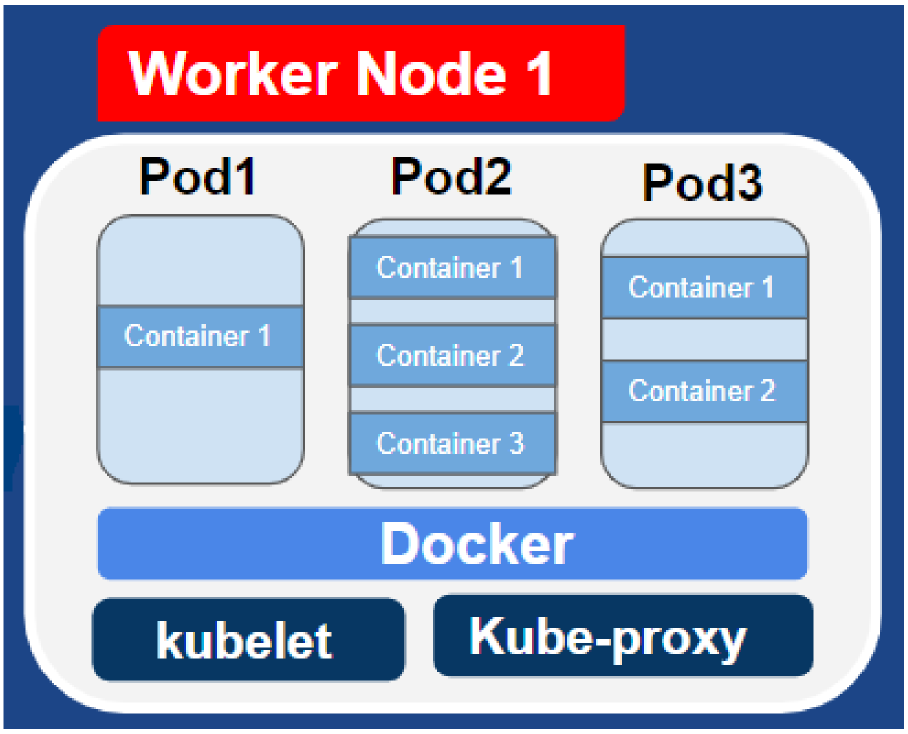
- **Scheduler**:

The **Scheduler** is responsible for making intelligent decisions about which Worker Node to place new Pods on. It takes into account factors like **resource requirements, quality of service, constraints, and affinity/anti-affinity rules**. When a new Pod is created, the Scheduler evaluates the current state of the cluster's nodes and **selects the best-suited node to host the Pod**. This ensures **optimal resource utilization and effective distribution of workloads** across

Explain Worker Node in Kubernetes ?

Worker Node:

A Worker Node is a machine within the Kubernetes cluster responsible for running containers and executing the tasks of deployed applications. These nodes host the actual workloads and are where containers are scheduled and executed. Each Worker Node runs multiple containers in isolation and communicates with other nodes and the control plane to ensure the cluster's proper functioning.



- **Kubelet**:

The **Kubelet** is an essential component that runs on each Worker Node. It acts as the primary agent responsible for managing and maintaining the containers within Pods. The Kubelet receives instructions from the control plane, specifically the API Server, about which Pods should be running on the node. It ensures that the specified containers are started and healthy according to the desired Pod configuration. The Kubelet also monitors the containers' health, reports their status to the control plane, and takes action if any issues arise.

- **Kube Proxy**:

The **Kube Proxy** is responsible for network management on each Worker Node. It maintains network rules and facilitates communication between Pods and services across the cluster. When a service is created, the Kube Proxy ensures that the necessary network rules are configured, enabling communication between different Pods and services. It also provides load balancing for services by distributing incoming network traffic among multiple instances of the service's Pods.

- **Container Runtime**:

The **Container Runtime** is the software responsible for running containers. Kubernetes supports various container runtimes, including Docker, containerd, and others. The Container Runtime handles tasks like downloading container images, setting up the container environment, starting and stopping containers, and ensuring the isolation and resource allocation of each container. It provides the execution environment for the containers specified in the Pods.

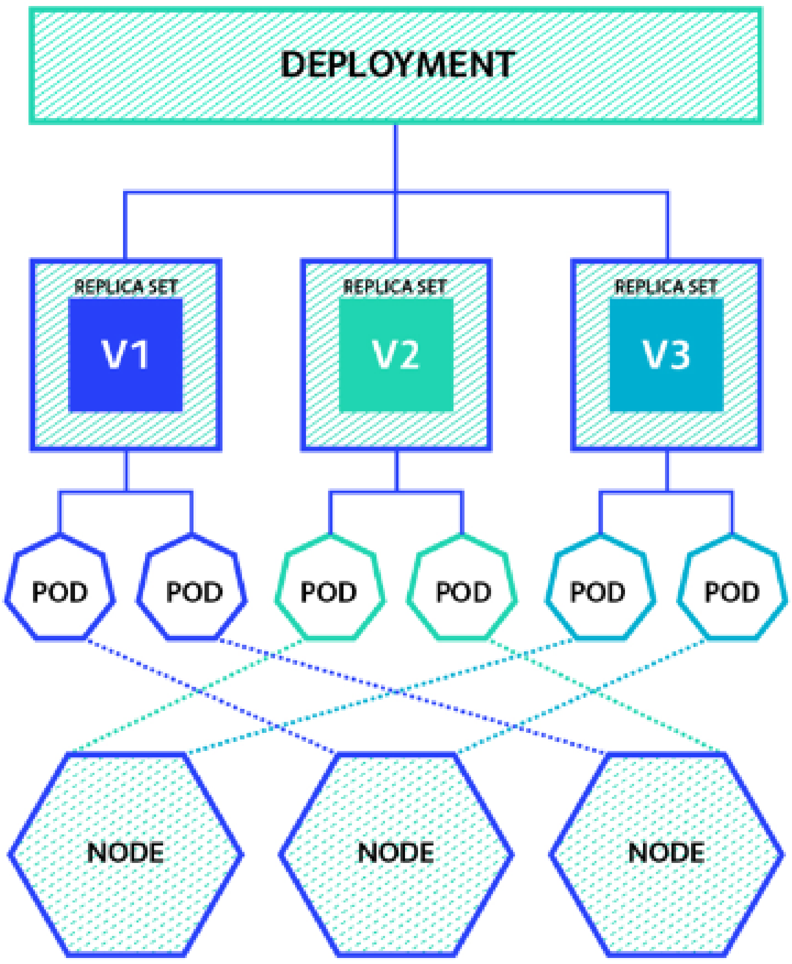
- **Pods**:

Pods are the smallest deployable units in Kubernetes and are scheduled to run on Worker Nodes. A Pod can contain one or more containers that share the same network namespace, IP address, and storage. Containers within the same Pod can communicate with each other using `localhost`, making them suitable for tightly coupled applications or microservices. Pods provide a way to group related containers together and ensure they are co-located on the same node.

Worker Nodes are where the action happens in a Kubernetes cluster. They run the containers that constitute the applications, and the components on each node work together to ensure the containers are scheduled, executed, and networked properly. This separation of concerns between the control plane (Master Node) and the workloads (Worker Nodes) is a fundamental

what are ReplicaSets & Deployments in k8's ?

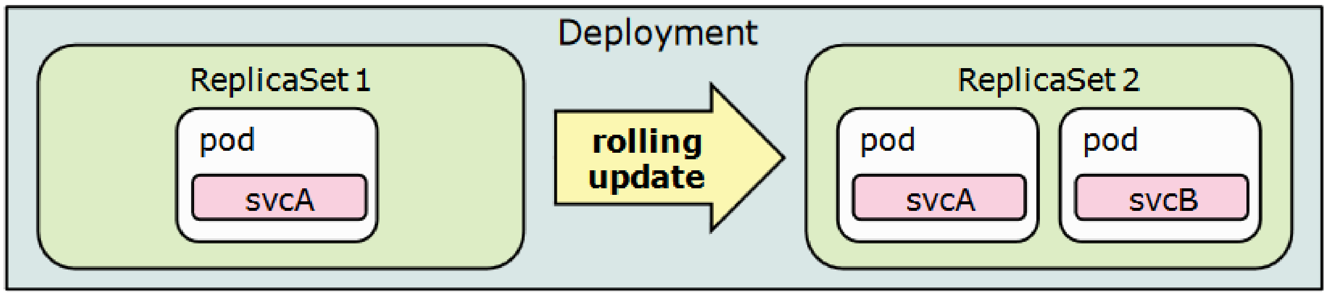
- **ReplicaSets**: Ensure that a specified number of replicas (Pod instances) are running at all times. They automatically create or destroy Pods to maintain the desired replica count.
- **Deployments**: Provide declarative updates to applications, allowing rolling updates and rollbacks.



ReplicaSets:

A **ReplicaSet** is a Kubernetes resource that ensures a specific number of identical copies, or replicas, of a Pod are running at all times. It guarantees high availability and fault tolerance by automatically adjusting the number of replicas to match the desired state defined by the user. If a Pod fails, the ReplicaSet replaces it with a new Pod to maintain the desired replica count. Here are the key points:

- **Specifying Replicas**: When you create a ReplicaSet, you define the desired number of replicas for the associated Pod template.
- **Pod Template**: The template specifies the configuration (such as container images and resource requirements) for the Pods managed by the ReplicaSet.
- **Scaling**: You can scale a ReplicaSet by updating its replica count in the configuration.
- **Automatic Healing**: If a Pod goes down or becomes unhealthy, the ReplicaSet automatically creates a replacement Pod to ensure the specified number of replicas is maintained.
- **Selector**: The ReplicaSet uses a selector to identify the Pods it manages based on labels. Any changes in labels or template configuration trigger the creation of new Pods to match the desired state.



Deployments:

A **Deployment** is a higher-level resource that provides declarative updates to applications. It manages ReplicaSets under the hood, making it easier to manage application updates, rollbacks, and scaling. Deployments ensure that the application's Pods are always in the desired state by managing the underlying ReplicaSets. Here are the key points:

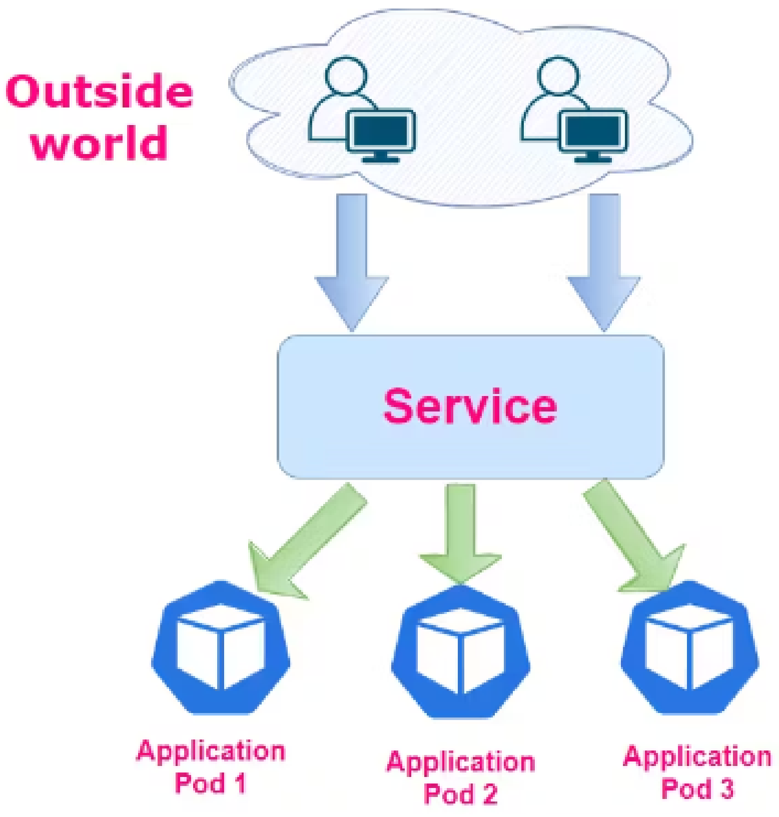
- **Declarative Updates**: Deployments allow you to specify the desired state of your application using a declarative approach.
- **Rolling Updates**: When you make changes to the Deployment configuration, such as updating container images or resource requirements, Deployments perform rolling updates. This means it gradually replaces old Pods with new ones, reducing downtime.
- **Rollbacks**: If an update causes issues, you can roll back to the previous version using the Deployment's revision history.
- **Desired State Management**: Deployments continuously monitor the actual state of the Pods and compare it to the desired state. They automatically make adjustments to achieve and maintain the desired state.
- **Scaling**: Deployments also handle scaling of the application by updating the number of replicas.
- **History and Rollback**: Deployments maintain a history of revisions, allowing you to roll back to a previous version if necessary.

In summary, **ReplicaSets** provide the foundation for managing the number of Pod replicas, ensuring high availability. **Deployments** build upon ReplicaSets and introduce features for declarative updates, rolling updates, scaling, and revision history, making it easier to manage application changes and maintain the desired state of the application across the cluster.

What are services ?

Services:

Services provide a stable IP address and DNS name for a set of Pods, enabling load balancing and communication across Pods within the cluster.



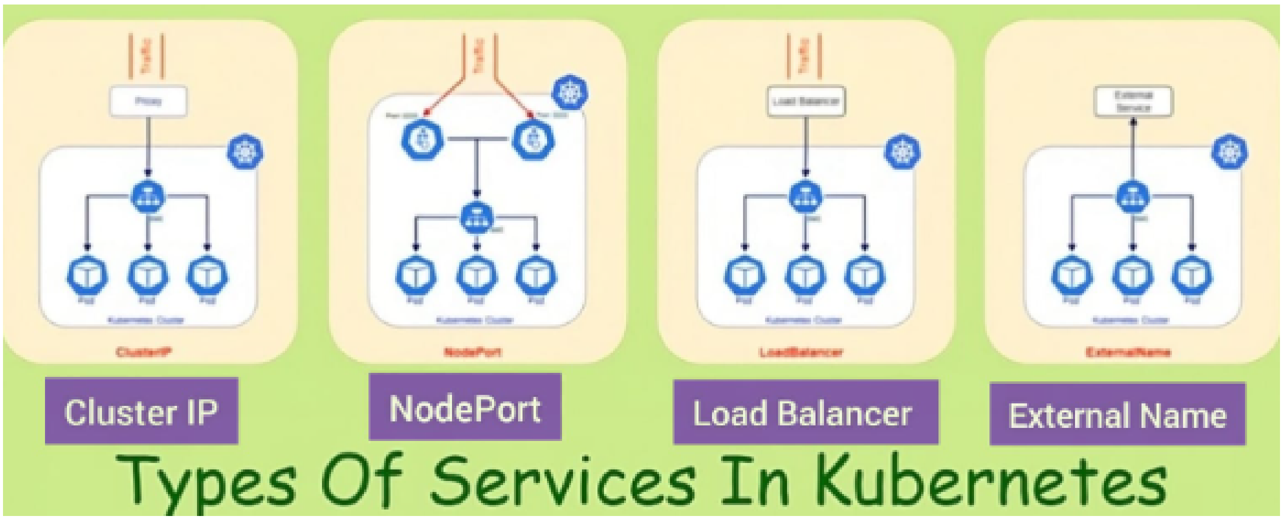
Services:

Services are a fundamental concept in Kubernetes that provide a way to expose and access groups of Pods as a single network service. They abstract the internal network details and provide a stable IP address and DNS name that clients can use to access the Pods, regardless of the underlying Pod IP changes or distribution across nodes. Services enable load balancing, service discovery, and communication between different components within the cluster. Here are the key points:

- **Stable Network Endpoint**: A Service assigns a unique IP address and DNS name to a group of Pods that match a certain label selector. This IP and DNS name remain stable, even if Pods are added, removed, or rescheduled.
- **Load Balancing**: Services distribute incoming network traffic evenly across the Pods they expose, providing load balancing for improved performance and resource utilization.
- **Internal Service Discovery**: Clients can access the Service using the Service's DNS name. This abstraction simplifies communication between Pods, as clients don't need to know the specific IP addresses of individual Pods.

What are types of services in k8s ?

Types of Services: Kubernetes offers different types of Services, each with its own network exposure and routing behavior:



- **ClusterIP**: Exposes the Service on a cluster-internal IP, making it accessible only within the cluster.
- **NodePort**: Exposes the Service on each Node's IP at a specified port. This is often used for external access.
- **LoadBalancer**: Creates an external load balancer (depends on the cloud provider) that forwards traffic to the Service.
- **ExternalName**: Maps a Service to an external DNS name.

Service Discovery: Kubernetes DNS automatically manages DNS records for Services. Pods within the cluster can discover and communicate with other Services using their DNS names.

Headless Services: By setting the Service's cluster IP to "None," you can create a "headless" Service. This doesn't provide load balancing, but it allows you to access individual Pods using DNS.

Selectors: Services use label selectors to determine which Pods to include. Any Pod with matching labels is automatically part of the Service.

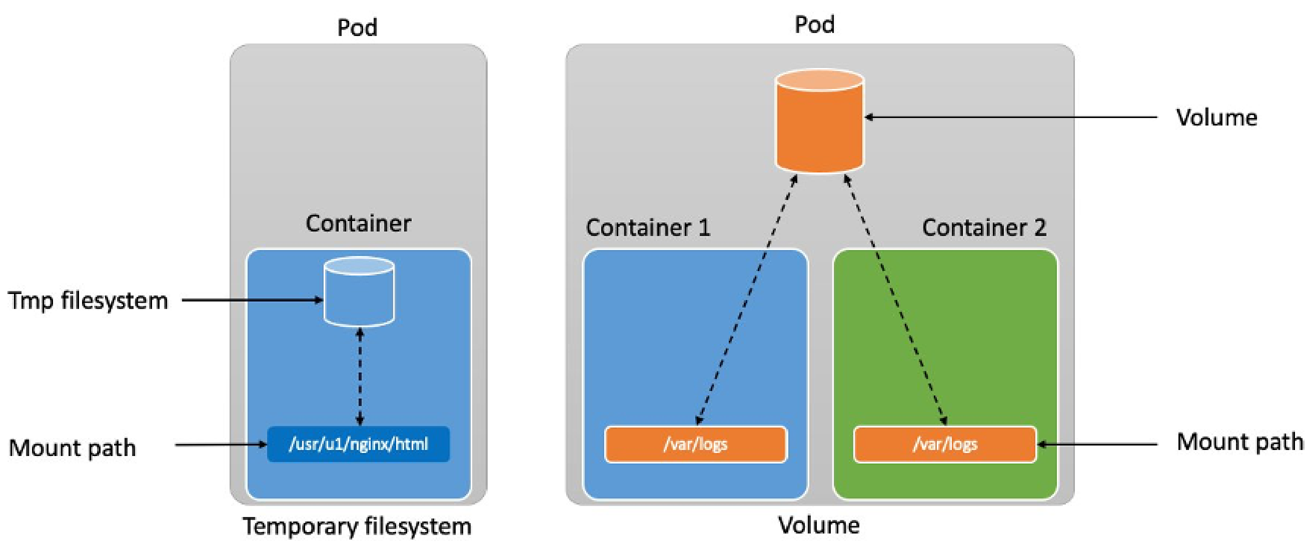
Namespace Scope: Services are scoped to a specific namespace. They allow communication between Pods within the same namespace and can also be exposed externally, depending on the Service type.

In essence, Services abstract the network and routing complexity, making it easier to access and communicate with groups of Pods. They play a critical role in connecting different components within a Kubernetes cluster, enabling efficient and reliable inter-Pod communication while handling load distribution and service discovery.

Explain volumes in kubernetes ?

Volumes:

Volumes provide persistent storage for containers. They allow data to survive container restarts



Volumes:

Volumes are a key feature in Kubernetes that provide a way to manage and persist data beyond the lifecycle of individual containers. They offer persistent storage solutions for containers, allowing data to survive container restarts, crashes, or rescheduling. Volumes provide a mechanism for sharing and exchanging data between containers, and they are mounted into containers as directories, enabling seamless access and manipulation of data. Here are the important points:

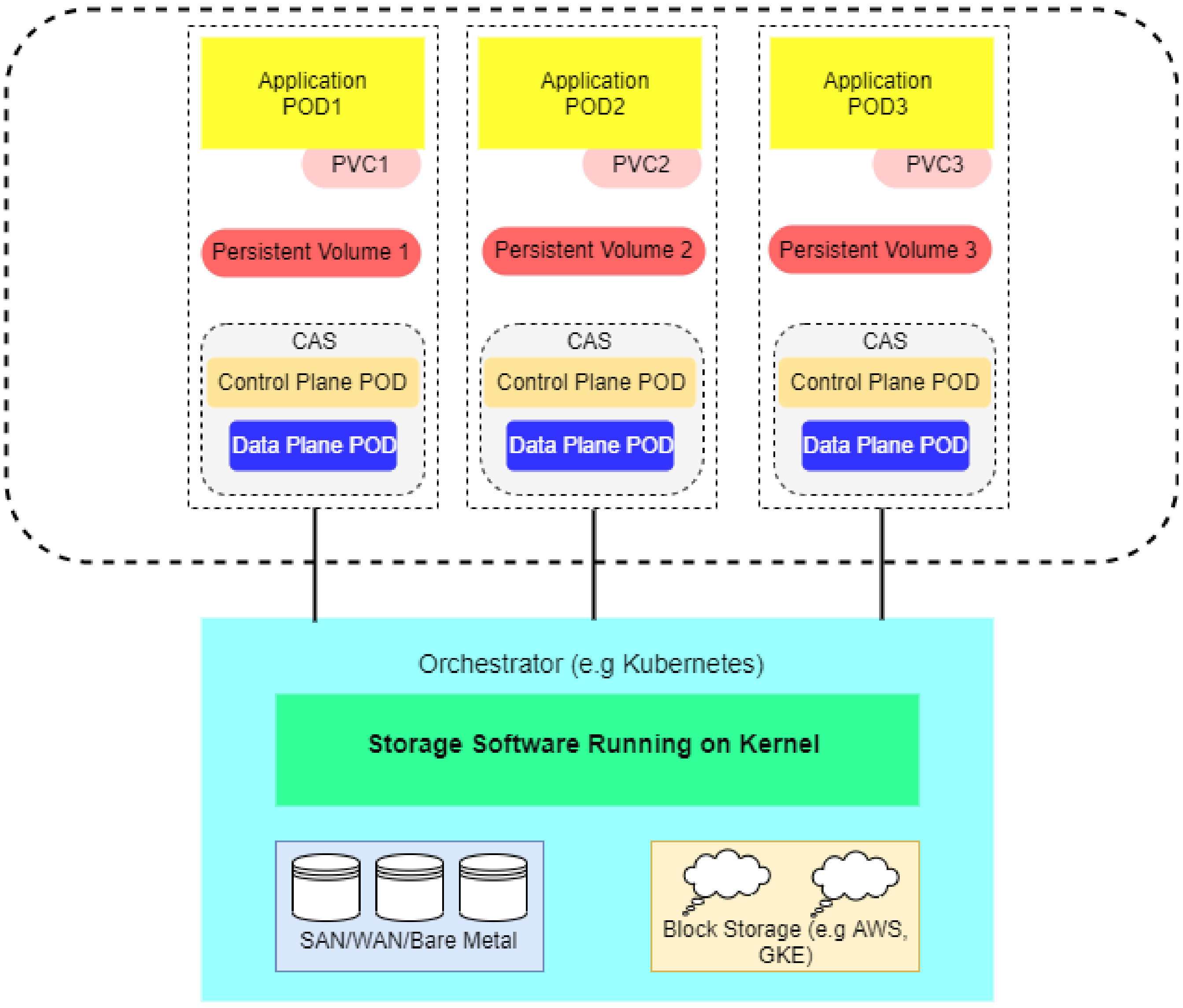
- **Persistent Storage**: Volumes are used to provide persistent storage for containers, ensuring that data is retained even when containers are terminated or rescheduled.
- **Data Sharing**: Volumes allow multiple containers within the same Pod to share data by mounting the same volume. This facilitates collaboration and data exchange between containers.
- **Types of Volumes**: Kubernetes supports various types of volumes, each with its own characteristics and use cases. Some examples include:

```
   1. EmptyDir: Creates a temporary volume within a Pod that's deleted
when the Pod terminates.

   2. HostPath: Mounts a file or directory from the host's filesystem i
nto the container's filesystem

  3. PersistentVolume : Provides persistent storage that is independent
of the Pod's lifecycle. Managed by the cluster  and can be shared acros
s Pods.

  4. ConfigMap and Secret : Special types of volumes used to inject con
figuration data or secrets into containers.
```



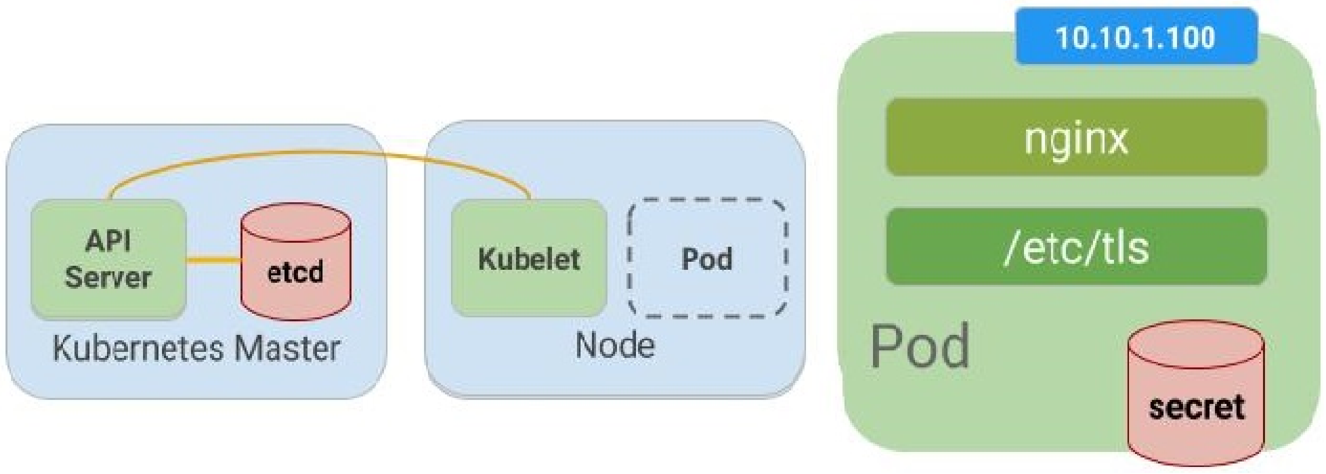
- **Mounting Directories**: Volumes are mounted into containers as directories, allowing containers to access and manipulate the data stored within them.
- **Lifecycle Independence**: Volumes allow data to exist beyond the lifespan of individual containers. This is particularly important for stateful applications that require consistent storage.
- **Read/Write Operations**: Volumes can be mounted in read-only or read-write mode, allowing containers to read and modify the data as needed.
- **Dynamic Provisioning**: Kubernetes can dynamically provision storage volumes based on Storage Classes, simplifying the process of managing and allocating storage resources.
- **Pod-Level Resources**: Volumes are defined at the Pod level and are accessible by all containers within the same Pod.
- **Data Migration**: Volumes facilitate data migration and upgrades by decoupling the storage from the containers.

Volumes are a crucial feature for managing persistent storage in Kubernetes. They allow containers to work with data beyond their lifecycle, enable data sharing between containers, and

What are ConfigMaps and Secrets ?

ConfigMaps and **Secrets**:

- **ConfigMaps**: Store configuration data as key-value pairs, which can be injected into containers or mounted as files.
- **Secrets**: Store sensitive information like passwords and API keys. They are securely stored and can be used by applications.## What are ConfigMaps & Secrets ?



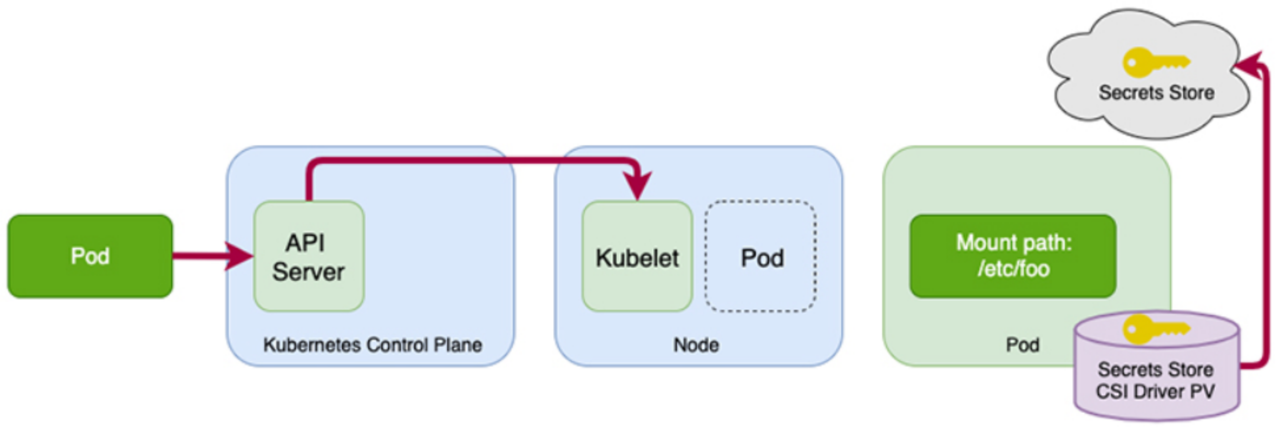
ConfigMaps and **Secrets** are Kubernetes resources designed to manage configuration data and sensitive information, respectively. They provide a way to separate configuration and sensitive data from application code, making it easier to manage, update, and secure this information independently.

ConfigMaps:

ConfigMaps are used to store configuration data in the form of key-value pairs or even plain configuration files. They allow you to centralize configuration settings that are required by multiple containers or Pods. The stored data can be injected into containers as environment variables or mounted as files. Here's what you need to know:

- **Key-Value Pairs**: ConfigMaps can store simple key-value pairs, where the keys are used to reference the configuration data.
- **Environment Variables**: ConfigMap data can be injected into containers as environment variables. This enables applications to access configuration values directly.
- **Volume Mounts**: ConfigMap data can also be mounted as files in a container's filesystem, allowing applications to read configuration files.

- **Decoupling Configuration**: By using ConfigMaps, you can separate configuration data from the application code. This simplifies updates and modifications.
- **Pod-Level**: ConfigMaps are associated with Pods. They can be referenced by one or more containers within the same Pod.



Secrets:

Secrets are specifically designed to store sensitive information, such as passwords, API tokens, and other confidential data. Secrets are base64-encoded and can be used by applications to securely access sensitive data without exposing it in the code or configuration files. Here's what you need to know about Secrets:

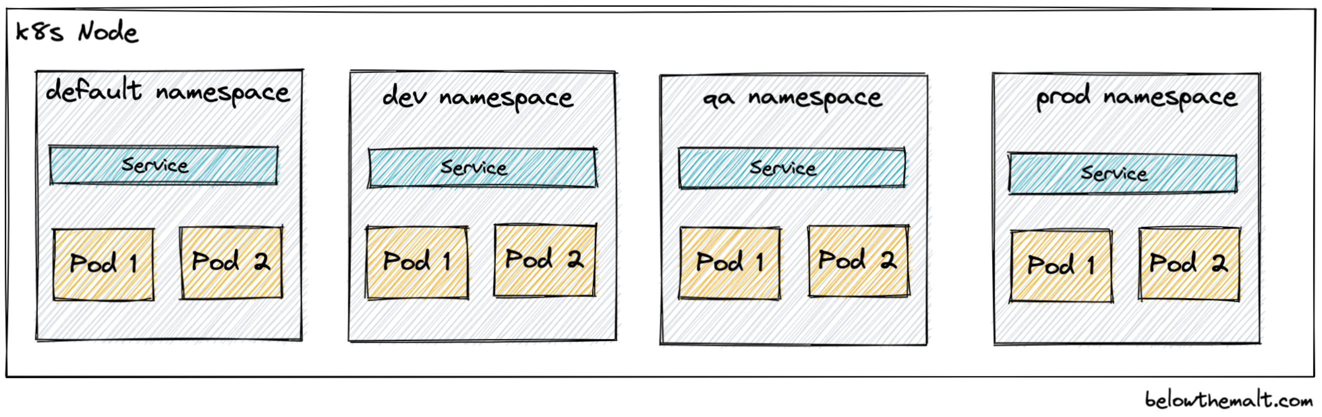
- **Sensitive Data**: Secrets are used to store sensitive information that should be kept confidential and not exposed in plain text.
- **Base64 Encoding**: Secrets are stored in base64-encoded format, which provides a level of obfuscation.
- **Secret Types**: Kubernetes supports different types of Secrets, such as generic, Docker registry, TLS certificates, and more.
- **Mounting Secrets**: Secrets can be mounted into containers as files or exposed as environment variables, similar to ConfigMaps.
- **Secure Storage**: Secrets are securely stored in the etcd cluster, which means they are encrypted at rest.
- **Usage Scenarios**: Secrets are useful for storing database passwords, API tokens, SSL certificates, and any other sensitive information needed by applications.

ConfigMaps provide a way to manage configuration data and inject it into containers, while **Secrets** handle the secure storage and distribution of sensitive information to applications. By using ConfigMaps and Secrets, you can enhance the separation of concerns in your Kubernetes applications, making them more manageable, maintainable, and secure.

What are Namespaces in k8s ?

Namespace:

Namespaces partition resources in the cluster, allowing different teams or projects to operate in isolation.



Namespaces:

Namespaces are a way to partition or segment resources within a Kubernetes cluster. They provide a virtual cluster environment, allowing you to create multiple isolated groups or "virtual clusters" within a single physical cluster. Namespaces help in organizing and managing resources, enabling different teams, projects, or applications to operate independently within the same Kubernetes cluster. Here's what you need to know:

- **Isolation and Segmentation**: Namespaces provide isolation by creating separate virtual clusters within the same physical cluster. Resources within a namespace are logically separated from resources in other namespaces.
- **Resource Scopes**: Resources, such as Pods, Services, ConfigMaps, and more, are scoped to namespaces. Resources with the same name can exist in different namespaces without conflicts.
- **Organization**: Namespaces are used to organize resources and avoid naming collisions. They're particularly useful in multi-team or multi-project environments.
- **Default Namespace**: Every Kubernetes cluster comes with a default namespace. If you don't specify a namespace when creating a resource, it's assumed to belong to the default namespace.
- **Creating Namespaces**: You can create custom namespaces to organize resources according to your needs. For example, you might create namespaces for development, testing, production, and more.
- **Access Control**: Namespaces can have their own access control policies, allowing you to restrict access to resources on a per-namespace basis.

- **Resource Quotas**: Namespaces can have resource quotas applied to them, ensuring that teams or projects stay within their allocated resource limits.

- **Monitoring and Resource Allocation**: Namespaces facilitate monitoring and resource allocation by providing a clear separation of resource usage for different teams or applications.

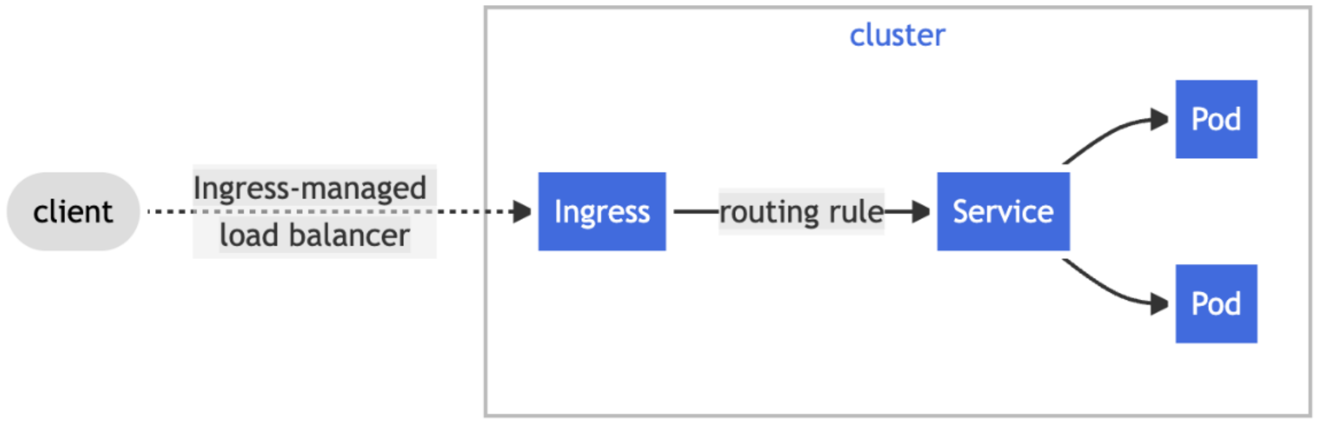
- **Limitations**: While namespaces provide logical isolation, they don't offer strong security boundaries. Sensitive or confidential data might require additional security mechanisms.

Namespaces are a vital feature in Kubernetes for organizing, isolating, and managing resources within a cluster. They allow you to maintain clarity and control in complex environments, supporting the seamless operation of multiple teams or projects without interfering with each other's resources

What is Ingress Controller ?

Ingress Controllers:

Ingress controllers manage external access to services within the cluster, handling routing, SSL termination, and more.



Ingress Controllers:

Ingress Controllers are Kubernetes resources and components that manage the external access to services within a cluster. They provide a way to route incoming traffic to specific services based on rules, and they also handle other functionalities such as SSL termination, load balancing, and name-based virtual hosting. Ingress Controllers act as a gateway for incoming external requests, allowing you to expose services to the outside world in a controlled and efficient manner. Here's what you need to know:

- **External Access Management**: Ingress Controllers manage the external access to services, acting as a reverse proxy and handling traffic routing.

- **Routing and URL-Based Access**: Ingress Controllers allow you to define rules for routing incoming traffic to specific services based on URL paths or hostnames.

- **SSL Termination**: Ingress Controllers can terminate SSL (TLS) connections, decrypting the traffic before forwarding it to the appropriate service.
- **Load Balancing**: Ingress Controllers provide load balancing capabilities, distributing incoming traffic across multiple instances of a service.
- **Virtual Hosts**: Ingress Controllers support name-based virtual hosting, allowing you to route traffic to different services based on the hostname in the incoming request.
- **Dynamic Configuration**: Ingress rules and configurations can be dynamically updated without changing the underlying services.
- **Ingress Resources**: In Kubernetes, Ingress Controllers are configured using **Ingress resources**, which define the routing rules and configurations for incoming traffic.
- **Multiple Ingress Controllers**: Kubernetes allows you to use multiple Ingress Controllers in the same cluster, each responsible for different sets of services or use cases.
- **Ingress Controllers vs. Services**: While Services expose services within the cluster, Ingress Controllers manage external access. Ingress Controllers often work with Services to route incoming traffic.
- **Popular Ingress Controllers**: There are several Ingress Controllers available for Kubernetes, such as Nginx Ingress Controller, Traefik, and Istio Gateway.

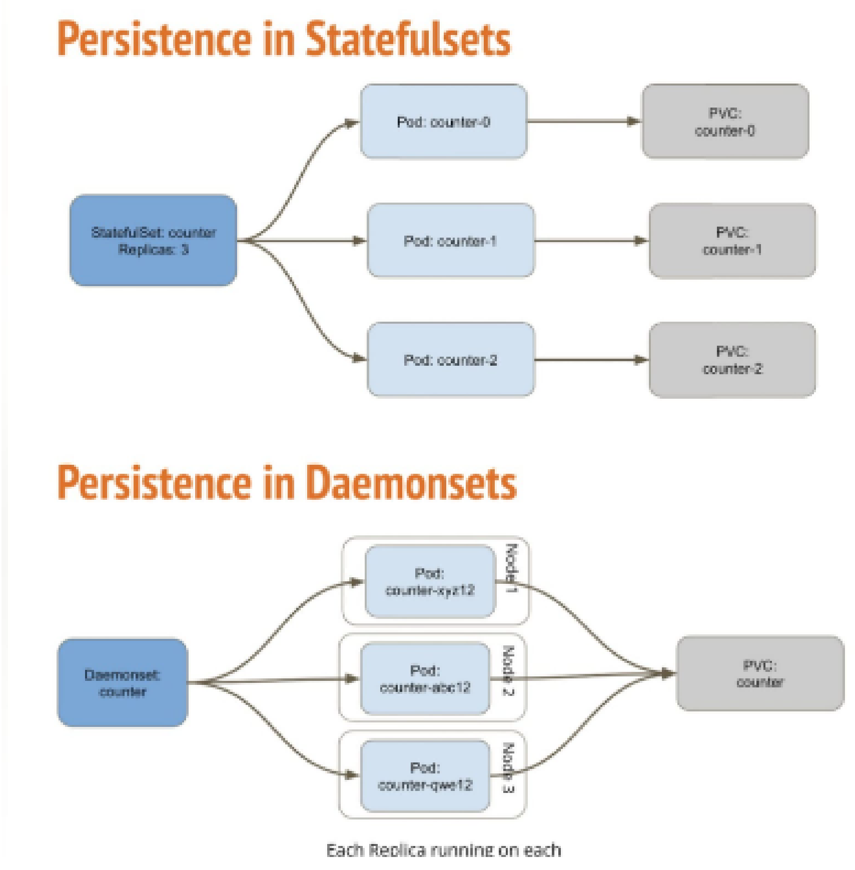
Ingress Controllers play a critical role in managing external access to services within a Kubernetes cluster. They provide advanced routing, load balancing, SSL termination, and virtual hosting capabilities, allowing you to expose your applications to the outside world while

What are StatefulSets and DaemonSets ?

StatefulSets and **DaemonSets**:

- **StatefulSets**: Manage stateful applications with stable network identities and persistent storage.
- **DaemonSets**: Ensure that a specific Pod runs on all (or a subset of) nodes for tasks like monitoring or logging.

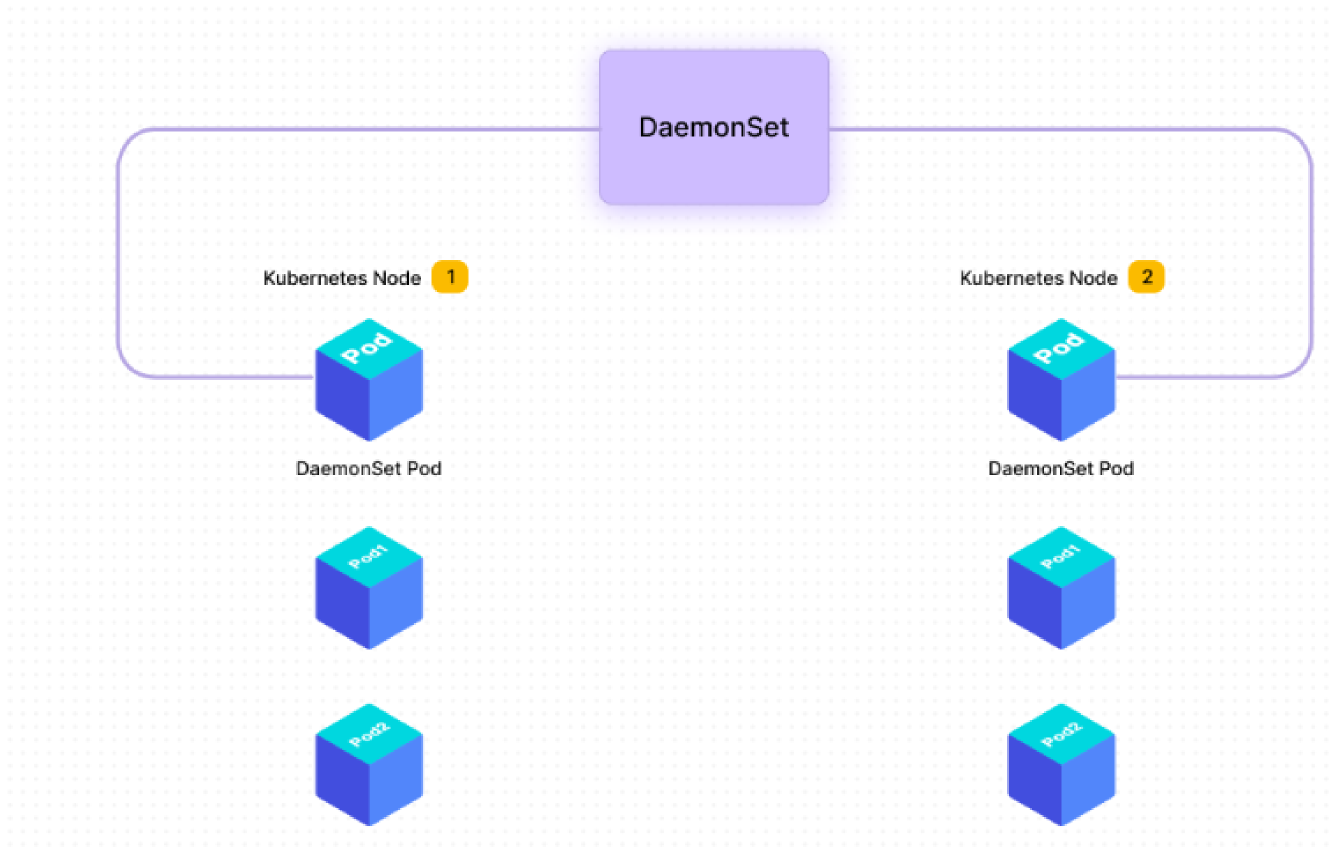
StatefulSets and **DaemonSets** are two different types of controllers in Kubernetes that serve specific purposes for managing applications and workloads.



StatefulSets:

StatefulSets are designed for managing stateful applications, where each instance (Pod) requires stable and unique network identities and persistent storage. These applications typically have their own identity, state, and specific requirements for ordering and scaling. StatefulSets ensure that Pods are created and scaled in an orderly fashion, allowing for stable network identities, persistent storage, and proper ordering during scaling events. Here's what you need to know:

- **Ordered Creation**: StatefulSets create Pods in an ordered manner, ensuring that each Pod has a unique and predictable identity.
- **Stable Hostnames**: Each Pod in a StatefulSet has a stable and unique hostname, which is useful for applications that rely on specific identity or naming conventions.
- **Persistent Storage**: StatefulSets provide support for attaching persistent storage to Pods, allowing stateful applications to store data that persists across Pod restarts and rescheduling.
- **Scaling**: StatefulSets can be scaled up or down, with the controller ensuring that new instances maintain the ordered identity.
- **Update Strategies**: StatefulSets support rolling updates and can also be used for deleting and replacing instances while preserving stable network identities and data.
- **Use Cases**: StatefulSets are suitable for applications like databases, messaging systems, and other stateful workloads.



DaemonSets:

DaemonSets ensure that a specific Pod is scheduled to run on all (or a subset of) nodes in the cluster. They are particularly useful for running system-level agents or applications that need to be present on every node for tasks such as monitoring, logging, or networking. DaemonSets ensure that each node has exactly one instance of the specified Pod running. Here's what you need to know:

- **One Pod per Node**: DaemonSets ensure that one instance of the designated Pod runs on every node in the cluster.
- **Use Cases**: DaemonSets are commonly used for system-level services, such as monitoring agents (e.g., Prometheus Node Exporter), logging agents (e.g., Fluentd), or network proxies.
- **Node Constraints**: You can control on which nodes the DaemonSet Pods are scheduled by using node selectors or affinity/anti-affinity rules.
- **Node Removal**: When a node is added or removed from the cluster, the DaemonSet controller automatically creates or deletes the corresponding Pods on the new or removed node.
- **Rolling Updates**: DaemonSets support rolling updates just like other controllers, allowing you to update the Pods on each node one by one.
- **Critical System Components**: DaemonSets play a crucial role in ensuring that essential system components are running consistently across the cluster.

StatefulSets and **DaemonSets** are both controller types in Kubernetes, but they cater to different use cases. StatefulSets manage stateful applications with ordered creation, stable network identities, and persistent storage. DaemonSets ensure that a specific Pod runs on every node in the cluster, making them ideal for system-level agents and services that need to be present

The combination of these components forms the foundation of the Kubernetes architecture, providing a powerful framework for managing containerized applications at scale. The Cloud Controller Manager, when applicable, enhances Kubernetes' capabilities in cloud environments by interfacing with cloud provider-specific services and resources.

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--- Prudhvi Vardhan ( LinkedIn)
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