Deployment vs. DaemonSet vs. StatefulSet

In Kubernetes, **Deployment**, **DaemonSet**, and **StatefulSet** are workload resources used to manage and run pods, but they serve different purposes and are suited for different use cases. Here's a breakdown of each:

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1. Deployment

- **Purpose**: A Deployment is used to manage stateless applications. It ensures that a specified number of pod replicas are running at all times and provides declarative updates for pods and ReplicaSets.
- **Key Features**:
  - Scales up or down by increasing or decreasing the number of pod replicas.
  - Supports rolling updates and rollbacks.
  - Pods are interchangeable (stateless) and can be replaced at any time.
  - No guarantee of pod order or uniqueness.
- **Use Cases**:
  - Stateless applications (e.g., web servers, APIs).
  - Applications that don't require stable network identities or persistent storage.
- **Example**: Running a web server with multiple replicas.

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2. DaemonSet

- **Purpose**: A DaemonSet ensures that a copy of a pod runs on all (or some) nodes in the cluster. It is typically used for system-level services that need to run on every node.
- **Key Features**:
  - Ensures that every node runs a copy of the pod.
  - Automatically adds pods to new nodes when they join the cluster.
  - Useful for node-specific tasks like logging, monitoring, or networking.
  - Pods are tied to specific nodes and are not interchangeable.
- **Use Cases**:
  - Node-level monitoring agents (e.g., Prometheus Node Exporter).
  - Log collection daemons (e.g., Fluentd, Logstash).
  - Networking plugins (e.g., CNI plugins like Calico).
- **Example**: Running a logging agent on every node in the cluster.

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3. StatefulSet

- **Purpose**: A StatefulSet is used to manage stateful applications that require stable network identities, persistent storage, and ordered deployment and scaling.
- **Key Features**:
  - Provides stable, unique network identifiers (e.g., `pod-0`, `pod-1`).
  - Ensures ordered and graceful deployment, scaling, and deletion of pods.
  - Each pod gets its own persistent storage (via PersistentVolume).
  - Pods are not interchangeable and maintain their identity.
- **Use Cases**:
  - Databases (e.g., MySQL, PostgreSQL, Cassandra).
  - Applications requiring stable network identities (e.g., Kafka, Zookeeper).
  - Applications that need persistent storage and ordered operations.
- **Example**: Running a distributed database like Cassandra with persistent storage.

Comparison Table

Feature	Deployment	DaemonSet	StatefulSet
Pod Uniqueness	Interchangeable	Node-specific	Unique and stable
Scaling	Scales replicas	One pod per node	Scales with ordered pods
Network Identity	No stable identity	No stable identity	Stable network identity
Storage	Ephemeral or shared	Ephemeral or shared	Persistent and unique
Use Case	Stateless applications	Node-level services	Stateful applications
Ordering	No ordering	No ordering	Ordered deployment

When to Use Which?

- Use a **Deployment** for stateless applications that don't require stable identities or persistent storage.
- Use a **DaemonSet** for system-level services that need to run on every node.
- Use a **StatefulSet** for stateful applications that require stable identities, persistent storage, and ordered operations.