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## **Lab Exercise 8- Creating and Managing a ReplicaSet in Kubernetes**

### **Objective:**

A ReplicaSet in Kubernetes ensures a specified number of Pod replicas are running at any given time. This exercise will guide you through creating a ReplicaSet to maintain the desired state of your application.

- Understand the syntax and structure of a Kubernetes ReplicaSet definition file (YAML).
- Learn how to create and manage a ReplicaSet to ensure application availability.
- Understand how a ReplicaSet helps in scaling applications and maintaining desired states.

### **Prerequisites**

- Kubernetes Cluster: Have a running Kubernetes cluster (locally using Minikube or kind, or a cloud-based service).
- kubectl: Install and configure kubectl to interact with your Kubernetes cluster.
- Basic Knowledge of YAML: Familiarity with YAML format will be helpful for understanding Kubernetes resource definitions.

### **Step-by-Step Guide**

## Step 1: Understanding ReplicaSet

A ReplicaSet ensures a specified number of Pod replicas are running at any given time. If a Pod crashes or is deleted, the ReplicaSet creates a new one to meet the defined number of replicas. This helps maintain application availability and ensures that your application can handle increased load by distributing traffic among multiple Pods.

## Step 2: Create a ReplicaSet

We'll define a ReplicaSet to maintain three replicas of a simple Nginx web server Pod. Create a YAML file named `nginx-replicaset.yaml` with the following content:

```
apiVersion: apps/v1    # Specifies the API version used.
kind: ReplicaSet        # The type of resource being defined; here, it's a ReplicaSet.
metadata:
  name: nginx-replicaset # The name of the ReplicaSet.
spec:
  replicas: 3           # The desired number of Pod replicas.
  selector:
    matchLabels:        # Criteria to identify Pods managed by this ReplicaSet.
      app: nginx        # The label that should match Pods.
  template:             # The Pod template for creating new Pods.
    metadata:
      labels:
        app: nginx      # Labels applied to Pods created by this ReplicaSet.
    spec:
      containers:
        - name: nginx    # Name of the container within the Pod.
          image: nginx:latest # Docker image to use for the container.
          ports:
            - containerPort: 80 # The port the container exposes.
```

```

! nginx-replicaset.yaml X
! nginx-replicaset.yaml
1  apiVersion: apps/v1      # Specifies the API version used.
2  kind: ReplicaSet        # The type of resource being defined; here, it's a ReplicaSet.
3  metadata:
4    | name: nginx-replicaset # The name of the ReplicaSet.
5  spec:
6    | replicas: 3           # The desired number of Pod replicas.
7    | selector:
8      | matchLabels:       # Criteria to identify Pods managed by this ReplicaSet.
9      |   app: nginx       # The label that should match Pods.
10   | template:             # The Pod template for creating new Pods.
11     | metadata:
12       | labels:
13       |   app: nginx      # Labels applied to Pods created by this ReplicaSet.
14     | spec:
15       | containers:
16       | - name: nginx     # Name of the container within the Pod.
17       |   image: nginx:latest # Docker image to use for the container.
18       |   ports:
19       | - containerPort: 80 # The port the container exposes.

```

## Explanation:

- apiVersion: Defines the API version (apps/v1) used for the ReplicaSet resource.
- kind: Specifies that this resource is a ReplicaSet.
- metadata: Contains metadata about the ReplicaSet, including name.
  - name: The unique name for the ReplicaSet.
- spec: Provides the specification for the ReplicaSet.
  - replicas: Defines the desired number of Pod replicas.
  - selector: Criteria for selecting Pods managed by this ReplicaSet.
    - matchLabels: Labels that Pods must have to be managed by this ReplicaSet.
  - template: Defines the Pod template used for creating new Pods.
    - metadata: Contains metadata for the Pods, including labels.
      - labels: Labels applied to Pods created by this ReplicaSet.
  - spec: Specification for the Pods.
    - containers: Lists the containers that will run in the Pod.

- name: The unique name of the container within the Pod.
- image: The Docker image used for the container.
- ports: Ports exposed by the container.

### Step 3: Apply the YAML to Create the ReplicaSet

Use the kubectl apply command to create the ReplicaSet based on the YAML file.

```
kubectl apply -f nginx-replicaset.yaml
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl apply -f nginx-replicaset.yaml
replicaset.apps/nginx-replicaset created
```

**Verify the ReplicaSet is running and maintaining the desired number of replicas:**

```
kubectl get replicaset
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl get replicaset
NAME           DESIRED   CURRENT   READY   AGE
nginx-replicaset 3         3         3       40s
```

This command lists all ReplicaSets in the current namespace.

**To check the Pods created by the ReplicaSet:**

```
kubectl get pods -l app=nginx
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl get pods -l app=nginx
NAME                READY   STATUS    RESTARTS   AGE
nginx-replicaset-n49fm 1/1     Running   0          68s
nginx-replicaset-nbbpr 1/1     Running   0          68s
nginx-replicaset-v6h8n 1/1     Running   0          68s
```

This command lists all Pods with the label app=nginx.

## Step 4: Managing the ReplicaSet

### 1. Scaling the ReplicaSet

You can scale the number of replicas managed by the ReplicaSet using the kubectl scale command.

```
kubectl scale --replicas=5 replicaset/nginx-replicaset
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl scale --replicas=5 replicaset/nginx-replicaset
replicaset.apps/nginx-replicaset scaled
```

This command scales the ReplicaSet to maintain 5 replicas. Verify the scaling operation:

```
kubectl get pods -l app=nginx
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl get pods -l app=nginx
NAME                READY   STATUS    RESTARTS   AGE
nginx-replicaset-42cvk 1/1     Running   0          39s
nginx-replicaset-9c71b 1/1     Running   0          39s
nginx-replicaset-n49fm 1/1     Running   0          2m38s
nginx-replicaset-nbbpr 1/1     Running   0          2m38s
nginx-replicaset-v6h8n 1/1     Running   0          2m38s
```

You should see that the number of Pods has increased to 5.

## 2. Updating the ReplicaSet

If you need to update the Pod template (e.g., to use a different Docker image version), modify the YAML file and apply it again. For instance, change the image to a specific version of Nginx:

```
spec:
  template:
    spec:
      containers:
      - name: nginx
        image: nginx:1.19.3 # Change to a specific version
```

```
! nginx-replicaset.yaml X
! nginx-replicaset.yaml
1  apiVersion: apps/v1      # Specifies the API version used.
2  kind: ReplicaSet        # The type of resource being defined; here, it's a ReplicaSet.
3  metadata:
4    name: nginx-replicaset # The name of the ReplicaSet.
5  spec:
6    replicas: 3            # The desired number of Pod replicas.
7    selector:
8      matchLabels:        # Criteria to identify Pods managed by this ReplicaSet.
9        app: nginx        # The label that should match Pods.
10   template:              # The Pod template for creating new Pods.
11     metadata:
12       labels:
13         app: nginx       # Labels applied to Pods created by this ReplicaSet.
14     spec:
15       containers:
16       - name: nginx      # Name of the container within the Pod.
17         image: nginx:1.19.3 # Change to a specific version
18         ports:
19         - containerPort: 80 # The port the container exposes.
```

**Apply the changes:**

```
kubectl apply -f nginx-replicaset.yaml
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl apply -f nginx-replicaset.yaml
replicaset.apps/nginx-replicaset configured
```

**Check the status to ensure the Pods are updated:**

```
kubectl get pods -l app=nginx
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl get pods -l app=nginx
NAME                                READY   STATUS    RESTARTS   AGE
nginx-replicaset-42cvk             1/1     Running   0           10m
nginx-replicaset-n49fm             1/1     Running   0           12m
nginx-replicaset-v6h8n             1/1     Running   0           12m
```

Note: Updating a ReplicaSet doesn't automatically replace existing Pods with new ones. In practice, you often create a new ReplicaSet or Deployment for updates.

### 3. Deleting the ReplicaSet

To clean up the ReplicaSet and its Pods, use the kubectl delete command:

```
kubectl delete -f nginx-replicaset.yaml
```

```
AARUSHI@Aarushi-Laptop MINGW64 ~/Desktop/Sem-5/LABS/Container and Docker Security/exp8
$ kubectl delete -f nginx-replicaset.yaml
replicaset.apps "nginx-replicaset" deleted
```

This command deletes the ReplicaSet and all the Pods managed by it.