

# 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.
```

### 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
```

```
Microsoft Windows [Version 10.0.26100.2314]
(c) Microsoft Corporation. All rights reserved.

C:\Users\OM VATS>kubectl cluster-info
Kubernetes control plane is running at https://kubernetes.docker.internal:6443
CoreDNS is running at https://kubernetes.docker.internal:6443/api/v1/namespaces/kube-system/services/kube-dns:dns/proxy

To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.

C:\Users\OM VATS>kubectl version --client
Client Version: v1.30.2
Kustomize Version: v5.0.4-0.20230601165947-6ce0bf390ce3

C:\Users\OM VATS>notepad nginx-replicaset.yaml

C:\Users\OM VATS>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
```

```
C:\Users\OM VATS>kubectl get replicaset
NAME                DESIRED   CURRENT   READY   AGE
my-app-5547858f48    1         1         1       19h
nginx-replicaset     3         3         2       8s
```

This command lists all ReplicaSets in the current namespace.

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

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

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

```
C:\Users\OM VATS>kubectl get pods -l app=nginx
NAME                READY   STATUS    RESTARTS   AGE
nginx-replicaset-7sjpx  1/1     Running   0          32s
nginx-replicaset-grztd  1/1     Running   0          32s
nginx-replicaset-vkkf9  1/1     Running   0          32s
```

## 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
```

```
C:\Users\OM VATS>kubectl scale --replicas=5 replicaset/nginx-replicaset
replicaset.apps/nginx-replicaset scaled

C:\Users\OM VATS>kubectl get pods -l app=nginx
NAME                READY   STATUS    RESTARTS   AGE
nginx-replicaset-6xhmj  1/1     Running   0          10s
nginx-replicaset-7sjpx  1/1     Running   0          57s
nginx-replicaset-grztd  1/1     Running   0          57s
nginx-replicaset-sq2ww  1/1     Running   0          10s
nginx-replicaset-vkkf9  1/1     Running   0          57s
```

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

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

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

```
C:\Users\OM VATS>kubectl get pods -l app=nginx
NAME                                READY   STATUS    RESTARTS   AGE
nginx-replicaset-6xhmj             1/1     Running   0           10s
nginx-replicaset-7sjpx             1/1     Running   0           57s
nginx-replicaset-grztd             1/1     Running   0           57s
nginx-replicaset-sq2ww             1/1     Running   0           10s
nginx-replicaset-vkkf9             1/1     Running   0           57s
```

## 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
```

**Apply the changes:**

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

```
C:\Users\OM VATS>notepad nginx-replicaset.yaml

C:\Users\OM VATS>kubectl apply -f nginx-replicaset.yaml
replicaset.apps/nginx-replicaset configured

C:\Users\OM VATS>kubectl get pods -l app=nginx
NAME                                READY    STATUS    RESTARTS    AGE
nginx-replicaset-7sjpx             1/1      Running   0           19m
nginx-replicaset-sq2ww             1/1      Running   0           18m
nginx-replicaset-vkkf9             1/1      Running   0           19m
```

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

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

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.

```
C:\Users\OM VATS>kubectll get pods -l app=nginx
```

NAME	READY	STATUS	RESTARTS	AGE
nginx-replicaset-7sjpx	1/1	Running	0	19m
nginx-replicaset-sq2ww	1/1	Running	0	18m
nginx-replicaset-vkkf9	1/1	Running	0	19m

### 3. Deleting the ReplicaSet

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

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

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

```
C:\Users\OM VATS>kubectl delete -f nginx-replicaset.yaml
replicaset.apps "nginx-replicaset" deleted

C:\Users\OM VATS>kubectl get replicaset
NAME                                DESIRED    CURRENT    READY    AGE
my-app-5547858f48                  1          1          1        19h
```