Deploying Apache HTTPD on Kubernetes Using Helm (With Lightweight Kubernetes Setup)

Introduction to Helm

Helm is a package manager for Kubernetes that simplifies the deployment and management of applications. Instead of writing multiple YAML files and applying them manually using kubectl apply -f, Helm allows you to package all Kubernetes resources into a single **Helm Chart**.

Using Helm, we can define variables in values.yaml and reuse them dynamically instead of hardcoding values in multiple YAML files.

Prerequisites

Before proceeding, ensure you have the following:

An AWS EC2 instance (Ubuntu 20.04 or later)

K3s (Lightweight Kubernetes) installed

Helm installed

Step-by-Step Deployment Guide

Step 1: Install a Lightweight Kubernetes (K3s) on Your EC2 Instance

Since running a full Kubernetes cluster (e.g., using kubeadm) can be resource-intensive, we'll use **K3s**, a lightweight Kubernetes distribution that is easy to install and well-suited for EC2 instances.

1. Install K3s

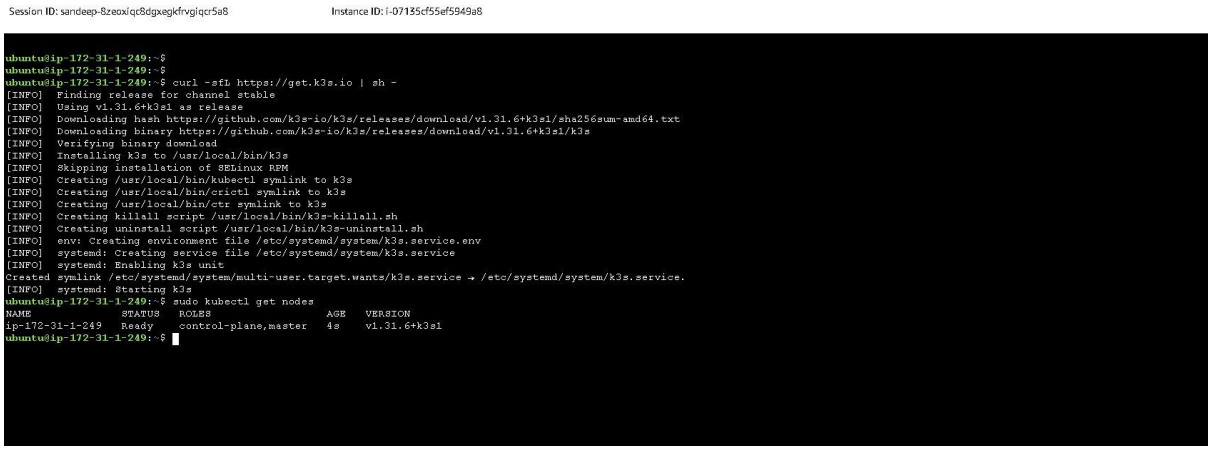
Run the following command on your EC2 instance:

curl -sfL https://get.k3s.io | sh -

2. Verify Kubernetes Installation

After installation, check if Kubernetes is running:

kubectl get nodes



If kubectl is not found, set up your environment:

export KUBECONFIG=/etc/rancher/k3s/k3s.yaml

Now check again:

kubectl get nodes

You should see your EC2 instance listed as a Kubernetes node.

Expected Output:

```
NAME STATUS ROLES AGE VERSION
ip-172-31-1-249 Ready control-plane,master 5m v1.31.6+k3s1
```

Step 2: Install Helm on Your EC2 Instance

If Helm is not installed, run the following commands:

curl -fsSL -o get_helm.sh https://raw.githubusercontent.com/helm/helm/main/scripts/get-helm-3

chmod 700 get_helm.sh

./get_helm.sh

Verify the installation:

helm version

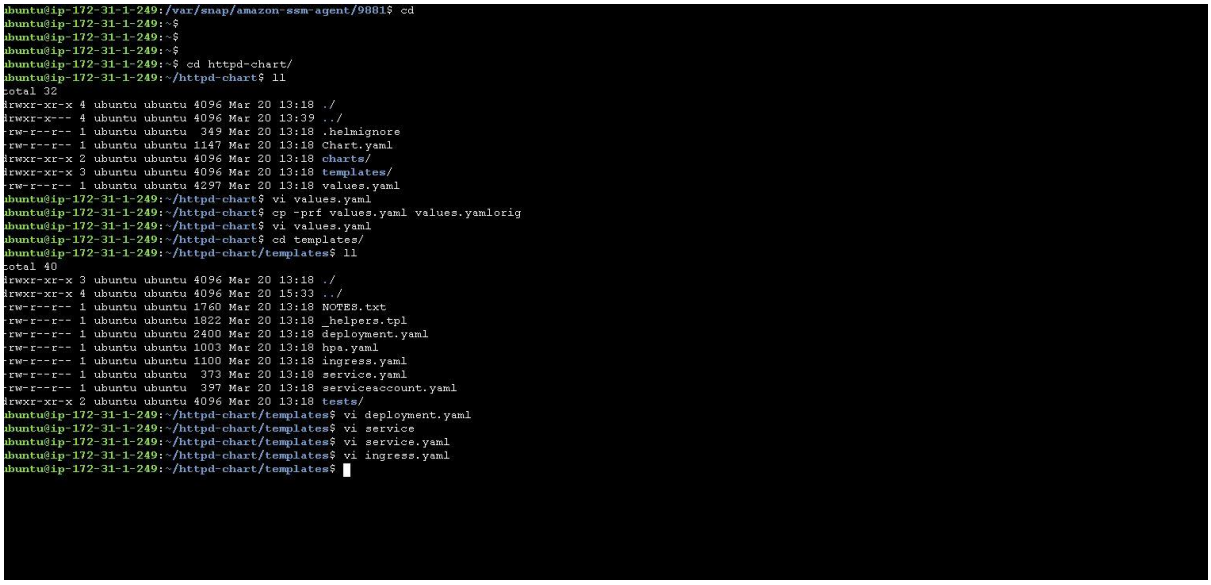
Step 3: Create a Helm Chart for HTTPD

helm create httpd-chart

cd httpd-chart

This command generates a folder structure under httpd-chart/. Now, modify the necessary files.

Step 4: Modify Helm Chart Files



1. **values.yaml (Configuration for Deployment, Service, and Ingress)**
   Modify `values.yaml` to configure the deployment settings

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2. templates/deployment.yaml (Deployment for HTTPD)

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3. templates/service.yaml (Service to Expose HTTPD)

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4. templates/ingress.yaml (Ingress for External Access - Optional)

Step 5: Deploy the Helm Chart

sudo cp -prf /etc/rancher/k3s/k3s.yaml /home/ubuntu/kube.conf

sudo chown ubuntu:ubuntu /home/ubuntu/kube.conf

export KUBECONFIG=/home/ubuntu/kube.conf

kubectl get nodes

NAME STATUS ROLES AGE VERSION

ip-172-31-1-249 Ready control-plane,master 148m v1.31.6+k3s1

Session ID: sandeep-xxiye2qkt82lbaxclx9prpqkf8 Instance ID: i-07135cf55ef5949a8

```
ubuntu@ip-172-31-1-249:~$ sudo cp -prf /etc/rancher/k3s/k3s.yaml /home/ubuntu/kube.conf
ubuntu@ip-172-31-1-249:~$ sudo chown ubuntu:ubuntu /home/ubuntu/kube.conf
ubuntu@ip-172-31-1-249:~$ cd /home/ubuntu/
ubuntu@ip-172-31-1-249:~$ ls -altr
total 60
-rw-r--r-- 1 ubuntu ubuntu   807 Mar 31  2024 .profile
-rw-r--r-- 1 ubuntu ubuntu  3771 Mar 31  2024 .bashrc
-rw-r--r-- 1 ubuntu ubuntu   220 Mar 31  2024 .bash_logout
drwx------ 2 ubuntu ubuntu  4096 Mar 20 13:08 .ssh
drwxr-xr-x 4 root   root    4096 Mar 20 13:08 ..
-rw-r--r-- 1 ubuntu ubuntu     0 Mar 20 13:09 .sudo_as_admin_successful
-rw------- 1 ubuntu ubuntu  2957 Mar 20 13:12 kube.conf
-rwx------ 1 ubuntu ubuntu 11913 Mar 20 13:16 get_helm.sh
-rw------- 1 ubuntu ubuntu   329 Mar 20 13:39 .bash_history
drwxr-xr-x 4 ubuntu ubuntu  4096 Mar 20 15:33 httpd-chart
-rw------- 1 ubuntu ubuntu  9436 Mar 20 15:35 .viminfo
drwxr-x--- 4 ubuntu ubuntu  4096 Mar 20 15:39 .
ubuntu@ip-172-31-1-249:~$ export KUBECONFIG=/home/ubuntu/kube.conf
ubuntu@ip-172-31-1-249:~$ kubectl get nodes
NAME              STATUS   ROLES                  AGE    VERSION
ip-172-31-1-249   Ready    control-plane,master   148m   v1.31.6+k3s1
ubuntu@ip-172-31-1-249:~$
```

1. **Install the chart**
2. helm install my-httpd ./httpd-chart

Session ID: sandeep-xxiye2qkt82lbaxclx9prpqkf8 Instance ID: i-07135cf55ef5949a8

```
ubuntu@ip-172-31-1-249:~/httpd-chart/templates$
ubuntu@ip-172-31-1-249:~/httpd-chart/templates$ cd
ubuntu@ip-172-31-1-249:~$ ls -altr httpd-chart/templates/
total 32
drwxr-xr-x 2 ubuntu ubuntu 4096 Mar 20 13:18 tests
-rw-r--r-- 1 ubuntu ubuntu 1822 Mar 20 13:18 _helpers.tpl
-rw-r--r-- 1 ubuntu ubuntu 1760 Mar 20 13:18 NOTES.txt
drwxr-xr-x 4 ubuntu ubuntu 4096 Mar 20 15:33 ..
-rw-r--r-- 1 ubuntu ubuntu  396 Mar 20 15:34 deployment.yaml
-rw-r--r-- 1 ubuntu ubuntu  219 Mar 20 15:34 service.yaml
-rw-r--r-- 1 ubuntu ubuntu  414 Mar 20 15:35 ingress.yaml
drwxr-xr-x 3 ubuntu ubuntu 4096 Mar 20 15:45 .
ubuntu@ip-172-31-1-249:~$ helm install my-httpd ./httpd-chart
NAME: my-httpd
LAST DEPLOYED: Thu Mar 20 15:46:08 2025
NAMESPACE: default
STATUS: deployed
REVISION: 1
NOTES:
1. Get the application URL by running these commands:
  export POD_NAME=$(kubectl get pods --namespace default -l "app.kubernetes.io/name=httpd-chart,app.kubernetes.io/instance=my-httpd" -o jsonpath="{.items[0].metadata.name}")
  export CONTAINER_PORT=$(kubectl get pod --namespace default $POD_NAME -o jsonpath="{.spec.containers[0].ports[0].containerPort}")
  echo "Visit http://127.0.0.1:8080 to use your application"
  kubectl --namespace default port-forward $POD_NAME 8080:$CONTAINER_PORT
ubuntu@ip-172-31-1-249:~$
```

3. **Check if the deployment is running**
4. kubectl get pods
5. kubectl get svc

```
ubuntu@ip-172-31-1-249:~$ kubectl get pods
NAME                                 READY   STATUS    RESTARTS   AGE
httpd-deployment-bf5c4df59-mhcb6   1/1     Running   0          83s
ubuntu@ip-172-31-1-249:~$ kubectl get svc
NAME              TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)    AGE
httpd-service     ClusterIP   10.43.151.81    <none>        80/TCP     116s
kubernetes        ClusterIP   10.43.0.1       <none>        443/TCP    155m
ubuntu@ip-172-31-1-249:~$
```

6. **Test the service**
7. kubectl port-forward svc/httpd-service 8080:80

8. curl http://localhost:8080

Step 6: Enable Ingress (Optional: Expose HTTPD Externally)

If you want to expose the service using Ingress, follow these steps:

1. **Install Nginx Ingress Controller**

   kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingress-nginx/main/deploy/static/provider/cloud/deploy.yaml

2. **Edit values.yaml** and set ingress.enabled to true
3. **Upgrade the Helm deployment**:

   helm upgrade my-httpd ./httpd-chart

```
ubuntu@ip-172-31-1-249:~$ kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingress-nginx/main/deploy/static/provider/cloud/deploy.yaml
namespace/ingress-nginx created
serviceaccount/ingress-nginx created
serviceaccount/ingress-nginx-admission created
role.rbac.authorization.k8s.io/ingress-nginx created
role.rbac.authorization.k8s.io/ingress-nginx-admission created
clusterrole.rbac.authorization.k8s.io/ingress-nginx created
clusterrole.rbac.authorization.k8s.io/ingress-nginx-admission created
rolebinding.rbac.authorization.k8s.io/ingress-nginx created
rolebinding.rbac.authorization.k8s.io/ingress-nginx-admission created
clusterrolebinding.rbac.authorization.k8s.io/ingress-nginx created
clusterrolebinding.rbac.authorization.k8s.io/ingress-nginx-admission created
configmap/ingress-nginx-controller created
service/ingress-nginx-controller created
service/ingress-nginx-controller-admission created
deployment.apps/ingress-nginx-controller created
job.batch/ingress-nginx-admission-create created
job.batch/ingress-nginx-admission-patch created
ingressclass.networking.k8s.io/nginx created
validatingwebhookconfiguration.admissionregistration.k8s.io/ingress-nginx-admission created
ubuntu@ip-172-31-1-249:~$ grep -i ingress.enabled  httpd-chart/values.yaml
ubuntu@ip-172-31-1-249:~$ grep -i ingress  httpd-chart/values.yaml
ingress:
  enabled: false  # Change to true if using Ingress
ubuntu@ip-172-31-1-249:~$ vi httpd-chart/values.yaml
ubuntu@ip-172-31-1-249:~$ grep -i ingress  httpd-chart/values.yaml
ingress:
  enabled: true  # Change to true if using Ingress
ubuntu@ip-172-31-1-249:~$ he
head       helm       help       helpztags  hexdump
ubuntu@ip-172-31-1-249:~$ helm upgrade my-httpd ./httpd-chart
Release "my-httpd" has been upgraded. Happy Helming!
NAME: my-httpd
LAST DEPLOYED: Thu Mar 20 15:55:05 2025
NAMESPACE: default
STATUS: deployed
REVISION: 2
NOTES:
1. Get the application URL by running these commands:
ubuntu@ip-172-31-1-249:~$
```

4. **Update /etc/hosts on your EC2 instance**:
5. echo "$(kubectl get nodes -o jsonpath='{.items[0].status.addresses[0].address}') httpd.local" | sudo tee -a /etc/hosts

Session ID: sandeep-xxiye2qkt82lbaxclx9prpqkf8 Instance ID: i-07135cf55ef5949a8

```
ubuntu@ip-172-31-1-249:~$ cat /etc/hosts
127.0.0.1 localhost

# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
ff02::3 ip6-allhosts
ubuntu@ip-172-31-1-249:~$ echo "$(kubectl get nodes -o jsonpath='{.items[0].status.addresses[0].address}') httpd.local" | sudo tee -a /etc/hosts
172.31.1.249 httpd.local
ubuntu@ip-172-31-1-249:~$ cat /etc/hosts
127.0.0.1 localhost

# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
ff02::3 ip6-allhosts
172.31.1.249 httpd.local
ubuntu@ip-172-31-1-249:~$
```

6. **Test the HTTPD service using the hostname**
7. curl http://httpd.local

```
ubuntu@ip-172-31-1-249:~$ kubectl get svc -n ingress-nginx
NAME                                 TYPE           CLUSTER-IP      EXTERNAL-IP   PORT(S)                      AGE
ingress-nginx-controller             LoadBalancer   10.43.106.242   <pending>     80:31788/TCP,443:31804/TCP   91m
ingress-nginx-controller-admission   ClusterIP      10.43.96.152    <none>        443/TCP                      91m
ubuntu@ip-172-31-1-249:~$
ubuntu@ip-172-31-1-249:~$
ubuntu@ip-172-31-1-249:~$ curl http://httpd.local
<html><body><h1>It works!</h1></body></html>
ubuntu@ip-172-31-1-249:~$
```

Step 7: Cleanup

To uninstall the Helm release:

helm uninstall my-httpd

To remove K3s (if needed):

/usr/local/bin/k3s-uninstall.sh

Conclusion

Using **K3s** (lightweight Kubernetes), we deployed an **Apache HTTPD service** on Kubernetes using Helm. Unlike kubectl apply -f, Helm makes deployments **reusable, configurable, and easy to maintain**.