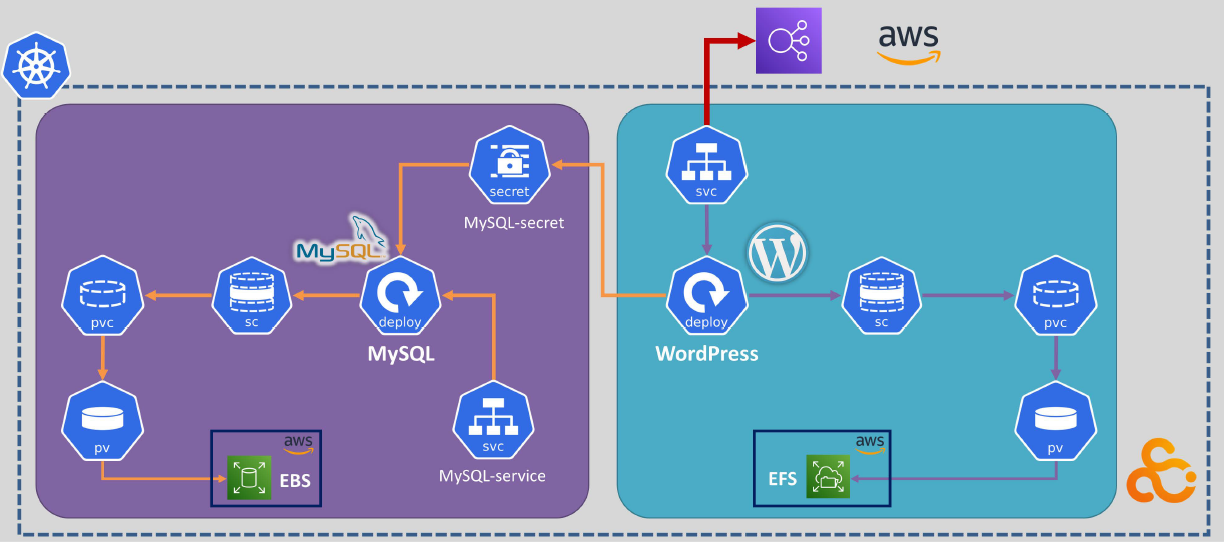
**Deploying A WordPress Site with MySQL Database Using Kubernetes on AWS**

**Project Summary:**

**This project implements a scalable and cloud-native deployment of a WordPress website backed by a MySQL database, orchestrated using Kubernetes and integrated with AWS storage services for high availability and persistence.**

**Components:**

1. **MySQL Database:**

* Deployed as a Kubernetes deployment.
* Secrets (MySQL-secret) are used for secure credential management.
* Exposed internally via a Kubernetes service (MySQL-service).
* Data persistence is ensured via a PersistentVolumeClaim (PVC) connected to an AWS Elastic Block Store (EBS) volume.

1. **WordPress Application:**

* Also deployed as a Kubernetes deployment.
* Communicates securely with the MySQL database using the MySQL-service.
* Exposes the application externally through a Kubernetes service which is fronted by an AWS Application Load Balancer (ALB).
* Persistent data such as uploads is stored using a PVC backed by AWS Elastic File System (EFS) for shared access and durability.

**Benefits:**

1. **Scalability:** Kubernetes enables horizontal scaling of WordPress pods to handle traffic spikes.
2. **High Availability:** Separate services for WordPress and MySQL promote fault tolerance and independent scaling.
3. **Persistent Storage:** EBS ensures reliable storage for MySQL, while EFS enables shared access to media files across WordPress pods.
4. **Security:** Sensitive database credentials are handled via Kubernetes Secrets.
5. **Cloud-Native Integration:** Deep integration with AWS services like EBS, EFS, and ALB allows for seamless cloud operation and resource management.

**Use Cases:**

1. Hosting dynamic content-driven websites and blogs using WordPress.
2. Demonstrating Kubernetes storage concepts with real-world AWS services.
3. Learning full-stack containerized application deployment on the cloud.

**Deployment Steps:**

1. **Setup Kubernetes with kubeadm on AWS:**
2. Launching **2 EC2 instances** (Master node – Worker node) with specs:

* **Instance Type:** t3.medium
* **OS:** ubuntu 22.04
* **Storage:** 20 GB (gp2)

1. Instances preparation and configuration via Bash script includes:

* Docker installation
* Hostname configuration [**Script Link**](https://github.com/eslambakr37/Deploying-a-WP-using-K8s-on-AWS/blob/main/install%20k8s%20-%20Master.sh)
* Kubernetes installation

1. Initialize Kubernetes on the Master node.

sudo kubeadm init --pod-network-cidr=10.244.0.0/16

mkdir -p $HOME/.kube

sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config

sudo chown $(id -u):$(id -g) $HOME/.kube/config

*#Deploy a Pod Network through the master node*

kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml

*#To Create a new token*

sudo kubeadm token create --print-join-command

1. Joining Worker nodes to the Kubernetes Cluster by token which created by Master node.
2. Installing CSI – EFS driver:

kubectl apply -k "github.com/kubernetes-sigs/aws-efs-csi-driver/deploy/kubernetes/overlays/stable/?ref=release-1.5"

kubectl get po -n kube-system

kubectl get csidriver

kubectl get csinode

1. Installing CSI – EBS driver:

kubectl apply -k "github.com/kubernetes-sigs/aws-ebs-csi-driver/deploy/kubernetes/overlays/stable/?ref=release-1.14"

kubectl get pods -n kube-system

kubectl get csidriver

kubectl get csinode

1. **IAM Configurations:**
2. Creating a user with EBS & EFS permissions (efs-ebs-eslam-wp)
3. Creating and downloading access key for the user
4. Creating a role with EBS & EFS permissions (ebs-efs-eslam-wp)
5. Attaching created role to machines
6. Adding user credential to Kubernetes cluster:

kubectl create secret generic efs-ebs-eslam-wp \

     --namespace kube-system \

     --from-literal "key\_id=AK\*\*\*\*\*\*\*\*\*\*\*\*" \

     --from-literal "access\_key=ie\*\*\*\*\*\*\*\*\*\*"

#list all secrets

Kubectl get secret -n kube-system

1. **Initializing MySQL Database (BackEnd):**
2. Creating a Secret for MySQL password:

echo -n 'myrootpassword' | openssl base64

bXlyb290cGFzc3dvcmQ=

1. Writing a **Secret** YAML file

apiVersion: v1

kind: Secret

metadata:

  name: mysql-password

type: Opaque

data:

  password: bXlyb290cGFzc3dvcmQ=

1. Writing a **Storage Class** YAML file for MySQL

apiVersion: storage.k8s.io/v1

kind: StorageClass

metadata:

  name: mysql-sc

provisioner: ebs.csi.aws.com

volumeBindingMode: WaitForFirstConsumer

1. Writing a **PVC** YAML file for MySQL

apiVersion: v1

kind: PersistentVolumeClaim

metadata:

  name: mysql-pvc

spec:

  accessModes:

    - ReadWriteOnce

  storageClassName:  mysql-sc

  resources:

    requests:

      storage: 5Gi

1. Writing a **Deployment** YAML file for MySQL

apiVersion: apps/v1

kind: Deployment

metadata:

  name: mysql-app

spec:

  selector:

    matchLabels:

      app: wp

      tier: mysql

  template:

    metadata:

      labels:

        app: wp

        tier: mysql

    spec:

      containers:

        - name: mysql

          image: mysql:5.6

          env:

          - name: MYSQL\_ROOT\_PASSWORD

            valueFrom:

              secretKeyRef:

                key: password

                name: mysql-password

          ports:

            - containerPort: 3306

          volumeMounts:

            - mountPath: /var/lib/mysql

              name: mysql-storage

      volumes:

        - name: mysql-storage

          persistentVolumeClaim:

            claimName: mysql-pvc

1. Writing a **Service** YAML file for MySQL

apiVersion: v1

kind: Service

metadata:

  name: mysql-svc

spec:

  selector:

    app: wp

    tier: mysql

  ports:

    - port: 3306

1. **Initializing** **WordPress (FrontEnd):**
2. Writing a **Storage Class** YAML file for WordPress

apiVersion: storage.k8s.io/v1

kind: StorageClass

metadata:

  name: wp-sc

provisioner: efs.csi.aws.com

1. Creating an **EFS** on AWS with access point specs:

* Name: efs
* Root dir: /wordpress
* User ID & Owner user ID: 1000
* Group ID & Owner Group ID: 1000
* Access Point permission: 777

1. Writing a **PV** YAML file for WordPress

apiVersion: v1

kind: PersistentVolume

metadata:

  name: wp-efs-pv

spec:

  capacity:

    storage: 5Gi

  volumeMode: Filesystem

  accessModes:

    - ReadWriteMany

  persistentVolumeReclaimPolicy: Retain

  storageClassName: wp-sc

  csi:

    driver: efs.csi.aws.com

    volumeHandle: fs-0b4115f0413669a96::fsap-08499189ba31d1961

1. Writing a **PVC** YAML file for WordPress

apiVersion: v1

kind: PersistentVolumeClaim

metadata:

  name: wp-efs-pvc

spec:

  accessModes:

   - ReadWriteMany

  storageClassName: wp-sc

  resources:

    requests:

      storage: 5Gi

1. Writing a **Deployment** YAML file for WordPress

apiVersion: apps/v1

kind: Deployment

metadata:

  name: wp-app

spec:

  selector:

    matchLabels:

      app: wp

      tier: frontend

  template:

    metadata:

      labels:

        app: wp

        tier: frontend

    spec:

      containers:

        - name: wordpress

          image: wordpress:php7.4-apache

          env:

            - name: WORDPRESS\_DB\_HOST

              value: mysql-svc

            - name: WORDPRESS\_DB\_PASSWORD

              valueFrom:

                secretKeyRef:

                  name: mysql-password

                  key: password

          ports:

            - containerPort: 80

              name: wordpress

          volumeMounts:

            - name: wordpress-storage

              mountPath: /var/www/html

      volumes:

        - name: wordpress-storage

          persistentVolumeClaim:

            claimName: wp-efs-pvc

        - name: mysql-storage

          persistentVolumeClaim:

            claimName: mysql-pvc

1. Writing a **Service** YAML file for WordPress

apiVersion: v1

kind: Service

metadata:

  name: wp-svc

spec:

  selector:

    app: wp

    tier: frontend

  ports:

    - port: 80

  type: LoadBalancer

1. Creating an **Application Load Balancer** and attaching machines to a **Target Group** working on port 30347

**Final Structure:**

