

Micro Services Application Deployment to Elastic Kubernetes Service

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I. Introduction

I.1. Target

The document aims at helping readers understand a few key features of **Kubernetes** such as “Pod”, “Deployment”, “StatefulSet”, “ConfigMap”, “Secret”, “Service”, “Ingress”, “StorageClass”, “PersistentVolume”, “PersistentVolumeClaim”, etc.

I.2. Demo Overview

The application will be deployed to AWS Elastic Kubernetes Service known as EKS.

The project used in this demo consists of 3 services:

- database
- backend
- frontend

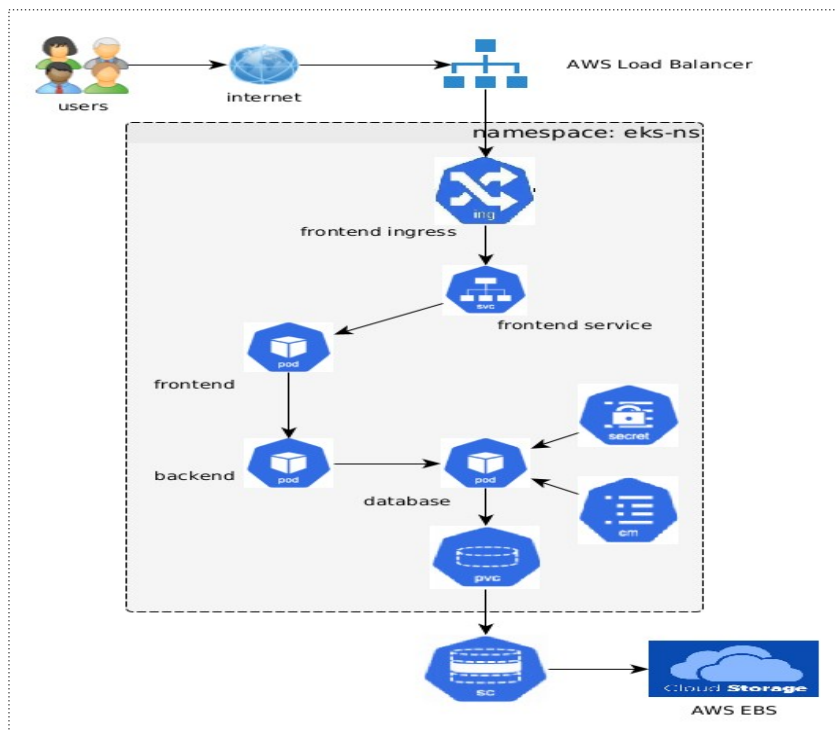


Figure 1: Application Components

There are 4 manifest yaml files for this project. They can be found in “[Demo source code](#)”

- mongodb.yaml
- backend.yaml
- frontend.yaml
- ingress.yml

Note: For the production environment, the database should be an external database service.

I.3. Prequisites

- EKS CLI is installed (refer to [Install EKS CLI](#))
- EKS cluster is already created (refer to [Create EKS Cluster](#)).
- EBS CSI driver is setup on the EKS cluster. See “[Setup EBS CSI driver](#)” for more details.
- Kubernetes CLI gets configured (kubectl) (refer [Configure kubectl](#))

II. Instruction

II.1. General steps

In order to get the application running, the following steps are required:

- Create a new namespace
- Create a new database
- Create backend and frontend applications

II.2. Execution

- **Create a namespace:**

create the a new namespace called “eks-ns” if it is not yet present:

kubectl create ns eks-ns

```
hatnguyencanh@vnlap03333:~$ kubectl create ns eks-ns
namespace/eks-ns created
```

Change default working namespace to that one

kubectl config set-context --current --namespace eks-ns

verify if you’ve set to this namespace:

kubectl config view --minify | grep namespace

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl config view --minify | grep namespace
namespace: eks-ns
```

- **Create a database**

create storageclass, pvc and database

kubectl apply -f mongodb.yaml

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl apply -f mongodb.yaml
storageclass.storage.k8s.io/mongo-sc created
service/mongo created
configmap/mongo-config created
secret/mongo-secrets created
statefulset.apps/mongo created
```

verify storage class

kubectl get sc

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get sc
NAME                PROVISIONER             RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
gp2 (default)       kubernetes.io/aws-ebs   Delete          WaitForFirstConsumer false                  34m
mongo-sc             kubernetes.io/aws-ebs   Delete          WaitForFirstConsumer false                  5s
```

verify pvc

kubectl get pvc

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get pvc
NAME                STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGE
data-volume-mongo-0 Bound      pvc-1c162f7b-d89b-4128-9cd1-ba8ccd4f55d6   1Gi        RWO             mongo-sc       8s
```

verify StatefulSet

kubectl get sts

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get sts
NAME        READY   AGE
mongo       1/1     2m48s
```

verify database pods

kubectl get pod

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get pod
NAME        READY   STATUS    RESTARTS   AGE
mongo-0     1/1     Running   0           3m34s
```

verify database service

kubectl get service

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get service
NAME        TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)    AGE
mongo       ClusterIP   10.100.61.145 <none>        27017/TCP   12m
```

verify configmap:

*kubect*l get configmap

```
statefulset.apps/mongo created
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get configmap
NAME          DATA  AGE
kube-root-ca.crt  1      9h
mongo-config    1      62s
```

check configmap details

*kubect*l describe configmap mongo-config

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl describe configmap mongo-config
Name:         mongo-config
Namespace:    eks-ns
Labels:       <none>
Annotations:  <none>

Data
====
MONGODB_INITDB_ROOT_USERNAME:
---
user
BinaryData
====
Events:  <none>
```

verify secret

*kubect*l get secret

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get secret
NAME          TYPE      DATA  AGE
mongo-secrets  Opaque    1      92s
```

check secret details

*kubect*l get secret mongo-secrets -o yaml

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get secret mongo-secrets -o yaml
apiVersion: v1
data:
  MONGODB_INITDB_ROOT_PASSWORD: cGFzc3dvcmQK
kind: Secret
metadata:
  annotations:
    kubectl.kubernetes.io/last-applied-configuration: |
      {"apiVersion":"v1","data":{"MONGODB_INITDB_ROOT_PASSWORD":"cGFzc3dvcmQK"},"kind":"Secret","metadata":{"annotations":{},"name":"mongo-secrets","namespace":"eks-ns"},"type":"Opaque"}
  creationTimestamp: "2023-05-23T22:30:23Z"
  name: mongo-secrets
  namespace: eks-ns
  resourceVersion: "108725"
  uid: 3a434885-a229-423a-b388-dbf1ac89085
type: Opaque
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ echo cGFzc3dvcmQK | base64 -d
password
```

- **Create applications**

Backend:

Create backend

kubectl apply -f backend.yaml

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl apply -f backend.yaml
service/backend created
deployment.apps/backend created
```

verify backend pods:

kubectl get pod

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get pod
NAME                                READY   STATUS    RESTARTS   AGE
backend-5867b9579f-cvsgk            1/1     Running   0           49s
mongo-0                             1/1     Running   0           6m50s
```

verify backend service:

kubectl get service

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get service
NAME      TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)    AGE
backend   ClusterIP   10.100.211.189 <none>        3000/TCP   100s
mongo     ClusterIP   10.100.61.145  <none>        27017/TCP  16m
```

Frontend

Create frontend

kubectl apply -f frontend.yaml

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl apply -f frontend.yaml
service/frontend created
deployment.apps/frontend created
```

verify frontend pods:

kubectl get pod

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get pod
NAME                                READY   STATUS    RESTARTS   AGE
backend-5867b9579f-cvsgk            1/1     Running   0           3m15s
frontend-6bf8c8c87-qv8rx            1/1     Running   0           32s
mongo-0                             1/1     Running   0           9m16s
```


verify frontend service:

kubectl get service

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl get service
NAME         TYPE        CLUSTER-IP      EXTERNAL-IP  PORT(S)    AGE
backend      ClusterIP   10.100.211.189  <none>       3000/TCP   4m3s
frontend     ClusterIP   10.100.3.51     <none>       3000/TCP   80s
mongo        ClusterIP   10.100.61.145   <none>       27017/TCP  18m
```

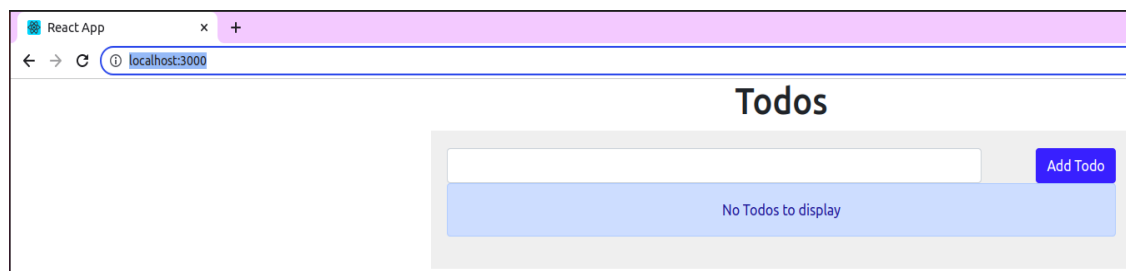
Application verification by exposing frontend service

expose frontend service to access application

kubectl port-forward service/frontend 3000:3000

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl port-forward service/frontend 3000:3000
Forwarding from 127.0.0.1:3000 -> 3000
Forwarding from [::1]:3000 -> 3000
```

open browser to access application at URL: localhost:3000



Application Ingress

- # install NGINX ingress controller

kubectl apply -f <https://raw.githubusercontent.com/kubernetes/ingress-nginx/controller-v1.7.1/deploy/static/provider/cloud/deploy.yaml>

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingress-nginx/controller-v1.7.1/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
```

verify ingress controller installation

`kubectrl get pods --namespace=ingress-nginx | grep nginx`

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectrl get pods --namespace=ingress-nginx | grep nginx
ingress-nginx-admission-create-d2st8      0/1      Completed      0          2m13s
ingress-nginx-admission-patch-sw4mw       0/1      Completed      0          2m12s
ingress-nginx-controller-6599b4f4c5-h8j47 1/1      Running        0          2m14s
```

install application ingress

`kubectrl apply -f ingress.yml`

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectrl apply -f ingress.yml
ingress.networking.k8s.io/ingress created
```

verify application ingress

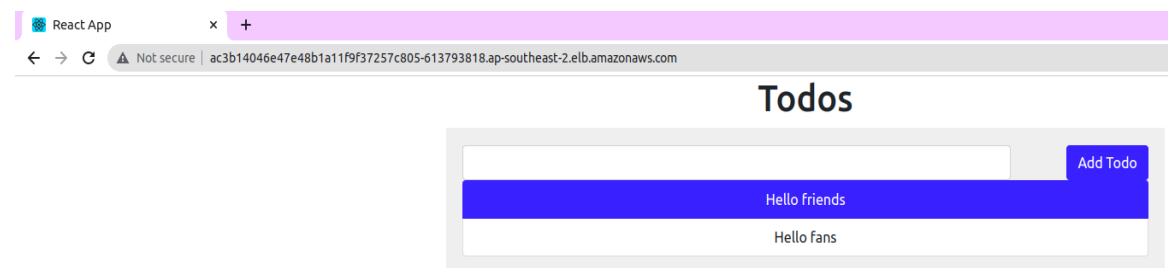
`kubectrl get ingress -o wide`

```
hatnguyencanh@vnlap03333:~/Documents/K8s/DEMO/k8s$ kubectrl get ingress -o wide
```

NAME	CLASS	HOSTS	ADDRESS	PORTS	AGE
ingress	nginx	*	ac3b14046e47e48b1a11f9f37257c805-613793818.ap-southeast-2.elb.amazonaws.com	80	42s

open browser to access application at URL created by ingress controller (e.g:

ac3b14046e47e48b1a11f9f37257c805-613793818.ap-southeast-2.elb.amazonaws.com)



III. Frequently Asked Questions

III.1. Setup EBS CSI driver

- Manually setup EBS CSI plugin, see at <https://docs.aws.amazon.com/eks/latest/userguide/managing-ebs-csi.html>
- Configure the EKS node role to have the AWS provided policy “AmazonEBSCSIDriverPolicy”

III.2. Demo source code

- <https://github.com/nashtech-garage/kubernetes>

IV. References

- EBS CSI driver setup: <https://docs.aws.amazon.com/eks/latest/userguide/managing-ebs-csi.html>
- NGINX Ingress controller setup: <https://kubernetes.github.io/ingress-nginx/deploy/>
- Source code for application: <https://github.com/docker/awesome-compose/tree/master/react-express-mongodb>