K21Academy
Learn Cloud from Experts

docker + kubernetes

Ingress-Controller, Dynamic Persistent Volumes, StatefulSet Resource

[Edition 6]

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Contents

1 INTRODUCTION

Ingress-Controller

In order for the Ingress resource to work, the cluster must have an ingress controller running.

Unlike other types of controllers which run as part of the kube-controller-manager binary, Ingress controllers are not started automatically with a cluster. Use this page to choose the ingress controller implementation that best fits your cluster.

This guide Covers:

- Advanced Routing with Ingress-Controller
- Dynamic Provisioning of Persistent Volumes
- Deploying and Managing a StatefulSet Resource

2 DOCUMENTATION

2.1 Kubernetes Documentation

1. Ingress Controllers

   https://kubernetes.io/docs/concepts/services-networking/ingress-controllers

2. Dynamic Volume Provisioning

   https://kubernetes.io/docs/concepts/storage/dynamic-provisioning/#:~:text=Dynamic%20volume%20provisioning%20allows%20storage,to%20represent%20them%20in%20Kubernetes.

3. StatefulSets

   https://kubernetes.io/docs/concepts/workloads/controllers/statefulset/

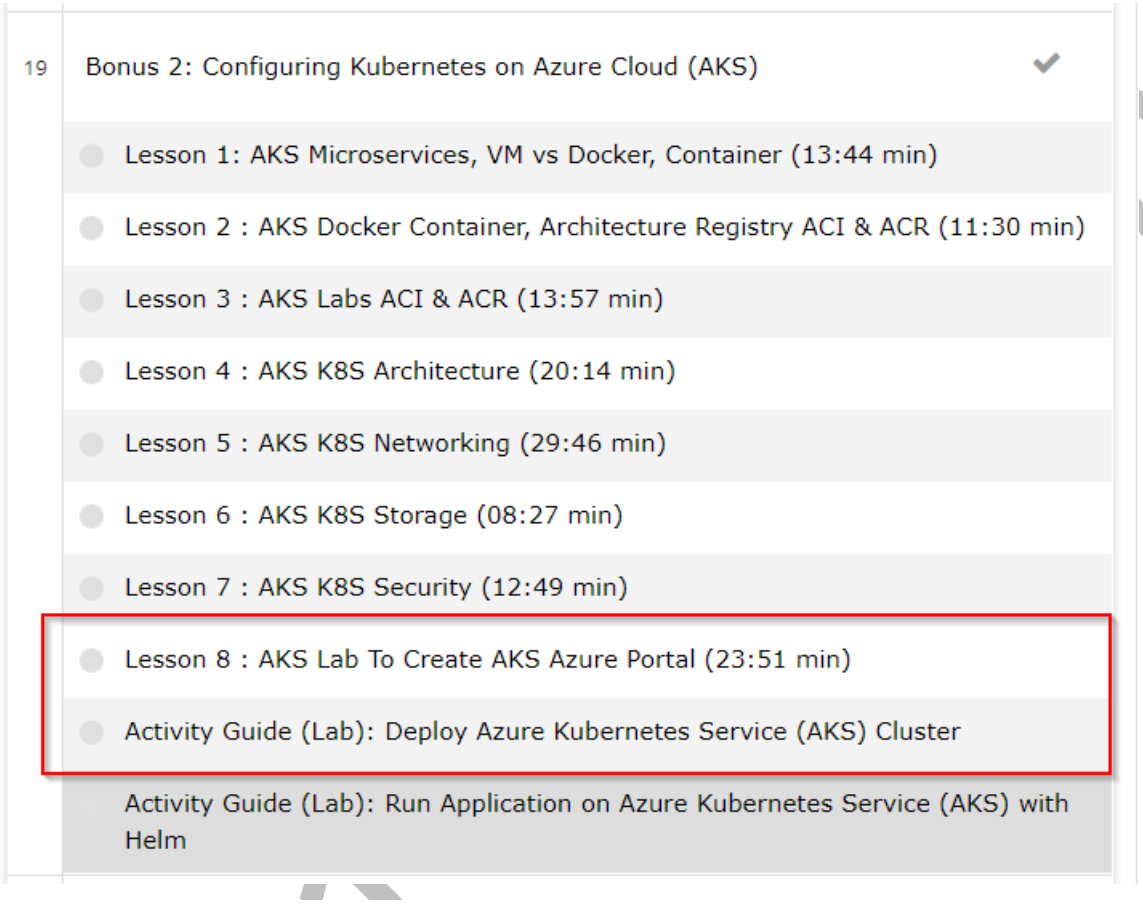
3 PREVIOUS GUIDES

Ensure that you have completed following activity guides:

- ***Note***: *Follow Activity Guide* ***AG_Bootstrap_Kubernetes_Cluster_Using_Kubeadm_Guide_ed**** *from portal*
- ***Note***: *Follow Activity Guide* ***AG_ Deploy_App_On_Pod_&_Basic_Networking_ed**** *from portal*
- ***Note***: *Follow Activity Guide* ***AG_Deploying_Scalable_and_Configuring_Autoscaling_For_Stateless_Application_ed**** *from portal*
- ***Note***: *Follow Activity Guide* ***AG_Configuring_NFS_Storage_Persistence_Volume_ed**** *from portal*
- ***Note***: *Follow Activity Guide* ***AG_Constraint_Pod_and_Node_Selector_Node_Affinity_&_Anti_Affinity_ed**** *from portal*
- ***Note***: *Follow Activity Guide* ***AG_Cluster_Node_Maintenance_Debugging_Application_Failure_Troubleshooting_Cluster_ed**** *from portal*
- ***Note***: *Follow Activity Guide* ***AG_Cluster_Security_Working_With_ConfigMap_&_Limiting_Resources_With_Resource_Quota_ed*** *from portal*
- ***Note***: *Follow Activity Guide* ***AG_Deploying_PHP_Guestbook_Collect_Logs_With_Elk_Stack_Backup_Restore_ETCD_Cluster_ed**** *from portal*

4 ADVANCED ROUTING WITH INGRESS-CONTROLLER

Note: Section 4, 5 & 6 **Ingress-Controller** and **Dynamic Provisioning of Persistent Volumes** and **Stateful set** you need to perform in AKS Cluster, not in your regular kubeadm cluster so before performing these sections first please follow Guide Deploy **Azure Kubernetes Service(AKS)** cluster guide from the portal.



Contents

Note: In below Sections we are going to use YAML files no need write complete yaml file because in CKA exam you can official Kubernetes documentation use Below GIT url to clone repo and use yaml files

```
$ git clone https://github.com/k21academyuk/Kubernetes
$ cd Kubernetes
```

```
root@master:~# ls
1  Kubernetes
root@master:~# cd Kubernetes/
root@master:~/Kubernetes# ls
Dockerfile                      foo-allow-to-hello.yaml      network-policy.yaml              rabbitmq-service.yaml
README.md                       guestbook-frontend-svc.yaml  nfs-pv.yaml                      readiness-pod.yaml
__pycache__                     guestbook-frontend.yaml      nfs-pvc.yaml                     readiness-svc.yaml
adapter-configmap.yaml          headlessservice.yaml         nfspv-pod.yaml                   redis-cm.yaml
adapter-pod.yaml                hello-allow-from-foo.yaml    nginx-deployment.yaml            redis-master-svc.yaml
app.py                          ingress-app1.yaml            nginx-hpa.yaml                   redis-master.yaml
apple.yaml                      ingress-app2.yaml            nginx-svc.yaml                   redis-pod.yaml
banana.yaml                     ingress-route.yaml           nodeaffinity-deployment.yaml     redis-slave-svc.yaml
config-map.yaml                 initcontainer.yaml           nodeaffinity1-deployment.yaml    redis-slave.yaml
configmap-pod.yaml              job-mq.yaml                  nodeanti-affinity-deployment.yaml requirements.txt
counter-pod.yaml                job-tmpl.yaml                nodeanti-affinity1-deployment.yaml role-dev.yaml
cron.yaml                       job.yaml                     oke-admin-service-account.yaml   rolebind.yaml
daemonset.yaml                  kibana-elk.yaml              pod-dynamicpv-oci.yaml           script.sh
demo-pod.yaml                   kibana.yaml                  pod-dynamicpv.yaml               security-cxt-nonroot.yaml
docker-compose.yaml             label-deployment.yaml        podaffinity-deployment.yaml      security-cxt-priv.yaml
docker-registry-secret.yaml     liveness-pod.yaml            podaffinity1-deployment.yaml     security-cxt-readonly.yaml
dockerfile-mq                   logstash-configmap.yaml      podanti-affinity-deployment.yaml security-cxt-rmcap.yaml
elasticsearch-rbac.yaml         logstash-deployment.yaml     podanti-affinity1-deployment.yaml security-cxt-time.yaml
elasticsearch-stfullset-oci.yaml logstash-svc.yaml           priv-reg-pod.yaml                security-cxt.yaml
elasticsearch-stfullset.yaml    metrics-server.yaml          pvc-oci.yaml                     statefulset1.yaml
elasticsearch-svc.yaml          multi-container.yaml         pvc.yaml                         tt-pod.yaml
elasticsearch.yaml              multi-pod-configmap.yaml     quota-pod.yaml                   tt-pod1.yaml
example-ingress.yaml            multi-pod-nginx.yaml         quota-pod1.yaml                  web.yaml
filebeat-agent.yaml             multi-prod-consumer.yaml     quota.yaml                       worker.py
fluentd.yaml                    namespace.yaml               rabbitmq-deployment.yaml
root@master:~/Kubernetes#
```

4.1 Install Helm On Ubuntu

1. Install helm on Ubuntu OS

```
$ sudo -i
$ curl https://baltocdn.com/helm/signing.asc | sudo apt-key add -
$ sudo apt-get install apt-transport-https --yes
$ echo "deb https://baltocdn.com/helm/stable/debian/ all main" | sudo tee /etc/apt/sources.list.d/helm-stable-debian.list
$ sudo apt-get update
```

```
root@master:~# curl https://baltocdn.com/helm/signing.asc | sudo apt-key add -
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  1700  100  1700    0     0  11643      0 --:--:-- --:--:-- --:--:-- 11643
OK
root@master:~# sudo apt-get install apt-transport-https --yes
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  apt-transport-https
0 upgraded, 1 newly installed, 0 to remove and 17 not upgraded.
Need to get 1692 B of archives.
After this operation, 154 kB of additional disk space will be used.
Get:1 http://azure.archive.ubuntu.com/ubuntu bionic-updates/universe amd64 apt-transport-https all 1.6.13 [1692 B]
Fetched 1692 B in 0s (4819 B/s)
Selecting previously unselected package apt-transport-https.
(Reading database ... 58811 files and directories currently installed.)
Preparing to unpack .../apt-transport-https_1.6.13_all.deb ...
Unpacking apt-transport-https (1.6.13) ...
Setting up apt-transport-https (1.6.13) ...
root@master:~# echo "deb https://baltocdn.com/helm/stable/debian/ all main" | sudo tee /etc/apt/sources.list.d/helm-stable-debian.list
deb https://baltocdn.com/helm/stable/debian/ all main
root@master:~# sudo apt-get update
Hit:1 http://azure.archive.ubuntu.com/ubuntu bionic InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu bionic-updates InRelease
Hit:3 http://azure.archive.ubuntu.com/ubuntu bionic-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu bionic-security InRelease
Get:5 https://baltocdn.com/helm/stable/debian all InRelease [7652 B]
Get:6 https://baltocdn.com/helm/stable/debian all/main amd64 Packages [2084 B]
Fetched 9736 B in 0s (19.9 kB/s)
Reading package lists... Done
```

```
$ sudo apt-get install helm
```

```
root@master:~# sudo apt-get install helm
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  helm
0 upgraded, 1 newly installed, 0 to remove and 17 not upgraded.
Need to get 13.7 MB of archives.
After this operation, 45.1 MB of additional disk space will be used.
Get:1 https://baltocdn.com/helm/stable/debian all/main amd64 helm amd64 3.6.1-1 [13.7 MB]
Fetched 13.7 MB in 0s (63.9 MB/s)
Selecting previously unselected package helm.
(Reading database ... 58815 files and directories currently installed.)
Preparing to unpack .../helm_3.6.1-1_amd64.deb ...
Unpacking helm (3.6.1-1) ...
Setting up helm (3.6.1-1) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
root@master:~#
```

4.2 Deploying NGINX Ingress Controller using helm chart

1. Create a namespace for your ingress resources

```
$ kubectl create namespace ingress-basic
```

```
ubuntu@master:~$ sudo su
root@master:/home/ubuntu# kubectl create namespace ingress-basic
namespace/ingress-basic created
```

2. Add the official stable repository

```
$ helm repo add ingress-nginx https://kubernetes.github.io/ingress-nginx
```

```
root@master:/home/ubuntu# helm repo add ingress-nginx https://kubernetes.github.io/ingress-nginx
"ingress-nginx" has been added to your repositories
```

3. Use Helm to deploy an NGINX ingress controller

```
$ helm install nginx-ingress ingress-nginx/ingress-nginx --namespace ingress-basic --set controller.replicaCount=2
```

```
root@master:/home/ubuntu# helm install nginx-ingress ingress-nginx/ingress-nginx --namespace ingress-basic --set controller.replicaCou
nt=2
NAME: nginx-ingress
LAST DEPLOYED: Tue Dec 15 06:54:41 2020
NAMESPACE: ingress-basic
STATUS: deployed
REVISION: 1
TEST SUITE: None
NOTES:
The ingress-nginx controller has been installed.
It may take a few minutes for the LoadBalancer IP to be available.
You can watch the status by running 'kubectl --namespace ingress-basic get services -o wide -w nginx-ingress-ingress-nginx-controller'

An example Ingress that makes use of the controller:

  apiVersion: networking.k8s.io/v1beta1
  kind: Ingress
  metadata:
    annotations:
      kubernetes.io/ingress.class: nginx
    name: example
    namespace: foo
  spec:
    rules:
      - host: www.example.com
        http:
          paths:
            - backend:
                serviceName: exampleService
                servicePort: 80
              path: /
    # This section is only required if TLS is to be enabled for the Ingress
    tls:
        - hosts:
            - www.example.com
          secretName: example-tls

If TLS is enabled for the Ingress, a Secret containing the certificate and key must also be provided:

  apiVersion: v1
  kind: Secret
  metadata:
    name: example-tls
    namespace: foo
  data:
    tls.crt: <base64 encoded cert>
    tls.key: <base64 encoded key>
  type: kubernetes.io/tls
```

4. Verify the helm chart is installed

```
$ helm list --namespace ingress-basic
```

```
root@master:/home/ubuntu# helm list -n ingress-basic
NAME            NAMESPACE       REVISION        UPDATED                                 STATUS          CHART                   APP VER
SION
nginx-ingress   ingress-basic   1               2020-12-15 06:54:41.605454932 +0000 UTC deployed        ingress-nginx-3.15.2    0.41.2

root@master:/home/ubuntu#
```

5. Verify that the load balancer service is created for the NGINX ingress controller and a dynamic public IP address is assigned to it

```
$ kubectl get all -n ingress-basic
```

```
root@master1:/home/ubuntu# kubectl get all -n ingress-basic
NAME                                                        READY   STATUS    RESTARTS   AGE
pod/nginx-ingress-ingress-nginx-controller-6d7cd9854f-cms2j   1/1     Running   0          34s
pod/nginx-ingress-ingress-nginx-controller-6d7cd9854f-ljvgq   1/1     Running   0          34s

NAME                                                  TYPE           CLUSTER-IP     EXTERNAL-IP    PORT(S)
      AGE
service/nginx-ingress-ingress-nginx-controller             LoadBalancer   10.0.99.212    20.62.158.84   80:30621/TCP,443:3079
9/TCP   34s
service/nginx-ingress-ingress-nginx-controller-admission   ClusterIP      10.0.218.186   <none>         443/TCP
        34s

NAME                                                   READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/nginx-ingress-ingress-nginx-controller   2/2     2            2           34s

NAME                                                              DESIRED   CURRENT   READY   AGE
replicaset.apps/nginx-ingress-ingress-nginx-controller-6d7cd9854f   2         2         2       34s
root@master1:/home/ubuntu#
```

4.3 Creating simple demo applications

1. cd to the directory

```
$ cd kubernetes
$ ls ingress-
```

```
root@master1:/home/ubuntu# git clone https://github.com/mamtajha-ts/Kubernetes.git
Cloning into 'Kubernetes'...
remote: Enumerating objects: 222, done.
remote: Counting objects: 100% (222/222), done.
remote: Compressing objects: 100% (160/160), done.
remote: Total 222 (delta 77), reused 200 (delta 57), pack-reused 0
Receiving objects: 100% (222/222), 17.09 MiB | 30.65 MiB/s, done.
Resolving deltas: 100% (77/77), done.
root@master1:/home/ubuntu# cd Kubernetes/
root@master1:/home/ubuntu/Kubernetes# cd ingress-
ingress-app1.yaml   ingress-app2.yaml   ingress-route.yaml
root@master1:/home/ubuntu/Kubernetes# cd ingress-
```

2. View the content of ingress-app1.yaml file and see the definition of first application and its service in the file

```
$ vim ingress-app1.yaml
```

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: aks-helloworld-one
spec:
  replicas: 1
  selector:
    matchLabels:
      app: aks-helloworld-one
  template:
    metadata:
      labels:
        app: aks-helloworld-one
    spec:
      containers:
      - name: aks-helloworld-one
        image: neilpeterson/aks-helloworld:v1
        ports:
        - containerPort: 80
        env:
        - name: TITLE
          value: "Welcome to Azure Kubernetes Service (AKS)"
---
apiVersion: v1
kind: Service
metadata:
  name: aks-helloworld-one
spec:
  type: ClusterIP
  ports:
  - port: 80
  selector:
    app: aks-helloworld-one
~
~
```

3. View the content of ingress-app2.yaml file and see the definition of second application and its service in the file

```
$ vim ingress-app2.yaml
```

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: aks-helloworld-two
spec:
  replicas: 1
  selector:
    matchLabels:
      app: aks-helloworld-two
  template:
    metadata:
      labels:
        app: aks-helloworld-two
    spec:
      containers:
      - name: aks-helloworld-two
        image: neilpeterson/aks-helloworld:v1
        ports:
        - containerPort: 80
        env:
        - name: TITLE
          value: "AKS Ingress Demo"
---
apiVersion: v1
kind: Service
metadata:
  name: aks-helloworld-two
spec:
  type: ClusterIP
  ports:
  - port: 80
  selector:
    app: aks-helloworld-two
~
~
```

4. Create the deployment and services resources from both the files created above:

```
$ kubectl create -f ingress-app1.yaml -n ingress-basic
$ kubectl create -f ingress-app2.yaml -n ingress-basic
```

```
root@master1:/home/ubuntu/Kubernetes# kubectl create -f ingress-app1.yaml -n ingress-basic
deployment.apps/aks-helloworld-one created
service/aks-helloworld-one created
root@master1:/home/ubuntu/Kubernetes# kubectl create -f ingress-app2.yaml -n ingress-basic
deployment.apps/aks-helloworld-two created
service/aks-helloworld-two created
root@master1:/home/ubuntu/Kubernetes#
```

4.4 Create Ingress Route to route traffic to both the running applications

1. View the ingress-route.yaml file and see the rules defined in the file to route the traffic to both the applications

$ vim ingress-route.yaml

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: hello-world-ingress
  namespace: ingress-basic
  annotations:
    kubernetes.io/ingress.class: nginx
    nginx.ingress.kubernetes.io/ssl-redirect: "false"
    nginx.ingress.kubernetes.io/rewrite-target: /$2
spec:
  rules:
  - http:
      paths:
      - backend:
          serviceName: aks-helloworld-one
          servicePort: 80
        path: /(.*)
      - backend:
          serviceName: aks-helloworld-two
          servicePort: 80
        path: /hello-world-two(/|$)(.*)
~
~
~
~
~
```

2. Create the ingress resource from ingress-route.yaml and verify using kubectl get command

$ kubectl create -f ingress-route.yaml -n ingress-basic

```
root@master1:/home/ubuntu/Kubernetes# kubectl create -f  ingress-route.yaml -n ingress-basic
ingress.extensions/hello-world-ingress created
root@master1:/home/ubuntu/Kubernetes#
```

$ kubectl get ingress -n ingress-basic

```
root@master1:/home/ubuntu/Kubernetes# kubectl get ingress -n ingress-basic
NAME                 CLASS    HOSTS   ADDRESS        PORTS   AGE
hello-world-ingress  <none>   *       20.62.158.84   80      33s
root@master1:/home/ubuntu/Kubernetes#
```

4.5 Testing the ingress controller routes correctly to both the application

1. Open a web browser to the IP address of your NGINX ingress controller, *EXTERNAL_IP*. The first demo application should be displayed in the web browser,

```
root@master1:/home/ubuntu# kubectl get all -n ingress-basic
NAME                                                        READY   STATUS    RESTARTS   AGE
pod/nginx-ingress-ingress-nginx-controller-6d7cd9854f-cms2j   1/1     Running   0          34s
pod/nginx-ingress-ingress-nginx-controller-6d7cd9854f-ljvgq   1/1     Running   0          34s

NAME                                                 TYPE           CLUSTER-IP     EXTERNAL-IP    PORT(S)
       AGE
service/nginx-ingress-ingress-nginx-controller             LoadBalancer   10.0.99.212    20.62.158.84   80:30621/TCP,443:3079
9/TCP   34s
service/nginx-ingress-ingress-nginx-controller-admission   ClusterIP      10.0.218.186   <none>         443/TCP
       34s

NAME                                                READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/nginx-ingress-ingress-nginx-controller   2/2     2            2           34s

NAME                                                           DESIRED   CURRENT   READY   AGE
replicaset.apps/nginx-ingress-ingress-nginx-controller-6d7cd9854f   2         2         2       34s
root@master1:/home/ubuntu# clear
```

Welcome to Azure Kubernetes Service (AKS)

2. Open a web browser to the IP address of your NGINX ingress controller with /hello-world-two path, EXTERNAL_IP /hello-world-two path. The second demo application should be displayed in the web browser,

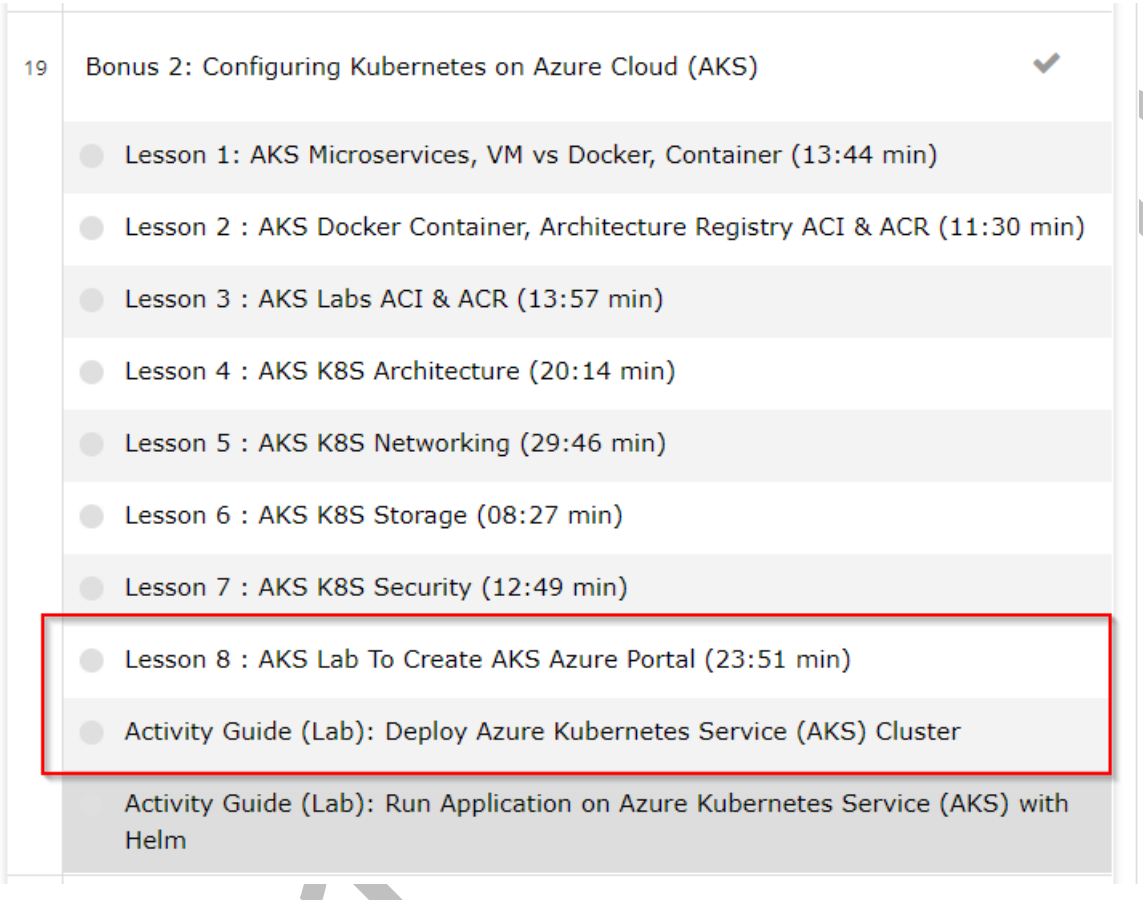
AKS Ingress Demo

4.6 Clean up resources created in this lab exercise

```
$ helm uninstall nginx-ingress --namespace ingress-basic
$ kubectl delete namespace ingress-basic
```

5 DYNAMIC PROVISIONING OF PERSISTENT VOLUMES

Note: Section 4, 5 & 6 **Ingress-Controller** and **Dynamic Provisioning of Persistent Volumes** and **Stateful set** you need to perform in AKS Cluster, not in your regular kubeadm cluster so before performing these sections first please follow Guide Deploy **Azure Kubernetes Service(AKS)** cluster guide from the portal.



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Note: In below Sections we are going to use YAML files no need write complete yaml file because in CKA exam you can official Kubernetes documentation use Below GIT url to clone repo and use yaml files

```
$ git clone https://github.com/k21academyuk/Kubernetes
$ cd Kubernetes
```

```
root@master:~# ls
1  Kubernetes
root@master:~# cd Kubernetes/
root@master:~/Kubernetes# ls
Dockerfile                      foo-allow-to-hello.yaml      network-policy.yaml              rabbitmq-service.yaml
README.md                       guestbook-frontend-svc.yaml  nfs-pv.yaml                      readiness-pod.yaml
__pycache__                     guestbook-frontend.yaml      nfs-pvc.yaml                     readiness-svc.yaml
adapter-configmap.yaml          headlessservice.yaml         nfspv-pod.yaml                   redis-cm.yaml
adapter-pod.yaml                hello-allow-from-foo.yaml    nginx-deployment.yaml            redis-master-svc.yaml
app.py                          ingress-app1.yaml            nginx-hpa.yaml                   redis-master.yaml
apple.yaml                      ingress-app2.yaml            nginx-svc.yaml                   redis-pod.yaml
banana.yaml                     ingress-route.yaml           nodeaffinity-deployment.yaml     redis-slave-svc.yaml
config-map.yaml                 initcontainer.yaml           nodeaffinity1-deployment.yaml    redis-slave.yaml
configmap-pod.yaml              job-mq.yaml                  nodeanti-affinity-deployment.yaml requirements.txt
counter-pod.yaml                job-tmpl.yaml                nodeanti-affinity1-deployment.yaml role-dev.yaml
cron.yaml                       job.yaml                     oke-admin-service-account.yaml   rolebind.yaml
daemonset.yaml                  kibana-elk.yaml              pod-dynamicpv-oci.yaml           script.sh
demo-pod.yaml                   kibana.yaml                  pod-dynamicpv.yaml               security-cxt-nonroot.yaml
docker-compose.yaml             label-deployment.yaml        podaffinity-deployment.yaml      security-cxt-priv.yaml
docker-registry-secret.yaml     liveness-pod.yaml            podaffinity1-deployment.yaml     security-cxt-readonly.yaml
dockerfile-mq                   logstash-configmap.yaml      podanti-affinity-deployment.yaml security-cxt-rmcap.yaml
elasticsearch-rbac.yaml         logstash-deployment.yaml     podanti-affinity1-deployment.yaml security-cxt-time.yaml
elasticsearch-stfullset-oci.yaml logstash-svc.yaml           priv-reg-pod.yaml                security-cxt.yaml
elasticsearch-stfullset.yaml    metrics-server.yaml          pvc-oci.yaml                     statefulset1.yaml
elasticsearch-svc.yaml          multi-container.yaml         pvc.yaml                         tt-pod.yaml
elasticsearch.yaml              multi-pod-configmap.yaml     quota-pod.yaml                   tt-pod1.yaml
example-ingress.yaml            multi-pod-nginx.yaml         quota-pod1.yaml                  web.yaml
filebeat-agent.yaml             multi-prod-consumer.yaml     quota.yaml                       worker.py
fluentd.yaml                    namespace.yaml               rabbitmq-deployment.yaml
root@master:~/Kubernetes#
```

5.1 Built-in storage classes

1. List the built-in storage classes in Azure AKS cluster

```
$ kubectl get sc
```

```
$
$  kubectl get sc
NAME                PROVISIONER                AGE
azurefile           kubernetes.io/azure-file   27h
azurefile-premium   kubernetes.io/azure-file   27h
default (default)   kubernetes.io/azure-disk   27h
managed-premium     kubernetes.io/azure-disk   27h
$
```

5.2 Creating Persistent Volume Claim

1. Verify the content of pvc.yaml file. The claim requests a disk named oracle-managed-disk that is 1GB in size with ReadWriteOnce access. The managed-premium storage class is specified as the storage class.

```
$ vim pvc.yaml
```

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: azure-managed-disk
spec:
  accessModes:
  - ReadWriteOnce
  storageClassName: managed-premium
  resources:
    requests:
      storage: 1Gi
~
~
~
~
~
~
~
~
~
```

```
$ kubectl create -f  pvc.yaml
```

2. Check the status of newly created pvc and see that dynamically a pv is created and bounded

```
$ kubectl get pvc
```

```
$
$ kubectl get pvc
NAME                 STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS      AGE
azure-managed-disk   Bound    pvc-4bb9012b-d917-4441-94e7-51eb74a4547a   1Gi        RWO            managed-premium   11s
$
```

5.3 Use PV in a Pod

1. The persistent volume claim has been created and the disk is successfully provisioned, a pod can be created with access to the disk. Check the content of pod-dynamicpv.yaml file

```
$ vim pod-dynamicpv.yaml
```

```
kind: Pod
apiVersion: v1
metadata:
  name: mypod
spec:
  containers:
  - name: mypod
    image: nginx:1.15.5
    resources:
      requests:
        cpu: 100m
        memory: 128Mi
      limits:
        cpu: 250m
        memory: 256Mi
    volumeMounts:
    - mountPath: "/mnt/azure"
      name: volume
  volumes:
    - name: volume
      persistentVolumeClaim:
        claimName: azure-managed-disk
~
~
~
~
~
~
```

2. Create the pod using apply command

```
$ kubectl apply -f pod-dynamicpv.yaml
```

```
$
$ kubectl apply -f pod-dynamicpv.yaml
pod/mypod created
$
```

3. Watch the creation of pod with -w option

```
$ kubectl get pods -w
```

```
$
$ kubectl get pods -w
NAME      READY   STATUS    RESTARTS   AGE
counter   1/1     Running   0          10h
mypod     1/1     Running   0          35s
```

4. Describe the pod and see that the volume details are mentions in pod specification

```
$ kubectl describe pod mypod
```

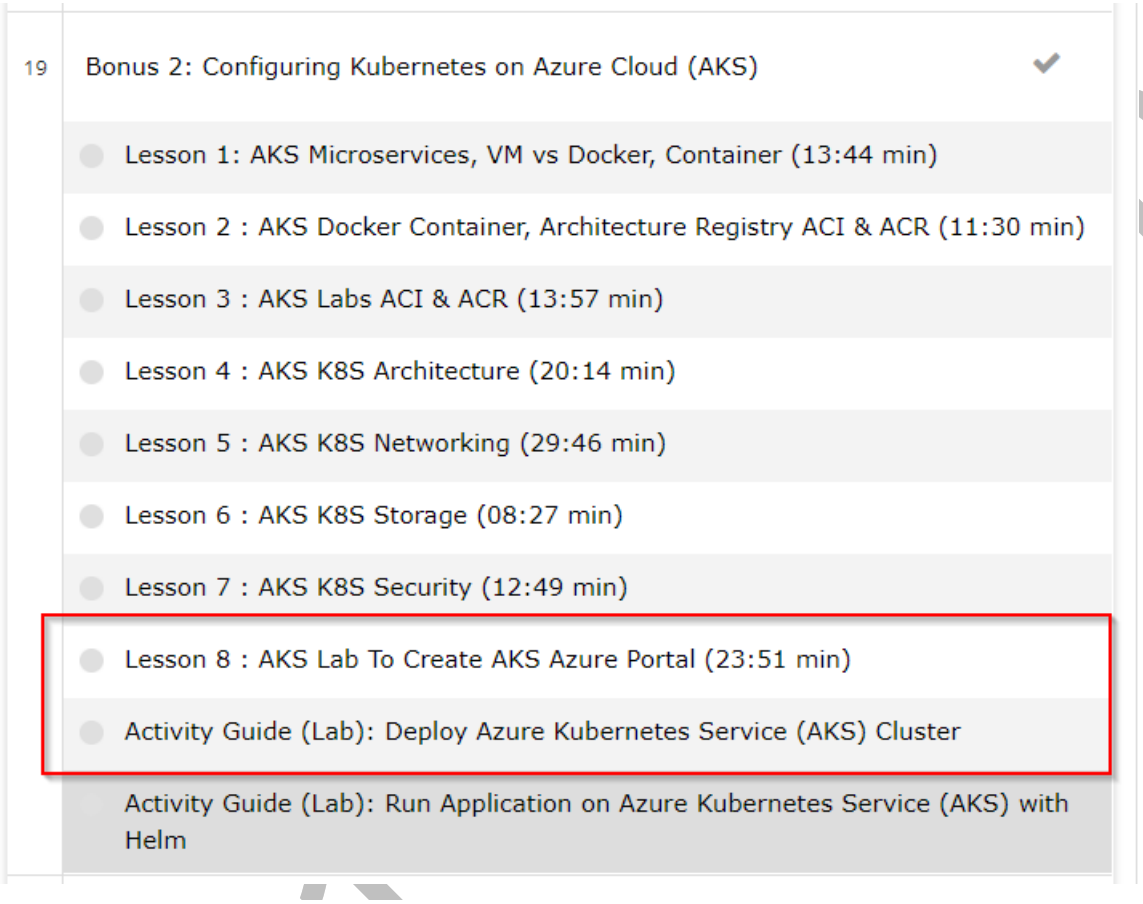
```
Volumes:
  volume:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same namespace)
    ClaimName:  azure-managed-disk
    ReadOnly:   false
  default-token-v7f66:
    Type:        Secret (a volume populated by a Secret)
    SecretName:  default-token-v7f66
    Optional:    false
QoS Class:       Burstable
Node-Selectors:  <none>
Tolerations:     node.kubernetes.io/not-ready:NoExecute for 300s
                 node.kubernetes.io/unreachable:NoExecute for 300s
Events:
  Type    Reason                 Age   From                                    Message
  ----    ------                 ----  ----                                    -------
  Normal  Scheduled              60s   default-scheduler                       Successfully assigned default/mypod to aks-agentpool-40017546-vmss000002
  Normal  SuccessfulAttachVolume  45s   attachdetach-controller                 AttachVolume.Attach succeeded for volume "pvc-4bb9012b-d917-4441-94e7-51eb7
4a4547a"
  Normal  Pulling                39s   kubelet, aks-agentpool-40017546-vmss000002  Pulling image "nginx:1.15.5"
  Normal  Pulled                 28s   kubelet, aks-agentpool-40017546-vmss000002  Successfully pulled image "nginx:1.15.5"
  Normal  Created                27s   kubelet, aks-agentpool-40017546-vmss000002  Created container mypod
  Normal  Started                27s   kubelet, aks-agentpool-40017546-vmss000002  Started container mypod
$
```

5.4 Clean-up resources created in this lab exercise

```
$ kubectl delete -f  pvc.yaml
$ kubectl delete -f pod-dynamicpv.yaml
```

6 DEPLOYING AND MANAGING A STATEFULSET RESOURCE

Note: Section 4, 5 & 6 **Ingress-Controller** and **Dynamic Provisioning of Persistent Volumes** and **Stateful set** you need to perform in AKS Cluster, not in your regular kubeadm cluster so before performing these sections first please follow Guide Deploy **Azure Kubernetes Service(AKS)** cluster guide from the portal.



Contents

Note: In below Sections we are going to use YAML files no need write complete yaml file because in CKA exam you can official Kubernetes documentation use Below GIT url to clone repo and use yaml files

```
$ git clone https://github.com/k21academyuk/Kubernetes
$ cd Kubernetes
```

```
root@master:~# ls
1  Kubernetes
root@master:~# cd Kubernetes/
root@master:~/Kubernetes# ls
Dockerfile                      foo-allow-to-hello.yaml      network-policy.yaml              rabbitmq-service.yaml
README.md                       guestbook-frontend-svc.yaml  nfs-pv.yaml                      readiness-pod.yaml
__pycache__                     guestbook-frontend.yaml      nfs-pvc.yaml                     readiness-svc.yaml
adapter-configmap.yaml          headlessservice.yaml         nfspv-pod.yaml                   redis-cm.yaml
adapter-pod.yaml                hello-allow-from-foo.yaml    nginx-deployment.yaml            redis-master-svc.yaml
app.py                          ingress-app1.yaml            nginx-hpa.yaml                   redis-master.yaml
apple.yaml                      ingress-app2.yaml            nginx-svc.yaml                   redis-pod.yaml
banana.yaml                     ingress-route.yaml           nodeaffinity-deployment.yaml     redis-slave-svc.yaml
config-map.yaml                 initcontainer.yaml           nodeaffinity1-deployment.yaml    redis-slave.yaml
configmap-pod.yaml              job-mq.yaml                  nodeanti-affinity-deployment.yaml requirements.txt
counter-pod.yaml                job-tmpl.yaml                nodeanti-affinity1-deployment.yaml role-dev.yaml
cron.yaml                       job.yaml                     oke-admin-service-account.yaml   rolebind.yaml
daemonset.yaml                  kibana-elk.yaml              pod-dynamicpv-oci.yaml           script.sh
demo-pod.yaml                   kibana.yaml                  pod-dynamicpv.yaml               security-cxt-nonroot.yaml
docker-compose.yaml             label-deployment.yaml        podaffinity-deployment.yaml      security-cxt-priv.yaml
docker-registry-secret.yaml     liveness-pod.yaml            podaffinity1-deployment.yaml     security-cxt-readonly.yaml
dockerfile-mg                   logstash-configmap.yaml      podanti-affinity-deployment.yaml security-cxt-rmcap.yaml
elasticsearch-rbac.yaml         logstash-deployment.yaml     podanti-affinity1-deployment.yaml security-cxt-time.yaml
elasticsearch-stfullset-oci.yaml logstash-svc.yaml           priv-reg-pod.yaml                security-cxt.yaml
elasticsearch-stfullset.yaml    metrics-server.yaml          pvc-oci.yaml                     statefulset1.yaml
elasticsearch-svc.yaml          multi-container.yaml         pvc.yaml                         tt-pod.yaml
elasticsearch.yaml              multi-pod-configmap.yaml     quota-pod.yaml                   tt-pod1.yaml
example-ingress.yaml            multi-pod-nginx.yaml         quota-pod1.yaml                  web.yaml
filebeat-agent.yaml             multi-prod-consumer.yaml     quota.yaml                       worker.py
fluentd.yaml                    namespace.yaml               rabbitmq-deployment.yaml
root@master:~/Kubernetes#
```

6.1 Creating Logging namespace

1. Viewing the contents of namespace.yaml file to create kube-logging namespace

```
$ vim namespace.yaml
```

```
kind: Namespace
apiVersion: v1
metadata:
  name: kube-logging
~
~
~
~
~
~
~
```

2. Creating namespace from above file

```
$ kubectl create -f namespace.yaml
```

```
$
$ kubectl create -f namespace.yaml
namespace/kube-logging created
$
```

3. Confirm that the Namespace was successfully created by listing all the namespace present in the cluster

```
$ kubectl get ns
```

```
$ kubectl get ns
NAME              STATUS   AGE
default           Active   16h
kube-logging      Active   13s
kube-node-lease   Active   16h
kube-public       Active   16h
kube-system       Active   16h
$
```

6.2 Setting up Elasticsearch application

1. Create the Elasticsearch StatefulSet using elasticsearch-stfullset.yaml file. Run through the content and create the resource

```
$ vim elasticsearch-stfullset.yaml
$ kubectl create -f elasticsearch-stfullset.yaml
```

```
$
$
$ kubectl create -f elasticsearch-svc.yaml
service/elasticsearch created
$
$
```

2. Verify the creation of StatefulSet Elasticsearch pods. monitor the StatefulSet as it is rolled out using kubectl rollout status

```
$ kubectl rollout status sts/es-cluster --namespace=kube-logging
$ kubectl get sts --namespace=kube-logging
$ kubectl get pods --namespace=kube-logging
```

```
$ kubectl rollout status sts/es-cluster --namespace=kube-logging
partitioned roll out complete: 3 new pods have been updated...
$
$ kubectl get sts --namespace=kube-logging
NAME         READY   AGE
es-cluster   3/3     25m
$
$ kubectl get pods --namespace=kube-logging
NAME                    READY   STATUS    RESTARTS   AGE
es-cluster-0            1/1     Running   0          25m
es-cluster-1            1/1     Running   0          6m27s
es-cluster-2            1/1     Running   0          4m51s
```

6.3 Pods in a StatefulSet

1. Pods in a StatefulSet have a unique ordinal index and a stable network identity.

   Each Pod has a stable hostname based on its ordinal index. Use kubectl exec to execute the hostname command in each Pod. Let's examine the pods

```
$ kubectl config set-context --current --namespace=kube-logging
$ kubectl get pods
```

```
for i in 0 1 2; do kubectl exec es-cluster-$i -- sh -c 'hostname'; done
```

```
$ kubectl config set-context --current --namespace=kube-logging
Context "k8s-demo" modified.
$ kubectl get pods
NAME                    READY   STATUS    RESTARTS   AGE
es-cluster-0            1/1     Running   0          3h14m
es-cluster-1            1/1     Running   0          174m
es-cluster-2            1/1     Running   0          172m
fluentd-2vw2j           1/1     Running   0          162m
fluentd-9f298           1/1     Running   0          162m
fluentd-m9hxb           1/1     Running   0          162m
kibana-cd68dcfb-pjnhc   1/1     Running   6          3h8m
$ for i in 0 1; do kubectl exec es-cluster-$i -- sh -c 'hostname' -n kube-logging; done
es-cluster-0
es-cluster-1
```

6.4 Scaling up and down a Statefulset object

1. Scaling up the replicas from 3 to 4 for sts es-cluster. The StatefulSet controller scales the number of replicas.

```
$ kubectl scale sts es-cluster --replicas=4
```

```
$ kubectl scale sts es-cluster --replicas=4
statefulset.apps/es-cluster scaled
```

2. The StatefulSet controller creates each Pod sequentially with respect to its ordinal index, and it waits for each Pod's predecessor to be Running and Ready before launching the subsequent Pod

```
$ kubectl rollout status sts/es-cluster
```

```
$ kubectl rollout status sts/es-cluster
Waiting for 1 pods to be ready...
partitioned roll out complete: 4 new pods have been updated...
$
```

```
$ kubectl get pods
```

```
$
$ kubectl get pods
NAME           READY   STATUS    RESTARTS   AGE
es-cluster-0   1/1     Running   0          9m40s
es-cluster-1   1/1     Running   0          8m54s
es-cluster-2   1/1     Running   0          8m8s
es-cluster-3   1/1     Running   0          66s
$
```

3. Scaling down the replicas from 4 to 2 for sts es-cluster. The StatefulSet controller scales the number of replicas.

```
$ kubectl scale sts es-cluster --replicas=2
```

```
$
$ kubectl scale sts es-cluster --replicas=2
statefulset.apps/es-cluster scaled
$
```

4. The controller deletes one Pod at a time, in reverse order with respect to its ordinal index, and it waits for each to completely shut down before deleting the next.

```
$ kubectl rollout status sts/es-cluster
```

```
$
$ kubectl rollout status sts/es-cluster
partitioned roll out complete: 2 new pods have been updated...
$
```

```
$ kubectl get pods
```

```
$
$ kubectl get pods
NAME           READY   STATUS    RESTARTS   AGE
es-cluster-0   1/1     Running   0          16m
es-cluster-1   1/1     Running   0          15m
$
```

6.5 Rolling update StatefulSets

1. The RollingUpdate update strategy will update all Pods in a StatefulSet, in reverse ordinal order, while respecting the StatefulSet guarantees.

2. Edit the StatefulSet to update the new image version of Elasticsearch elasticsearch:7.5.0

```
$ kubectl edit sts es-cluster
```

```
# reopened with the relevant failures.
#
apiVersion: apps/v1
kind: StatefulSet
metadata:
  creationTimestamp: "2020-06-03T13:28:20Z"
  generation: 3
  name: es-cluster
  namespace: kube-logging
  resourceVersion: "117909"
  selfLink: /apis/apps/v1/namespaces/kube-logging/statefulsets/es-cluster
  uid: 2e6a26e5-4af2-4b44-84af-1c4b3b5da978
spec:
  podManagementPolicy: OrderedReady
  replicas: 2
  revisionHistoryLimit: 10
  selector:
    matchLabels:
      app: elasticsearch
  serviceName: elasticsearch
  template:
    metadata:
      creationTimestamp: null
      labels:
        app: elasticsearch
    spec:
      containers:
      - env:
        - name: cluster.name
          value: k8s-logs
        - name: node.name
          valueFrom:
            fieldRef:
              apiVersion: v1
              fieldPath: metadata.name
        - name: discovery.seed_hosts
          value: es-cluster-0.elasticsearch,es-cluster-1.elasticsearch,es-cluster-2.elasticsearch
        - name: cluster.initial_master_nodes
          value: es-cluster-0,es-cluster-1,es-cluster-2
        - name: ES_JAVA_OPTS
          value: -Xms512m -Xmx512m
        image: docker.elastic.co/elasticsearch/elasticsearch:7.5.0
/.4
```

3. Verify the updation of StatefulSet Elasticsearch pods. Monitor the StatefulSet as it is rolled out using kubectl rollout status

```
$ kubectl rollout status sts/es-cluster
```

```
$ kubectl rollout status sts/es-cluster
Waiting for 1 pods to be ready...
Waiting for 1 pods to be ready...
```

```
$ kubectl get pods -w
```

```
$ kubectl get pods -w
NAME           READY   STATUS            RESTARTS   AGE
es-cluster-0   1/1     Running           0          28m
es-cluster-1   0/1     PodInitializing   0          2m1s
es-cluster-1   1/1     Running           0          2m4s
es-cluster-0   1/1     Terminating       0          28m
es-cluster-0   0/1     Terminating       0          28m
es-cluster-0   0/1     Terminating       0          28m
es-cluster-0   0/1     Terminating       0          28m
es-cluster-0   0/1     Pending           0          0s
es-cluster-0   0/1     Pending           0          0s
es-cluster-0   0/1     Init:0/3          0          0s
es-cluster-0   0/1     Init:1/3          0          15s
es-cluster-0   0/1     Init:2/3          0          17s
es-cluster-0   0/1     PodInitializing   0          18s
es-cluster-0   1/1     Running           0          65s
```

4. Verify the image version with describe command

```
$ kubectl describe sts es-cluster | grep Image
```

```
$
$ kubectl describe sts es-cluster | grep Image
    Image:      busybox
    Image:      busybox
    Image:      busybox
    Image:       docker.elastic.co/elasticsearch/elasticsearch:7.5.0
$
```

6.6 Clean Up resources created the lab exercise

```
$ kubectl delete ns kube-logging
$ kubectl config set-context --current --namespace=default
```

7 TROUBLESHOOTING

7.1 Unbound Immediate Persistentvolumeclaim

Issue: When we are creating Statefulset, Statefulset is not creating faling with error 3 pod has unbound immediate persistentVolumeClaim.

```
    Host Ports:  0/TCP, 0/TCP
    Limits:
      cpu:  1
    Requests:
      cpu:  100m
    Environment:
      cluster.name:                  k8s-logs
      node.name:                     es-cluster-0 (v1:metadata.name)
      discovery.seed_hosts:          es-cluster-0.elasticsearch,es-cluster-1.elasticsearch,es-cluster-2.elasticsearch
      cluster.initial_master_nodes:  es-cluster-0,es-cluster-1,es-cluster-2
      ES_JAVA_OPTS:                  -Xms512m -Xmx512m
    Mounts:
      /usr/share/elasticsearch/data from data (rw)
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-wkg8s (ro)
Conditions:
  Type           Status
  PodScheduled   False
Volumes:
  data:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same namespace)
    ClaimName:  data-es-cluster-0
    ReadOnly:   false
  kube-api-access-wkg8s:
    Type:                     Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:   3607
    ConfigMapName:            kube-root-ca.crt
    ConfigMapOptional:        <nil>
    DownwardAPI:              true
QoS Class:                    Burstable
Node-Selectors:               <none>
Tolerations:                  node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                              node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason            Age               From               Message
  ----     ------            ----              ----               -------
  Warning  FailedScheduling  38s (x2 over 39s)  default-scheduler  0/3 nodes are available: 3 pod has unbound immediate PersistentVolumeClaims.
root@Master:/home/ubuntu/Kubernetes#
```

Reason: To create the statefulset we are using the Dynamic Volume to claim the Volume for the POD. If you are using a Normal Kubernetes cluster *(kubeadm cluster)* then I azure CSI driver is not installed.

```
      - name: fix-permissions
        image: busybox
        command: ["sh", "-c", "chown -R 1000:1000 /usr/share/elasticsearch/data"]
        securityContext:
          privileged: true
        volumeMounts:
        - name: data
          mountPath: /usr/share/elasticsearch/data
      - name: increase-vm-max-map
        image: busybox
        command: ["sysctl", "-w", "vm.max_map_count=262144"]
        securityContext:
          privileged: true
      - name: increase-fd-ulimit
        image: busybox
        command: ["sh", "-c", "ulimit -n 65536"]
        securityContext:
          privileged: true
  volumeClaimTemplates:
  - metadata:
      name: data
      labels:
        app: elasticsearch
    spec:
      accessModes: [ "ReadWriteOnce" ]
      storageClassName: managed-premium
      resources:
        requests:
          storage: 10Gi
```

Fix: To fix this issue please use AKS cluster by using the default storage class you can create volume.

8 SUMMARY

In this guide we Covered:

- Advanced Routing with Ingress-Controller
- Dynamic Provisioning of Persistent Volumes
- Deploying and Managing a StatefulSet Resource