Tony Shen

AWS EKS

Contents

Revision History
Revision v1, December, 2020
Revision v2, February, 2021

Glossary

Term	Description
AWS	Amazon Web Services
Kubernetes	An open-source system for automating deployment, scaling, and management of containerized applications
K8	Abbreviation for Kubernetes
Control Plane	K8 cluster management software system that manages nodes and pods
Node	A Node is a worker machine in Kubernetes and may be either a virtual or a physical machine, depending on the cluster. Also referred to as work nodes. K8 cluster has at least one node. Nodes run containerized application workloads. Nodes are managed by Control Plane
Control Plane components	There are five (5) control plane components, i.e., Cluster Controller (c-m), Cloud Controller Manager (c-c-m), api / api server, sched (Scheduler), etcd (agent that communicates with nodes), and node controller
Node components	There are three node components, i.e., kubelet, kube-proxy, container runtime
Addons	DNS, Web UI (dashboard), container resource monitoring, cluster-level logging, where DNS is required, and others are optional
Pod	Logical host that runs on a node. Logical resource grouping that runs containerized workloads on a node. One node can run multiple pods when the node capacity allows. When a node fails, K8 control plane recreates pods on surviving nodes.
Container runtime	Docker, containerd, CRI-O, and any implementation of the Kubernetes CRI (Container Runtime Interface)
Job	Job is a Kubernetes resource that runs a Pod, or perhaps several Pods, to carry out a task and then stop.
Cluster state	Current state or desired state
K8 objects	Persistent entities in K8 system. K8 uses these entities to represent the state of your cluster. Objects are expressed in YAML format
Kubernetes API	Based on RESTful API
RESTful API	
Prometheus	an open-source systems monitoring and alerting toolkit
CNCF	Cloud Native Computing Foundation

Introduction

Kubernetes is a software system that manages and orchestrates Docker containerized apps to run in a fairly comprehensive frame that includes a cluster taking care of workloads with auto-scaling and load balancing capabilities built-in, and a control plane that manages the cluster. Kubernetes, or simply K8 for short, integrates well with container development systems such as Docker Community Edition (CE) or Docker Enterprise Edition (EE). In addition, it fully supports popular software repos and registries such as Docker Hub, Git/GitHub/GitLab/GitOps for distributing and version controlling docker images and source code. K8 is a power tool for organizations large and small to use in pursuing DevOps/DevSecOps in seek of greater IT efficiency, cost-effectiveness, security, and agility.

AWS offers K8 as a service in AWS cloud, which is called EKS, standing for Elastic Kubernetes Service. AWS Management Console (Console) and AWS CLI (CLI) are two primary interfaces for user to use in interacting with EKS.

This write-up walks you through a process of how to set up an EKS cluster and how to run containerized apps in the cluster using both Console and CLI in your AWS cloud environment.

Overview

Before creating a cluster, you need to meet a number of prerequisites.

1. Set up AWS CLI on a local workstation (WS) with access to your AWS account
2. Install kubectl utility on WS
3. Install eksctl on WS
4. Create EKS cluster role
5. Create EKS cluster node group role
6. Create Key Pair for access to EKS cluster nodes
7. Create EKS VPC (VPC) to deploy EKS cluster, if that VPC does not already exists

How-to details are provided in Preparing to Create EKS Cluster section below

After you have done all your preparation work, you are ready to create a cluster and verify it all works by deploying a container app in the cluster. A few steps in doing so are listed below.

1. Create EKS cluster (Cluster) using AWS Management Console (Console)
2. Check authentication
3. Set up or update kubeconfig for kubectl to use in managing EKS cluster created in Step 8
4. Create KS cluster node group (NG) using Console, and check NG nodes status before deploying a container app to the cluster
5. Deploy a sample app

How-to details are provided in Creating EKS Cluster section

To minimize your cost for using EKS, you may remove a cluster that you don't intend to keep. Unlike in Azure where you can simply remove your resource group that contains all your cluster resources and nothing else to accomplish your cluster removal by one click in Azure Portal, equivalent to AWS Management Console, or by one command in Azure CLI, similar to AWS CLI, it takes a quite few steps for you to remove a cluster cleanly from your AWS cloud space. These steps are listed below.

1. Check sample app running status
2. Remove the sample app
3. Remove NG
4. Remove Cluster
5. Remove VPC

How-to details are provided in Removing EKS Cluster section

To recap, first of all, there are 7 steps for you to take to get ready before creating your EKS cluster. Secondly, 5 steps for you to take in creating and verifying your cluster. Thirdly, there are another 5 steps for you to take in removing your cluster cleanly.

Now that you are clear of your roadmap. You are ready to move on.

Environment and naming convention

It is highly advisable that you devise a naming standard (NS), if you don't have one already, to guide you in naming EKS cluster resources that you are going to create.

In this write-up, a simple NS was adopted. The NS is based on three elements.

1. Account alias
2. Selected Region
3. Service type

Table 1 below illustrates how this NS works in resource naming

Table-1 Naming Convention

Item	Name	Comment
Account alias	dls1	
Region	usw2	Oregon (us-west-2)
Cluster	dls1-usw2-eks-cluster-201206	201206 was the cluster creation date
Cluster Node Group	dls1-usw2-eks-cluster-node-grp-201206	
Cluster role	dls1-eks-cluster-role	This is an IAM role, global, having no region scope
Cluster NG role	dls1-eks-cluster-node-grp-role	This is an IAM role, global, having no

		region scope
Cluster NG Key Pair	dls1-usw2-eks-cluster-node-grp-keypair	
VPC	dls1-usw2-eks-cluster-vpc-201206	201206 was the VPC creation date

Note:
An IAM admin user was used in the following examples. The user was granted with full permissions to EKS. The user has programmatic access to the AWS account. When interacting with EKS using AWS CLI, the user accesses from a Linux workstation, and not from AWS Cloud Shell. The user has AWS CLI for Linux installed on his workstation.

Preparing to Create EKS Cluster

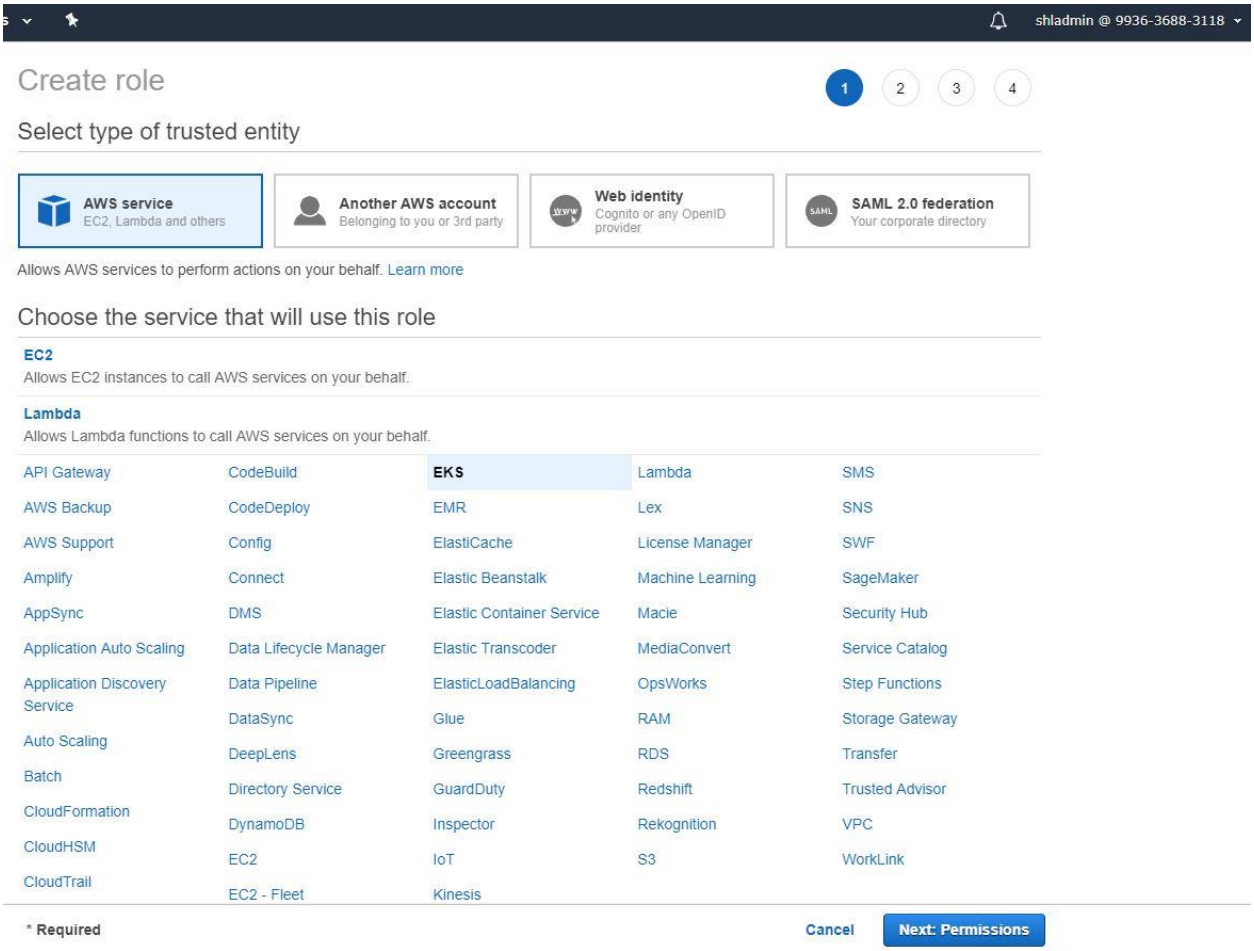
Prep work steps 1 through 7

1. **Install AWS CLI version 2**
   awsdls1admin@ubun1802:~$ aws --version
   aws-cli/2.1.2 Python/3.7.3 Linux/4.15.0-123-generic exe/x86_64.ubuntu.18
   awsdls1admin@ubun1802:~$

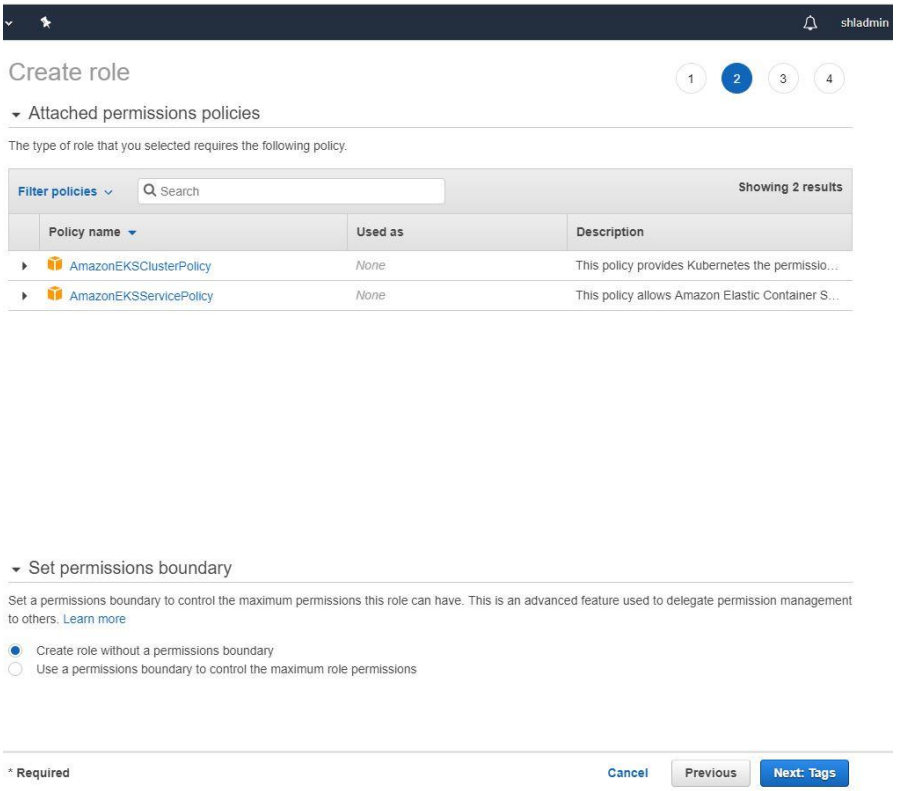
2. **Install kubectl (installed previously)**
   awsdls1admin@ubun1802:~$ kubectl version --short --client
   Client Version: v1.17.2
   awsdls1admin@ubun1802:~$

3. **Install eksctl**
   awsdls1admin@ubun1802:~$ curl --silent --location "https://github.com/weaveworks/eksctl/releases/latest/download/eksctl_$(uname -s)_amd64.tar.gz" | tar xz -C /tmp
   awsdls1admin@ubun1802:~$ sudo mv /tmp/eksctl /usr/local/bin
   awsdls1admin@ubun1802:~$ eksctl version
   0.32.0
   awsdls1admin@ubun1802:~$ which eksctl
   /usr/local/bin/eksctl
   awsdls1admin@ubun1802:~$

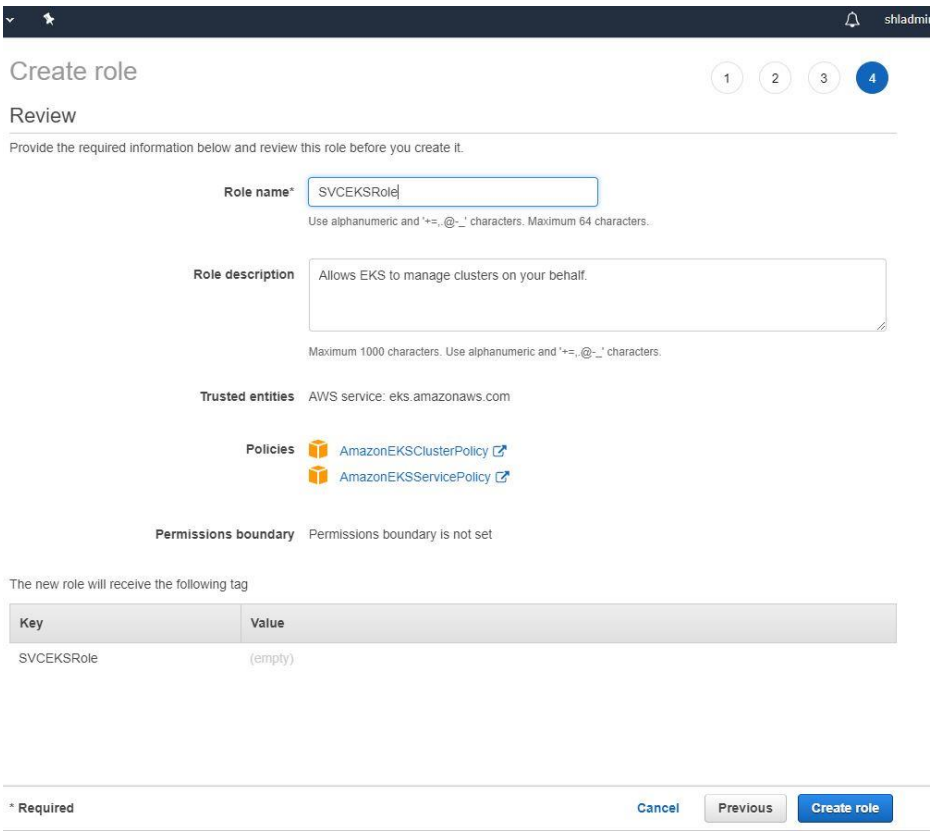
4. **Create EKS cluster role (that includes AmazonEKSClusterPolicy)**
   Use AWS IAM Console to create the required role Cluster Role dls1-eks-cluster-role
   Screen 1 – Select EKS



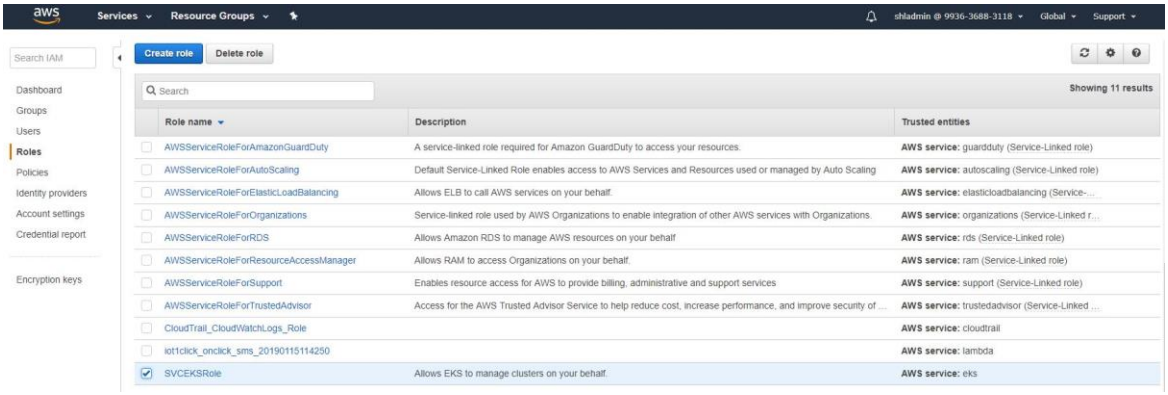
Screen 2 – Attach two policies



Screen 3 – Review and Create

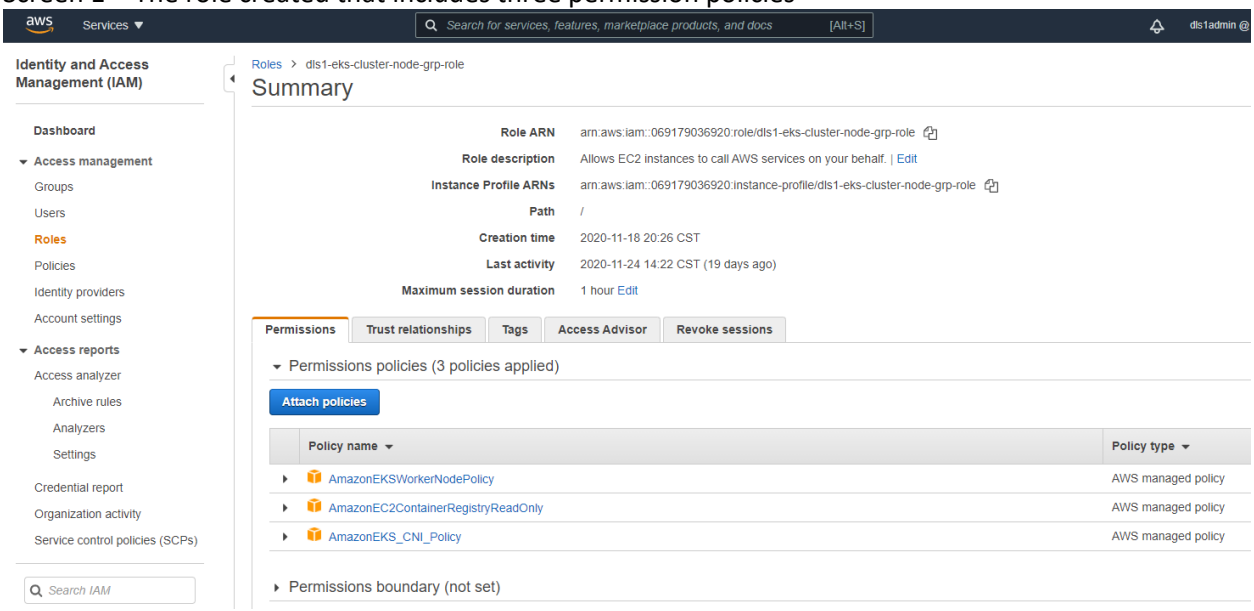


Screen 4 – Role created



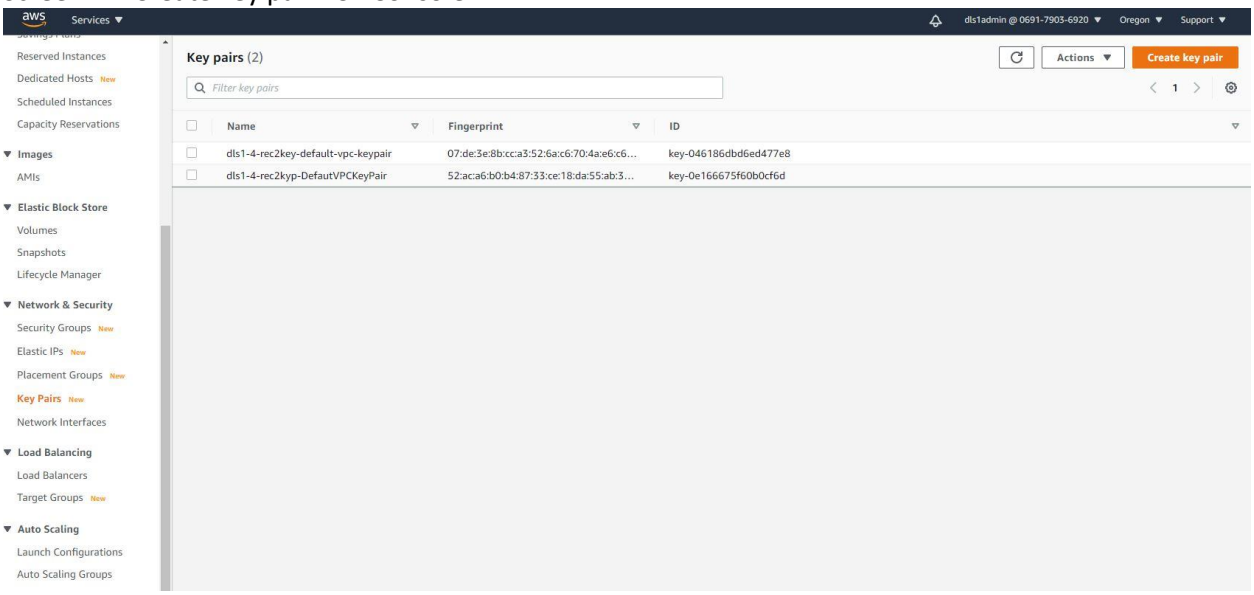
5. **Create EKS node (group) role that includes three (3) policies**
   dls1-eks-cluster-node-grp-role
   This role needs to include three policies. Those three policies are:
   AmazonEKSWorkerNodePolicy
   AmazonEC2ContainerRegistryReadOnly
   AmazonEKS_CNI_Policy

Screen 1 - The role created that includes three permission policies

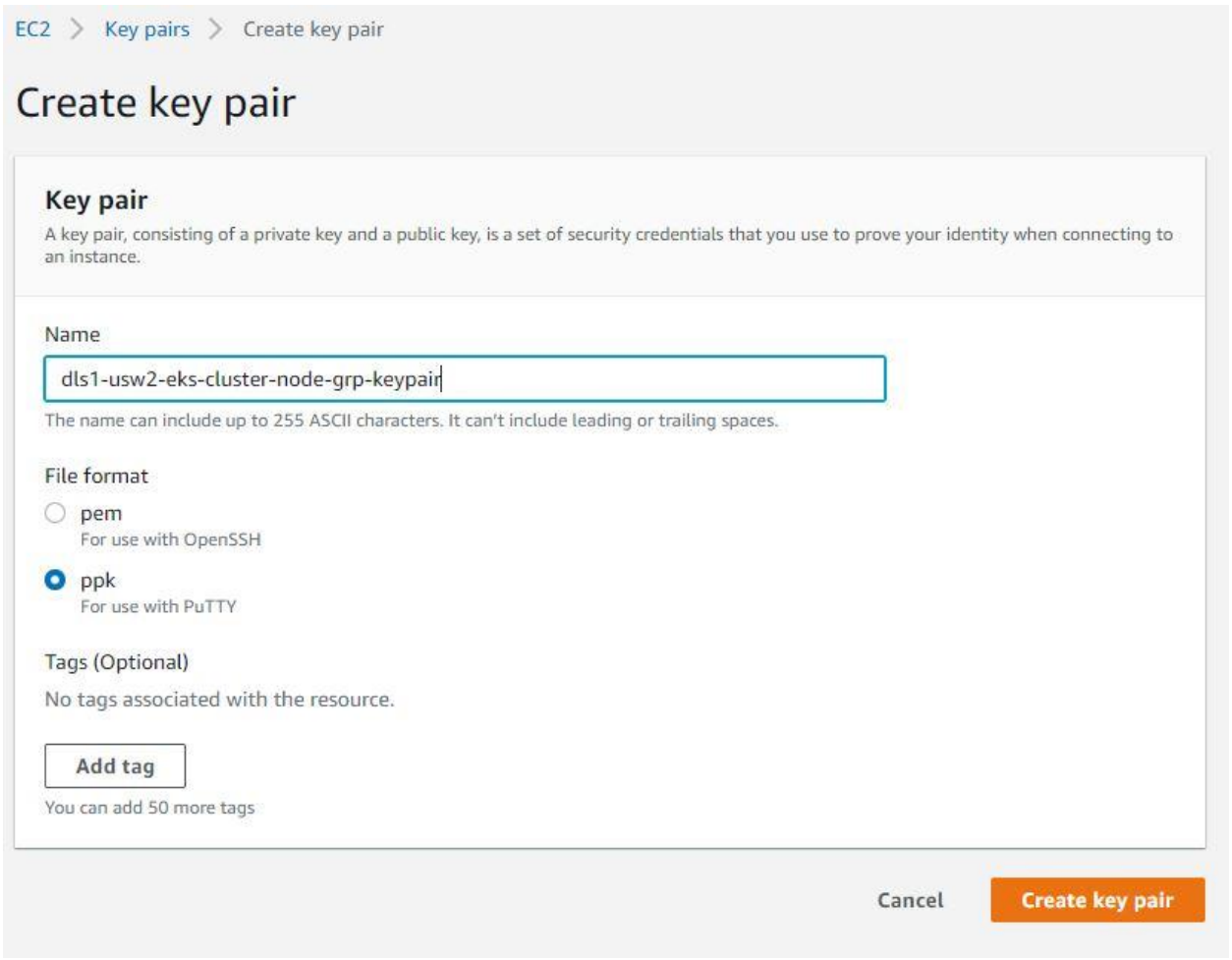


6. **Create EKS cluster node group key pair**
   dls1-usw2-eks-cluster-node-grp-keypair

Screen 1 – Create key pair EC2 Console

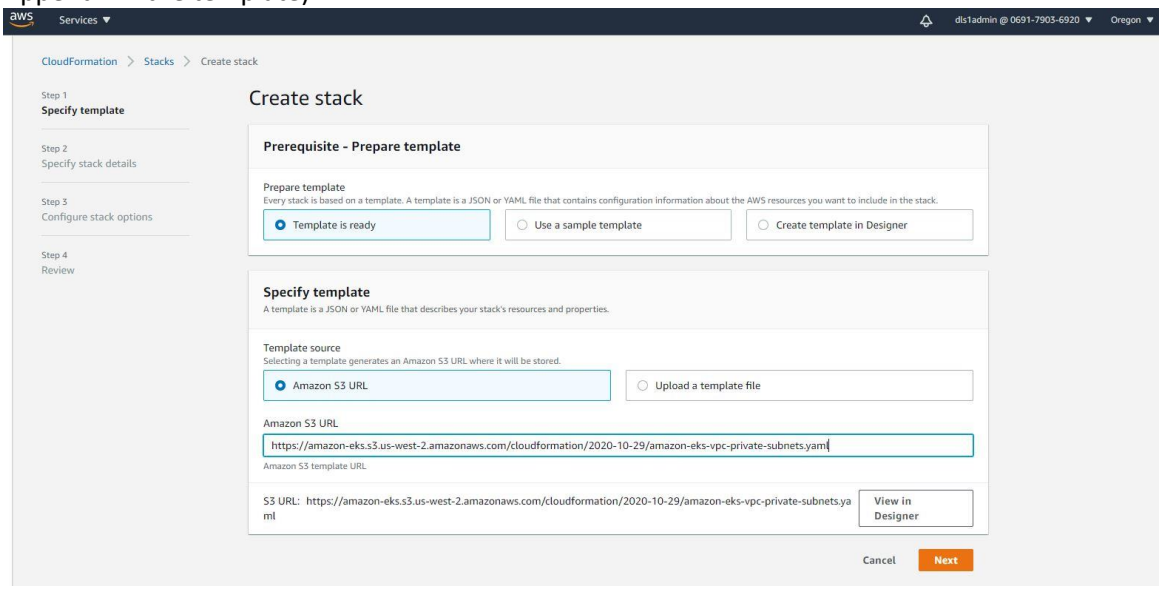


Scree2 – Name key pair. Specify file format

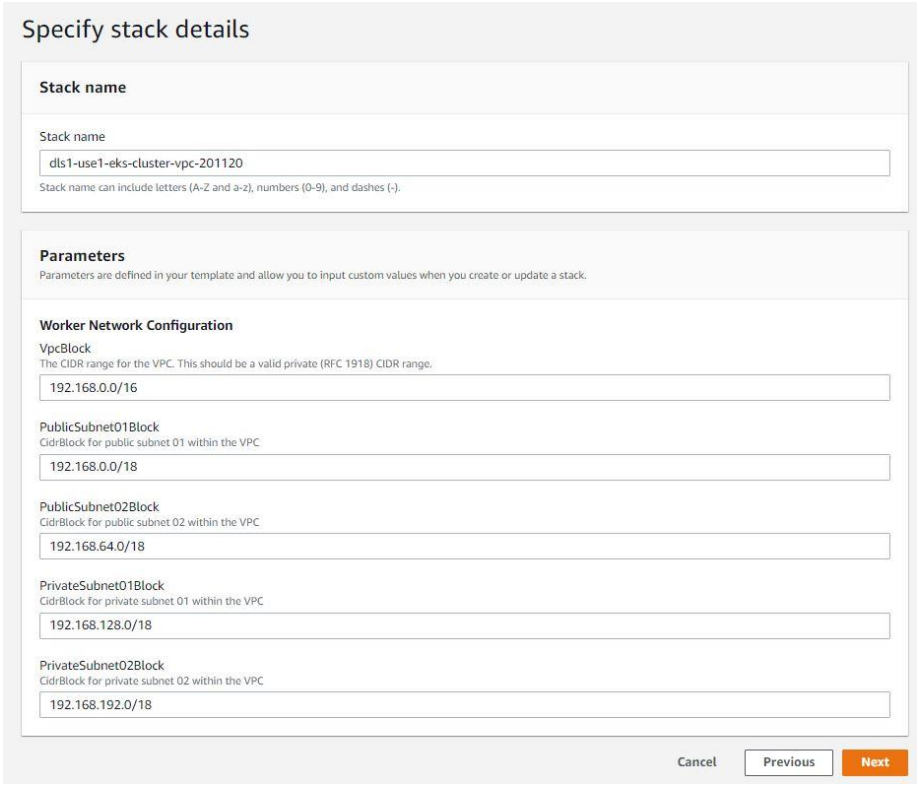


7. **Create EKS VPC and subnets using AWS provided CloudFormation template**
   dls1-use1-eks-cluster-vpc-201120 (two public subnets and two private subnets)
   https://amazon-eks.s3.us-west-2.amazonaws.com/cloudformation/2020-10-29/amazon-eks-vpc-private-subnets.yaml

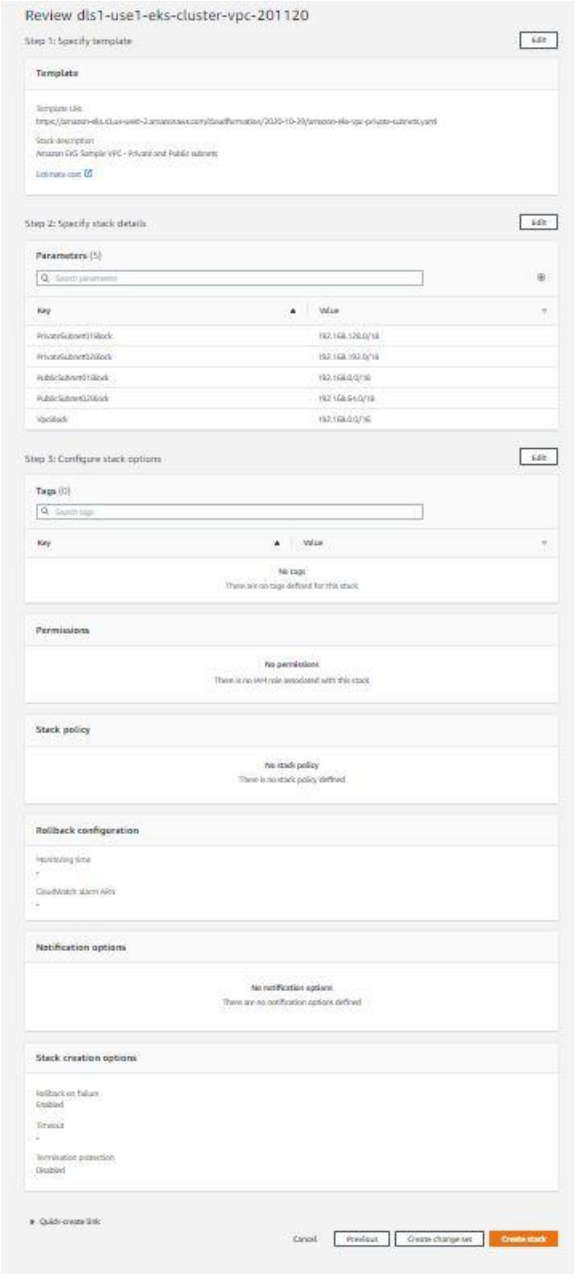
   Screen 1 – Create VPC in CloudFormation (CF) Console, using CF template provided (See in Appendix A the template)



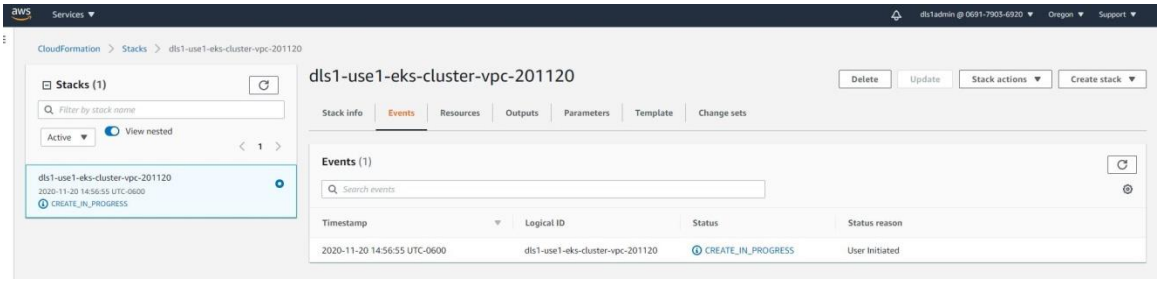
Screen 2 – Specify CF stack details



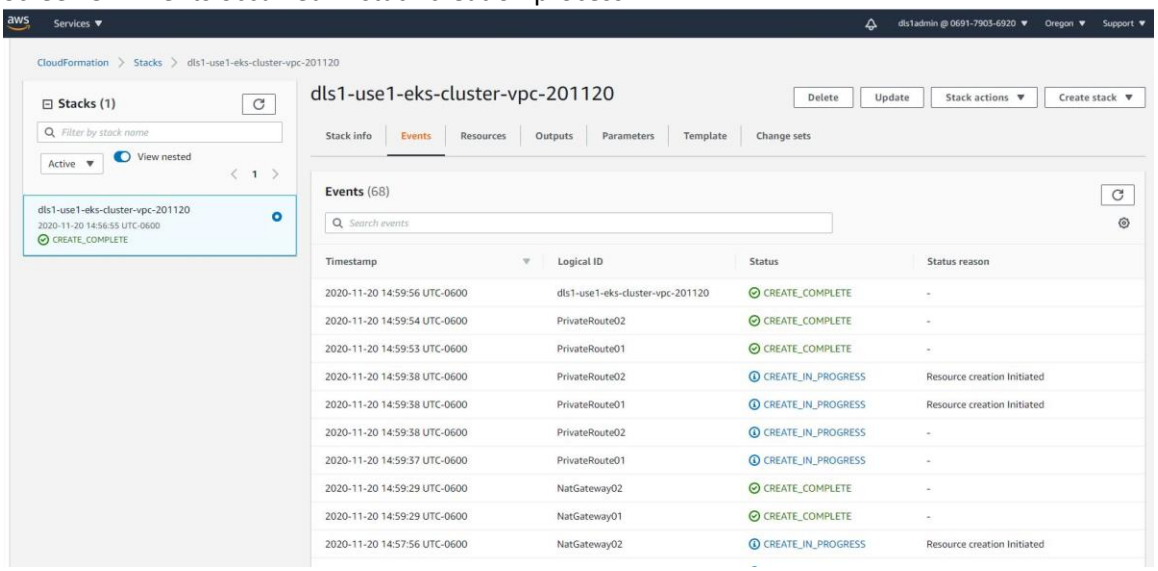
Screen 3 – Specify CF stack details (Continued)



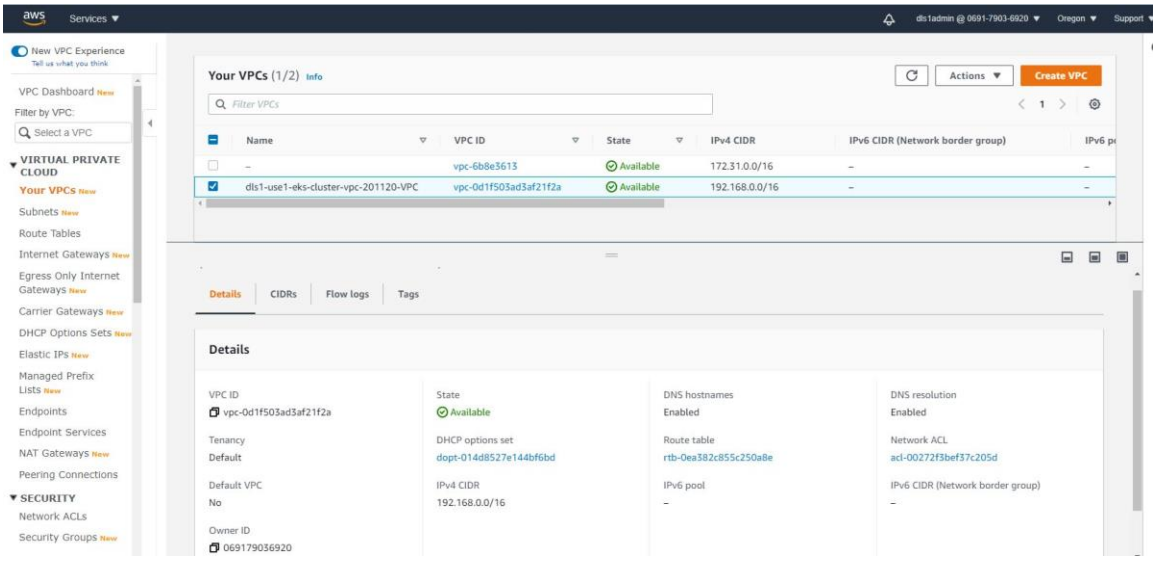
Screen 4 – Stack being created



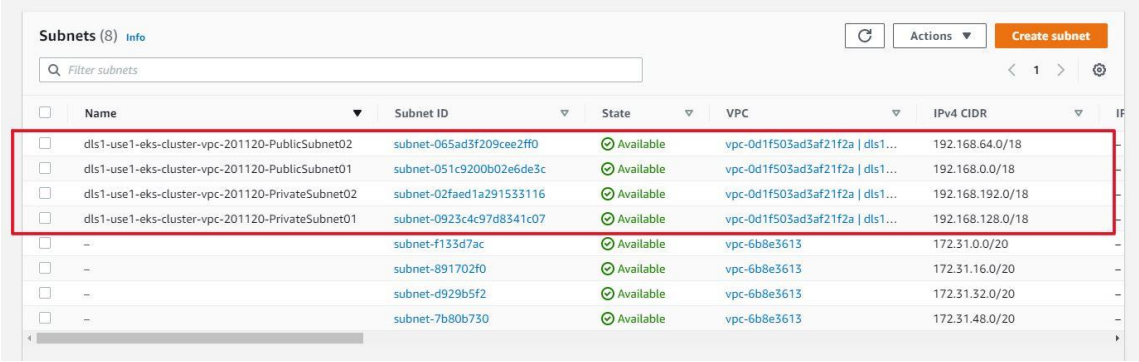
Screen 5 – Events occurred in stack creation process



Screen 6 – Stack created and available



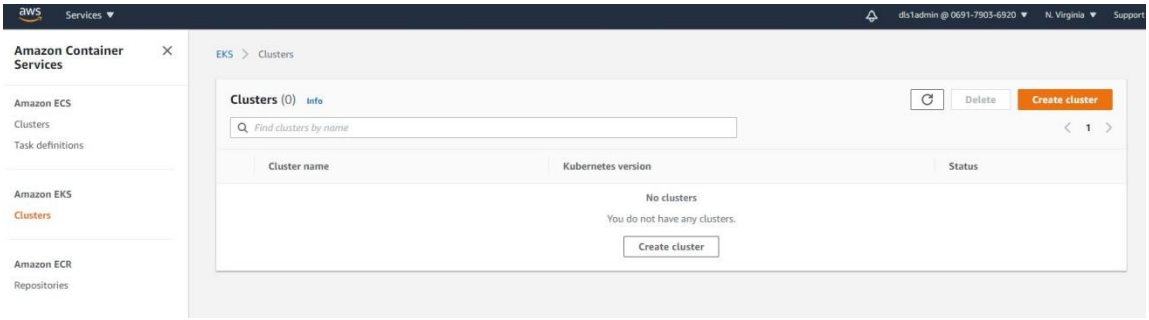
Screen 7 – In VPC Console four subnets showed up



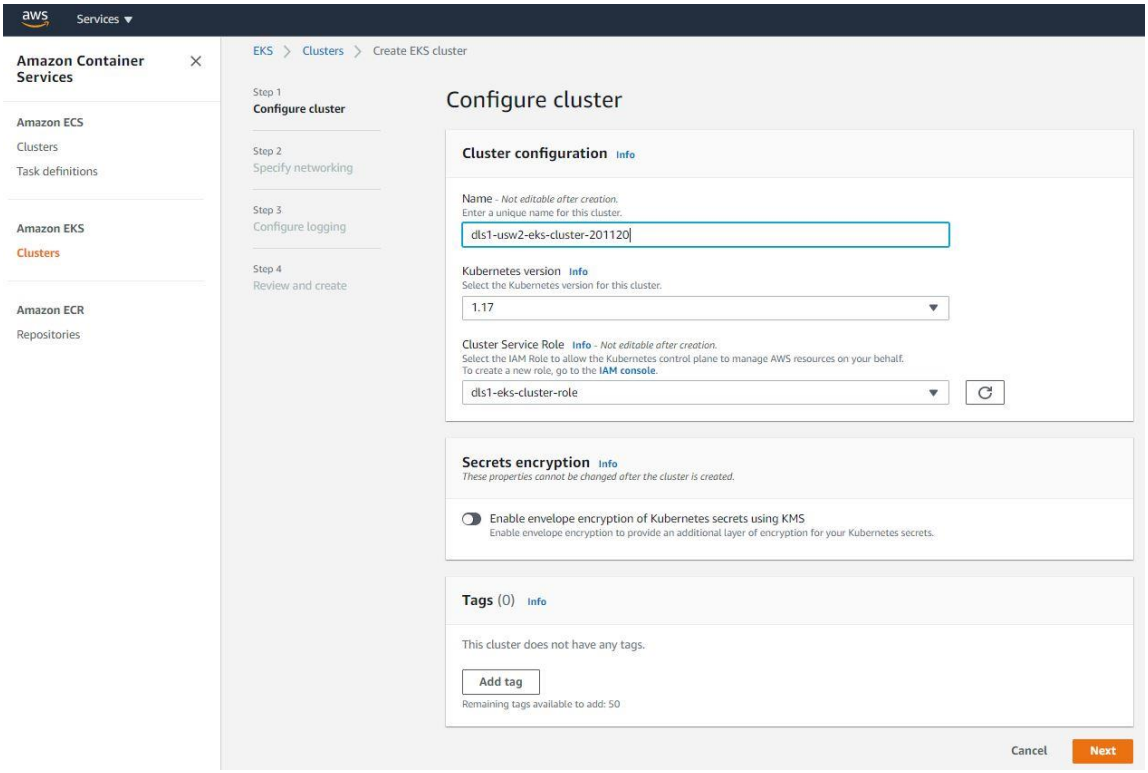
Creating EKS Cluster

8. **Create EKS cluster using console**
   dls1-usw2-eks-cluster-201123

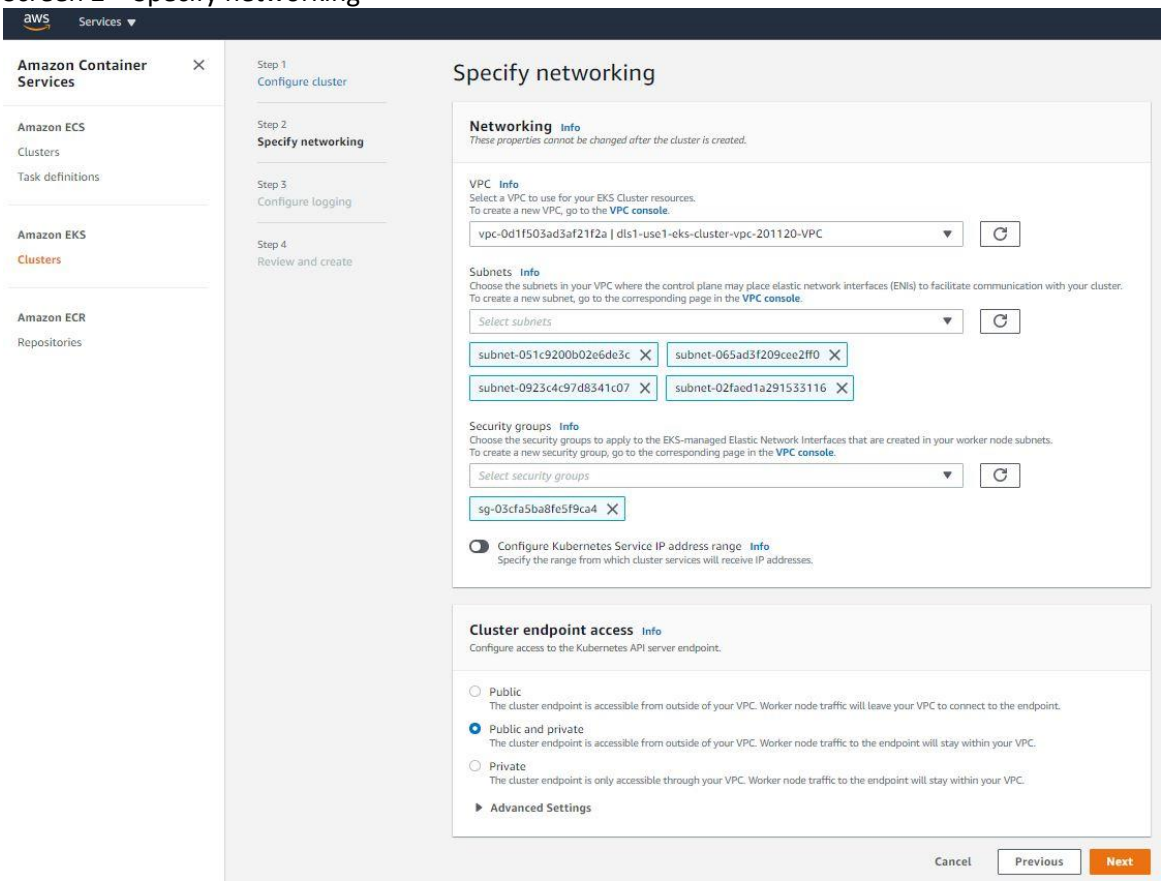
Screen 1 – In EKS Console create cluster



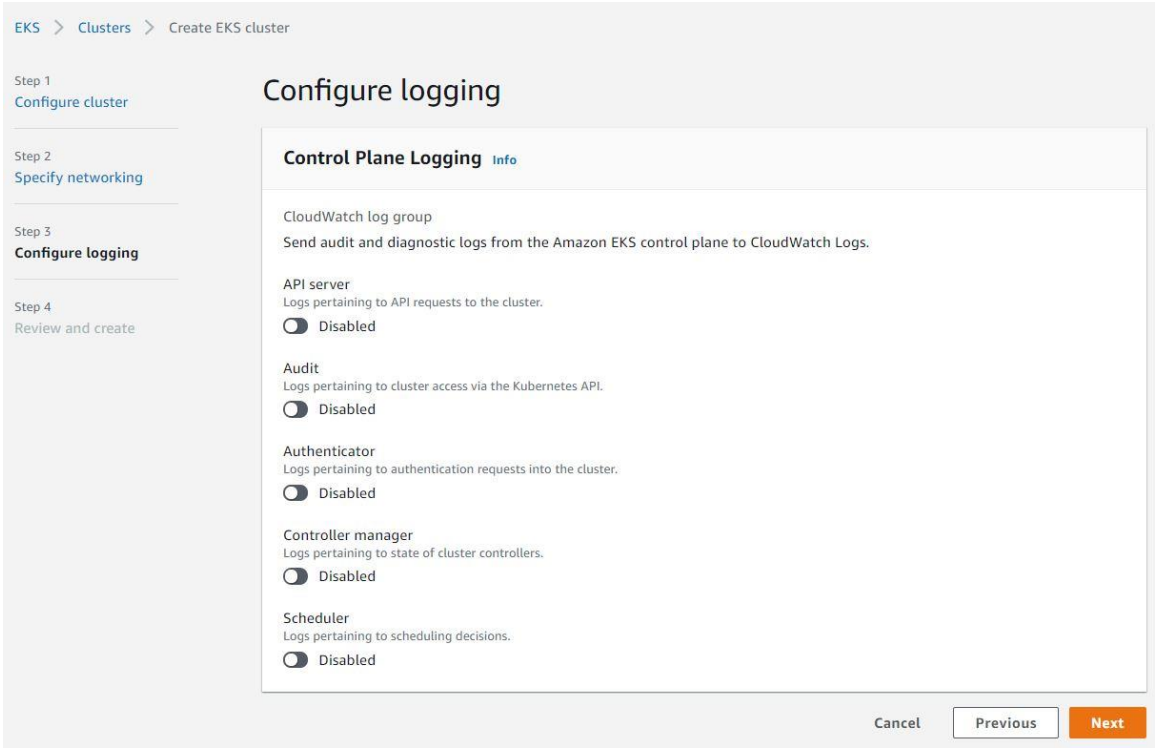
Screen 2 – Configure cluster



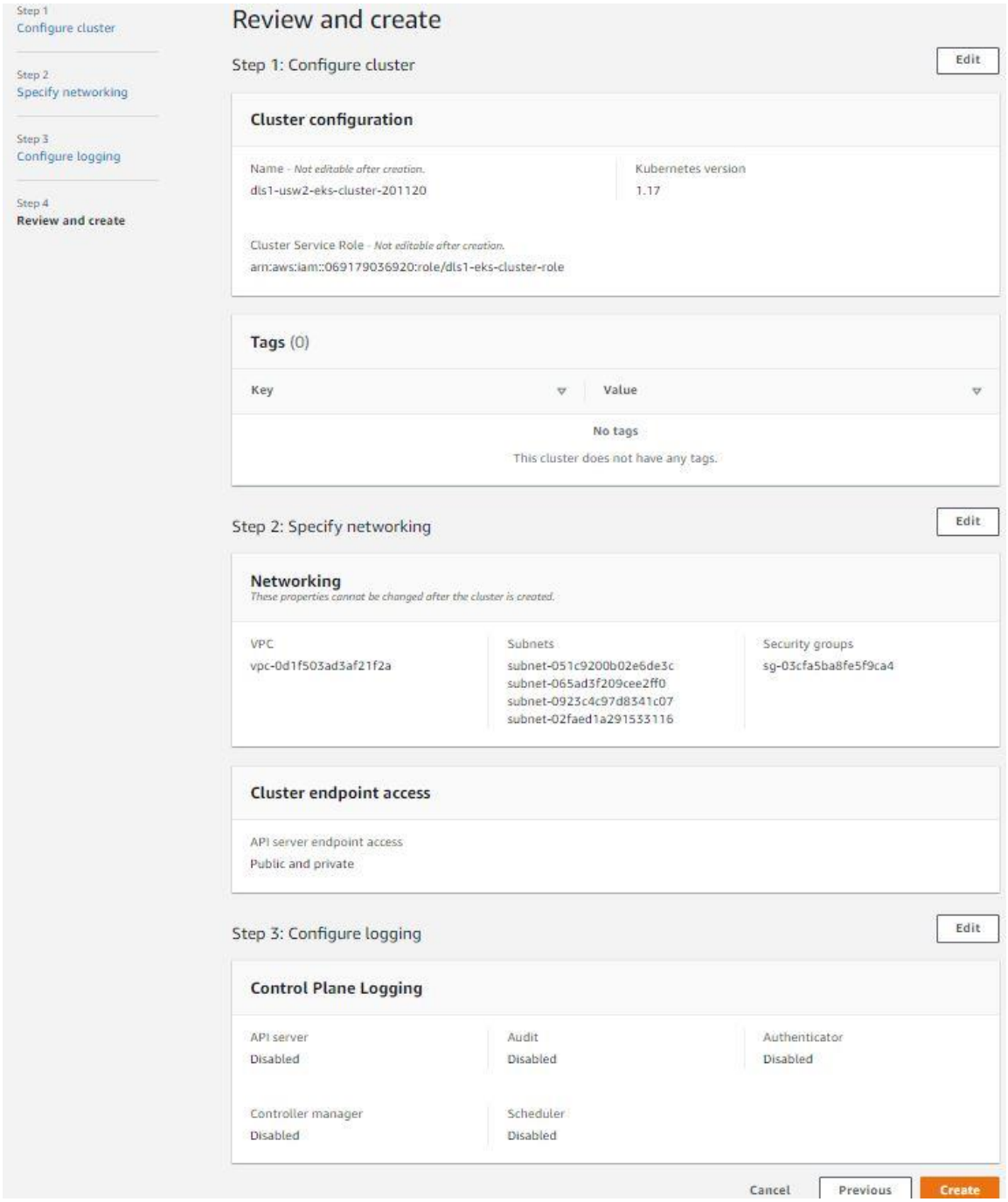
Screen 2 – Specify networking



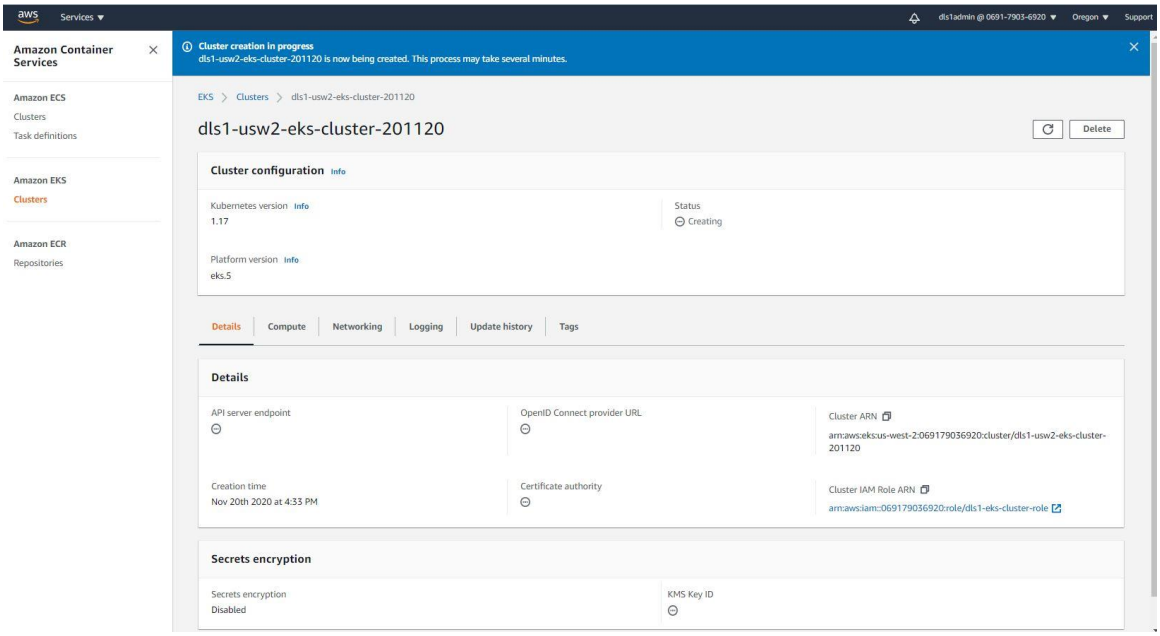
Screen 3 – Configure logging



Screen 4 – Review and create



Screen 5 – Cluster being created



9. **Check authentication**

```
awsdls1admin@ubun1802:~$ aws sts get-caller-identity
{
   "UserId": "AIDARAG3EKT4MVCKMWGJ5",
   "Account": "069179036920",
   "Arn": "arn:aws:iam::069179036920:user/dls1admin"
}
awsdls1admin@ubun1802:~$
```

10. **Create / update configuration kubeconfig, and verify**

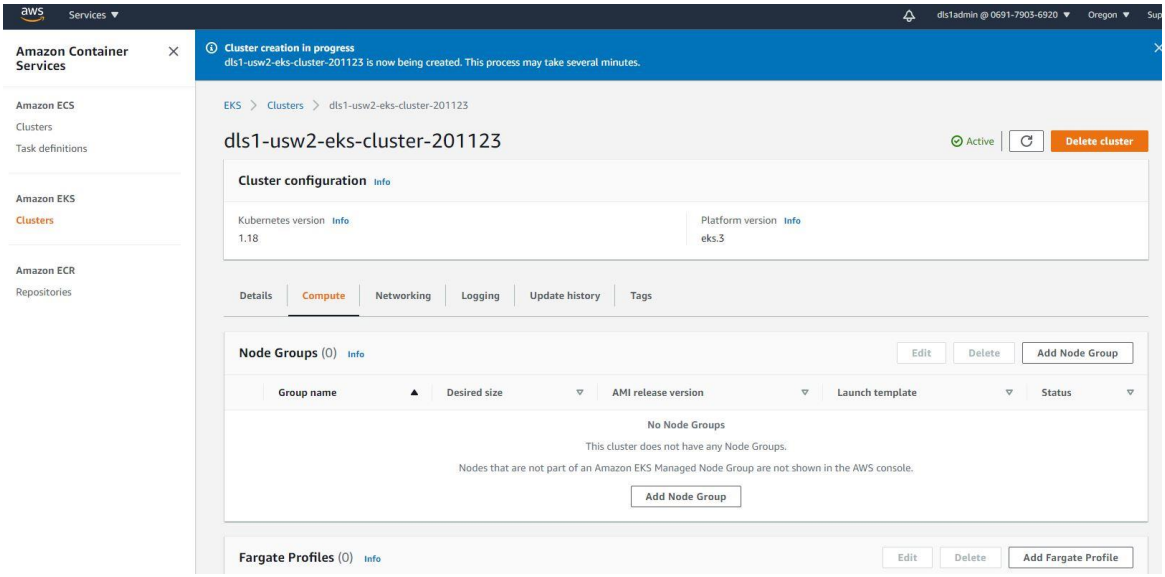
```
awsdls1admin@ubun1802:~$ aws eks --region us-west-2 update-kubeconfig --name dls1-usw2-eks-cluster-201123
Added new context arn:aws:eks:us-west-2:069179036920:cluster/dls1-usw2-eks-cluster-201123 to /home/awsdls1admin/.kube/config
awsdls1admin@ubun1802:~$

awsdls1admin@ubun1802:~$ kubectl get svc
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   10.100.0.1   <none>        443/TCP   52m
awsdls1admin@ubun1802:~$
```

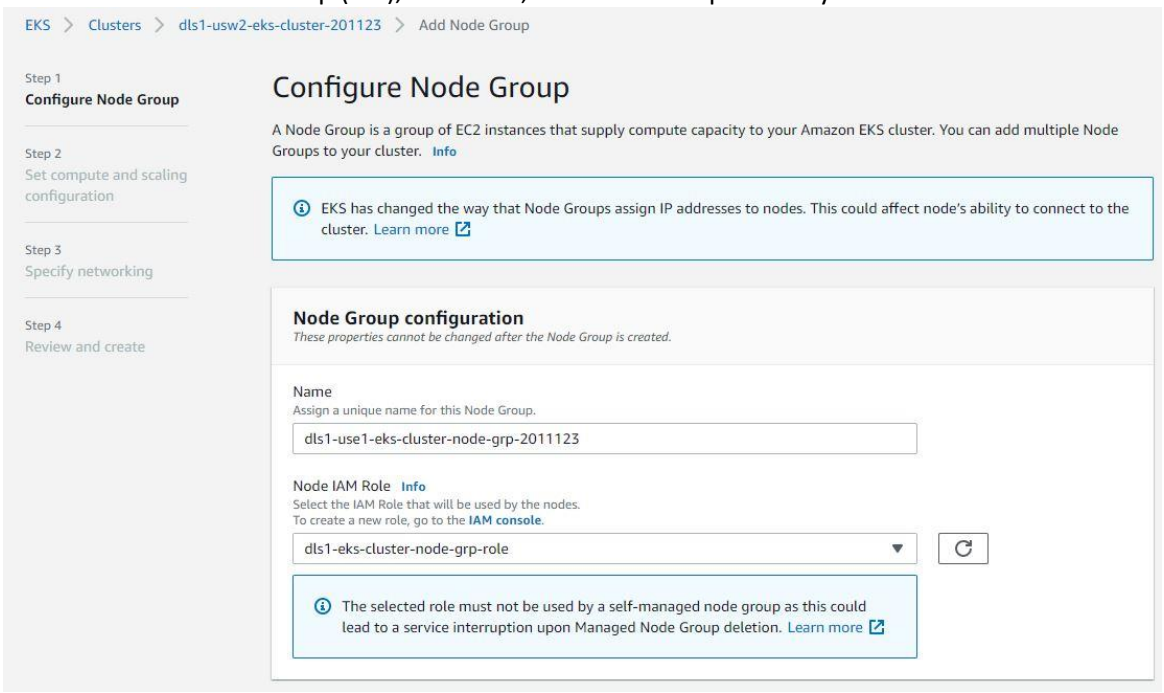
11. **Create EKS node group (Managed Node Group) using console**

dls1-usw2-eks-cluster-node-grp-2011123

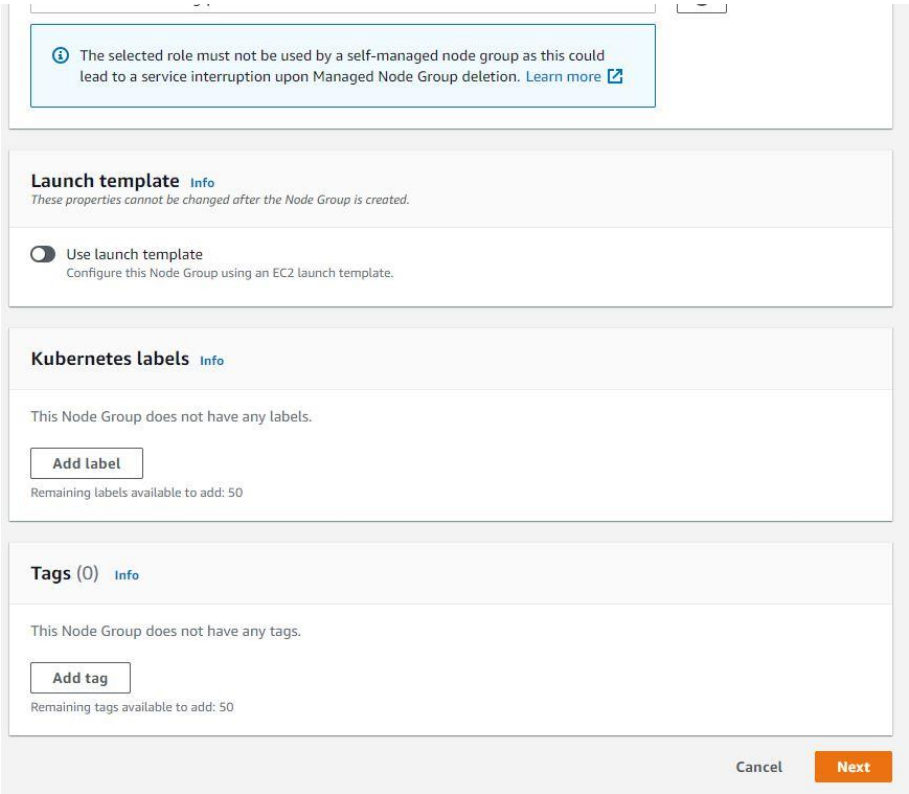
Screen 1 – in EKS Console, select Cluster just created. Select Compute tab



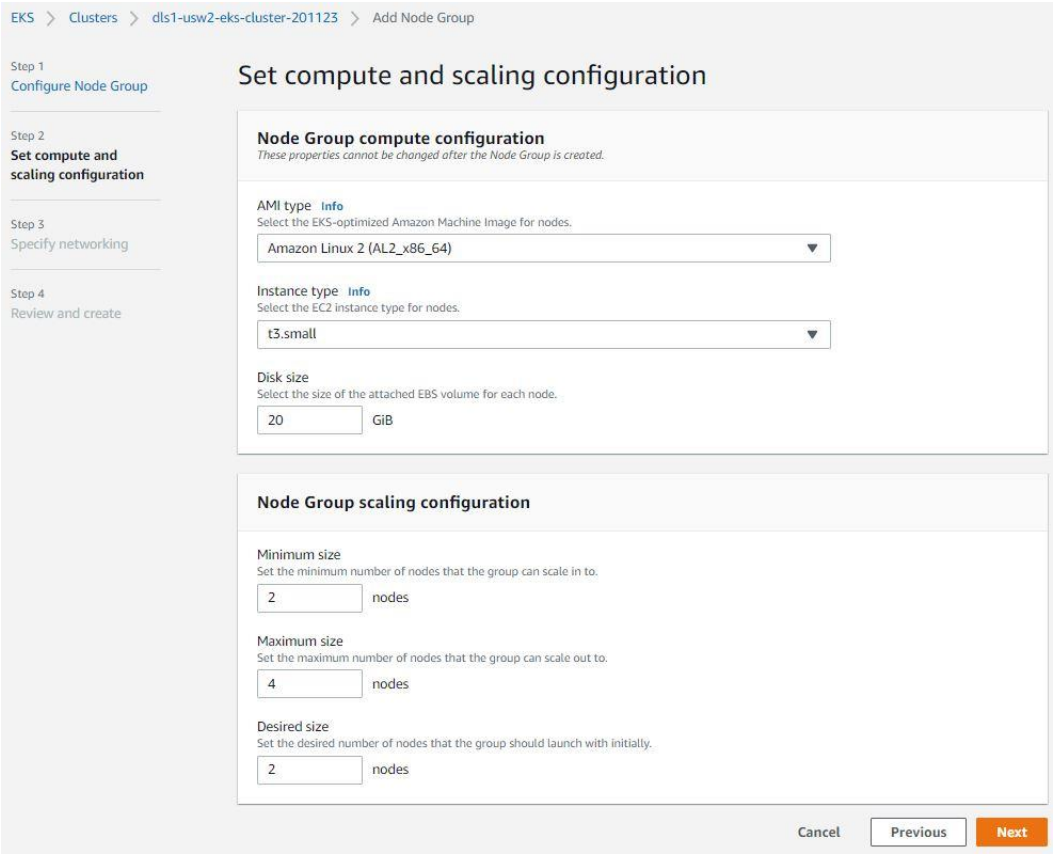
Screen 2 – Add Node Group (NG), name NG, select NG role previously created



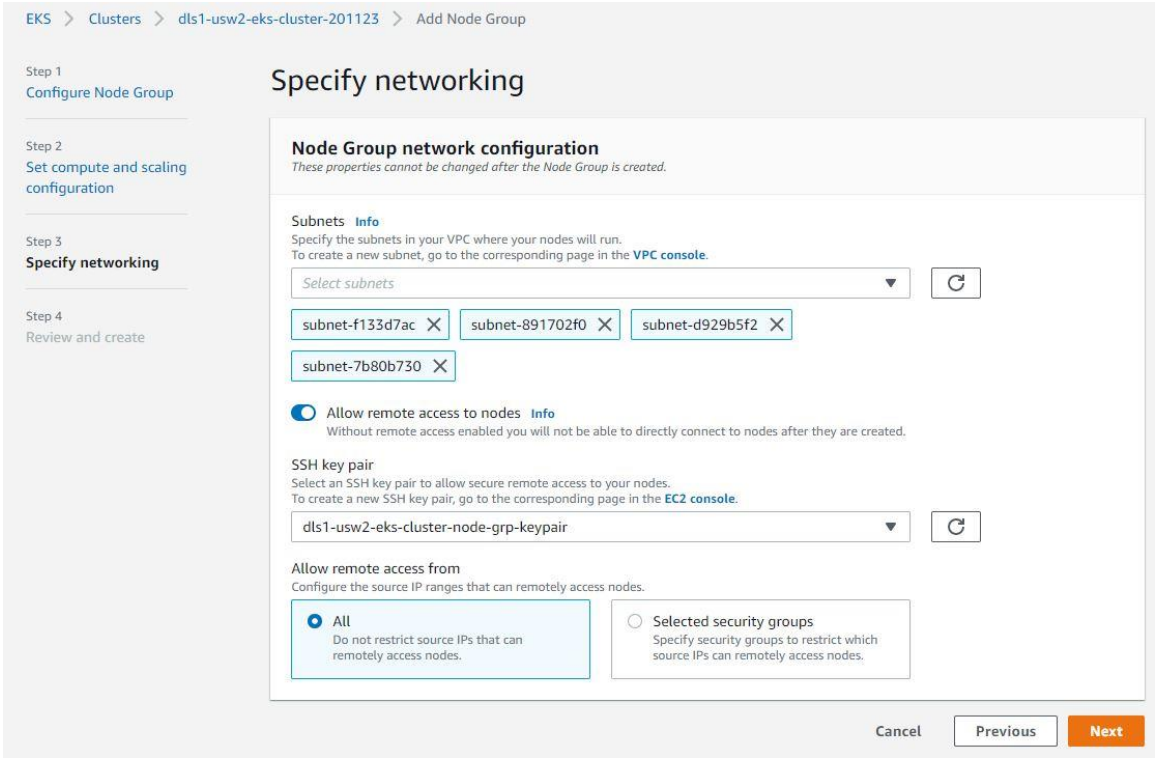
Screen 3 – Use Default, go to Next



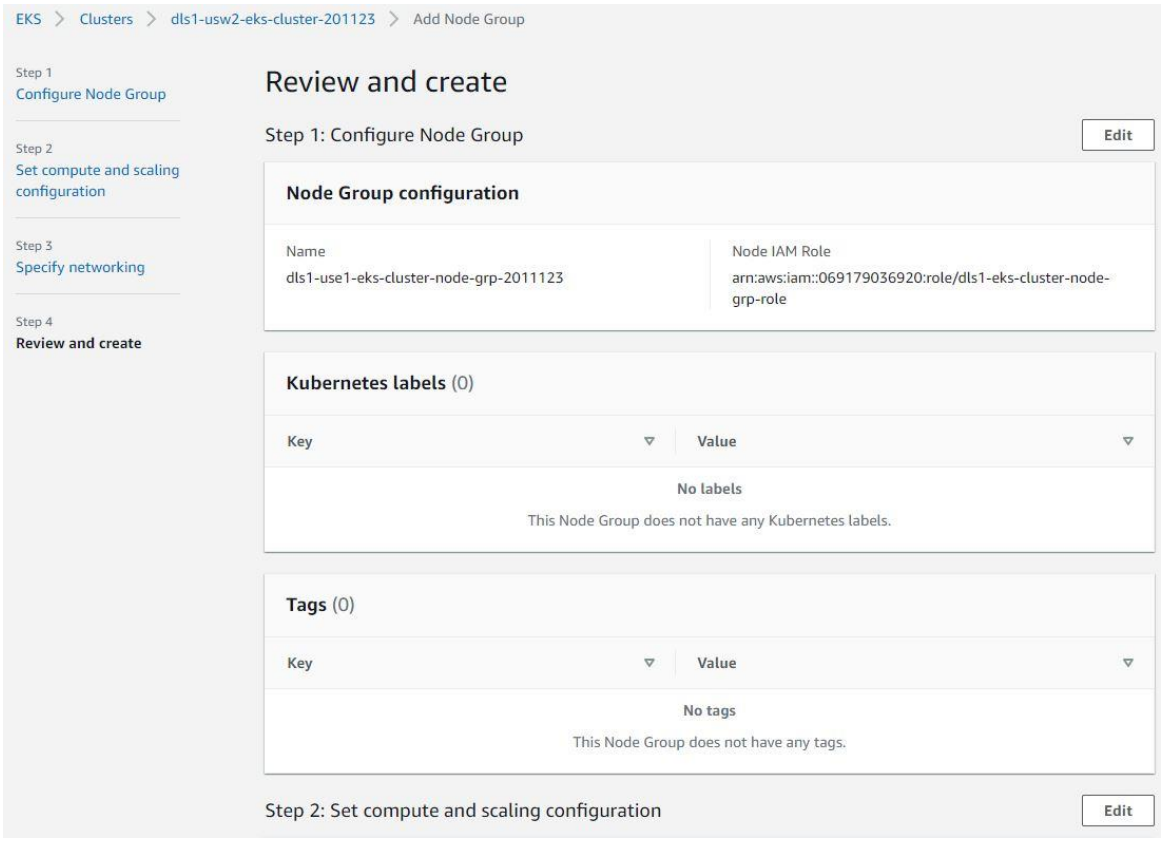
Screen 4 – Set compute and scaling configuration



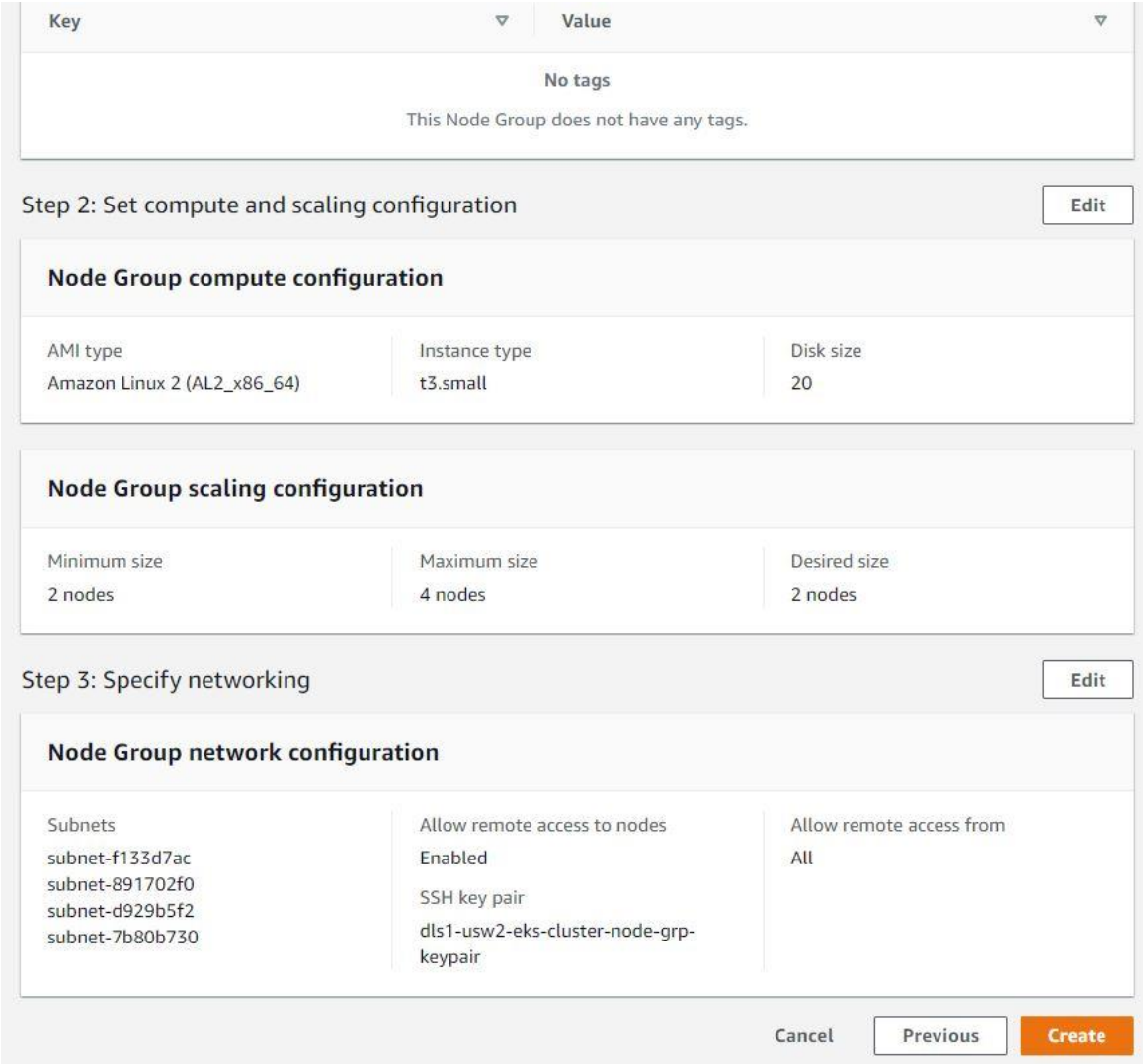
Screen 5 – Specify networking



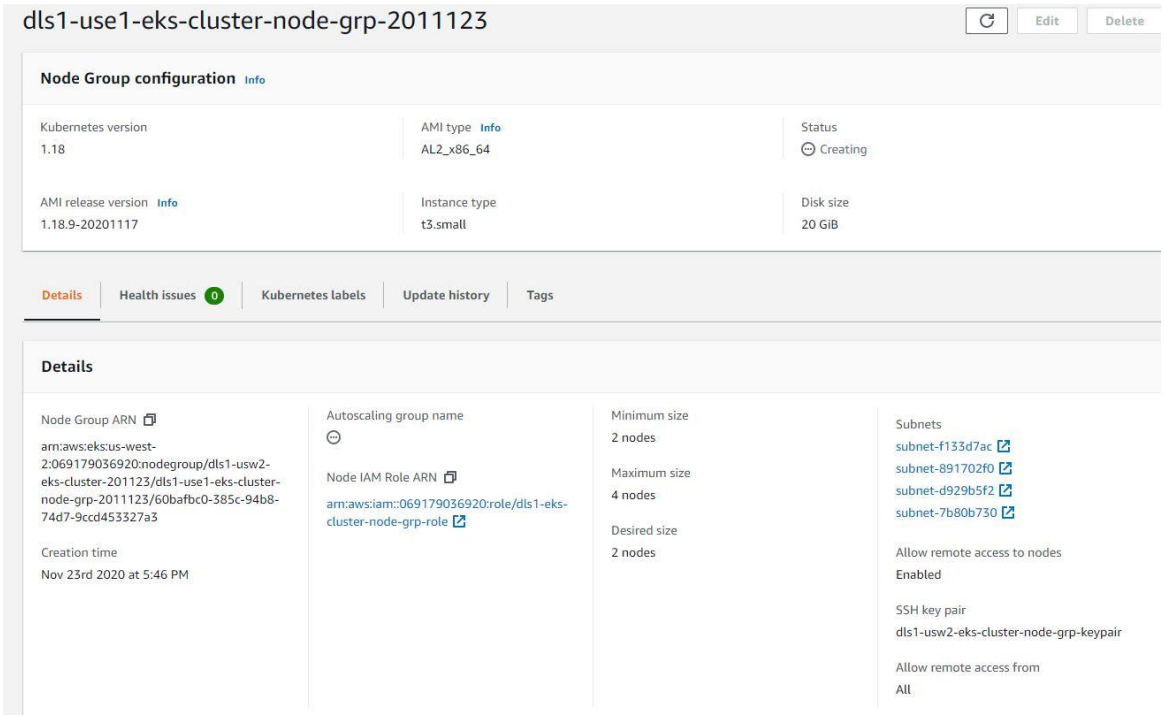
Screen 6 – Review and create



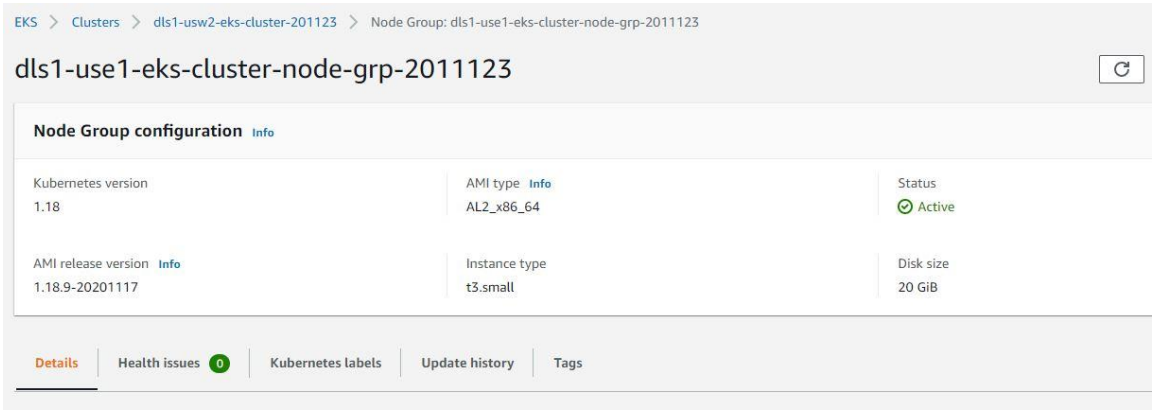
Screen 7 – Review and create (Continued)



Screen 8 – NG being created



Screen 9 – NG created and active



Verify status of nodes:

```
awsdls1admin@ubun1802:~$ kubectl get nodes --watch
NAME                          STATUS   ROLES    AGE   VERSION
ip-192-168-108-148.ec2.internal   Ready    <none>   63m   v1.17.12-eks-7684af
ip-192-168-138-102.ec2.internal   Ready    <none>   63m   v1.17.12-eks-7684af

awsdls1admin@ubun1802:~$ kubectl get nodes --watch
NAME                                          STATUS   ROLES    AGE    VERSION
ip-172-31-12-3.us-west-2.compute.internal   Ready    <none>   8m55s   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready    <none>   8m57s   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready    <none>   10m     v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready    <none>   10m     v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready    <none>   15m     v1.18.9-eks-d1db3c
```

```
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   15m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   20m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   20m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   25m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   25m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   30m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   30m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   35m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   35m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   40m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   40m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   45m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   45m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   50m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   50m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   55m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   55m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   60m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   60m   v1.18.9-eks-d1db3c
ip-172-31-41-3.us-west-2.compute.internal   Ready   <none>   65m   v1.18.9-eks-d1db3c
ip-172-31-12-3.us-west-2.compute.internal   Ready   <none>   65m   v1.18.9-eks-d1db3c
awsdls1admin@ubun1802:~$
```

Running Apps in EKS Cluster

Namespace in Cluster

12. Deploy a sample app (sample-service.yaml)

```
awsdls1admin@ubun1802:~$ kubectl create namespace my-namespace
namespace/my-namespace created
awsdls1admin@ubun1802:~$ kubectl apply -f /tmp/sample-service.yaml
service/my-service created
deployment.apps/my-deployment created
awsdls1admin@ubun1802:~$ kubectl get all -n my-namespace
NAME                             READY   STATUS    RESTARTS   AGE
pod/my-deployment-778b477dd5-bnkk4   1/1     Running   0          36s
pod/my-deployment-778b477dd5-htldg   1/1     Running   0          36s
pod/my-deployment-778b477dd5-stgnp   1/1     Running   0          36s

NAME                 TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)   AGE
service/my-service   ClusterIP   10.100.17.218   <none>        80/TCP    36s

NAME                            READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/my-deployment   3/3     3            3           36s
```

```
NAME                                DESIRED   CURRENT   READY   AGE
replicaset.apps/my-deployment-778b477dd5   3         3         3       37s
awsdls1admin@ubun1802:~$ kubectl -n my-namespace describe service my-service
Name:              my-service
Namespace:         my-namespace
Labels:            app=my-app
Annotations:       kubectl.kubernetes.io/last-applied-configuration:

{"apiVersion":"v1","kind":"Service","metadata":{"annotations":{},"labels":{"app":"my-
app"},"name":"my-service","namespace":"my-namespace"}...
Selector:          app=my-app
Type:              ClusterIP
IP:                10.100.17.218
Port:              <unset>  80/TCP
TargetPort:        80/TCP
Endpoints:         172.31.11.65:80,172.31.13.32:80,172.31.46.245:80
Session Affinity:  None
Events:            <none>
awsdls1admin@ubun1802:~$
```

In this step, a name space “my-service” was create before deploying a sample app to it
After the sample app was deployed, K8 runs it in three pods per “replica=3” in deployment YAML specification. See **Appendix B** for details.
Each pod has its own endpoint. Three pods, therefore, yielded three endpoints, via which pods interface with outside world. Each endpoint includes an IP address and a port number. K8 resolves the pod name to its endpoint by DNS

kubectl get all -n my-namespace displays pod names, sorted by name. See below

```
awsdls1admin@ubun1802:~$ kubectl get all -n my-namespace
NAME                                READY   STATUS    RESTARTS   AGE
pod/my-deployment-778b477dd5-bnkk4  1/1     Running   0          36s
pod/my-deployment-778b477dd5-htldg  1/1     Running   0          36s
pod/my-deployment-778b477dd5-stgnp  1/1     Running   0          36s
…
awsdls1admin@ubun1802:~$
```

kubectl -n my-namespace describe service my-service | grep Endpoints displays pod endpoints in one line, ordered by IP address. See below

```
awsdls1admin@ubun1802:~$ kubectl -n my-namespace describe service my-service | grep
Endpoints
Endpoints:         172.31.11.65:80,172.31.13.32:80,172.31.46.245:80
awsdls1admin@ubun1802:~$
```

Pod names and their endpoints do not match in their respective display order, though both are in ascending order, because Pod IP was assigned randomly. See Table 2 below

Table 2 – Sample app pod names and endpoints

POD Name	Endpoint	Node
my-deployment-778b477dd5-bnkk4	172.31.46.245	172.31.41.3
my-deployment-778b477dd5-htldg	172.31.11.65	172.31.12.3
my-deployment-778b477dd5-stgnp	172.31.13.32	172.31.12.3

K8 runs two (2) work nodes per Cluster NG specification. See Step 11 Screen 4 Desired nodes = 2. Three pods are distributed to run on the two nodes, two pods ended up running on one same node with IP of **172.31.12.3**. It indicates that K8 load balances pods among work nodes by round-robin algorithm.

Pod details

To show pod details, use command kubectl –n <name space> describe pod <pod name>. See three pod examples below. For easy identification, the pods are color-coded in red, green, and blue.

Pod in red

awsdls1admin@ubun1802:~$ kubectl -n my-namespace describe pod my-deployment-778b477dd5-bnkk4
Name: my-deployment-778b477dd5-bnkk4
Namespace: my-namespace
Priority: 0
Node: ip-172-31-41-3.us-west-2.compute.internal/172.31.41.3
Start Time: Tue, 24 Nov 2020 01:56:48 +0000
Labels: app=my-app
pod-template-hash=778b477dd5
Annotations: kubernetes.io/psp: eks.privileged
Status: Running
IP: 172.31.46.245
IPs:
IP: 172.31.46.245
Controlled By: ReplicaSet/my-deployment-778b477dd5
Containers:
nginx:
Container ID: docker://0568f8a86074015b5d18590b8a1734311a83c430b0eb8863759f3053ae4217ca
Image: nginx:1.19.2
Image ID: docker-pullable://nginx@sha256:c628b67d21744fce822d22fdcc0389f6bd763daac23a6b77147d0712ea7102d0
Port: 80/TCP
Host Port: 0/TCP
State: Running
Started: Tue, 24 Nov 2020 01:56:54 +0000
Ready: True

```
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-hthcw (ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
  default-token-hthcw:
    Type:       Secret (a volume populated by a Secret)
    SecretName:  default-token-hthcw
    Optional:   false
QoS Class:       BestEffort
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  2m24s  default-scheduler                           Successfully assigned my-
namespace/my-deployment-778b477dd5-bnkk4 to ip-172-31-41-3.us-west-2.compute.internal
  Normal  Pulling    2m23s  kubelet, ip-172-31-41-3.us-west-2.compute.internal  Pulling image
"nginx:1.19.2"
  Normal  Pulled     2m18s  kubelet, ip-172-31-41-3.us-west-2.compute.internal  Successfully
pulled image "nginx:1.19.2"
  Normal  Created    2m18s  kubelet, ip-172-31-41-3.us-west-2.compute.internal  Created
container nginx
  Normal  Started    2m18s  kubelet, ip-172-31-41-3.us-west-2.compute.internal  Started
container nginx
```

Pod in green

```
awsdls1admin@ubun1802:~$ kubectl -n my-namespace describe pod my-deployment-
778b477dd5-htldg
Name:         my-deployment-778b477dd5-htldg
Namespace:    my-namespace
Priority:     0
Node:         ip-172-31-12-3.us-west-2.compute.internal/172.31.12.3
Start Time:   Tue, 24 Nov 2020 01:56:48 +0000
Labels:       app=my-app
              pod-template-hash=778b477dd5
Annotations:  kubernetes.io/psp: eks.privileged
Status:       Running
IP:           172.31.11.65
IPs:
  IP:         172.31.11.65
```

```
Controlled By:  ReplicaSet/my-deployment-778b477dd5
Containers:
  nginx:
    Container ID:
docker://6e67e40d5a72c8e1a080767473decc43eedfb604e5d9d9aea98d137a1127f301
    Image:         nginx:1.19.2
    Image ID:      docker-
pullable://nginx@sha256:c628b67d21744fce822d22fdcc0389f6bd763daac23a6b77147d0712ea
7102d0
    Port:          80/TCP
    Host Port:     0/TCP
    State:         Running
      Started:     Tue, 24 Nov 2020 01:56:55 +0000
    Ready:         True
    Restart Count:  0
    Environment:   <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-hthcw (ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
  default-token-hthcw:
    Type:       Secret (a volume populated by a Secret)
    SecretName:  default-token-hthcw
    Optional:   false
QoS Class:      BestEffort
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  3m4s   default-scheduler                   Successfully assigned my-
namespace/my-deployment-778b477dd5-htldg to ip-172-31-12-3.us-west-2.compute.internal
  Normal  Pulling    3m2s   kubelet, ip-172-31-12-3.us-west-2.compute.internal  Pulling image
"nginx:1.19.2"
  Normal  Pulled     2m58s  kubelet, ip-172-31-12-3.us-west-2.compute.internal  Successfully
pulled image "nginx:1.19.2"
  Normal  Created    2m57s  kubelet, ip-172-31-12-3.us-west-2.compute.internal  Created
container nginx
  Normal  Started    2m57s  kubelet, ip-172-31-12-3.us-west-2.compute.internal  Started
container nginx
```

Pod in blue

```
awsdls1admin@ubun1802:~$ kubectl -n my-namespace describe pod my-deployment-778b477dd5-stgnp
Name:         my-deployment-778b477dd5-stgnp
Namespace:    my-namespace
Priority:     0
Node:         ip-172-31-12-3.us-west-2.compute.internal/172.31.12.3
Start Time:   Tue, 24 Nov 2020 01:56:48 +0000
Labels:       app=my-app
              pod-template-hash=778b477dd5
Annotations:  kubernetes.io/psp: eks.privileged
Status:       Running
IP:           172.31.13.32
IPs:
  IP:         172.31.13.32
Controlled By:  ReplicaSet/my-deployment-778b477dd5
Containers:
  nginx:
    Container ID:  docker://4f8be18e7c20d03f6b5eb39e28daa41a37ebbc67f38f02e7976f68874d9ae4b6
    Image:         nginx:1.19.2
    Image ID:      docker-pullable://nginx@sha256:c628b67d21744fce822d22fdcc0389f6bd763daac23a6b77147d0712ea7102d0
    Port:          80/TCP
    Host Port:     0/TCP
    State:         Running
      Started:     Tue, 24 Nov 2020 01:56:55 +0000
    Ready:         True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-hthcw (ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
  default-token-hthcw:
    Type:       Secret (a volume populated by a Secret)
    SecretName:  default-token-hthcw
    Optional:    false
QoS Class:       BestEffort
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  4m24s  default-scheduler                           Successfully assigned my-
namespace/my-deployment-778b477dd5-stgnp to ip-172-31-12-3.us-west-2.compute.internal
  Normal  Pulling    4m23s  kubelet, ip-172-31-12-3.us-west-2.compute.internal  Pulling image
"nginx:1.19.2"
  Normal  Pulled     4m18s  kubelet, ip-172-31-12-3.us-west-2.compute.internal  Successfully
pulled image "nginx:1.19.2"
  Normal  Created    4m17s  kubelet, ip-172-31-12-3.us-west-2.compute.internal  Created
container nginx
  Normal  Started    4m17s  kubelet, ip-172-31-12-3.us-west-2.compute.internal  Started
container nginx
awsdls1admin@ubun1802:~$
```

Accessing Pod

Since the sample app is a Linux based docker image, you can access each pod BASH Shell by the following command

```
awsdls1admin@ubun1802:~$ kubectl exec -it my-deployment-778b477dd5-bnkk4 -n my-
namespace -- /bin/bash
root@my-deployment-778b477dd5-bnkk4:/# cat /etc/hosts
# Kubernetes-managed hosts file.
127.0.0.1       localhost
::1     localhost ip6-localhost ip6-loopback
fe00::0 ip6-localnet
fe00::0 ip6-mcastprefix
fe00::1 ip6-allnodes
fe00::2 ip6-allrouters
172.31.46.245   my-deployment-778b477dd5-bnkk4
root@my-deployment-778b477dd5-bnkk4:/# exit
exit
command terminated with exit code 127

awsdls1admin@ubun1802:~$ kubectl exec -it my-deployment-778b477dd5-htldg -n my-
namespace -- /bin/bash
root@my-deployment-778b477dd5-htldg:/# cat /etc/hosts
# Kubernetes-managed hosts file.
127.0.0.1       localhost
::1     localhost ip6-localhost ip6-loopback
fe00::0 ip6-localnet
fe00::0 ip6-mcastprefix
fe00::1 ip6-allnodes
fe00::2 ip6-allrouters
172.31.11.65    my-deployment-778b477dd5-htldg
```

```
root@my-deployment-778b477dd5-htldg:/# exit
exit

awsdls1admin@ubun1802:~$ kubectl exec -it my-deployment-778b477dd5-stgnp -n my-
namespace -- /bin/bash
root@my-deployment-778b477dd5-stgnp:/# cat /etc/hosts
# Kubernetes-managed hosts file.
127.0.0.1       localhost
::1     localhost ip6-localhost ip6-loopback
fe00::0 ip6-localnet
fe00::0 ip6-mcastprefix
fe00::1 ip6-allnodes
fe00::2 ip6-allrouters
172.31.13.32    my-deployment-778b477dd5-stgnp
root@my-deployment-778b477dd5-stgnp:/# exit
exit
awsdls1admin@ubun1802:~$
```

Cluster networking

(Details to be added in future revision(s)

Removing EKS Cluster

13. **Remove sample app namespace**

```
awsdls1admin@ubun1802:~$ kubectl delete namespace my-namespace
namespace "my-namespace" deleted
awsdls1admin@ubun1802:~$
```

14. **Delete cluster node group (in cluster)**

    In EKS Console, select Cluster dls1-usw2-eks-cluster-vpc-201123
    In Cluster, select NG dls1-use1-eks-cluster-node-grp-2011123
    In Console, delete NG

15. **Delete cluster**

    In EKS Console, select Cluster dls1-usw2-eks-cluster-201123
    Delete Cluster

16. **Delete cluster VPC (by CloudFormation stack)**

    In CloudFormation Console, select Stack dls1-usw2-eks-cluster-vpc-201123
    Delete Stack

Summary

This write-up introduced and described three phases of using AWS EKS.

Phase 1 – Getting ready to create EKS cluster
Phase 2 – Creating and running EKS cluster
Phase 3 – Removing the EKS cluster (optional)

EKS cluster creation requires a VPC (Virtual Private Cloud) for it to be deployed to. The VPC needs to have at least two subnets. Those subnets can be all private or public. In this walk-through an AWS provided CloudFormation template was used to create that VPC with 2 public subnets and 2 private subnets in it. The template is listed in its entirety in Appendix A.

After cluster creation, containerized apps can be deployed to the cluster. The cluster launches and runs apps distributing the workload over the entire cluster automatically for you.

A small Nginx web server app was used in this walk-through. Its deployment was specified the app's YAML configuration file. According the YAML file, EKS cluster will launch three instances of app called pods. Those pods run simultaneously in the cluster. Should one pod fail, the cluster detects it and compensates for it by launching another pod, again, automatically for you. This way your cluster provides you with not only load-balancing but also high availability. The app's YAML file is listed in its entirely in Appendix B.

Details of the following are not discussed in this version of write-up. They will be added in future revisions.

1. How to grant enough permissions to an IAM user to create and manage EKS clusters
2. How to set up a Linux workstation to interact with EKS using AWS CLI
3. How to set up a Windows workstation to interact with EKS using AWS CLI
4. How to set up ECR (AWS Elastic Container Registry) for EKS to use

Author of this write-up always welcomes your feedback.
Please direct your questions and/or comments to Tony Shen at tony.shen@datacommlabs.com

Appendix A - EKS Cluster VPC CloudFormation Template

```
---
AWSTemplateFormatVersion: '2010-09-09'
Description: 'Amazon EKS Sample VPC - Private and Public subnets'

Parameters:

  VpcBlock:
    Type: String
    Default: 192.168.0.0/16
    Description: The CIDR range for the VPC. This should be a valid private (RFC 1918) CIDR range.

  PublicSubnet01Block:
    Type: String
    Default: 192.168.0.0/18
    Description: CidrBlock for public subnet 01 within the VPC

  PublicSubnet02Block:
    Type: String
    Default: 192.168.64.0/18
    Description: CidrBlock for public subnet 02 within the VPC

  PrivateSubnet01Block:
    Type: String
    Default: 192.168.128.0/18
    Description: CidrBlock for private subnet 01 within the VPC

  PrivateSubnet02Block:
    Type: String
    Default: 192.168.192.0/18
    Description: CidrBlock for private subnet 02 within the VPC

Metadata:
  AWS::CloudFormation::Interface:
    ParameterGroups:
      -
        Label:
          default: "Worker Network Configuration"
        Parameters:
          - VpcBlock
          - PublicSubnet01Block
          - PublicSubnet02Block
          - PrivateSubnet01Block
          - PrivateSubnet02Block

Resources:
  VPC:
```

```
  Type: AWS::EC2::VPC
  Properties:
    CidrBlock:  !Ref VpcBlock
    EnableDnsSupport: true
    EnableDnsHostnames: true
    Tags:
    - Key: Name
      Value: !Sub '${AWS::StackName}-VPC'

InternetGateway:
  Type: "AWS::EC2::InternetGateway"

VPCGatewayAttachment:
  Type: "AWS::EC2::VPCGatewayAttachment"
  Properties:
    InternetGatewayId: !Ref InternetGateway
    VpcId: !Ref VPC

PublicRouteTable:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
    Tags:
    - Key: Name
      Value: Public Subnets
    - Key: Network
      Value: Public

PrivateRouteTable01:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
    Tags:
    - Key: Name
      Value: Private Subnet AZ1
    - Key: Network
      Value: Private01

PrivateRouteTable02:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref VPC
    Tags:
    - Key: Name
      Value: Private Subnet AZ2
    - Key: Network
      Value: Private02
```

```
PublicRoute:
  DependsOn: VPCGatewayAttachment
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PublicRouteTable
    DestinationCidrBlock: 0.0.0.0/0
    GatewayId: !Ref InternetGateway

PrivateRoute01:
  DependsOn:
  - VPCGatewayAttachment
  - NatGateway01
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PrivateRouteTable01
    DestinationCidrBlock: 0.0.0.0/0
    NatGatewayId: !Ref NatGateway01

PrivateRoute02:
  DependsOn:
  - VPCGatewayAttachment
  - NatGateway02
  Type: AWS::EC2::Route
  Properties:
    RouteTableId: !Ref PrivateRouteTable02
    DestinationCidrBlock: 0.0.0.0/0
    NatGatewayId: !Ref NatGateway02

NatGateway01:
  DependsOn:
  - NatGatewayEIP1
  - PublicSubnet01
  - VPCGatewayAttachment
  Type: AWS::EC2::NatGateway
  Properties:
    AllocationId: !GetAtt 'NatGatewayEIP1.AllocationId'
    SubnetId: !Ref PublicSubnet01
    Tags:
    - Key: Name
      Value: !Sub '${AWS::StackName}-NatGatewayAZ1'

NatGateway02:
  DependsOn:
  - NatGatewayEIP2
  - PublicSubnet02
  - VPCGatewayAttachment
  Type: AWS::EC2::NatGateway
  Properties:
```

```
    AllocationId: !GetAtt 'NatGatewayEIP2.AllocationId'
    SubnetId: !Ref PublicSubnet02
    Tags:
    - Key: Name
      Value: !Sub '${AWS::StackName}-NatGatewayAZ2'

NatGatewayEIP1:
  DependsOn:
  - VPCGatewayAttachment
  Type: 'AWS::EC2::EIP'
  Properties:
    Domain: vpc

NatGatewayEIP2:
  DependsOn:
  - VPCGatewayAttachment
  Type: 'AWS::EC2::EIP'
  Properties:
    Domain: vpc

PublicSubnet01:
  Type: AWS::EC2::Subnet
  Metadata:
    Comment: Subnet 01
  Properties:
    MapPublicIpOnLaunch: true
    AvailabilityZone:
      Fn::Select:
      - '0'
      - Fn::GetAZs:
          Ref: AWS::Region
    CidrBlock:
      Ref: PublicSubnet01Block
    VpcId:
      Ref: VPC
    Tags:
    - Key: Name
      Value: !Sub "${AWS::StackName}-PublicSubnet01"
    - Key: kubernetes.io/role/elb
      Value: 1

PublicSubnet02:
  Type: AWS::EC2::Subnet
  Metadata:
    Comment: Subnet 02
  Properties:
    MapPublicIpOnLaunch: true
    AvailabilityZone:
```

```
      Fn::Select:
      - '1'
      - Fn::GetAZs:
          Ref: AWS::Region
    CidrBlock:
      Ref: PublicSubnet02Block
    VpcId:
      Ref: VPC
    Tags:
    - Key: Name
      Value: !Sub "${AWS::StackName}-PublicSubnet02"
    - Key: kubernetes.io/role/elb
      Value: 1

PrivateSubnet01:
  Type: AWS::EC2::Subnet
  Metadata:
    Comment: Subnet 03
  Properties:
    AvailabilityZone:
      Fn::Select:
      - '0'
      - Fn::GetAZs:
          Ref: AWS::Region
    CidrBlock:
      Ref: PrivateSubnet01Block
    VpcId:
      Ref: VPC
    Tags:
    - Key: Name
      Value: !Sub "${AWS::StackName}-PrivateSubnet01"
    - Key: kubernetes.io/role/internal-elb
      Value: 1

PrivateSubnet02:
  Type: AWS::EC2::Subnet
  Metadata:
    Comment: Private Subnet 02
  Properties:
    AvailabilityZone:
      Fn::Select:
      - '1'
      - Fn::GetAZs:
          Ref: AWS::Region
    CidrBlock:
      Ref: PrivateSubnet02Block
    VpcId:
      Ref: VPC
```

```
      Tags:
      - Key: Name
        Value: !Sub "${AWS::StackName}-PrivateSubnet02"
      - Key: kubernetes.io/role/internal-elb
        Value: 1

  PublicSubnet01RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PublicSubnet01
      RouteTableId: !Ref PublicRouteTable

  PublicSubnet02RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PublicSubnet02
      RouteTableId: !Ref PublicRouteTable

  PrivateSubnet01RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PrivateSubnet01
      RouteTableId: !Ref PrivateRouteTable01

  PrivateSubnet02RouteTableAssociation:
    Type: AWS::EC2::SubnetRouteTableAssociation
    Properties:
      SubnetId: !Ref PrivateSubnet02
      RouteTableId: !Ref PrivateRouteTable02

  ControlPlaneSecurityGroup:
    Type: AWS::EC2::SecurityGroup
    Properties:
      GroupDescription: Cluster communication with worker nodes
      VpcId: !Ref VPC

Outputs:

  SubnetIds:
    Description: Subnets IDs in the VPC
    Value: !Join [ ",", [ !Ref PublicSubnet01, !Ref PublicSubnet02, !Ref PrivateSubnet01, !Ref
PrivateSubnet02 ] ]

  SecurityGroups:
    Description: Security group for the cluster control plane communication with worker nodes
    Value: !Join [ ",", [ !Ref ControlPlaneSecurityGroup ] ]

  VpcId:
```

```
  Description: The VPC Id
  Value: !Ref VPC
```

Appendix B – Container deployment YAML

```
apiVersion: v1
kind: Service
metadata:
  name: my-service
  namespace: my-namespace
  labels:
    app: my-app
spec:
  selector:
    app: my-app
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
---
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-deployment
  namespace: my-namespace
  labels:
    app: my-app
spec:
  replicas: 3
  selector:
    matchLabels:
      app: my-app
  template:
    metadata:
      labels:
        app: my-app
    spec:
      affinity:
        nodeAffinity:
          requiredDuringSchedulingIgnoredDuringExecution:
            nodeSelectorTerms:
            - matchExpressions:
              - key: beta.kubernetes.io/arch
                operator: In
```

```
        values:
        - amd64
    containers:
    - name: nginx
      image: nginx:1.19.2
      ports:
      - containerPort: 80
```

Appendix C – Installing helm

```
awsdls1admin@ubun1802:~$ curl
https://raw.githubusercontent.com/helm/helm/master/scripts/get-helm-3 > get_helm.sh
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 11391  100 11391    0     0  62245      0 --:--:-- --:--:-- --:--:-- 62245
awsdls1admin@ubun1802:~$ chmod 700 get_helm.sh
awsdls1admin@ubun1802:~$ ./get_helm.sh
Downloading https://get.helm.sh/helm-v3.4.1-linux-amd64.tar.gz
Verifying checksum... Done.
Preparing to install helm into /usr/local/bin
helm installed into /usr/local/bin/helm
awsdls1admin@ubun1802:~$ which helm
/usr/local/bin/helm
awsdls1admin@ubun1802:~$ helm help
The Kubernetes package manager

Common actions for Helm:

- helm search:    search for charts
- helm pull:      download a chart to your local directory to view
- helm install:   upload the chart to Kubernetes
- helm list:      list releases of charts

Environment variables:

| Name                         | Description                                                                                  |
|------------------------------|----------------------------------------------------------------------------------------------|
| $HELM_CACHE_HOME             | set an alternative location for storing cached files.
|
| $HELM_CONFIG_HOME            | set an alternative location for storing Helm configuration.
|
| $HELM_DATA_HOME              | set an alternative location for storing Helm data.
|
```

$HELM_DEBUG	indicate whether or not Helm is running in Debug mode
$HELM_DRIVER	set the backend storage driver. Values are: configmap, secret, memory, postgres
$HELM_DRIVER_SQL_CONNECTION_STRING	set the connection string the SQL storage driver should use.
$HELM_MAX_HISTORY	set the maximum number of helm release history.
$HELM_NAMESPACE	set the namespace used for the helm operations.
$HELM_NO_PLUGINS	disable plugins. Set HELM_NO_PLUGINS=1 to disable plugins.
$HELM_PLUGINS	set the path to the plugins directory
$HELM_REGISTRY_CONFIG	set the path to the registry config file.
$HELM_REPOSITORY_CACHE	set the path to the repository cache directory
$HELM_REPOSITORY_CONFIG	set the path to the repositories file.
$KUBECONFIG	set an alternative Kubernetes configuration file (default "~/.kube/config")
$HELM_KUBEAPISERVER	set the Kubernetes API Server Endpoint for authentication
$HELM_KUBEASGROUPS	set the Groups to use for impersonation using a comma-separated list.
$HELM_KUBEASUSER	set the Username to impersonate for the operation.
$HELM_KUBECONTEXT	set the name of the kubeconfig context.
$HELM_KUBETOKEN	set the Bearer KubeToken used for authentication.

Helm stores cache, configuration, and data based on the following configuration order:

- If a HELM_*_HOME environment variable is set, it will be used
- Otherwise, on systems supporting the XDG base directory specification, the XDG variables will be used
- When no other location is set a default location will be used based on the operating system

By default, the default directories depend on the Operating System. The defaults are listed below:

Operating System	Cache Path	Configuration Path	Data Path

Linux	$HOME/.cache/helm	$HOME/.config/helm	$HOME/.local/share/helm
macOS	$HOME/Library/Caches/helm	$HOME/Library/Preferences/helm	$HOME/Library/helm
Windows	%TEMP%\helm	%APPDATA%\helm	%APPDATA%\helm

Usage:
  helm [command]

Available Commands:
  completion generate autocompletions script for the specified shell
  create   create a new chart with the given name
  dependency manage a chart's dependencies
  env   helm client environment information
  get   download extended information of a named release
  help   Help about any command
  history   fetch release history
  install   install a chart
  lint   examine a chart for possible issues
  list   list releases
  package   package a chart directory into a chart archive
  plugin   install, list, or uninstall Helm plugins
  pull   download a chart from a repository and (optionally) unpack it in local directory
  repo   add, list, remove, update, and index chart repositories
  rollback   roll back a release to a previous revision
  search   search for a keyword in charts
  show   show information of a chart
  status   display the status of the named release
  template   locally render templates
  test   run tests for a release
  uninstall   uninstall a release
  upgrade   upgrade a release
  verify   verify that a chart at the given path has been signed and is valid
  version   print the client version information

Flags:
      --debug   enable verbose output
  -h, --help   help for helm
      --kube-apiserver string   the address and the port for the Kubernetes API server
      --kube-as-group stringArray   Group to impersonate for the operation, this flag can be repeated to specify multiple groups.
      --kube-as-user string   Username to impersonate for the operation
      --kube-context string   name of the kubeconfig context to use

```
    --kube-token string          bearer token used for authentication
    --kubeconfig string          path to the kubeconfig file
 -n, --namespace string          namespace scope for this request
    --registry-config string     path to the registry config file (default
"/home/awsdls1admin/.config/helm/registry.json")
    --repository-cache string    path to the file containing cached repository indexes (default
"/home/awsdls1admin/.cache/helm/repository")
    --repository-config string   path to the file containing repository names and URLs (default
"/home/awsdls1admin/.config/helm/repositories.yaml")

Use "helm [command] --help" for more information about a command.
awsdls1admin@ubun1802:~$
```

Appendix D – Installing metrics server for Prometheus

```
awsdls1admin@ubun1802:~$ kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/download/v0.3.6/components.yaml
awsdls1admin@ubun1802:~$ kubectl get deployment metrics-server -n kube-system
awsdls1admin@ubun1802:~$ kubectl get --raw /metrics
awsdls1admin@ubun1802:~$ kubectl create namespace Prometheus
awsdls1admin@ubun1802:~$ helm repo add stable https://charts.helm.sh/stable
awsdls1admin@ubun1802:~$ helm install prometheus stable/prometheus --namespace
prometheus --set
alertmanager.persistentVolume.storageClass="gp2",server.persistentVolume.storageClass="gp
2"
awsdls1admin@ubun1802:~$ kubectl get pods -n prometheus
NAME                                             READY   STATUS    RESTARTS   AGE
prometheus-alertmanager-6b64586d49-csvdr         2/2     Running   0          28m
prometheus-kube-state-metrics-c65b87574-4vrl8    1/1     Running   0          28m
prometheus-node-exporter-8ghb8                   1/1     Running   0          28m
prometheus-node-exporter-n589n                   1/1     Running   0          28m
prometheus-pushgateway-7d5f5746c7-jl68m          1/1     Running   0          28m
prometheus-server-f8d46859b-grppr                2/2     Running   0          28m
awsdls1admin@ubun1802:~$ sudo ufw allow 9090
awsdls1admin@ubun1802:~$ kubectl --namespace=prometheus port-forward
deploy/prometheus-server 9090
```

References

AWS Documentation Index Page
Kubernetes Cluster Networking

RESTful API