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What is EKS

- AWS EKS is a `Managed Kubernetes Service` from Amazon, which means AWS manages the Master Nodes.
- All the necessary applications/services are already pre-installed like the container runtime or master processes and in addition it also takes care of scaling and backups.
- You only create the Worker Nodes.

Steps to create EKS

- To create a K8s cluster in EKS you need to do following steps:
- Create a VPC
- Create an IAM role with Security Group (or in other words: create AWS user with list of permissions)
- Create Cluster Control Plane - Master Nodes
  - choose basic information like cluster name and k8s version
  - choose region and VPC for your cluster
  - set security
- Create Worker Nodes and connect to cluster
  - The Worker Nodes are some EC2 instances with CPU and storage resources.
  - Create as a Node Group
  - Choose cluster it will attach to
  - Define Security Group, select instance type etc.

> With `NodeGroup` you have autoscaling, depending on how much load the cluster has new Worker Nodes will automatically added or removed in the cluster.

EKSCTL CLI

- Execute below commands in either one of the below options:

  - AWS CloudShell (Uses AWS Console Login IAM Credentials)
  - Local Linux Machine (Uses IAM User Credentials configured)
  - Amazon EC2 Linux Machine (Uses AWS IAM Role Permissions)

- Download the `eksctl` on your machine linux cli

```
curl --silent --location
"https://github.com/weaveworks/eksctl/releases/latest/download/eksctl_$(uname -
s)_amd64.tar.gz" | tar xz -C /tmp
sudo mv /tmp/eksctl /usr/local/bin
```

- The IAM account used for EKS cluster creation should have these minimal access levels.

AWS Service	Access Level
CloudFormation	Full Access
EC2	**Full:** Tagging **Limited:** List, Read, Write
EC2 Auto Scaling	**Limited:** List, Write
EKS	Full Access
IAM	**Limited:** List, Read, Write, Permissions Management
Systems Manager	**Limited:** List, Read

- Command to create EKS Cluster

```
eksctl create cluster \
--name test-eks-cluster \
--version 1.21 \
--region ap-south-1 \
--nodegroup-name eks-worker-nodegroup \
--node-type t2.micro \
--nodes 2

#####OUTPUT#######
2022-01-26 01:53:53 [ℹ]  eksctl version 0.80.0
2022-01-26 01:53:53 [ℹ]  using region ap-south-1
2022-01-26 01:53:54 [ℹ]  setting availability zones to [ap-south-1b ap-south-1a
ap-south-1c]
2022-01-26 01:53:54 [ℹ]  subnets for ap-south-1b - public:192.168.0.0/19
private:192.168.96.0/19
2022-01-26 01:53:54 [ℹ]  subnets for ap-south-1a - public:192.168.32.0/19
private:192.168.128.0/19
2022-01-26 01:53:54 [ℹ]  subnets for ap-south-1c - public:192.168.64.0/19
private:192.168.160.0/19
2022-01-26 01:53:54 [ℹ]  nodegroup "ng-2564739d" will use "" [AmazonLinux2/1.21]
2022-01-26 01:53:54 [ℹ]  using Kubernetes version 1.21
2022-01-26 01:53:54 [ℹ]  creating EKS cluster "test-eks-cluster" in "ap-south-1"
region with managed nodes
2022-01-26 01:53:54 [ℹ]  will create 2 separate CloudFormation stacks for cluster
itself and the initial managed nodegroup
2022-01-26 01:53:54 [ℹ]  if you encounter any issues, check CloudFormation
console or try 'eksctl utils describe-stacks --region=ap-south-1 --cluster=test-
```

```
eks-cluster'
2022-01-26 01:53:54 [ℹ]  Kubernetes API endpoint access will use default of
{publicAccess=true, privateAccess=false} for cluster "test-eks-cluster" in "ap-
south-1"
2022-01-26 01:53:54 [ℹ]  CloudWatch logging will not be enabled for cluster
"test-eks-cluster" in "ap-south-1"
2022-01-26 01:53:54 [ℹ]  you can enable it with 'eksctl utils update-cluster-
logging --enable-types={SPECIFY-YOUR-LOG-TYPES-HERE (e.g. all)} --region=ap-south-
1 --cluster=test-eks-cluster'
2022-01-26 01:53:54 [ℹ]
2 sequential tasks: { create cluster control plane "test-eks-cluster",
    2 sequential sub-tasks: {
        wait for control plane to become ready,
        create managed nodegroup "ng-2564739d",
    }
}
2022-01-26 01:53:54 [ℹ]  building cluster stack "eksctl-test-eks-cluster-cluster"
2022-01-26 01:53:55 [ℹ]  deploying stack "eksctl-test-eks-cluster-cluster"
2022-01-26 01:54:25 [ℹ]  waiting for CloudFormation stack "eksctl-test-eks-
cluster-cluster"
#####OUTPUT#######
```

- Install `kubectl` linux utility on your local linux client.

```
curl -o kubectl https://amazon-eks.s3.us-west-2.amazonaws.com/1.21.2/2021-07-
05/bin/linux/amd64/kubectl
chmod +x ./kubectl
mkdir -p $HOME/bin && cp ./kubectl $HOME/bin/kubectl && export
PATH=$PATH:$HOME/bin
echo 'export PATH=$PATH:$HOME/bin' >> ~/.bashrc
```

```
# View the Local kubeconfig file
kubectl config view
# This command shows content inside the ~/.kube/config file
#####OUTPUT#######
apiVersion: v1
clusters:
- cluster:
    certificate-authority-data: DATA+OMITTED
    server: https://00D6914D1CB90D39116178B3A9A2ECA6.yl4.ap-south-
1.eks.amazonaws.com
  name: test-eks-cluster.ap-south-1.eksctl.io
contexts:
- context:
    cluster: test-eks-cluster.ap-south-1.eksctl.io
    user: ansible-user@test-eks-cluster.ap-south-1.eksctl.io
  name: ansible-user@test-eks-cluster.ap-south-1.eksctl.io
current-context: ansible-user@test-eks-cluster.ap-south-1.eksctl.io
```

```
kind: Config
preferences: {}
users:
- name: ansible-user@test-eks-cluster.ap-south-1.eksctl.io
  user:
    exec:
      apiVersion: client.authentication.k8s.io/v1alpha1
      args:
      - eks
      - get-token
      - --cluster-name
      - test-eks-cluster
      - --region
      - ap-south-1
      command: aws
      env:
      - name: AWS_STS_REGIONAL_ENDPOINTS
        value: regional
      provideClusterInfo: false
#####OUTPUT#######
```

> When you create an Amazon EKS cluster, the AWS Identity and Access Management (IAM) entity user or role that creates the cluster, is automatically granted `system:masters` permissions in the cluster's `role-based access control` (RBAC) configuration in the Amazon EKS control plane.This IAM entity doesn't appear in any visible configuration, so make sure to keep track of which IAM entity originally created the cluster.

- Validate the CloudFormation Template Resources created with above command.

Verify Cluster, NodeGroup in EKS Management Console

- Go to Services -> Elastic Kubernetes Service

List Worker Nodes

```
# List EKS clusters
eksctl get cluster

# List NodeGroups in a cluster
eksctl get nodegroup --cluster=<clusterName>

# List Nodes in current kubernetes cluster
kubectl get nodes -o wide

# Our kubectl context should be automatically changed to new cluster
kubectl config view --minify
```

kubectl commands

```
kubectl get pods -n kube-system
```

- Create the Deployment by running the following command:

```
kubectl apply -f https://k8s.io/examples/controllers/nginx-deployment.yaml

[cloudshell-user@ip-10-0-50-112 ~]$ kubectl get events
LAST SEEN   TYPE      REASON              OBJECT
MESSAGE
2m48s       Normal    Scheduled           pod/nginx-deployment-66b6c48dd5-qkst9
Successfully assigned default/nginx-deployment-66b6c48dd5-qkst9 to ip-192-168-21-
139.ap-south-1.compute.internal
2m47s       Normal    Pulling             pod/nginx-deployment-66b6c48dd5-qkst9
Pulling image "nginx:1.14.2"
2m38s       Normal    Pulled              pod/nginx-deployment-66b6c48dd5-qkst9
Successfully pulled image "nginx:1.14.2" in 9.12123707s
2m37s       Normal    Created             pod/nginx-deployment-66b6c48dd5-qkst9
Created container nginx
2m37s       Normal    Started             pod/nginx-deployment-66b6c48dd5-qkst9
Started container nginx
37s         Warning   FailedScheduling    pod/nginx-deployment-66b6c48dd5-x92pj
0/2 nodes are available: 2 Too many pods.
2m48s       Normal    Scheduled           pod/nginx-deployment-66b6c48dd5-zb9bb
Successfully assigned default/nginx-deployment-66b6c48dd5-zb9bb to ip-192-168-46-
56.ap-south-1.compute.internal
2m47s       Normal    Pulling             pod/nginx-deployment-66b6c48dd5-zb9bb
Pulling image "nginx:1.14.2"
2m37s       Normal    Pulled              pod/nginx-deployment-66b6c48dd5-zb9bb
Successfully pulled image "nginx:1.14.2" in 9.470360458s
2m37s       Normal    Created             pod/nginx-deployment-66b6c48dd5-zb9bb
Created container nginx
2m37s       Normal    Started             pod/nginx-deployment-66b6c48dd5-zb9bb
Started container nginx
2m48s       Normal    SuccessfulCreate    replicaset/nginx-deployment-66b6c48dd5
Created pod: nginx-deployment-66b6c48dd5-zb9bb
2m48s       Normal    SuccessfulCreate    replicaset/nginx-deployment-66b6c48dd5
Created pod: nginx-deployment-66b6c48dd5-qkst9
2m48s       Normal    SuccessfulCreate    replicaset/nginx-deployment-66b6c48dd5
Created pod: nginx-deployment-66b6c48dd5-x92pj
2m48s       Normal    ScalingReplicaSet   deployment/nginx-deployment
Scaled up replica set nginx-deployment-66b6c48dd5 to 3

kubectl describe pods -n default > pods.txt
cat pods.txt

Name:         nginx-deployment-66b6c48dd5-qkst9
Namespace:    default
Priority:     0
Node:         ip-192-168-21-139.ap-south-1.compute.internal/192.168.21.139
Start Time:   Wed, 02 Feb 2022 19:29:23 +0000
Labels:       app=nginx
```

```
              pod-template-hash=66b6c48dd5
Annotations:  kubernetes.io/psp: eks.privileged
Status:       Running
IP:           192.168.15.247
IPs:
  IP:           192.168.15.247
Controlled By:  ReplicaSet/nginx-deployment-66b6c48dd5
Containers:
  nginx:
    Container ID:
docker://cb8aaf025035aa3a81d05f1598efbfc945bbe4ae01558a0ee0dee02942f32175
    Image:          nginx:1.14.2
    Image ID:       docker-
pullable://nginx@sha256:f7988fb6c02e0ce69257d9bd9cf37ae20a60f1df7563c3a2a6abe24160
306b8d
    Port:           80/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Wed, 02 Feb 2022 19:29:34 +0000
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-5qrpp
(ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
  kube-api-access-5qrpp:
    Type:                    Projected (a volume that contains injected data from
multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
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
  ----    ------     ----   ----               -------
  Normal  Scheduled  9m3s   default-scheduler  Successfully assigned
default/nginx-deployment-66b6c48dd5-qkst9 to ip-192-168-21-139.ap-south-
1.compute.internal
  Normal  Pulling    9m2s   kubelet            Pulling image "nginx:1.14.2"
  Normal  Pulled     8m53s  kubelet            Successfully pulled image
"nginx:1.14.2" in 9.12123707s
```

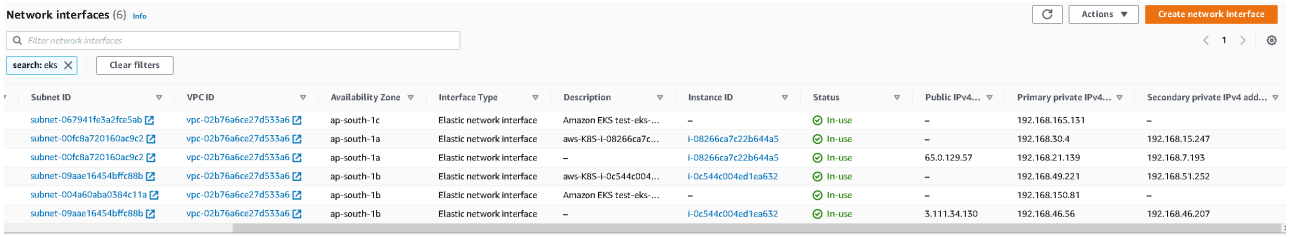
```
  Normal  Created    8m52s  kubelet            Created container nginx
  Normal  Started    8m52s  kubelet            Started container nginx


Name:           nginx-deployment-66b6c48dd5-x92pj
Namespace:      default
Priority:       0
Node:           <none>
Labels:         app=nginx
                pod-template-hash=66b6c48dd5
Annotations:    kubernetes.io/psp: eks.privileged
Status:         Pending
IP:
IPs:            <none>
Controlled By:  ReplicaSet/nginx-deployment-66b6c48dd5
Containers:
  nginx:
    Image:        nginx:1.14.2
    Port:         80/TCP
    Host Port:    0/TCP
    Environment:  <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-x7mxn
(ro)
Conditions:
  Type           Status
  PodScheduled   False
Volumes:
  kube-api-access-x7mxn:
    Type:                     Projected (a volume that contains injected data from
multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
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  52s (x9 over 9m3s)  default-scheduler  0/2 nodes are
available: 2 Too many pods.


Name:         nginx-deployment-66b6c48dd5-zb9bb
Namespace:    default
Priority:     0
Node:         ip-192-168-46-56.ap-south-1.compute.internal/192.168.46.56
Start Time:   Wed, 02 Feb 2022 19:29:23 +0000
Labels:       app=nginx
```

```
              pod-template-hash=66b6c48dd5
Annotations:  kubernetes.io/psp: eks.privileged
Status:       Running
IP:           192.168.51.252
IPs:
  IP:           192.168.51.252
Controlled By:  ReplicaSet/nginx-deployment-66b6c48dd5
Containers:
  nginx:
    Container ID:
docker://9558a069050aba846aa62160509592ebb85dd82d1d90504bc5b03665a0259d47
    Image:          nginx:1.14.2
    Image ID:       docker-
pullable://nginx@sha256:f7988fb6c02e0ce69257d9bd9cf37ae20a60f1df7563c3a2a6abe24160
306b8d
    Port:           80/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Wed, 02 Feb 2022 19:29:34 +0000
    Ready:          True
    Restart Count:  0
    Environment:    <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-tnsxj
(ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
  kube-api-access-tnsxj:
    Type:                    Projected (a volume that contains injected data from
multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
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
  ----    ------     ----   ----               -------
  Normal  Scheduled  9m3s   default-scheduler  Successfully assigned
default/nginx-deployment-66b6c48dd5-zb9bb to ip-192-168-46-56.ap-south-
1.compute.internal
  Normal  Pulling    9m2s   kubelet            Pulling image "nginx:1.14.2"
  Normal  Pulled     8m52s  kubelet            Successfully pulled image
"nginx:1.14.2" in 9.470360458s
```

```
  Normal  Created    8m52s  kubelet            Created container nginx
  Normal  Started    8m52s  kubelet            Started container nginx
```

- The above command shows pods details where the pod gets an IP from ENI in the Subnet.
- 

- AWS EKS supports native VPC networking with the Amazon VPC Container Network Interface (CNI) plugin for Kubernetes.
- Using this plugin allows Kubernetes Pods to have the same IP address inside the pod as they do on the VPC network.
- For more information, see amazon-vpc-cni-k8s and Proposal: CNI plugin for Kubernetes networking over AWS VPC on GitHub.
- The Amazon VPC CNI plugin is fully supported for use on Amazon EKS and self-managed Kubernetes clusters on AWS.
- Refer the ENI Limit as per Instance Type : https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-eni.html#AvailableIpPerENI
    - The formula for defining the maximum number of Pods per EC2 Node instance is as follows:
        - `N * (M-1) + 2`
            - `N` is the number of Elastic Network Interfaces (ENI) of the instance type
            - `M` is the number of IP addresses per ENI.
        - For e.g. **t2.micro** instance, this calculation is 2 * (2-1) + 2 = 4 Pods
- Use below command to get details on same:

```
aws ec2 describe-instance-types --filters "Name=instance-type,Values=t2.*" --query
"InstanceTypes[].{Type: InstanceType, MaxENI:
NetworkInfo.MaximumNetworkInterfaces, IPv4addr:
NetworkInfo.Ipv4AddressesPerInterface}" --output table
-------------------------------------
|        DescribeInstanceTypes       |
+----------+----------+--------------+
| IPv4addr | MaxENI   |    Type      |
+----------+----------+--------------+
|  15      |  3       |  t2.2xlarge  |
|  2       |  2       |  t2.micro    |
|  12      |  3       |  t2.large    |
|  15      |  3       |  t2.xlarge   |
|  4       |  3       |  t2.small    |
|  2       |  2       |  t2.nano     |
|  6       |  3       |  t2.medium   |
```

```
+----------+----------+--------------+

kubectl get pods --all-namespaces -o wide
kubectl get pods --all-namespaces -o wide | grep -i running
[cloudshell-user@ip-10-0-50-112 ~]$ kubectl get pods --all-namespaces -o wide |
grep -i running
default       nginx-deployment-66b6c48dd5-qkst9  1/1     Running   0  38m
192.168.15.247 ip-192-168-21-139.ap-south-1.compute.internal
default       nginx-deployment-66b6c48dd5-zb9bb  1/1     Running   0  38m
192.168.51.252 ip-192-168-46-56.ap-south-1.compute.internal
kube-system   aws-node-jls58                     1/1     Running   0  125m
192.168.46.56  ip-192-168-46-56.ap-south-1.compute.internal
kube-system   aws-node-tmwl2                     1/1     Running   0  125m
192.168.21.139 ip-192-168-21-139.ap-south-1.compute.internal
kube-system   coredns-7f95bc96cc-dl6dn           1/1     Running   0  135m
192.168.46.207 ip-192-168-46-56.ap-south-1.compute.internal
kube-system   coredns-7f95bc96cc-fj56b           1/1     Running   0  135m
192.168.7.193  ip-192-168-21-139.ap-south-1.compute.internal
kube-system   kube-proxy-dqlph                   1/1     Running   0  125m
192.168.21.139 ip-192-168-21-139.ap-south-1.compute.internal
kube-system   kube-proxy-xlpfk                   1/1     Running   0  125m
192.168.46.56  ip-192-168-46-56.ap-south-1.compute.internal
[cloudshell-user@ip-10-0-50-112 ~]$
```

- Delete the cluster using

```
eksctl delete cluster --name test-eks-cluster
```

Reference

- EKS Cost Optimization
- Kubernetes instance calculator

EKS Cluster Pricing

- EKS is not free (Unlike other AWS Services), In short, no free-tier for EKS.

EKS Cluster Pricing

- Below is the EKS Cluster Pricing:
  - $0.10/hour
  - $2.4/day
  - $72/month

EKS Worker Nodes Pricing-EC2

- You pay for AWS resources (e.g. EC2 instances or EBS volumes)
- T3 Medium Server in N.Virginia
  - $0.0416 per Hour

    - Per Day: $0.9984 - Approximately $1
    - Per Month: $30 per 1 t3.medium server
- Reference: https://aws.amazon.com/ec2/pricing/on-demand/