Resource Lifecycle

Resources have a strict lifecycle, and can be thought of as basic state machines. Understanding this lifecycle can help better understand how Terraform generates an execution plan, how it safely executes that plan, and what th
 , me resource provider is doing throughout all of this.

Lifecycle

A resource roughly follows the steps below:

1. **ValidateResource** is called to do a high-level structural validation of a resource's configuration. The configuration at this point is raw and the interpolations have not been processed. The value of any key is not guaranteed and is just meant to be a quick structural check.
2. **Diff** is called with the current state and the configuration. The resource provider inspects this and returns a diff, outlining all the changes that need to occur to the resource. The diff includes details such as whether or not the resource is being destroyed, what attribute necessitates the **destroy**, old values and new values, whether a value is computed, etc. It is up to the resource provider to have this knowledge.
3. **Apply** is called with the current state and the diff. Apply does not have access to the configuration. This is a safety mechanism that limits the possibility that a provider changes a diff on the fly. Apply must apply a diff as prescribed and do nothing else to remain true to the Terraform execution plan. Apply returns the new state of the resource (or nil if the resource was destroyed).
4. If a resource was just created and did not exist before, and the apply succeeded without error, then the provisioners are executed in sequence. If any provisioner errors, the resource is marked as tainted, so that it will be destroyed on the next apply.

Partial State and Error Handling

If an error happens at any stage in the lifecycle of a resource, Terraform stores a partial state of the resource. This behavior is critical for Terraform to ensure that you don't end up with any zombie resources: resources that were created by Terraform but no longer managed by Terraform due to a loss of state.

```
$ terraform init
$ terraform plan -out "outfile"
$ terraform apply "outfile"

$ terraform init
$ terraform plan
$ terraform apply -auto-approve
```

Cluster Provision:

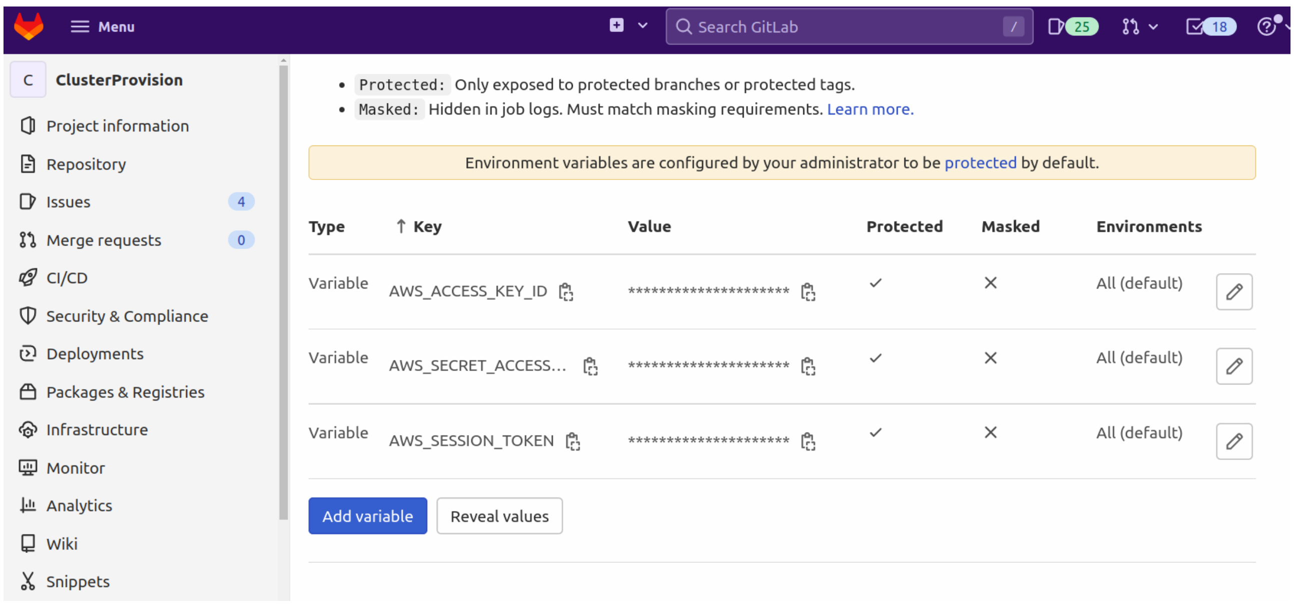
AWS STS token generation for Gitlab and AWS CLI

Prerequisites: latest version of AWS CLI should be installed in the server where gitlab runner is running. [For my case] Group Gitlab runner is installed on my laptop with the tag of devsecops. Since we have enabled MFA, we need to generate a token for every session (12 hours validity).
Command:
$aws sts get-session-token --serial-number arn:aws:iam::594977439087:mfa/sathiyan.sivaprakasam@synapsica.com --token-code 385749

Output:
```
{
   "Credentials": {
      "AccessKeyId": "ASIAYVB3LHVX46IXXKOE",
      "SecretAccessKey": "z45wqE/XpWK7I7BTIdTuCjucf4tyHpzGXTYFLevm",
      "SessionToken":
"IQoJb3JpZ2luX2VjEA0aCXVzLWVhc3QtMSJHMEUCIQDHpztQdFagIbIFrUvGJXw/YygLViyDTEIe
67iM7btPFgIgZ0wzyqde6UScbMvCzPbAe57qw4U1Q2ImACPZz6G0GrUq+AEIhv//////////ARADG",
      "Expiration": "2022-08-23T16:38:50+00:00"
   }
}
```

Update secret with CI/CD variables and AWS CLI

Update the above values with CI/CD variables like below.

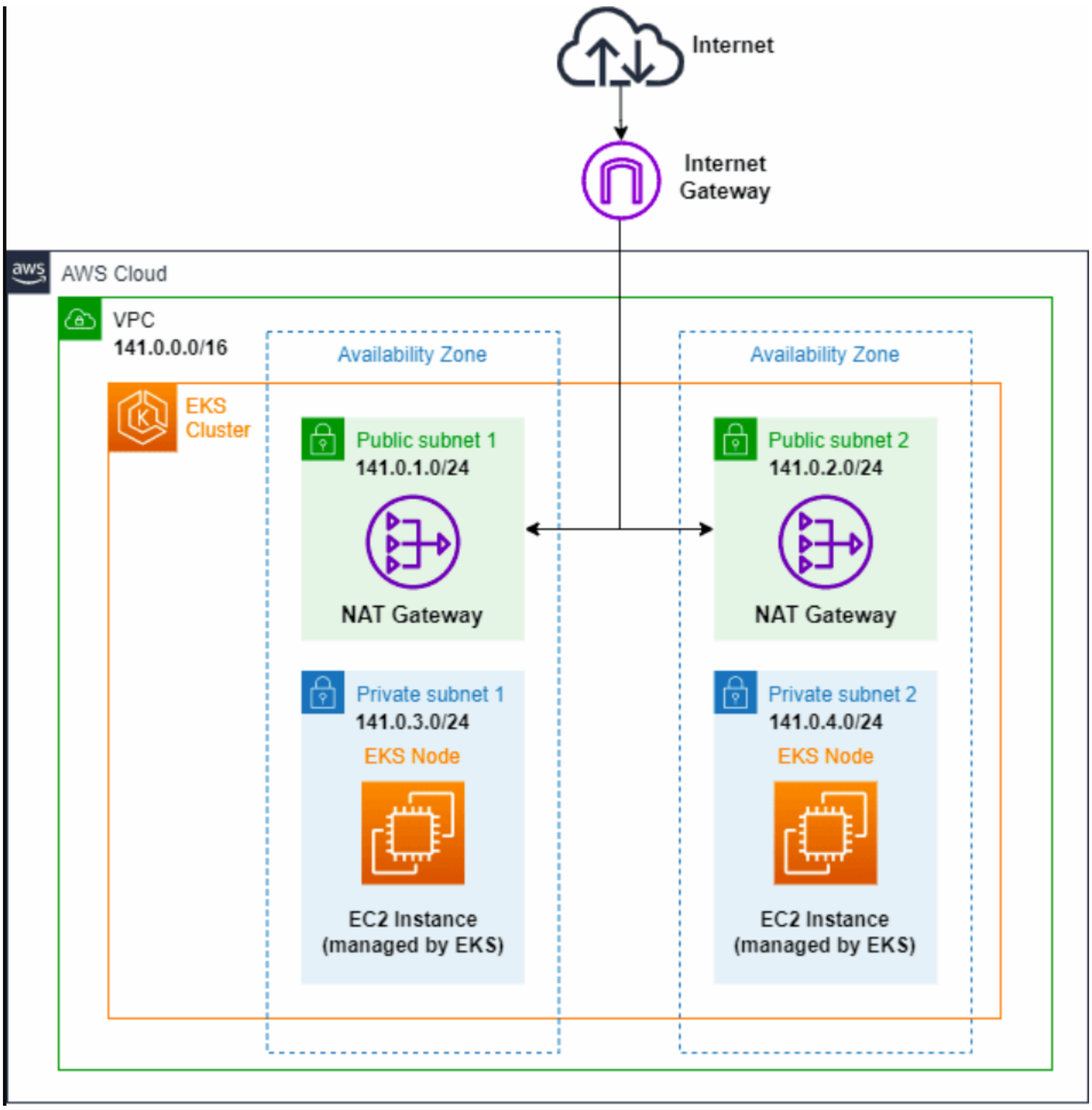


- `Protected:` Only exposed to protected branches or protected tags.
- `Masked:` Hidden in job logs. Must match masking requirements. Learn more.

Environment variables are configured by your administrator to be protected by default.

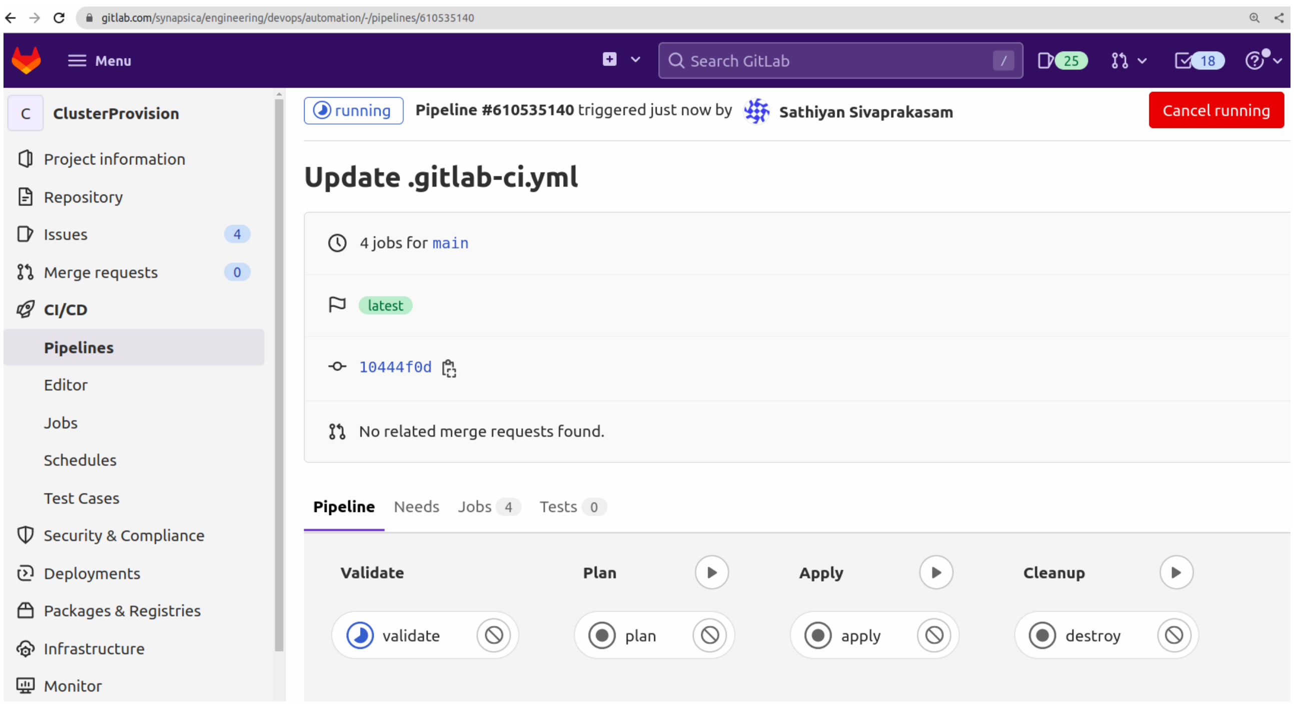
Type	↑ Key	Value	Protected	Masked	Environments
Variable	AWS_ACCESS_KEY_ID	*********************	✓	✕	All (default)
Variable	AWS_SECRET_ACCESS...	*********************	✓	✕	All (default)
Variable	AWS_SESSION_TOKEN	*********************	✓	✕	All (default)

Prerequisites: You need to have privilege for “clusterprovision” project in devops group. You also need to update those values with ~/.aws/credentials also along with some profile name [for instance, profile = mfa].



Run pipeline of your cluster provision project

Click on “Run Pipeline”. It executes the .gitlab-ci.yml with the following pipeline.



gitlab.com/synapsica/engineering/devops/automation/-/pipelines/610535140

running **Pipeline #610535140** triggered just now by **Sathiyan Sivaprakasam**

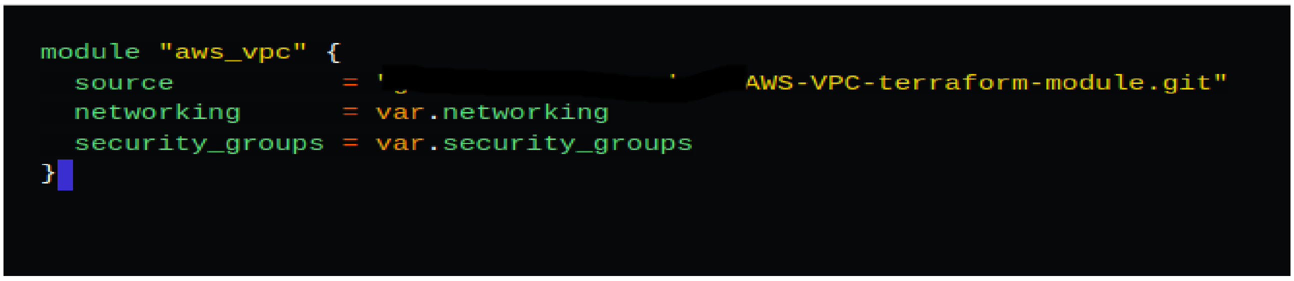
Update .gitlab-ci.yml

4 jobs for `main`

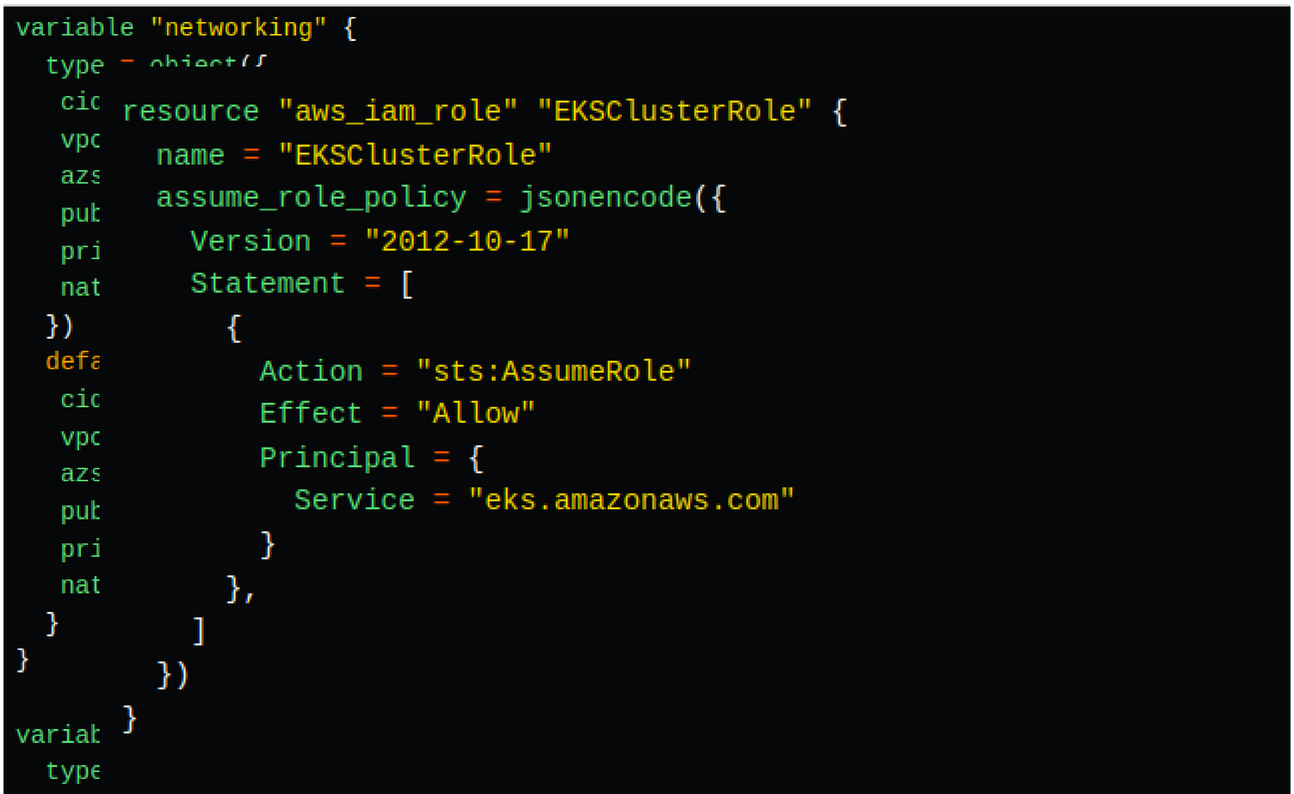
latest

`10444f0d`

No related merge requests found.



```
module "aws_vpc" {
  source          = '[redacted]AWS-VPC-terraform-module.git"
  networking      = var.networking
  security_groups = var.security_groups
}
```



```
variable "networking" {
  type = object({
    cic
    vpc
    azs
    puk
    pri
    nat
  })
  defa
    cic
    vpc
    azs
    puk
    pri
    nat
  }
}

variab
  type
```

```
resource "aws_iam_role" "EKSClusterRole" {
  name = "EKSClusterRole"
  assume_role_policy = jsonencode({
    Version = "2012-10-17"
    Statement = [
      {
        Action = "sts:AssumeRole"
        Effect = "Allow"
        Principal = {
          Service = "eks.amazonaws.com"
        }
      },
    ]
  })
}
```

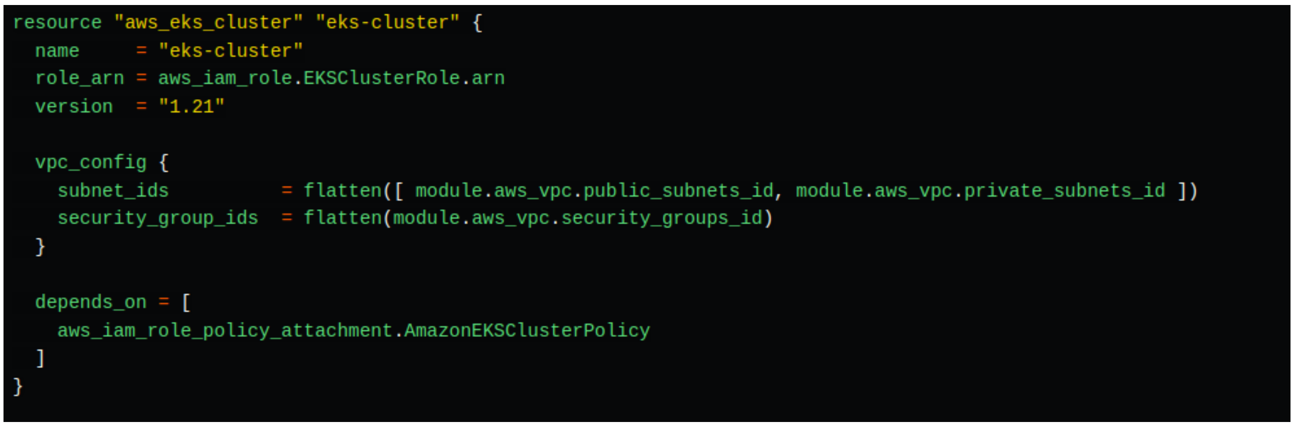
```
resource "aws_iam_role" "NodeGroupRole" {
  name = "EKSNodeGroupRole"
  assume_role_policy = jsonencode({
    Version = "2012-10-17"
    Statement = [
      {
        Action = "sts:AssumeRole"
        Effect = "Allow"
        Principal = {
          Service = "ec2.amazonaws.com"
        }
      },
    ]
  })
}
```

```
resource "aws_iam_role_policy_attachment" "AmazonEKSWorkerNodePolicy" {
  policy_arn = "arn:aws:iam::aws:policy/AmazonEKSWorkerNodePolicy"
  role       = aws_iam_role.NodeGroupRole.name
}
```

```
resource "aws_iam_role_policy_attachment" "AmazonEKS_CNI_Policy" {
  policy_arn = "arn:aws:iam::aws:policy/AmazonEKS_CNI_Policy"
  role       = aws_iam_role.NodeGroupRole.name
}
```

```
resource "aws_iam_role_policy_attachment" "AmazonEKSClusterPolicy" {
  policy_arn = "arn:aws:iam::aws:policy/AmazonEKSClusterPolicy"
  role       = aws_iam_role.EKSClusterRole.name
}
```

```
resource "aws_iam_role_policy_attachment" "AmazonEC2ContainerRegistryReadOnly" {
  policy_arn = "arn:aws:iam::aws:policy/AmazonEC2ContainerRegistryReadOnly"
  role       = aws_iam_role.NodeGroupRole.name
}
```



```
resource "aws_eks_cluster" "eks-cluster" {
  name     = "eks-cluster"
  role_arn = aws_iam_role.EKSClusterRole.arn
  version  = "1.21"

  vpc_config {
    subnet_ids          = flatten([ module.aws_vpc.public_subnets_id, module.aws_vpc.private_subnets_id ])
    security_group_ids  = flatten(module.aws_vpc.security_groups_id)
  }

  depends_on = [
    aws_iam_role_policy_attachment.AmazonEKSClusterPolicy
  ]
}
```

Trust for Kubernetes Provider

```
provider "kubernetes" {
  host                   = data.aws_eks_cluster.cluster.endpoint
  token                  = data.aws_eks_cluster_auth.cluster.token
  cluster_ca_certificate = base64decode(data.aws_eks_cluster.cluster.certificate_authority.0.data)
}
```

or

```
provider "kubernetes" {
 config_path    = "../eks_setup/spindle-ai-eks-terraform-cluster_config"
}
```

decode the secret

Just use the base64 program from the coreutils package:

```
echo QWxhZGRpbjpvcGVuIHNlc2FtZQ== | base64 --decode
```

Create KubeConfig for AWS EKS [through command prompt]

$ aws eks update-kubeconfig --region us-east-1 --name eks-cluster --profile mfa

Output:

```
Added new context arn:aws:eks:us-east-1:594977439087:cluster/test-eks-cluster-Mw6qwFqF to /home/sathiyan/.kube/config
```

```
resource "aws_eks_node_group" "node-ec2" {
  cluster_name    = aws_eks_cluster.eks-cluster.name
  node_group_name = "t3_micro-node_group"
  node_role_arn   = aws_iam_role.NodeGroupRole.arn
  subnet_ids      = flatten( module.aws_vpc.private_subnets_id )

  scaling_config {
    desired_size = 2
    max_size     = 3
    min_size     = 1
  }

  ami_type       = "AL2_x86_64"
  instance_types = ["t3.micro"]
  capacity_type  = "ON_DEMAND"
  disk_size      = 20

  depends_on = [
    aws_iam_role_policy_attachment.AmazonEKSWorkerNodePolicy,
    aws_iam_role_policy_attachment.AmazonEC2ContainerRegistryReadOnly,
    aws_iam_role_policy_attachment.AmazonEKS_CNI_Policy
  ]
}
```

Create KubeConfig Manually [If any challenges on command prompt]

To create your kubeconfig file manually

1. Set values for a few variables by replacing the example values with your own and then running the modified commands.
   ```
   export region_code=region-code
   export cluster_name=my-cluster
   export account_id=111122223333
   ```

2. Retrieve the endpoint for your cluster and store the value in a variable.
   ```
   cluster_endpoint=$(aws eks describe-cluster \
       --region $region_code \
       --name $cluster_name \
       --query "cluster.endpoint" \
       --output text)
   ```

3. Retrieve the Base64-encoded certificate data required to communicate with your cluster and store the value in a variable.
   ```
   certificate_data=$(aws eks describe-cluster \
       --region $region_code \
   ```

```
  --name $cluster_name \
  --query "cluster.certificateAuthority.data" \
  --output text)
```

4. Create the default ~/.kube directory if it doesn't already exist.
   ```
   mkdir -p ~/.kube
   ```

5. Run the command for your preferred client token method (AWS CLI or AWS IAM authenticator for Kubernetes) to create the config file in the ~/.kube directory. You can specify the following before running one of the commands by modifying the command to include the following:
   An IAM role – Remove the # at the start of the lines under args:. Replace my-role with the name of the IAM role that you want to perform cluster operations with instead of the default AWS credential provider chain.
   An AWS CLI named profile – Remove the # at the start of the env: line, and remove # at the start of the lines under it. Replace aws-profile with the name of the profile to use. If you don't specify a profile, then the default profile is used.
   AWS CLI
   AWS IAM Authenticator for Kubernetes
   Prerequisite
   Version 1.16.156 or later of the AWS CLI must be installed on your device.
   ```
   #!/bin/bash
   read -r -d '' KUBECONFIG <<EOF
   apiVersion: v1
   clusters:
   - cluster:
       certificate-authority-data: $certificate_data
       server: $cluster_endpoint
     name: arn:aws:eks:$region_code:$account_id:cluster/$cluster_name
   contexts:
   - context:
       cluster: arn:aws:eks:$region_code:$account_id:cluster/$cluster_name
       user: arn:aws:eks:$region_code:$account_id:cluster/$cluster_name
     name: arn:aws:eks:$region_code:$account_id:cluster/$cluster_name
   current-context: arn:aws:eks:$region_code:$account_id:cluster/$cluster_name
   kind: Config
   preferences: {}
   users:
   - name: arn:aws:eks:$region_code:$account_id:cluster/$cluster_name
     user:
       exec:
         apiVersion: client.authentication.k8s.io/v1beta1
         command: aws
         args:
           - --region
           - $region_code
           - eks
           - get-token
           - --cluster-name
           - $cluster_name
           # - "- --role-arn"
   ```

```
    # - "arn:aws:iam::$account_id:role/my-role"
  # env:
    # - name: "AWS_PROFILE"
    #   value: "aws-profile"
EOF
echo "${KUBECONFIG}" > ~/.kube/config
```

6. Add the file path to your KUBECONFIG environment variable so that kubectl knows where to look for your cluster configuration.
   For Bash shells on macOS or Linux:
   export KUBECONFIG=$KUBECONFIG:~/.kube/config
   For PowerShell on Windows:
   $ENV:KUBECONFIG="{0};{1}" -f $ENV:KUBECONFIG, "$ENV:userprofile\.kube\config"

7. (Optional) Add the configuration to your shell initialization file so that it is configured when you open a shell.
   For Bash shells on macOS:
   echo 'export KUBECONFIG=$KUBECONFIG:~/.kube/config' >> ~/.bash_profile
   For Bash shells on Linux:
   echo 'export KUBECONFIG=$KUBECONFIG:~/.kube/config' >> ~/.bashrc

8. Test your configuration.
   kubectl get svc

Create a kubeconfig file dynamically [Prefered Approach]

We can create a kubeconfig file dynamically with the help of a template in eks_setup module after creating the cluster successfully.

$ export KUBECONFIG=$(pwd)/spindle-ai-eks-terraform-cluster_config
$ export KUBECONFIG=../eks_setup/spindle-ai-eks-terraform-cluster_config
or
export KUBECONFIG=~/assignments/devsecops/iac/spindle-scaler/prod/eks/spindle-radiolens-monitor-cluster_config

Check the cluster health

Before Auto Scaling Cluster Creation

$aws autoscaling describe-auto-scaling-groups --query "AutoScalingGroups[? Tags[?(Key=='k8s.io/cluster-autoscaler/enabled') && Value=='true']]".AutoScalingGroupName --region us-east-1 --profile mfa
Output:
```
[
]
```

initially empty array for us.

After Auto Scaling Cluster Created

```
$ aws autoscaling --region us-east-1 describe-auto-scaling-groups --profile mfa
{
   "AutoScalingGroups": [
      {
         "AutoScalingGroupName":
"test-eks-cluster-GDI9F3iW-worker-group-120220812100108383000000016",
         "AutoScalingGroupARN":
"arn:aws:autoscaling:us-east-1:594977439087:autoScalingGroup:9472abf2-dab3-4bf9-81ec-026a4
40da03c:autoScalingGroupName/test-eks-cluster-GDI9F3iW-worker-group-120220812100108383
000000016",
         "LaunchConfigurationName":
"test-eks-cluster-GDI9F3iW-worker-group-120220812100058478200000014",
         "MinSize": 1,
         "MaxSize": 3,
         "DesiredCapacity": 2,
         "DefaultCooldown": 300,
         "AvailabilityZones": [
            "us-east-1a",
            "us-east-1b",
            "us-east-1c"
         ],
         "LoadBalancerNames": [],
         "TargetGroupARNs": [],
         "HealthCheckType": "EC2",
         "HealthCheckGracePeriod": 300,
         "Instances": [
            {
               "InstanceId": "i-0a767af5e7d681990",
               "InstanceType": "t2.small",
               <<more key pair>>
               "test-eks-cluster-GDI9F3iW-worker-group-120220812100058478200000014",
               "ProtectedFromScaleIn": false
            },
            {
               "InstanceId": "i-0b3514de2aeb49bde",
               "InstanceType": "t2.small",
               "AvailabilityZone": "us-east-1c",
               "LifecycleState": "InService",
               "HealthStatus": "Healthy",
               "LaunchConfigurationName":
"test-eks-cluster-GDI9F3iW-worker-group-120220812100058478200000014",
               "ProtectedFromScaleIn": false
            }
         ],
  "CreatedTime": "2022-08-12T10:01:08.917000+00:00",
            "SuspendedProcesses": [
                {
                    "ProcessName": "AZRebalance",
                    "SuspensionReason": "User suspended at 2022-08-12T10:02:56Z"
                }
            ],
            "VPCZoneIdentifier":
"subnet-0eedea74271ec7c2b,subnet-0e954ce7869db4a52,subnet-030a54f66b4b44890",
            "EnabledMetrics": [],
            "Tags": [
                {
                    "ResourceId":
"test-eks-cluster-GDI9F3iW-worker-group-120220812100108383000000016",
                    "ResourceType": "auto-scaling-group",
                    "Key": "Name",
                    "Value": "test-eks-cluster-GDI9F3iW-worker-group-1-eks_asg",
                    "PropagateAtLaunch": true
                },
                {
                    "ResourceId":
"test-eks-cluster-GDI9F3iW-worker-group-120220812100108383000000016",
                    "ResourceType": "auto-scaling-group",
                    "Key": "k8s.io/cluster/test-eks-cluster-GDI9F3iW",
                    "Value": "owned",
                    "PropagateAtLaunch": true
                },
                {
                    "ResourceId":
"test-eks-cluster-GDI9F3iW-worker-group-120220812100108383000000016",
                    "ResourceType": "auto-scaling-group",
                    "Key": "kubernetes.io/cluster/test-eks-cluster-GDI9F3iW",
                    "Value": "owned",
                    "PropagateAtLaunch": true
                }
            ],
            "TerminationPolicies": [
                "Default"
            ],
            "NewInstancesProtectedFromScaleIn": false,
            "ServiceLinkedRoleARN":
"arn:aws:iam::594977439087:role/aws-service-role/autoscaling.amazonaws.com/AWSServiceRole
ForAutoScaling"
        },
```

Auto scaling groups
[test-eks-cluster-Mw6qwFqF-worker-group-120220813051019680600000017]()
[test-eks-cluster-Mw6qwFqF-worker-group-220220813051019680400000016]()

```
$ aws autoscaling describe-auto-scaling-groups --query "AutoScalingGroups[? Tags[?
(Key=='k8s.io/cluster-autoscaler/enabled') && Value=='true']]".AutoScalingGroupName
--region us-east-1
[
    "test-eks-cluster-Mw6qwFqF-worker-group-120220813051019680600000017"
]
```

Namespaced objects Vs. Cluster-wide objects

In Kubernetes, namespaces provide a mechanism for isolating groups of resources within a single cluster. Names of resources need to be unique within a namespace, but not across namespaces. Namespace-based scoping is applicable only for namespaced objects (e.g. Deployments, Services, etc) and not for cluster-wide objects (e.g. StorageClass, Nodes, PersistentVolumes, etc).

$ kubectl api-resources --namespaced=false

The following are cluster-wide objects.

NAME	SHORTNAMES	APIVERSION	KIND
componentstatuses	cs	v1	ComponentStatus
namespaces	ns	v1	Namespace
nodes	no	v1	Node
persistentvolumes	pv	v1	PersistentVolume
mutatingwebhookconfigurations		admissionregistration.k8s.io/v1	MutatingWebhookConfiguration
validatingwebhookconfigurations		admissionregistration.k8s.io/v1	ValidatingWebhookConfiguration
customresourcedefinitions	crd,crds	apiextensions.k8s.io/v1	CustomResourceDefinition
apiservices		apiregistration.k8s.io/v1	APIService
tokenreviews		authentication.k8s.io/v1	TokenReview
selfsubjectaccessreviews		authorization.k8s.io/v1	SelfSubjectAccessReview
selfsubjectrulesreviews		authorization.k8s.io/v1	SelfSubjectRulesReview
subjectaccessreviews		authorization.k8s.io/v1	SubjectAccessReview
certificatesigningrequests	csr	certificates.k8s.io/v1	CertificateSigningRequest

eniconfigs		crd.k8s.amazonaws.com/v1alpha1	ENIConfig
flowschemas		flowcontrol.apiserver.k8s.io/v1beta1	FlowSchema
prioritylevelconfigurations		flowcontrol.apiserver.k8s.io/v1beta1	PriorityLevelConfiguration
ingressclasses		networking.k8s.io/v1	IngressClass
runtimeclasses		node.k8s.io/v1	RuntimeClass
podsecuritypolicies	psp	policy/v1beta1	PodSecurityPolicy
clusterrolebindings		rbac.authorization.k8s.io/v1	ClusterRoleBinding
clusterroles		rbac.authorization.k8s.io/v1	ClusterRole
priorityclasses	pc	scheduling.k8s.io/v1	PriorityClass
csidrivers		storage.k8s.io/v1	CSIDriver
csinodes		storage.k8s.io/v1	CSINode
storageclasses	sc	storage.k8s.io/v1	StorageClass
volumeattachments		storage.k8s.io/v1	VolumeAttachment

Frequently used Kubectl commands

$kubectl get all

$ kubectl get nodes -A

```
NAME                         STATUS   ROLES    AGE    VERSION
ip-10-0-2-86.ec2.internal    Ready    <none>   139m   v1.20.15-eks-99076b2
ip-10-0-3-236.ec2.internal   Ready    <none>   139m   v1.20.15-eks-99076b2
```

1. **$kubectl get events –all-namespaces**
2. **$kubectl apply -f <<name of the yaml>> [to create deployment-pod/service]**
3. **$kubectl get pod**

You can also watch ongoing things through

4. **$kubectl get pod –watch**
5. **$kubectl describe pod <<pod name>>**
6. **$kubectl describe pods -n <<namespace>>**
7. **$kubectl describe service <<service name>>**
8. **$kubectl logs <<name of the pod – So you can get the things what's going on inside the pod creation>>**

Checking the Status of the Pods for All the Namespaces

Issue: You want to check the status of the pods for all the namespaces.
Workaround: To check the status of all the pods for all the namespaces use the following command:
$ kubectl get pods -A
or
$ kubectl get pods --all-namespaces

NAMESPACE	NAME	READY	STATUS	RESTARTS	AGE
kube-system	aws-node-c55j9	1/1	Running	0	47h
kube-system	coredns-65bfc5645f-pz57v	1/1	Running	0	47h
kube-system	kube-proxy-47bck	1/1	Running	0	47h
kube-system	kube-proxy-msz7m	1/1	Running	0	47h
spindle-nuance	spindle-nuance-8464d6f96c-mfdvh	1/1	Running	0	47h

Checking the Physical and Internal IP Details of All the Pods
Issue: You want to check the physical and internal IP details of all the pods.
Workaround: To check the physical and internal IP details of all the pods use the following command:
$kubectl get pods -n spindle-nuance -o wide

NAME	READY	STATUS	RESTARTS	AGE	IP	NODE	NOMINATED NODE	READINESS GATES
spindle-nuance-7684d65bb-7qzsf	1/1	Running	2 (81s ago)	5m59s	10.10.2.203	ip-10-10-2-65.ec2.internal	<none>	<none>
spindle-nuance-7684d65bb-9x8qb	0/1	Error	0	5m59s	10.10.3.199	ip-10-10-3-104.ec2.internal	<none>	<none>
spindle-nuance-7684d65bb-fmw7l	0/1	Pending	0	46s	<none>	<none>	<none>	<none>
spindle-nuance-7684d65bb-gmssw	0/1	ContainerStatusUnknown	1 (104s ago)	5m	<none>	ip-10-10-2-65.ec2.internal	<none>	<none>
spindle-nuance-7684d65bb-	0/1	OOMKilled	2 (90s ago)	3m58s	10.10.2.124	ip-10-10-2-65.ec2.internal	<none>	<none>

jd2pc								

To look for errors in the logs of the previous pod that crashed, run the following command:
$ kubectl logs - - previous YOUR_POD_NAME -n NAMESPACE

$ kubectl logs coredns-65bfc5645f-m822w -n kube-system --tail 20 --follow

```
"livenessProbe": {
              "exec": {
                "command": [
                  "/app/grpc-health-probe",
                  "-addr=:50051"
                ]
              },
              "initialDelaySeconds": 60,
             <<some more key-value pair>>
            },
            "readinessProbe": {
              "exec": {
                "command": [
                  "/app/grpc-health-probe",
                  "-addr=:50051"
                ]
              },
              "initialDelaySeconds": 1,
             <<some more key-value pair>>
            },
            "terminationMessagePath": "/dev/termination-log",
            "terminationMessagePolicy": "File",
            "imagePullPolicy": "Always",
            "securityContext": {
              "capabilities": {
                "add": [
                  "NET_ADMIN"
                ]
              }
            }
          }
        ],
        "restartPolicy": "Always",
        "terminationGracePeriodSeconds": 10,
        "dnsPolicy": "ClusterFirst",
        <<some more key-value pair>>
        "securityContext": {},
```

$ kubectl get events --sort-by='.metadata.creationTimestamp' -A

exec command will help you to execute OS specific commands on your runtime container [that has exactly the structure of docker image and its path]. For instance, The hosts file content would look like this:

$ kubectl exec spindle-nuance-84bb657fb4-4x2ks -n spindle-nuance -- cat /etc/hosts

$ kubectl exec -it prometheus-prometheus-prometheus-oper-prometheus-0 -- /bin/sh

$ kubectl exec spindle-nuance-84bb657fb4-4x2ks -n spindle-nuance -- cat /etc/passwd
Use the “cat” command to list all the users on the terminal to display all the user account details and passwords stored in the /etc/passwd file of the Linux system.

$ kubectl apply -f hpa.yml
horizontalpodautoscaler.autoscaling/spindle-nuance **created**
[If you apply the same file with some modification, status message will be like below]

$ kubectl apply -f hpa.yml
horizontalpodautoscaler.autoscaling/spindle-nuance **configured**

Source of ‘kubectl explain’ output

kubectl explain command is used to show documentation about Kubernetes resources like pod.
Example:
$ kubectl explain Pods
The information displayed as output of this command is obtained from the OpenAPI Specification for the Pod. OpenAPI Spec for all the Types is generated by the main API server when it starts up and is maintained by it in memory.
Another Example:
$ kubectl explain deployment.spec.template.spec.securityContext

Evicted Pod

Why bother deleting an Evicted Pod?

1. When we have too many evicted pods in our cluster, this can lead to network load as each pod, even though it is evicted is connected to the network
2. In case of a cloud Kubernetes cluster, will have blocked an IP address, which can lead to exhaustion of IP addresses too if you have a fixed pool of IP addresses for your cluster.
3. Also, when we have too many pods in Evicted status, it becomes difficult to monitor the pods by running the kubectl get pod command as you will see too many evicted pods, which can be a bit confusing at times.

But what if you have 100 Evicted pods?

Well, don't worry, we have a special command, which will find all the evicted pods and delete them just by running a single command.
$kubectl get pod -n studytonight | grep Evicted | awk '{print $1}' | xargs kubectl delete pod -n studytonight

In the above command, we are searching for the pods with status Evicted and then running kubectl delete pod command for all of them. You can also use the above command to delete pods in any particular status like Running, Evicted, CrashLoopBackOff, etc.

Metrics Server

Is Metrics API available at your cluster?

$ kubectl top pods -n spindle-nuance
error: Metrics API not available
If you get the above error, your cluster doesn't have Metrics Server.

Other approach to make sure about availability of metrics server:
To see whether the metrics-server is running, or another provider of the resource metrics API (metrics.k8s.io), run the following command:
$ kubectl get apiservices

If the resource metrics API is available, the output includes a reference to metrics.k8s.io.
NAME
v1beta1.metrics.k8s.io

If your output doesn't include an above name reference, then your cluster doesn't have metrics server.

Installing the Kubernetes Metrics Server

The Kubernetes Metrics Server is an aggregator of resource usage data in your cluster, and it is not deployed by default in Amazon EKS clusters. The Metrics Server is commonly used by other Kubernetes add ons, such as the Horizontal Pod Autoscaler or the Kubernetes Dashboard. For more information, see Resource metrics pipeline in the Kubernetes documentation. This topic explains how to deploy the Kubernetes Metrics Server on your Amazon EKS cluster.

Deploy the Metrics Server onto your cluster

$ kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/latest/download/components.yaml

Verify that the metrics-server deployment is running the desired number of pods
$kubectl get deployment metrics-server -n kube-system

If you execute top pods after the above fix, you will get results instead of errors.
$ kubectl top pods -n kube-system

NAMESPACE	NAME	CPU(cores)	MEMORY(bytes)

kube-system	Aws-node-c55j9	5m	50Mi
kube-system	Aws-node-cmrrv	5m	49Mi
kube-system	coredns-65bfc5645f-m822w	2m	15Mi
kube-system	coredns-65bfc5645f-pz57v	3m	15Mi
kube-system	Kube-proxy-msz7m	1m	20Mi
kube-system	metrics-server-6594d67d48-q4ntq	4m	15Mi

$ kubectl get apiservices

NAME	SERVICE	AVAILABLE	AGE
v1.	Local	True	7d22h
v1.admissionregistration.k8s.io	Local	True	7d22h
v1.apiextensions.k8s.io	Local	True	7d22h
v1.apps	Local	True	7d22h
v1.authentication.k8s.io	Local	True	7d22h
v1.authorization.k8s.io	Local	True	7d22h
v1.autoscaling	Local	True	7d22h
v1.batch	Local	True	7d22h
v1.certificates.k8s.io	Local	True	7d22h
v1.coordination.k8s.io	Local	True	7d22h
v1.events.k8s.io	Local	True	7d22h
v1.networking.k8s.io	Local	True	7d22h
v1.node.k8s.io	Local	True	7d22h
v1.rbac.authorization.k8s.io	Local	True	7d22h
v1.scheduling.k8s.io	Local	True	7d22h
v1.storage.k8s.io	Local	True	7d22h
v1alpha1.crd.k8s.amazonaws.com	Local	True	7d22h
v1beta1.admissionregistration.k8s.io	Local	True	7d22h
v1beta1.apiextensions.k8s.io	Local	True	7d22h
v1beta1.authentication.k8s.io	Local	True	7d22h

v1beta1.authorization.k8s.io	Local	True	7d22h
v1beta1.batch	Local	True	7d22h
v1beta1.certificates.k8s.io	Local	True	7d22h
v1beta1.coordination.k8s.io	Local	True	7d22h
v1beta1.discovery.k8s.io	Local	True	7d22h
v1beta1.events.k8s.io	Local	True	7d22h
v1beta1.extensions	Local	True	7d22h
v1beta1.flowcontrol.apiserver.k8s.io	Local	True	7d22h
v1beta1.metrics.k8s.io	Kube-system/metrics-server	True	14h
v1beta1.networking.k8s.io	Local	True	7d22h
v1beta1.node.k8s.io	Local	True	7d22h
v1beta1.policy	Local	True	7d22h
v1beta1.rbac.authorization.k8s.io	Local	True	7d22h
v1beta1.scheduling.k8s.io	Local	True	7d22h
v1beta1.storage.k8s.io	Local	True	7d22h
v1beta1.vpcresources.k8s.aws	Local	True	7d22h
v2beta1.autoscaling	Local	True	7d22h
v2beta2.autoscaling	Local	True	7d22h

Once Metrics Server is deployed, you can query the Metrics API to retrieve current metrics from any node or pod using the below commands.

```
kubectl get --raw /apis/metrics.k8s.io/v1beta1/nodes/<NODE_NAME> | jq

kubectl get --raw
/apis/metrics.k8s.io/v1beta1/namespaces/<NAMESPACE>/pods/<POD_NAME> | jq
```

```
$ kubectl get --raw
/apis/metrics.k8s.io/v1beta1/namespaces/spindle-nuance/pods/spindle-nuance-8968dcb69
-bnn42  | jq
{
  "kind": "PodMetrics",
  "apiVersion": "metrics.k8s.io/v1beta1",
  "metadata": {
    "name": "spindle-nuance-8968dcb69-bnn42",
    "namespace": "spindle-nuance",
    "creationTimestamp": "2022-10-12T13:16:59Z",
    "labels": {
      "app": "spindle-nuance",
      "pod-template-hash": "8968dcb69"
    }
  },
  "timestamp": "2022-10-12T13:16:42Z",
  "window": "18.473s",
  "containers": [
    {
      "name": "spindle-nuance-container",
      "usage": {
        "cpu": "31095930n",
        "memory": "4744636Ki"
      }
    }
  ]
}
```

```
$ kubectl get --raw /apis/metrics.k8s.io/v1beta1/nodes/ip-10-10-2-221.ec2.internal | jq
{
  "kind": "NodeMetrics",
  "apiVersion": "metrics.k8s.io/v1beta1",
  "metadata": {
    "name": "ip-10-10-2-221.ec2.internal",
    "creationTimestamp": "2022-10-12T13:24:26Z",
    "labels": {
      "beta.kubernetes.io/arch": "amd64",
      "beta.kubernetes.io/instance-type": "t3.2xlarge",
      "beta.kubernetes.io/os": "linux",
      "eks.amazonaws.com/capacityType": "ON_DEMAND",
      <<more key-value pairs>>
      "topology.kubernetes.io/zone": "us-east-1a"
    }
  },
  "timestamp": "2022-10-12T13:24:21Z",
  "window": "20.035s",
  "usage": {
    "cpu": "156989995n",
    "memory": "6003324Ki"
  }
}
```

```
$ kubectl describe hpa spindle-nuance -n spindle-nuance
```

```
Name:                                   spindle-nuance
Namespace:                                   spindle-nuance
Labels:                                 <none>
Annotations:                               <none>
CreationTimestamp:                              Wed, 10 Aug 2022 20:07:49 +0530
Reference:                                 Deployment/spindle-nuance
Metrics:                                ( current / target )
  resource cpu on pods  (as a percentage of request):  112% (563m) / 10%
Min replicas:                              1
Max replicas:                               5
Behavior:
  Scale Up:
    Stabilization Window: 0 seconds
    Select Policy: Max
    Policies:
      - Type: Percent  Value: 100  Period: 30 seconds
      - Type: Pods     Value: 3    Period: 30 seconds
  Scale Down:
    Stabilization Window: 300 seconds
    Select Policy: Max
    Policies:
      - Type: Percent  Value: 100  Period: 15 seconds
Deployment pods:       4 current / 4 desired
Conditions:
  Type           Status  Reason                 Message
  ----           ------  ------                 -------
  AbleToScale     True    SucceededGetScale       the HPA controller was able to get the target's
current scale
  ScalingActive   False   FailedGetResourceMetric  the HPA was unable to compute the replica
count: failed to get cpu utilization: unable to get metrics for resource cpu: unable to fetch metrics
from resource metrics API: the server is currently unable to handle the request (get
pods.metrics.k8s.io)
  ScalingLimited  True    ScaleUpLimit            the desired replica count is increasing faster than the
maximum scale rate
Events:
  Type     Reason                  Age                 From                    Message
  ----     ------                  ----                ----                    -------
  Warning  FailedGetResourceMetric  3m48s (x4502 over 19h)  horizontal-pod-autoscaler  failed to
get cpu utilization: missing request for cpu
```

```
arn:aws:logs:ap-south-1:594977439087:log-group:/aws/kinesisfirehose/KDS-HTP-fkdxO:*
arn:aws:logs:ap-south-1:594977439087:log-group:/aws/kinesisfirehose/KDS-HTP-fkdxO:*
```

Image Management

Purging All Unused or Dangling Images, Containers, Volumes, and Networks

Docker provides a single command that will clean up any resources — images, containers, volumes, and networks — that are dangling (not tagged or associated with a container):
$ docker system prune

To additionally remove any stopped containers and all unused images (not just dangling images), add the -a flag to the command:
$ docker system prune -a

docker pull

After checkout specific branch (for instance, spindle-nuance), Pull an image or a repository from a registry

$docker login registry.gitlab.com -p /home/sathiyan/.docker/config.json

$docker build --pull -t "spindle_nuance:latest_nuance_v1"

ECR (Elastic Container Registry) is a kind of Docker Hub registry from AWS. Since we are into B2B space, we don't need to put images outside of our aws account. So ECR is our prefered registry to Docker Hub.

Convert image from local repository to file system

Let assume the following is your image name along with a tag at your local repository.

How do we need to get that into our file system, so that you can share it to your peer or put inside the gitlab repository.

$docker save myimage:latest | gzip > myimage_latest.tar.gz
$docker save 594977439087.dkr.ecr.us-east-1.amazonaws.com/spindle/nuance:latest | gzip > spindle_nuance_latest.tar.gz

Push the images into ECR (Elastic Container Registry) [if team delivers in the form of tar gz]

$docker load -i synapsica_spindle_v1.9.tar.gz

$aws ecr get-login-password --region us-east-1 -- profile mfa | docker login --username AWS --password-stdin 594977439087.dkr.ecr.us-east-1.amazonaws.com

$docker tag synapsica-spindle:v1.9 594977439087.dkr.ecr.us-east-1.amazonaws.com/synapsica-spindle:v1.9

$docker push 594977439087.dkr.ecr.us-east-1.amazonaws.com/synapsica-spindle:v1.9

Cluster Autoscaler

Two parameters should be updated in cluster-autoscaler.yml. Cluster-autoscaler.yml is mostly standard common scripts across all projects except the following two dynamic parameters.

Parameter 1: Cluster name [outcome of eks_setup module]

```
$ aws eks list-clusters --region us-east-1
{
   "clusters": [
      "spindle-ai-eks-terraform-cluster"
   ]
}
```

Parameter 2: cluster autoscaler role arn [outcome of eks_cluster_autoscaler_role_arn module]

```
eks_ca_iam_role_arn =
"arn:aws:iam::594977439087:role/spindle-ai-eks-terraform-cluster-autoscaler"
```

You need to execute the following command after update the two parameters in cluster-autoscaler.yml

```
$kubectl apply -f ./cluster_autoscaler/cluster-autoscaler.yml
```

Enabling IAM user and role access to your cluster

Access to your cluster using AWS Identity and Access Management (IAM) entities is enabled by the AWS IAM Authenticator for Kubernetes, which runs on the Amazon EKS control plane. The authenticator gets its configuration information from the aws-auth ConfigMap.

You can see which other roles or users currently have access to your cluster with the following command:

```
$ kubectl describe -n kube-system configmap/aws-auth
```

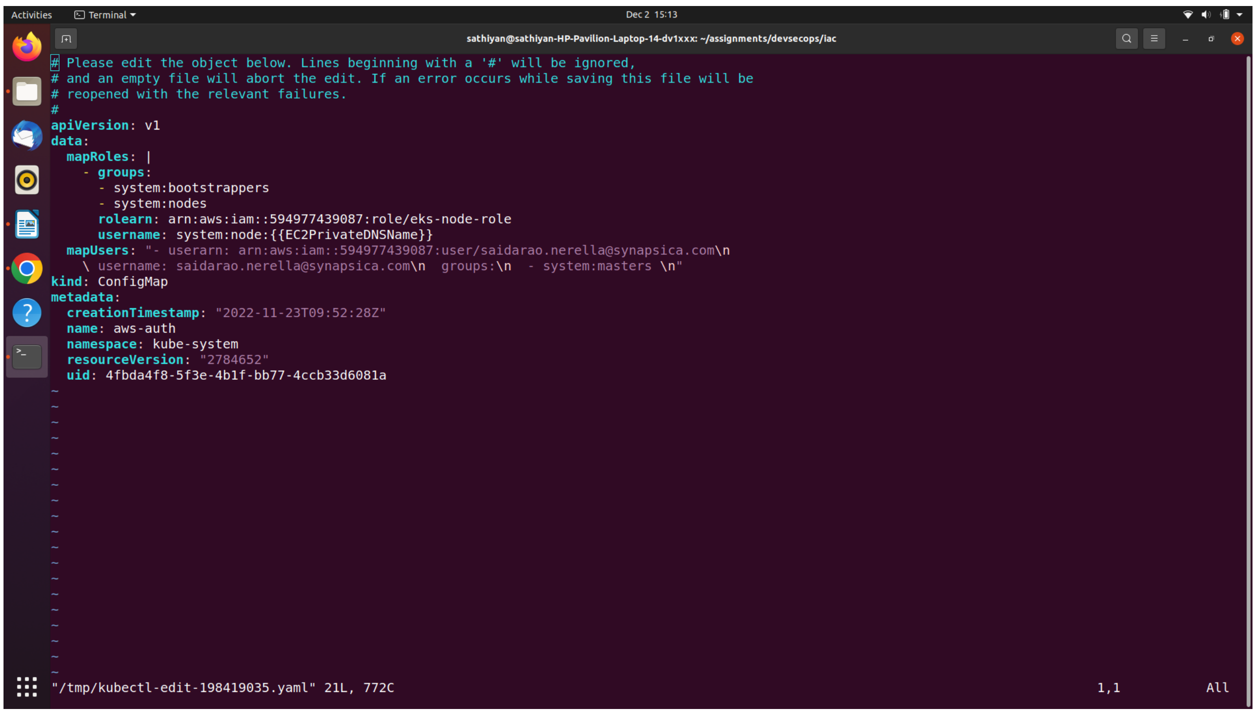
Edit the `aws-auth ConfigMap`:

```
$ kubectl edit configmap aws-auth -n kube-system
```

(or) you can download the yaml file, then you can edit and apply by kubectl.

```
curl -o aws-auth-cm.yaml
https://s3.us-west-2.amazonaws.com/amazon-eks/cloudformation/2020-10-29/aws-auth-cm.yaml
```

```
$ kubectl apply -f aws-auth-cm.yaml
```


Activities
Terminal
Dec 2 15:13
sathiyan@sathiyan-HP-Pavilion-Laptop-14-dv1xxx: ~/assignments/devsecops/iac

```
# Please edit the object below. Lines beginning with a '#' will be ignored,
# and an empty file will abort the edit. If an error occurs while saving this file will be
# reopened with the relevant failures.
#
apiVersion: v1
data:
  mapRoles: |
    - groups:
      - system:bootstrappers
      - system:nodes
      rolearn: arn:aws:iam::594977439087:role/eks-node-role
      username: system:node:{{EC2PrivateDNSName}}
  mapUsers: "- userarn: arn:aws:iam::594977439087:user/saidarao.nerella@synapsica.com\n
    \ username: saidarao.nerella@synapsica.com\n  groups:\n  - system:masters \n"
kind: ConfigMap
metadata:
  creationTimestamp: "2022-11-23T09:52:28Z"
  name: aws-auth
  namespace: kube-system
  resourceVersion: "2784652"
  uid: 4fbda4f8-5f3e-4b1f-bb77-4ccb33d6081a
~
"/tmp/kubectl-edit-198419035.yaml" 21L, 772C                                    1,1           All
```

How To Setup Kube State Metrics on Kubernetes

Kube State metrics is a service that talks to the Kubernetes API server to get all the details about all the API objects like deployments, pods, daemonsets, Statefulsets, etc.

Primarily it produces metrics in Prometheus format with the stability as the Kubernetes API. Overall it provides kubernetes objects & resources metrics that you cannot get directly from native Kubernetes monitoring components.

Kube state metrics service exposes all the metrics on /metrics URI. Prometheus can scrape all the metrics exposed by Kube state metrics.

Following are some of the important metrics you can get from Kube state metrics.

1. Node status, node capacity (CPU and memory)
2. Replica-set compliance (desired/available/unavailable/updated status of replicas per deployment)
3. Pod status (waiting, running, ready, etc)
4. Ingress metrics
5. PV, PVC metrics
6. Daemonset & Statefulset metrics.
7. Resource requests and limits.
8. Job & Cronjob metrics

Setup Guide

1) helm repo add prometheus-community https://prometheus-community.github.io/helm-charts
2) helm repo update

3) `helm install kube-state-metrics prometheus-community/kube-state-metrics`
4) `helm list <<namespace>> [It will list all the installed helm names in the given namespaces. It can be used for delete those]`

Get the Metrics through endpoint in raw format

```
[This is through metrics server - for cpu and memory alone]
kubectl get --raw
/apis/metrics.k8s.io/v1beta1/namespaces/spindle-nuance/pods/spindle-nuance-8968dcb
69-bnn42  | jq

kubectl get --raw
/apis/metrics.k8s.io/v1beta1/namespaces/<NAMESPACE>/pods/<POD_NAME> | jq
```

How to Expose the cluster service

You have some cluster service For instance, kube-state-metrics, you can use port forwarding technique to test the service.

```
$ kubectl get svc --all-namespaces
NAMESPACE       NAME                TYPE        CLUSTER-IP      EXTERNAL-IP
PORT(S)
default         kube-state-metrics  ClusterIP   172.20.1.144    <none>
8080/TCP
```

Let’s test it locally, by exposing the service, run the below command

```
$ kubectl --namespace default<<or other namespace where service resides>> port-forward
svc/kube-state-metrics 8080:8080
Forwarding from 127.0.0.1:8080 -> 8080
Forwarding from [::1]:8080 -> 8080
Handling connection for 8080
Handling connection for 8080
```

[After port forward] You will get the output for the below url http://127.0.0.1:8080/metrics

Troubleshoot in your clusters:

Troubleshoot the pod:

Encoded Error Message

If your application sends sensitive error messages in encoded form, you can get decoded through sts.

$aws sts decode-authorization-message --encoded-message <<encoded error messages that are from aws/kubernetes>>

```
$aws sts decode-authorization-message --encoded-message <<error messages>>
```

Pods in the pending state

It can't be scheduled onto a node. Below - the output of the "describe pod" command to get some insights on why it is in pending state.

$ kubectl describe pod spindle-nuance-7684d65bb-5577h -n spindle-nuance

```
Name:         spindle-nuance-7684d65bb-5577h
Priority:     0
Status:       Pending
Containers:
  spindle-nuance-container:
    State:          Waiting
      Reason:       ContainerCreating
    Ready:          False
    Restart Count:  0
    Limits:
      cpu:  1
    Requests:
      cpu:  500m
Conditions:
  Type              Status
  Initialized       True
  Ready             False
  ContainersReady   False
  PodScheduled      True

  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  2m29s  default-scheduler   0/2 nodes are available: 1 node(s) had
taint {node.kubernetes.io/memory-pressure: }, that the pod didn't tolerate, 1 node(s) were
unschedulable.
  <<some more messages here>>
  Normal   Pulling         58s    kubelet           Pulling image
"594977439087.dkr.ecr.us-east-1.amazonaws.com/spindle/nuance:v1.9"
```

Reason for Pending state

Pending state can happen because:

1) There are no nodes available
2) There are insufficient resources on the available worker nodes
    a) This can be due to not enough available cpu/disk/ram/pods on the worker node to accommodate the pods
3) Nodes have taints that which pods can't tolerate
4) You have defined an occupied hostPort

```
kubectl describe node ip-10-10-2-118.ec2.internal
Name:             ip-10-10-2-118.ec2.internal
Roles:            <none>
Labels:           beta.kubernetes.io/arch=amd64
               beta.kubernetes.io/instance-type=t3.medium
               beta.kubernetes.io/os=linux
               eks.amazonaws.com/capacityType=ON_DEMAND
               eks.amazonaws.com/nodegroup=spindle-ai-eks-terraform-cluster-private-ng
               eks.amazonaws.com/nodegroup-image=ami-06ce408c7d97c5f2d
               failure-domain.beta.kubernetes.io/region=us-east-1
               failure-domain.beta.kubernetes.io/zone=us-east-1a
               k8s.io/cloud-provider-aws=f1e7420fe24818b3ea0df8f6de77268f
               kubernetes.io/arch=amd64
               kubernetes.io/hostname=ip-10-10-2-118.ec2.internal
               kubernetes.io/os=linux
               node.kubernetes.io/instance-type=t3.medium
               topology.kubernetes.io/region=us-east-1
               topology.kubernetes.io/zone=us-east-1a
Annotations:       node.alpha.kubernetes.io/ttl: 0
               volumes.kubernetes.io/controller-managed-attach-detach: true
CreationTimestamp:  Wed, 31 Aug 2022 12:57:36 +0530
Taints:            DeletionCandidateOfClusterAutoscaler=1661932171:PreferNoSchedule
Unschedulable:      false
Lease:
  HolderIdentity:  ip-10-10-2-118.ec2.internal
  AcquireTime:     <unset>
  RenewTime:       Wed, 31 Aug 2022 13:36:24 +0530
Conditions:
  Type           Status  LastHeartbeatTime                LastTransitionTime               Reason
Message
  ----           ------  -----------------                ------------------               ------                 -------
  MemoryPressure   False   Wed, 31 Aug 2022 13:35:25 +0530   Wed, 31 Aug 2022 13:30:24
+0530   KubeletHasSufficientMemory   kubelet has sufficient memory available
  DiskPressure     False   Wed, 31 Aug 2022 13:35:25 +0530   Wed, 31 Aug 2022 12:57:34 +0530
KubeletHasNoDiskPressure     kubelet has no disk pressure
  PIDPressure      False   Wed, 31 Aug 2022 13:35:25 +0530   Wed, 31 Aug 2022 12:57:34 +0530
KubeletHasSufficientPID      kubelet has sufficient PID available
  Ready            True    Wed, 31 Aug 2022 13:35:25 +0530   Wed, 31 Aug 2022 12:57:56 +0530
KubeletReady                 kubelet is posting ready status
Addresses:
  InternalIP:   10.10.2.118
  Hostname:     ip-10-10-2-118.ec2.internal
  InternalDNS:  ip-10-10-2-118.ec2.internal
```

```
Capacity:
  attachable-volumes-aws-ebs:  25
  cpu:                         2
  ephemeral-storage:           20959212Ki
  hugepages-1Gi:               0
  hugepages-2Mi:               0
  memory:                      3965444Ki
  pods:                        17
Allocatable:
  attachable-volumes-aws-ebs:  25
  cpu:                         1930m
  ephemeral-storage:           18242267924
  hugepages-1Gi:               0
  hugepages-2Mi:               0
  memory:                      3410436Ki
  pods:                        17
System Info:
  Machine ID:                  ec2c512cb9dcdd250cad4b2db03ddc5e
  <<some more key-value pair>>
  Namespace                    Name               CPU Requests  CPU Limits  Memory Requests  Memory
Limits  Age
  ---------                    ----               ------------  ----------  ---------------  -------------  ---
  kube-system                  aws-node-qgrsc     25m (1%)      0 (0%)      0 (0%)           0 (0%)         11m
  kube-system                  kube-proxy-lmvvj   100m (5%)     0 (0%)      0 (0%)           0 (0%)         11m
Allocated resources:
  (Total limits may be over 100 percent, i.e., overcommitted.)
  Resource                     Requests   Limits
  --------                     --------   ------
  cpu                          125m (6%)  0 (0%)
 <<some more rows>>
  attachable-volumes-aws-ebs  0          0
Events:
  Type    Reason                     Age                From               Message
  ----    ------                     ----               ----               -------
  Normal  Starting                   38m                kube-proxy
  Normal  Starting                   11m                kube-proxy
  Normal  NodeHasNoDiskPressure      39m (x2 over 39m)  kubelet            Node
ip-10-10-2-118.ec2.internal status is now: NodeHasNoDiskPressure
  Normal  NodeAllocatableEnforced    39m                kubelet            Updated Node Allocatable
limit across pods
  Normal  Starting                   39m                kubelet            Starting kubelet.
  Normal  NodeHasSufficientPID       39m (x2 over 39m)  kubelet            Node
ip-10-10-2-118.ec2.internal status is now: NodeHasSufficientPID
  Normal  RegisteredNode             38m                node-controller    Node
ip-10-10-2-118.ec2.internal event: Registered Node ip-10-10-2-118.ec2.internal in Controller
  Normal  NodeReady                  38m                kubelet            Node ip-10-10-2-118.ec2.internal
status is now: NodeReady
  Normal  ScaleDown                  11m                cluster-autoscaler  marked the node as
toBeDeleted/unschedulable
```

```
  Warning  EvictionThresholdMet       11m (x5 over 35m)    kubelet            Attempting to reclaim
memory
  Normal   NodeHasInsufficientMemory  11m (x3 over 35m)    kubelet            Node
ip-10-10-2-118.ec2.internal status is now: NodeHasInsufficientMemory
  Normal   ClusterAutoscalerCleanup   10m                  cluster-autoscaler  removed
ToBeDeletedTaint taint from node ip-10-10-2-118.ec2.internal
  Normal   NodeHasSufficientMemory    6m10s (x5 over 39m)  kubelet            Node
ip-10-10-2-118.ec2.internal status is now: NodeHasSufficientMemory
```

Troubleshoot the memory and storage

This issue happened due to the lack of temporary storage while processing such as applications process their jobs and store temporary, cache data. To resolve this issue, you must dive into your pod, and check when the process running which device location cost your available storage by command df-h, and observe the available capacity size. You can create an pvc (with hostpath, or other ways) which has larger size and mount into pod's directory which store their temporary data.

```
curl --location --request POST
'http://afc2153d20f6541adbc082fe2235cb05-1550214045.us-east-1.elb.amazonaws.com:7000
/api/v1/spindle/getprediction' --form 'aiProduct="spindle"' --form
'studyId="456.456.35.4645.6567.567.457"' --form 'version="2"' --form 'type="zip"' --form
'file=@"Downloads/ANON_PATIENT_0659_MR_1643812383.zip"'
```

To get the free memory on the node

```
free -h -s 5 -c 20
```

to understand the port used status:

```
sudo lsof -i -P -n | grep LISTEN
```

Unlock the terraform acquired state

Manually unlock the state for the defined configuration.

This will not modify your infrastructure. This command removes the lock on the state for the current configuration. The behavior of this lock is dependent on the backend being used. Local state files cannot be unlocked by another process.

Usage: terraform force-unlock [options] LOCK_ID

Manually unlock the state for the defined configuration.

This will not modify your infrastructure. This command removes the lock on the state for the current configuration. The behavior of this lock is dependent on the backend being used. Local state files cannot be unlocked by another process.

Exposing multiple ports/services on same Load Balancer in Kubernetes

Scenario: I have to expose Kibana (5601), Apache Storm (8080) & say nginx (80), all on the same Load Balancer (public IP) on Kubernetes.

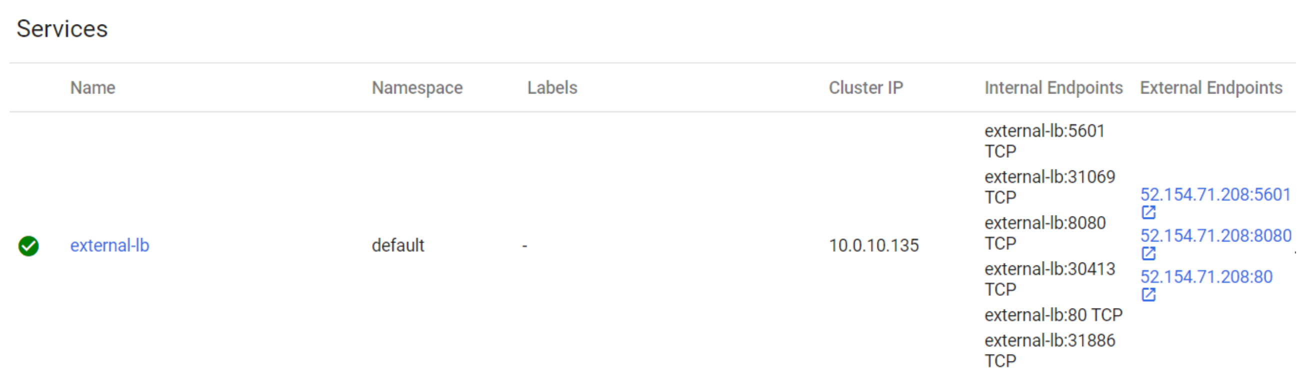
Implementation:

You can have multiple tags on the same workload (Deployment /Service /Pod /etc.). And then Kubernetes will internally link objects with similar tags together.

Step 1: Create an external facing Load Balancer

```
apiVersion: v1
kind: Service
metadata:
  name: external-lb
spec:
  type: LoadBalancer
  ports:
  - name: elk-kibana
    port: 5601
    targetPort: "5601-port"
  - name: storm-nimbus
    port: 8080
    targetPort: "8080-port"
  - name: nginx
    port: 80
    targetPort: "80-port"
  selector:
    lbtype: external
```

Nothing fancy in the yaml file other than a label architecture as an important point – selector (lbtype: external)


Services

	Name	Namespace	Labels	Cluster IP	Internal Endpoints	External Endpoints
✓	external-lb	default	-	10.0.10.135	external-lb:5601 TCP external-lb:31069 TCP external-lb:8080 TCP external-lb:30413 TCP external-lb:80 TCP external-lb:31886 TCP	52.154.71.208:5601 52.154.71.208:8080 52.154.71.208:80

<u>Step 2</u>: Create deployment/services to setup Kibana, Apache Storm & Nginx

Kibana : Kind - Deployment

```
—-------------------- —-----------
apiVersion: apps/v1
kind: Deployment
 metadata:
   name: elk-kibana
   labels:
     app: elk-kibana
 spec:
   replicas: 1
   selector:
     matchLabels:
       lbtype: external
   template:
     metadata:
       labels:
         lbtype: external
         app: elk-kibana
     spec:
       containers:
       - name: elk-kibana
         image: elk-kibana:7.4.0-2
         imagePullPolicy: Always
         resources:
           limits:
             cpu: 1500m
             memory: "2Gi"
         ports:
```

```
        - containerPort: 5601
          name: "5601-port"
```

Nimbus: Kind - Service with StatefuleSet

——————————— ——————————

```
apiVersion: v1
kind: Service
metadata:
  name: storm-nimbus
  labels:
    app: storm-nimbus
spec:
  ports:
  - port: 8080
    targetPort: 8080
    name: 8080-port
  selector:
    app: storm-nimbus
---
apiVersion: apps/v1
kind: StatefulSet
metadata:
  name: storm-nimbus
spec:
  selector:
    matchLabels:
      lbtype: external
  serviceName: storm-nimbus
  replicas: 2
  updateStrategy:
    type: RollingUpdate
  template:
    metadata:
      labels:
        app: storm-nimbus
        lbtype: external
    spec:
```

```
    containers:
    - name: storm-nimbus
      imagePullPolicy: Always
      image: storm-nimbus-clustered:1.2.1
      resources:
        requests:
          memory: "2G"
      ports:
      - containerPort: 8080
        name: 8080-port
      volumeMounts:
      - name: storm-nimbus-data
        mountPath: /var/lib/storm
      - name: storm-logs
        mountPath: /usr/share/storm/logs
      env:
        - name: node.name
          valueFrom:
            fieldRef:
              fieldPath: metadata.name
    volumes:
    - name: storm-logs
      hostPath:
        path: /var/log/containers/storm-nimbus/default
volumeClaimTemplates:
- metadata:
    name: storm-nimbus-data
    labels:
      app: storm-nimbus
  spec:
    accessModes: [ "ReadWriteOnce" ]
    storageClassName: managed-premium-retain
    resources:
      requests:
        storage: 10Gi
```

Nginx: Kind - Deployment
—--------------------------- —------------

```
apiVersion: apps/v1
kind: Deployment
 metadata:
   name: nginx
   labels:
     app: nginx
 spec:
   replicas: 1
   selector:
     matchLabels:
       lbtype: external
   template:
     metadata:
       labels:
         lbtype: external
         app: nginx
     spec:
       containers:
       - name: nginx
         image: nginx:latest
         tty: true
         imagePullPolicy: Always
         resources:
           limits:
             cpu: 500m
             memory: "1Gi"
         ports:
         - containerPort: 80
           name: "80-port"
```

In all of the above deployment files, if you see carefully, there are multiple labels, one for selector and one for template. Selector will link each workload with external-lb (based of label name) whereas, to individually track deployment/service, we are using another label "app".
"lbtype: external" is set as selector for external-lb and so all the objects will be linked to external-lb with same label.

Advanced traffic routing in Kubernetes using Ingress resources

Ingress can be used to expose your Pods running behind a Service object to the external world using HTTP and HTTPS routes.

Some cons on expose your application using Service objects directly, especially the LoadBalancer Service:

1. This approach works fine only in cloud environments where you have cloud-controller-manager running and by configuring external load balancers to be used with this type of Service.
2. Each LoadBalancer Service requires a separate instance of the cloud load balancer, which brings additional costs and maintenance overhead.

We are going to introduce Ingress and Ingress Controller, which can be used in any type of environment to provide routing and load-balancing capabilities for your application.

We have learned about Service objects, which can be used to expose Pods to load-balanced traffic, both internal as well as external. Internally, they are implemented as virtual IP addresses managed by kube-proxy at each of the Nodes. We are going to do a quick recap of different types of services:

1. ClusterIP
2. NodePort
3. LoadBalancer

To make it easier to explain, we will assume that we have a Deployment running three replicas of Pods running the nginx container, which has the following YAML manifest:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment-example
spec:
  replicas: 3

  selector:
    matchLabels:
      environment: test

  template:
    metadata:
      labels:
        environment: test

    spec:
      containers:
```

```
    - name: nginx
      image: nginx:1.17
      ports:
      - containerPort: 80
```

The Pod exposes TCP port 80, which is used by the nginx process to serve the requests, and we will now discuss the details of using the ClusterIP Service to expose this Deployment internally.

The ClusterIP Service

Let's now take a look at the ClusterIP Service type. This type of Service exposes Pods using internally visible virtual IP addresses managed by kube-proxy on each Node. This means that the Service will be reachable from within the cluster only. Consider the following manifest for the service:

```
apiVersion: v1
kind: Service

metadata:
  name: nginx-deployment-example-clusterip
spec:
  selector:
    environment: test
  type: ClusterIP

  ports:
  - port: 8080
    protocol: TCP
    targetPort: 80
```

The ClusterIP Service is configured in such a way that it will map requests coming from its IP and TCP port 8080 to the container's TCP port 80. The actual ClusterIP address is assigned dynamically, unless you specify one explicitly in the specifications. The internal DNS Service in a Kubernetes cluster is responsible for resolving the nginx-deployment-example name to the actual ClusterIP address as a part of service discovery.

Following diagrams that represent how the Service types are implemented logically. In fact, under the hood, kube-proxy is responsible for managing the virtual IP addresses on the Nodes and modifying all forwarding rules. So, services exist only as a logical concept inside the cluster. There is no physical process that runs inside the cluster for each Service and does the proxying.

We have visualized the ClusterIP Service principles in the following diagram:

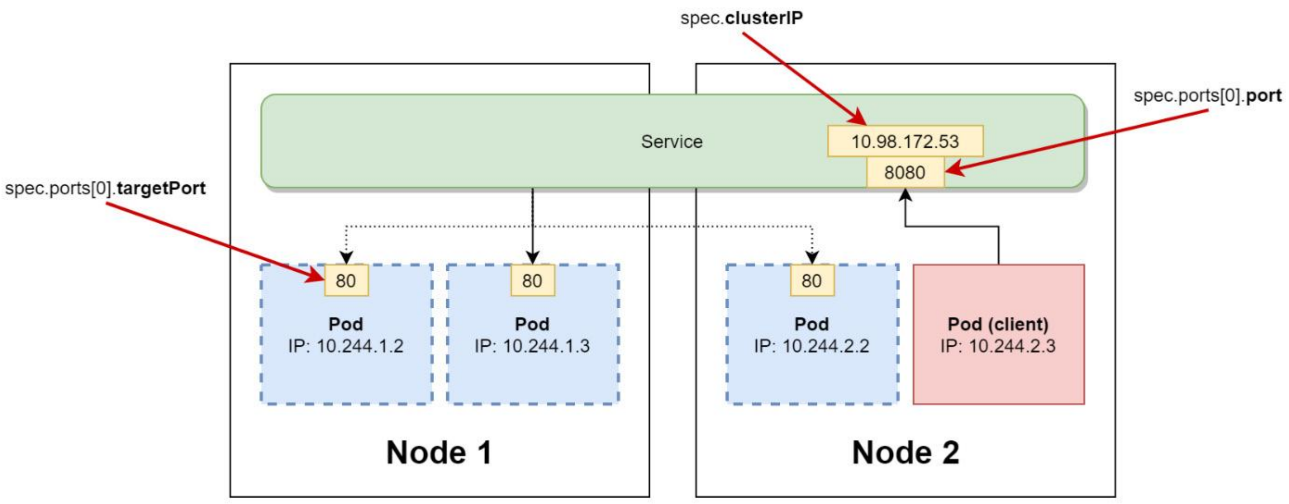


Figure – ClusterIP Service

The diagram includes references to the Kubernetes objects specifications to make it easier to understand the connections. ClusterIP Services are the most basic type of Service in Kubernetes and they are part of other Service types that allow Pods to be exposed to external traffic: NodePort and LoadBalancer.

NodePort service

This type of Service is similar to the ClusterIP Service but additionally, it can be reached by any cluster node IP address and specified port. To achieve that, kube-proxy exposes the same port on each Node in the range 30000-32767 (which is configurable) and sets up forwarding so that any connections to this port will be forwarded to ClusterIP.

Let's take a look at an example YAML manifest of the NodePort Service:

```
apiVersion: v1
kind: Service
metadata:
  name: nginx-deployment-example-nodeport

spec:
  selector:
    environment: test

  type: NodePort

  ports:
  - port: 8080
    nodePort: 31001
    protocol: TCP
    targetPort: 80
```

In this case, TCP port 31001 is used as the external port on each Node. If you do not specify nodePort, it will be allocated dynamically using the range. For internal communication, this Service still behaves like a simple ClusterIP Service, and you can use its ClusterIP address.

These principles have been visualized in the following diagram:

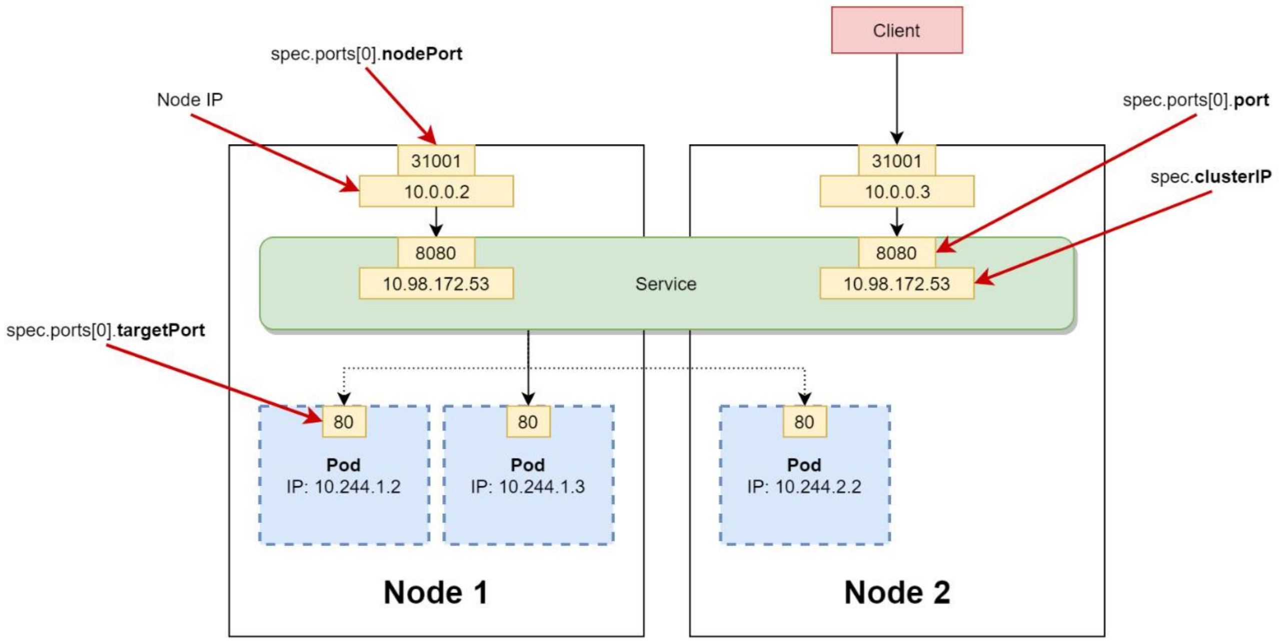


Figure – NodePort service

You will need the NodePort Service if you want to set up load balancing externally, without using any Kubernetes constructs. They can also be used for communicating directly with the Pods, but exposing the external IP addresses of Nodes is usually not a good idea in terms of security. Please note that many other components rely on NodePort Services; for example, they are used in LoadBalancer Service implementations or when exposing Ingress Controller.
We will now do a quick recap of the LoadBalancer Service.

The LoadBalancer service

This is the second type of Service that allows external traffic to the Pods. The LoadBalancer Service is usually used in cloud environments where you have software-defined networking (SDN), and you can configure load balancers on demand that redirect traffic to your cluster. The automatic provisioning of load balancers in the cloud is done by vendor-specific plugins in cloud-controller-manager. This type of service combines the approach of the NodePort Service with an additional external load balancer in front of it, which routes traffic to NodePorts.

Let's take a look at an example YAML manifest of the LoadBalancer Service:

```
apiVersion: v1
kind: Service
metadata:
  name: nginx-deployment-example-lb

spec:
  selector:
    environment: test
  type: LoadBalancer
```

```
 ports:
 - port: 8080
   protocol: TCP
   targetPort: 80
```

When you create such a Service, it will behave as a NodePort Service with a randomly assigned port and a cloud load balancer that serves requests at TCP port 8080 and forwards them to NodePorts. The external IP address of the service is provided by the load balancer and is also available in the Service object in .status.loadBalancer.ingress[0].ip. These principles have been visualized in the following diagram:

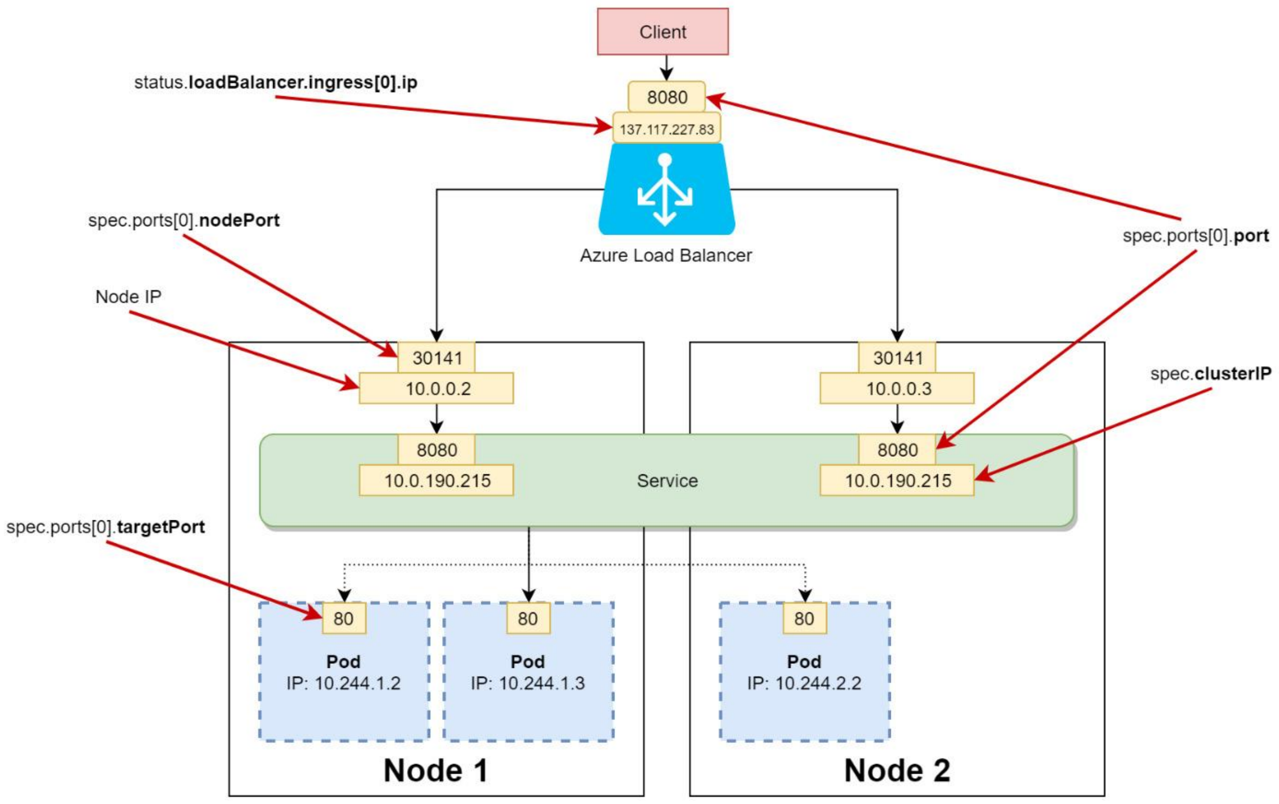


Figure – LoadBalancer service

You can still, of course, use the service internally via its ClusterIP.

It may seem appealing to always use Kubernetes services for allowing external traffic to the cluster, but there are a few disadvantages of using them all the time. We will now introduce the Ingress object and discuss why it is needed and when it should be used instead of Services to manage external traffic.

Introducing the Ingress object

In the previous section, we did a short recap of Service objects in Kubernetes and their role in routing traffic. From the perspective of external traffic, the most important are the NodePort Service and the LoadBalancer Service. In general, the NodePort Service can only be used in conjunction with a different routing and load balancing component, as exposing multiple external endpoints on all Kubernetes Nodes is not secure. This leaves us with the LoadBalancer Service, which, under the hood, relies on NodePort. There are a few problems with this type of Service in some use cases:

1. The LoadBalancer Service is used for L4 load balancing, which means it is done at OSI layer 4 (transport). The load balancer can make the decisions based on the TCP/UDP protocol.
2. Applications that use HTTP or HTTPS protocols often require L7 load balancing, which is done at OSI layer 7 (application).
3. The L4 load balancer cannot do HTTPS traffic termination and offloading.
4. You cannot implement name-based virtual hosting using the same L4 load balancer for multiple domain names.
5. You need an L7 load balancer to implement path-based routing. For example, configuring requests to https://<loadBalancerIp>/service1 to be redirected to the Kubernetes Service named service1, and requests to https://<loadBalancerIp>/service2 to be redirected to the Kubernetes Service named service2 is not possible with the L4 load balancer – it is not aware of the HTTP(S) protocol.
6. You need an L7 load balancer if you want to implement features such as sticky sessions or cookie affinity.

In Kubernetes, you can solve these problems using an Ingress object, which can be used for implementing and modeling L7 load balancing. The Ingress object is used for defining the routing and balancing rules only, for example, which path should be routed to which Kubernetes Service.

Let's take a look at an example YAML manifest file, example-ingress.yaml, for Ingress:

```
apiVersion: networking.k8s.io/v1beta1
kind: Ingress

metadata:
  name: example-ingress
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /

spec:
  rules:
  - http:
host
      paths:

      - path: /service1
        pathType: Prefix
        backend:
          serviceName: example-service1
          servicePort: 80

      - path: /service2
        pathType: Prefix
        backend:
          serviceName: example-service2
          servicePort: 80
```

Simply put, Ingress is an abstract definition of routing rules for your Services. Alone, it is not doing anything; it requires the Ingress Controller to actually process and implement these rules – you can apply the manifest file, but at this point, it will have no effect. But first, we will explain how the Ingress HTTP routing rules are built. Each of these rules in the specification contains the following:

Optional host: In the example, we are not using this field, so the rule that we defined is applied to all incoming traffic. If the field value is provided, then the rule applies only to requests that have this host as the destination – you can have multiple hostnames resolving to the same IP address. The host field supports wildcards.

List of path routings: Each of the paths has an associated Ingress backend that you define by providing serviceName and servicePort. In the preceding example, all requests arriving at the path with the prefix /service1 will be routed to Pods of the example-service1 Service, and all requests arriving at the path with the prefix /service2 will be routed to Pods of the example-service2 Service. The path fields support prefixes and exact matching, and it is also possible to use implementation-specific matching, which is carried out by the underlying Ingress Controller.
In this way, you can configure complex routing rules that involve multiple Services in the cluster, but externally they will be visible as a single endpoint with multiple paths available. This is especially useful when you create API gateways in microservice architecture for frontend or client applications.

To materialize Ingress objects, we need to have an Ingress Controller installed in the cluster.

Using nginx as an Ingress Controller

An Ingress Controller is a Kubernetes controller that is deployed manually to the cluster, most often as a DaemonSet or a Deployment object that runs dedicated Pods for handling incoming traffic load balancing and smart routing. It is responsible for processing the Ingress objects (which specify that they especially want to use the Ingress Controller) and dynamically configuring real routing rules. A commonly used Ingress controller for Kubernetes is ingress-nginx (https://www.nginx.com/products/nginx/kubernetes-ingress-controller), which is installed in the cluster as a Deployment of an nginx web host with a set of rules for handling Ingress API objects. The Ingress Controller is exposed as a Service with a type that depends on the installation – in cloud environments, this will be LoadBalancer.

The installation of ingress-nginx is described for different environments in the official documentation: https://kubernetes.github.io/ingress-nginx/deploy/. Note that it is also possible to use Helm to install this Ingress Controller, which makes management and upgrades a bit easier. For cloud environments, the installation is usually very simple and involves applying a single YAML manifest file, which creates multiple Kubernetes objects.

```
$ kubectl apply -f
https://raw.githubusercontent.com/kubernetes/ingress-nginx/master/deploy/static/provider/cloud/de
ploy.yaml
namespace/ingress-nginx created
serviceaccount/ingress-nginx created
configmap/ingress-nginx-controller created

...
```

Now, we can also create our example Services together with the Ingress object that defines routings for them. First, we will create the Service objects and Deployment objects. There is no need to explain the YAML manifests as they are simple web servers printing out a welcome message with information on which Service you have reached:

```
$ kubectl apply -f
https://raw.githubusercontent.com/PacktPublishing/Kubernetes-for-Beginners/master/Chapter21/02
_ingress/example-services.yaml

deployment.apps/example-service1 created
deployment.apps/example-service2 created
service/example-service1 created
service/example-service2 created
```

Next, we can apply the Ingress object to the cluster that we created earlier:

```
$ kubectl apply -f ./example-ingress.yaml

ingress.networking.k8s.io/example-ingress created
```

By this time, the LoadBalancer Service that is running as part of Ingress Controller should already be functional and have an external IP address available. You can get it using the following command:

```
$ kubectl describe svc -n ingress-nginx ingress-nginx-controller
...

LoadBalancer Ingress:     137.117.227.83
...
```

At this point, we can visualize what is happening behind Ingress Controller in the following diagram:

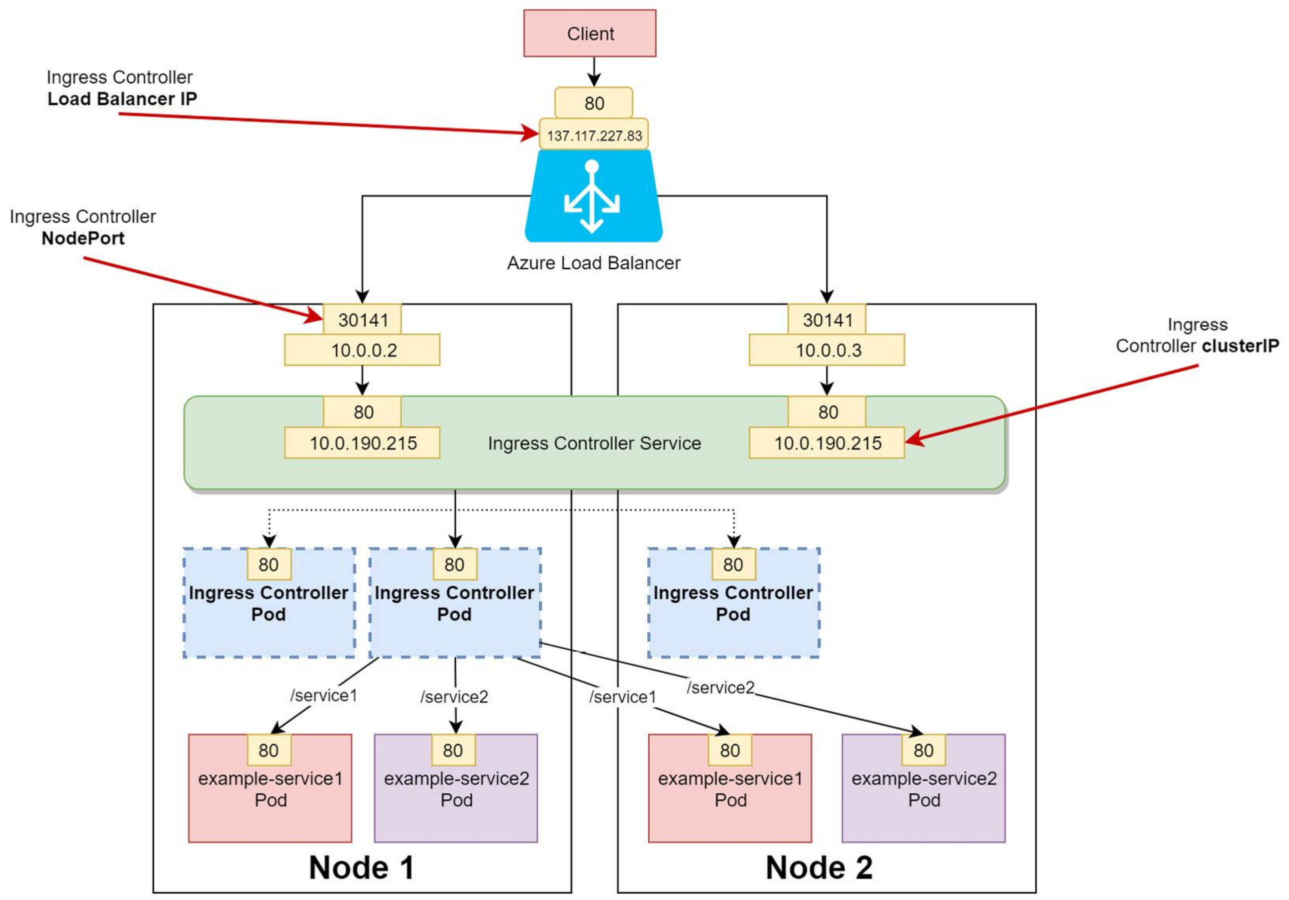
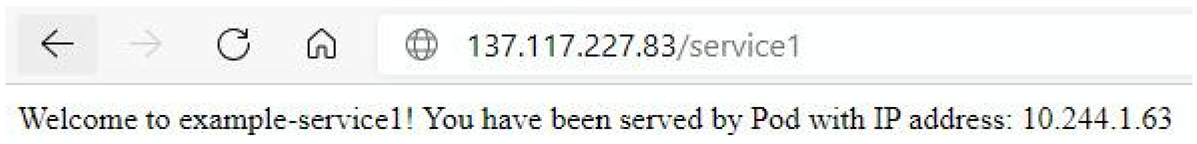


Figure – Using nginx as Ingress Controller in a cloud environment

When you perform an HTTP request to http://<ingressServiceLoadBalancerIp>/service1, the traffic will be routed by nginx to example-service1. Similarly, when you use the /service2 path, the traffic will be routed to example-service2. Note that you are using only one cloud load balancer for this operation, and that the actual routing to Kubernetes Services is performed by the Ingress Controller Pods using path-based routing.

In practice, you need to set up SSL certificates for your HTTP endpoints to ensure proper security. In our examples, we are not doing that for simplicity and to make the demonstrations clearer.

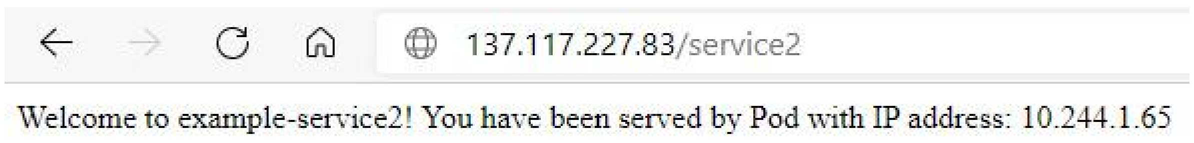
Let's verify this in practice. In your web browser, navigate to the /service1 path. In our case, this will be http://137.117.227.83/service1. You will see that you are served by example-service1 Pods:


137.117.227.83/service1

Welcome to example-service1! You have been served by Pod with IP address: 10.244.1.63

Figure – Routing to example-service1 via the nginx Ingress Controller

Now, navigate to the /service2 path. In our case, this will be http://137.117.227.83/service2. You will see that you are served by example-service2 Pods:



137.117.227.83/service2

Welcome to example-service2! You have been served by Pod with IP address: 10.244.1.65

Figure – Routing to example-service2 via the nginx Ingress Controller

Congratulations! You have successfully configured Ingress and Ingress Controller in your cluster.

Summary

We have explained advanced traffic routing approaches in Kubernetes using Ingress objects and Ingress Controllers. At the beginning, we did a brief recap of Kubernetes Service types. We refreshed our knowledge regarding ClusterIP, NodePort, and LoadBalancer Service objects. Based on that, we introduced Ingress objects and Ingress Controller and explained how they fit into the landscape of traffic routing in Kubernetes. Now, you know that simple Services are commonly used when L4 load balancing is required, but if you have HTTP or HTTPS endpoints in your applications, it is better to use L7 load balancing offered by Ingress and Ingress Controllers. You learned how to deploy the nginx web server as Ingress Controller and we tested this on example Deployments.

For more information regarding autoscaling in Kubernetes, please refer to the following Packt books:

The Complete Kubernetes Guide, by Jonathan Baier, Gigi Sayfan, Jesse White (https://www.packtpub.com/virtualization-and-cloud/complete-kubernetes-guide)

Getting Started with Kubernetes – Third Edition, by Jonathan Baier, Jesse White (https://www.packtpub.com/virtualization-and-cloud/getting-started-kubernetes-third-edition)

Kubernetes for Developers, by Joseph Heck (https://www.packtpub.com/virtualization-and-cloud/kubernetes-developers)

You can also refer to the following official documentation:

Kubernetes documentation (https://kubernetes.io/docs/home/), which is always the most up-to-date source of knowledge regarding Kubernetes in general.

A list of many available Ingress Controllers can be found at the following link: https://kubernetes.io/docs/concepts/services-networking/ingress-controllers/.

For Amazon EKS, there is AWS Load Balancer Controller. You can find more information in the official documentation: https://docs.aws.amazon.com/eks/latest/userguide/alb-ingress.html

Starting a message queue service

Reference Link: https://kubernetes.io/docs/tasks/job/coarse-parallel-processing-work-queue/

Fine Parallel Processing Using a Work Queue

https://kubernetes.io/docs/tasks/job/fine-parallel-processing-work-queue/

In practice you could set up a message queue service once in a cluster and reuse it for many jobs, as well as for long-running services.
Start RabbitMQ as follows:

```
kubectl create -f
https://raw.githubusercontent.com/kubernetes/kubernetes/release-1.3/examples
/celery-rabbitmq/rabbitmq-service.yaml

service "rabbitmq-service" created

kubectl create -f
https://raw.githubusercontent.com/kubernetes/kubernetes/release-1.3/examples
/celery-rabbitmq/rabbitmq-controller.yaml

replicationcontroller "rabbitmq-controller" created
```

1. `helm repo add airflow-stable https://airflow-helm.github.io/charts`

2. `helm repo update`

3.
   ```
   helm install RELEASE_NAME airflow-stable/airflow
   --namespace NAMESPACE \
   --version CHART_VERSION
   ```

4.
   ```
   helm install --generate-name airflow-stable/airflow
   --namespace spindle-nuance --version 8.6.1
   ```
   a. **`RELEASE_NAME is airflow-1666420923`**

Prometheus Introduction

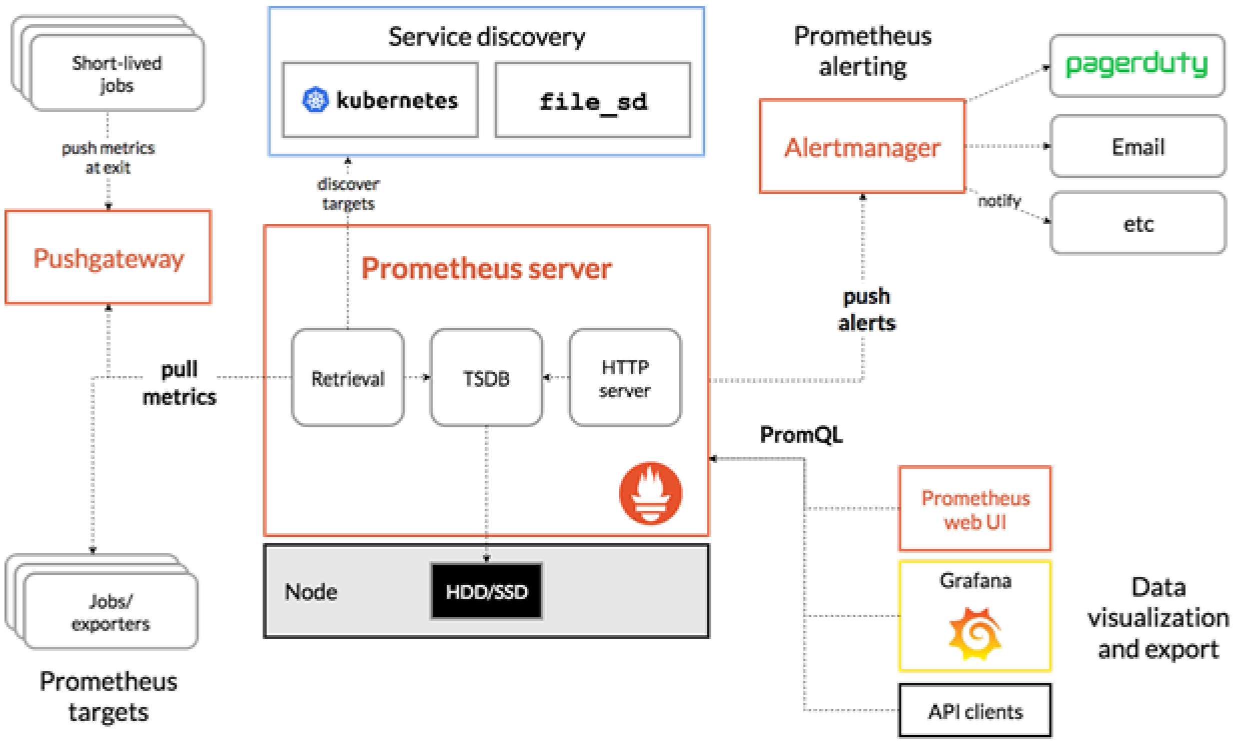
1. An open-source monitoring system with a dimensional data model, flexible query language, efficient time series database and modern alerting approach (i.e., metrics information is stored with the timestamp at which it was recorded, alongside optional key-value pairs called labels).
2. Prometheus comes with its language called “PromQL” to query the metrics it scrapes from various sources.
3. Target endpoints can be added to Prometheus via Service Discovery, using node exporters, through static configuration, or client libraries.

Prometheus Architecture

Prometheus mostly works through a Pull-based model of gathering data exposed via HTTP endpoints of the targets. A push-based data gathering can be achieved through a Push-gateway setup. Prometheus architecture can be divided into **five** components.

1. The central **Prometheus Server** is the heart of the monitoring system.

2. **Targets:** which are the producers of metrics, the metric data on them are exposed to the Prometheus Server via Client Libraries (To access application code-related metrics available in multiple supported languages. These libraries format the metrics in Prometheus readable form), Exporters (are used when the application source code is not accessible, they live alongside the application. Ex: Database Exporter, Node Exporter for host stats, HaProxy Exporter for storage, messaging & HTTP).
3. **Service Discovery:** a mechanism for discovering services like EC2 instances and K8S on the cloud and scraping data from them.
4. **Storage:** Prometheus persists the data on the local host or in a cloud environment; an external persistent storage volume can be used.
5. **Alerting & Visualizing:** The expression browser is a web-based UI where these metrics can be visualized in a central location. Using the Alertmanager component of Prometheus, alerts can be set and managed.



MONITORING LINUX HOST METRICS WITH THE NODE EXPORTER

Node Exporter is **a Prometheus exporter for server level and OS level metrics with configurable metric collectors**. It helps us in measuring various server resources such as RAM, disk space, and CPU utilization.

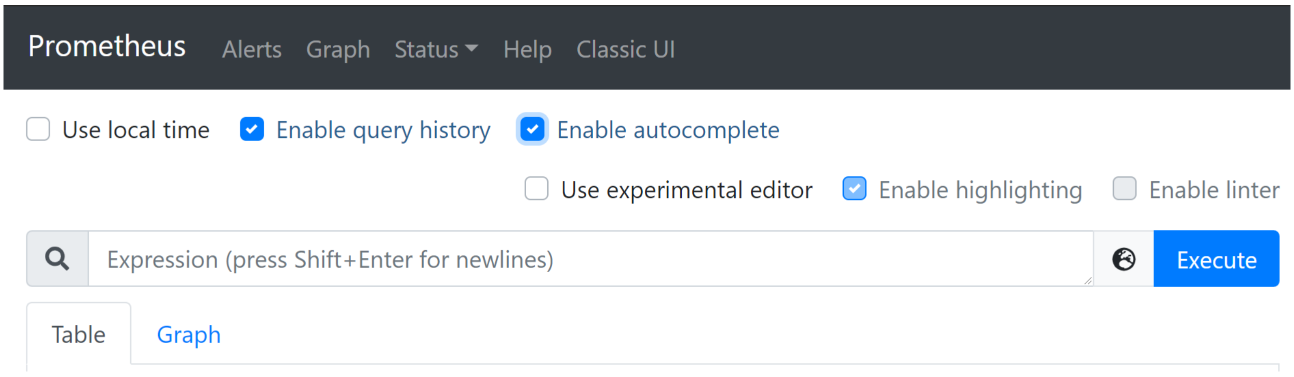
The Prometheus Node Exporter exposes a wide variety of hardware- and kernel-related metrics.

[if node is inside EKS/Kubernetes cluster, Node Exporter can be installed as a DaemonSet kind in the kubernetes cluster]

1) cd opt
2) touch node_exporter_download.tar.gz
3) sudo wget -O /opt/node_exporter_download.tar.gz https://github.com/prometheus/node_exporter/releases/download/v1.4.0/node_exporter-1.4.0.linux-amd64.tar.gz
4) sudo tar xf node_exporter_download.tar.gz
5) sudo mv node_exporter-1.4.0.linux-amd64 node_exporter
6) cd node_exporter
7) ./node_exporter
8) open 9100 tcp in security group
9) <<public ip or dns>>:9100/metrics (Once the Node Exporter is installed and running, you can verify that metrics are being exported by browsing or cURLing the `/metrics` endpoint)

Exploring Node Exporter metrics through the Prometheus expression browser

Now that Prometheus is scraping metrics from a running Node Exporter instance, you can explore those metrics using the Prometheus UI (aka the expression browser). Navigate to <<ip or dns of prometheus>>:9090/graph in your browser and use the main expression bar at the top of the page to enter expressions. The expression bar looks like this:



Metrics specific to the Node Exporter are prefixed with node_ and include metrics like node_cpu_seconds_total and node_exporter_build_info.

Metric	**Meaning**
`rate(node_cpu_seconds_total{mode="system"}[1m])`	The average amount of CPU time spent in system mode, per second, over the last minute (in seconds)

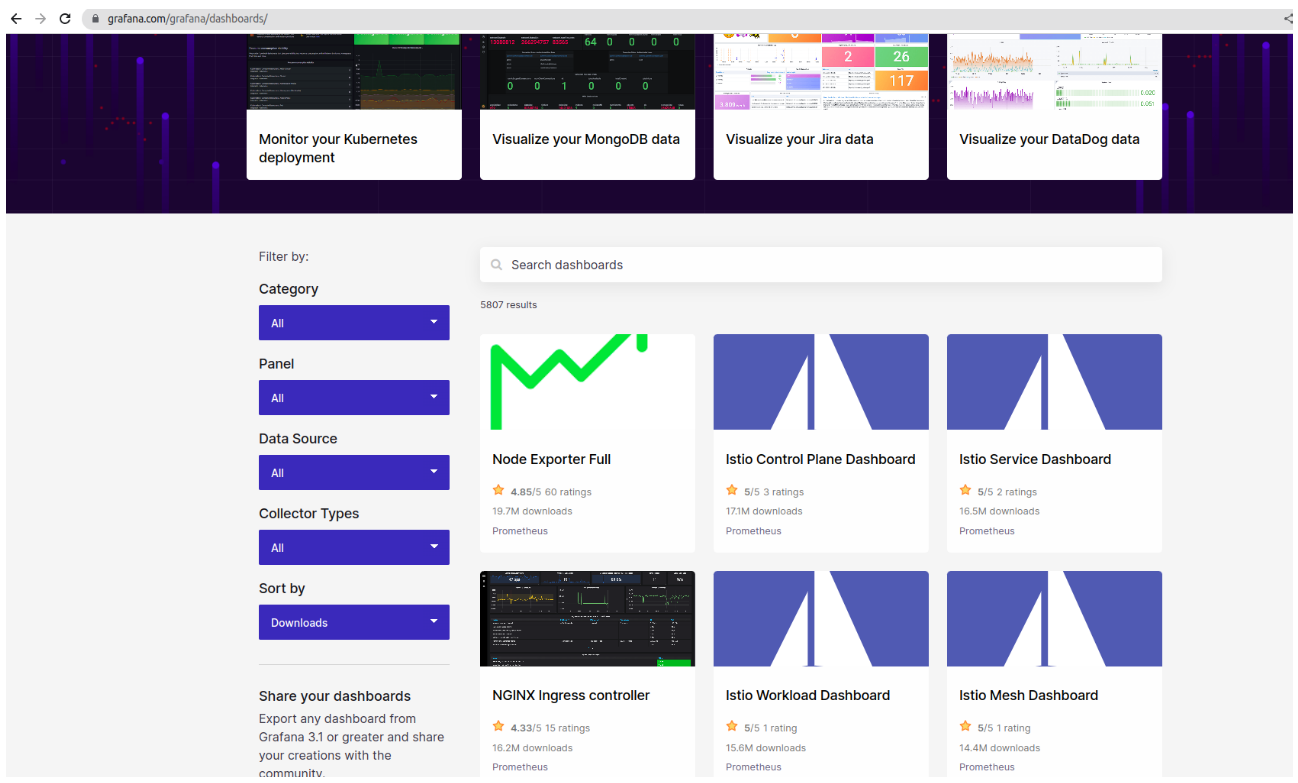
`node_filesystem_avail_bytes`	The filesystem space available to non-root users (in bytes)
`rate(node_network_receive_bytes_total[1m])`	The average network traffic received, per second, over the last minute (in bytes)

Built-in Grafana Dashboard

Grafana community has developed around 5800 dashboards (still growing). We can use it in our product. You can filter by category, panel, datasource and community social feed like rating/download/review. You can import that into your existing grafana in the cluster.

Every dashboard has a unique dashboard id, for instance, https://grafana.com/grafana/dashboards/1860-node-exporter-full/ gnetId is the key in the json model.

```
"description": "Node Exporter Full Prometheus Dashboard",
 "editable": true,
 "fiscalYearStartMonth": 0,
 "gnetId": 1860,
```


grafana.com/grafana/dashboards/

Monitor your Kubernetes deployment

Visualize your MongoDB data

Visualize your Jira data

Visualize your DataDog data

Filter by:

Category: All

Panel: All

Data Source: All

Collector Types: All

Sort by: Downloads

Share your dashboards

Export any dashboard from Grafana 3.1 or greater and share your creations with the community.

Search dashboards

5807 results

Node Exporter Full
4.85/5 60 ratings
19.7M downloads
Prometheus

Istio Control Plane Dashboard
5/5 3 ratings
17.1M downloads
Prometheus

Istio Service Dashboard
5/5 2 ratings
16.5M downloads
Prometheus

NGINX Ingress controller
4.33/5 15 ratings
16.2M downloads
Prometheus

Istio Workload Dashboard
5/5 1 rating
15.8M downloads
Prometheus

Istio Mesh Dashboard
5/5 1 rating
14.4M downloads
Prometheus

Create a Docker Credentials file

In order for Kubernetes to use the credentials, we need to first give it the credentials, and then assign those credentials to either the service account that will be used to pull the images, or specify them directly on the deployment files that need to pull these images.
So first let's create the secret.

The format of the secret is in the format of a .dockerconfigjson file.

The general format of this file is

```
{
    "auths": {
        "https://registry.gitlab.com":{
            "username":"REGISTRY_USERNAME",
            "password":"REGISTRY_PASSWORD",
            "email":"REGISTRY_EMAIL", //We didn't use email
            "auth":"BASE_64_BASIC_AUTH_CREDENTIALS (see below)"
     }
    }
}
```

`BASE_64_BASIC_AUTH_CREDENTIALS:`

The base 64 basic credentials mentioned above are the username and password in basic credentials format `username:password`, encoded with base64 format.

To achieve this simply run :

```
echo -n "REGISTRY_USERNAME:REGISTRY_PASSWORD" | base64
```

```
Create a file with above mentioned json format, and then base64 encode
it for the Kubernetes secret.
cat .dockerconfigjson | base64
This will output the base64 you need for the registry secret.
```

Create a Kubernetes Secret

`Create a file called registry-credentials.yml`

KEDA - scale through external metrics

kubectl apply -f https://github.com/kedacore/keda/releases/download/v2.8.1/keda-2.8.1.yaml

```
namespace/keda created
customresourcedefinition.apiextensions.k8s.io/clustertriggerauthentications.keda.sh created
customresourcedefinition.apiextensions.k8s.io/scaledjobs.keda.sh created
customresourcedefinition.apiextensions.k8s.io/scaledobjects.keda.sh created
customresourcedefinition.apiextensions.k8s.io/triggerauthentications.keda.sh created
serviceaccount/keda-operator created
clusterrole.rbac.authorization.k8s.io/keda-external-metrics-reader created
clusterrole.rbac.authorization.k8s.io/keda-operator created
rolebinding.rbac.authorization.k8s.io/keda-auth-reader created
clusterrolebinding.rbac.authorization.k8s.io/keda-hpa-controller-external-metrics created
clusterrolebinding.rbac.authorization.k8s.io/keda-operator created
clusterrolebinding.rbac.authorization.k8s.io/keda-system-auth-delegator created
service/keda-metrics-apiserver created
deployment.apps/keda-metrics-apiserver created
deployment.apps/keda-operator created
apiservice.apiregistration.k8s.io/v1beta1.external.metrics.k8s.io created
```

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https://learn.hashicorp.com/tutorials/terraform/blue-green-canary-tests-deployments

https://registry.terraform.io/modules/terraform-aws-modules/eks/aws/latest

https://www.youtube.com/watch?v=rv6MOvpXU90

https://www.clickittech.com/devops/terraform-kubernetes-deployment/

https://www.youtube.com/watch?v=rv6MOvpXU90

https://cloud.google.com/docs/terraform/best-practices-for-terraform

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https://blog.wimwauters.com/devops/2019-11-23-aws_terraform_gitlab/

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https://dev.to/stack-labs/deploying-production-ready-gitlab-on-amazon-eks-with-terraform-3coh

Reference – Terraform State Lock
https://jhooq.com/terraform-state-file-locking/

Reference – Kubernetes Course

https://www.youtube.com/watch?v=X48VuDVv0do

https://www.youtube.com/watch?v=EQNO_kM96Mo

Reference - Cluster Autoscaling – creation:
https://hands-on.cloud/how-to-set-up-amazon-eks-cluster-using-terraform/#h-creating-cluster-autoscaler-iam-role-using-terraform

Reference - Scaling user stories
https://github.com/kubernetes/enhancements/blob/master/keps/sig-autoscaling/853-configurable-hpa-scale-velocity/README.md

Reference – Mapping document between docker compose and kubernetes
https://github.com/docker/compose-on-kubernetes/blob/master/docs/mapping.md

Reference – PV and PVC
https://www.containiq.com/post/kubernetes-persistent-volumes

Reference – Few steps to troubleshoot the Pod
https://www.youtube.com/watch?v=FMUAuNrbpcI

Reference - Kubectl
https://www.containiq.com/post/kubectl-cheat-sheet

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Reference - Prometheus and Grafana
https://github.com/prometheus/cloudwatch_exporter
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https://gitlab.com/xavki/presentation-prometheus-grafana
https://github.com/gurpreet0610/Deploy-Prometheus-Grafana-on-Kubernetes
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https://aws.amazon.com/blogs/containers/cost-optimization-for-kubernetes-on-aws/
https://aws.amazon.com/blogs/compute/cost-optimization-and-resilience-eks-with-spot-instances/
https://aws.amazon.com/blogs/containers/saving-money-pod-at-time-with-eks-fargate-and-aws-compute-savings-plans/
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https://tf-eks-workshop.workshop.aws/500_eks-terraform-workshop/560_nodegroup/nodeg-tf.html
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https://github.com/PacktPublishing/The-Kubernetes-Bible/tree/master/Chapter21

Cloud Native Learning
https://github.com/cncf/curriculum.git
https://github.com/antonputra/tutorials/tree/main/lessons

Step 1 - Install NGINX Ingress Controller using Helm

An ingress controller, because it is a core component of Kubernetes, requires specific configuration to be performed at the cluster level as part of installation. Lets look into what happens behind the scenes when you install NGINX ingress using helm. If you'd like to skip this, navigate to the bottom of this section to see the actual steps to install the NGINIX ingress controller.

The recommended configuration for NGINX uses three Kubernetes ConfigMaps:

- Base Deployment
- TCP configuration
- UDP configuration

A Kubernetes service account is required to run NGINX as a service within the cluster. The service account needs to have following roles:

- A cluster role to allow it to get, list, and read the configuration of all services and events. This role could be limited if you were to have multiple ingress controllers installed within the cluster. But in most cases, limiting access for this service account may not be needed.
- A namespace-specific role to read and update all the ConfigMaps and other items that are specific to the NGINX Ingress controller’s own configuration.

To install an NGINX Ingress controller using Helm, add the `nginx-stable` repository to helm, then run `helm repo update` . After we have added the repository we can deploy using the chart `nginx-stable/nginx-ingress`.

1. helm repo add nginx-stable https://helm.nginx.com/stable
2. helm repo update
3. helm install nginx-ingress nginx-stable/nginx-ingress --set rbac.create=true -n monitoring

Step 2 - Validate that NGINX is Running

Make sure the NGINX Ingress controller is running.

Step 3 - Exposing Services using NGINX Ingress Controller

Now that an ingress controller is running in the cluster, you will need to create services that leverage it using either host, URI mapping, or even both.

Sample of a host-based service mapping through an ingress controller using the type “Ingress”:

https://kubernetes.github.io/ingress-nginx/deploy/#aws

https://www.fairwinds.com/blog/intro-to-kubernetes-ingress-set-up-nginx-ingress-in-kubernetes-bare-metal

https://devopscube.com/setup-ingress-kubernetes-nginx-controller/

https://github.com/scriptcamp/nginx-ingress-controller

https://towardsdatascience.com/how-to-set-up-ingress-controller-in-aws-eks-d745d9107307

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https://eksctl.io
https://github.com/cncf/curriculum
https://kubernetes-sigs.github.io/aws-load-balancer-controller/v2.4/
https://github.com/aws/eks-charts
https://artifacthub.io
https://www.youtube.com/watch?v=ZfjpWOC5eoE

https://github.com/antonputra/tutorials/tree/main/lessons/112

--set ingress.enabled=true

--set ingress.ingressClassName=“internet-facing-ingress”

--set ingress.hosts=“your host name”

```
alb.ingress.kubernetes.io/scheme: internet-facing

    kubernetes.io/ingress.class: alb

    alb.ingress.kubernetes.io/certificate-arn:
arn:aws:acm:us-east-1:594977439087:certificate/578df8b2-7df0-4fb8-
ba4d-7b4261cc1cb9

    alb.ingress.kubernetes.io/listen-ports: '[{"HTTP": 80},
{"HTTPS":443}]'

    alb.ingress.kubernetes.io/actions.viewer-redirect: '{"Type": "redirect",
"RedirectConfig": { "Protocol": "HTTPS", "Port": "443", "Path":"/", "Query": "#{query}",
"StatusCode": "HTTP_301"}}'



    alb.ingress.kubernetes.io/actions.ssl-redirect: '{"Type":
"redirect", "RedirectConfig": { "Protocol": "HTTPS", "Port":
"443", "StatusCode": "HTTP_301"}}'

    external-dns.alpha.kubernetes.io/hostname:
echo.radiolensdashboard.com
```