Deploy Prometheus and Grafana on Kubernetes (Major Project)

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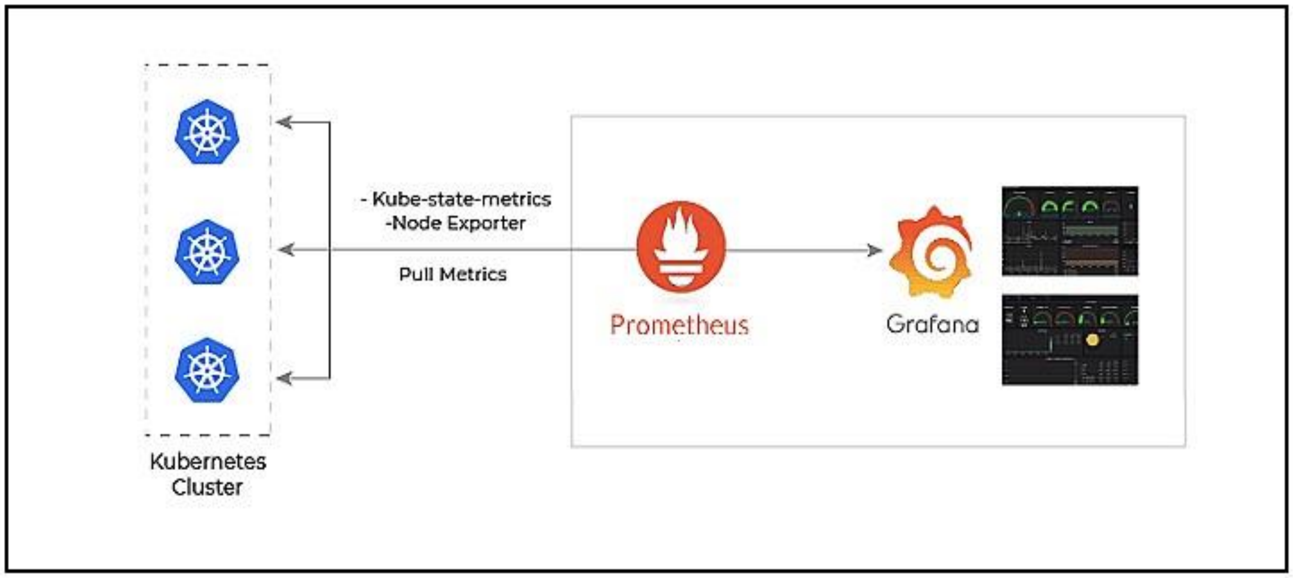
Prometheus and Grafana

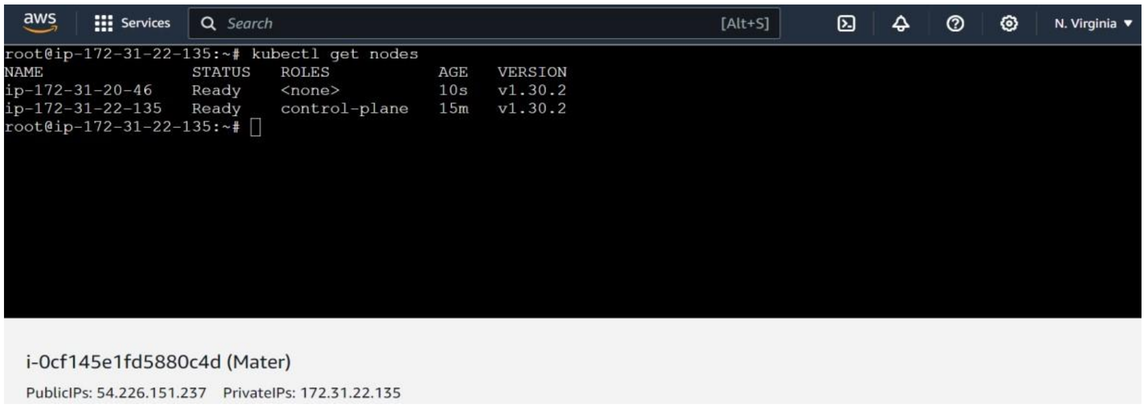
Prometheus is an open-source monitoring and alerting toolkit designed specifically for reliability and scalability. It collects metrics from configured targets at given intervals, evaluates rule expressions, displays results, and triggers alerts if certain conditions are met. In a Kubernetes environment, Prometheus is widely used to gather detailed metrics on cluster components, application performance, and resource usage.

Grafana is an open-source analytics and interactive visualization tool that integrates seamlessly with Prometheus. It allows users to create, explore, and share dashboards that can display real-time data from Prometheus. Grafana's powerful query capabilities and customizable visualizations make it ideal for monitoring Kubernetes clusters.

Architecture



1. **Prerequisites**: Ensure you have kubernetes (v1.30.0) installed and running.

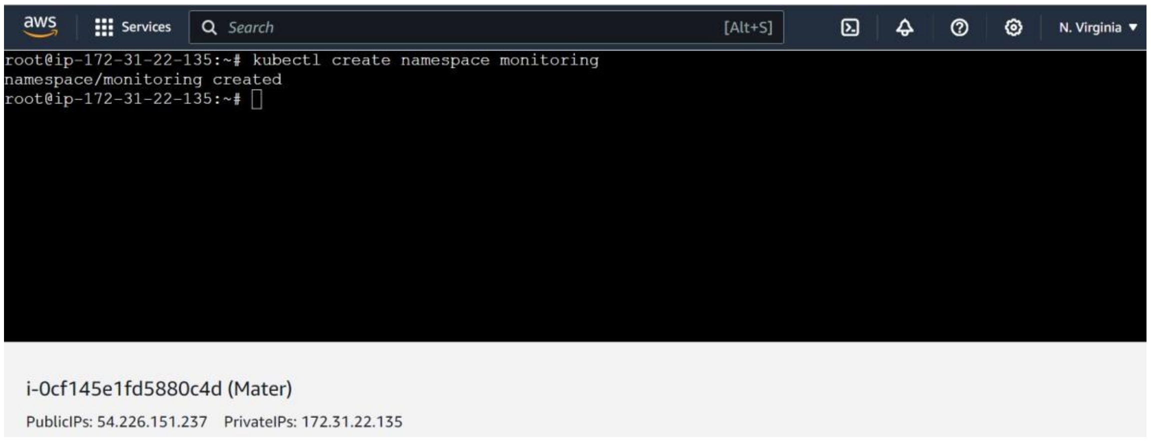


```
root@ip-172-31-22-135:~# kubectl get nodes
NAME               STATUS   ROLES           AGE   VERSION
ip-172-31-20-46    Ready    <none>          10s   v1.30.2
ip-172-31-22-135   Ready    control-plane   15m   v1.30.2
root@ip-172-31-22-135:~#
```

i-0cf145e1fd5880c4d (Mater)

PublicIPs: 54.226.151.237   PrivateIPs: 172.31.22.135

2. Create Namespace "monitoring" for deployments of Prometheus and Grafana:

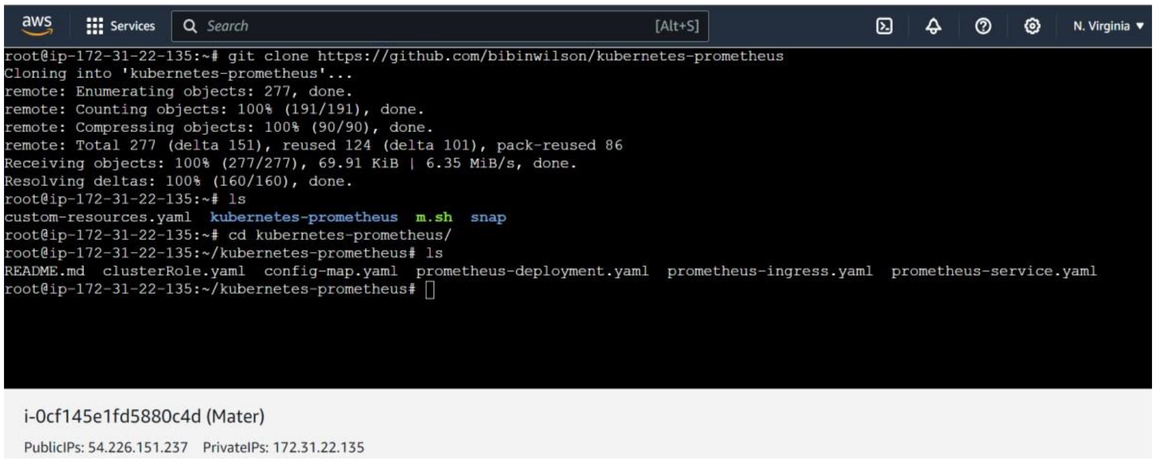


```
root@ip-172-31-22-135:~# kubectl create namespace monitoring
namespace/monitoring created
root@ip-172-31-22-135:~#
```

i-0cf145e1fd5880c4d (Mater)

PublicIPs: 54.226.151.237   PrivateIPs: 172.31.22.135

3. Git clone the Prometheus files into system:



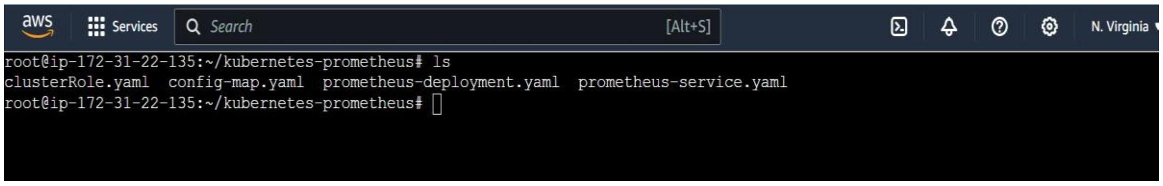
```
root@ip-172-31-22-135:~# git clone https://github.com/bibinwilson/kubernetes-prometheus
Cloning into 'kubernetes-prometheus'...
remote: Enumerating objects: 277, done.
remote: Counting objects: 100% (191/191), done.
remote: Compressing objects: 100% (90/90), done.
remote: Total 277 (delta 151), reused 124 (delta 101), pack-reused 86
Receiving objects: 100% (277/277), 69.91 KiB | 6.35 MiB/s, done.
Resolving deltas: 100% (160/160), done.
root@ip-172-31-22-135:~# ls
custom-resources.yaml  kubernetes-prometheus  m.sh  snap
root@ip-172-31-22-135:~# cd kubernetes-prometheus/
root@ip-172-31-22-135:~/kubernetes-prometheus# ls
README.md  clusterRole.yaml  config-map.yaml  prometheus-deployment.yaml  prometheus-ingress.yaml  prometheus-service.yaml
root@ip-172-31-22-135:~/kubernetes-prometheus#
```

i-0cf145e1fd5880c4d (Mater)

PublicIPs: 54.226.151.237   PrivateIPs: 172.31.22.135

4. In kubernetes-prometheus folder you can see all the Prometheus files have been downloaded:

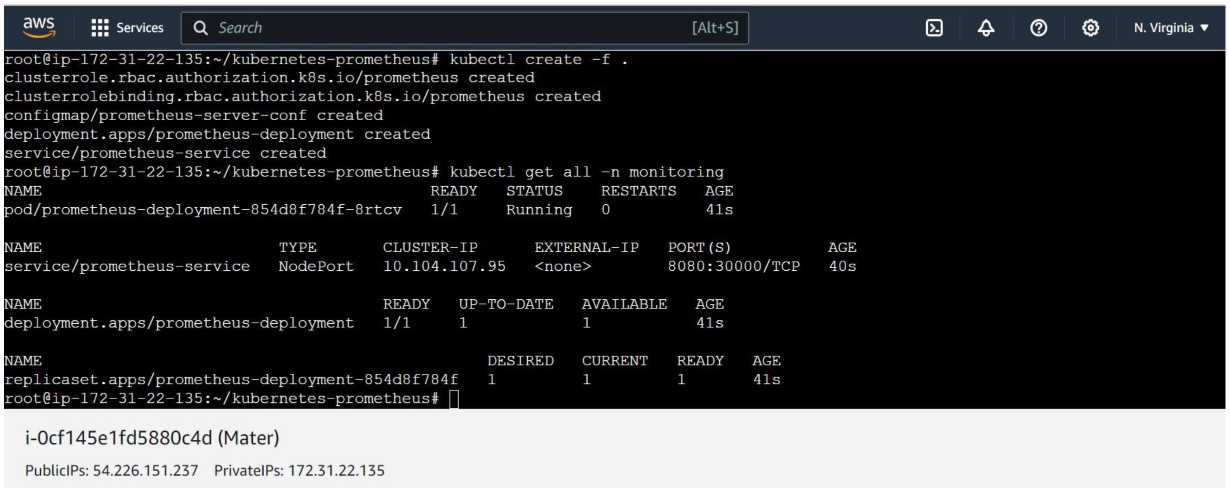
- prometheus-deployment.yaml
- prometheus-service.yaml
- clusterRole.yaml
- config-map.yaml



```
root@ip-172-31-22-135:~/kubernetes-prometheus# ls
clusterRole.yaml  config-map.yaml  prometheus-deployment.yaml  prometheus-service.yaml
root@ip-172-31-22-135:~/kubernetes-prometheus# 
```

5. Create Kubernetes resources from configuration files in the current directory:

- kubectl create –f .
- kubectl get all –n monitoring (to see all objects in that namespace)



```
root@ip-172-31-22-135:~/kubernetes-prometheus# kubectl create -f .
clusterrole.rbac.authorization.k8s.io/prometheus created
clusterrolebinding.rbac.authorization.k8s.io/prometheus created
configmap/prometheus-server-conf created
deployment.apps/prometheus-deployment created
service/prometheus-service created
root@ip-172-31-22-135:~/kubernetes-prometheus# kubectl get all -n monitoring
NAME                                         READY   STATUS    RESTARTS   AGE
pod/prometheus-deployment-854d8f784f-8rtcv   1/1     Running   0          41s

NAME                         TYPE       CLUSTER-IP      EXTERNAL-IP   PORT(S)          AGE
service/prometheus-service   NodePort   10.104.107.95   <none>        8080:30000/TCP   40s

NAME                                    READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/prometheus-deployment   1/1     1            1           41s

NAME                                               DESIRED   CURRENT   READY   AGE
replicaset.apps/prometheus-deployment-854d8f784f   1         1         1       41s
root@ip-172-31-22-135:~/kubernetes-prometheus# 
```

i-0cf145e1fd5880c4d (Mater)

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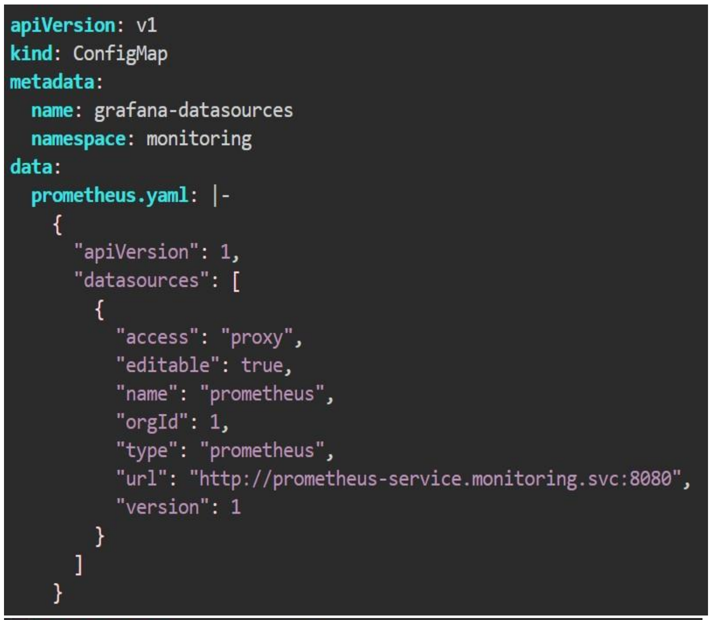
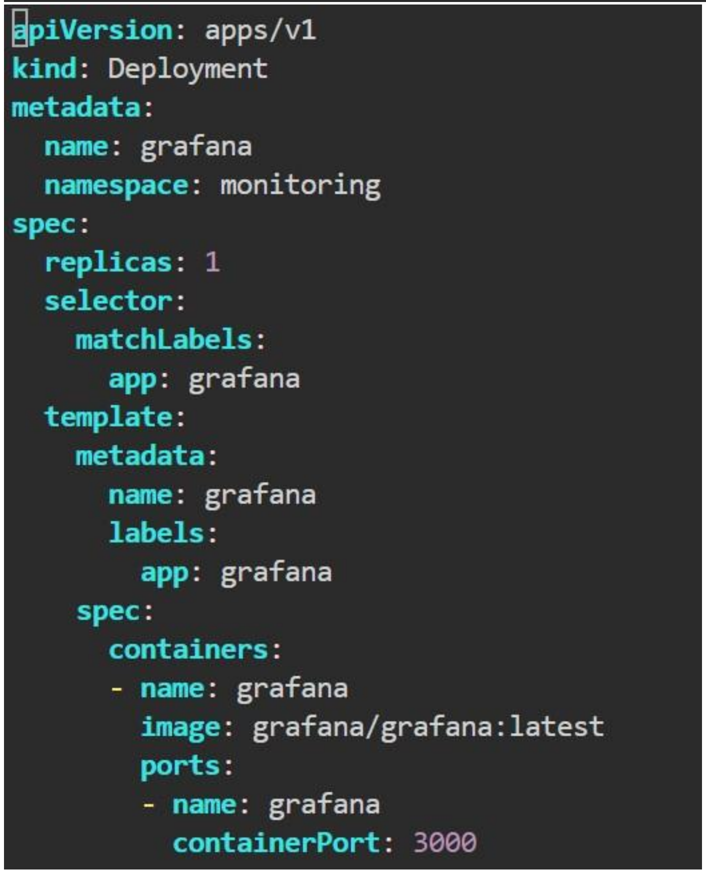
6. Create a yaml file for Grafana including all the objects in it:

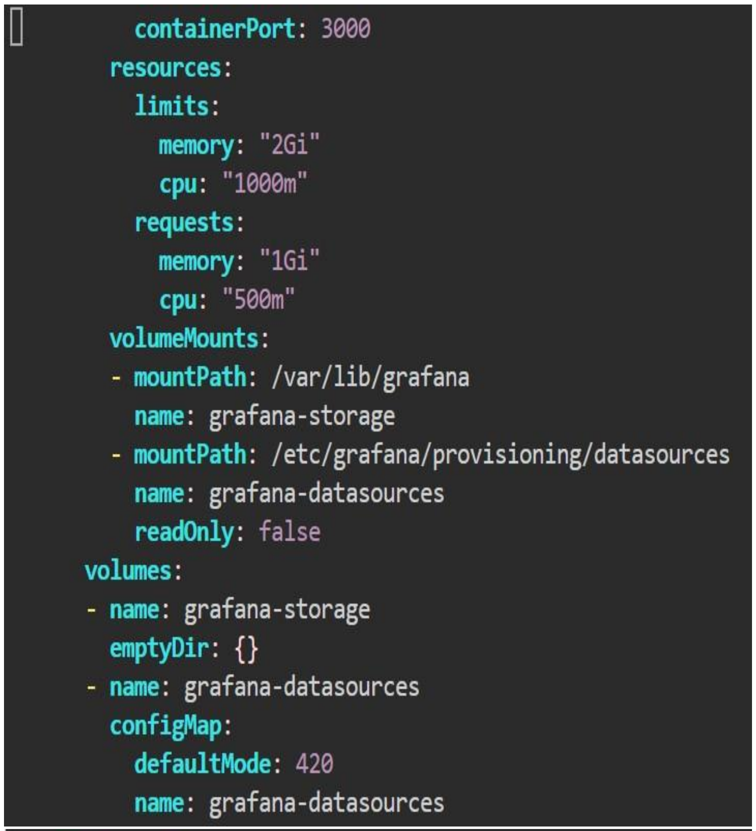
vi grafana.yaml



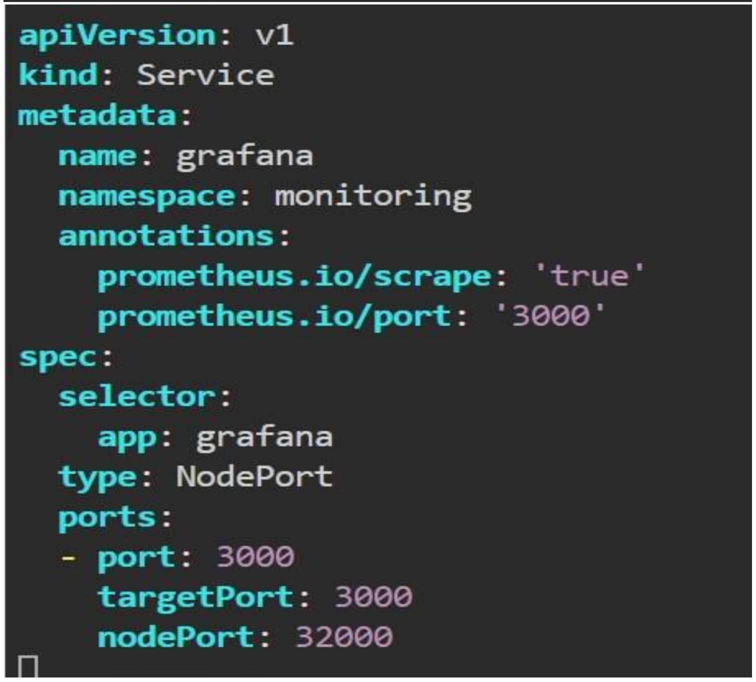
```
apiVersion: v1
kind: ConfigMap
metadata:
  name: grafana-datasources
  namespace: monitoring
data:
  prometheus.yaml: |-
    {
      "apiVersion": 1,
      "datasources": [
        {
          "access": "proxy",
          "editable": true,
          "name": "prometheus",
          "orgId": 1,
          "type": "prometheus",
          "url": "http://prometheus-service.monitoring.svc:8080",
          "version": 1
        }
      ]
    }
```



```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: grafana
  namespace: monitoring
spec:
  replicas: 1
  selector:
    matchLabels:
      app: grafana
  template:
    metadata:
      name: grafana
      labels:
        app: grafana
    spec:
      containers:
      - name: grafana
        image: grafana/grafana:latest
        ports:
        - name: grafana
          containerPort: 3000
```



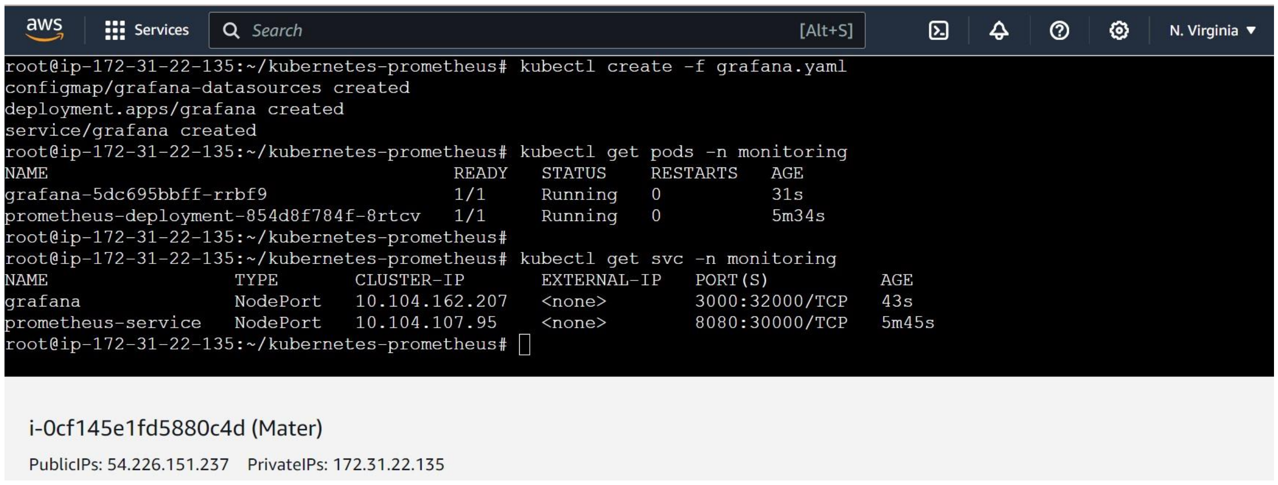
```yaml
          containerPort: 3000
        resources:
          limits:
            memory: "2Gi"
            cpu: "1000m"
          requests:
            memory: "1Gi"
            cpu: "500m"
        volumeMounts:
        - mountPath: /var/lib/grafana
          name: grafana-storage
        - mountPath: /etc/grafana/provisioning/datasources
          name: grafana-datasources
          readOnly: false
      volumes:
      - name: grafana-storage
        emptyDir: {}
      - name: grafana-datasources
        configMap:
          defaultMode: 420
          name: grafana-datasources
```



```yaml
apiVersion: v1
kind: Service
metadata:
  name: grafana
  namespace: monitoring
  annotations:
    prometheus.io/scrape: 'true'
    prometheus.io/port: '3000'
spec:
  selector:
    app: grafana
  type: NodePort
  ports:
  - port: 3000
    targetPort: 3000
    nodePort: 32000
```

7. Then apply the code by:

- kubectl create –f grafana.yml
- kubectl get pods –n monitoring (to see pods)
- kubectl get svc –n monitoring(to see services)



```
root@ip-172-31-22-135:~/kubernetes-prometheus# kubectl create -f grafana.yaml
configmap/grafana-datasources created
deployment.apps/grafana created
service/grafana created
root@ip-172-31-22-135:~/kubernetes-prometheus# kubectl get pods -n monitoring
NAME                                    READY   STATUS    RESTARTS   AGE
grafana-5dc695bbff-rrbf9                1/1     Running   0          31s
prometheus-deployment-854d8f784f-8rtcv  1/1     Running   0          5m34s
root@ip-172-31-22-135:~/kubernetes-prometheus#
root@ip-172-31-22-135:~/kubernetes-prometheus# kubectl get svc -n monitoring
NAME                 TYPE       CLUSTER-IP       EXTERNAL-IP   PORT(S)          AGE
grafana              NodePort   10.104.162.207   <none>        3000:32000/TCP   43s
prometheus-service   NodePort   10.104.107.95    <none>        8080:30000/TCP   5m45s
root@ip-172-31-22-135:~/kubernetes-prometheus#
```

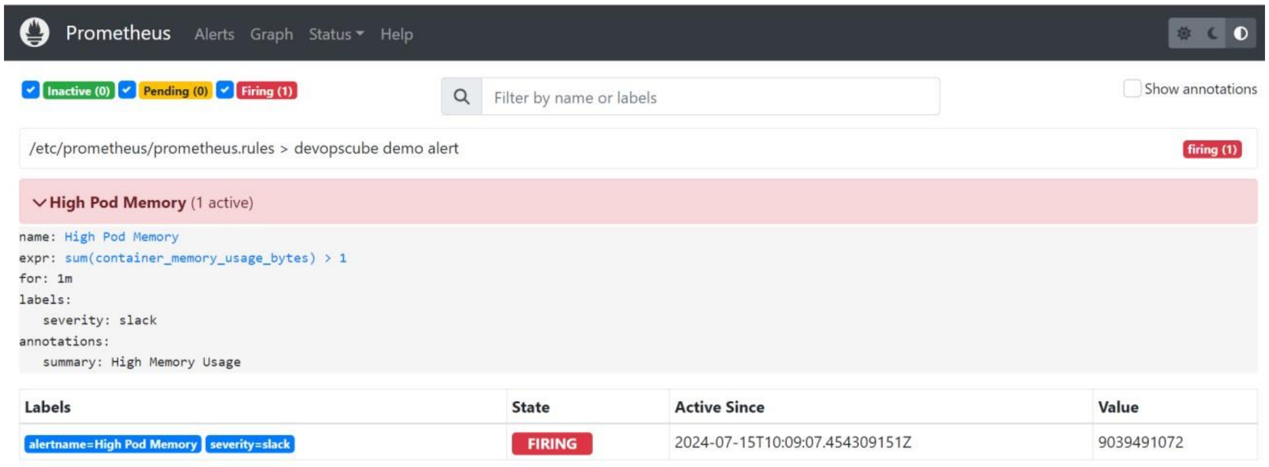
i-0cf145e1fd5880c4d (Mater)

PublicIPs: 54.226.151.237 PrivateIPs: 172.31.22.135

8. Use the **Public-IP** of worker node and the node ports to access the Prometheus and Grafana dashboards outside the cluster environment:

http://<IP_Address>:NodePort

Prometheus Dashboard and metrices:

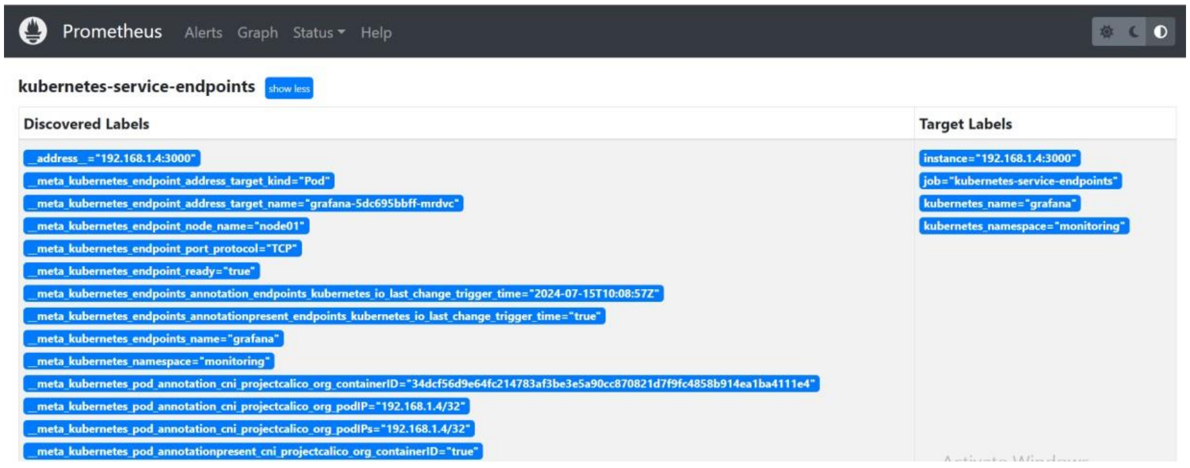


/etc/prometheus/prometheus.rules > devopscube demo alert firing (1)

High Pod Memory (1 active)

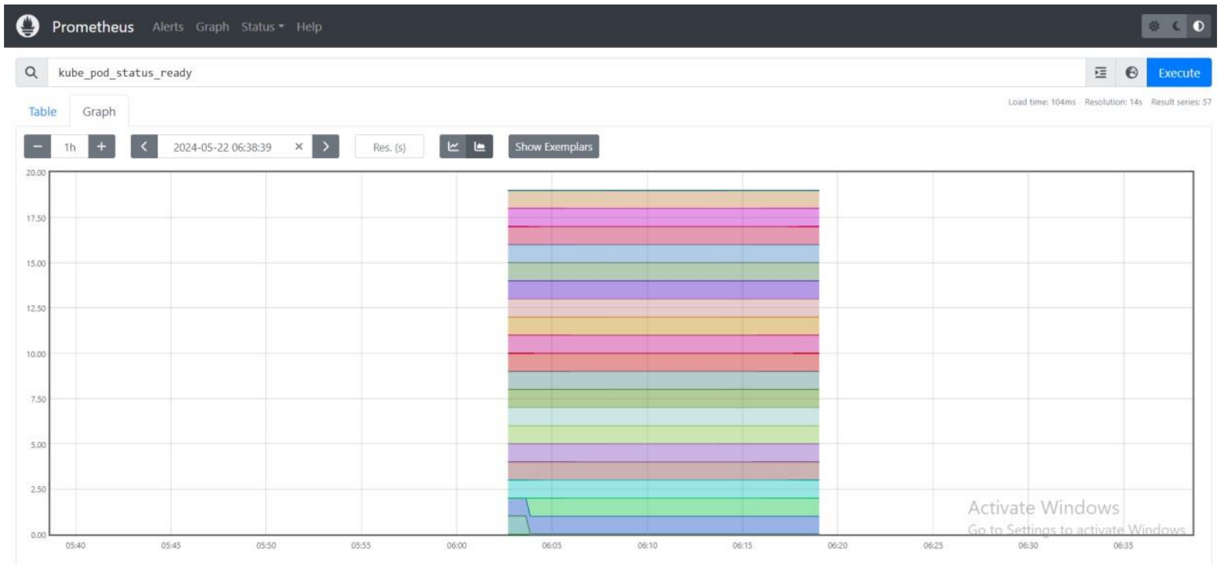
```
name: High Pod Memory
expr: sum(container_memory_usage_bytes) > 1
for: 1m
labels:
  severity: slack
annotations:
  summary: High Memory Usage
```

Labels	State	Active Since	Value
alertname=High Pod Memory severity=slack	FIRING	2024-07-15T10:09:07.454309151Z	9039491072



kubernetes-service-endpoints

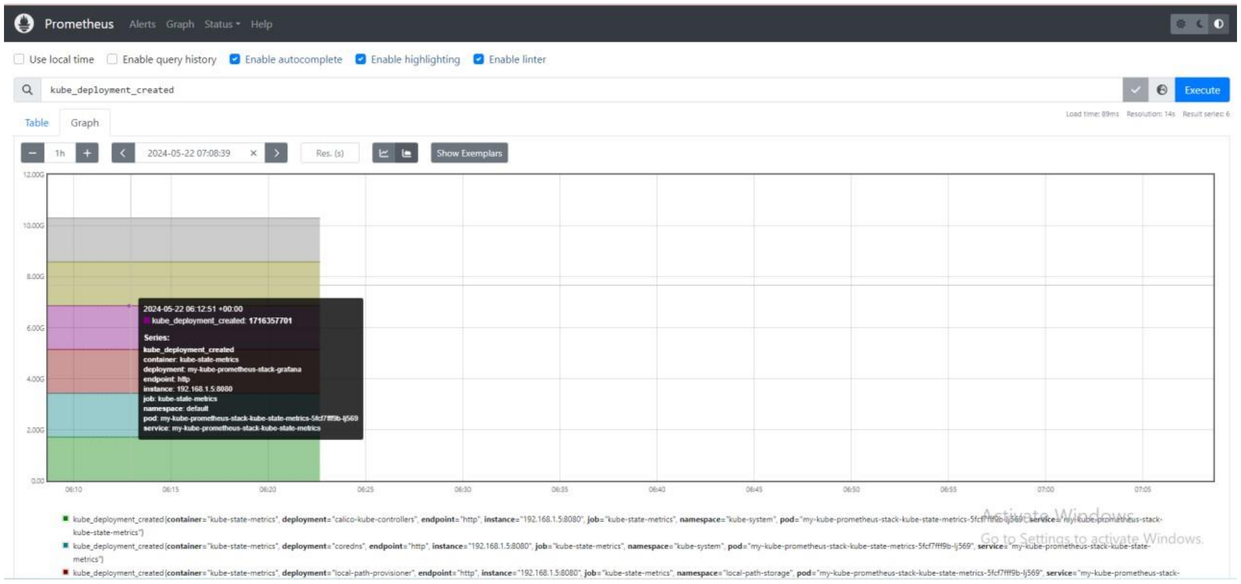
Discovered Labels	Target Labels
__address__="192.168.1.4:3000"	instance="192.168.1.4:3000"
__meta_kubernetes_endpoint_address_target_kind="Pod"	job="kubernetes-service-endpoints"
__meta_kubernetes_endpoint_address_target_name="grafana-5dc695bbff-mrdvc"	kubernetes_name="grafana"
__meta_kubernetes_endpoint_node_name="node01"	kubernetes_namespace="monitoring"
__meta_kubernetes_endpoint_port_protocol="TCP"	
__meta_kubernetes_endpoint_ready="true"	
__meta_kubernetes_endpoints_annotation_endpoints_kubernetes_io_last_change_trigger_time="2024-07-15T10:08:57Z"	
__meta_kubernetes_endpoints_annotationpresent_endpoints_kubernetes_io_last_change_trigger_time="true"	
__meta_kubernetes_endpoints_name="grafana"	
__meta_kubernetes_namespace="monitoring"	
__meta_kubernetes_pod_annotation_cni_projectcalico_org_containerID="34dcf56d9e64fc214783af3be3e5a90cc870821d7f9fc4858b914ea1ba4111e4"	
__meta_kubernetes_pod_annotation_cni_projectcalico_org_podIP="192.168.1.4/32"	
__meta_kubernetes_pod_annotation_cni_projectcalico_org_podIPs="192.168.1.4/32"	
__meta_kubernetes_pod_annotationpresent_cni_projectcalico_org_containerID="true"	



```
kube_pod_status_ready
```

Load time: 104ms Resolution: 14s Result series: 57

2024-05-22 06:38:39



☐ Use local time ☐ Enable query history ☑ Enable autocomplete ☑ Enable highlighting ☑ Enable linter

```
kube_deployment_created
```

Load time: 89ms Resolution: 14s Result series: 6

2024-05-22 07:08:39

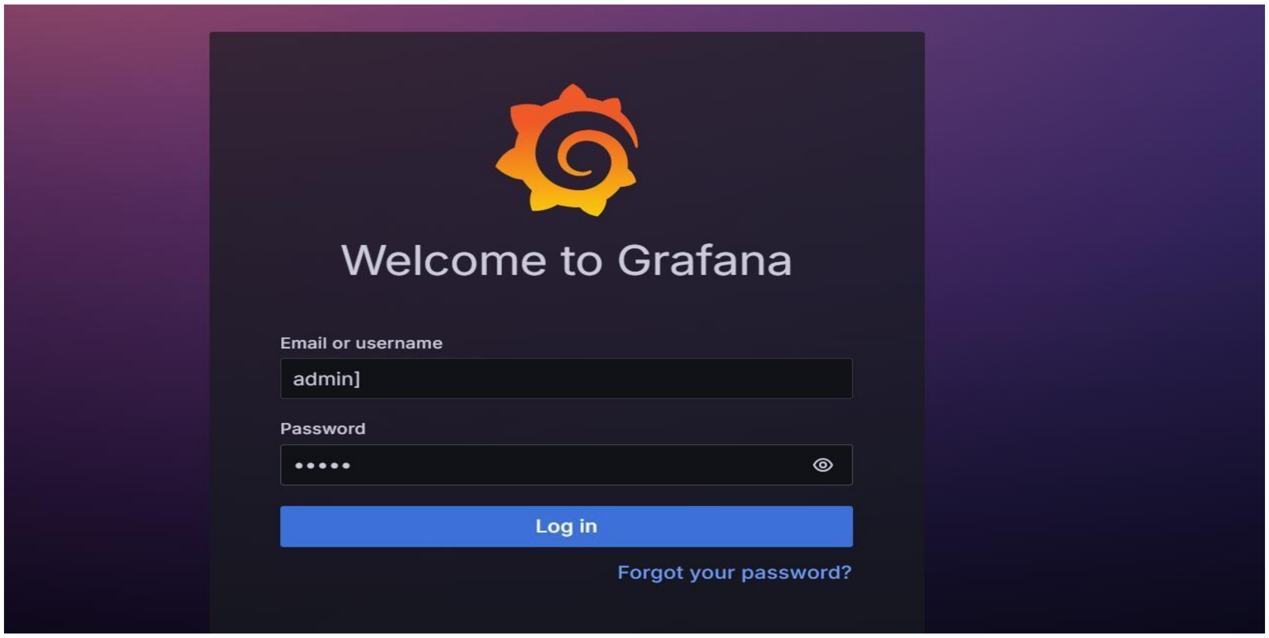
```
2024-05-22 06:12:51 +00:00
kube_deployment_created: 1716357701

Series:
kube_deployment_created
container: kube-state-metrics
deployment: my-kube-prometheus-stack-grafana
endpoint: http
instance: 192.168.1.5:8080
job: kube-state-metrics
namespace: default
pod: my-kube-prometheus-stack-kube-state-metrics-5fcf7fff9b-lj569
service: my-kube-prometheus-stack-kube-state-metrics
```

```
kube_deployment_created{container="kube-state-metrics", deployment="calico-kube-controllers", endpoint="http", instance="192.168.1.5:8080", job="kube-state-metrics", namespace="kube-system", pod="my-kube-prometheus-stack-kube-state-metrics-5fcf7fff9b-lj569", service="my-kube-prometheus-stack-kube-state-metrics"}
kube_deployment_created{container="kube-state-metrics", deployment="coredns", endpoint="http", instance="192.168.1.5:8080", job="kube-state-metrics", namespace="kube-system", pod="my-kube-prometheus-stack-kube-state-metrics-5fcf7fff9b-lj569", service="my-kube-prometheus-stack-kube-state-metrics"}
kube_deployment_created{container="kube-state-metrics", deployment="local-path-provisioner", endpoint="http", instance="192.168.1.5:8080", job="kube-state-metrics", namespace="local-path-storage", pod="my-kube-prometheus-stack-kube-state-metrics-5fcf7fff9b-lj569", service="my-kube-prometheus-stack-
```

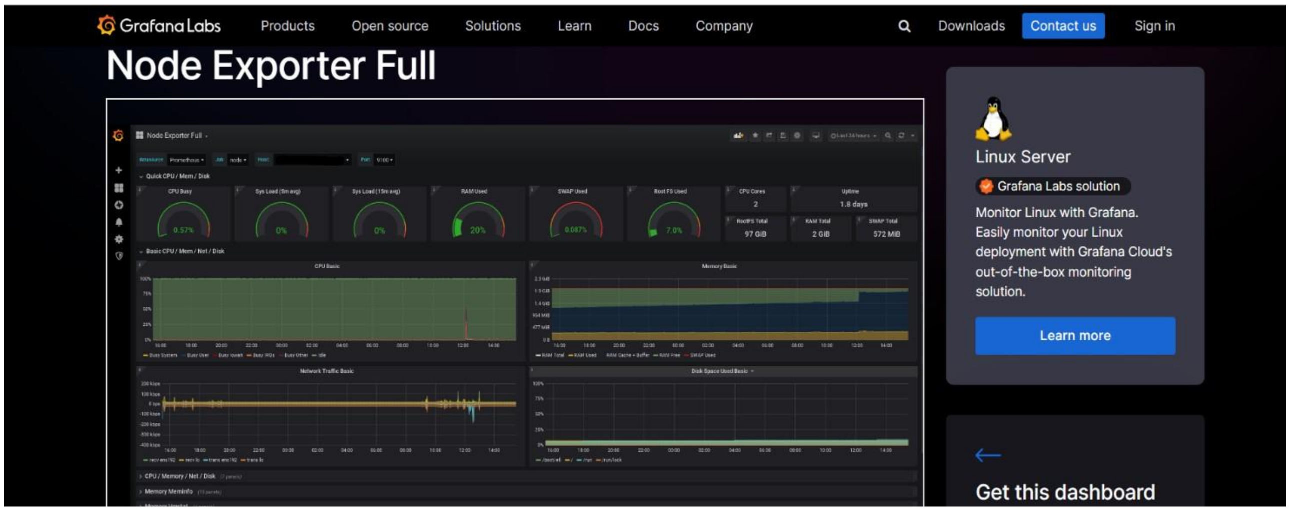
9. Grafana Dashboard :

The default username & password is "admin" for both, then also you can change your password.

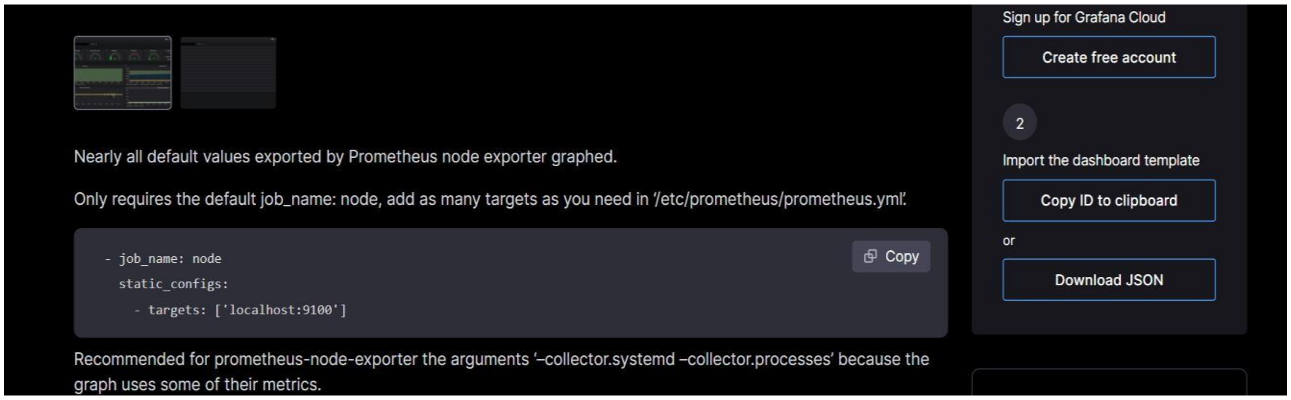


We also have the option of creating our dashboards from scratch as well as importing multiple Grafana dashboards provided by the Grafana library.

We can use this Node Exporter dashboard to monitor & observe the health of our nodes present in our Kubernetes Cluster.



Select Dashboard and copy the Dashboard ID



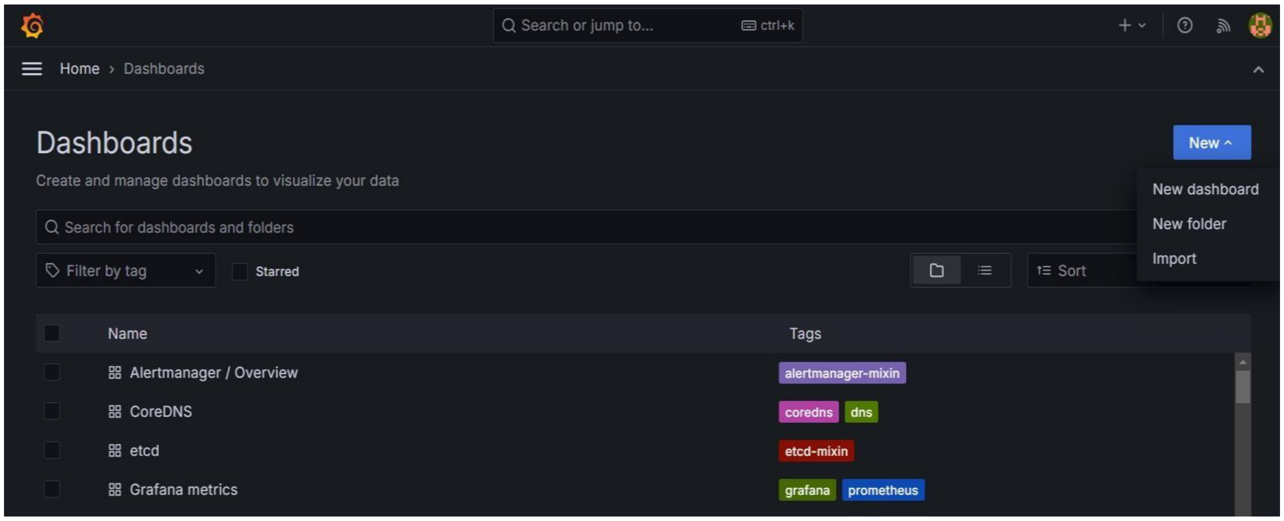
Nearly all default values exported by Prometheus node exporter graphed.

Only requires the default job_name: node, add as many targets as you need in '/etc/prometheus/prometheus.yml'.

```
- job_name: node
  static_configs:
    - targets: ['localhost:9100']
```

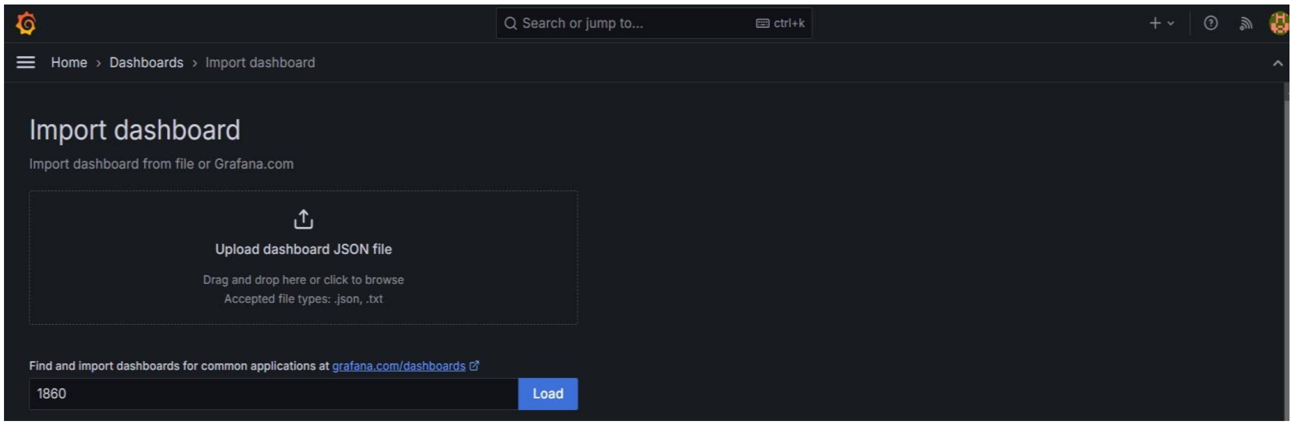
Recommended for prometheus-node-exporter the arguments '–collector.systemd –collector.processes' because the graph uses some of their metrics.

Under **Dashboards** page we can get the **Import** option:



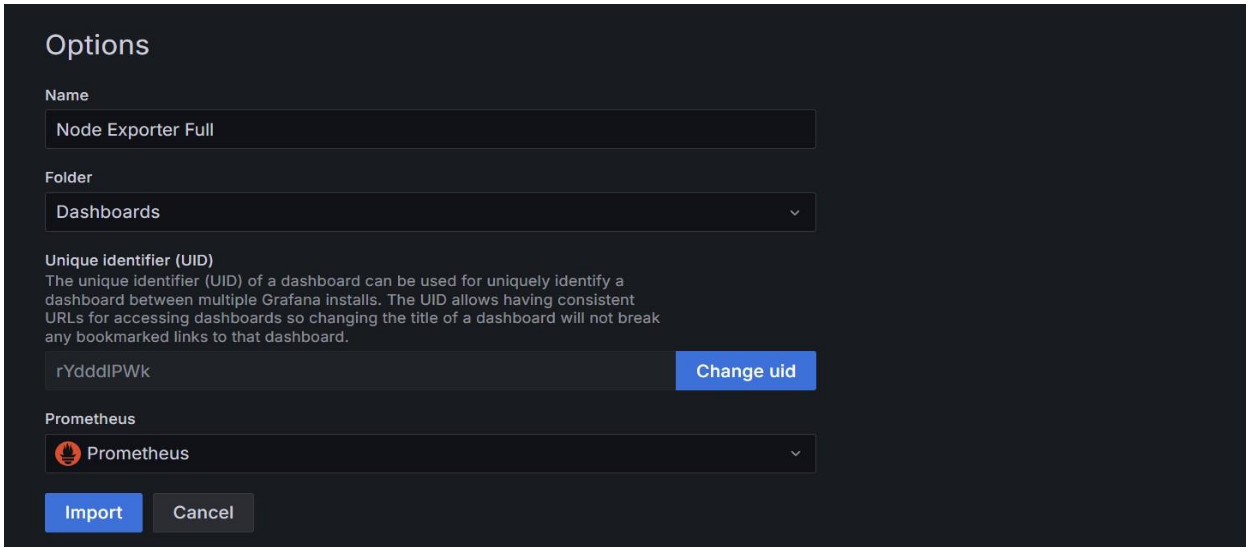
Name	Tags
Alertmanager / Overview	alertmanager-mixin
CoreDNS	coredns dns
etcd	etcd-mixin
Grafana metrics	grafana prometheus

Under "Import Dashboard" page, we need to paste the Dashboard IP that we copied earlier & click on the **Load** button.



Search or jump to...
ctrl+k
Home › Dashboards › Import dashboard
Import dashboard
Import dashboard from file or Grafana.com
Upload dashboard JSON file
Drag and drop here or click to browse
Accepted file types: .json, .txt
Find and import dashboards for common applications at grafana.com/dashboards
1860
Load

After clicking on the **Load** button, it will auto-load the dashboard from the library after which we can import the dashboard by clicking on the **Import** button.



Options

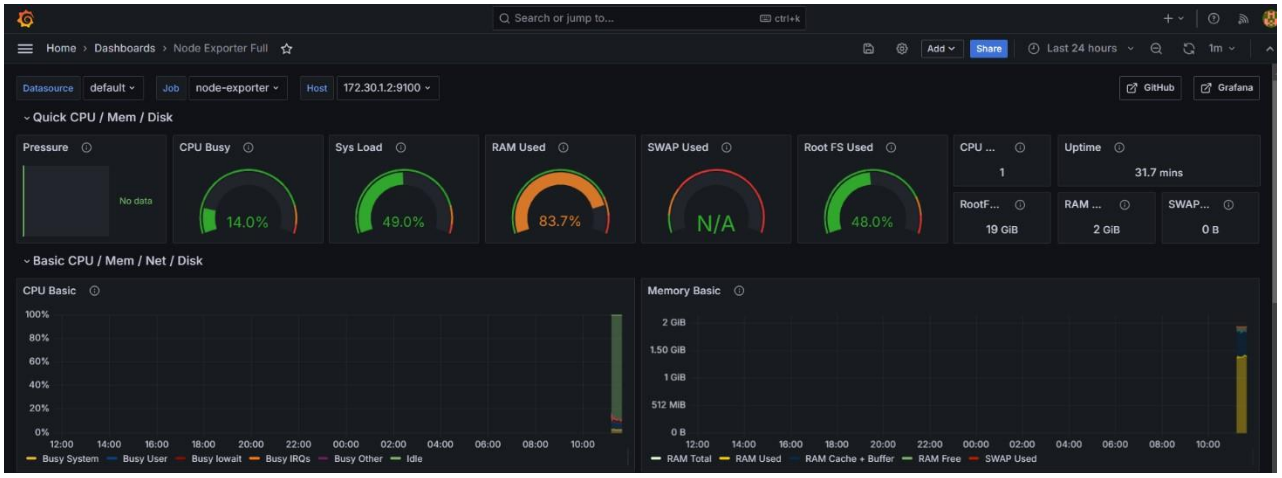
Name
Node Exporter Full

Folder
Dashboards

Unique identifier (UID)
The unique identifier (UID) of a dashboard can be used for uniquely identify a dashboard between multiple Grafana installs. The UID allows having consistent URLs for accessing dashboards so changing the title of a dashboard will not break any bookmarked links to that dashboard.
rYdddlPWk

Prometheus
Prometheus

New imported dashboard:



Home › Dashboards › Node Exporter Full

Datasource: default | Job: node-exporter | Host: 172.30.1.2:9100

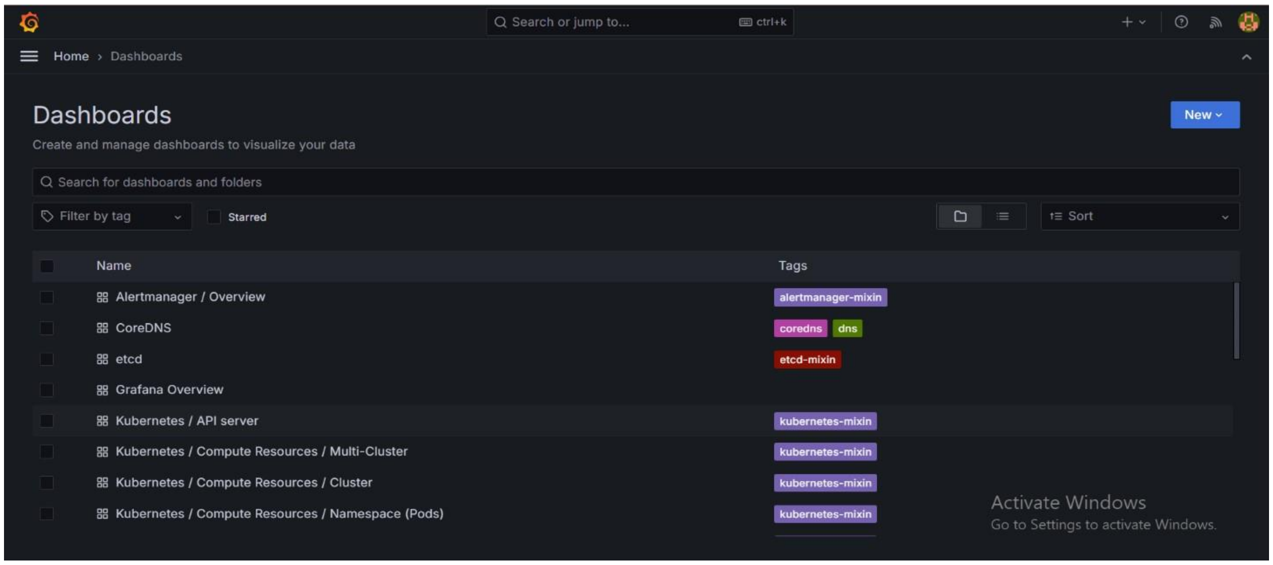
Last 24 hours | 1m

Quick CPU / Mem / Disk

Pressure	CPU Busy	Sys Load	RAM Used	SWAP Used	Root FS Used	CPU ...	Uptime
No data	14.0%	49.0%	83.7%	N/A	48.0%	1	31.7 mins

RootF...	RAM ...	SWAP...
19 GiB	2 GiB	0 B

It has multiple dashboards to monitor the health of the Kubernetes cluster and its resources:



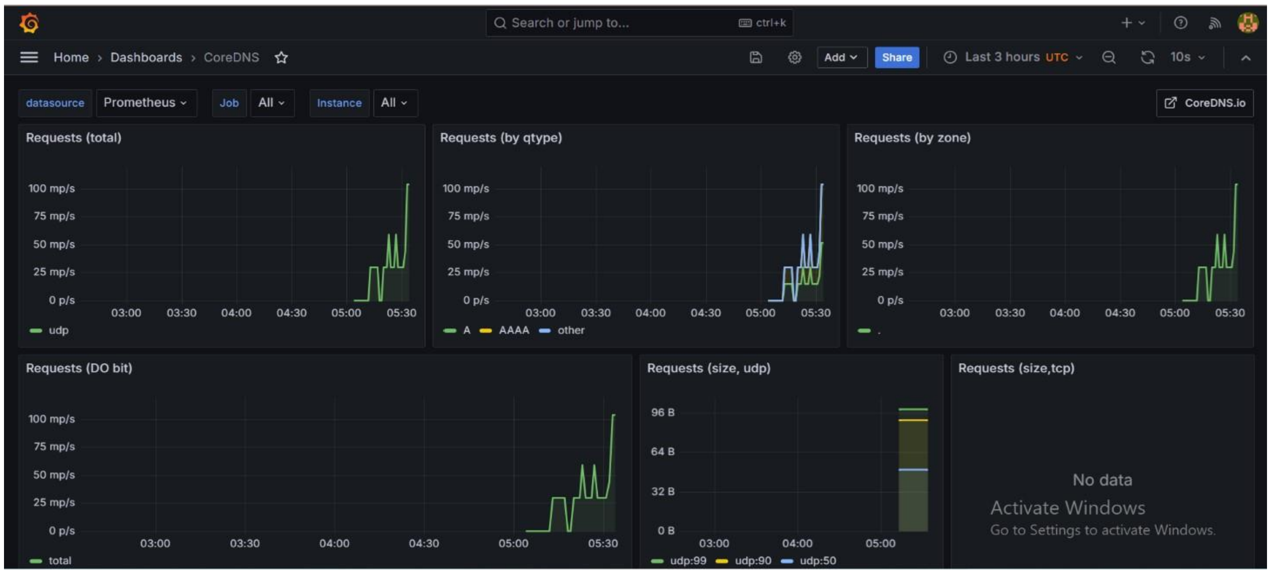
Dashboards

Create and manage dashboards to visualize your data

Search for dashboards and folders

Name	Tags
Alertmanager / Overview	alertmanager-mixin
CoreDNS	coredns dns
etcd	etcd-mixin
Grafana Overview	
Kubernetes / API server	kubernetes-mixin
Kubernetes / Compute Resources / Multi-Cluster	kubernetes-mixin
Kubernetes / Compute Resources / Cluster	kubernetes-mixin
Kubernetes / Compute Resources / Namespace (Pods)	kubernetes-mixin

Monitor & observe the resources present in our Kubernetes Cluster:


Search or jump to...
ctrl+k
Home › Dashboards › CoreDNS
Add
Share
Last 3 hours UTC
10s
datasource
Prometheus
Job
All
Instance
All
CoreDNS.io
Requests (total)
udp
Requests (by qtype)
A
AAAA
other
Requests (by zone)
.
Requests (DO bit)
total
Requests (size, udp)
udp:99
udp:90
udp:50
Requests (size,tcp)
No data
100 mp/s
75 mp/s
50 mp/s
25 mp/s
0 p/s
96 B
64 B
32 B
0 B
03:00
03:30
04:00
04:30
05:00
05:30
Activate Windows
Go to Settings to activate Windows.