

# Event Sphere

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Github:

<https://github.com/containerization-team-cems-eks/EventSphere>

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## Introduction

EventSphere is a Campus event management system that helps manage campus events like lectures, workshops, club activities, student programs, and more. Users are students and faculty who can use the website for searching and registering for events. Organizers interact with the website to manage events. The application is deployed in the cloud with EKS on AWS, and scales automatically, allowing for high availability.

# Architecture & Design

The EventSphere application handles traffic with a microservices architecture, prioritizing decoupled components to ensure scalability and maintainability. By separating the system into distinct domains, i.e, Authentication, Events, Bookings, and Notifications, we enable independent development and deployment cycles for each core feature.

## Core Components

**Frontend Client:** A React-based Single Page Application (SPA) serves as the entry point for users. It provides a responsive interface for browsing events, managing bookings, and administration. It interacts with the backend services via RESTful HTTP APIs.

### Backend Services:

- **Auth Service:** Handles user registration and login, issuing JSON Web Tokens (JWT) to secure subsequent requests across the platform. It enforces Role-Based Access Control (RBAC) to distinguish between attendees and administrators.
- **Event Service:** Serves as the catalog source of truth, managing event metadata (locations, dates, prices) and inventory.
- **Booking Service:** Manages the transaction logic for reservations, ensuring that bookings are linked correctly to users and events while validating availability with the Event Service.
- **Notification Service:** A lightweight service designed to decouple email operations from the critical path. Instead of sending emails directly, it publishes messages to an AWS SNS topic, offloading the actual delivery logic to the cloud.

**Data Layer:** We utilize MongoDB as our persistent storage. While the services share a database cluster for development simplicity, the architecture supports logical separation, where each microservice owns its specific collections (e.g., auth, events, bookings), preventing tight data coupling.

**Infrastructure & Orchestration:** The application is containerized using Docker and orchestrated via Amazon EKS (Elastic Kubernetes Service). This cloud-native approach allows for features like Horizontal Pod Autoscaling (HPA) and automated health checks. Traffic is routed into the cluster via an AWS Application Load Balancer (ALB).

# Infrastructure-as-Code

- eksctl IaC template VPC, subnets, node groups, and the EKS control plane:  
[eks-cluster.yaml](#)

```
! eksctl-cluster.yaml X

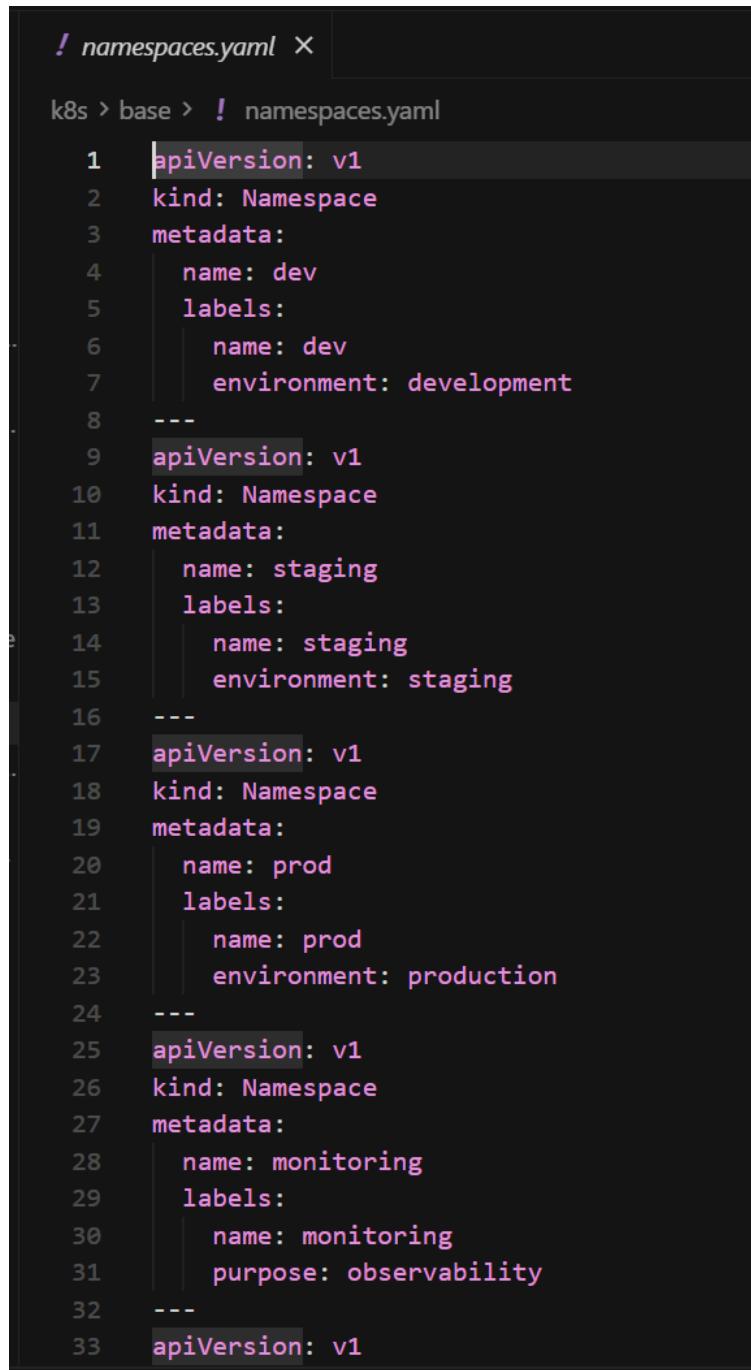
infrastructure > ! eksctl-cluster.yaml

1  apiVersion: eksctl.io/v1alpha5
2  kind: ClusterConfig
3
4  metadata:
5    name: eventsphere-cluster
6    region: us-east-1
7    version: "1.34"
8    tags:
9      Project: EventSphere
10     Environment: Production
11     ManagedBy: eksctl
12
13 # VPC Configuration
14 # eksctl will create a new VPC with public and private subnets across all AZs
15 vpc:
16   cidr: 10.0.0.0/16
17   nat:
18     gateway: HighlyAvailable # One NAT Gateway per AZ for high availability
19   clusterEndpoints:
20     publicAccess: true
21     privateAccess: true
22
23 # IAM Configuration
24 iam:
25   withOIDC: true # Required for IRSA (IAM Roles for Service Accounts)
26   serviceAccounts:
27     # AWS Load Balancer Controller
28     - metadata:
29       name: aws-load-balancer-controller
30       namespace: kube-system
31     wellKnownPolicies:
32       awsLoadBalancerController: true
33   # Cluster Autoscaler
```

- RBAC manifests for namespaces and service accounts (including IRSA):

- Namespaces:

[namespaces.yaml](#)



The screenshot shows a terminal window with the title bar 'namespaces.yaml X'. The window displays a YAML configuration for four Kubernetes namespaces: dev, staging, prod, and monitoring. Each namespace is defined by an 'apiVersion: v1' block, 'kind: Namespace', and 'metadata' section. The 'dev' namespace has a 'name: dev' and 'environment: development' label. The 'staging' namespace has a 'name: staging' and 'environment: staging' label. The 'prod' namespace has a 'name: prod' and 'environment: production' label. The 'monitoring' namespace has a 'name: monitoring' and 'purpose: observability' label.

```
! namespaces.yaml X

k8s > base > ! namespaces.yaml

1  apiVersion: v1
2  kind: Namespace
3  metadata:
4    name: dev
5    labels:
6      name: dev
7      environment: development
8  ---
9  apiVersion: v1
10 kind: Namespace
11 metadata:
12   name: staging
13   labels:
14     name: staging
15     environment: staging
16  ---
17  apiVersion: v1
18  kind: Namespace
19  metadata:
20    name: prod
21    labels:
22      name: prod
23      environment: production
24  ---
25  apiVersion: v1
26  kind: Namespace
27  metadata:
28    name: monitoring
29    labels:
30      name: monitoring
31      purpose: observability
32  ---
33  apiVersion: v1
```

- Service Accounts:

[rbac.yaml](#)

```
! rbac.yaml X

k8s > base > ! rbac.yaml

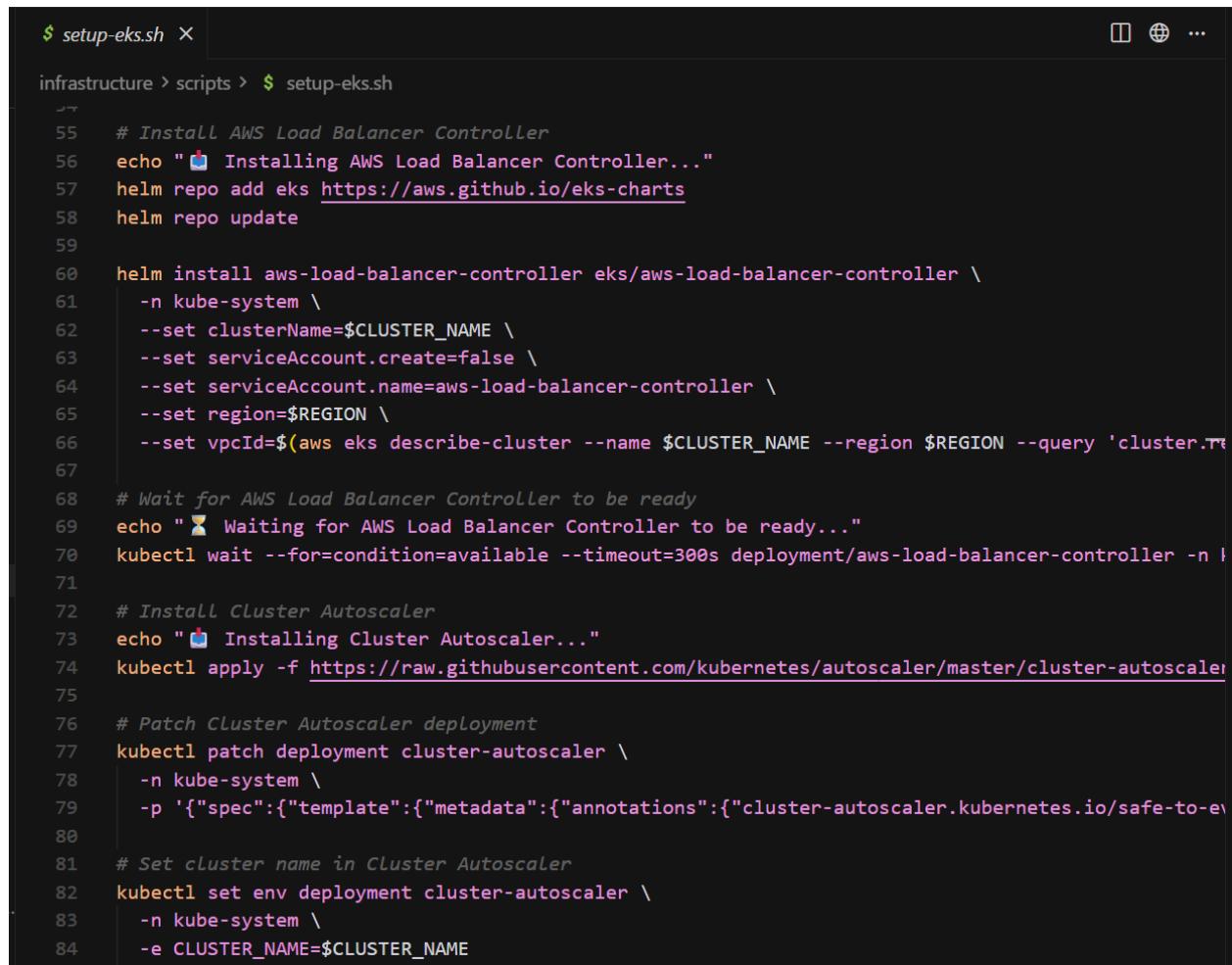
1  # -----
2  # RBAC Configuration for EventSphere
3  # -----
4  # This file contains:
5  # 1. Service Accounts for all microservices (dev, staging, prod)
6  # 2. Service-specific Roles with Least-privilege access
7  # 3. User Roles (Developer, Operator, Admin) for environment access
8  # 4. RoleBindings to connect users/service accounts to roles
9  # -----
10 #
11 # -----
12 # SERVICE ACCOUNTS - Production Namespace
13 # -----
14 ---
15 apiVersion: v1
16 kind: ServiceAccount
17 metadata:
18   name: auth-service-sa
19   namespace: prod
20   labels:
21     app: auth-service
22     environment: production
23 ---
24 apiVersion: v1
25 kind: ServiceAccount
26 metadata:
27   name: event-service-sa
28   namespace: prod
29   labels:
30     app: event-service
31     environment: production
32 ---
33 apiVersion: v1
```

# Docker and Kubernetes Configuration

## Deploy and Manage a Kubernetes Cluster on AWS EKS:

- Installed add-ons (ALB Controller, Cluster Autoscaler) with configs:

### [setup-eks.sh](#)



The screenshot shows a terminal window with the title '\$ setup-eks.sh X'. The window displays a shell script named 'setup-eks.sh' with line numbers from 55 to 84. The script installs the AWS Load Balancer Controller and the Cluster Autoscaler. It uses Helm to install the controller and kubectl to apply a configuration file. The script also patches the deployment and sets the cluster name.

```
$ setup-eks.sh X
infrastructure > scripts > $ setup-eks.sh
55  # Install AWS Load Balancer Controller
56  echo "📦 Installing AWS Load Balancer Controller..."
57  helm repo add eks https://aws.github.io/eks-charts
58  helm repo update
59
60  helm install aws-load-balancer-controller eks/aws-load-balancer-controller \
61      -n kube-system \
62      --set clusterName=$CLUSTER_NAME \
63      --set serviceAccount.create=false \
64      --set serviceAccount.name=aws-load-balancer-controller \
65      --set region=$REGION \
66      --set vpcId=$(aws eks describe-cluster --name $CLUSTER_NAME --region $REGION --query 'cluster.resourcesVpcConfig.vpcId')
67
68  # Wait for AWS Load Balancer Controller to be ready
69  echo "⏳ Waiting for AWS Load Balancer Controller to be ready..."
70  kubectl wait --for=condition=available --timeout=300s deployment/aws-load-balancer-controller -n kube-system
71
72  # Install Cluster Autoscaler
73  echo "📦 Installing Cluster Autoscaler..."
74  kubectl apply -f https://raw.githubusercontent.com/kubernetes/autoscaler/master/cluster-autoscaler/deploy/kube-addon.yaml
75
76  # Patch Cluster Autoscaler deployment
77  kubectl patch deployment cluster-autoscaler \
78      -n kube-system \
79      -p '{"spec": {"template": {"metadata": {"annotations": {"cluster-autoscaler.kubernetes.io/safe-to-evict": "true"}, "labels": {"k8s-app": "cluster-autoscaler", "beta.kubernetes.io/arch": "amd64", "beta.kubernetes.io/os": "linux", "node-role.kubernetes.io/master": ""}}}, "strategy": {"type": "RollingUpdate", "rollingUpdate": {"maxSurge": "10%", "maxUnavailable": "0%"}, "type": "RollingUpdate"}, "updateStrategy": {"type": "RollingUpdate"}, "version": "v1"}, "status": {"observedGeneration": 1, "readyReplicas": 1, "replicas": 1, "updatedReplicas": 1, "unavailableReplicas": 0}}
```

- kubectl get nodes -o wide shows nodes in multiple AZs:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl get nodes -o wide
NAME           STATUS   ROLES      AGE    VERSION   INTERNAL-IP   EXTERNAL-IP   OS-IMAGE
ip-10-0-39-3.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.39.3   184.72.214.172   Amazon Linux 2023
.ip-10-0-4-244.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.4.244   34.204.168.21   Amazon Linux 2023
.ip-10-0-40-82.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.40.82   107.20.100.184   Amazon Linux 2023
.ip-10-0-41-129.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.41.129   54.81.207.250   Amazon Linux 2023
.ip-10-0-6-193.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.6.193   98.92.155.102   Amazon Linux 2023
.ip-10-0-39-3.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.39.3   184.72.214.172   Amazon Linux 2023
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl get nodes -o custom-columns=NAME:.metadata.name,ZONE:.metadata.labels."topology\kubernetes\.io/zone",INSTANCE-TYPE:.metadata.labels."node\kubernetes\.io/instance-type",STATUS:.status.conditions[-1].type
NAME           ZONE     INSTANCE-TYPE   STATUS
ip-10-0-39-3.ec2.internal   us-east-1b   t3.small       Ready
ip-10-0-4-244.ec2.internal   us-east-1f   t3.small       Ready
ip-10-0-40-82.ec2.internal   us-east-1b   t3.small       Ready
ip-10-0-41-129.ec2.internal   us-east-1b   t3.small       Ready
ip-10-0-6-193.ec2.internal   us-east-1f   t3.small       Ready
```

- Autoscaler responds to load changes and logs scale events:

1. Total node count 5 before load test:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl get nodes -o wide
NAME           STATUS   ROLES      AGE    VERSION   INTERNAL-IP   EXTERNAL-IP   OS-IMAGE
ip-10-0-39-3.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.39.3   184.72.214.172   Amazon Linux 2023
.ip-10-0-4-244.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.4.244   34.204.168.21   Amazon Linux 2023
.ip-10-0-40-82.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.40.82   107.20.100.184   Amazon Linux 2023
.ip-10-0-41-129.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.41.129   54.81.207.250   Amazon Linux 2023
.ip-10-0-6-193.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.6.193   98.92.155.102   Amazon Linux 2023
.ip-10-0-39-3.ec2.internal   Ready    <none>    15h   v1.34.2-eks-ecaa3a6   10.0.39.3   184.72.214.172   Amazon Linux 2023
```

2. Node group 1 node count before load test (desiredSize=2):

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ aws eks describe-nodegroup --cluster-name eventsphere-cluster --nodegroup-name eventsphere-mng-1 --region us-east-1 --query 'nodegroup.scalingConfig'
{
    "minSize": 2,
    "maxSize": 5,
    "desiredSize": 2
}
```

3. Starting load test:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl apply -f ./k8s/load-test.yaml
deployment.apps/load-test created
```

4. Node group 1 node count during load test (desiredSize=5):

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ aws eks describe-nodegroup --cluster-name eventsphere-cluster --nodegroup-name eventsphere-mng-1 --region us-east-1 --query 'nodegroup.scalingConfig'
{
    "minSize": 2,
    "maxSize": 5,
    "desiredSize": 5
}
```

5. New nodes created and total node count is now 8:

NAME	STATUS	ROLES	AGE	VERSION CONTAINER-RUNTIME	INTERNAL-IP	EXTERNAL-IP	OS-IMAGE
				KERNEL-VERSION			
ip-10-0-11-113.ec2.internal	Ready	<none>	20h	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.11.113	44.203.89.35	Amazon Linux 20
ip-10-0-31-26.ec2.internal	Ready	<none>	21h	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.31.26	44.203.197.239	Amazon Linux 20
ip-10-0-4-42.ec2.internal	Ready	<none>	3m22s	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.4.42	18.205.189.23	Amazon Linux 20
ip-10-0-40-129.ec2.internal	Ready	<none>	21h	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.40.129	18.207.240.232	Amazon Linux 20
ip-10-0-43-2.ec2.internal	Ready	<none>	9h	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.43.2	44.192.19.69	Amazon Linux 20
ip-10-0-50-151.ec2.internal	Ready	<none>	3m25s	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.50.151	3.230.158.223	Amazon Linux 20
ip-10-0-55-2.ec2.internal	Ready	<none>	21h	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.55.2	3.238.116.104	Amazon Linux 20
ip-10-0-60-236.ec2.internal	Ready	<none>	3m24s	v1.34.2-eks-ecaa3a6 containerd://2.1.4	10.0.60.236	98.93.42.178	Amazon Linux 20
ip-10-0-74-119.amzn2023.x86_64							

6. Autoscaler logs showing scale up event:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl get events -n kube-system --sort-by='.lastTimestamp' | grep -i scale-up
9m8s      Normal    ScaledUpGroup    configmap/cluster-autoscaler-status  Scale-up: setting group eks-eventsphere-mng-1-dacd7a87-de3e-36a2-dbd2-c697cda37bfe size to 5 instead of 2 (max: 5)
9m7s      Normal    ScaledUpGroup    configmap/cluster-autoscaler-status  Scale-up: group eks-eventsphere-mng-1-dacd7a87-de3e-36a2-dbd2-c697cda37bfe size set to 5 instead of 2 (max: 5)
```

7. Deleting load-test deployment to trigger scale-down:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl delete deployment load-test -n prod
deployment.apps "load-test" deleted from prod namespace
```

8. Scale-down logs:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/  
Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSpher  
e$ kubectl logs -n kube-system -l app=cluster-autoscaler --tail=100 | grep -i "scale.*down\|removed\|drain"  
I1207 16:22:40.716653      1 eligibility.go:163] Node ip-10-0-1  
1-113.ec2.internal unremovable: memory requested (52.0856% of all  
allocatable) is above the scale-down utilization threshold  
I1207 16:22:40.716695      1 eligibility.go:163] Node ip-10-0-3  
1-26.ec2.internal unremovable: memory requested (55.9954% of all  
allocatable) is above the scale-down utilization threshold  
I1207 16:22:40.716728      1 eligibility.go:163] Node ip-10-0-4  
0-129.ec2.internal unremovable: memory requested (77.7791% of all  
allocatable) is above the scale-down utilization threshold  
I1207 16:22:40.716759      1 eligibility.go:163] Node ip-10-0-5  
5-2.ec2.internal unremovable: memory requested (86.437% of alloc  
atable) is above the scale-down utilization threshold  
I1207 16:22:40.716771      1 eligibility.go:104] Scale-down cal  
culation: ignoring 1 nodes unremovable in the last 5m0s  
I1207 16:22:40.716819      1 cluster.go:173] node ip-10-0-50-15  
1.ec2.internal may be removed  
I1207 16:22:40.716856      1 cluster.go:173] node ip-10-0-60-23  
6.ec2.internal may be removed  
I1207 16:22:40.716907      1 cluster.go:173] node ip-10-0-4-42.  
ec2.internal may be removed  
I1207 16:22:40.717160      1 static_autoscaler.go:598] Scale do  
wn status: lastScaleUpTime=2025-12-07 16:10:35.936363273 +0000 U  
TC m=+75397.498723648 lastScaleDownDeleteTime=2025-12-06 18:14:2  
0.939505455 +0000 UTC m=-3577.498134162 lastScaleDownFailTime=20  
25-12-06 18:14:20.939505455 +0000 UTC m=-3577.498134162 scaleDow  
nForbidden=false scaleDownInCooldown=false  
I1207 16:22:40.717211      1 static_autoscaler.go:619] Starting  
scale down
```

9. Node group 1 node count after scale-down (desiredSize=2):

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl delete deployment load-test -n prod
deployment.apps "load-test" deleted from prod namespace
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ aws eks describe-nodegroup --cluster-name eventsphere-cluster --nodegroup-name eventsphere-mng-1 --region us-east-1 --query 'nodegroup.scalingConfig'
{
    "minSize": 2,
    "maxSize": 5,
    "desiredSize": 2
}
```

10. Total node count 5 after scale-down:

NAME	KERNEL-VERSION	STATUS	ROLES	AGE	VERSION	CONTAINER-RUNTIME	INTERNAL-IP	EXTERNAL-IP	OS-IMAGE
ip-10-0-39-3.ec2.internal	6.12.55-74.119.amzn2023.x86_64	Ready	<none>	15h	v1.34.2-eks-ecaa3a6	containerd://2.1.4	10.0.39.3	184.72.214.172	Amazon Linux 2023
ip-10-0-4-244.ec2.internal	6.12.55-74.119.amzn2023.x86_64	Ready	<none>	15h	v1.34.2-eks-ecaa3a6	containerd://2.1.4	10.0.4.244	34.204.168.21	Amazon Linux 2023
ip-10-0-40-82.ec2.internal	6.12.55-74.119.amzn2023.x86_64	Ready	<none>	15h	v1.34.2-eks-ecaa3a6	containerd://2.1.4	10.0.40.82	107.20.100.184	Amazon Linux 2023
ip-10-0-41-129.ec2.internal	6.12.55-74.119.amzn2023.x86_64	Ready	<none>	15h	v1.34.2-eks-ecaa3a6	containerd://2.1.4	10.0.41.129	54.81.207.250	Amazon Linux 2023
ip-10-0-6-193.ec2.internal	6.12.55-74.119.amzn2023.x86_64	Ready	<none>	15h	v1.34.2-eks-ecaa3a6	containerd://2.1.4	10.0.6.193	98.92.155.102	Amazon Linux 2023

- At least one workload uses IRSA for AWS access:

- External Secrets Operator Uses IRSA:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl get serviceaccount external-secrets -n external-secrets-system -o yaml
apiVersion: v1
kind: ServiceAccount
metadata:
  annotations:
    eks.amazonaws.com/role-arn: arn:aws:iam::277707118728:role/external-secrets-role
    kubernetes.kubernetestes.io/last-applied-configuration: |
      {"apiVersion":"v1","kind":"ServiceAccount","metadata":{"annotations":{},"creationTimestamp":null,"name":"external-secrets","namespace":"external-secrets-system"}}
    creationTimestamp: "2025-12-06T19:05:19Z"
  labels:
    app.kubernetes.io/managed-by: eksctl
  name: external-secrets
  namespace: external-secrets-system
  resourceVersion: "6037"
  uid: d13b643b-fdbc-4f35-8086-30b780237d6c
```

- ALB or NGINX Ingress Controller routes public traffic correctly:
  1. Curl to ALB DNS responds with 301 status and location as <https://www.enpm818rgroup7.work.gd:443/> to enforce HTTPS:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/Eventsphere$ curl -v -H "Host: www.enpm818rgroup7.work.gd" http://$ALB_DNS/
* Host k8s-prod-eventsph-395841f6f1-1344915046.us-east-1.elb.amazonaws.com:80 was resolved.
* IPv6: (none)
* IPv4: 52.6.253.22, 3.221.240.165
* Trying 52.6.253.22:80...
* Connected to k8s-prod-eventsph-395841f6f1-1344915046.us-east-1.elb.amazonaws.com (52.6.253.22) port 80
> GET / HTTP/1.1
> Host: www.enpm818rgroup7.work.gd
> User-Agent: curl/8.5.0
> Accept: */*
>
< HTTP/1.1 301 Moved Permanently
< Server: awselb/2.0
< Date: Sun, 07 Dec 2025 17:08:04 GMT
< Content-Type: text/html
< Content-Length: 134
< Connection: keep-alive
< Location: https://www.enpm818rgroup7.work.gd:443/
<
<html>
<head><title>301 Moved Permanently</title></head>
<body>
<center><h1>301 Moved Permanently</h1></center>
</body>
</html>
* Connection #0 to host k8s-prod-eventsph-395841f6f1-1344915046.us-east-1.elb.amazonaws.com left intact
```

2. Curl to <https://www.enpm818rgroup7.work.gd:443/>

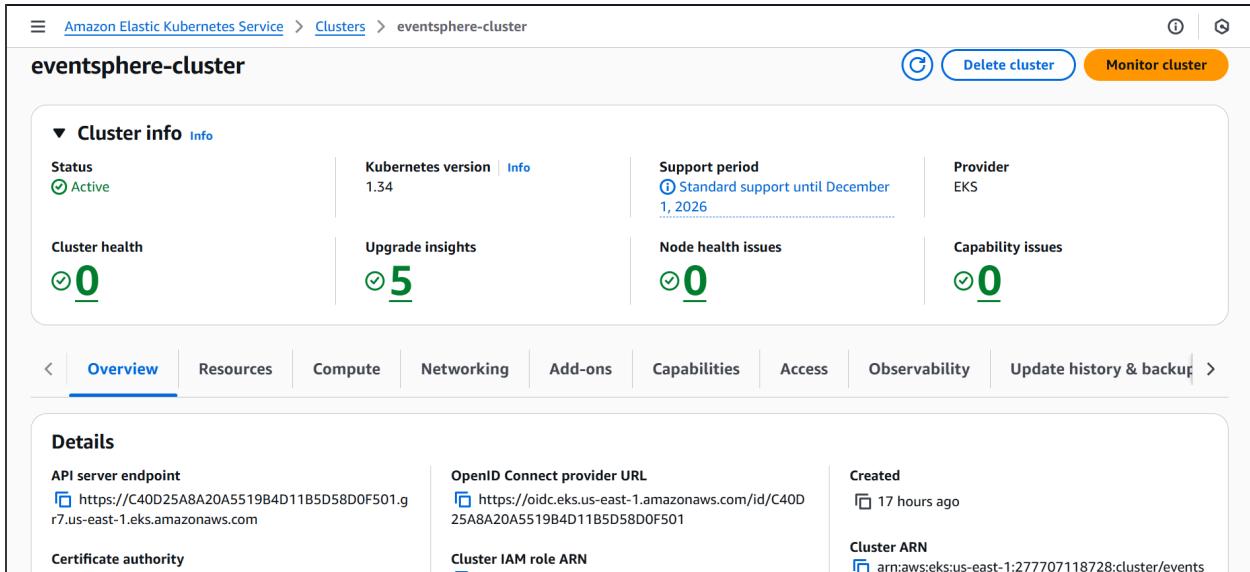
```

kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/Events
phere$ curl -v -H "Host: www.enpm818rgroup7.work.gd" https://www.enpm818rgroup7.work.gd:443/
* Host www.enpm818rgroup7.work.gd:443 was resolved.
* IPv6: (none)
* IPv4: 3.221.240.165, 52.6.253.22
* Trying 3.221.240.165:443...
* Connected to www.enpm818rgroup7.work.gd (3.221.240.165) port 443
* ALPN: curl offers h2,http/1.1
* TLSv1.3 (OUT), TLS handshake, Client hello (1):
* CAfile: /etc/ssl/certs/ca-certificates.crt
* CApth: /etc/ssl/certs
* TLSv1.3 (IN), TLS handshake, Server hello (2):
* TLSv1.2 (IN), TLS handshake, Certificate (11):
* TLSv1.2 (IN), TLS handshake, Server key exchange (12):
* TLSv1.2 (IN), TLS handshake, Server finished (14):
* TLSv1.2 (OUT), TLS handshake, Client key exchange (16):
* TLSv1.2 (OUT), TLS change cipher, Change cipher spec (1):
* TLSv1.2 (OUT), TLS handshake, Finished (20):
* TLSv1.2 (IN), TLS handshake, Finished (20):
* SSL connection using TLSv1.2 / ECDHE-RSA-AES128-GCM-SHA256 / prime256v1 / rsaEncryption
* ALPN: server accepted h2
* Server certificate:
*   subject: CN=enpm818rgroup7.work.gd
*   start date: Nov 22 00:00:00 2025 GMT
*   expire date: Dec 21 23:59:59 2026 GMT
*   subjectAltName: host "www.enpm818rgroup7.work.gd" matched cert's "www.enpm818rgroup7.work.gd"
*   issuer: C=US; O=Amazon; CN=Amazon RSA 2048 M04
*   SSL certificate verify ok.
*   Certificate level 0: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
*   Certificate level 1: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
*   Certificate level 2: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
* using HTTP/2
* [HTTP/2] [1] OPENED stream for https://www.enpm818rgroup7.work.gd:443/
* [HTTP/2] [1] [:method: GET]
* [HTTP/2] [1] [:scheme: https]

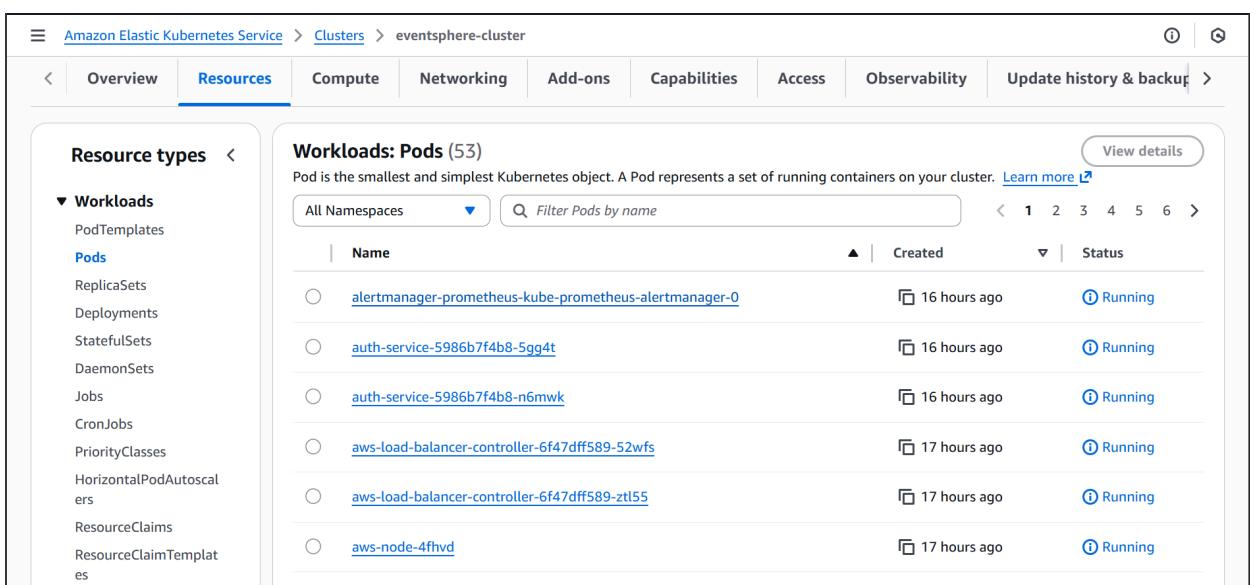
* issuer: C=US; O=Amazon; CN=Amazon RSA 2048 M04
* SSL certificate verify ok.
*   Certificate level 0: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
*   Certificate level 1: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
*   Certificate level 2: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
* using HTTP/2
* [HTTP/2] [1] OPENED stream for https://www.enpm818rgroup7.work.gd:443/
* [HTTP/2] [1] [:method: GET]
* [HTTP/2] [1] [:scheme: https]
* [HTTP/2] [1] [:authority: www.enpm818rgroup7.work.gd]
* [HTTP/2] [1] [:path: /]
* [HTTP/2] [1] [:user-agent: curl/8.5.0]
* [HTTP/2] [1] [:accept: */*]
> GET / HTTP/2
> Host: www.enpm818rgroup7.work.gd
> User-Agent: curl/8.5.0
> Accept: */*
>
< HTTP/2 200
< date: Sun, 07 Dec 2025 17:11:51 GMT
< content-type: text/html
< content-length: 936
< server: nginx/1.29.2
< last-modified: Thu, 04 Dec 2025 07:32:27 GMT
< etag: "6931390b-3a8"
< accept-ranges: bytes
<
* Connection #0 to host www.enpm818rgroup7.work.gd left intact
<!doctype html><html lang="en"><head><meta charset="utf-8"/><link rel="icon" href="/favicon.ico"/><meta name="viewport" content="width=device-width,initial-scale=1"/><meta name="theme-color" content="#000000"/><meta name="description" content="Web site created using create-react-app"/><link rel="apple-touch-icon" href="/logo192.png"/><link rel="manifest" href="/manifest.json"/><title>Campus Event Management</title><link rel="preconnect" href="https://fonts.googleapis.com"><link rel="preconnect" href="https://fonts.gstatic.com" crossorigin><link href="https://fonts.googleapis.com/css2?family=Roboto:wght@300;400;500;700&family=Montserrat:wght@400;500;600;700&display=swap" rel="stylesheet"><script defer="defer" src="/static/js/main.81c7b
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/Events

```

- EKS Console:



The screenshot shows the 'Overview' tab of the EKS Cluster details page. It displays cluster status (Active), Kubernetes version (1.34), support period (Standard support until December 1, 2026), and provider (EKS). Key metrics include 0 cluster health issues, 5 upgrade insights, 0 node health issues, and 0 capability issues. Below this, the 'Details' section provides API server endpoint (<https://C40D25A8A20A5519B4D11B5D58D0F501.g7.us-east-1.eks.amazonaws.com>), OpenID Connect provider URL (<https://oidc.eks.us-east-1.amazonaws.com/id/C40D25A8A20A5519B4D11B5D58D0F501>), and Cluster IAM role ARN (<arn:aws:eks:us-east-1:277707119728:cluster/eventsphere-cluster>).

The screenshot shows the 'Resources' tab of the EKS Cluster details page. The left sidebar lists resource types: Workloads (PodTemplates, Pods, ReplicaSets, Deployments, StatefulSets, DaemonSets, Jobs, CronJobs, PriorityClasses, HorizontalPodAutoscalers, ResourceClaims, ResourceClaimTemplates), Services, Ingresses, and Events. The main area displays a table titled 'Workloads: Pods (53)'. The table header includes 'Name', 'Created', and 'Status'. The table lists several pods, all of which are currently running.

Name	Created	Status
<a href="#">alertmanager-prometheus-kube-prometheus-alertmanager-0</a>	16 hours ago	Running
<a href="#">auth-service-5986b7f4b8-5gg4t</a>	16 hours ago	Running
<a href="#">auth-service-5986b7f4b8-n6mwk</a>	16 hours ago	Running
<a href="#">aws-load-balancer-controller-6f47dff589-52wfs</a>	17 hours ago	Running
<a href="#">aws-load-balancer-controller-6f47dff589-ztl55</a>	17 hours ago	Running
<a href="#">aws-node-4fhvd</a>	17 hours ago	Running

Amazon Elastic Kubernetes Service > Clusters > eventsphere-cluster

**Resource types**

- Workloads
- PodTemplates
- Pods
- ReplicaSets**
- Deployments
- StatefulSets
- DaemonSets
- Jobs
- CronJobs
- PriorityClasses
- HorizontalPodAutoscalers
- ResourceClaims
- ResourceClaimTemplates
- ResourceSlices

**Workloads: ReplicaSets (26)**

ReplicaSet aims to maintain a set of replica Pods running at any given time. [Learn more ↗](#)

Name	Namespace	Type	Created	Pod count	Status
<a href="#">auth-service-54b59c4d5c</a>	prod	replicasets	17 hours ago	0	0 Ready   0 Failed   0 Desired
<a href="#">auth-service-5986b7f4b8</a>	prod	replicasets	16 hours ago	2	2 Ready   0 Failed   2 Desired
<a href="#">aws-load-balancer-controller-6f47dff589</a>	kube-system	replicasets	17 hours ago	2	2 Ready   0 Failed   2 Desired
<a href="#">booking-service-7c6d6c87f7</a>	prod	replicasets	16 hours ago	2	2 Ready   0 Failed   2 Desired

**Booking service** 17 hours

[View details](#)

Amazon Elastic Kubernetes Service > Clusters > eventsphere-cluster

**Resource types**

- Workloads
- PodTemplates
- Pods
- ReplicaSets
- Deployments**
- StatefulSets
- DaemonSets
- Jobs
- CronJobs
- PriorityClasses
- HorizontalPodAutoscalers
- ResourceClaims
- ResourceClaimTemplates
- ResourceSlices

**Workloads: Deployments (16)**

Deployment is an API object that manages a replicated application, typically by running Pods with no local state. [Learn more ↗](#)

Name	Namespace	Type	Created	Pod count	Status
<a href="#">auth-service</a>	prod	deployments	17 hours ago	2	2 Ready   0 Failed   2 Desired
<a href="#">aws-load-balancer-controller</a>	kube-system	deployments	17 hours ago	2	2 Ready   0 Failed   2 Desired
<a href="#">booking-service</a>	prod	deployments	17 hours ago	2	2 Ready   0 Failed   2 Desired
<a href="#">cluster-autoscaler</a>	kube-system	deployments	17 hours ago	1	1 Ready   0 Failed   1 Desired

17 hours

[View details](#)

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### Resource types <

▼ Workloads

- PodTemplates
- Pods
- ReplicaSets
- Deployments
- StatefulSets
- DaemonSets**
- Jobs
- CronJobs
- PriorityClasses
- HorizontalPodAutoscalers
- ResourceClaims
- ResourceClaimTemplates
- ResourceSlices

### Workloads: DaemonSets (6)

Daemonset ensures a copy of a Pod is running across a set of nodes in a cluster. [Learn more ↗](#)

Name	Namespace	Type	Created	Pod count	Status
<a href="#">aws-node</a>	kube-system	daemonsets	17 hours ago	5	5 Ready   0 Failed   5 Desired
<a href="#">ebs-csi-node</a>	kube-system	daemonsets	17 hours ago	5	5 Ready   0 Failed   5 Desired
<a href="#">ebs-csi-node-windows</a>	kube-system	daemonsets	17 hours ago	0	0 Ready   0 Failed   0 Desired
<a href="#">fluent-bit</a>	amazon-cloudwatch	daemonsets	16 hours ago	0	0 Ready   0 Failed   5 Desired
			17 hours ago		

[View details](#)

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### Resource types <

▼ Workloads

- PodTemplates
- Pods
- ReplicaSets
- Deployments
- StatefulSets
- DaemonSets
- Jobs
- CronJobs
- PriorityClasses
- HorizontalPodAutoscalers**
- ResourceClaims
- ResourceClaimTemplates
- ResourceSlices

### Workloads: HorizontalPodAutoscalers (5)

The horizontal pod autoscaler automatically scales Pods depending on CPU demand. [Learn more ↗](#)

Name	Created
<a href="#">auth-service-hpa</a>	17 hours ago
<a href="#">booking-service-hpa</a>	17 hours ago
<a href="#">event-service-hpa</a>	17 hours ago
<a href="#">frontend-hpa</a>	17 hours ago
<a href="#">notification-service-hpa</a>	17 hours ago

[View details](#)

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Amazon Elastic Kubernetes Service > Clusters > eventsphere-cluster

### Resource types <

- ▶ Workloads
- ▼ Cluster
  - Nodes**
  - Namespaces
  - APIServices
  - Leases
  - RuntimeClasses
  - FlowSchemas
  - PriorityLevelConfigurations
- ▶ Service and networking
- ▶ Config and secrets
- ▶ Storage
- ▶ Authentication
- ▶ Authorization

**Cluster: Nodes (5)**  
A node is a worker machine in Kubernetes. [Learn more ↗](#)

Node name	Instance type	Compute	Managed by	Created	Status
ip-10-0-39-3.ec2.internal	t3.small	Node group	eventsphere-mng-2	16 hours ago	Read
ip-10-0-4-244.ec2.internal	t3.small	Node group	eventsphere-mng-2	17 hours ago	Read
ip-10-0-40-82.ec2.internal	t3.small	Node group	eventsphere-mng-1	17 hours ago	Read
ip-10-0-41-129.ec2.internal	t3.small	Node group	eventsphere-mng-2	17 hours ago	Read
ip-10-0-6-193.ec2.internal	t3.small	Node group	eventsphere-mng-1	17 hours ago	Read

Amazon Elastic Kubernetes Service > Clusters > eventsphere-cluster

### Resource types <

- ▶ Workloads
- ▼ Cluster
  - Nodes
  - Namespaces**
  - APIServices
  - Leases
  - RuntimeClasses
  - FlowSchemas
  - PriorityLevelConfigurations
- ▶ Service and networking
- ▶ Config and secrets
- ▶ Storage
- ▶ Authentication
- ▶ Authorization

**Cluster: Namespaces (10)**  
Namespace is an abstraction used by Kubernetes to support isolation of groups of resources within a single cluster. [Learn more ↗](#)

Name	Created
amazon-cloudwatch	16 hours ago
default	17 hours ago
dev	17 hours ago
external-secrets-system	17 hours ago
kube-node-lease	17 hours ago
kube-public	17 hours ago
kube-system	17 hours ago
monitoring	17 hours ago

kubectl get pvc,pv outputs showing Bound state:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/Events
phere$ kubectl get pvc -n prod
NAME           STATUS    VOLUME                                     CAPACITY   ACCESS MODES  STORAGECLASS  VOLUME
ATTRIBUTESCLASS AGE
mongodb-data-mongodb-0 Bound    pvc-4273ef6d-40aa-4766-839a-e2d128954985  20Gi       RWO          mongodb-ebs  <unset>
>              2d4h
```

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/Events
phere$ kubectl get pv -n prod
NAME           CAPACITY   ACCESS MODES  RECLAIM POLICY  STATUS    CLAIM
STORAGECLASS  VOLUMEATRIBUTESCLASS  REASON  AGE
pvc-4273ef6d-40aa-4766-839a-e2d128954985  20Gi     RWO        Retain      Bound    prod/mongodb-data-mongodb-0
mongodb-ebs  <unset>      2d4h
```

## Design and Build Dockerized Microservices

Screenshot of containers running locally:

The screenshot shows the Docker Desktop interface. On the left, there's a sidebar with options like Ask Gordon, Containers (which is selected), Images, Volumes, Kubernetes, Builds, Models, MCP Toolkit, Docker Hub, Docker Scout, and Extensions. The main area is titled 'Containers' and shows various metrics: Container CPU usage (3.21% / 1600%), Container memory usage (342.07MB / 7.28GB), and a 'Show charts' button. Below these are search and filter fields ('Search' and 'Only show running containers'). A table lists seven containers:

Name	Container ID	Image	Port(s)	CPU	Actions
eventsphere	-	-	-	3	[...]
event-platform-mongodb	a39f82d3337e	mongo:7	27017:27017	0	[...]
notification-service	d033e94d7558	eventspher_4004:4004	c2	0	[...]
auth-service	e00c4fb66be3	eventspher_4001:4001	c2	0	[...]
event-service	1266afbea28a	eventspher_4002:4002	c2	0	[...]
booking-service	336346264a32	eventspher_4003:4003	c2	0	[...]
frontend	2ddc3c83f1f0	eventspher_3000:80	c2	0	[...]

```
>> => unpacking to docker.io/library/eventsphere-frontend:latest
=> [notification-service] resolving provenance for metadata file
=> [auth-service] resolving provenance for metadata file
=> [event-service] resolving provenance for metadata file
=> [booking-service] resolving provenance for metadata file
=> [frontend] resolving provenance for metadata file
[+] Running 13/13
✓eventsphere-frontend          Built
✓eventsphere-notification-service Built
✓eventsphere-auth-service        Built
✓eventsphere-event-service       Built
✓eventsphere-booking-service    Built
✓Network eventsphere_event-platform-network Created
✓Volume eventsphere_mongo-data   Created
✓Container event-platform-mongodb Healthy
✓Container notification-service  Started
✓Container auth-service          Started
✓Container event-service         Started
✓Container booking-service       Started
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/Eventsphere$ docker ps
CONTAINER ID IMAGE                                COMMAND                  CREATED                 STATUS                  PORTS
2ddc3c83f1f0  eventsphere-frontend              "/docker-entrypoint...." 2 minutes ago   Up 2 minutes (unhealthy)  0.0.0.
0:3000->80/tcp, [::]:3000->80/tcp
336346264a32  eventsphere-booking-service     "docker-entrypoint.s..." 2 minutes ago   Up 2 minutes (healthy)   0.0.0.
0:4003->4003/tcp, [::]:4003->4003/tcp
1266afbea28a  eventsphere-event-service       "docker-entrypoint.s..." 2 minutes ago   Up 2 minutes (healthy)   0.0.0.
0:4002->4002/tcp, [::]:4002->4002/tcp
e00c4fb66be3  eventsphere-auth-service        "docker-entrypoint.s..." 2 minutes ago   Up 2 minutes (healthy)   0.0.0.
0:4001->4001/tcp, [::]:4001->4001/tcp
d033e94d7558  eventsphere-notification-service "docker-entrypoint.s..." 2 minutes ago   Up 2 minutes (healthy)   0.0.0.
0:4004->4004/tcp, [::]:4004->4004/tcp
a39f82d3337e  mongo:7                         "docker-entrypoint.s..." 2 minutes ago   Up 2 minutes (healthy)   0.0.0.
0:27017->27017/tcp, [::]:27017->27017/tcp  event-platform-mongodb
```

## ECR listing with tagged versions:

Private repositories (5)				
	Repository name	URI	Created at	Tag immutability
<input type="radio"/>	auth-service	277707118728.dkr.ecr.us-east-1.amazonaws.com/auth-service	December 06, 2025, 14:19:13 (UTC-05)	Mutable
<input type="radio"/>	booking-service	277707118728.dkr.ecr.us-east-1.amazonaws.com/booking-service	December 06, 2025, 14:19:19 (UTC-05)	Mutable
<input type="radio"/>	event-service	277707118728.dkr.ecr.us-east-1.amazonaws.com/event-service	December 06, 2025, 14:19:17 (UTC-05)	Mutable
<input type="radio"/>	frontend	277707118728.dkr.ecr.us-east-1.amazonaws.com/frontend	December 06, 2025, 14:19:25 (UTC-05)	Mutable
<input type="radio"/>	notification-service	277707118728.dkr.ecr.us-east-1.amazonaws.com/notification-service	December 06, 2025, 14:19:22 (UTC-05)	Mutable

auth-service						
	Summary	Images				
<b>Images (24)</b>						
	Filter active images		Delete	Copy URI	Details	Scan
	Image tags	Type	Created at	Image size	Image digest	Last pulled at
<input type="checkbox"/>	latest	Image Index	December 06, 2025, 14:19:34 (UTC-05)	68.56	sha256:f7...	December 07, 2025, 15:01:22 (UTC-05)
<input type="checkbox"/>	v1	Image Index	December 08, 2025, 12:32:34 (UTC-05)	68.56	sha256:1...	-
<input type="checkbox"/>	v1.1	Image Index	December 08, 2025, 12:33:55 (UTC-05)	68.56	sha256:7...	-
<input type="checkbox"/>	v1.2	Image Index	December 08, 2025, 12:35:56 (UTC-05)	68.56	sha256:6...	-

## Trivy scan reports (no Critical vulnerabilities):

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ ./bin/trivy image auth-service:latest
2025-12-08T13:30:22-05:00    INFO  [vuln] Vulnerability scanning is enabled
2025-12-08T13:30:22-05:00    INFO  [secret] Secret scanning is enabled
2025-12-08T13:30:22-05:00    INFO  [secret] If your scanning is slow, please try '--scanners vuln' to disable secret scanning
2025-12-08T13:30:22-05:00    INFO  [secret] Please see https://trivy.dev/docs/v0.68/guide/scanner/secret#recommendation for faster secret detection
2025-12-08T13:30:22-05:00    INFO  Detected OS   family="alpine" version="3.23.0"
2025-12-08T13:30:22-05:00    WARN  This OS version is not on the EOL list  family="alpine" version="3.23"
2025-12-08T13:30:22-05:00    INFO  [alpine] Detecting vulnerabilities...  os_version="3.23" repository="3.23" pkg_num=18
2025-12-08T13:30:22-05:00    INFO  Number of language-specific files      num=1
2025-12-08T13:30:22-05:00    INFO  [node-pkg] Detecting vulnerabilities...
2025-12-08T13:30:22-05:00    INFO  Table result includes only package filenames. Use '--format json' option to get the full path to the package file.

Report Summary
```

Target	Type	Vulnerabilities	Secrets
auth-service:latest (alpine 3.23.0)	alpine	0	-
app/node_modules/@isaacs/clui/package.json	node-pkg	0	-
app/node_modules/@isaacs/fs-minipass/package.json	node-pkg	0	-
app/node_modules/@mongodb-js/saslprep/package.json	node-pkg	0	-
app/node_modules/@opentelemetry/api/package.json	node-pkg	0	-
app/node_modules/@pkjjs/parseargs/package.json	node-pkg	0	-
app/node_modules/@types/webidl-conversions/package.json	node-pkg	0	-
app/node_modules/@types/whatwg-url/package.json	node-pkg	0	-
app/node_modules/accepts/package.json	node-pkg	0	-
app/node_modules/ansi-regex/package.json	node-pkg	0	-
app/node_modules/ansi-styles/package.json	node-pkg	0	-
app/node_modules/asynckit/package.json	node-pkg	0	-
app/node_modules/axios/package.json	node-pkg	0	-
app/node_modules/balanced-match/package.json	node-pkg	0	-

usr/local/lib/node_modules/npm/node_modules/yallist/package.json	node-pkg	0	-
usr/local/lib/node_modules/npm/package.json	node-pkg	0	-

Legend:  
- '-': Not scanned  
- '0': Clean (no security findings detected)

```
Node.js (node-pkg)
Total: 3 (UNKNOWN: 0, LOW: 0, MEDIUM: 1, HIGH: 2, CRITICAL: 0)


```

Library	Vulnerability	Severity	Status	Installed Version	Fixed Version	Title
glob (package.json)	CVE-2025-64756	HIGH	fixed	10.4.5	11.1.0, 10.5.0	glob: glob: Command Injection Vulnerability via Malicious Filenames <a href="https://avd.aquasec.com/nvd/cve-2025-64756">https://avd.aquasec.com/nvd/cve-2025-64756</a>
tar (package.json)	CVE-2025-64118	MEDIUM		7.5.1	7.5.2	node-tar has a race condition leading to uninitialized memory exposure <a href="https://avd.aquasec.com/nvd/cve-2025-64118">https://avd.aquasec.com/nvd/cve-2025-64118</a>

# Load Balancing & Networking

## ALB:

The screenshot shows the AWS CloudFormation Load Balancer configuration for the stack `k8s-prod-eventsph-395841f6f1`. The main details are:

- Scheme:** Internet-facing
- Hosted zone:** Z355XDOTRQ7X7K
- Availability Zones:** subnet-0e4331bf6cf4a9bff (us-east-1f (use1-az5)), subnet-0ecc6b14bc81ab99f (us-east-1a (use1-az2))
- Date created:** December 6, 2025, 14:29 (UTC-05:00)

**Load balancer ARN:** arn:aws:elasticloadbalancing:us-east-1:277707118728:loadbalancer/app/k8s-prod-eventsph-395841f6f1/c74fc405daabc92e

**DNS name Info:** k8s-prod-eventsph-395841f6f1-1344915046.us-east-1.elb.amazonaws.com (A Record)

**Listeners and rules:** (2) [Info](#)

A listener checks for connection requests on its configured protocol and port. Traffic received by the listener is routed according to the default action and any additional rules.

Protocol:Port	Default action	Rules	ARN	Security policy	Default SSL/TLS certificate	mTLS
HTTP:80	Redirect to HTTPS://#{host}:443/#{path}?	1 rule	ARN	Not applicable	Not applicable	Not applicable
HTTP:301	Status code: HTTP_301					
HTTPS:443	Return fixed response	7 rules	ARN	ELBSecurityPolicy-TLS-1-2-20...	enpm818rgroup7.work.gd (Cer...	Off
	Response code: 404					
	Response body					
	Response content type: text/plain					

## ALB Network Mapping:

The screenshot shows the AWS CloudFormation Network mapping configuration for the stack `k8s-prod-eventsph-395841f6f1`. The main details are:

- Internet-facing:** Z355XDOTRQ7X7K
- Subnets:** subnet-0e4331bf6cf4a9bff (us-east-1f (use1-az5)), subnet-0ecc6b14bc81ab99f (us-east-1a (use1-az2))
- Date created:** December 6, 2025, 14:29 (UTC-05:00)

**Load balancer ARN:** arn:aws:elasticloadbalancing:us-east-1:277707118728:loadbalancer/app/k8s-prod-eventsph-395841f6f1/c74fc405daabc92e

**DNS name Info:** k8s-prod-eventsph-395841f6f1-1344915046.us-east-1.elb.amazonaws.com (A Record)

**Network mapping:** [Info](#)

Targets in the listed zones and subnets are available for traffic from the load balancer using the IP addresses shown.

VPC	Load balancer IP address type	IP pools
vpc-0fa3cec13b872361a	IPv4	-
IPv4 VPC CIDR: 10.0.0.0/16		
IPv6 VPC CIDR: -		

**Availability Zones and subnets:** [Info](#)

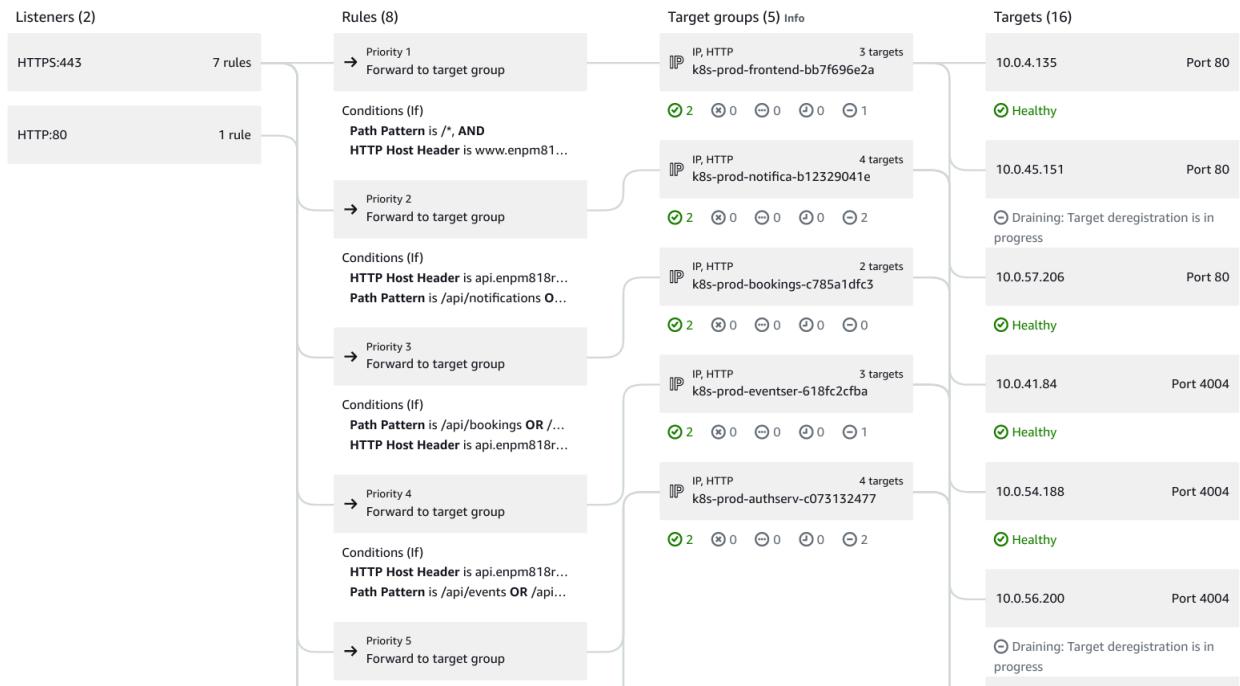
Including two or more Availability Zones, and corresponding subnets, increases the fault tolerance of your applications.

Zone	Subnet	Private IPv4 address	IPv6 address
us-east-1f (use1-az5)	subnet-0e4331bf6cf4a9bff	Assigned from CIDR 10.0.32.0/19	Not applicable
us-east-1a (use1-az2)	subnet-0ecc6b14bc81ab99f	Assigned from CIDR 10.0.0.0/19	Not applicable

## ALB Resource Map (target health OK):

Load balancer: k8s-prod-eventsph-395841f6f1

us-east-1 | 277707118728



## Output of kubectl describe ingress:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cyber/Sem 3/ENPM818R - Virtualization/Final project 2/EventSphere$ kubectl describe ingress -n prod
Name:           eventsphere-ingress
Labels:         app=eventsphere
                environment=production
Namespace:     prod
Address:       k8s-prod-eventsph-395841f6f1-1344915046.us-east-1.elb.amazonaws.com
Ingress Class: alb
Default backend: <default>
Rules:
  Host          Path  Backends
  ----          ----
  www.enpm818rgroup7.work.gd
    /   frontend:80 (10.0.4.135:80,10.0.57.206:80)
  api.enpm818rgroup7.work.gd
    /api/auth        auth-service:4001 (10.0.55.26:4001,10.0.39.74:4001)
    /api/events      event-service:4002 (10.0.23.181:4002,10.0.27.88:4002)
    /api/bookings    booking-service:4003 (10.0.47.216:4003,10.0.57.233:4003)
    /api/notifications notification-service:4004 (10.0.54.188:4004,10.0.41.84:4004)
    /health          auth-service:4001 (10.0.55.26:4001,10.0.39.74:4001)
Annotations:
  alb.ingress.kubernetes.io/certificate-arn: arn:aws:acm:us-east-1:277707118728:certificate/2ab5f4c8-842c-447b-842f-b741fdbdb2126
  alb.ingress.kubernetes.io/healthcheck-interval-seconds: 30
  alb.ingress.kubernetes.io/healthcheck-path: /health
  alb.ingress.kubernetes.io/healthcheck-timeout-seconds: 5
  alb.ingress.kubernetes.io/healthy-threshold-count: 2
  alb.ingress.kubernetes.io/listen-ports: [{"HTTP": 80, "HTTPS": 443}]
  alb.ingress.kubernetes.io/load-balancer-attributes: idle_timeout.timeout_seconds=60
  alb.ingress.kubernetes.io/scheme: internet-facing
  alb.ingress.kubernetes.io/ssl-policy: ELBSecurityPolicy-TLS-1-2-2017-01
  alb.ingress.kubernetes.io/ssl-redirect: 443
  alb.ingress.kubernetes.io/tags: Environment=production,Project=EventSphere
  alb.ingress.kubernetes.io/target-type: ip
  alb.ingress.kubernetes.io/unhealthy-threshold-count: 3
Events:
```

Curl test results of API health endpoint confirm that the ALB is responding:

```
kunal@ASUS:/mnt/c/Users/kunal/OneDrive - University of Maryland/Cloudsphere$ curl -I https://www.enpm818rgroup7.work.gd/api/health
HTTP/2 200
date: Mon, 08 Dec 2025 15:52:55 GMT
content-type: text/html
content-length: 936
server: nginx/1.29.2
last-modified: Thu, 04 Dec 2025 07:32:27 GMT
etag: "6931390b-3a8"
accept-ranges: bytes
```

# CI/CD Pipeline and Version Control

To manage the development across our team, we set up a dedicated GitHub Organization to centralize our code repositories and infrastructure files. We enforced a strict workflow where no developer was allowed to push code directly to the main branch.

Instead, every update, whether it was a fix for a microservice or a change to a Helm chart, required a Pull Request (PR). This allowed us to review each other's code for logic errors and potential security issues before integrating it.

We connected these PRs directly to our CI/CD pipeline. Whenever a pull request was created, our automated testing suite (GitHub Actions) would run immediately. We configured the repository settings so that a PR could only be merged into main after all the pipeline tests passed successfully. This "quality gate" ensured that we never accidentally broke the production build with faulty code.

# Observability

## Observability Implementation

The system implements a complete observability stack using **Prometheus**, **Grafana**, and **AWS CloudWatch**, deployed in an **Amazon EKS cluster using Helm**.

### Metrics and Visualization

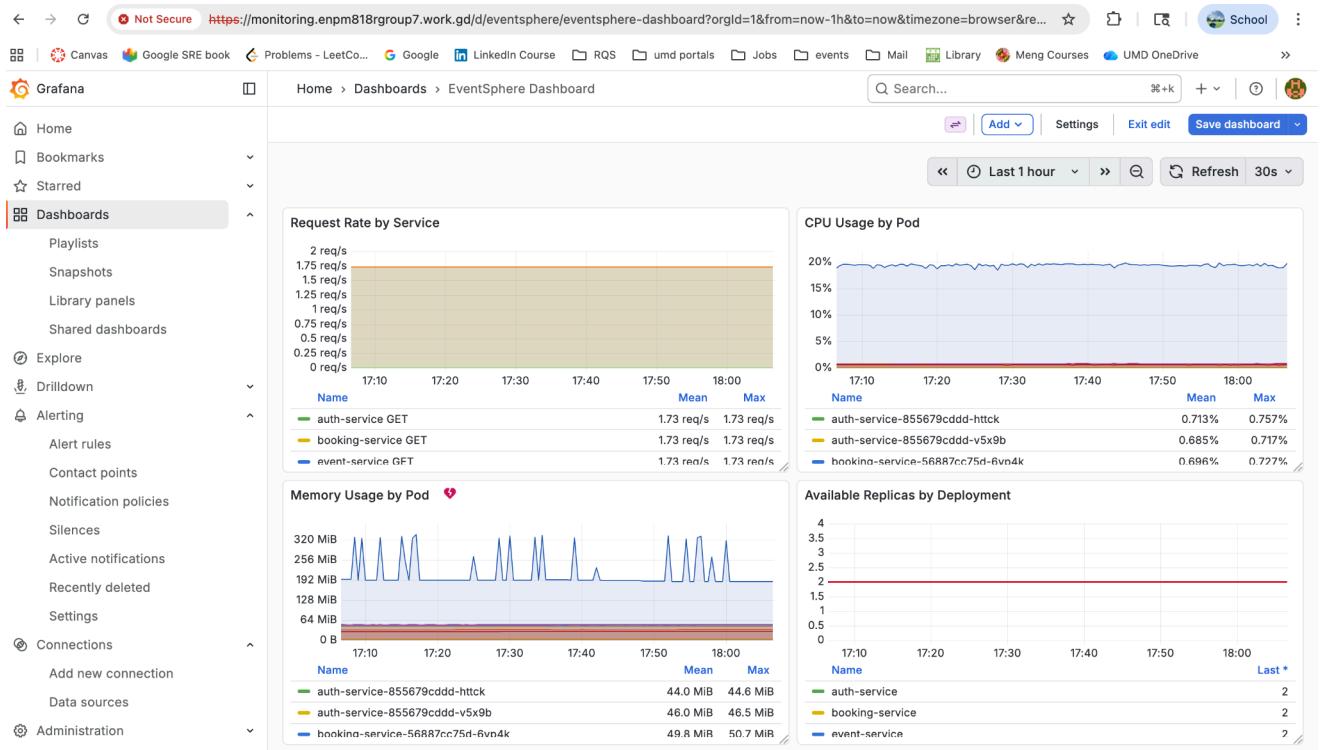
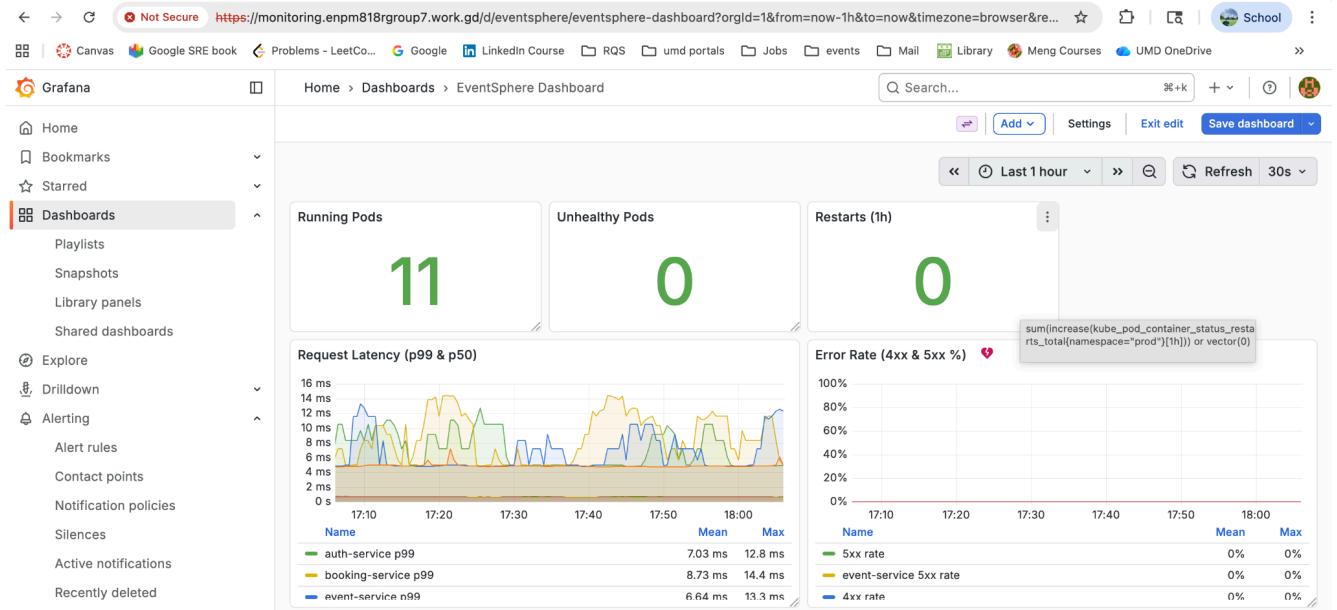
**Prometheus** scrapes Kubernetes and application-level metrics from all microservices running in the production namespace. Each service exposes a /metrics endpoint instrumented using Prometheus client libraries.

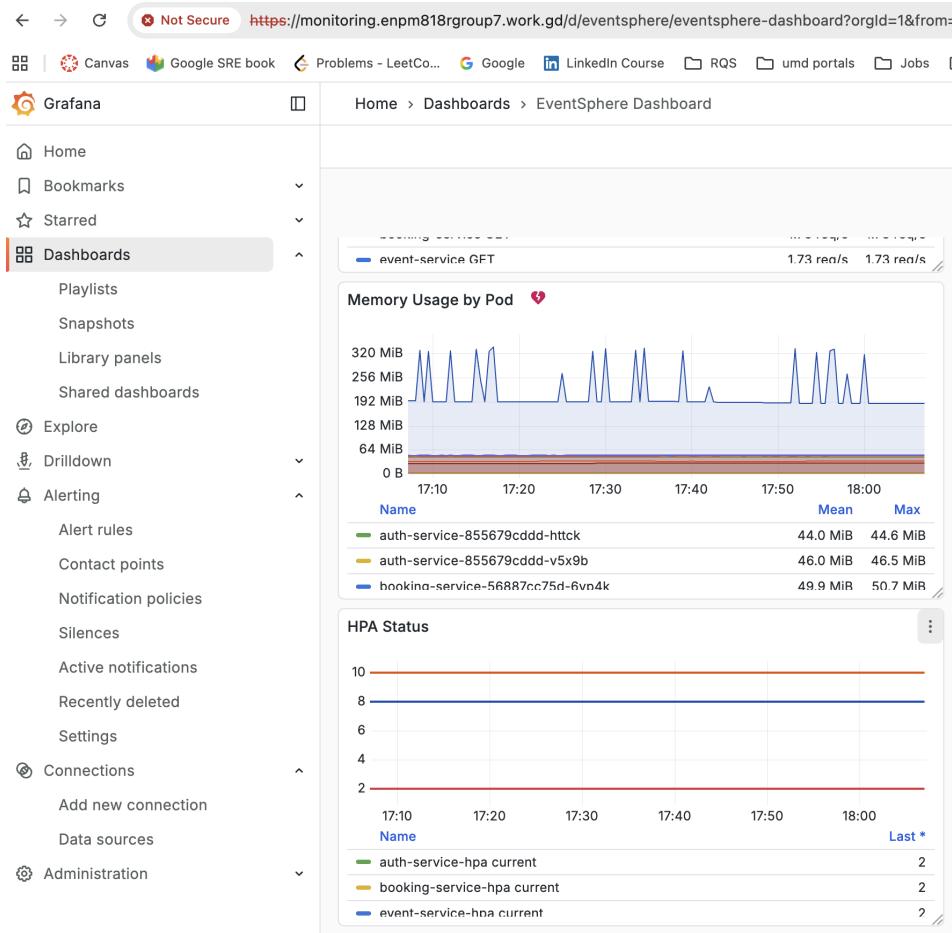
**Grafana** is used for metric visualization and alert evaluation through **Grafana Unified Alerting**. Unlike a port-forward-only setup, Grafana is exposed externally through an **AWS Application Load Balancer (ALB)** and accessed via DNS.

- **Grafana URL:** <https://monitoring.enpm818rgroup7.work.gd/>
- **Username:** admin
- **Password:** EventSphere2024
- **Dashboard:** *EventSphere Dashboard*

Grafana dashboards visualize:

1. Request latency (p99 and p50)
2. HTTP error rate (4xx & 5xx)
3. CPU and memory utilization by pod
4. Request rate per service
5. Pod status, restarts, and HPA state





## Prometheus Access

The Prometheus server itself is not publicly exposed and is accessed securely using port forwarding when needed for inspection and validation.

kubectl port-forward -n monitoring svc/prometheus-kube-prometheus-prometheus 9090:9090

Prometheus UI:

<http://localhost:9090/alerts>

localhost:9090/alerts

Prometheus

Alerts

Status

Filter by rule group state

Filter by rule name or labels

1 2 >

**eventsphere.deployment** /etc/prometheus/rules/prometheus-prometheus-kube-prometheus-prometheus-rulefiles-0/monitoring-eventsphere-alerts-a7f7ae9d-d47a-4b12-8887-56b0158e2d57.yaml

INACTIVE (2)

- DeploymentReplicasMismatch
- HPAAAtMaxReplicas

**eventsphere.pods** /etc/prometheus/rules/prometheus-prometheus-kube-prometheus-prometheus-rulefiles-0/monitoring-eventsphere-alerts-a7f7ae9d-d47a-4b12-8887-56b0158e2d57.yaml

INACTIVE (2)

- PodCrashLooping
- PodNotReady

**eventsphere.resources** /etc/prometheus/rules/prometheus-prometheus-kube-prometheus-prometheus-rulefiles-0/monitoring-eventsphere-alerts-a7f7ae9d-d47a-4b12-8887-56b0158e2d57.yaml

INACTIVE (2)

- HighMemoryUsage

localhost:9090/alerts

Prometheus

Alerts

Status

**alertmanager.rules**

/etc/prometheus/rules/prometheus-prometheus-kube-prometheus-prometheus-rulefiles-0/monitoring-prometheus-kube-prometheus-alertmanager.rules-f281270a-0d5d-4fb-a654-a3d9cccd955.yaml

INACTIVE (8)

- AlertmanagerFailedReload
- AlertmanagerMembersInconsistent
- AlertmanagerFailedToSendAlerts
- AlertmanagerClusterFailedToSendAlerts
- AlertmanagerClusterFailedToSendAlerts
- AlertmanagerConfigInconsistent
- AlertmanagerClusterDown
- AlertmanagerClusterCrashlooping

**config-reloaders**

/etc/prometheus/rules/prometheus-prometheus-kube-prometheus-prometheus-rulefiles-0/monitoring-prometheus-kube-prometheus-config-reloaders-3106b860-ef4d-4d51-94a6-f93341fe85f9.yaml

INACTIVE (1)

- ConfigReloaderSidecarError

The screenshot shows the Prometheus Alerts interface at [localhost:9090/alerts](http://localhost:9090/alerts). The top navigation bar includes links to Canvas, Google SRE book, Problems - LeetCode, Google, LinkedIn Course, RQS, umd portals, Jobs, events, Mail, Library, Meng Courses, and UMD OneDrive. The main content area has tabs for 'Alerts' (selected) and 'Status'. The 'Alerts' tab displays two sections:

- Kubernetes storage**: A list of alerts from the file [/etc/prometheus/rules/prometheus-prometheus-kube-prometheus-prometheus-rulefiles-0/monitoring-prometheus-kube-prometheus-kubernetes-storage-4743d631-9bea-4bec-ab8e-2b3ddc0c6d31.yaml](#). It shows 5 inactive alerts:
  - KubePersistentVolumeFillingUp
  - KubePersistentVolumeFillingUp
  - KubePersistentVolumeNodesFillingUp
  - KubePersistentVolumeNodesFillingUp
  - KubePersistentVolumeErrors
- Inactive (5)**: A list of alerts that are currently inactive:
  - KubeCPUQuotaOvercommit
  - KubeMemoryQuotaOvercommit
  - KubeQuotaAlmostFull
  - KubeQuotaFullyUsed
  - KubeQuotaExceeded
  - CPUThrottlingHigh

## Logging Pipeline

**CloudWatch** is used for centralized log ingestion and log analytics.

Application logs, Kubernetes events, and alerting-related logs are ingested into **CloudWatch** and stored in **structured JSON format**, enabling filtering and correlation by pod, service, and timestamp.

### Role of CloudWatch in the Observability Stack

CloudWatch is used to:

- Store and query **application and Kubernetes control-plane logs**
- Enable **on-demand log analysis** using CloudWatch Logs and Logs Insights
- Provide visibility into Kubernetes audit logs and request-level events

This complements, but does not duplicate, the Prometheus–Grafana metrics pipeline.

Relevant log groups include:

- `/aws/eks/eventsphere-cluster/cluster`
- `/aws/lambda/eventsphere-email-sender`
- `/aws/lambda/grafana-alerting`

In this architecture:

- Metrics and alerting are handled by Prometheus and Grafana
- Logs and log analytics are handled by CloudWatch

This separation follows recommended cloud-native observability practices.

The screenshot shows the AWS CloudWatch Log management interface. On the left, there's a navigation sidebar with sections like Application Signals (APM), Infrastructure Monitoring, Logs (Log Management, Log Anomalies, Live Tail, Logs Insights, Contributor Insights), Metrics, Network Monitoring, Setup (Ingestion, Getting Started), and CloudWatch Metrics. The main content area is titled "Log groups (4)" and shows a table with four entries:

Log group	Log class	Anomaly d...	Deletio...	Data ...	Sens...	Retenti...
<a href="#">/aws/eks/eventsphere-cluster/application</a>	Standard	Configure	Off	-	-	1 month
<a href="#">/aws/eks/eventsphere-cluster/cluster</a>	Standard	Configure	Off	-	-	Never exp...
<a href="#">/aws/lambda/eventsphere-email-sender</a>	Standard	Configure	Off	-	-	Never exp...
<a href="#">/aws/lambda/grafana-alerting</a>	Standard	Configure	Off	-	-	Never exp...

The screenshot shows the AWS CloudWatch Log management interface, specifically the Log streams page for the log group `/aws/eks/eventsphere-cluster/cluster`. The left sidebar is identical to the previous screenshot. The main content area is titled "Log streams (12)" and shows a table with twelve entries:

Log stream	Last event time
<a href="#">kube-apiserver-a8390d0aa74a4e88356d7cb4183f297e</a>	2025-12-07 23:16:25 (UTC)
<a href="#">kube-scheduler-de3d1856b0abd2c9a1d91d76b36c17b0</a>	2025-12-07 23:05:09 (UTC)
<a href="#">kube-apiserver-audit-de3d1856b0abd2c9a1d91d76b36c17b0</a>	2025-12-07 23:01:50 (UTC)
<a href="#">kube-apiserver-audit-a8390d0aa74a4e88356d7cb4183f297e</a>	2025-12-07 23:01:45 (UTC)
<a href="#">authenticator-a8390d0aa74a4e88356d7cb4183f297e</a>	2025-12-07 22:52:41 (UTC)
<a href="#">kube-apiserver-de3d1856b0abd2c9a1d91d76b36c17b0</a>	2025-12-07 22:50:25 (UTC)
<a href="#">authenticator-de3d1856b0abd2c9a1d91d76b36c17b0</a>	2025-12-07 22:49:40 (UTC)
<a href="#">kube-controller-manager-de3d1856b0abd2c9a1d91d76b36c17b0</a>	2025-12-07 22:32:28 (UTC)
<a href="#">cloud-controller-manager-de3d1856b0abd2c9a1d91d76b36c17b0</a>	2025-12-07 22:29:50 (UTC)
<a href="#">kube-scheduler-a8390d0aa74a4e88356d7cb4183f297e</a>	2025-12-07 20:13:49 (UTC)
<a href="#">kube-controller-manager-a8390d0aa74a4e88356d7cb4183f297e</a>	2025-12-06 19:04:57 (UTC)
<a href="#">cloud-controller-manager-a8390d0aa74a4e88356d7cb4183f297e</a>	2025-12-06 19:04:51 (UTC)

AWS CloudWatch Logs Insights interface showing a query for log group arm:awslogsus-east-1:277707118728:log-group:/aws/eks/eventsphere-cluster/cluster. The query filters for @message like /error|Error|ERROR|exception|Exception|failed|Failed/ and sorts by @timestamp desc, limit 100.

**Log class:** Standard

**Queries**

**Saved queries**

**Sample queries**

- Common queries
- Lambda
- VPC Flow Logs
- CloudTrail
- NetworkFirewall
- Route53
- AWS AppSync
- NAT Gateway
- IoT
- Elemental MediaPackage V2 Access Logs
- SES Mail Manager
- Amazon Q Business Conversation Log
- CloudFront Standard Logs

CloudWatch Dashboards interface showing the eventsphere dashboard. The main view displays a log stream with 231 records matched, 59,477 records scanned in 1.8s at 33,376 records/s (45.8 MB/s). The log stream shows audit events from kube-apiserver and audit-de3d18560abd29a1d91d7636c17b0.

**Logs (100)**

**Requests by service**

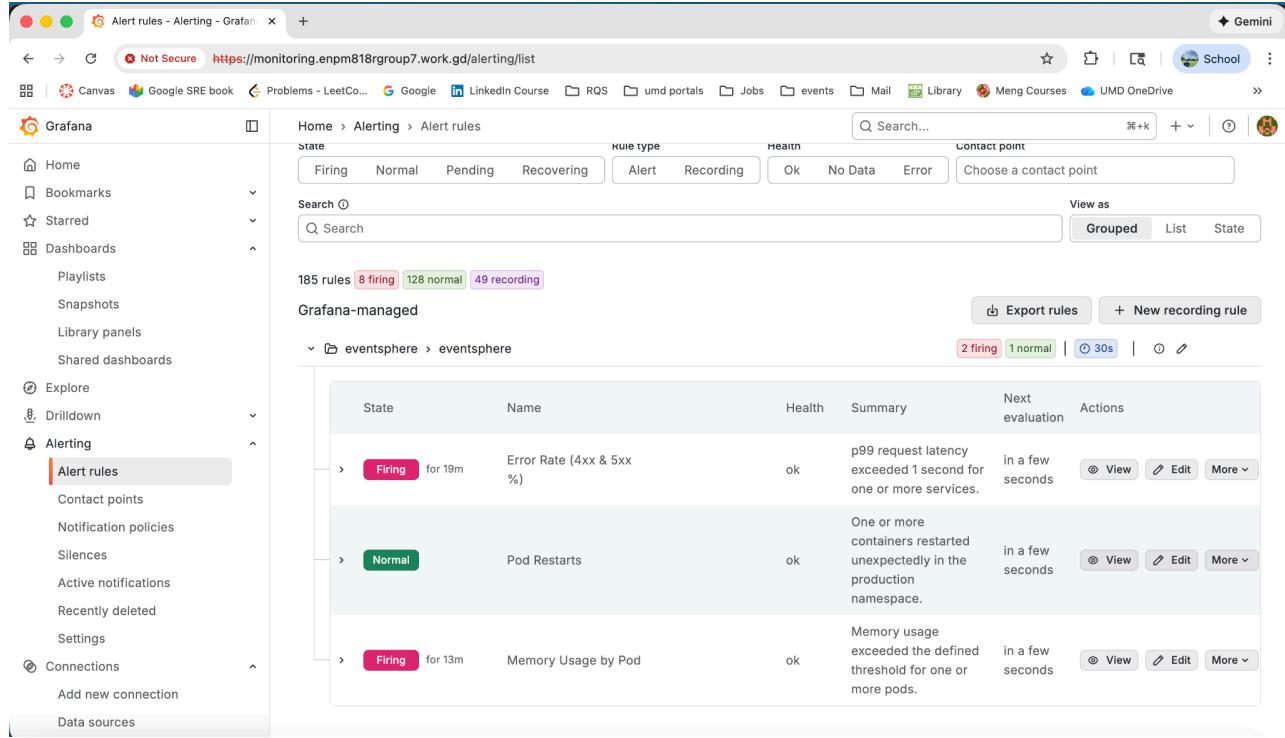
Legend:

1. kube-apiserver-audit-de3d18560abd29a1d91d7636c17b0
2. kube-apiserver-audit-a83900daa74a4e88356d7db183f297e
3. kube-controller-manager-d034...
4. kube-apiserver-audit-03900da...
5. kube-apiserver-audit-03900da...
6. authenticator-a3d7800da...
7. authenticator-de3d18560abd...
8. cloud-controller-manager-d0...
9. kube-scheduler-d3d18560ab...

## Alerting and Notifications

Alert rules are evaluated using **Grafana Unified Alerting**, and notifications are delivered through an AWS-native pipeline:

**Grafana → Webhook → AWS Lambda → Amazon SNS → Email**



The screenshot shows the Grafana Alerting interface with the URL <https://monitoring.enpm818rgroup7.work.gd/alerting/list>. The left sidebar is collapsed, and the main area displays a table of alert rules. The table has columns for State, Name, Health, Summary, Next evaluation, and Actions. There are three rows:

State	Name	Health	Summary	Next evaluation	Actions
Firing	Error Rate (4xx & 5xx %)	ok	p99 request latency exceeded 1 second for one or more services.	in a few seconds	<a href="#">View</a> <a href="#">Edit</a> <a href="#">More</a>
Normal	Pod Restarts	ok	One or more containers restarted unexpectedly in the production namespace.	in a few seconds	<a href="#">View</a> <a href="#">Edit</a> <a href="#">More</a>
Firing	Memory Usage by Pod	ok	Memory usage exceeded the defined threshold for one or more pods.	in a few seconds	<a href="#">View</a> <a href="#">Edit</a> <a href="#">More</a>

## Alerting and Runbooks Implementation

We implemented **three production-grade alert rules** using **Grafana Unified Alerting (Grafana-managed Alert manager)**. Alert notifications are delivered through an **AWS-integrated pipeline**, consisting of **Grafana webhook notifications routed through AWS Lambda and delivered via Amazon SNS (email)**.

The alerts are actively evaluated and observed in a **firing state**, as shown in the Grafana Alert Rules view.

### Configured Alerts

1. **Error Rate (4xx & 5xx)**
  - Monitors elevated HTTP error rates across application services
  - Triggers when the error percentage exceeds the defined SLO threshold
2. **Memory Usage by Pod**
  - Tracks pod-level memory consumption using Kubernetes container metrics
  - Triggers when memory usage exceeds the configured threshold for a sustained period

### 3. Pod Restart Spike

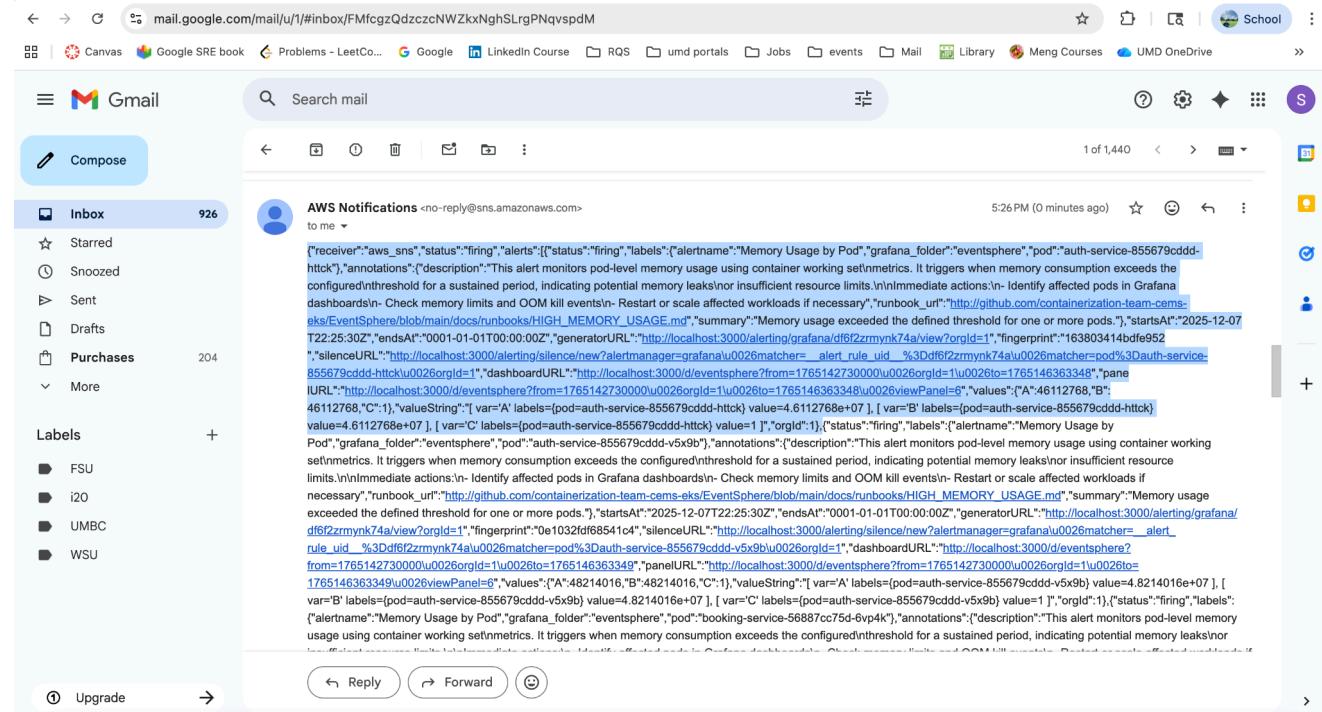
- Detects unexpected container restarts within the production namespace
  - Indicates potential crash loops, failed deployments, or resource misconfigurations

All alert rules are evaluated by **Grafana Alert manager**, while notifications are delivered using **Amazon SNS**, invoked via an **AWS Lambda webhook integration**.

## Runbooks

For each alert, a corresponding operational runbook has been created. Each runbook documents possible root causes, investigation steps, and remediation actions.

- **Error Rate Alert Runbook**  
[https://github.com/containerization-team-cems-eks/EventSphere/blob/main/docs/runbooks/ERROR\\_RATE.md](https://github.com/containerization-team-cems-eks/EventSphere/blob/main/docs/runbooks/ERROR_RATE.md)
  - **Pod Restart Spike Runbook**  
[https://github.com/containerization-team-cems-eks/EventSphere/blob/main/docs/runbooks/POD\\_RESTART\\_SPIKE.md](https://github.com/containerization-team-cems-eks/EventSphere/blob/main/docs/runbooks/POD_RESTART_SPIKE.md)
  - **High Memory Usage Runbook**  
[https://github.com/containerization-team-cems-eks/EventSphere/blob/main/docs/runbooks/HIGH\\_MEMORY\\_USAGE.md](https://github.com/containerization-team-cems-eks/EventSphere/blob/main/docs/runbooks/HIGH_MEMORY_USAGE.md)



This email is an automated **AWS SNS notification triggered by a Grafana alert** indicating **high memory usage at the pod level**. The alert fires when one or more Kubernetes pods

exceed the configured memory threshold for a sustained period, signaling potential memory leaks, misconfigured resource limits, or abnormal traffic patterns. Along with detailed metadata such as the affected pod, timestamps, and alert labels, the notification **includes links to Grafana dashboards and an attached runbook**, providing clear, predefined steps for investigation and remediation to reduce response time and operational guesswork.

## Three Pillars of Observability

### 1. Metrics (Prometheus + Grafana)

Component	Description
prom-client	Each service exposes /metrics with latency histograms and request counters
middleware	Scrapes metrics from all pods and stores time-series data
Prometheus	Custom dashboard (eventsphere-dashboard.json) for visualization
Grafana	Evaluates alert rules and triggers notifications

#### Key metrics collected:

- http\_request\_duration\_seconds – latency histogram
- http\_requests\_total – request count by method/route/status
- Default Node.js metrics (CPU, memory, event loop)

### 2. Logs (Fluent Bit → CloudWatch)

Component	Description
Fluent Bit	DaemonSet tailing /var/log/containers/*_prod_*.log
CloudWatch	Centralized log storage and search

### 3. Alerting

Alert rules are defined and managed using Helm configuration and evaluated by Grafana Alertmanager.

#### Configured Alerts:

Alert	Trigger	Severity

PodCrashLooping	Restart rate > 0 for 5m	Critical
PodNotReady	Pending/Failed > 10m	Warning
HighMemoryUsage	> 90% limit for 5m	Warning
HighCPUUsage	> 80% limit for 10m	Warning
DeploymentReplicasMismatc h	Desired ≠ available for 10m	Warning
HPAAtMaxReplicas	Max replicas for 15m	Warning

## Deployment Using Helm

All observability components in the EventSphere platform are deployed to the Amazon EKS cluster using **Helm**, ensuring consistency, repeatability, and version-controlled configuration.

Helm charts are used to deploy and manage:

- Prometheus (metrics scraping and storage)
- Grafana (dashboards and alerting)
- Alert rules (Prometheus Rule and Grafana alert definitions)
- Fluent Bit (log forwarding to AWS CloudWatch)

Using Helm allows centralized configuration management, simplified upgrades, and reproducible deployments across environments.

The Helm-based deployment confirms that the observability stack follows cloud-native and production-aligned deployment practices rather than ad-hoc manual configuration.

```
sakethbolla@sakeths-MacBook-Air-2 ~ % kubectl get pods -n monitoring --show-labels | grep helm
prometheus-grafana-5965f805c-1d908      3/3   Running   0    3h54m   app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=grafana,app.kubernetes.io/version=2.1.3,app.helm.sh/chart=grafana-18.3.0,app.kubernetes.io/pod-template-hash=5965f805c
prometheus-state-metrics-exporter-4cfb1b- 1/1   Running   0    3h54s   app.kubernetes.io/component=metrics,app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=prometheus-state-metrics-exporter,app.kubernetes.io/part-of=prometheus-node-exporter,app.kubernetes.io/released-prometheus-node-exporter-v4cfb1b,app.kubernetes.io/version=1.10.2,controller-revision-hash=5d7db7286,release=prometheus
prometheus-prometheus-node-exporter-4cfb6- 1/1   Running   0    3h54m   app.kubernetes.io/component=metrics,app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=prometheus-node-exporter,app.kubernetes.io/part-of=prometheus-node-exporter,app.kubernetes.io/released-prometheus-node-exporter-v4cfb6,app.kubernetes.io/version=1.10.2,controller-revision-hash=66df454fc,helm.sh/chart=prometheus-node-exporter-4.49.2
prometheus-prometheus-node-exporter-4cfb7- 1/1   Running   0    3h54m   app.kubernetes.io/component=metrics,app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=prometheus-node-exporter,app.kubernetes.io/part-of=prometheus-node-exporter,app.kubernetes.io/released-prometheus-node-exporter-v4cfb7,app.kubernetes.io/version=1.10.2,controller-revision-hash=7a50454fc,helm.sh/chart=prometheus-node-exporter-4.49.2
prometheus-prometheus-node-exporter-4cfb8- 1/1   Running   0    3h54m   app.kubernetes.io/component=metrics,app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=prometheus-node-exporter,app.kubernetes.io/part-of=prometheus-node-exporter,app.kubernetes.io/released-prometheus-node-exporter-v4cfb8,app.kubernetes.io/version=1.10.2,controller-revision-hash=868f454fc,helm.sh/chart=prometheus-node-exporter-4.49.2
prometheus-prometheus-node-exporter-4cfb9- 1/1   Running   0    3h54m   app.kubernetes.io/component=metrics,app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=prometheus-node-exporter,app.kubernetes.io/part-of=prometheus-node-exporter,app.kubernetes.io/released-prometheus-node-exporter-v4cfb9,app.kubernetes.io/version=1.10.2,controller-revision-hash=968f454fc,helm.sh/chart=prometheus-node-exporter-4.49.2
prometheus-prometheus-node-exporter-4cfba- 0/1   Pending   0    17h    app.kubernetes.io/component=metrics,app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=prometheus-node-exporter,app.kubernetes.io/part-of=prometheus-node-exporter,app.kubernetes.io/released-prometheus-node-exporter-v4cfba,app.kubernetes.io/version=1.10.2,controller-revision-hash=a68f454fc,helm.sh/chart=prometheus-node-exporter-4.49.2
prometheus-prometheus-node-exporter-4cfbb- 0/1   Pending   0    17h    app.kubernetes.io/component=metrics,app.kubernetes.io/instance=prometheus,app.kubernetes.io/name=prometheus-node-exporter,app.kubernetes.io/part-of=prometheus-node-exporter,app.kubernetes.io/released-prometheus-node-exporter-v4cfbb,app.kubernetes.io/version=1.10.2,controller-revision-hash=b68f454fc,helm.sh/chart=prometheus-node-exporter-4.49.2
sakethbolla@sakeths-MacBook-Air-2 ~ %
```

```
sakethbolla@sakeths-MacBook-Air-2 ~ % helm list -A
NAME          NAMESPACE      REVISION      UPDATED           VERSION
aws-load-balancer-controller  kube-system   1            2025-12-06 14:13:51.2220488 -0500 EST
external-secrets      external-secrets-system 1            2025-12-06 14:14:42.9649706 -0500 EST
prometheus          monitoring     1            2025-12-06 14:30:17.1225593 -0500 EST
```

```
sakethbolla@Sakeths-MacBook-Air-2 ~ % kubectl get pods -n monitoring
NAME                                     READY   STATUS    RESTARTS   AGE
alertmanager-prometheus-kube-prometheus-alertmanager-0   2/2     Running   0          3h57m
prometheus-grafana-5965ff89c5-ld998      3/3     Running   0          3h57m
prometheus-kube-prometheus-operator-6fc45cb74f-h7t6g      1/1     Running   0          3h57m
prometheus-kube-state-metrics-5d7bdb7c86-7fhbl       1/1     Running   0          3h57m
prometheus-prometheus-kube-prometheus-prometheus-0      2/2     Running   0          3h57m
prometheus-prometheus-node-exporter-4cj66      1/1     Running   0          3h57m
prometheus-prometheus-node-exporter-lhxgf      1/1     Running   0          3h57m
prometheus-prometheus-node-exporter-svfb6      1/1     Running   0          3h56m
prometheus-prometheus-node-exporter-x4jbp      1/1     Running   0          17h
prometheus-prometheus-node-exporter-xj5zr      0/1     Pending   0          3h57m
```

```
sakethbolla@Sakeths-MacBook-Air-2 ~ % kubectl get svc -n monitoring
NAME           TYPE        CLUSTER-IP   EXTERNAL-IP  PORT(S)   AGE
alertmanager-operated  ClusterIP  None         <none>      9093/TCP, 9094/TCP, 9094/UDP  28h
prometheus-grafana  ClusterIP  172.20.65.33  <none>      80/TCP     28h
prometheus-kube-prometheus-alertmanager  ClusterIP  172.20.35.219 <none>      9093/TCP, 8080/TCP  28h
prometheus-kube-prometheus-operator  ClusterIP  172.20.31.130 <none>      443/TCP    28h
prometheus-kube-prometheus-prometheus  ClusterIP  172.20.51.12  <none>      9090/TCP, 8080/TCP  28h
prometheus-kube-state-metrics  ClusterIP  172.20.235.236 <none>      8080/TCP    28h
prometheus-operated  ClusterIP  None         <none>      9090/TCP    28h
prometheus-prometheus-node-exporter  ClusterIP  172.20.139.39 <none>      9100/TCP    28h
sakethbolla@Sakeths-MacBook-Air-2 ~ %
```

## Deliverable

Prometheus/Grafana Helm  
Values

PrometheusRule (Alerts)

Grafana Dashboard JSON

Fluent Bit Config

## File Path

[monitoring/prometheus/values.yaml](#)

[monitoring/prometheus/alertrules.yaml](#)

[monitoring/grafana/dashboards/eventsphere-dashboard.json](#)

[monitoring/cloudwatch/fluent-bit-config.yaml](#)

```
EventSphere / monitoring / prometheus / values.yaml
Code Blame 92 lines (86 loc) · 1.9 KB ↑ Top
4 # Reduce resource usage for smaller clusters
5 prometheus:
6   prometheusSpec:
7     retention: 7d
8     resources:
9       requests:
10      memory: 256Mi
11      cpu: 100m
12     limits:
13      memory: 1Gi
14      cpu: 500m
15 # Use emptyDir instead of PVC for simplicity (data lost on restart, but works everywhere)
16   storageSpec: {}
17
18 alertmanager:
19   enabled: true
20   alertmanagerSpec:
21     resources:
22       requests:
23         memory: 64Mi
24         cpu: 25m
25       limits:
26         memory: 128Mi
27         cpu: 100m
28   storage: {}
29
30 grafana:
31   enabled: true
32   adminUser: admin
33   adminPassword: "EventSphere2024"
34   resources:
35     requests:
36       memory: 128Mi
37       cpu: 50m
38     limits:
```

## **Deployment Methodology**

All observability components, including **Prometheus**, **Grafana**, **Alerting rules**, and **Fluent Bit**, are deployed into the EKS cluster **using Helm charts**, ensuring reproducibility and consistency.

Amazon Elastic Kubernetes Service > Clusters > eventsphere-cluster

**Resource types**

- Workloads
- PodTemplates
- Pods
- ReplicaSets
- Deployments
- StatefulSets**
- DaemonSets
- Jobs
- CronJobs
- PriorityClasses
- HorizontalPodAutoscalers
- ResourceClaims
- ResourceClaimTemplates
- ResourceSlices

**Workloads: StatefulSets (3)**

Statefulset manages the deployment and scaling of a set of Pods, and provides guarantees about the ordering and uniqueness of these Pods.

Learn more [↗](#)

Name	Namespace	Type	Created	Pod count	Status
<a href="#">alertmanager-prometheus-kube-prometheus-alertmanager</a>	monitoring	statefulsets	16 hours ago	1	<div style="width: 100%; background-color: green;"></div> 1 Ready   0 Failed   1 Desired
<a href="#">mongodb</a>	prod	statefulsets	17 hours ago	1	<div style="width: 100%; background-color: green;"></div> 1 Ready   0 Failed   1 Desired
<a href="#">prometheus-prometheus-kube-prometheus-prometheus</a>	monitoring	statefulsets	16 hours ago	1	<div style="width: 100%; background-color: green;"></div> 1 Ready   0 Failed   1 Desired

[View details](#)

# Security and Compliance

All Images are taken from trusted sources. Images are scanned for vulnerabilities with trivy, and rejected if there are critical vulnerabilities. Database is encrypted, and TLS is enforced for all data in transit. Trivy Scan reports:

eventsphere-auth-service:latest (alpine 3.23.0) - Trivy Report - 2025-12-09 12:03:33.33226948 -0500 EST m=+0.794909274

alpine					
No Vulnerabilities found					
No Misconfigurations found					
node-pkg					
Package	Vulnerability ID	Severity	Installed Version	Fixed Version	Links
glob	CVE-2025-64756	HIGH	10.4.5	11.1.0, 10.5.0	<a href="https://access.redhat.com/security/cve/CVE-2025-64756">https://access.redhat.com/security/cve/CVE-2025-64756</a> <a href="https://github.com/isaac/node-glob">https://github.com/isaac/node-glob</a> <a href="https://github.com/isaac/node-glob/commit/1e4e297342a09f2aa0ced87fcda4a70ddc325d75">https://github.com/isaac/node-glob/commit/1e4e297342a09f2aa0ced87fcda4a70ddc325d75</a> <a href="#">Toggle more links</a>
glob	CVE-2025-64756	HIGH	11.0.3	11.1.0, 10.5.0	<a href="https://access.redhat.com/security/cve/CVE-2025-64756">https://access.redhat.com/security/cve/CVE-2025-64756</a> <a href="https://github.com/isaac/node-glob">https://github.com/isaac/node-glob</a> <a href="https://github.com/isaac/node-glob/commit/1e4e297342a09f2aa0ced87fcda4a70ddc325d75">https://github.com/isaac/node-glob/commit/1e4e297342a09f2aa0ced87fcda4a70ddc325d75</a> <a href="#">Toggle more links</a>
tar	CVE-2025-64118	MEDIUM	7.5.1	7.5.2	<a href="https://github.com/isaac/node-tar">https://github.com/isaac/node-tar</a> <a href="https://github.com/isaac/node-tar/commit/5530eb804bc43014f216e5c271b40d5c00d45224">https://github.com/isaac/node-tar/commit/5530eb804bc43014f216e5c271b40d5c00d45224</a> <a href="https://github.com/isaac/node-tar/commit/5e1a8e638600dc3a2909b4de69e0c44fa70dc4">https://github.com/isaac/node-tar/commit/5e1a8e638600dc3a2909b4de69e0c44fa70dc4</a> <a href="#">Toggle more links</a>

eventsphere-booking-service:latest (alpine 3.23.0) - Trivy Report - 2025-12-09 12:08:07.252320747 -0500 EST m=+1.756425588

eventsphere-event-service:latest (alpine 3.23.0) - Trivy Report - 2025-12-09 12:08:01.892374016 -0500 EST m=+2.317336817

alpine					
No Vulnerabilities found					
No Misconfigurations found					
node-pkg					
Package	Vulnerability ID	Severity	Installed Version	Fixed Version	Links
glob	CVE-2025-64756	HIGH	10.4.5	11.1.0, 10.5.0	<a href="https://access.redhat.com/security/cve/CVE-2025-64756">https://access.redhat.com/security/cve/CVE-2025-64756</a> <a href="https://github.com/isaacs/node-glob">https://github.com/isaacs/node-glob</a> <a href="https://github.com/isaacs/node-glob/commit/1e4e297342a09f2aa0ced87fd4a70ddc325d7">https://github.com/isaacs/node-glob/commit/1e4e297342a09f2aa0ced87fd4a70ddc325d7</a> Toggle more links
glob	CVE-2025-64756	HIGH	11.0.3	11.1.0, 10.5.0	<a href="https://access.redhat.com/security/cve/CVE-2025-64756">https://access.redhat.com/security/cve/CVE-2025-64756</a> <a href="https://github.com/isaacs/node-glob">https://github.com/isaacs/node-glob</a> <a href="https://github.com/isaacs/node-glob/commit/1e4e297342a09f2aa0ced87fd4a70ddc325d7">https://github.com/isaacs/node-glob/commit/1e4e297342a09f2aa0ced87fd4a70ddc325d7</a> Toggle more links
tar	CVE-2025-64118	MEDIUM	7.5.1	7.5.2	<a href="https://github.com/isaacs/node-tar">https://github.com/isaacs/node-tar</a> <a href="https://github.com/isaacs/node-tar/commit/5330eb04bc43014f216e5c271b40d5c00d4522a">https://github.com/isaacs/node-tar/commit/5330eb04bc43014f216e5c271b40d5c00d4522a</a> <a href="https://github.com/isaacs/node-tar/commit/5e1a8e638600d3c3a2969b4de6a6ec44fa8d74c">https://github.com/isaacs/node-tar/commit/5e1a8e638600d3c3a2969b4de6a6ec44fa8d74c</a> Toggle more links

eventsphere-notification-service:latest (alpine 3.23.0) - Trivy Report - 2025-12-09 12:03:50.955954529 -0500 EST m=+0.496271750

alpine					
No Vulnerabilities found					
No Misconfigurations found					
node-pkg					
Package	Vulnerability ID	Severity	Installed Version	Fixed Version	Links
glob	CVE-2025-64756	HIGH	10.4.5	11.1.0, 10.5.0	<a href="https://access.redhat.com/security/cve/CVE-2025-64756">https://access.redhat.com/security/cve/CVE-2025-64756</a> <a href="https://github.com/isaacs/node-glob">https://github.com/isaacs/node-glob</a> <a href="https://github.com/isaacs/node-glob/commit/1e4a207342a09f2aa0ced87fd4a70ddc325d75f">https://github.com/isaacs/node-glob/commit/1e4a207342a09f2aa0ced87fd4a70ddc325d75f</a> Toggle more links
glob	CVE-2025-64756	HIGH	11.0.3	11.1.0, 10.5.0	<a href="https://access.redhat.com/security/cve/CVE-2025-64756">https://access.redhat.com/security/cve/CVE-2025-64756</a> <a href="https://github.com/isaacs/node-glob">https://github.com/isaacs/node-glob</a> <a href="https://github.com/isaacs/node-glob/commit/1e4a207342a09f2aa0ced87fd4a70ddc325d75f">https://github.com/isaacs/node-glob/commit/1e4a207342a09f2aa0ced87fd4a70ddc325d75f</a> Toggle more links
tar	CVE-2025-64118	MEDIUM	7.5.1	7.5.2	<a href="https://github.com/isaacs/node-tar">https://github.com/isaacs/node-tar</a> <a href="https://github.com/isaacs/node-tar/commit/53130eb04bc43014f218e5c271b40d5c00d45224d">https://github.com/isaacs/node-tar/commit/53130eb04bc43014f218e5c271b40d5c00d45224d</a> <a href="https://github.com/isaacs/node-tar/commit/5e1a8ed38900d3c3a29c9b4de9a0ec44fb8d74c9">https://github.com/isaacs/node-tar/commit/5e1a8ed38900d3c3a29c9b4de9a0ec44fb8d74c9</a> Toggle more links
No Misconfigurations found					

eventsphere-frontend:latest (alpine 3.22.2) - Trivy Report - 2025-12-09 11:59:09.832655202 -0500 EST m=+0.854720586

alpine					
Package	Vulnerability ID	Severity	Installed Version	Fixed Version	Links
busybox	CVE-2024-58251	MEDIUM	1.37.0-r19	1.37.0-r20	<a href="http://www.openwall.com/lists/oss-security/2025/04/23/6">http://www.openwall.com/lists/oss-security/2025/04/23/6</a> <a href="https://bugs.busybox.net/show_bug.cgi?id=15922">https://bugs.busybox.net/show_bug.cgi?id=15922</a> <a href="https://www.busybox.net">https://www.busybox.net</a> Toggle more links
busybox	CVE-2025-46394	LOW	1.37.0-r19	1.37.0-r20	<a href="http://www.openwall.com/lists/oss-security/2025/04/23/5">http://www.openwall.com/lists/oss-security/2025/04/23/5</a> <a href="http://www.openwall.com/lists/oss-security/2025/04/24/3">http://www.openwall.com/lists/oss-security/2025/04/24/3</a> <a href="https://bugs.busybox.net/show_bug.cgi?id=16018">https://bugs.busybox.net/show_bug.cgi?id=16018</a> Toggle more links
busybox-binsh	CVE-2024-58251	MEDIUM	1.37.0-r19	1.37.0-r20	<a href="http://www.openwall.com/lists/oss-security/2025/04/23/6">http://www.openwall.com/lists/oss-security/2025/04/23/6</a> <a href="https://bugs.busybox.net/show_bug.cgi?id=15922">https://bugs.busybox.net/show_bug.cgi?id=15922</a> <a href="https://www.busybox.net">https://www.busybox.net</a> Toggle more links
busybox-binsh	CVE-2025-46394	LOW	1.37.0-r19	1.37.0-r20	<a href="http://www.openwall.com/lists/oss-security/2025/04/23/5">http://www.openwall.com/lists/oss-security/2025/04/23/5</a> <a href="http://www.openwall.com/lists/oss-security/2025/04/24/3">http://www.openwall.com/lists/oss-security/2025/04/24/3</a> <a href="https://bugs.busybox.net/show_bug.cgi?id=16018">https://bugs.busybox.net/show_bug.cgi?id=16018</a> Toggle more links
libpng	CVE-2025-64720	HIGH	1.6.47-r0	1.6.51-r0	<a href="https://access.redhat.com/security/cve/CVE-2025-64720">https://access.redhat.com/security/cve/CVE-2025-64720</a> <a href="https://github.com/pnggroup/libpng/commit/08da3394c88cfcd36e5a706558a8d7e0e4773643">https://github.com/pnggroup/libpng/commit/08da3394c88cfcd36e5a706558a8d7e0e4773643</a> <a href="https://github.com/pnggroup/libpng/issues/686">https://github.com/pnggroup/libpng/issues/686</a> Toggle more links
libpng	CVE-2025-65018	HIGH	1.6.47-r0	1.6.51-r0	<a href="https://access.redhat.com/security/cve/CVE-2025-65018">https://access.redhat.com/security/cve/CVE-2025-65018</a> <a href="https://github.com/pnggroup/libpng/commit/10463823918840aae65c0a6da57c78a5a496a4d">https://github.com/pnggroup/libpng/commit/10463823918840aae65c0a6da57c78a5a496a4d</a> <a href="https://github.com/pnggroup/libpng/commit/218612dd9b17944e21eda56cafb4bf7779d1ea">https://github.com/pnggroup/libpng/commit/218612dd9b17944e21eda56cafb4bf7779d1ea</a> Toggle more links
libpng	CVE-2025-66293	HIGH	1.6.47-r0	1.6.53-r0	<a href="http://www.openwall.com/lists/oss-security/2025/12/03/8">http://www.openwall.com/lists/oss-security/2025/12/03/8</a> <a href="http://www.openwall.com/lists/oss-security/2025/12/03/7">http://www.openwall.com/lists/oss-security/2025/12/03/7</a> <a href="http://www.openwall.com/lists/oss-security/2025/12/03/8">http://www.openwall.com/lists/oss-security/2025/12/03/8</a> Toggle more links
libpng	CVE-2025-64505	MEDIUM	1.6.47-r0	1.6.51-r0	<a href="https://access.redhat.com/security/cve/CVE-2025-64505">https://access.redhat.com/security/cve/CVE-2025-64505</a> <a href="https://github.com/pnggroup/libpng/commit/6a528eb51d0dd7f6de1c39d30de0e41473431c37">https://github.com/pnggroup/libpng/commit/6a528eb51d0dd7f6de1c39d30de0e41473431c37</a> <a href="https://github.com/pnggroup/libpng/commit/6a528eb51d0dd7f6de1c39d30de0e41473431c37. (v1.6.51)">https://github.com/pnggroup/libpng/commit/6a528eb51d0dd7f6de1c39d30de0e41473431c37. (v1.6.51)</a> Toggle more links
libpng	CVE-2025-64506	MEDIUM	1.6.47-r0	1.6.51-r0	<a href="https://access.redhat.com/security/cve/CVE-2025-64506">https://access.redhat.com/security/cve/CVE-2025-64506</a> <a href="https://github.com/pnggroup/libpng/commit/2bd84c019c300b78e811743fbcd67c9dbf821">https://github.com/pnggroup/libpng/commit/2bd84c019c300b78e811743fbcd67c9dbf821</a> <a href="https://github.com/pnggroup/libpng/pull/749">https://github.com/pnggroup/libpng/pull/749</a> Toggle more links
ssl_client	CVE-2024-58251	MEDIUM	1.37.0-r19	1.37.0-r20	<a href="http://www.openwall.com/lists/oss-security/2025/04/23/6">http://www.openwall.com/lists/oss-security/2025/04/23/6</a> <a href="https://bugs.busybox.net/show_bug.cgi?id=15922">https://bugs.busybox.net/show_bug.cgi?id=15922</a> <a href="https://www.busybox.net">https://www.busybox.net</a> Toggle more links
ssl_client	CVE-2025-46394	LOW	1.37.0-r19	1.37.0-r20	<a href="http://www.openwall.com/lists/oss-security/2025/04/23/5">http://www.openwall.com/lists/oss-security/2025/04/23/5</a> <a href="http://www.openwall.com/lists/oss-security/2025/04/24/3">http://www.openwall.com/lists/oss-security/2025/04/24/3</a> <a href="https://bugs.busybox.net/show_bug.cgi?id=16018">https://bugs.busybox.net/show_bug.cgi?id=16018</a> Toggle more links
No Misconfigurations found					

Once we analyze the trivy reports, we mitigate each of the vulnerabilities found and do a report once again. If a fix isn't available, we can setup alerts and monitor those images closely with our monitoring stack, while waiting for the vendor to publish a fix.

# Innovation

In developing EventSphere, our team moved beyond simple containerization to implement an operations-ready platform. The primary innovation lies in our automated resiliency and proactive security capabilities.

**Dynamic Auto-Scaling instead of static provisioning:** We implemented a dual-layer scaling strategy. We configured the Cluster Autoscaler to watch for pending pods and automatically provision new EC2 nodes when resources run low. We validated this by running a load test that pushed the cluster from 2 nodes up to 5 nodes automatically when traffic spiked, and then scaled it back down when the load was removed. We also implemented Horizontal Pod Autoscalers (HPA) for individual services like the auth-service and booking-service to scale pod replicas based on CPU demand.

**DevSecOps Integration:** We integrated security directly into our pipeline. We used Trivy to scan our container images for vulnerabilities before deployment. For example, our scans of the auth-service identified specific package vulnerabilities, allowing us to address risks before they hit production.

**Production-Grade Alerting & Runbooks:** Rather than just staring at dashboards, we set up an automated alerting pipeline. If error rates spike (4xx/5xx errors) or memory usage gets too high, Grafana triggers a webhook that routes through AWS Lambda to Amazon SNS, sending us an email notification immediately. Crucially, each alert is paired with a specific Runbook (hosted on GitHub) that tells the on-call engineer exactly how to diagnose the crash loop or memory leak, significantly reducing time-to-recovery.

## Notification Service

### 1. Introduction:

The Notification Service is a cloud-native microservice responsible for delivering transactional emails—including welcome emails and booking confirmations—in the EventSphere system. It leverages Amazon SNS for message brokering, AWS Lambda for serverless processing, and Amazon SES for authenticated email delivery. The service runs on AWS EKS and uses IRSA (IAM Roles for Service Accounts) for secure AWS integration.

### 2. Architecture Overview

The notification pipeline follows an event-driven architecture:

User registers / books an event

Auth or Booking Service calls Notification Service REST endpoint

Notification Service publishes a structured message to SNS

SNS invokes Lambda

Lambda sends email via SES

SES delivers to end-user inbox

### 3. Technology Stack

Node.js + Express backend service  
AWS SNS – asynchronous messaging  
AWS Lambda – email processing  
AWS SES – email delivery  
Amazon EKS – container orchestration  
Amazon ECR – container registry  
Kubernetes HPA – auto-scaling  
IAM + IRSA – identity and permissions

#### 4.1 Notification Service (Microservice)

Handles REST API requests and publishes messages to SNS.

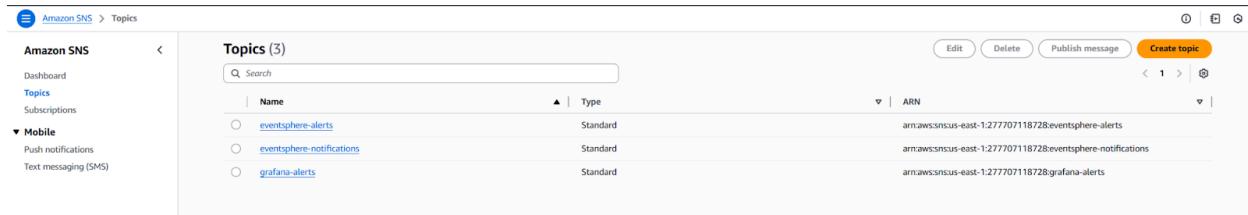
Endpoints:

POST /api/notifications/welcome  
POST /api/notifications/booking-confirmation  
GET /health

#### 4.2 Amazon SNS (Message Broker)

SNS topic receives messages from the Notification Service and triggers Lambda.

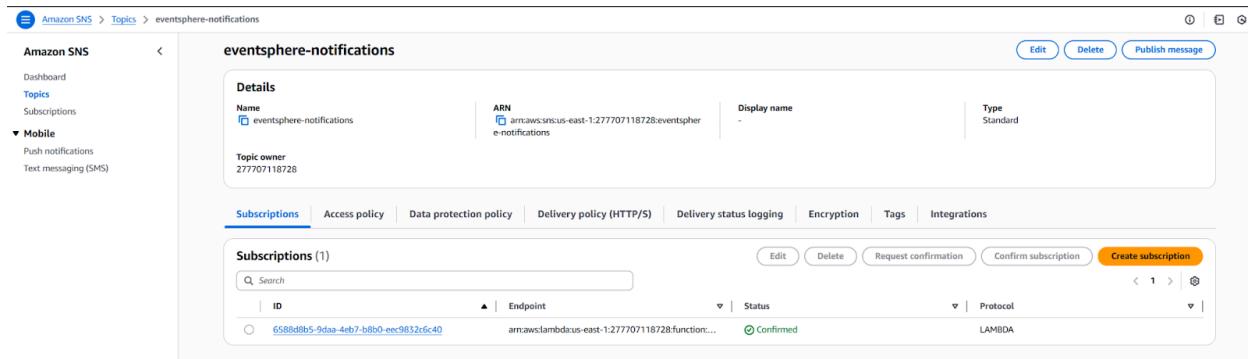
**Displays the SNS Topic List page**, confirming that the topic *eventsphere-notifications* exists in the correct region.



The screenshot shows the 'Topics' section of the Amazon SNS console. It lists three topics: 'eventsphere-alerts', 'eventsphere-notifications', and 'grafana-alerts'. Each topic entry includes its ARN and type (Standard). The 'eventsphere-notifications' topic is highlighted.

Name	Type	ARN
eventsphere-alerts	Standard	arn:aws:sns:us-east-1:277707118728:eventsphere-alerts
eventsphere-notifications	Standard	arn:aws:sns:us-east-1:277707118728:eventsphere-notifications
grafana-alerts	Standard	arn:aws:sns:us-east-1:277707118728:grafana-alerts

**Shows the SNS Topic Details page**, including the Topic ARN and the number of connected subscriptions, verifying correct configuration and availability.



The screenshot shows the 'Details' page for the 'eventsphere-notifications' topic. It displays the topic's name, ARN, display name (empty), and type (Standard). Below this, the 'Subscriptions' tab is selected, showing one confirmed subscription to an AWS Lambda function. The subscription ID is '6588dbb5-9daa-4eb7-bb00-eec9832c6c40'.

ID	Endpoint	Status	Protocol
6588dbb5-9daa-4eb7-bb00-eec9832c6c40	arn:aws:lambda:us-east-1:277707118728:function:...	Confirmed	LAMBDA

**Provides the SNS Subscriptions page**, confirming that the Notification Service's SNS topic is successfully subscribed to the Lambda function and that the subscription status is *Confirmed*.

Amazon SNS > Topics > eventsphere-notifications > Subscription: 6588d8b5-9daa-4eb7-b8b0-eec9832c6c40

**Subscription: 6588d8b5-9daa-4eb7-b8b0-eec9832c6c40**

[Edit](#) [Delete](#)

Details		Status
ARN	arn:aws:sns:us-east-1:277707118728:eventsphere-notifications:6588d8b5-9daa-4eb7-b8b0-eec9832c6c40	Confirmed
Endpoint	arn:aws:lambda:us-east-1:277707118728:function:eventsphere-email-sender	
Topic	<a href="#">eventsphere-notifications</a>	Protocol
Subscription Principal	arn:aws:iam::277707118728:user/admin	LAMBDA

[Subscription filter policy](#) [Redrive policy \(dead-letter queue\)](#)

**Subscription filter policy** Info

This policy filters the messages that a subscriber receives.

No filter policy configured for this subscription.  
To apply a filter policy, edit this subscription.

[Edit](#)

#### 4.3 AWS Lambda (Email Processor)

Lambda receives SNS messages and sends emails using SES.

**Shows the Lambda Code interface**, index.js file implements SNS event handling and SES email sending.

The screenshot shows the AWS Lambda Code source interface. The left sidebar displays the project structure under 'EXPLORER' and 'TEST EVENTS'. The main area shows the 'index.js' file content:

```
index.js
6  * Flow:
7  * 1. SNS receives message from notification service
8  * 2. SNS triggers this Lambda function
9  * 3. Lambda extracts email and message from SNS event
10 * 4. Lambda sends email via SES to specific user
11 */
12
13 const { SESClient, SendEmailCommand } = require('@aws-sdk/client-ses');
14
15 // AWS_REGION is automatically available in Lambda environment
16 const sesClient = new SESClient({ region: process.env.AWS_REGION || 'us-east-1' });
17 const FROM_EMAIL = process.env.FROM_EMAIL || 'noreply@example.com';
18
19 exports.handler = async (event) => {
20   console.log('Received SNS event:', JSON.stringify(event, null, 2));
21
22   try {
23     // Process each SNS record
24     for (const record of event.Records) {
25       if (record.EventSource === 'aws:sns') {
26         const snsMessage = record.sns;
27
28         // Extract email from message attributes
29         const emailAttribute = snsMessage.MessageAttributes?.email;
30         const toEmail = emailAttribute?.Value;
31
32         if (!toEmail) {
33           console.error('No email found in message attributes');
34           continue;
35         }
36
37         const params = {
38           Destination: {
39             ToAddresses: [toEmail]
40           },
41           Message: {
42             Body: {
43               Raw: snsMessage.Message
44             },
45             Subject: {
46               Data: snsMessage.Subject
47             }
48           }
49         };
50
51         await sesClient.send(SendEmailCommand, params);
52       }
53     }
54   } catch (error) {
55     console.error(error);
56   }
57 }
58
```

**Displays the Lambda Trigger configuration**, confirming that the Lambda function is correctly triggered by the SNS topic defined earlier.

The screenshot shows the AWS Lambda Function Overview page for the function 'eventsphere-email-sender'. The top navigation bar includes 'Lambda > Functions > eventsphere-email-sender'. On the right, there are buttons for 'Throttle', 'Copy ARN', and 'Actions'. Below the navigation, the function name 'eventsphere-email-sender' is displayed with a 'Function overview' section and an 'Info' link. A 'Diagram' button is highlighted, showing a visual representation of the function's architecture with components like 'eventsphere-email-sender' (Lambda icon), 'Layers (0)', 'SNS' (topic icon), and 'AWS Lambda' (function icon). Buttons for '+ Add destination' and '+ Add trigger' are present. To the right, there is a 'Description' section with a link to 'Last modified 2 days ago', a 'Function ARN' link (arn:aws:lambda:us-east-1:277707118728:function:eventsphere-email-sender), and a 'Function URL' link. At the bottom, tabs for 'Code', 'Test', 'Monitor', 'Configuration' (which is selected), 'Aliases', and 'Versions' are visible. The 'Configuration' tab contains sections for 'General configuration', 'Triggers (1)', 'Permissions', 'Destinations', 'Function URL', 'Environment variables', and 'Tags'. The 'Triggers' section shows one trigger: 'SNS: eventsphere-notifications' (arn:aws:sns:us-east-1:277707118728:eventsphere-notifications). The 'Details' section for this trigger shows it is a complex statement and is associated with the service principal sns.amazonaws.com, with a Service ID of sns:Invoke and a Subscription ARN of arn:aws:sns:us-east-1:277707118728:eventsphere-notifications:6588d8b5-9daa-4eb7-b8b0-eec9832c6c40.

**Shows the CloudWatch Lambda log stream**, containing a log entry such as “*Email sent successfully. MessageId: ...*”, proving that the Lambda processor executed successfully and SES accepted the outgoing email.

## Email received evidences

Welcome to EventSphere! Inbox x

 **noreply@enpm818rgroup7.work.gd**  
to me ▾

7:18 PM (4 minutes ago) ☆ ⓘ ↗ ⋮

Hello s,

Welcome to EventSphere - Your Gateway to Amazing Events!

We're thrilled to have you join our community. EventSphere makes it easy to discover, book, and manage tickets for exciting events.

Here's what you can do:

- Browse upcoming events across various categories
- Book tickets instantly with our seamless booking system
- Manage your bookings and view your event history
- Get real-time updates about your events

Start exploring events now at <https://enpm818rgroup7.work.gd>

If you have any questions, feel free to reach out to our support team.

Happy event hunting!

Best regards,  
The EventSphere Team

---  
This is an automated message. Please do not reply to this email.

## Booking Confirmed - MAGE Christmas Inbox x

 **noreply@enpm818rgroup7.work.gd**  
to me ▾

Hello s,

Your booking has been confirmed!

Event Details:

- Event: MAGE Christmas
- Date: 12/25/2025
- Time: 10:00 AM
- Venue: JMP
- Category: festival

Booking Details:

- Booking ID: BKG1765239534560526
- Number of Tickets: 1
- Total Amount: \$0
- Booking Date: 12/9/2025, 12:18:54 AM

Important Information:

- Please arrive at least 15 minutes before the event starts
- Bring a valid ID for verification
- Your booking reference: BKG1765239534560526

View your booking details at: <https://enpm818rgroup7.work.gd/my-bookings>

We look forward to seeing you at the event!

Best regards,  
The EventSphere Team

---  
This is an automated message. Please do not reply to this email.

## 4.4 Amazon SES (Email Delivery)

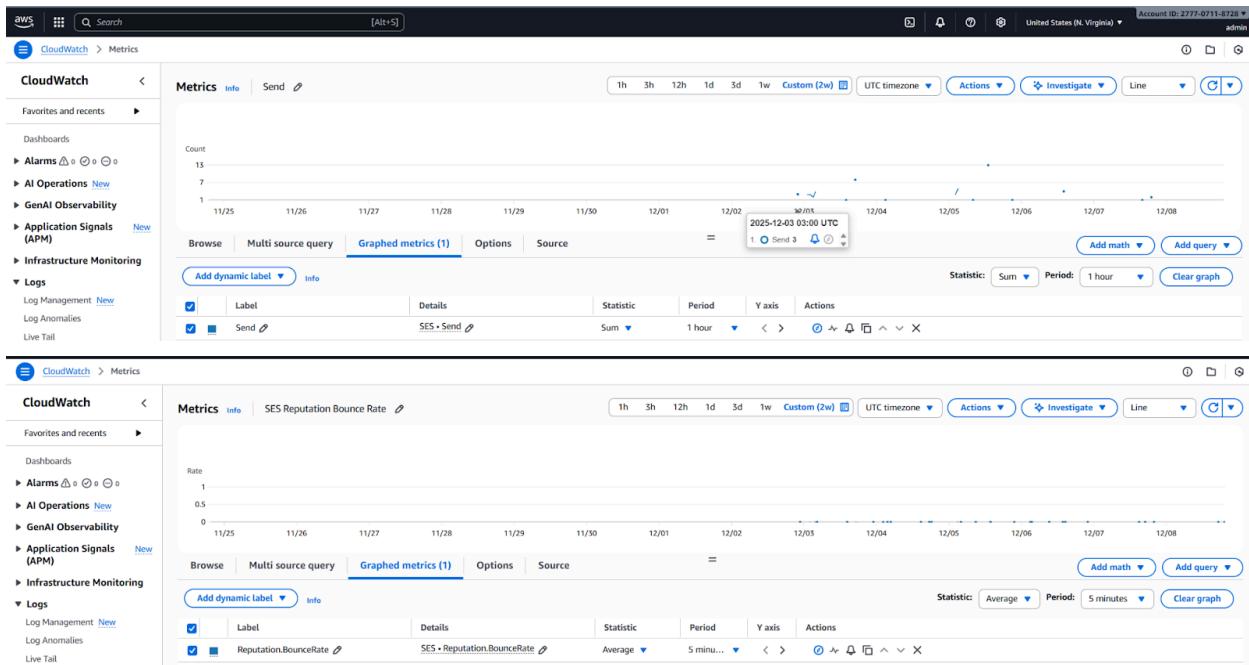
**Displays the SES Sending Statistics dashboard**, showing metrics such as total messages sent, delivery success rate, and bounce rates. This evidence confirms that SES is actively processing and delivering outgoing emails.

The screenshot shows the AWS Management Console for Amazon SES. The left sidebar navigation includes: Get set up, Account dashboard, Reputation metrics, SMTP settings, What's new, Configuration (with sub-options: Identities, Configuration sets, Tenants, Dedicated IPs, Global endpoints, Email templates, Suppression list, Email receiving), WorkMail (Overview, Get set up), Virtual Deliverability Manager (Adviser, Dashboard, Settings), and Mail Manager (Overview, Get set up, Dashboard). The main content area is titled "enpm818rgroup7.work.gd". It displays the "Summary" section with Identity status (Verified) and ARN (arn:aws:ses:us-east-1:277707118728:identity/enpm818rgroup7.work.gd). The "AWS Region" is set to US East (N. Virginia). Below this is the "Recommendations" section, which lists a single item: "DMARC configuration was not found." with an impact of "High" and an age of "5 days". A "Check for recommendations" button is available. The "Authentication" tab is selected, showing DKIM configuration (Successful) and DKIM signatures (Enabled). The "DomainKeys Identified Mail (DKIM)" section indicates DKIM-signed messages help validate message integrity. The "Easy DKIM" section shows current signing length (RSA\_2048\_BIT) and next signing length (RSA\_2048\_BIT). The "Last generated time" is December 3, 2025 at 04:03 (UTC-05:00). A "Send test email" button is located in the top right corner.

Shows the SES Reputation Metrics dashboard, confirming that SES is active and healthy.

The screenshot shows the AWS Management Console for Amazon SES. The left sidebar navigation is identical to the previous screenshot. The main content area is titled "Reputation metrics". It displays the "Summary" section with Status (Healthy), Emails sent (last 24 hours) (4), Remaining sends (49,996), and Sending quota used (0.01%). Below this is the "Account-level" tab, which is selected. It contains sections for "Monitoring historic bounce and complaint rates", "Bounce rate", and "Complaint rate". The "Bounce rate" section shows a chart with a blue line for "Historic bounce rate" and a red line for "Account at risk". The "Complaint rate" section shows a chart with a blue line for "Historic complaint rate" and a red line for "Account at risk". Both charts have a legend: blue square for "Historic [metric] rate", yellow dashed line for "Warning", and red dashed line for "Account at risk". The "Monitoring historic bounce and complaint rates" section notes that the following rates are calculated based on a representative volume of mail.

## Metrics showing email sent and bounce rates in Cloudwatch.



## 5. Infrastructure & Deployment (Kubernetes + AWS)

This screenshot shows the **EKS worker nodes** successfully registered with the cluster. All nodes report a Ready status, confirming that the EKS node group is functioning correctly and able to run workloads.

```
Jerem@NOVO MINGW64 ~ (master)
$ aws eks update-kubeconfig --name eventsphere-cluster --region us-east-1
Added new context arn:aws:eks:us-east-1:27707118728:cluster/eventsphere-cluster to C:\Users\Jerem\.kube\config

Jerem@NOVO MINGW64 ~ (master)
$ kubectl get nodes -o wide
NAME           STATUS  ROLES   AGE    VERSION      INTERNAL-IP     EXTERNAL-IP   OS-IMAGE        KERNEL-VERSION   CONTAINER-RUNTIME
ip-10-0-31-26.ec2.internal  Ready   <none>  2d5h  v1.34.2-eks-ecaa3a6  10.0.31.26  44.203.197.239  Amazon Linux 2023.9.20251117  6.12.55-74.119.amzn2023.x86_64  containerd://2.1.4
ip-10-0-37-166.ec2.internal  Ready   <none>  28h   v1.34.2-eks-ecaa3a6  10.0.37.166  3.235.41.204   Amazon Linux 2023.9.20251117  6.12.55-74.119.amzn2023.x86_64  containerd://2.1.4
ip-10-0-43-2.ec2.internal   Ready   <none>  42h   v1.34.2-eks-ecaa3a6  10.0.43.2   44.192.19.69   Amazon Linux 2023.9.20251117  6.12.55-74.119.amzn2023.x86_64  containerd://2.1.4
ip-10-0-50-15.ec2.internal  Ready   <none>  28h   v1.34.2-eks-ecaa3a6  10.0.50.15  44.200.139.230  Amazon Linux 2023.9.20251117  6.12.55-74.119.amzn2023.x86_64  containerd://2.1.4
ip-10-0-6-229.ec2.internal  Ready   <none>  28h   v1.34.2-eks-ecaa3a6  10.0.6.229  54.164.143.16   Amazon Linux 2023.9.20251117  6.12.55-74.119.amzn2023.x86_64  containerd://2.1.4
```

This screenshot confirms that the Notification Service has **two running pods** in the prod namespace and displays the deployment configuration, including image version, replicas, environment variables, and health probes.

```
Jerem@NOVO MINGW64 ~ (master)
$ kubectl get pods -n prod -l app=notification-service -o wide
NAME          READY   STATUS    RESTARTS   AGE   IP          NODE          NOMINATED-NODE   READINESS   GATES
notification-service-69dd79f78c-29rns  1/1    Running   0          28h   10.0.41.84  ip-10-0-50-15.ec2.internal  <none>       <none>
notification-service-69dd79f78c-c169w  1/1    Running   0          28h   10.0.54.188 ip-10-0-37-166.ec2.internal  <none>       <none>

Jerem@NOVO MINGW64 ~ (master)
$ kubectl describe deployment notification-service -n prod
Name:           notification-service
Namespace:      prod
CreationTimestamp: Sat, 06 Dec 2025 14:22:29 -0500
Labels:         app=notification-service
                app.kubernetes.io/part-of=eventsphere
                tier-backend
Annotations:   deployment.kubernetes.io/revision: 1
Selector:       app=notification-service
Replicas:       2 desired | 2 updated | 2 total | 2 available | 0 unavailable
StrategyType:  RollingUpdate
MinReadySeconds: 0
RollingUpdateStrategy: 25% max unavailable, 25% max surge
Pod Template:
  Labels:      app=notification-service
                app.kubernetes.io/part-of=eventsphere
                tier-backend
  Service Account: notification-service-sa
  Containers:
    notification-service:
      Image:      27707118728.dkr.ecr.us-east-1.amazonaws.com/notification-service:latest
      Port:       4004/TCP (http)
      Host Port: 0/TCP (http)
      Limits:
        cpu: 200m
        memory: 256Mi
      Requests:
        cpu: 100m
        memory: 128Mi
      Liveness:   http-get http://:4004/health delay=30s timeout=5s period=10s #success=1 #failure=3
      Readiness:  http-get http://:4004/health delay=10s timeout=3s period=5s #success=1 #failure=3
      Environment:
        PORT:        4004
        NODE_ENV:    production
        AWS_REGION: <set to the key 'AWS_REGION' of config map 'app-config'>
        SNS_TOPIC_ARN: <set to the key 'SNS_TOPIC_ARN' of config map 'notification-service-config'> Optional: false
        AUTH_SERVICE_URL: http://auth-service:4001
      Mounts:
        /tmp from tmp (rw)
  Volumes:
    tmp:
      Type:      EmptyDir (a temporary directory that shares a pod's lifetime)
      Medium:
      SizeLimit: <unset>
  Node-Selectors: <none>
  Tolerations:  <none>
Conditions:
  Type        Status  Reason
  ----        ----   -----
  Progressing True   NewReplicaSetAvailable
  Available   True   MinimumReplicasAvailable
OldReplicaSets: <none>
NewReplicaSet:  notification-service-69dd79f78c (2/2 replicas created)
Events:        <none>
```

This screenshot shows the Notification Service's **IRSA-enabled ServiceAccount**, its ConfigMap with environment settings, and the Horizontal Pod Autoscaler, confirming proper AWS integration, externalized configuration, and autoscaling.

```

[jonathan@MING64 ~ (master)]$ kubectl get serviceaccount notification-service-sa -n prod -o yaml
apiVersion: v1
kind: ServiceAccount
metadata:
  annotations:
    eks.amazonaws.com/role-arm: arn:aws:iam::277707118728:role/eventsphere-notification-service-role
    k8s.kubernetes.io/last-updated-configuration: 1
    k8s.kubernetes.io/service-account-name: notification-service-sa
  creationTimestamp: "2025-12-06T19:22:22Z"
  labels:
    app: notification-service
    environment: production
    name: notification-service-sa
    namespace: prod
    role: notification-service
    uid: df93c9f-2ab4-4008-8f10-bd8317fe3d7
[jonathan@MING64 ~ (master)]$ kubectl get configmap notification-service-config -n prod -o yaml
apiVersion: v1
data:
  AUTH_SERVICE_URL: http://auth-service.prod.svc.cluster.local:4001
  CORS_ORIGINS: http://localhost:3000,https://www.eventsp818group7.work.gd,https://emp818group7.work.gd
  NODE_ENV: production
  PORT: 4004
  SNS_TOPIC_ARN: arn:aws:sns:us-east-1:277707118728:eventsphere-notifications
  WORKER_THREADS: 2
kind: ConfigMap
metadata:
  annotations:
    kubernetes.io/last-updated-configuration: 1
    kubernetes.io/resourceVersion: 22200
  creationTimestamp: "2025-12-06T19:22:20Z"
  labels:
    name: notification-service-config
    namespace: prod
    resourceVersion: "638"
  uid: 51736303-cadd-4068-b1e-1dfff7b5ec9
[jonathan@MING64 ~ (master)]$ kubectl get hpa -n prod
NAME          REFERENCE          TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
auth-service-hpa Deployment/auth-service   cpu: 7%/10%, memory: 37%/80%   2          10        2          2d5h
auth-service-hpa Deployment/auth-service   cpu: 7%/10%, memory: 37%/80%   2          10        2          2d5h
event-service-hpa Deployment/event-service  cpu: 7%/10%, memory: 37%/80%   2          10        2          2d5h
event-service-hpa Deployment/event-service  cpu: 2%/10%, memory: 37%/80%   2          5         2          2d5h
notification-service-hpa Deployment/notification-service  cpu: 0%/10%, memory: 25%/80%   2          10        2          2d5h
[jonathan@MING64 ~ (master)]$ 

```

## 5.1 IAM Role

**IAM Role trust relationship** for eventsphere-notification-service-role. This policy shows that only the EKS OIDC provider and the Kubernetes ServiceAccount prod:notification-service-sa are allowed to assume this role via sts:AssumeRoleWithWebIdentity. This confirms that the Notification Service uses IRSA for secure, credential-free access to AWS services.

The screenshot shows the AWS IAM Roles page with the following details:

- Identity and Access Management (IAM)** sidebar.
- eventsphere-notification-service-role** selected in the main pane.
- Summary** tab:
  - Creation date: December 06, 2025, 14:18 (UTC-05:00)
  - Last activity: 1 hour ago
  - ARN: arn:aws:iam::277707118728:role/eventsphere-notification-service-role
  - Maximum session duration: 1 hour
- Permissions** tab: Shows the JSON policy document for the role.
- Trust relationships** tab: Shows the trust policy, which grants sts:AssumeRoleWithWebIdentity to the EKS OIDC provider and the notification-service-sa ServiceAccount.
- Tags**: None
- Last Accessed**: None
- Revoke sessions**: None
- Trusted entities** section: Shows the JSON policy document for the role.

```

{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": "arn:aws:iam::277707118728:oidc-provider/eks.us-east-1.amazonaws.com/id/7340932E960B1230204D7B53329E3F55",
      "Action": "sts:AssumeRoleWithWebIdentity",
      "Condition": {
        "StringEquals": {
          "oidc.eks.us-east-1.amazonaws.com/id/7340932E960B1230204D7B53329E3F55:sub": "sts.amazonaws.com",
          "oidc.eks.us-east-1.amazonaws.com/id/7340932E960B1230204D7B53329E3F55:aud": "system:serviceaccount:prod:notification-service-sa"
        }
      }
    }
  ]
}

```

**IAM policy** eventsphere-notification-sns-policy attached to the Notification Service role. The policy grants the minimum required permission—sns:Publish—allowing the service to publish notification messages to the SNS topic eventsphere-notifications.

The screenshot shows the AWS IAM Policies page. The left sidebar shows navigation options like Identity and Access Management (IAM), Dashboard, Access management, and Policies. The main content area displays the details of the 'eventsphere-notification-sns-policy'. It includes a 'Policy details' section with creation and edited times, and an 'ARN' field. Below this is a 'Permissions' tab showing the JSON code for the policy:

```

1  [ "Version": "2012-10-17",
2   "Statement": [
3     {
4       "Effect": "Allow",
5       "Action": "sns:Publish"
6     },
7     {
8       "Resource": "arn:aws:sns:us-east-1:277707118728:eventsphere-notifications"
9     }
10    ]
11  ]
12 ]

```

## 6.CI/CD Pipeline (Notification Service)

The Notification Service is integrated into the EventSphere GitHub Actions **CI/CD pipeline**. Any change in the services/notification-service/ directory triggers the CI workflow, which runs security scans, validates Kubernetes manifests, and builds the container image. After changes are merged into main, the CD pipeline builds and pushes the final Docker image to ECR and deploys it to EKS using Helm with atomic rollouts and automated health checks.

Below screenshot shows the full set of **CI/CD workflows running** in the EventSphere repository, including the Notification Service integration pipeline, the “Build and Push Docker Images” job, and the “Deploy to Production (EKS)” workflow. The presence of successful and failed runs demonstrates that automated pipelines enforce quality control and ensure reliable deployments to EKS. too long

The screenshot shows the GitHub Actions pipeline for the EventSphere repository. The left sidebar lists actions like CD, CI, Management, Caches, Deployments, Attestations, Usage metrics, and Performance metrics. The main area shows the 'All workflows' page with 147 workflow runs. The runs are listed in a table with columns for Event, Status, Branch, Actor, and Duration. The runs include various steps such as 'Merge pull request #12 from Darpankarur/main', 'Email Notification System Integration - SNS + SES + Lambda', 'Deploy to Production (EKS)', 'Deploy to Staging (kind)', 'Build and Push Docker Images', 'Merge pull request #11 from sakethbolla/kugadgil/autoscaler-and-eks...', and 'fix: cluster autoscaler autodiscovery, eks control plane logging and some run...'. Most runs are successful, indicated by green icons.

This screenshot displays the **complete GitHub Actions CD pipeline** for the EventSphere project. The workflow includes environment selection, image build and push to ECR, Helm deployment to EKS, and post-deployment smoke tests. All steps succeeded, confirming reliable automated deployment of the Notification Service to the cluster.

containerization-team-cems-eks / EventSphere

Code Issues Pull requests Actions Projects Wiki Security Insights Settings

← CD Fix Frontend.js Test and CI Pipeline (#22) #11

Re-run all jobs ...

Summary

Triggered via push 1 hour ago Status Success Total duration 6m 29s Artifacts

baeful pushed → 8c83035 main

Jobs

- Determine Environment
- Build and Push Images
- Deploy to EKS
- Post-Deployment Smoke Tests

cd.yml on: push

```
graph LR; A[Determine Environment] --> B[Build and Push Images]; B --> C[Deploy to EKS]; C --> D[Post-Deployment Smoke Tests]
```

Run details Usage Workflow file

The screenshot shows a GitHub Actions pipeline summary for a repository named 'EventSphere'. The pipeline is triggered via a push to the 'main' branch. It consists of four jobs: 'Determine Environment', 'Build and Push Images', 'Deploy to EKS', and 'Post-Deployment Smoke Tests'. All jobs are marked as successful (green checkmarks). The total duration of the pipeline run is 6 minutes and 29 seconds. The pipeline is defined in a 'cd.yml' file, which triggers on pushes to the 'push' event. The pipeline summary includes links for 'Run details', 'Usage', and 'Workflow file'.

# Reflection