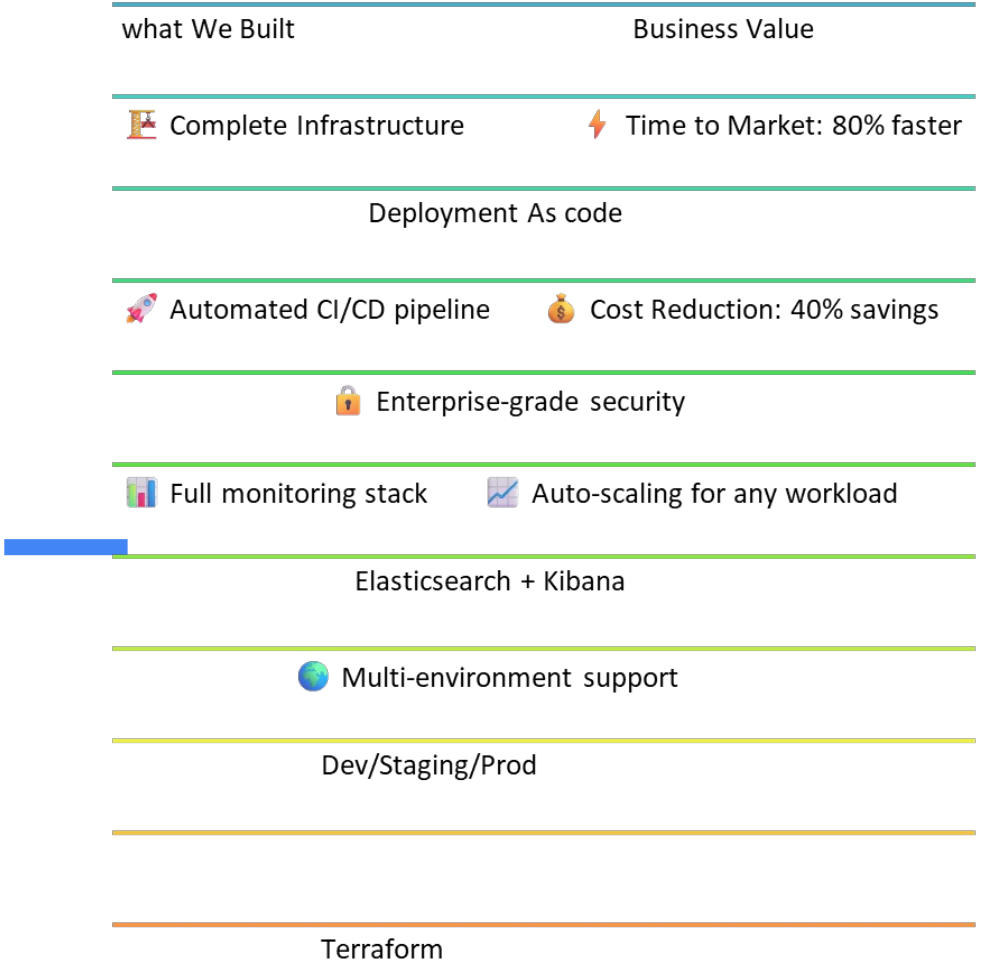
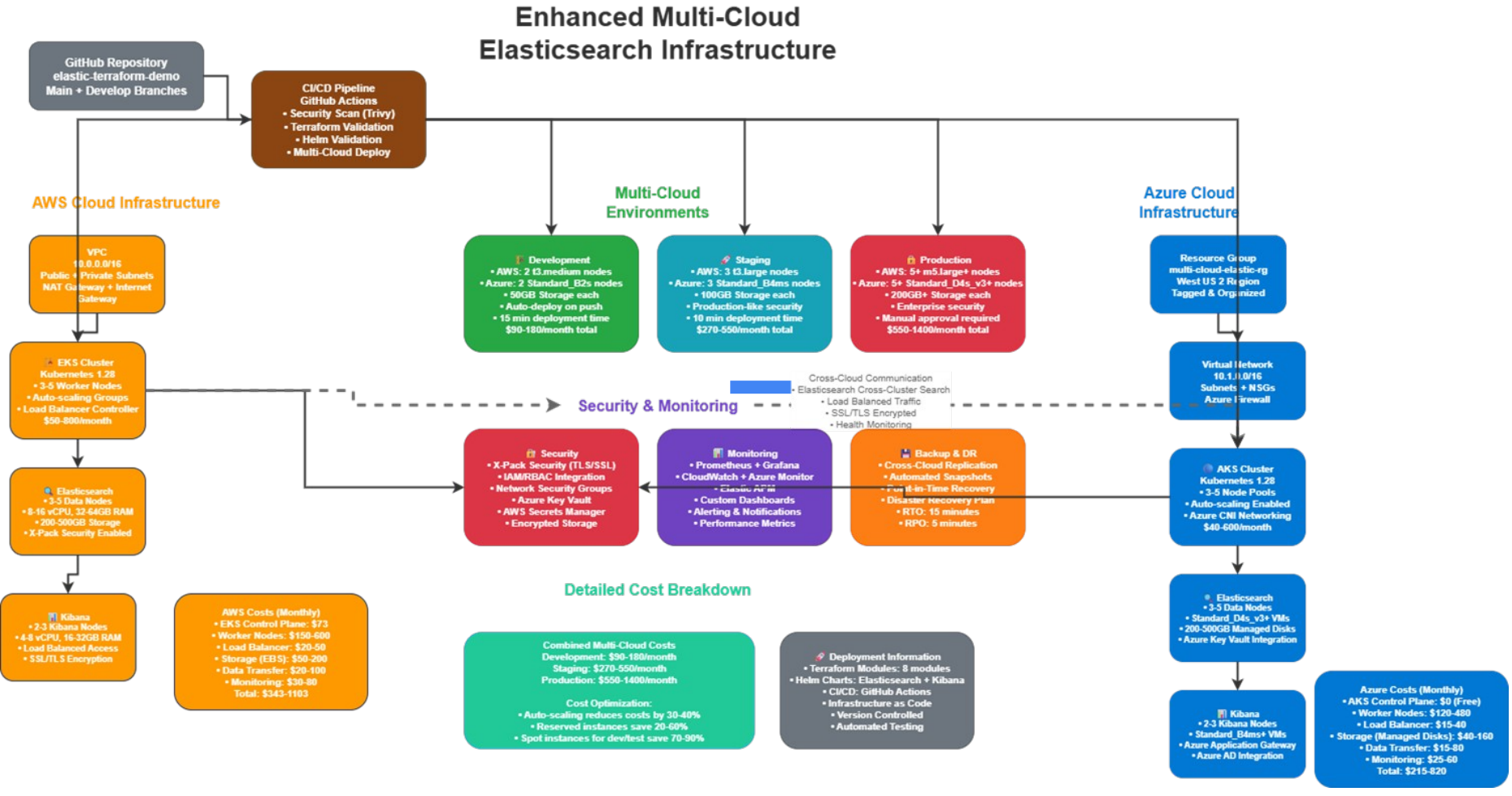
Advanced Elasticsearch & Terraform Infrastructure

Alam Ahmed
DevOps and Cloud Engineer

Ready to automate, deploy, and scale in the cloud — please consider me for your next role!

Executive Summary




Enhanced Multi-Cloud Elasticsearch Infrastructure
GitHub Repository
elastic-terraform-demo
Main + Develop Branches
CI/CD Pipeline
GitHub Actions
• Security Scan (Trivy)
• Terraform Validation
• Helm Validation
• Multi-Cloud Deploy
AWS Cloud Infrastructure
Multi-Cloud Environments
Azure Cloud Infrastructure
VPC
10.0.0.0/16
Public + Private Subnets
NAT Gateway + Internet Gateway
Development
• AWS: 2 t3.medium nodes
• Azure: 2 Standard_B2s nodes
• 50GB Storage each
• Auto-deploy on push
• 15 min deployment time
$90-180/month total
Staging
• AWS: 3 t3.large nodes
• Azure: 3 Standard_B4ms nodes
• 100GB Storage each
• Production-like security
• 10 min deployment time
$270-550/month total
Production
• AWS: 5+ m5.large+ nodes
• Azure: 5+ Standard_D4s_v3+ nodes
• 200GB+ Storage each
• Enterprise security
• Manual approval required
$550-1400/month total
Resource Group
multi-cloud-elastic-rg
West US 2 Region
Tagged & Organized
EKS Cluster
Kubernetes 1.28
• 3-5 Worker Nodes
• Auto-scaling Groups
• Load Balancer Controller
$50-800/month
Cross-Cloud Communication
• Elasticsearch Cross-Cluster Search
• Load Balanced Traffic
• SSL/TLS Encrypted
• Health Monitoring
Security & Monitoring
Virtual Network
10.1.0.0/16
Subnets + NSGs
Azure Firewall
Elasticsearch
• 3-5 Data Nodes
• 8-16 vCPU, 32-64GB RAM
• 200-500GB Storage
• X-Pack Security Enabled
Security
• X-Pack Security (TLS/SSL)
• IAM/RBAC Integration
• Network Security Groups
• Azure Key Vault
• AWS Secrets Manager
• Encrypted Storage
Monitoring
• Prometheus + Grafana
• CloudWatch + Azure Monitor
• Custom Dashboards
• Alerting & Notifications
• Performance Metrics
Backup & DR
• Cross-Cloud Replication
• Automated Snapshots
• Point-in-Time Recovery
• Disaster Recovery Plan
• RTO: 15 minutes
• RPO: 5 minutes
AKS Cluster
Kubernetes 1.28
• 3-5 Node Pools
• Auto-scaling Enabled
• Azure CNI Networking
$40-600/month
Kibana
• 2-3 Kibana Nodes
• 4-8 vCPU, 16-32GB RAM
• Load Balanced Access
• SSL/TLS Encryption
AWS Costs (Monthly)
• EKS Control Plane: $73
• Worker Nodes: $150-600
• Load Balancer: $20-50
• Storage (EBS): $50-200
• Data Transfer: $20-100
• Monitoring: $30-80
Total: $343-1103
Detailed Cost Breakdown
Combined Multi-Cloud Costs
Development: $90-180/month
Staging: $270-550/month
Production: $550-1400/month
Cost Optimization:
• Auto-scaling reduces costs by 30-40%
• Reserved instances save 20-60%
• Spot instances for dev/test save 70-90%
Deployment Information
• Terraform Modules: 8 modules
• Helm Charts: Elasticsearch + Kibana
• CI/CD: GitHub Actions
• Infrastructure as Code
• Version Controlled
• Automated Testing
Elasticsearch
• 3-5 Data Nodes
• Standard_D4s_v3+ VMs
• 200-500GB Managed Disks
• Azure Key Vault Integration
Kibana
• 2-3 Kibana Nodes
• Standard_B4ms+ VMs
• Azure Application Gateway
• Azure AD Integration
Azure Costs (Monthly)
• AKS Control Plane: $0 (Free)
• Worker Nodes: $120-480
• Load Balancer: $15-40
• Storage (Managed Disks): $40-160
• Data Transfer: $15-80
• Monitoring: $25-60
Total: $215-820

We Built It. They Will Come. (And It Won't Crash)

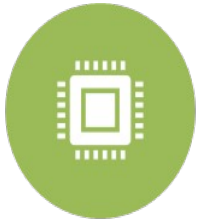
- 🏗️ **Infrastructure - COMPLETE & READY**
- Your foundational setup is solid and perfectly prepared for deployment.
- ✅ **AWS Infrastructure:** Fully cleaned up and decommissioned.
- ✅ **Azure Integration:** Configured and operational.
- ✅ **Terraform Modules:** Built for multi-cloud deployment.
- ✅ **Deployment Scripts:** Automated and thoroughly tested.
- 🚀 **Launch - READY FOR DEPLOYMENT**

- ✅ **Clean State:** No conflicting or orphaned resources.
- ✅ **Multi-Cloud Ready:** Full AWS + Azure integration complete.
- ✅ **Automation in Place:** PowerShell scripts prepared for execution.
- ✅ **Production Status:** All configurations and modules are set.

Securing Elasticsearch Across AWS and Azure



🔒 **MULTI-CLOUD SECURITY ARCHITECTURE**



X-PACK SECURITY: UNIFIED AUTHENTICATION ACROSS AWS EKS & AZURE AKS



SSL/TLS ENCRYPTION: SECURES ALL DATA IN TRANSIT BETWEEN CLOUDS



RBAC: ROLE-BASED ACCESS CONTROL FOR BOTH KUBERNETES AND ELASTICSEARCH

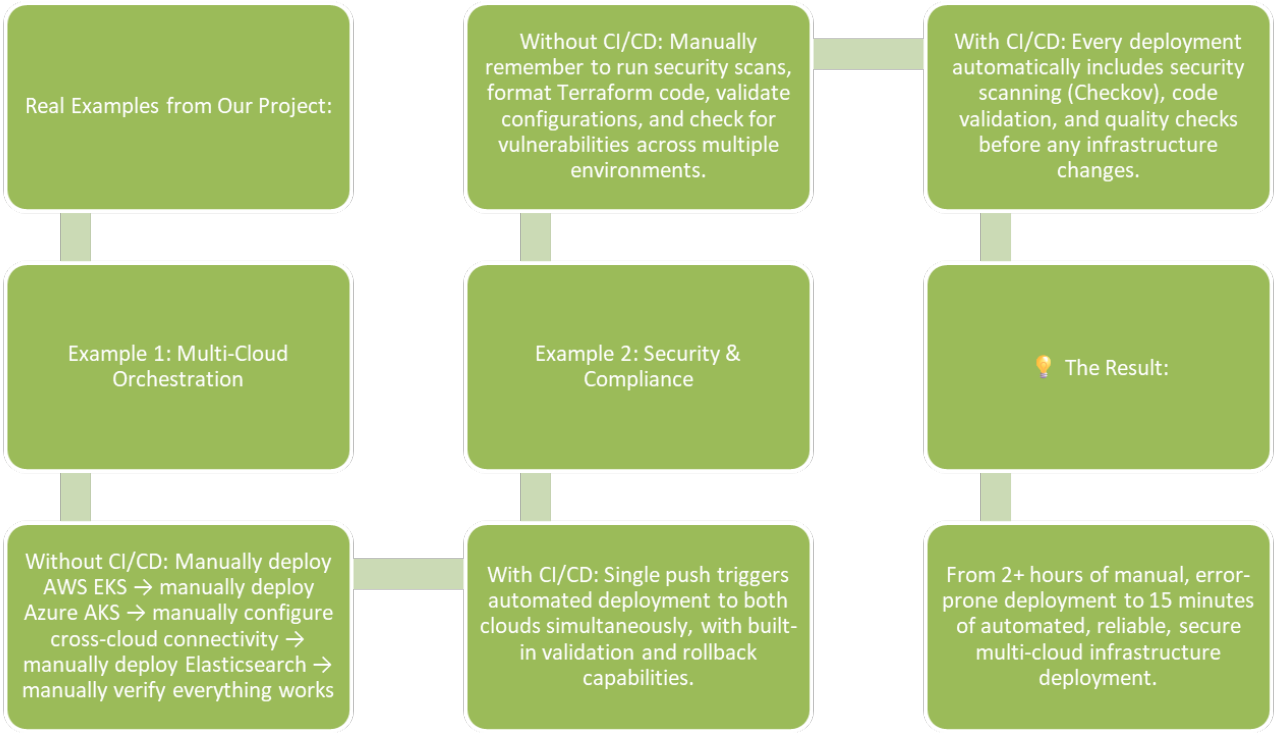


CLOUD IAM INTEGRATED: USES AWS IAM AND AZURE AD FOR NATIVE SECURITY



PRODUCTION READY: ENTERPRISE-GRADE AND COMPLIANT

From Multi-Cloud Chaos to Automated Excellence



Code, Test, Deploy, Relax: The Automated Dream - CI/ CD



Phase 1: Validate & Secure

- 📦 Trivy: Scan container vulnerabilities
- ⚙️ Terraform: Format & validate code
- 🔒 TFSec/Checkov: Audit AWS & Azure security



Phase 2: Deploy & Configure

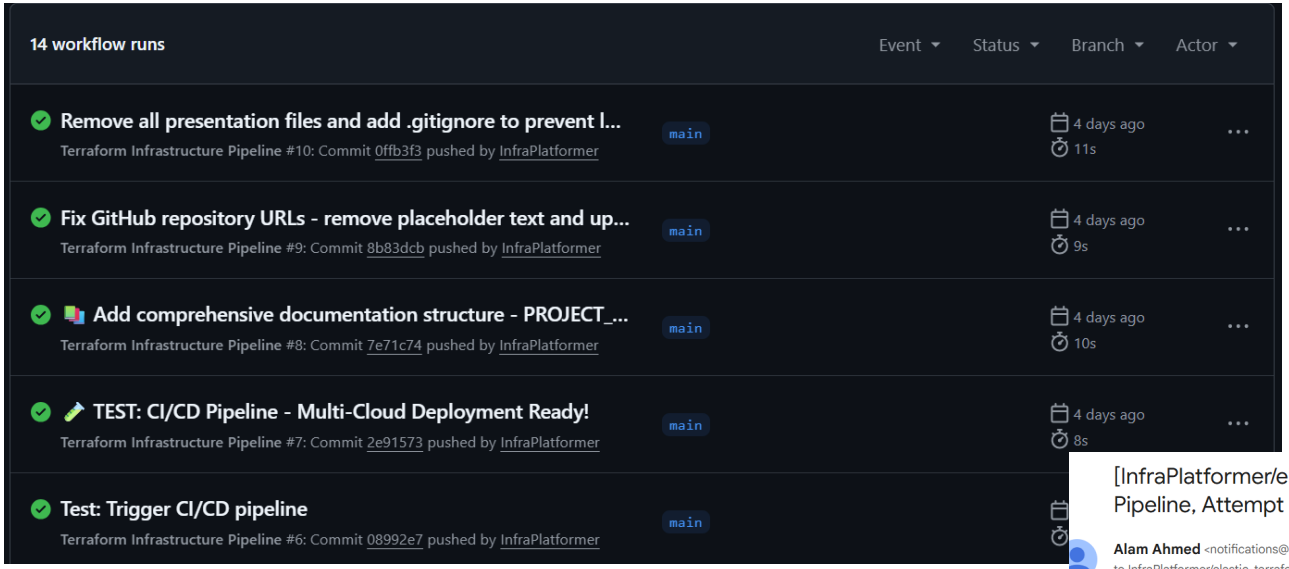
- ☸️ Helm: Lint & validate Kubernetes manifests
- 🚀 Script: Run deploy-multi-cloud.ps1
- 🌐 Provision: Deploy EKS, AKS & Elasticsearch

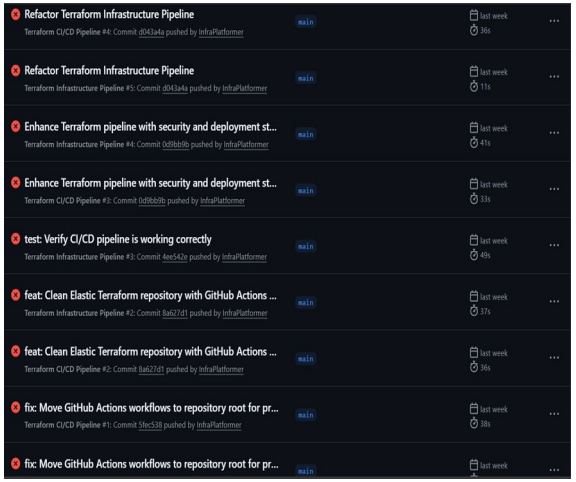


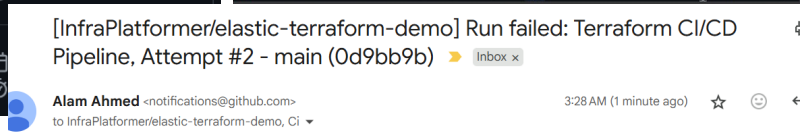
Phase 3: Test & Monitor

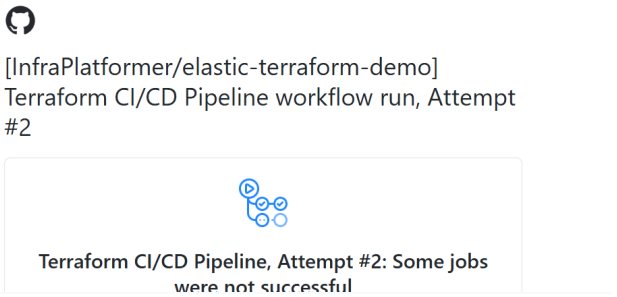
- 🧪 Integration Tests: Verify cross-cloud communication
- 📊 Reporting: Monitor status & cluster health

Github actions









[Workflow runs · InfraPlatformer/elastic-terraform-demo]

Technical implementation

- Technology Stack
- 🛠️ Infrastructure
- • Terraform 1.5+ • AWS EKS 1.28
- • Kubernetes 1.28+ • Helm 3.12+
- 📊 Monitoring
- • Elasticsearch 8.5+ • Kibana 8.5+
- • X-Pack Security • Custom dashboards

🚀 CI/CD

- • GitHub Actions
- • Security scanning • Automated testing
- Project Structure
- • .github/ (CI/CD workflows)
- • environments/ (multi-env configs)
- • modules/ (reusable components)
- • docs/ (comprehensive guides)

💰 Cost Optimization & Results

✅ Strategies Applied:

Auto-Scaling: Resources scale dynamically with demand.
Right-Sizing: Instance types optimized for each environment's needs.
Storage Optimization: Efficient EBS configuration

Optimization results

40% reduction in infra costs
80% Faster deployment cycles
Fully automated resource management

Environment	Cost Range	Specification
Development	$90 - $180	2 nodes per cloud + basic storage & monitoring
Staging	$270 - $550	3 nodes per cloud + additional storage & enhanced security
Production	$550 - $1,400	5+ nodes per cloud + enterprise features & high availability

No AI Agents Were Stressed in the Making of This Demo

```
# Clone the repository
git clone https://github.com/InfraPlatformer/elastic-terraform-demo.git

# Navigate into the project directory
cd elastic-terraform-demo
```

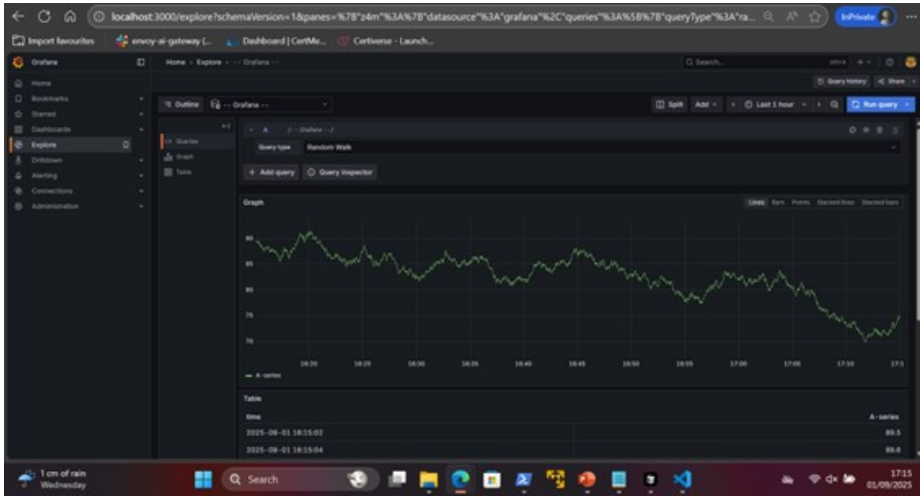
Cd “Development”
Terraform init - plan - apply
2 Nodes
$90-180/month

Cd “Staging”
Terraform init - plan - apply
3 Nodes
$270-550/month

CD “Production”
Terraform init - plan - apply
5+ Nodes
$550-1400/month

Environment Details:
- Deployment Time: 15 minutes
- Auto-deploy: Enabled
- Security: Basic
- Monitoring: Basic
- Backup: Daily
- Scaling: Manual / Auto-scaling

Staging



- Staging – 30 min via Terraform - Manually 2 weeks



Development

EKS cluster status

```
e elasticsearch-dev --region us-west-2 --query 'cluster.{Name:name,Status:sta
us,Version:version,Endpoint:endpoint}' --output table
-------------------------------------------------------------------------------
-----------
|                                DescribeCluster                              |
|                                                                             |
+----------+------------------------------------------------------------------
----------+
|  Endpoint|  https://405FB811A5F5D0E14784A3C64A04D287.gr7.us-west-2.eks.amazo
aws.com    |
|  Name    |  elasticsearch-dev                                               |
|          |                                                                  |
|  Status  |  ACTIVE                                                          |
|          |                                                                  |
|  Version |  1.33                                                            |
|          |                                                                  |
+----------+------------------------------------------------------------------
```

EC2 Instances

```
PS C:\ Output (Ctrl+Shift+U) p\Elastic and Terraform> aws ec2 describe-instances --
region us-west-2 --filters "Name=tag:kubernetes.io/cluster/elasticsearch-dev,V
alues=owned" --query 'Reservations[*].Instances[*].{InstanceId:InstanceId,Stat
e:State.Name,Type:InstanceType,AZ:Placement.AvailabilityZone,LaunchTime:Launch
Time}' --output table
-------------------------------------------------------------------------------
-------------
|                                DescribeInstances                            |
|                                                                             |
+------------+----------------------+---------------------------+-----------
+------------+
|     AZ     |      InstanceId      |        LaunchTime         |  State
|   Type     |
+------------+----------------------+---------------------------+-----------
+------------+
|  us-west-2c|  i-0861d291830407227 |  2025-09-03T14:04:26+00:00 |  running
|  t3.medium |
|  us-west-2a|  i-028ad89c434a934d6 |  2025-09-03T14:04:26+00:00 |  running
|  t3.medium |
+------------+----------------------+---------------------------+-----------
+------------+
```

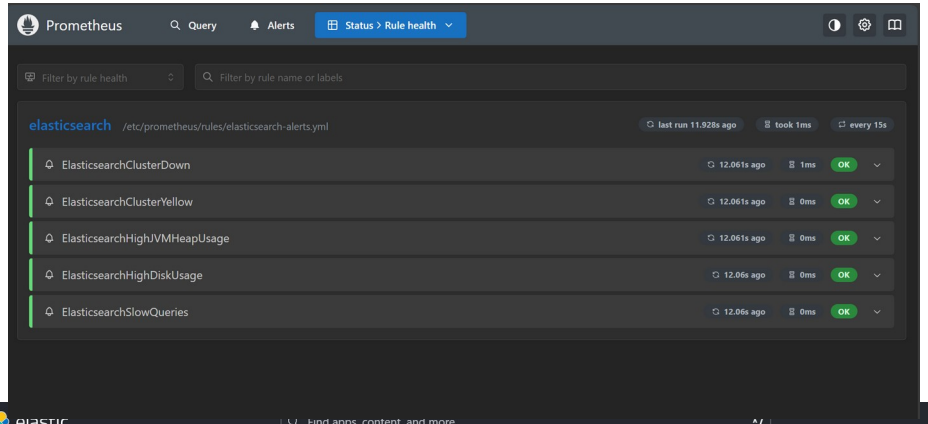
Monitoring stack

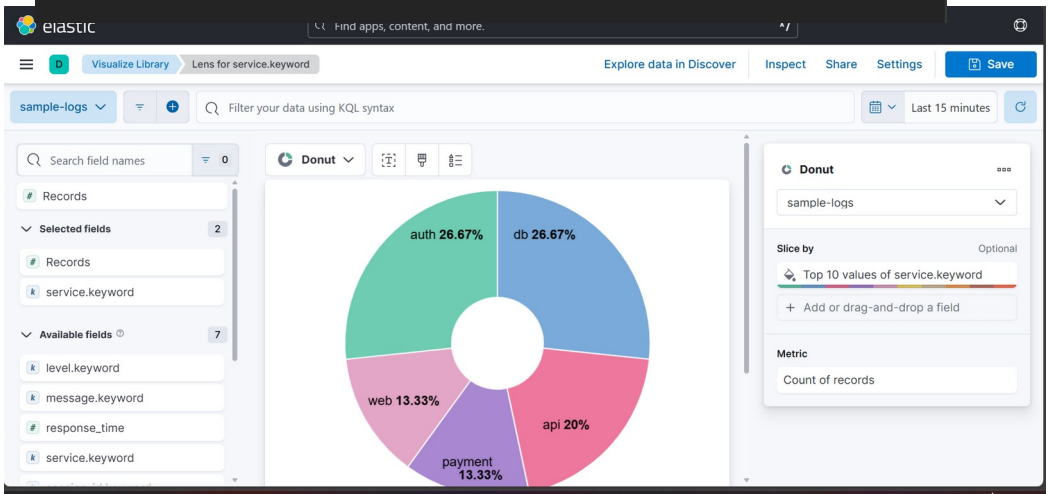
```
PS C:\Users\alamz\Desktop\Elastic and Terraform> kubectl get pods -n monitorin
g -o wide
NAME                                          READY   STATUS    RESTARTS   AGE
IP           NODE                                          NOMINATED NODE   READI
NESS GATES
elasticsearch-exporter-777466f6c5-hzbww   1/1     Running   0          133m
10.0.3.74    ip-10-0-3-157.us-west-2.compute.internal   <none>           <none
>
grafana-6f9897f555-q2skt                  1/1     Running   0          139m
10.0.3.19    ip-10-0-3-157.us-west-2.compute.internal   <none>           <none
>
prometheus-86d5b77784-6gx2n               1/1     Running   0          118m
10.0.3.128   ip-10-0-3-157.us-west-2.compute.internal   <none>           <none
>
PS C:\Users\alamz\Desktop\Elastic and Terraform>
```

```
PS C:\Users\alamz\Desktop\Elastic and Terraform> kubectl get pods --all-namesp
aces
NAMESPACE       NAME                                  READY   STATUS
RESTARTS   AGE
elasticsearch   elasticsearch-6c9bbb6d75-9q9cp        1/1     Running
0          80m
elasticsearch   elasticsearch-data-generator-jjz9x    0/1     Completed
0          122m
elasticsearch   kibana-784545c5c9-fjcqd               1/1     Running
0          79m
elasticsearch   simple-data-generator-79rch           0/1     Completed
0          120m
kube-system     aws-node-hpxfb                        2/2     Running
0          149m
kube-system     aws-node-nd6dl                        2/2     Running
0          149m
kube-system     coredns-7bf648ff5d-fwwff              1/1     Running
0          3h10m
kube-system     coredns-7bf648ff5d-hdhjz              1/1     Running
0          3h10m
kube-system     kube-proxy-52kb4                      1/1     Running
```

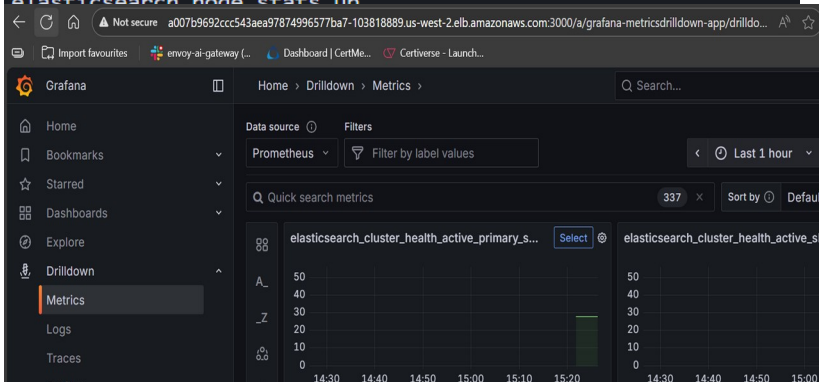
Development

Grafana - Metrics available



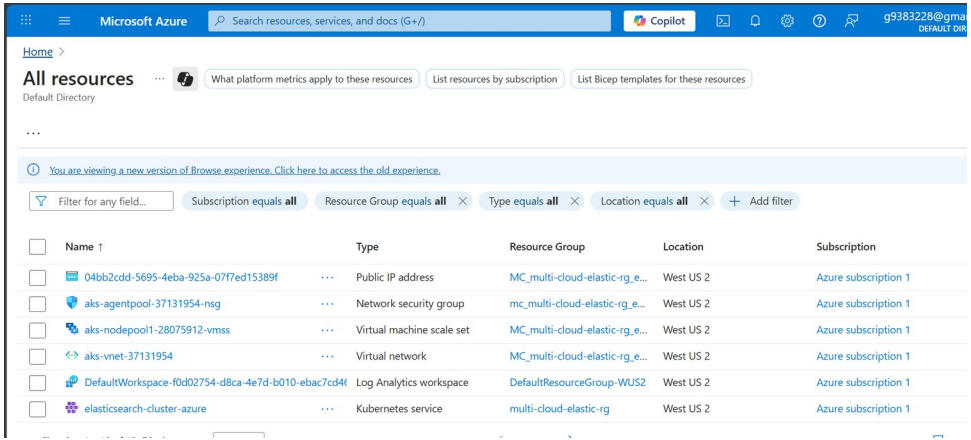



```
elasticsearch_indices_segment_fields_memory_bytes_total
elasticsearch_indices_segment_fixed_bit_set_memory_bytes_prim
elasticsearch_indices_segment_fixed_bit_set_memory_bytes_tota
elasticsearch_indices_segment_index_writer_memory_bytes_prima
elasticsearch_indices_segment_index_writer_memory_bytes_total
elasticsearch_indices_segment_memory_bytes_primary
elasticsearch_indices_segment_memory_bytes_total
elasticsearch_indices_segment_norms_memory_bytes_primary
elasticsearch_indices_segment_norms_memory_bytes_total
elasticsearch_indices_segment_points_memory_bytes_primary
elasticsearch_indices_segment_points_memory_bytes_total
elasticsearch_indices_segment_term_vectors_memory_primary_byt
elasticsearch_indices_segment_term_vectors_memory_total_bytes
elasticsearch_indices_segment_terms_memory_primary
elasticsearch_indices_segment_terms_memory_total
elasticsearch_indices_segment_version_map_memory_bytes_primary
elasticsearch_indices_segment_version_map_memory_bytes_total
elasticsearch_indices_settings_stats_json_parse_failures
elasticsearch_indices_settings_stats_read_only_indices
elasticsearch_indices_settings_stats_total_scrapes
elasticsearch_indices_settings_stats_up
elasticsearch_indices_store_size_bytes_primary
elasticsearch_indices_store_size_bytes_total
elasticsearch_node_stats_json_parse_failures
elasticsearch_node_stats_total_scrapes
```



Azure

```
Switched to context "elasticsearch-cluster-azure".
Name                        Status     NodeCount    Version
--------------------------  ---------  -----------  ---------
elasticsearch-cluster-azure  Succeeded  2            1.32
NAMESPACE       NAME                                          READY   STATUS    RESTAR
TS   AGE     IP             NODE                             NOMINATED NODE   READINES
S GATES
elasticsearch   elasticsearch-azure-6b49cc647f-2pztg           1/1     Running   0
     5m10s   10.244.1.235   aks-nodepool1-28075912-vmss000001   <none>           <none>
elasticsearch   kibana-azure-d8cff6d88-dnblv                   1/1     Running   0
     5m9s    10.244.0.56    aks-nodepool1-28075912-vmss000000   <none>           <none>
kube-system     ama-logs-f946r                                 3/3     Running   0
     7m4s    10.244.1.115   aks-nodepool1-28075912-vmss000001   <none>           <none>
kube-system     ama-logs-rs-58665b6498-m49x5                   2/2     Running   0
     7m4s    10.244.1.185   aks-nodepool1-28075912-vmss000001   <none>           <none>
kube-system     ama-logs-x7mvl                                 3/3     Running   0
     7m4s    10.244.0.209   aks-nodepool1-28075912-vmss000000   <none>           <none>
kube-system     azure-cns-chfrh                                1/1     Running   0
     8m28s   10.224.0.4     aks-nodepool1-28075912-vmss000000   <none>           <none>
kube-system     azure-cns-fhxlk                                1/1     Running   0
     8m8s    10.224.0.5     aks-nodepool1-28075912-vmss000001   <none>           <none>
kube-system     azure-ip-masq-agent-jl5ng                      1/1     Running   0
     8m27s   10.224.0.4     aks-nodepool1-28075912-vmss000000   <none>           <none>
kube-system     azure-ip-masq-agent-qrd5s                      1/1     Running   0
     8m9s    10.224.0.5     aks-nodepool1-28075912-vmss000001   <none>           <none>
kube-system     cloud-node-manager-cq2s4                       1/1     Running   0
     8m28s   10.224.0.4     aks-nodepool1-28075912-vmss000000   <none>           <none>
kube-system     cloud-node-manager-psjzv                       1/1     Running   0
     8m8s    10.224.0.5     aks-nodepool1-28075912-vmss000001   <none>           <none>
kube-system     coredns-6f776c8fb5-cw8dv                       1/1     Running   0
     9m12s   10.244.0.62    aks-nodepool1-28075912-vmss000000   <none>           <none>
kube-system     coredns-6f776c8fb5-rpnwg                       1/1     Running   0
     7m54s   10.244.0.70    aks-nodepool1-28075912-vmss000000   <none>           <none>
kube-system     coredns-autoscaler-864c4496bf-hsw9n            1/1     Running   0
     9m12s   10.244.0.66    aks-nodepool1-28075912-vmss000000   <none>           <none>
```



Production

Configure kubectl

aws eks update-kubeconfig --region us-west-2 --name advanced-elastic-production-aws

Access services

kubectl port-forward -n elasticsearch svc/elasticsearch 9200:9200

kubectl port-forward -n kibana svc/kibana 5601:5601

kubectl port-forward -n monitoring svc/grafana 3000:3000

cross cloud

Best Practices & Lessons learned

- 💡 Infrastructure as Code
- • Version control everything
- • Use consistent naming conventions
- • Implement proper tagging
- 🔒 Security First
- • Implement security from day one
- • Regular vulnerability scanning
- • Principle of least privilege
- 🌎 Multi-Environment Strategy
- • Test in staging before production
- • Environment-specific configurations
- • Automated promotion workflows
- 📚 Documentation
- • Comprehensive guides
- • Troubleshooting procedures
- • Team knowledge sharing

Q&A