Azure AKS Monitoring with Grafana - POC Implementation

This document outlines the implementation of a monitoring solution for an existing Azure Kubernetes Service (AKS) cluster using Azure Monitor metrics with Grafana integration, deployed via Azure DevOps CI/CD pipeline using Helm.

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Prerequisites

- Existing AKS cluster
- Azure subscription with permissions to:
 - Create Azure Monitor resources
 - Access Azure Key Vault
 - Deploy to AKS
- Azure DevOps project
- Azure CLI installed
- · Helm CLI installed
- · kubectl configured for your AKS cluster

Solution Architecture

Show Image

The solution consists of:

- 1. Azure Monitor: Collects metrics from AKS cluster
- 2. Container Insights: Provides container-level monitoring
- 3. **Grafana**: Visualizes metrics with customizable dashboards
- 4. Azure Key Vault: Stores sensitive information securely
- 5. Azure DevOps Pipeline: Automates deployment
- 6. Helm Charts: Packages resources for Kubernetes deployment

Implementation Steps

1. Enable Azure Monitor for AKS

First, enable Azure Monitor for your AKS cluster:

```
# Variables
AKS_CLUSTER_NAME="your-aks-cluster"
RESOURCE_GROUP="your-resource-group"
# Enable container insights for your AKS cluster
az aks enable-addons -a monitoring -n $AKS_CLUSTER_NAME -g $RESOURCE_GROUP
```

2. Create Azure Key Vault and Store Secrets

```
bash
```

```
# Variables
KEY_VAULT_NAME="aks-monitoring-kv"
RESOURCE_GROUP="your-resource-group"
LOCATION="eastus"
# Create Key Vault
az keyvault create --name $KEY_VAULT_NAME --resource-group $RESOURCE_GROUP --location
# Create service principal for Key Vault access
SP_NAME="aks-monitoring-sp"
SP_PASSWORD=$(az ad sp create-for-rbac --name $SP_NAME --skip-assignment --query passw
SP_APP_ID=$(az ad sp list --display-name $SP_NAME --query [].appId -o tsv)
# Store secrets in Key Vault
az keyvault secret set --vault-name $KEY_VAULT_NAME --name "grafana-admin-password" --
az keyvault secret set --vault-name $KEY_VAULT_NAME --name "sp-client-id" --value $SP_
az keyvault secret set --vault-name $KEY_VAULT_NAME --name "sp-client-secret" --value
# Assign Key Vault permissions to the service principal
az keyvault set-policy ---name $KEY_VAULT_NAME ---spn $SP_APP_ID ---secret-permissions ge
```

3. Create Key Vault Integration with AKS

Create a CSI driver for Key Vault integration:

```
# Install Azure Key Vault provider for Secrets Store CSI Driver
helm repo add csi-secrets-store-provider-azure https://raw.githubusercontent.com/Azure
helm repo update

# Install the Azure Key Vault provider
helm install csi-secrets-store-provider-azure/csi-secrets-store-provider-azure --gener
```

4. Create Helm Chart for Grafana Deployment

Create a Helm chart structure for Grafana with Azure Monitor datasource:

```
bash
```

```
mkdir -p monitoring-helm-chart/templates
mkdir -p monitoring-helm-chart/charts
touch monitoring-helm-chart/Chart.yaml
touch monitoring-helm-chart/values.yaml
```

Chart.yaml

```
apiVersion: v2
name: aks-monitoring
description: AKS Monitoring solution with Grafana and Azure Monitor
type: application
version: 0.1.0
appVersion: "1.0.0"
dependencies:
   - name: grafana
    version: ~6.52.1
    repository: https://grafana.github.io/helm-charts
```

values.yaml

```
grafana:
 adminPassword: "" # Will be injected from Key Vault
 datasources:
   datasources.yaml:
      apiVersion: 1
     datasources:
     - name: Azure Monitor
       type: grafana-azure-monitor-datasource
       access: proxy
       isDefault: true
       jsonData:
         cloudName: azuremonitor
         tenantId: ${TENANT_ID}
         clientId: ${CLIENT_ID}
          subscriptionId: ${SUBSCRIPTION_ID}
        secureJsonData:
          clientSecret: ${CLIENT_SECRET}
 dashboardProviders:
   dashboardproviders.yaml:
      apiVersion: 1
     providers:
     - name: 'default'
       orgId: 1
       folder: ''
       type: file
       disableDeletion: false
       editable: true
       options:
          path: /var/lib/grafana/dashboards/default
 dashboards:
   default:
      aks-overview:
        gnetId: 10956 # Use Grafana.com AKS dashboard
        revision: 1
        datasource: Azure Monitor
 # Pod security context
 securityContext:
   runAsUser: 472
   runAsGroup: 472
```

fsGroup: 472

```
# Azure KeyVault integration
keyVault:
    tenantId: "${TENANT_ID}"
    subscriptionId: "${SUBSCRIPTION_ID}"
    resourceGroup: "${RESOURCE_GROUP}"
    name: "${KEY_VAULT_NAME}"
```

5. Create Kubernetes Secret Provider Class

Create a template for SecretProviderClass:

monitoring-helm-chart/templates/secretproviderclass.yaml

```
yaml
```

```
apiVersion: secrets-store.csi.x-k8s.io/v1
kind: SecretProviderClass
metadata:
  name: azure-kvname
spec:
  provider: azure
  parameters:
    usePodIdentity: "false"
    useVMManagedIdentity: "false"
    clientID: {{ .Values.keyVault.clientId }}
    keyvaultName: {{ .Values.keyVault.name }}
    tenantId: {{ .Values.keyVault.tenantId }}
    objects: |
      array:
          objectName: grafana-admin-password
          objectType: secret
          objectVersion: ""
          objectName: sp-client-id
          objectType: secret
          objectVersion: ""
          objectName: sp-client-secret
          objectType: secret
          objectVersion: ""
  secretObjects:
    - secretName: grafana-secrets
      type: Opaque
      data:
      - objectName: grafana-admin-password
        key: admin-password
      - objectName: sp-client-id
        key: client-id
      - objectName: sp-client-secret
        key: client-secret
```

6. Create Azure DevOps CI/CD Pipeline

Create an Azure DevOps pipeline file:

azure-pipelines.yaml

```
trigger:
  branches:
    include:
    - main
    - feature/*
variables:
  # Pipeline variables
  vmImageName: 'ubuntu-latest'
  aks.resourceGroup: 'your-resource-group'
  aks.clusterName: 'your-aks-cluster'
  keyVault.name: 'aks-monitoring-kv'
  azure.subscriptionId: '$(AZURE_SUBSCRIPTION_ID)'
  azure.tenantId: '$(AZURE_TENANT_ID)'
stages:
- stage: Build
  displayName: Build stage
  jobs:
  - job: Build
    displayName: Build
    pool:
      vmImage: $(vmImageName)
    steps:
    - task: HelmInstaller@1
      inputs:
        helmVersionToInstall: 'latest'
      displayName: 'Install Helm'
    - script: |
        helm dependency update ./monitoring-helm-chart
      displayName: 'Update Helm dependencies'
    - task: HelmDeploy@0
      displayName: 'Package Helm chart'
      inputs:
        command: package
        chartPath: ./monitoring-helm-chart
        destination: '$(Build.ArtifactStagingDirectory)'
    - task: PublishBuildArtifacts@1
      displayName: 'Publish Artifacts'
      inputs:
        PathtoPublish: '$(Build.ArtifactStagingDirectory)'
```

```
publishLocation: 'Container'
- stage: Deploy
 displayName: Deploy stage
 dependsOn: Build
 jobs:
 - deployment: Deploy
    displayName: Deploy
    pool:
     vmImage: $(vmImageName)
   environment: 'Development'
    strategy:
      runOnce:
        deploy:
          steps:
          - task: DownloadBuildArtifacts@0
            inputs:
              buildType: 'current'
              downloadType: 'single'
              artifactName: 'helm-chart'
              downloadPath: '$(System.ArtifactsDirectory)'
          - task: AzureKeyVault@1
            inputs:
              azureSubscription: 'your-azure-service-connection'
              KeyVaultName: '$(keyVault.name)'
              SecretsFilter: 'grafana-admin-password, sp-client-id, sp-client-secret'
              RunAsPreJob: true
            displayName: 'Get secrets from Azure Key Vault'
          - task: AzureCLI@2
            inputs:
              azureSubscription: 'your-azure-service-connection'
              scriptType: 'bash'
              scriptLocation: 'inlineScript'
              inlineScript: |
                az aks get-credentials -g $(aks.resourceGroup) -n $(aks.clusterName) -
              displayName: 'Get AKS credentials'
          - task: HelmDeploy@0
            displayName: 'Deploy Helm chart'
            inputs:
              connectionType: 'None'
              command: 'upgrade'
              chartType: 'FilePath'
```

chart Dath, It (System Artifacts Directory) (holm shart /aks manitoring 0 1 0

ArtifactName: 'helm-chart'

releaseName: 'aks-monitoring'
namespace: 'monitoring'
overrideValues: 'grafana.adminPassword=\$(grafana-admin-password), keyVaul
arguments: '--create-namespace'

7. Create Grafana AKS Dashboard

Create a custom AKS dashboard for Grafana:

monitoring-helm-chart/templates/grafana-dashboards/aks-dashboard.json

```
json
```

```
{
 "annotations": {
    "list": [
     {
       "builtIn": 1,
        "datasource": "-- Grafana --",
        "enable": true,
        "hide": true,
       "iconColor": "rgba(0, 211, 255, 1)",
       "name": "Annotations & Alerts",
       "type": "dashboard"
     }-
   ]
 },
 "editable": true,
 "gnetId": null,
 "graphTooltip": 0,
 "id": 1,
 "links": [],
 "panels": [
   {
     "aliasColors": {},
     "bars": false,
     "dashLength": 10,
     "dashes": false,
     "datasource": "Azure Monitor",
     "fieldConfig": {
       "defaults": {},
       "overrides": []
     },
      "fill": 1,
     "fillGradient": 0,
     "gridPos": {
       "h": 8,
       "w": 12,
       "x": 0,
       "v": 0
      },
      "hiddenSeries": false,
     "id": 2,
     "legend": {
        "avg": false,
       "current": false,
        "max": false,
```

```
"min": false,
  "show": true,
  "total": false,
  "values": false
},
"lines": true,
"linewidth": 1,
"nullPointMode": "null",
"options": {
  "alertThreshold": true
},
"percentage": false,
"pluginVersion": "7.5.5",
"pointradius": 2,
"points": false,
"renderer": "flot",
"seriesOverrides": [],
"spaceLength": 10,
"stack": false,
"steppedLine": false,
"targets": [
  -{
    "appInsights": {
      "dimension": [],
      "metricName": "select",
      "timeGrain": "auto"
    },
    "azureLogAnalytics": {
      "query": "",
      "resultFormat": "time series",
      "workspace": ""
    },
    "azureMonitor": {
      "aggOptions": [],
      "aggregation": "Average",
      "allowedTimeGrainsMs": [],
      "dimension": [],
      "dimensionFilter": "*",
      "dimensions": [],
      "metricDefinition": "Microsoft.ContainerService/managedClusters",
      "metricName": "node_cpu_usage_percentage",
      "metricNamespace": "Insights.Container/nodes",
      "resourceGroup": "${aks.resourceGroup}",
      "resourceName": "${aks.clusterName}",
      "timeGrain": "auto",
      "top": "10"
```

```
"queryType": "Azure Monitor",
     "refId": "A",
     "subscription": "$subscription"
   }-
 ],
  "thresholds": [],
 "timeFrom": null,
 "timeRegions": [],
 "timeShift": null,
 "title": "Node CPU Usage",
 "tooltip": {
   "shared": true,
   "sort": 0,
   "value_type": "individual"
 },
 "type": "graph",
 "xaxis": {
   "buckets": null,
   "mode": "time",
   "name": null,
   "show": true,
   "values": []
 },
  "yaxes": [
   -{
     "format": "percent",
     "label": null,
     "logBase": 1,
     "max": null,
     "min": null,
     "show": true
    },
     "format": "short",
     "label": null,
     "logBase": 1,
     "max": null,
     "min": null,
     "show": true
 ],
 "yaxis": {
   "align": false,
   "alignLevel": null
 }-
},
```

```
{
 "aliasColors": {},
 "bars": false,
 "dashLength": 10,
 "dashes": false,
 "datasource": "Azure Monitor",
 "fieldConfig": {
   "defaults": {},
   "overrides": []
  },
  "fill": 1,
 "fillGradient": 0,
 "aridPos": {
    "h": 8,
   "w": 12,
   "x": 12,
   "v": 0
 },
  "hiddenSeries": false,
 "id": 3,
 "legend": {
   "avg": false,
   "current": false,
   "max": false,
    "min": false,
   "show": true,
   "total": false,
   "values": false
 },
 "lines": true,
 "linewidth": 1,
 "nullPointMode": "null",
 "options": {
   "alertThreshold": true
 },
 "percentage": false,
 "pluginVersion": "7.5.5",
 "pointradius": 2,
 "points": false,
 "renderer": "flot",
 "seriesOverrides": [],
 "spaceLength": 10,
 "stack": false,
 "steppedLine": false,
 "targets": [
    {
```

```
"azuremonitor": {
      "aggregation": "Average",
      "dimension": [],
      "dimensionFilter": "*",
      "dimensions": [],
      "metricDefinition": "Microsoft.ContainerService/managedClusters",
      "metricName": "node_memory_working_set_percentage",
      "metricNamespace": "Insights.Container/nodes",
      "resourceGroup": "${aks.resourceGroup}",
      "resourceName": "${aks.clusterName}",
      "timeGrain": "auto".
      "top": "10"
    },
    "queryType": "Azure Monitor",
    "refId": "A",
    "subscription": "$subscription"
  }-
],
"thresholds": [],
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"timeRegions": [],
"timeShift": null,
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"tooltip": {
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  "sort": 0,
  "value_type": "individual"
},
"type": "graph",
"xaxis": {
  "buckets": null.
  "mode": "time",
  "name": null,
  "show": true,
  "values": []
},
"yaxes": [
 {
   "format": "percent",
    "label": null,
    "logBase": 1,
    "max": null,
    "min": null,
    "show": true
  },
  {
    "format": "short",
```

```
"label": null,
      "logBase": 1,
      "max": null,
      "min": null,
      "show": true
    }-
  ],
  "yaxis": {
   "align": false,
   "alignLevel": null
 }-
},
  "aliasColors": {},
 "bars": false,
  "dashLength": 10,
  "dashes": false,
  "datasource": "Azure Monitor",
 "fieldConfig": {
   "defaults": {},
   "overrides": []
  },
  "fill": 1,
  "fillGradient": 0,
 "gridPos": {
   "h": 8,
   "w": 12,
   "x": 0,
   "v": 8
  },
  "hiddenSeries": false,
  "id": 4,
  "legend": {
    "avg": false,
    "current": false,
    "max": false,
    "min": false,
    "show": true,
    "total": false,
   "values": false
  },
  "lines": true,
  "linewidth": 1,
  "nullPointMode": "null",
  "options": {
    "alertThreshold": true
```

```
"percentage": false,
"pluginVersion": "7.5.5",
"pointradius": 2,
"points": false.
"renderer": "flot",
"seriesOverrides": [],
"spaceLength": 10,
"stack": false,
"steppedLine": false,
"targets": [
  {
    "azureMonitor": {
      "aggregation": "Average",
      "dimension": [],
      "dimensionFilter": "*".
      "dimensions": [],
      "metricDefinition": "Microsoft.ContainerService/managedClusters",
      "metricName": "container_cpu_usage_percent",
      "metricNamespace": "Insights.Container/containers",
      "resourceGroup": "${aks.resourceGroup}",
      "resourceName": "${aks.clusterName}",
      "timeGrain": "auto".
      "top": "10"
    },
    "queryType": "Azure Monitor",
    "refId": "A",
    "subscription": "$subscription"
  }-
],
"thresholds": [],
"timeFrom": null,
"timeRegions": [],
"timeShift": null,
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"tooltip": {
  "shared": true,
 "sort": 0,
  "value_type": "individual"
},
"type": "graph",
"xaxis": {
  "buckets": null.
  "mode": "time",
  "name": null,
  "show": true,
  "values": []
```

```
},
  "yaxes": [
   -{
     "format": "percent",
     "label": null,
     "logBase": 1,
     "max": null,
     "min": null,
     "show": true
   },
     "format": "short",
     "label": null,
     "logBase": 1,
     "max": null,
     "min": null,
     "show": true
   }-
 ],
 "yaxis": {
   "align": false,
   "alignLevel": null
 }-
},
{
 "aliasColors": {},
 "bars": false,
 "dashLength": 10,
 "dashes": false,
 "datasource": "Azure Monitor",
 "fieldConfig": {
   "defaults": {},
   "overrides": []
 },
 "fill": 1,
 "fillGradient": 0,
 "gridPos": {
   "h": 8,
   "w": 12,
   "x": 12,
   "y": 8
  },
 "hiddenSeries": false,
 "id": 5,
 "legend": {
   "avg": false,
```

```
"current": false,
  "max": false,
  "min": false,
  "show": true,
  "total": false,
  "values": false
},
"lines": true,
"linewidth": 1,
"nullPointMode": "null",
"options": {
  "alertThreshold": true
},
"percentage": false,
"pluginVersion": "7.5.5",
"pointradius": 2,
"points": false,
"renderer": "flot",
"seriesOverrides": [],
"spaceLength": 10,
"stack": false,
"steppedLine": false,
"targets": [
  {
    "azureMonitor": {
      "aggregation": "Average",
      "dimension": [],
      "dimensionFilter": "*".
      "dimensions": [].
      "metricDefinition": "Microsoft.ContainerService/managedClusters",
      "metricName": "container_memory_working_set_percentage",
      "metricNamespace": "Insights.Container/containers",
      "resourceGroup": "${aks.resourceGroup}",
      "resourceName": "${aks.clusterName}",
      "timeGrain": "auto",
      "top": "10"
    },
    "queryType": "Azure Monitor",
    "refId": "A",
    "subscription": "$subscription"
  }-
],
"thresholds": [],
"timeFrom": null,
"timeRegions": [],
"timeShift": null,
H+4+1 all . Il Cantadona Mamanu Llangall
```

```
titte": "Container Memory Usage",
 "tooltip": {
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   "sort": 0,
   "value_type": "individual"
 },
 "type": "graph",
 "xaxis": {
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   "mode": "time",
   "name": null,
   "show": true,
   "values": []
 },
  "yaxes": [
   -{
     "format": "percent",
     "label": null,
     "logBase": 1,
     "max": null,
     "min": null,
     "show": true
    },
   {
     "format": "short",
     "label": null,
     "logBase": 1,
     "max": null,
     "min": null,
     "show": true
   }-
 ],
 "yaxis": {
   "align": false,
   "alignLevel": null
 }-
},
 "datasource": "Azure Monitor",
 "fieldConfig": {
   "defaults": {
     "color": {
       "mode": "thresholds"
      },
      "mappings": [],
      "thresholds": {
       "mode": "absolute",
```

```
"steps": [
        {
          "color": "green",
          "value": null
        },
        {
          "color": "red",
         "value": 80
        }
    }-
  },
  "overrides": []
},
"gridPos": {
 "h": 8,
 "w": 6,
 "x": 0,
 "y": 16
},
"id": 6,
"options": {
  "reduceOptions": {
    "calcs": [
      "mean"
    ],
    "fields": "",
    "values": false
  },
  "showThresholdLabels": false,
  "showThresholdMarkers": true,
  "text": {}
},
"pluginVersion": "7.5.5",
"targets": [
  {
    "azureMonitor": {
      "aggregation": "Average",
      "dimension": [],
      "dimensionFilter": "*",
      "dimensions": [],
      "metricDefinition": "Microsoft.ContainerService/managedClusters",
      "metricName": "node_disk_usage_percentage",
      "metricNamespace": "Insights.Container/nodes",
      "resourceGroup": "${aks.resourceGroup}",
      "resourceName": "${aks.clusterName}",
```

```
"timeGrain": "auto",
        "top": "10"
      },
      "queryType": "Azure Monitor",
      "refId": "A",
     "subscription": "$subscription"
    }-
  ],
 "title": "Node Disk Usage",
 "type": "gauge"
},
 "datasource": "Azure Monitor",
 "fieldConfig": {
   "defaults": {
      "color": {
        "mode": "palette-classic"
      },
      "custom": {
       "axisLabel": "",
        "axisPlacement": "auto",
        "barAlignment": 0,
        "drawStyle": "line",
        "fillOpacity": 0,
        "gradientMode": "none",
        "hideFrom": {
          "legend": false,
         "tooltip": false,
          "viz": false
        },
        "lineInterpolation": "linear",
        "lineWidth": 1,
        "pointSize": 5,
        "scaleDistribution": {
          "type": "linear"
        },
        "showPoints": "auto",
        "spanNulls": false,
        "stacking": {
          "group": "A",
          "mode": "none"
        },
        "thresholdsStyle": {
          "mode": "off"
        }-
      },
      "mappings": [].
```

```
"thresholds": {
      "mode": "absolute",
      "steps": [
        {
          "color": "green",
         "value": null
        },
          "color": "red",
          "value": 80
        }-
    }-
  },
  "overrides": []
},
"gridPos": {
 "h": 8,
 "w": 18,
  "x": 6,
  "v": 16
},
"id": 7,
"options": {
  "legend": {
    "calcs": [],
    "displayMode": "list",
    "placement": "bottom"
  },
  "tooltip": {
    "mode": "single"
  }-
},
"targets": [
  {
    "azureMonitor": {
      "aggregation": "Total",
      "dimension": [],
      "dimensionFilter": "*",
      "dimensions": [],
      "metricDefinition": "Microsoft.ContainerService/managedClusters",
      "metricName": "kube_pod_status_ready",
      "metricNamespace": "Insights.Container/pods",
      "resourceGroup": "${aks.resourceGroup}",
      "resourceName": "${aks.clusterName}",
      "timeGrain": "auto",
```

```
"top": "10"
        },
        "queryType": "Azure Monitor",
        "refId": "A",
        "subscription": "$subscription"
    ],
    "title": "Pod Ready Status",
    "type": "timeseries"
  }
],
"refresh": "5s",
"schemaVersion": 27,
"style": "dark",
"tags": [],
"templating": {
  "list": [
    {
      "current": {
       "selected": false,
        "text": "Default",
        "value": "Default"
      },
      "description": null,
      "error": null,
      "hide": 0,
      "includeAll": false,
      "label": "Subscription",
      "multi": false,
      "name": "subscription",
      "options": [],
      "query": "Azure Monitor",
      "queryValue": "",
      "refresh": 1,
      "regex": "",
      "skipUrlSync": false,
      "type": "datasource"
    }-
  ]
},
"time": {
 "from": "now-6h",
 "to": "now"
},
"timepicker": {},
"timezone": "",
"+i+le" | "AKS Cluster Overview"
```

```
"uid": "aks-overview",

"version": 1
}
```

8. Test the Deployment Locally

Before committing to Azure DevOps, test the Helm chart locally:

```
bash
# Variables
export TENANT_ID="your-tenant-id"
export SUBSCRIPTION_ID="your-subscription-id"
export CLIENT_ID="your-client-id"
export CLIENT_SECRET="your-client-secret"
export RESOURCE_GROUP="your-resource-group"
export KEY_VAULT_NAME="aks-monitoring-kv"
# Add Grafana repository
helm repo add grafana https://grafana.github.io/helm-charts
helm repo update
# Update dependencies
helm dependency update ./monitoring-helm-chart
# Deploy the chart
helm upgrade ——install aks—monitoring ./monitoring—helm—chart \
  --namespace monitoring \
  --create-namespace \
  --set grafana.adminPassword="tempPassword" \
  --set keyVault.tenantId=$TENANT_ID \
  --set keyVault.subscriptionId=$SUBSCRIPTION_ID \
  --set keyVault.resourceGroup=$RESOURCE_GROUP \
  --set keyVault
```