Open source monitoring and observability stack on Kubernetes

Student Team

Pooja Srinivasan (1BM18CS069)
Anusree Manoj K (1BM18CS017)
Niha (1BM18CS060)
Shikha N (1BM18CS149)

Faculty Mentor

Dr. Nandhini V
Associate Professor

HPE Mentors

Divakar Padiyar
Sonu Sudhakaran

Hewlett Packard Enterprise

kubernetes

Agenda

- Introduction
- Abstract
- What is observability
- Pillars of observability
- Observability vs Monitoring
- Observability Use cases
- Observability solution with Prometheus, Grafana, Loki and Jaeger
- Demo
- Learnings
- Next steps

Introduction

- **Aim** - Open source monitoring and observability stack on kubernetes.
- **Kubernetes** - open-source container orchestration platform.
- Designed to automate the **deployment**, **scaling**, and **management** of containerized applications.
- **Three pillars of observability** - **logs, metrics, and traces**
  When combined, they provide sufficient insights to monitor software at any scale.
- The project covers Monitoring, Alerting/Visualization, Log Aggregation/analytics, and Distributed systems tracing infrastructure which collectively make up observability.

Abstract

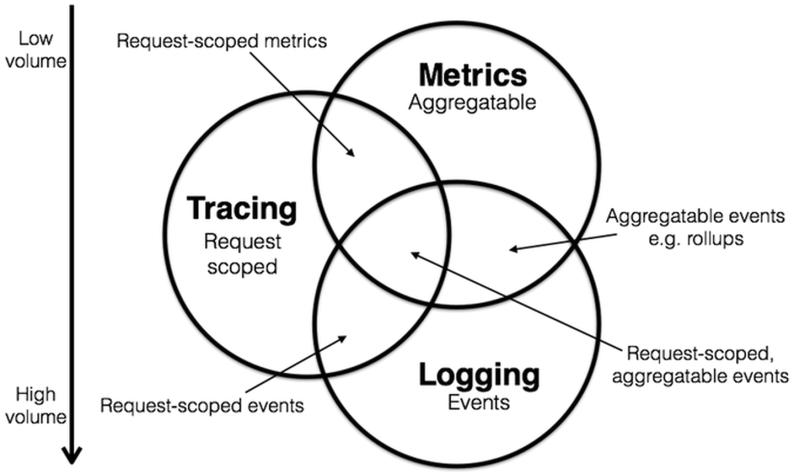
- Containerization and role of Kubernetes.
- Physical Server vs Virtual Machine vs Containers.
- Observability and Monitoring with respect to K8s.
- Setting up kubernetes tools - MicroK8s, Minikube, K3s.
- Using Grafana and Prometheus stack on the cluster to observe metrics of cluster.
- Configuring Alertmanager to receive alerts on slack channel.
- Logging and Tracing using Loki and Jaeger.

What is Observability?

- A way to get insights into the whole infrastructure.
- Can explain any questions about what is happening on the inside of the system just by observing the outside of the system.
- Helps developers understand multi-layered architectures: what's slow, what's broken, and what needs to be done to improve performance.
- Creates an insight through an actionable knowledge of the whole environment by assembling all fragments from logs, monitoring tools and organizing them.

Three Pillars Of Observability

- **Metrics:**
  These are numeric representation of data measured over intervals of time.
- **Logging:**
  They are discrete events and data in a structured textual form.
- **Tracing:**
  Represents consecutive events which reflect an end-to-end request path in a distributed system.



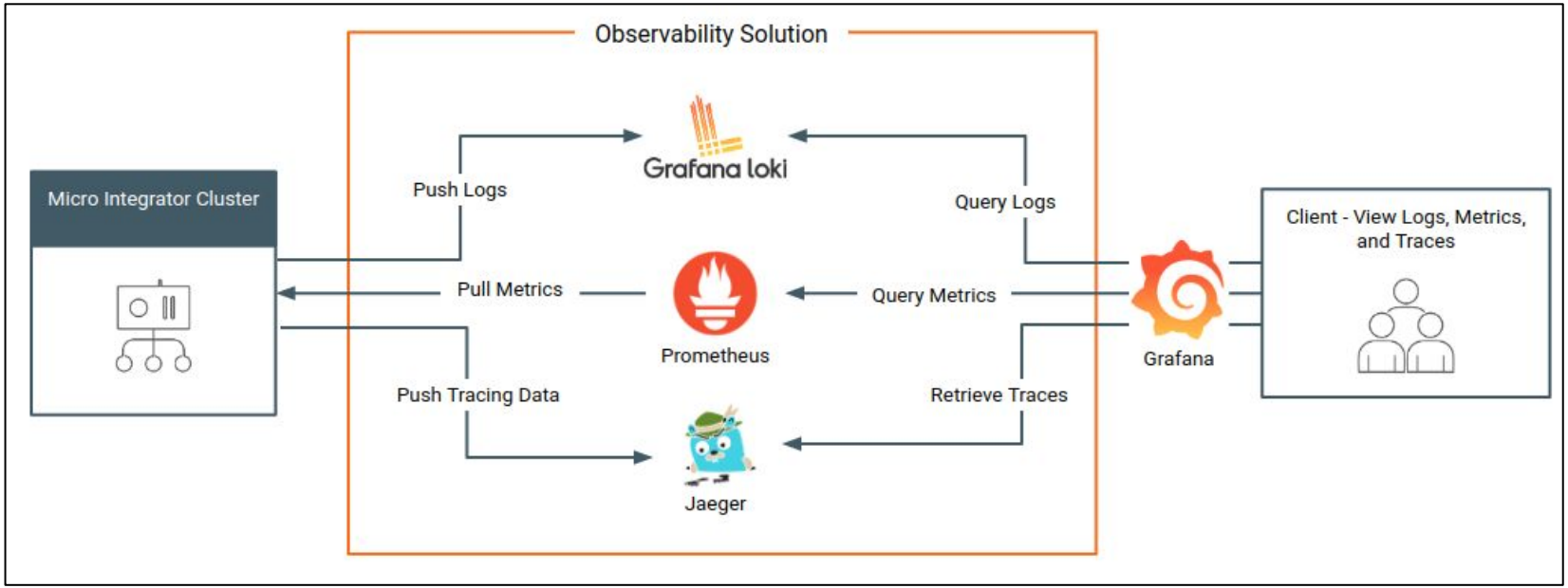
Observability vs Monitoring

Observability	Monitoring
What is the system doing?	Is the system working?
Tells us **why** something goes wrong	Tells us **when** something went wrong
Proactive in nature	**Reactive** in nature
Reduces the duration and impact of incidents	Enables **quick response** when an incident occurs
Gain understanding **actively**	Consume information **passively**
Build to tame dynamic environments with changing complexity	Built to maintain static environments with little variation
Preferred by developers of systems with variability and **unknown permutations**	Used by developers of systems with little change and **known permutation**

Observability Use cases

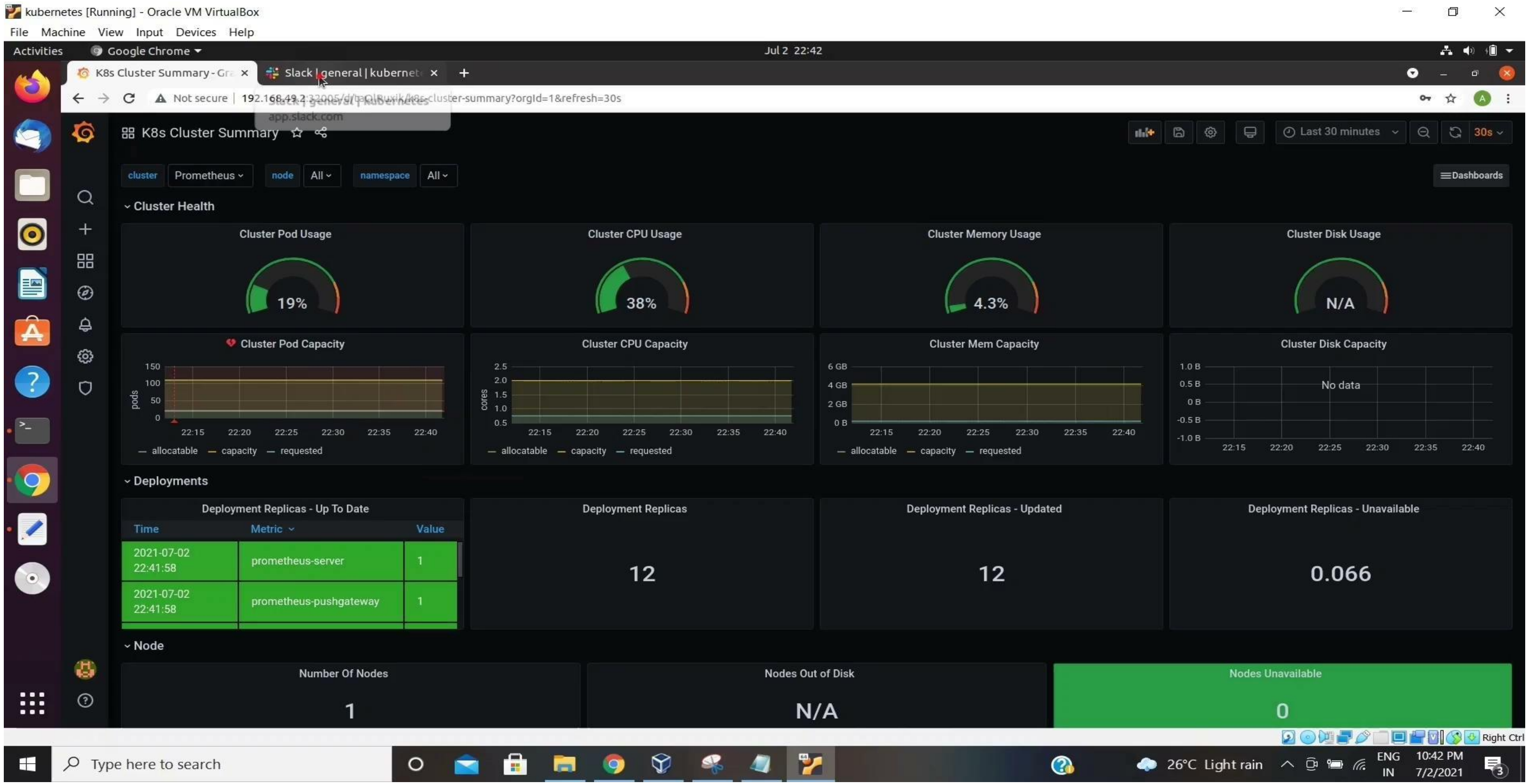
- As a Infrastructure Admin, I would like the "Platform" services are monitored constantly for application runtime errors, re-curing operational / API / UI failures and generate alerts so that assigned / scheduled Support team gets notified immediately and is able to troubleshoot the error through Operations Console.
- As a Infrastructure Admin, I would like to configure Monitoring in the "Platform" to send Monitoring alerts to Operations console for any persistent failures in the System for timely response from the Operations team.
- As an SRE, I would like to monitor a gradual but consistent degradation of the Platform services performance / response times so that I can rectify any h/w resource related or scaling issues with the application and prevent missing any SLA(s).
- As an IT Operator, I would like to monitor cluster kube state and node metrics of Platform.
- As an IT Operator, I would like to monitor all the namespaces of the Platform.

Observability solution with Prometheus, Grafana, Loki and Jaeger

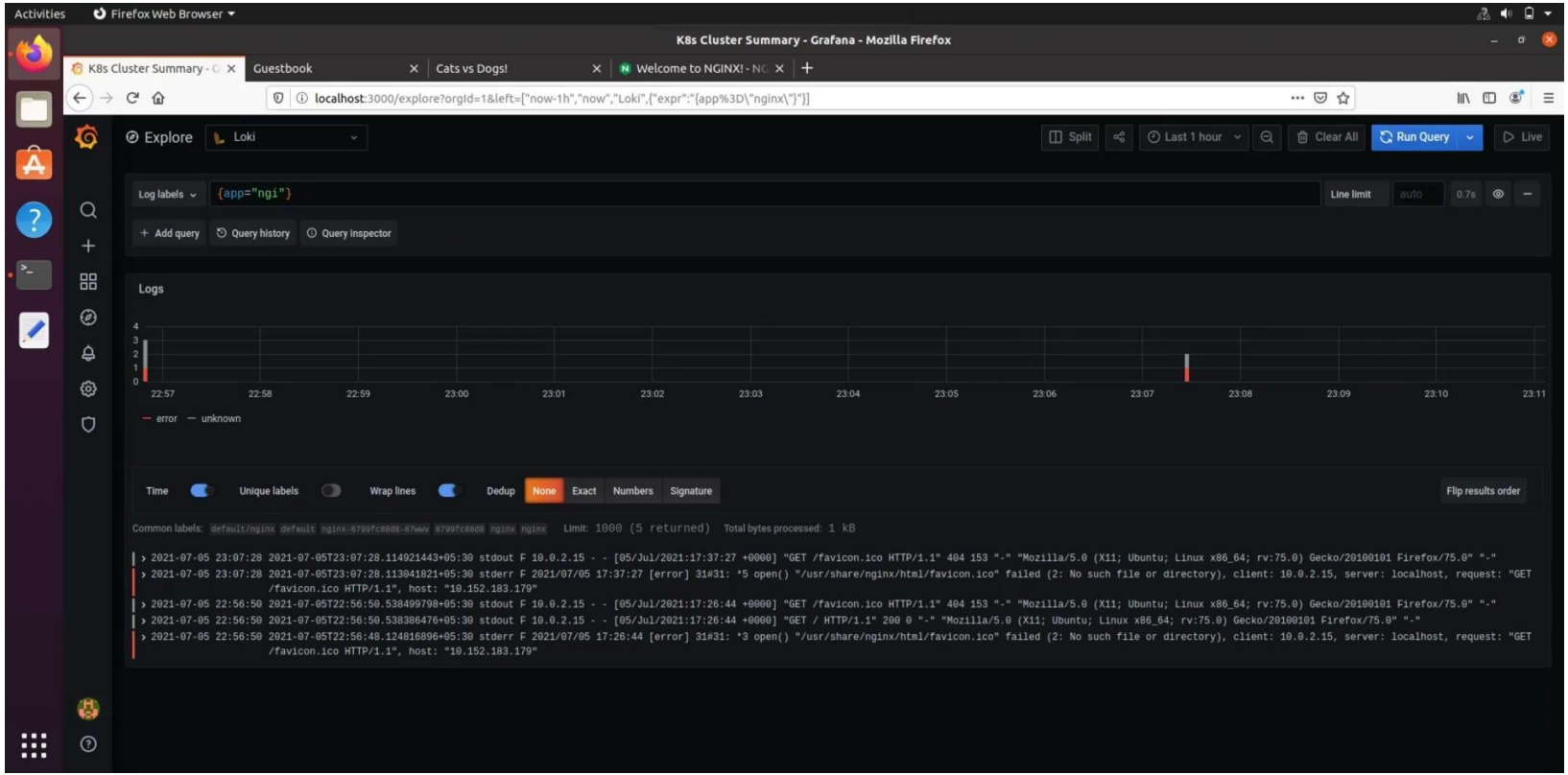


Hewlett Packard Enterprise

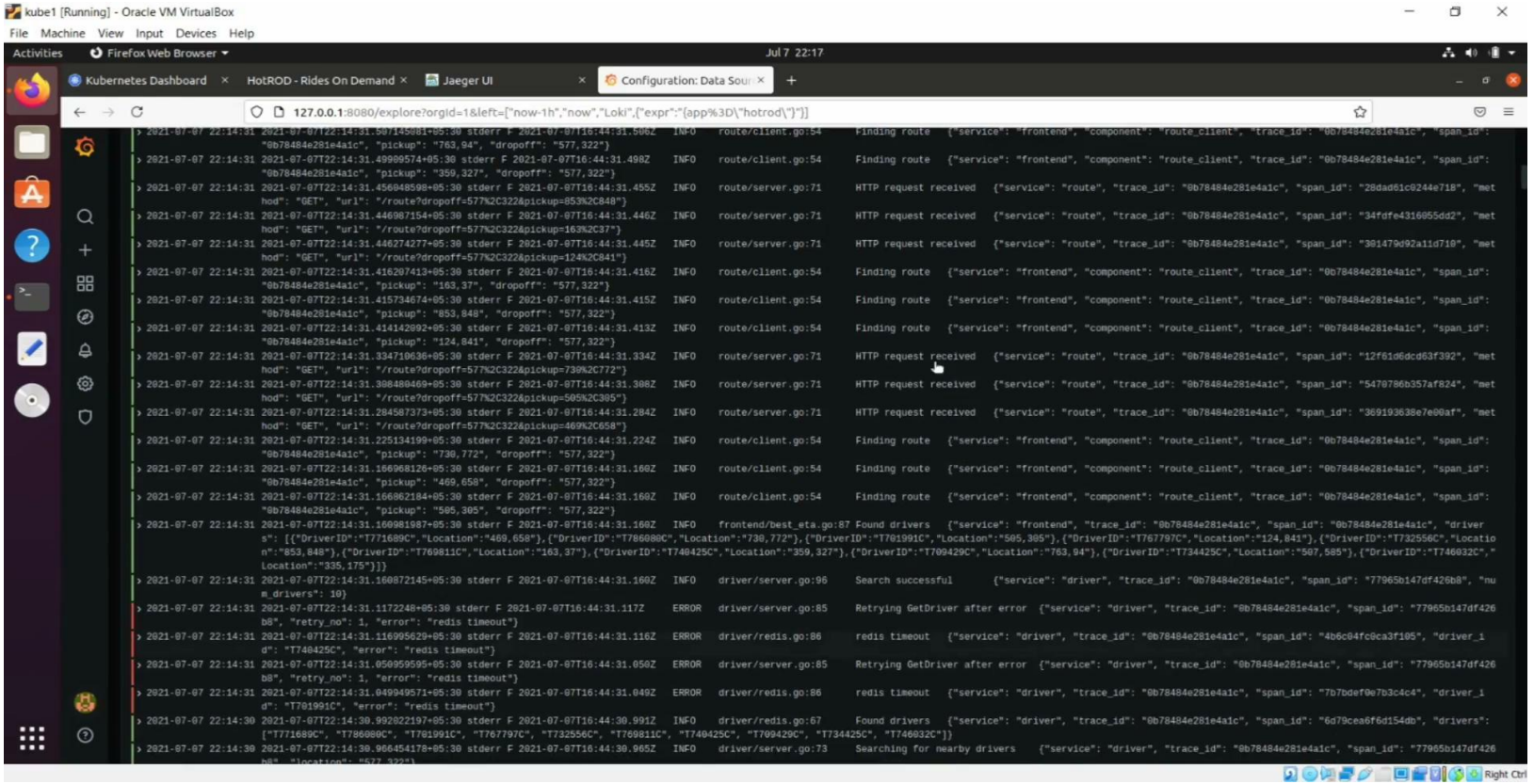
Demo


kubernetes [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
K8s Cluster Summary
cluster Prometheus node All namespace All
Cluster Health
Cluster Pod Usage 19%
Cluster CPU Usage 38%
Cluster Memory Usage 4.3%
Cluster Disk Usage N/A
Cluster Pod Capacity
Cluster CPU Capacity
Cluster Mem Capacity
Cluster Disk Capacity
No data
Deployments
Deployment Replicas - Up To Date
Time Metric Value
2021-07-02 22:41:58 prometheus-server 1
2021-07-02 22:41:58 prometheus-pushgateway 1
Deployment Replicas 12
Deployment Replicas - Updated 12
Deployment Replicas - Unavailable 0.066
Node
Number Of Nodes 1
Nodes Out of Disk N/A
Nodes Unavailable 0

Demo


Activities
Firefox Web Browser
K8s Cluster Summary - Grafana - Mozilla Firefox
K8s Cluster Summary
Guestbook
Cats vs Dogs!
Welcome to NGINX!
localhost:3000/explore?orgId=1&left=["now-1h","now","Loki",{"expr":"{app%3D\"nginx\"}"}]
Explore
Loki
Split
Last 1 hour
Clear All
Run Query
Live
Log labels
{app="ngi"}
Line limit
auto
0.7s
Add query
Query history
Query inspector
Logs
22:57
22:58
22:59
23:00
23:01
23:02
23:03
23:04
23:05
23:06
23:07
23:08
23:09
23:10
23:11
error
unknown
Time
Unique labels
Wrap lines
Dedup
None
Exact
Numbers
Signature
Flip results order
Common labels:
Limit: 1000 (5 returned)
Total bytes processed: 1 kB
2021-07-05 23:07:28 2021-07-05T23:07:28.114921443+05:30 stdout F 10.0.2.15 - - [05/Jul/2021:17:37:27 +0000] "GET /favicon.ico HTTP/1.1" 404 153 "-" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:75.0) Gecko/20100101 Firefox/75.0" "-"
2021-07-05 23:07:28 2021-07-05T23:07:28.113041821+05:30 stderr F 2021/07/05 17:37:27 [error] 31#31: *5 open() "/usr/share/nginx/html/favicon.ico" failed (2: No such file or directory), client: 10.0.2.15, server: localhost, request: "GET /favicon.ico HTTP/1.1", host: "10.152.183.179"
2021-07-05 22:56:50 2021-07-05T22:56:50.538499798+05:30 stdout F 10.0.2.15 - - [05/Jul/2021:17:26:44 +0000] "GET /favicon.ico HTTP/1.1" 404 153 "-" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:75.0) Gecko/20100101 Firefox/75.0" "-"
2021-07-05 22:56:50 2021-07-05T22:56:50.538386476+05:30 stdout F 10.0.2.15 - - [05/Jul/2021:17:26:44 +0000] "GET / HTTP/1.1" 200 0 "-" "Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:75.0) Gecko/20100101 Firefox/75.0" "-"
2021-07-05 22:56:50 2021-07-05T22:56:48.124816896+05:30 stderr F 2021/07/05 17:26:44 [error] 31#31: *3 open() "/usr/share/nginx/html/favicon.ico" failed (2: No such file or directory), client: 10.0.2.15, server: localhost, request: "GET /favicon.ico HTTP/1.1", host: "10.152.183.179"

Demo


kube1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Firefox Web Browser
Jul 7 22:17
Kubernetes Dashboard
HotROD - Rides On Demand
Jaeger UI
Configuration: Data Sour
127.0.0.1:8080/explore?orgId=1&left=["now-1h","now","Loki",{"expr":"{app%3D\"hotrod\"}"}]
Right Ctrl

Learnings

- Importance of containerization and container orchestration.
- Importance of using Kubernetes.
- Using different tools to set up kubernetes clusters.
- Importance of observability and monitoring.
- Exploring different tools for observability and monitoring.
- Deploying multiple applications on a kubernetes cluster.
- Practical implementation of three pillars of observability i.e metrics, logging and tracing.
- Exploring multi-cluster observability.

Next steps

- Creating a central dashboard for visualizing metrics of multiple clusters.
- Using Spark to process Big Data on Kubernetes.
- Implementation of load balancers using traefik.
- Monitoring and observability using EFK Stack.
- Observability using Open Telemetry.
- Setting up a High availability cluster using K3d.
- AI/ML stack on Kubernetes.

CHALLENGES FACED

- Working remotely
- Insufficient hardware
- Ramp up time in working with various tools

Hewlett Packard Enterprise

Any Questions?

Hewlett Packard Enterprise

Thank You!

Hewlett Packard Enterprise