Computing on the Edge with Kubernetes

Kubernetes at the Wellsite

Vassilis Varveropoulos
Lead Architect of Reservoir Performance Division, Schlumberger

Mikhail Kozorovitskiy
Architect, Rancher Labs

Seyi Verma
Head of Product Marketing, ZEDEDA

October 21, 2020

Wellsite

Stimulation operation

Coil tubing intervention

Offshore wireline logging unit

Well testing offshore installation

Wireline land unit

Wellsite

Harsh environment…

High humidity, dust, heat, shock and vibration

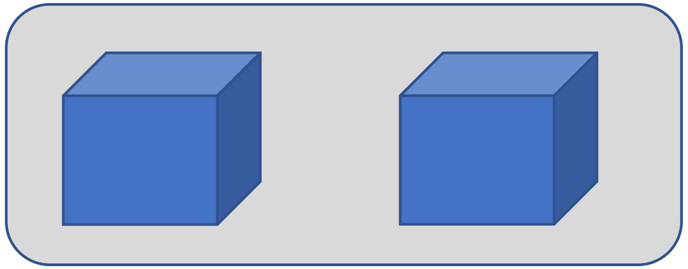
Equipment must be ruggedized and qualified for harsh environments

Data center equipment don’t survive long!

A typical journey to Kubernetes

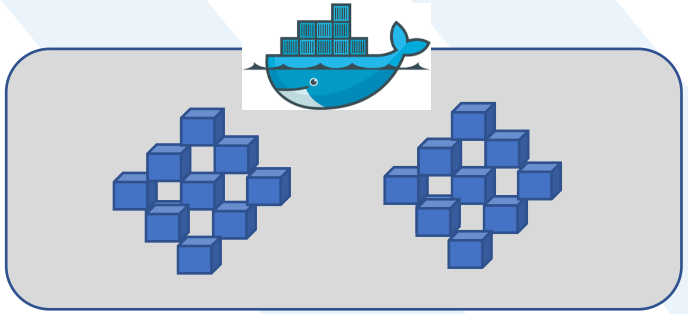
Monolith

Monolithic applications running in a single node



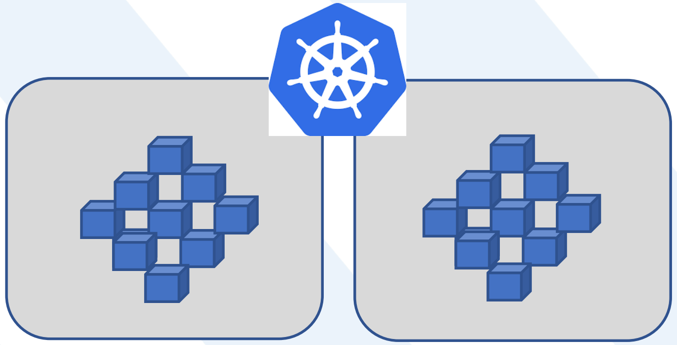
Breaking it down

Introducing containerized microservices



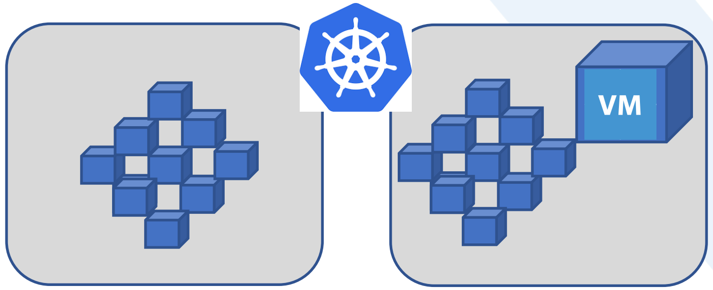
Distributing the services

Introducing clustering



The reality…

Still need to accommodate the legacy applications



Overview of Workloads

Process Automation

Control surface and wellbore equipment through fieldbuses and PLCs.

Machine Learning and AI

Machine vision and deep learning algorithms requiring GPU acceleration.

Historians

Databases are used to record events and data.

Wellsite User Interfaces

Web applications for wellsite users to monitor and control the operation.

Cloud Gateways

Provide the connection for remote users to monitor and control the wellsite.

Virtual Machines

Applications that can’t be containerized are deployed in VMs (e.g. legacy applications).

Benefits of Kubernetes at the Edge

High availability and scalability

Not every wellsite operation is the same.

High profile, complex jobs require more compute and high availability.

Less complex jobs are very cost sensitive.

Shorten the software release cycles

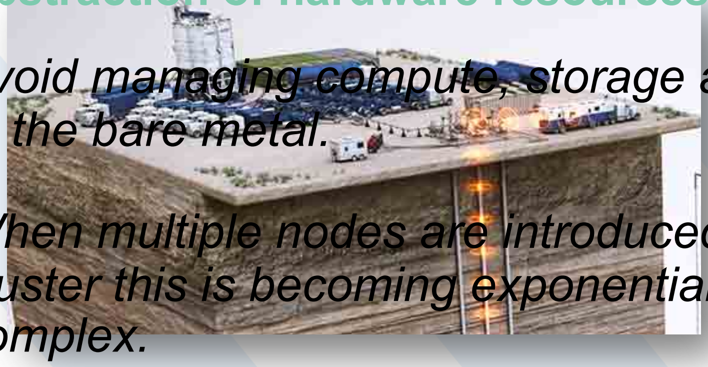
Switch from infrequent massive releases to frequent small releases.

Manage fleet centrally, push software to the edge.

Abstraction of hardware resources

Avoid managing compute, storage and network at the bare metal.

When multiple nodes are introduced in a single cluster this is becoming exponentially more complex.

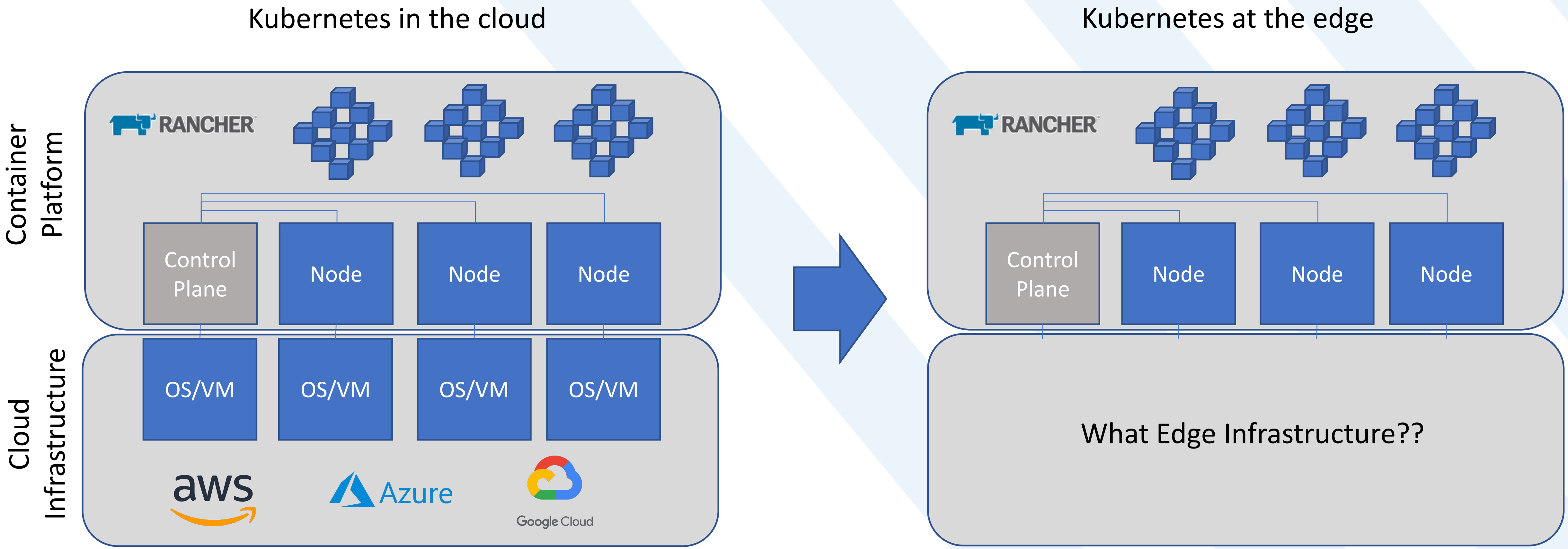


Bring the cloud closer to the edge

Develop microservices that can be used in both edge and cloud depending on where they are needed.

Leverage the rapid technology innovation happening in the cloud.

From Kubernetes in the cloud to the edge



Unique challenges at the Edge

Connectivity…

Intermittent: clusters are online while a job is taking place, then offline in-between.

Inconsistent: Even during the job connectivity quality can greatly vary.

Large number of small clusters

Unlike the cloud, edge clusters tend to be small (a few nodes) but hundreds to thousands of them.

Interface with physical world

Edge clusters interface and control physical hardware, sometimes involving mission and safety critical processes

Observability

Cluster rarely online when you want to troubleshoot.

Logging and monitoring data needs to be persistent off cluster.

Managing the infrastructure

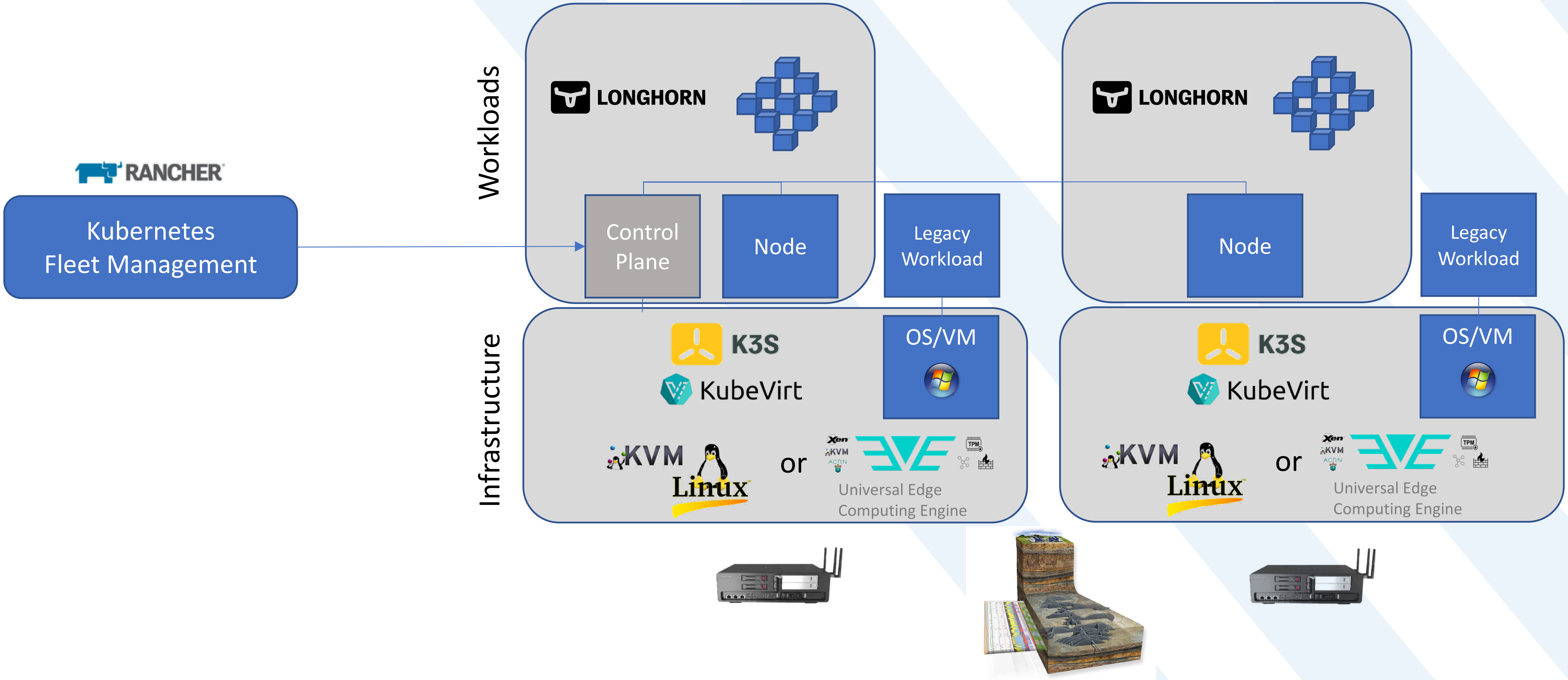
How to manage the edge infrastructure?

Deploy Kubernetes on bare metal or VM?

Schlumberger RANCHER LABS ZEDEDA

A promising stack:
Kubernetes on bare metal

Kubernetes at the edge



RANCHER

Kubernetes Fleet Management

Workloads

Infrastructure

LONGHORN

Control Plane

Node

Legacy Workload

K3S

KubeVirt

OS/VM

KVM

Linux

or

Universal Edge Computing Engine

LONGHORN

Node

Legacy Workload

K3S

KubeVirt

OS/VM

KVM

Linux

or

Universal Edge Computing Engine

Requirements for edge infrastructure

Heterogeneous

Edge servers and nodes

Networks and connectivity

Applications

I/O and sensors/devices

Lifecycle in field

Security

Public networks as backhaul

Physically insecure

No usernames/passwords

Patch reliably and fast

Remote attestation

Scale

As a service, just like cloud

High number of clusters

Certificate/PKI management

Eventual consistent

API-driven configuration

Introducing LF Edge and EVE

LF EDGE

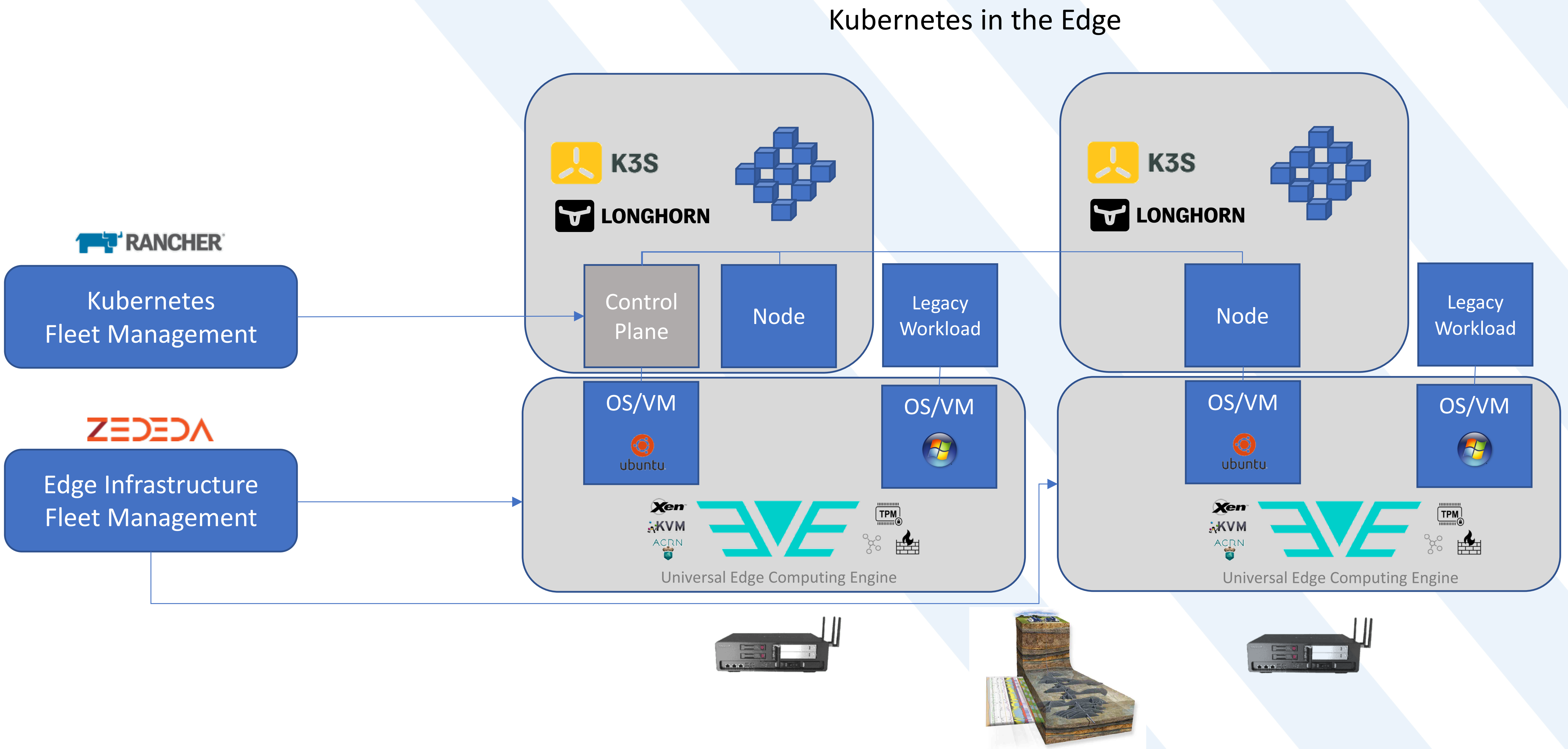
Edge Computing Open Source Foundation for
Telco, Enterprise and IoT Edge

Part of Linux Foundation & sister organization to CNCF

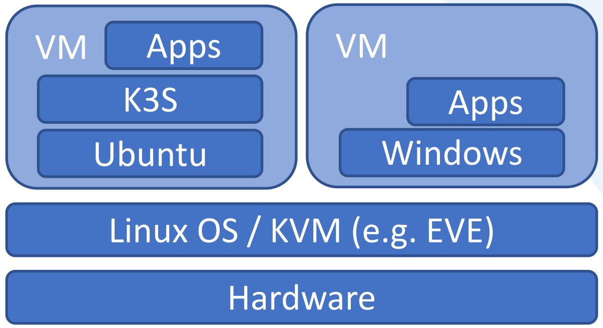
EVE

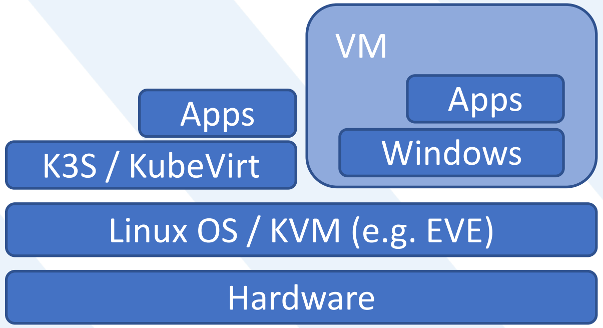
Lightweight, bare-metal, secure,
open, universal Linux-based
IoT edge operating system

A promising stack:
Kubernetes on a universal edge computing engine



Non-integrated vs. integrated Kubernetes





Non-integrated Kubernetes

Better isolation between bare metal and Kubernetes workloads.

An additional OS to manage (Ubuntu).

Multiple virtualization layers may impact performance.

Not a fully integrated user experience (split control planes).

Integrated Kubernetes

Fewer OS to manage

Fewer virtualization layers will make most of limited hardware resources

Cluster managed through Kubernetes APIs from a single control plane.

Kubernetes control plane becomes single point of failure.

Opportunities and gaps

Kubernetes + Virtualization

A solution that seamlessly integrates Virtualization and Kubernetes at the Edge is needed.

Split vs. single management planes for VM and Kubernetes?

Scale to a large fleet

Scale to thousands of devices.

Efficiently manage large images (containers and VM).

Trust the hardware

Need to ensure the edge devices have not been tampered with, currently not a Kubernetes concern.

Simplify device management

Want to focus on workloads not OS and bare metal.

Full observability across micro-services, runtimes, OS, networking and hardware for fast troubleshooting and diagnostics.

Thank You!

Vassilis Varveropoulos
Lead Architect, Schlumberger
VVarveropoulos@slb.com

Mikhail Kozorovitskiy
Architect, Rancher Labs
Mikhael@Rancher.com

Seyi Verma
Head of Product Marketing, ZEDEDA
Seyi@ZEDEDA.com