

Red Hat OpenShift Virtualization

DeepDive

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Principal Learning and Development Instructor

Agenda

9:30 Welcome and Intro

9:45 OCP Virt Overview

10:30 Deeper into the Technologie (storage / Networking)

11:30 BREAK

11:15 Server Configurations and HostetControlPlane & ACM

12:30 LUNCH BREAK

13:30 Guidelines and Considerations for Migration

14:15 Partner Ecosystem

15:00 Q&A

Hybrid cloud application platform



Red Hat
OpenShift

Advanced Management & Security

Multicluster Management | Cluster Security | Global Registry | Cluster Data Management | Compliance & Policy Automation

Integrated DevOps Services

Service Mesh | Serverless | Builds | Pipelines | GitOps | Tracing | Log Management | Cost Management

Containers

Image Registry | Container Runtime | Pod Autoscaling | Resource Quotas & Limits | Namespace Isolation | Container Networking

VMs

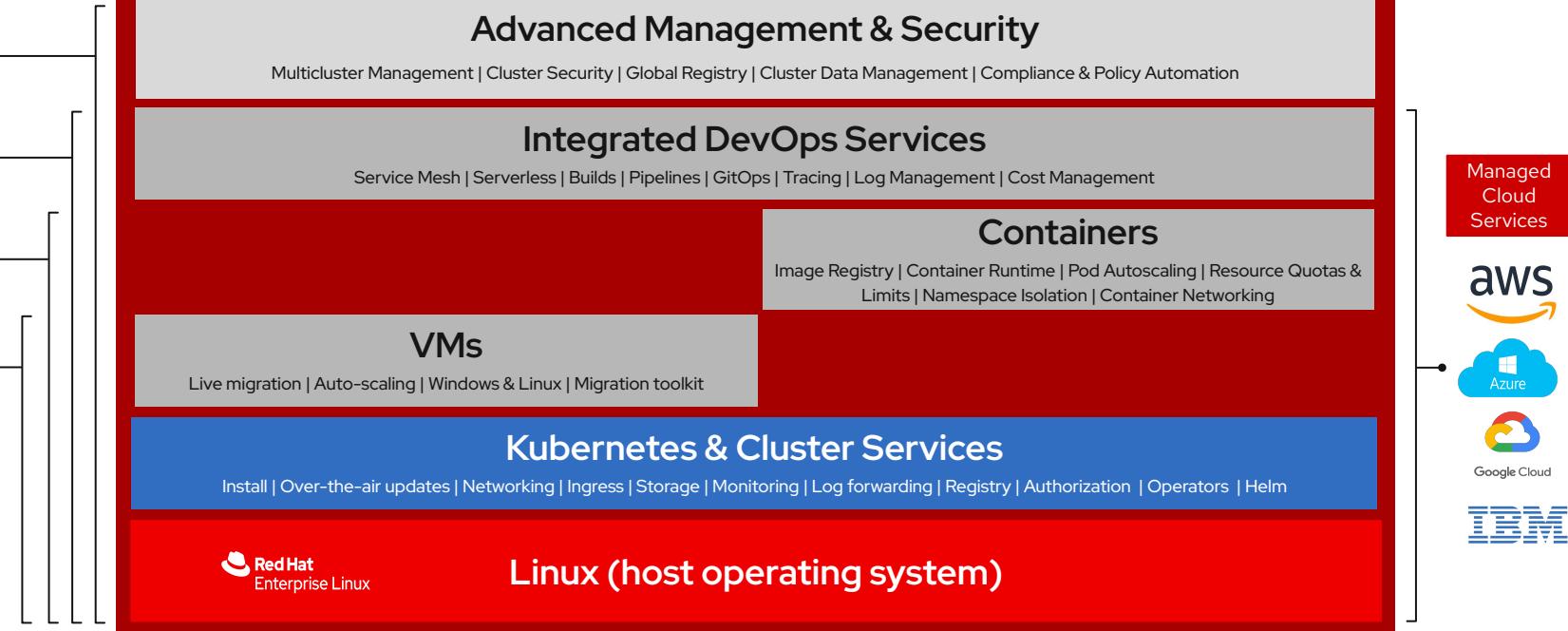
Live migration | Auto-scaling | Windows & Linux | Migration toolkit

Kubernetes & Cluster Services

Install | Over-the-air updates | Networking | Ingress | Storage | Monitoring | Log forwarding | Registry | Authorization | Operators | Helm



Linux (host operating system)



Physical



Virtual



Private cloud



Public cloud



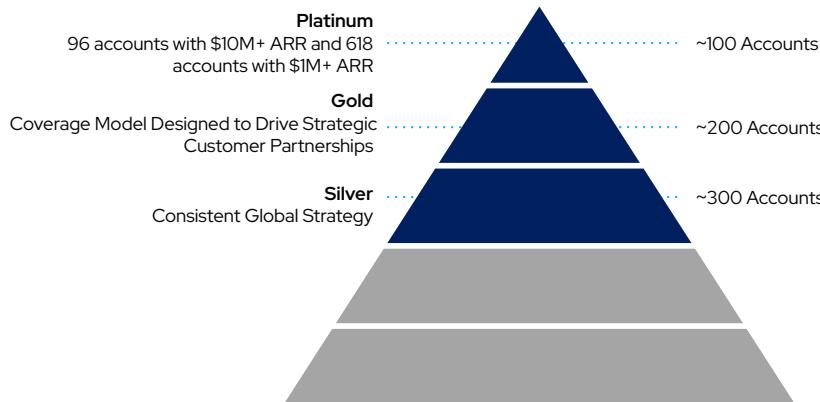
Edge



The announcement of Broadcom to Acquire VMware has sparked concerns in the industry.

Technology Risk

With the announcement of the new Go-to-Market Model by Broadcom to focus on the **top 600 accounts** globally leaves many enterprises in open.



Increase of cost of virtualization software and subscription[#]



Reduction of enterprise support for non-focus accounts

[Partner Connect](#)[Your Profile](#)[Promotions](#)[Support Center](#)

VMware Partner Programs Termination Notice

For more than two years, VMware has outlined its plan to transition from a perpetual to a subscription-based business model. This is consistent with the overall market trend toward cloud operating models and was reinforced with the launch and evolution of VMware's Partner Connect Program.

On December 11, 2023, VMware by Broadcom announced its simplified licensing model and solution portfolio. Broadcom and VMware are driven by technology and innovation and have a shared passion for, and commitment to, partner profitability and success. You are now well positioned to capture substantial growth opportunities for delivering advanced, innovative cloud infrastructure and associated services wherever your customers need.

Disruptions to VMware Partners...

Broadcom Takes Top VMware Accounts Direct 'Effective Immediately'

BY O'RYAN JOHNSON ►

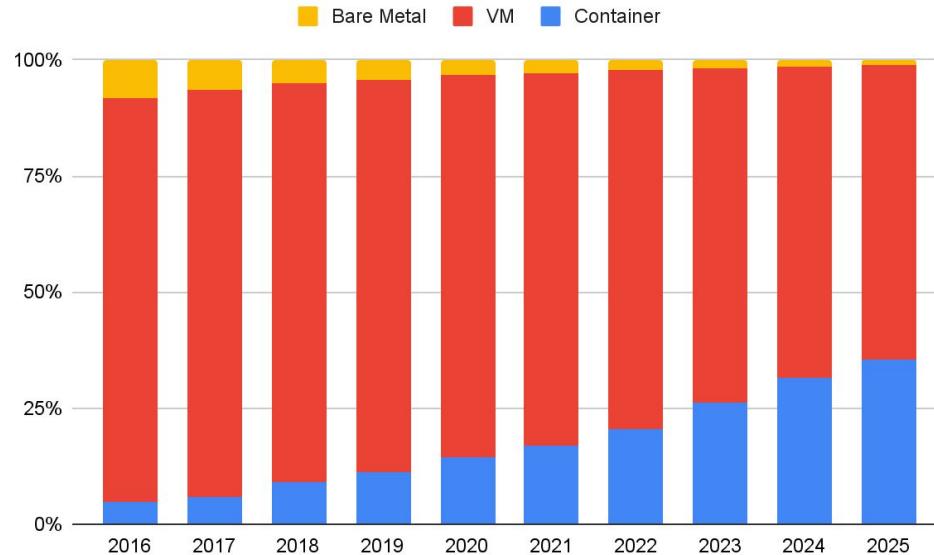
JANUARY 8, 2024, 8:42 AM EST

'Effective Immediately: Strategic customer segments are no longer eligible for Opportunity Registration,' Broadcom wrote to partners in a newly issued Opportunity Registration Policies, according to material obtained by CRN.



Virtualization is here to stay

But not as we know it today



Source: IDC Container Infrastructure Software Market Assessment: Container Deployment Forecast, 2022–2025 (IDC #US48670722, January 2022)

De-Risking Your Virtualisation Technology Investment

Future-Proof Your Virtualization Strategy

New and modern applications will be built on containers. They provide new levels of agility and empowers organisations to accelerate their digital capabilities.

However, **not all applications** can or are **ready** to be containerized and operate in microservices.

In most organizations, the **journey** will be a **multi-phased approach**, requiring IT operations to maintain and **coexist** workloads with both virtual machines and containers in their IT landscape.

1

Rehosting by “shifting” virtual machine workloads into the OpenShift platform

2

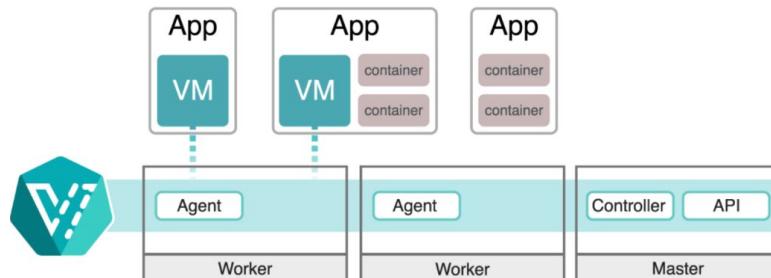
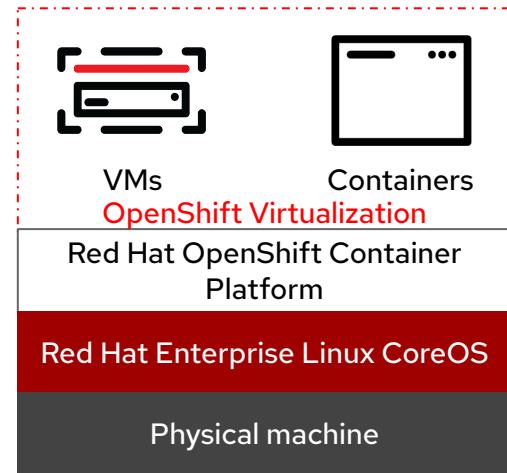
Replatform by “upgrading” the application into a container-based architecture

3

Refactor applications from monolithic to microservices

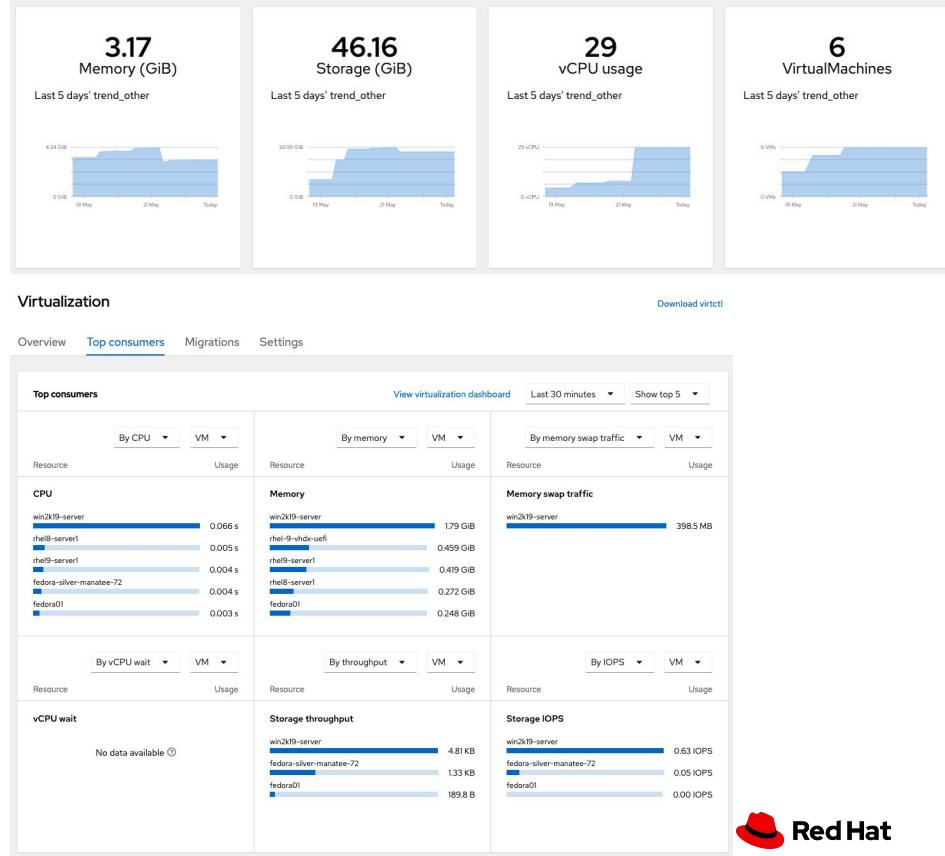
What is OpenShift Virtualization?

- Unified platform for running VMs and Containers
- Include features of the OpenShift application platform
- Run VMs in OpenShift
- Performance, stability, scalability, and reliability of KVM, the Linux kernel-based hypervisor
- Manageability and ecosystem of OpenShift
- Supports Microsoft Windows guests – Microsoft Server Virtualization Validation Program (SVVP)

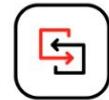


OpenShift Virtualization Overview

- Virtual Machine
 - Provisioning, Deprovisioning
 - Life Cycle Management
 - Live Migration (vMotion equivalent)
- Platform
 - Storage
 - Software Defined (Block, File, NFS, Object Storage)
 - Traditional Storage with Container Storage Interface
 - Dell, EMC, HPE, Hitachi, IBM, Pure etc
 - Network
 - Software Defined (OpenShift OVN)
 - Multiple Networks with VLANs segregation (Multus)
 - Load Balancing
 - MetalLB, F5 etc
- Backup and Restore
 - OADP (Valero), Kasten, Portworx, NetApp, Veritas etc
- Migration to OpenShift
 - vSphere, ESXi, OVA
 - Red Hat Virtualization, OpenStack
 - Hyper-V and other KVM variants (Automate with Ansible)



Migration Toolkit for Virtualization (MTV)



Main Features:

- Easy to use UI
- Mass migration of VMs from VMware, Red Hat Virtualization, OpenStack to OpenShift and between OpenShift Clusters
- VM data pre-copied before shutdown (Warm Migration) for VMware and Red Hat Virtualization migrations
- VM validation service:
 - Runs checks on VM configuration to avoid migration issues
- Parallelized VM Conversion
 - Maximize Throughput
- Migration Network Selection
 - Avoid impact on other running workloads

The screenshot displays the Red Hat OpenShift MTV interface. It features a left sidebar with navigation links for Home, Operators, Workloads, Migration (selected), and Virtualization. The Migration section is expanded, showing sub-links for Providers for virtualization, Plans for virtualization, NetworkMaps for virtualization, and StorageMaps for virtualization. The main content area is divided into two tabs: 'Providers' and 'NetworkMaps'. The 'Providers' tab shows a list of providers with columns for Name, Status, Type, Endpoint, Type, VMs, Networks, and Hosts. It lists three providers: 'vSphere' (VMware source), 'rhv' (oVirt source), and 'k8s' (KubeVirt). The 'NetworkMaps' tab shows a list of network maps with columns for Name, Source..., Target..., From, Status, and To. It lists two network maps: 'vSphere-map' (Source: vSphere, Target: k8s) and 'rhv-map' (Source: rhv, Target: k8s). Below the tables, there are sections for 'Source networks' and 'Target namespaces / networks'.

Modernize at your own pace

Legacy Virtualization

Apps in VMs

Slow evolution
⌚

Increasing costs
💲



Developer toil

Infrastructure Modernization

Apps in VMs



Cloud elasticity + scalability



Reduced cost



Increase IT efficiency +
reliability

Migration
Toolkit for
VMs

DevOps & Infrastructure Modernization

Apps in VMs or Containers



Innovate at speed



Higher annual revenue



Increased developer output

Cloud
Native

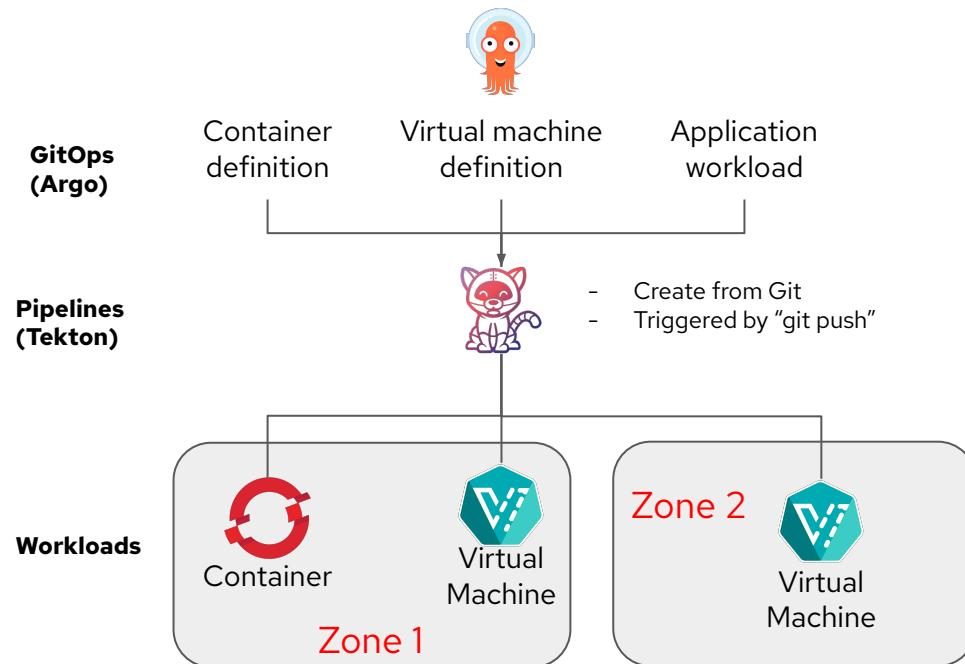
Direct path to cloud native

Speed of Infrastructure Deployment
Speed of Application Development



OpenShift Virtualization: Build Cloud-native VMs

Deploy VMs as Code with CI/CD



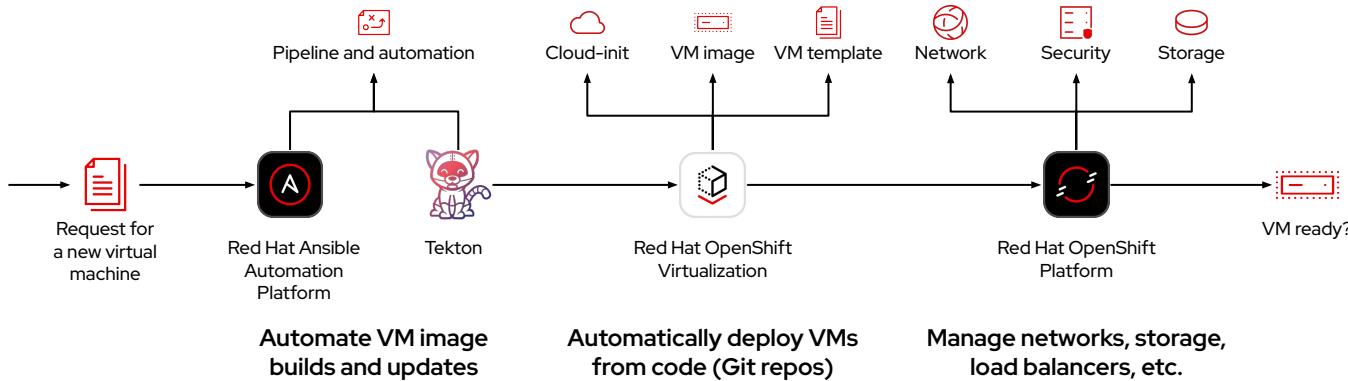
Integrate legacy VMs with a modern GitOps framework

- ▶ Deploy different security zones to run both composite applications of pods/VMs as well as traditional VM workloads
 - ▶ Deploy and automate Virtual Machines as Code with GitOps

Next-generation approach to virtual machine provisioning

A process that can be optimized down to a few minutes

Virtual machine
▶ CPU: 4 vCPU, 1 core
▶ Memory: 16GB
▶ Disk: 30 GB
▶ OS: RHEL
Additional file systems
▶ Data: 500GB, disk
▶ Logs: 100GB, partition
Application platform
▶ JBoss 7.4 update 11
Firewall rules
▶ Ingress: SSH, HTTPS
▶ Egress: *.redhat.com
DNS and LB
▶ api.service.org
▶ Healthcheck: HTTPS port



Creating Mission Critical Virtualization with AAP



Virtualization Operations

Automate daily activities (remediation)

- ▶ Application deployments and CI/CD pipelines
- ▶ Life cycle management and enforcement
- ▶ OS patching (Windows and Linux) and maintenance
- ▶ Event Driven Remediation



Deployment and retirement

Provision, configure and teardown virtual instances

- ▶ Create turn key deployments for infrastructure teams
- ▶ Govern instance creation and enforce retirements
- ▶ Create service catalog items for ordering environments

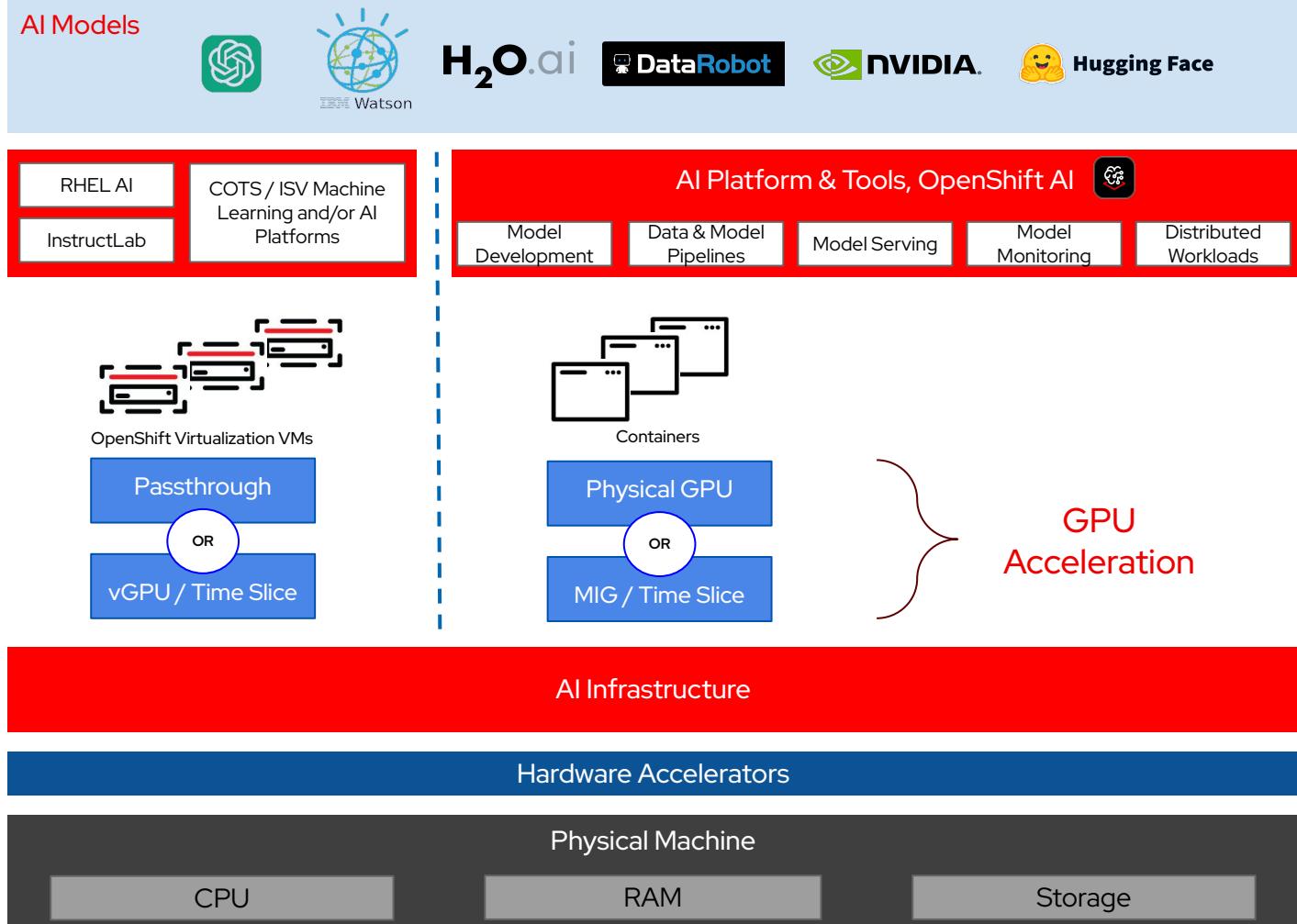


Virtual Machine migration

Move workloads to OpenShift safely

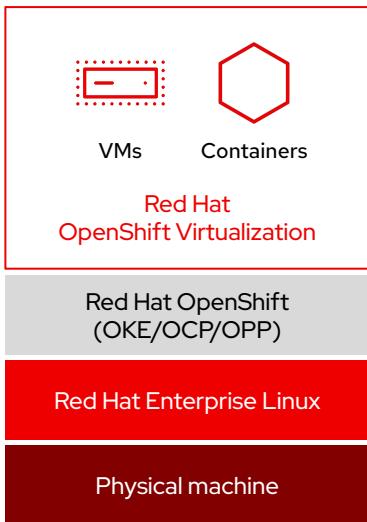
- ▶ Pre and Post processing for VM Migration from vSphere
- ▶ Last mile configuration checks

OpenShift Virtualization for AI



Red Hat OpenShift Virtualization

The modern option for general purpose virtualization



- ▶ **Unified platform**
for virtual machines and containers
- ▶ **Consistent management**
tools, interfaces, and APIs incl. ACM and AAP integrations
- ▶ **Performance and stability**
of Linux, KVM, and qemu
- ▶ **Healthy open source community**
the KubeVirt project is a top 10 CNCF active project, with 200+ contributing companies
- ▶ **Supports Microsoft Windows**
guests through Microsoft SVVP
- ▶ **Inbound guest migration**
using Ansible Automation Platform + Migration Toolkit for Virtualization, Training and Consulting
- ▶ **Diverse ecosystem**
of Red Hat & partner operators

OpenShift Virtualization Unlocks Tangible Value

COST EFFECTIVENESS



Lower TCO



Cloud-native approach to VM manageability minus the cost of proprietary SW

RISK MANAGEMENT



Highly resilient
and scalable



Manage VM fleet with single-pane of glass with modern dashboard technology

ITERATIVE MODERNIZATION



Flexibility of
approach



Traditional VM behavior while VMs participate in modern DevSecOps and GitOps pipelines via Infrastructure as Code



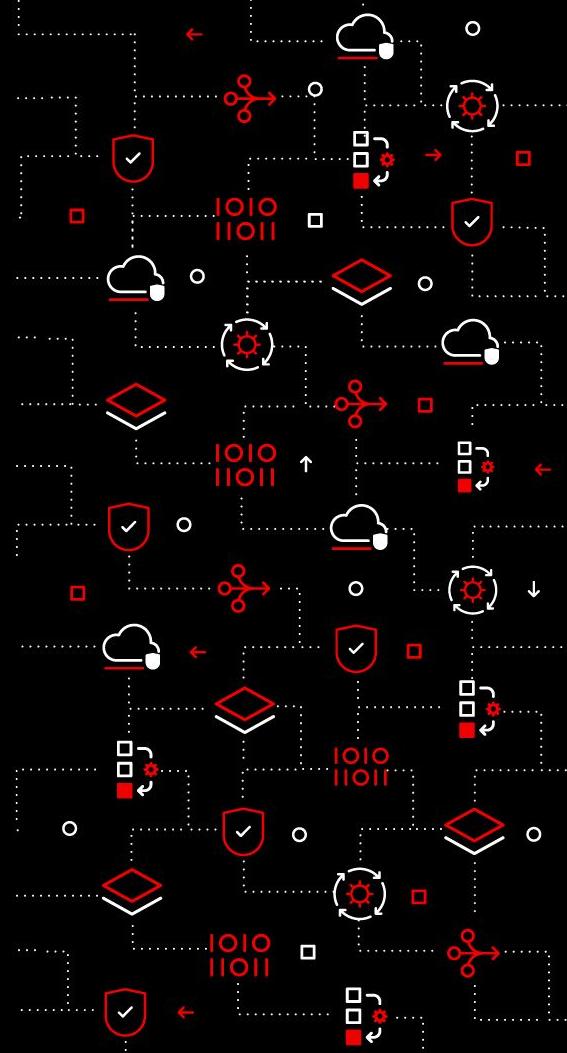
Up to 21% Higher
Operational
Infrastructure Efficiency*



Consistency of
Management



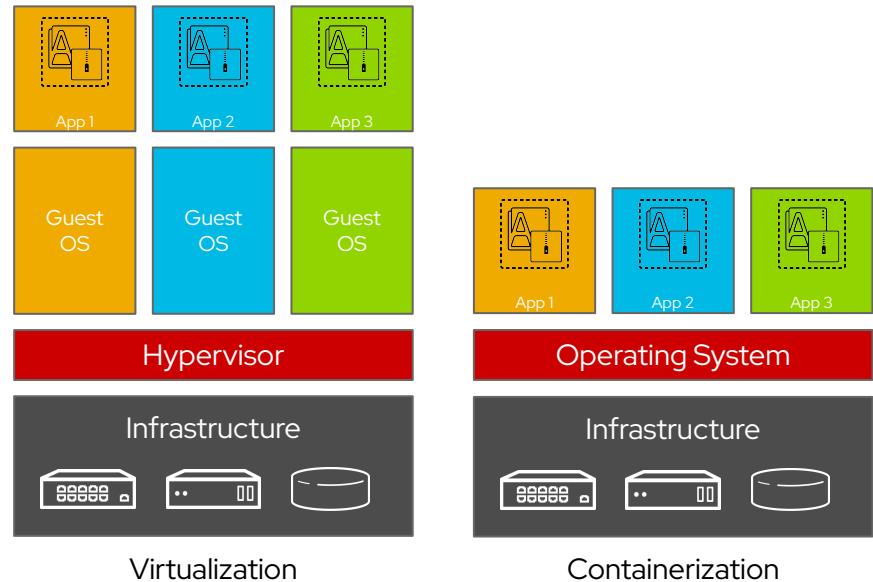
Up to 42% reduction of
Unplanned Outages*



Deeper Dive into the Technology

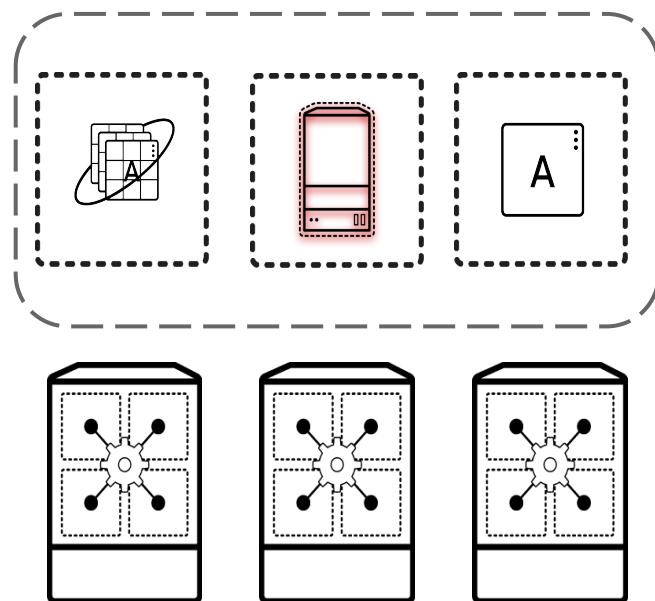
Containers are not Virtual Machines

- Containers are process isolation
- Kernel namespaces provide isolation and cgroups provide resource controls
- No hypervisor needed for containers
- Contain only binaries, libraries, and tools which are needed by the application
- Ephemeral



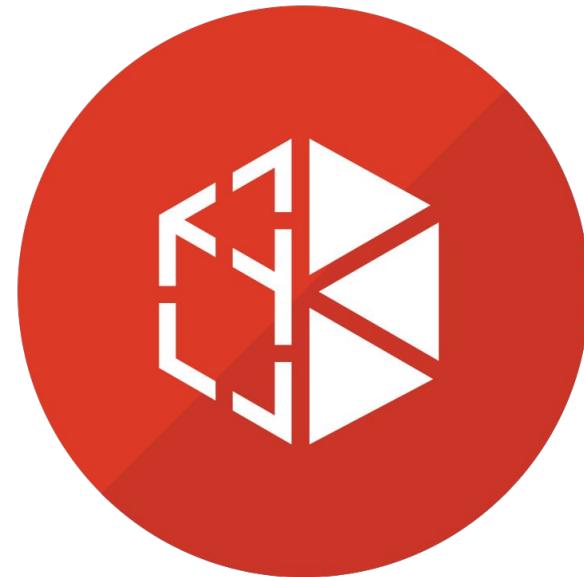
Virtual Machines can be put into Containers

- A KVM virtual machine is a process
- Containers encapsulate processes
- Both have the same underlying resource needs:
 - Compute
 - Network
 - (sometimes) Storage



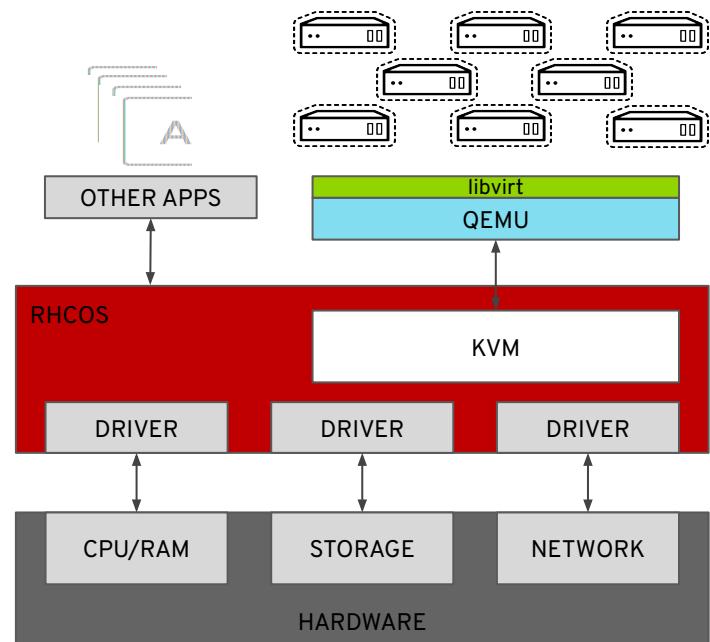
OpenShift Virtualization

- Virtual machines
 - Running in containers, managed as Pods
 - Using the KVM hypervisor
- Scheduled, deployed, and managed by Kubernetes
- Integrated with container orchestrator resources and services
 - Traditional Pod-like SDN connectivity and/or connectivity to external VLAN and other networks via multus
 - Persistent storage paradigm (PVC, PV, StorageClass)

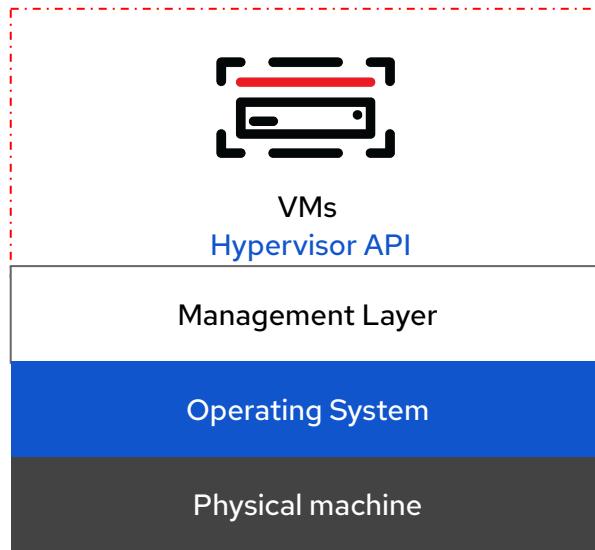


OpenShift Virtualization uses KVM

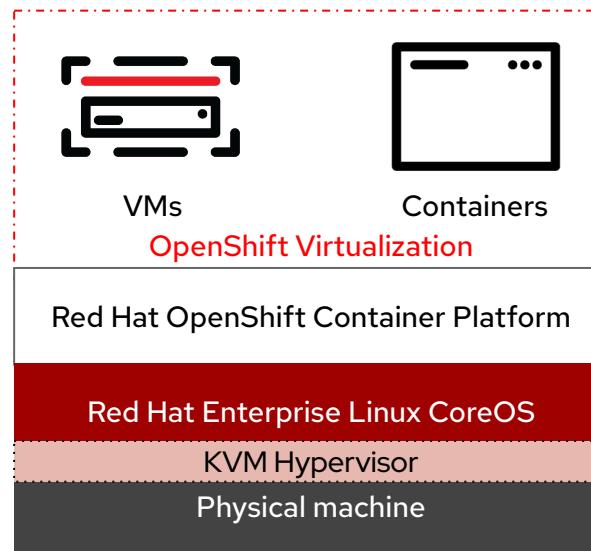
- OpenShift Virtualization uses KVM, the Linux kernel hypervisor
- KVM is a core component of the Red Hat Enterprise Linux kernel
 - KVM has 10+ years of production use: Red Hat Virtualization, Red Hat OpenStack Platform, and RHEL all leverage KVM, QEMU, and libvirt
- QEMU uses KVM to execute virtual machines
- libvirt provides a management abstraction layer
- Currently supported on x86 bare metal
- For other platforms contact Product Management for roadmap



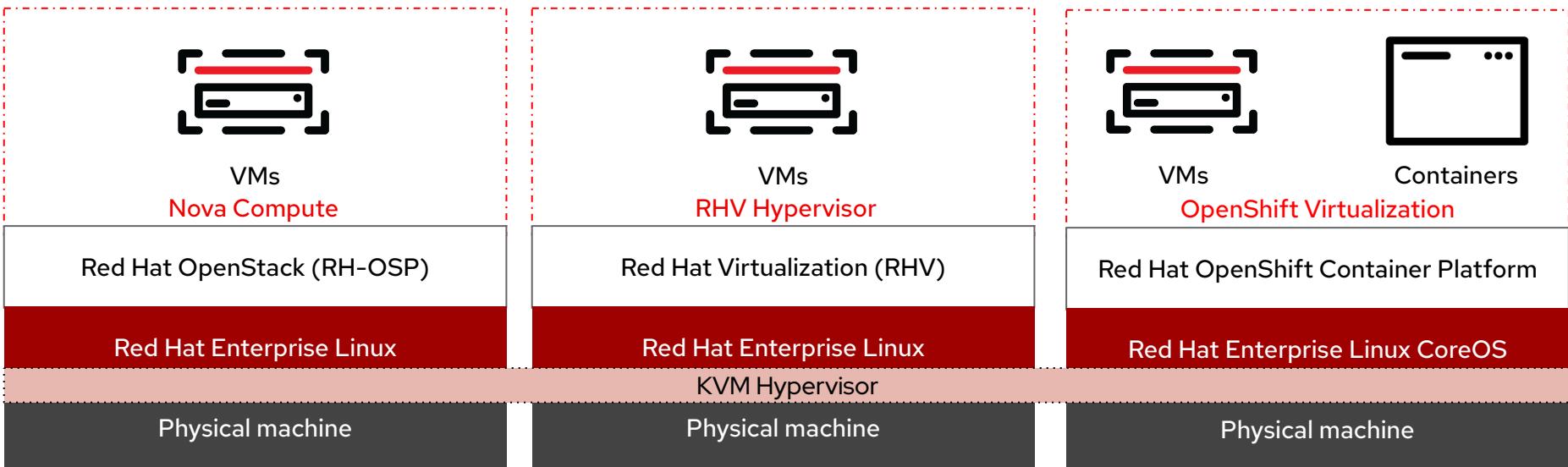
Traditional Type 1 Hypervisor



vs OpenShift Virtualization

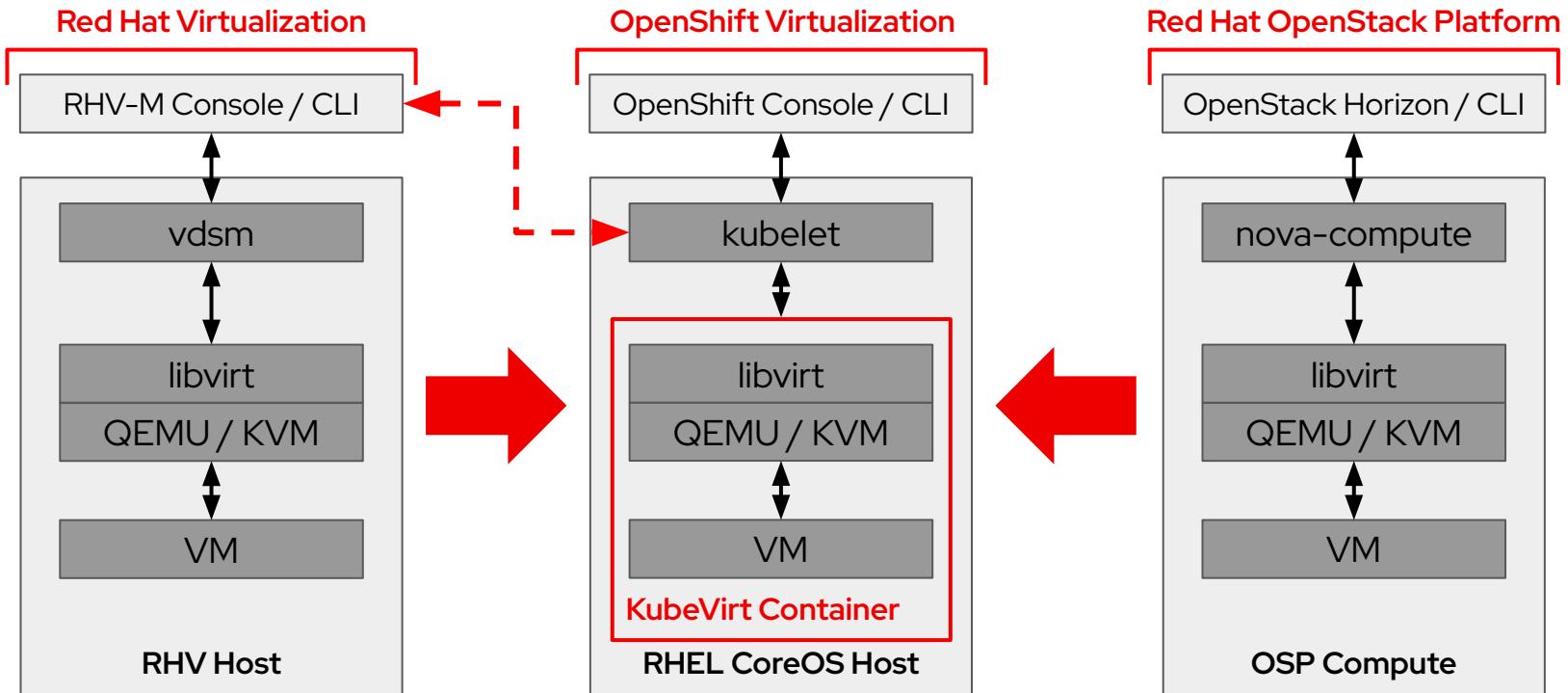


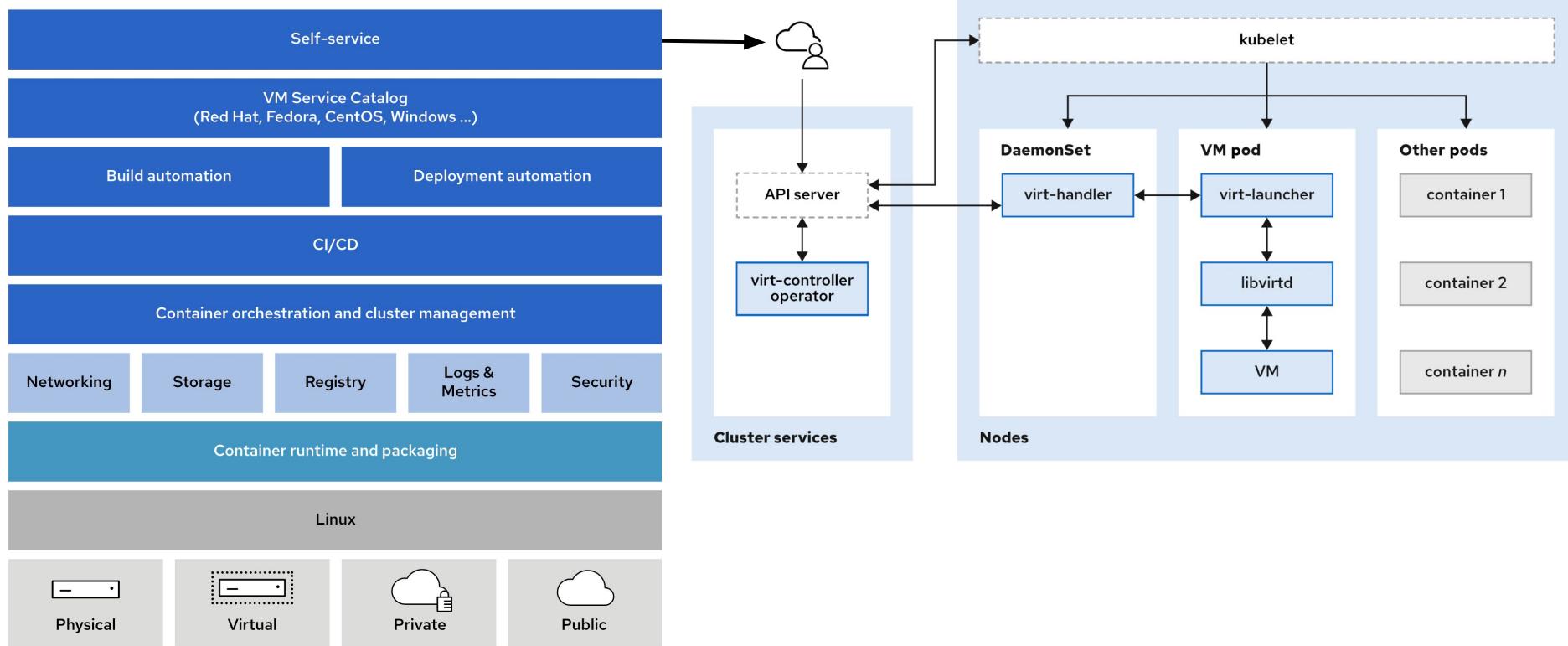
OpenStack vs RHV vs OpenShift Virtualization



Containerizing KVM

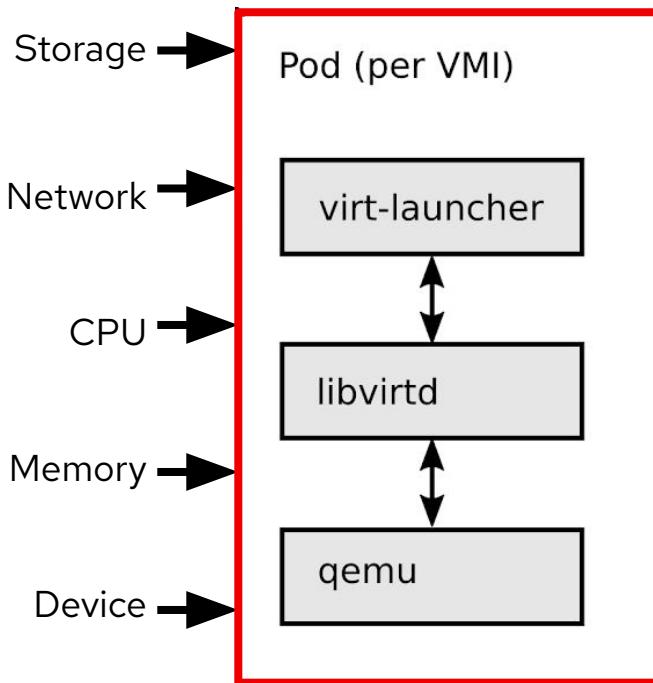
Trusted, mature KVM wrapped in modern management and automation





Architecture of the OpenShift Virtualization Operator

Containerized Virtual Machines



Kubernetes resources

- Every VM runs in a launcher pod. The launcher process will supervise, using libvirt, and provide pod integration.

Red Hat Enterprise Linux

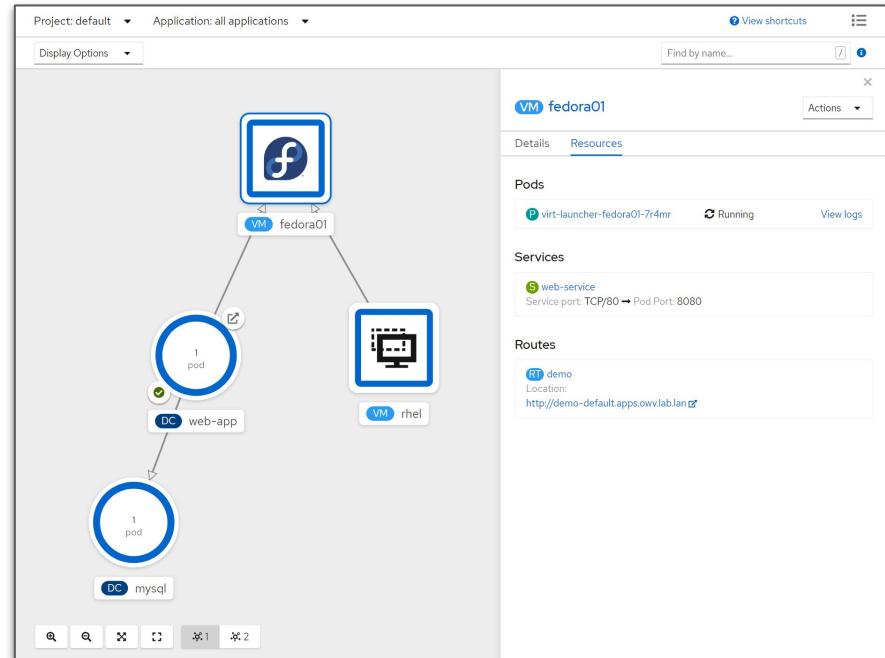
- libvirt and qemu from RHEL are mature, have high performance, provide stable abstractions, and have a minimal overhead.

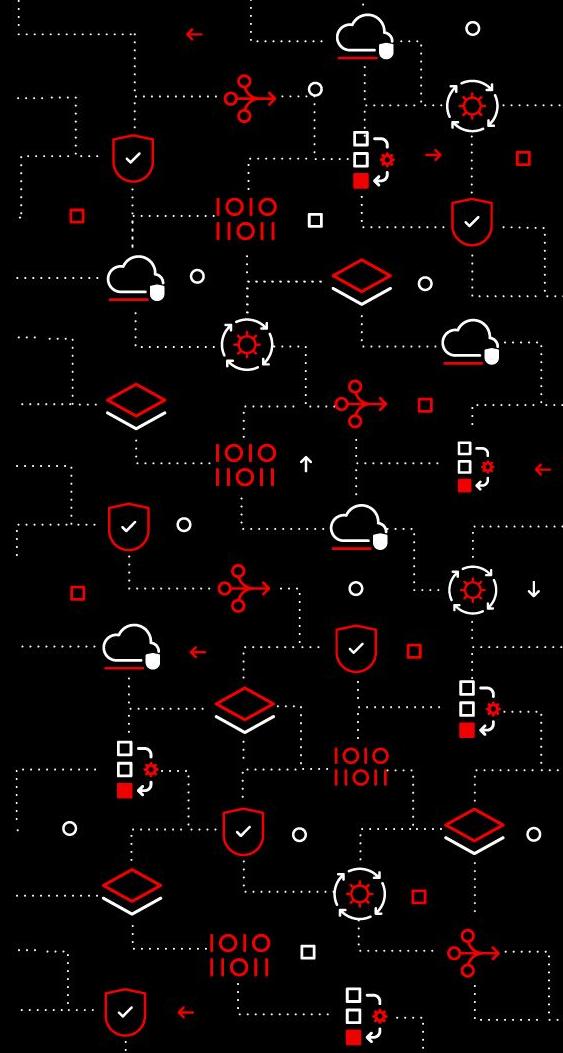
Security - Defense in depth

- Immutable RHCOS by default, SELinux MCS, plus KVM isolation - inherited from the Red Hat Portfolio stack

Using VMs and Containers Together

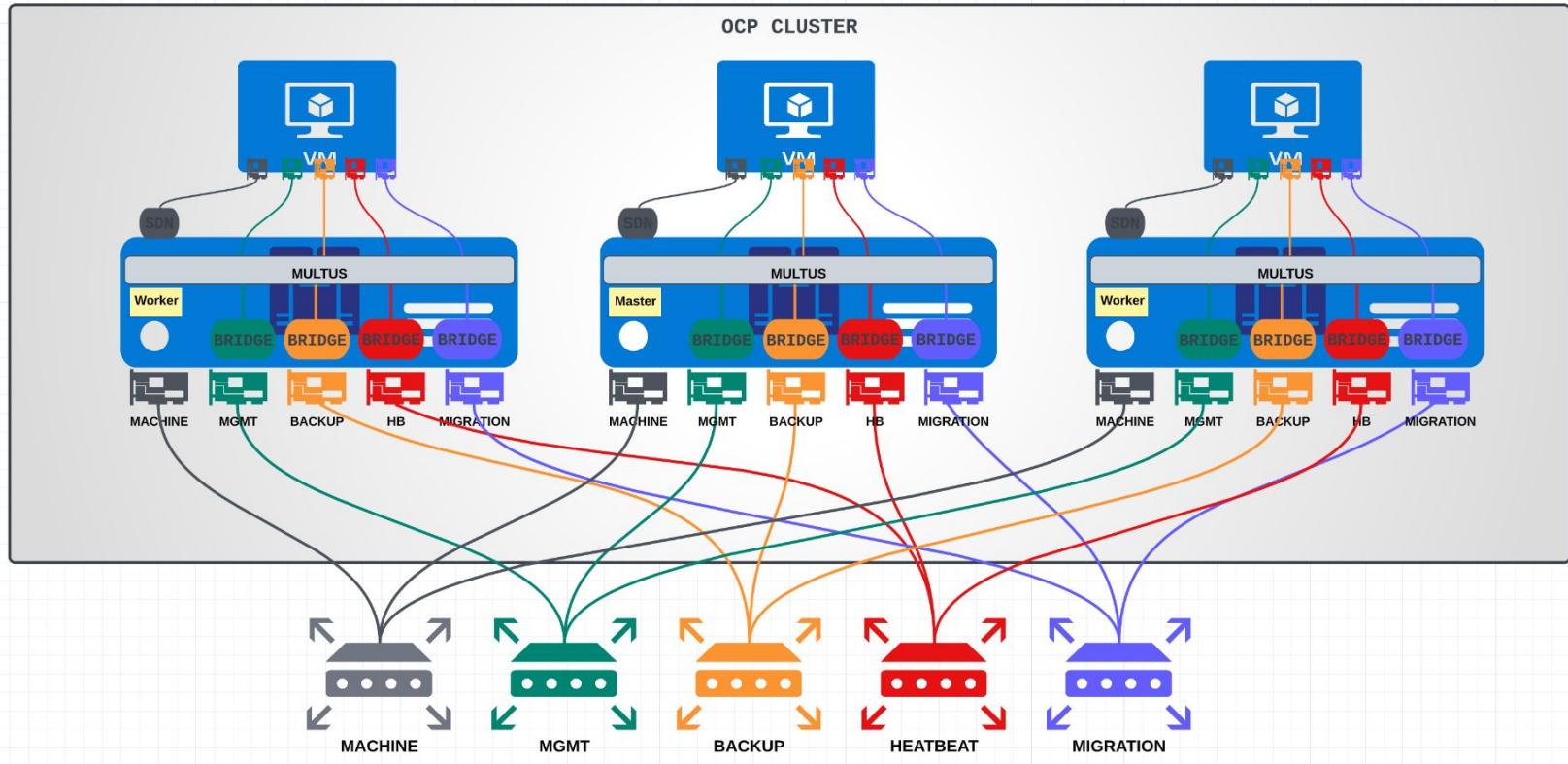
- Virtual machines connected to pod networks are accessible using standard Kubernetes methods:
 - Service
 - Route
 - Ingress
- Network policies apply to VM pods the same as application pods
- VM-to-pod, and vice-versa, communication happens over SDN or ingress depending on network connectivity





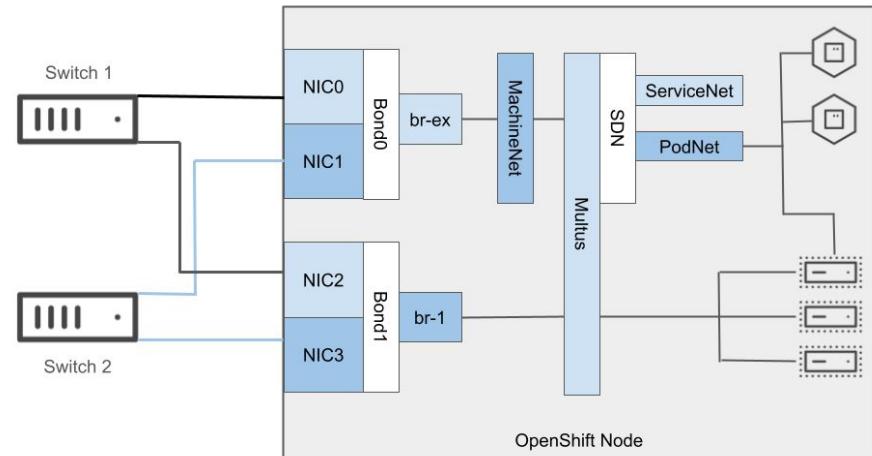
Networking

VM Multi-NIC High Level Architecture

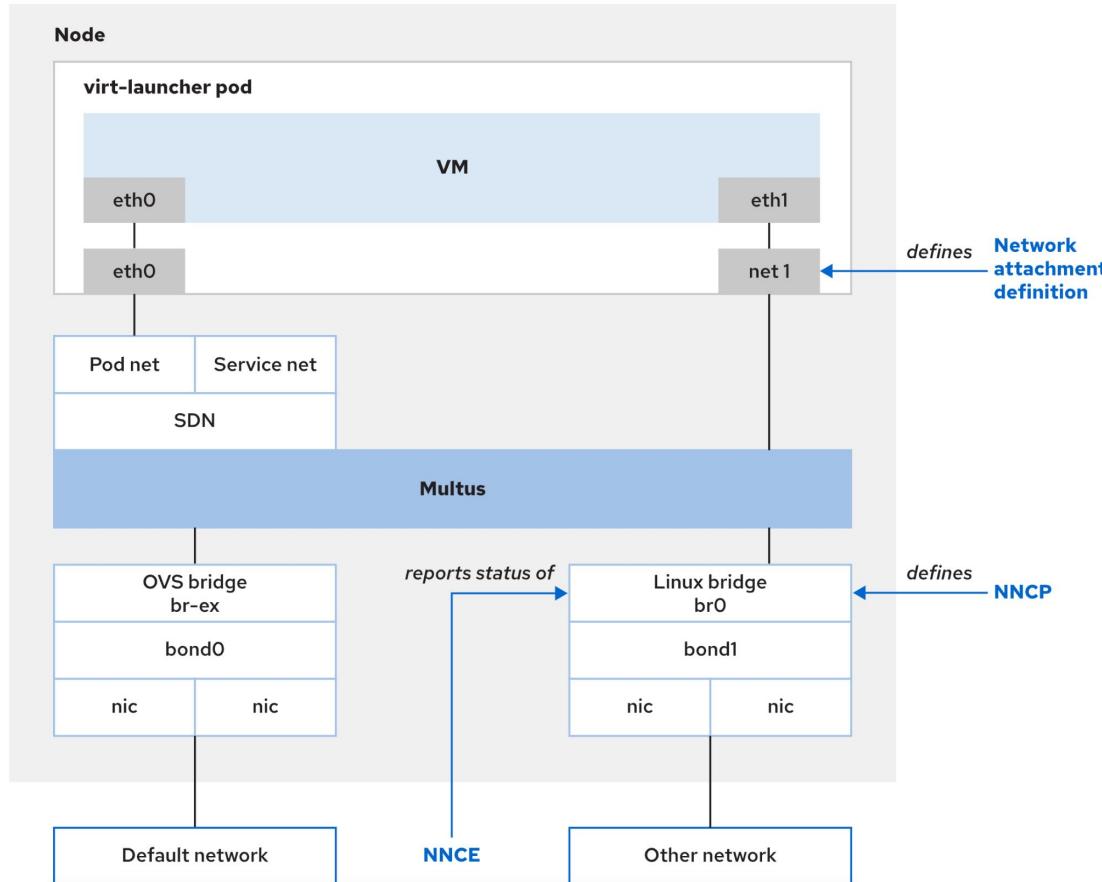


Physical Host Configuration, VM Connectivity

- Virtual machines optionally connect to the standard pod network
 - OVN-Kubernetes or partners (Tigera Calico/F5)
- Additional network interfaces accessible via Multus:
 - Bridge, SR-IOV, OVN secondary networks
 - VLAN and other networks
- NMstate applies declarative host network configuration to all machines which match the selector
 - Bond, bridge, OVS
- Node firewall and ingress/egress rules apply



Linux Bridge Node Networking with Multus and Kubernetes NMState



VM Networking in OpenShift Virtualization

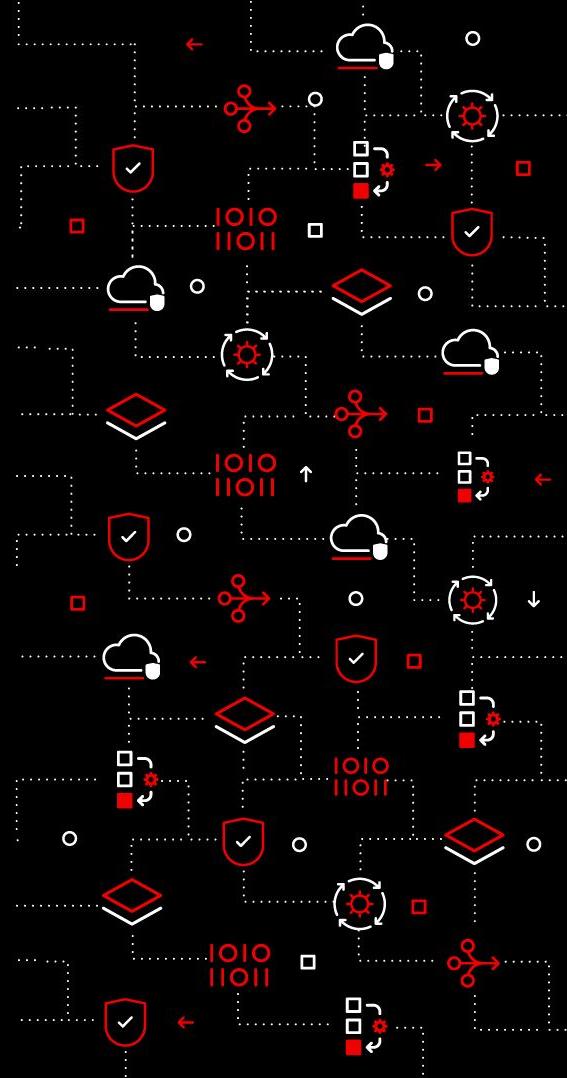
- VMs connected to the SDN have the same functionality as Pods
 - Service-based discoverability and (internal) load balancing
 - Route-based external access
 - Ingress/egress throughput control
 - MetalLB for externally accessible load balanced connections
 - NetworkPolicy for microsegmentation
 - Service Mesh features and functions
- VMs connected to an OVN-K secondary network inherit functionality of OVN/OVS
 - MultiNetworkPolicy for microsegmentation
 - L2 topology for east-west isolated networks
 - Localnet topology for external access, including VLANs

OpenShift Virtualization Prior to 4.17+

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Customer or partner by presentation only, **do not** email outside Red Hat



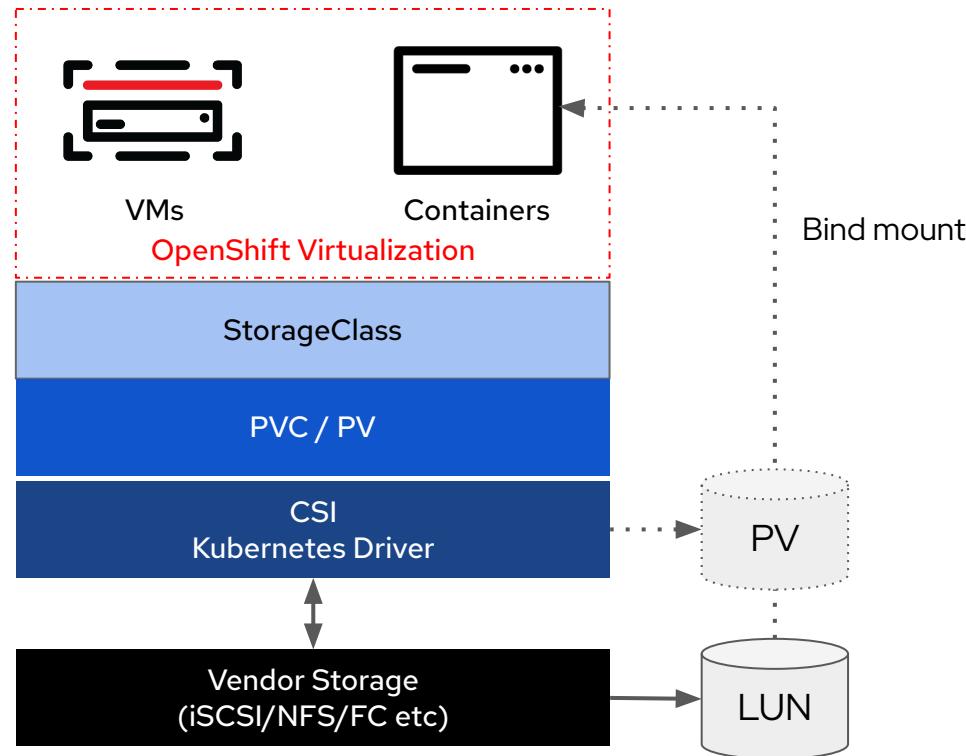
Storage

Policy Based Storage



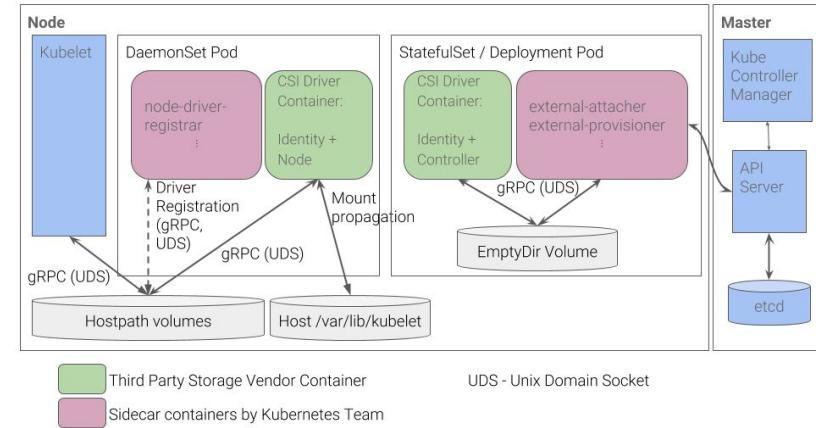
Type: Block, File or Object
Gold, Silver or Bronze

Request: Block, 10GB
Read-Write Many



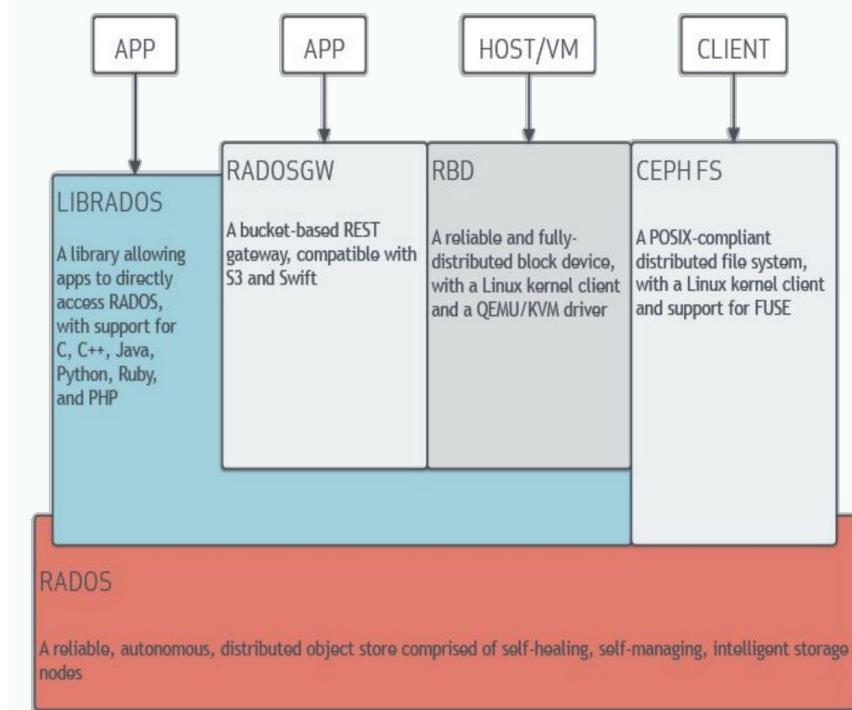
Container Storage Interface (CSI)

- Container Storage Interface (CSI) was proposed as a solution to problems faced by in-tree volume plugins
- CSI Specification defined APIs (RPCs) to enable:
 - Dynamic provisioning and deprovisioning of a volume
 - Attaching/detaching a volume from a node
 - Mounting/unmounting a volume from a node
 - Consumption of both block and mountable volumes
 - Creating and deleting a snapshot
 - Provisioning a new volume from a snapshot
- Storage vendors now had to develop only a single CSI Driver and it would work across a number of container orchestration (CO) systems.

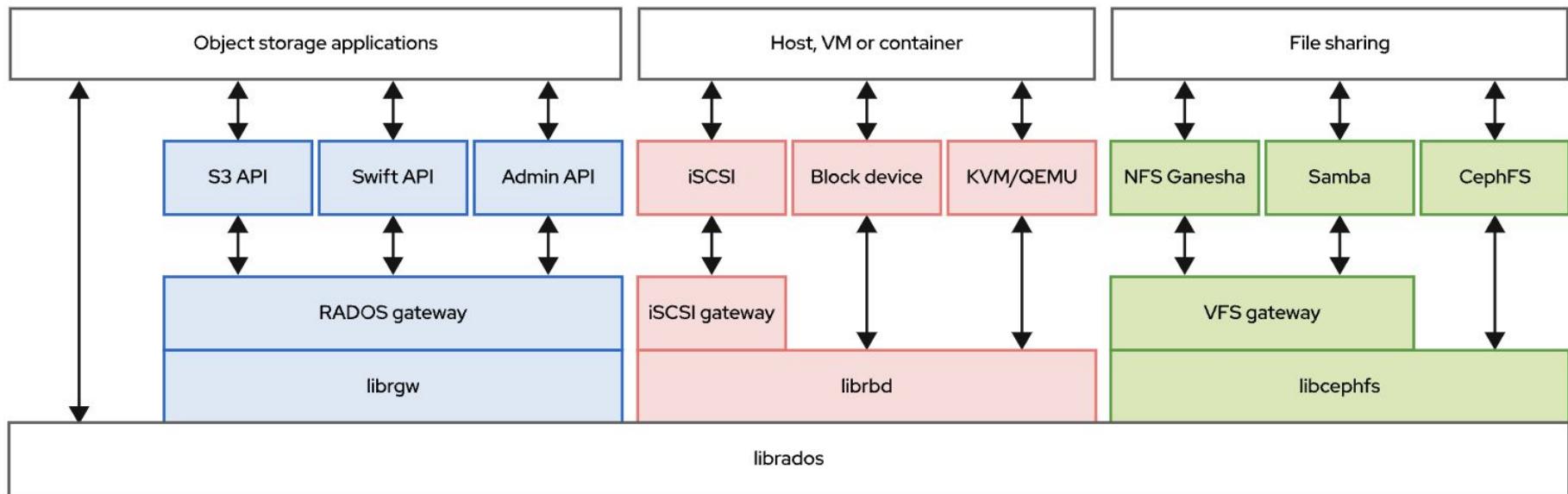


CONTAINER
STORAGE
INTERFACE

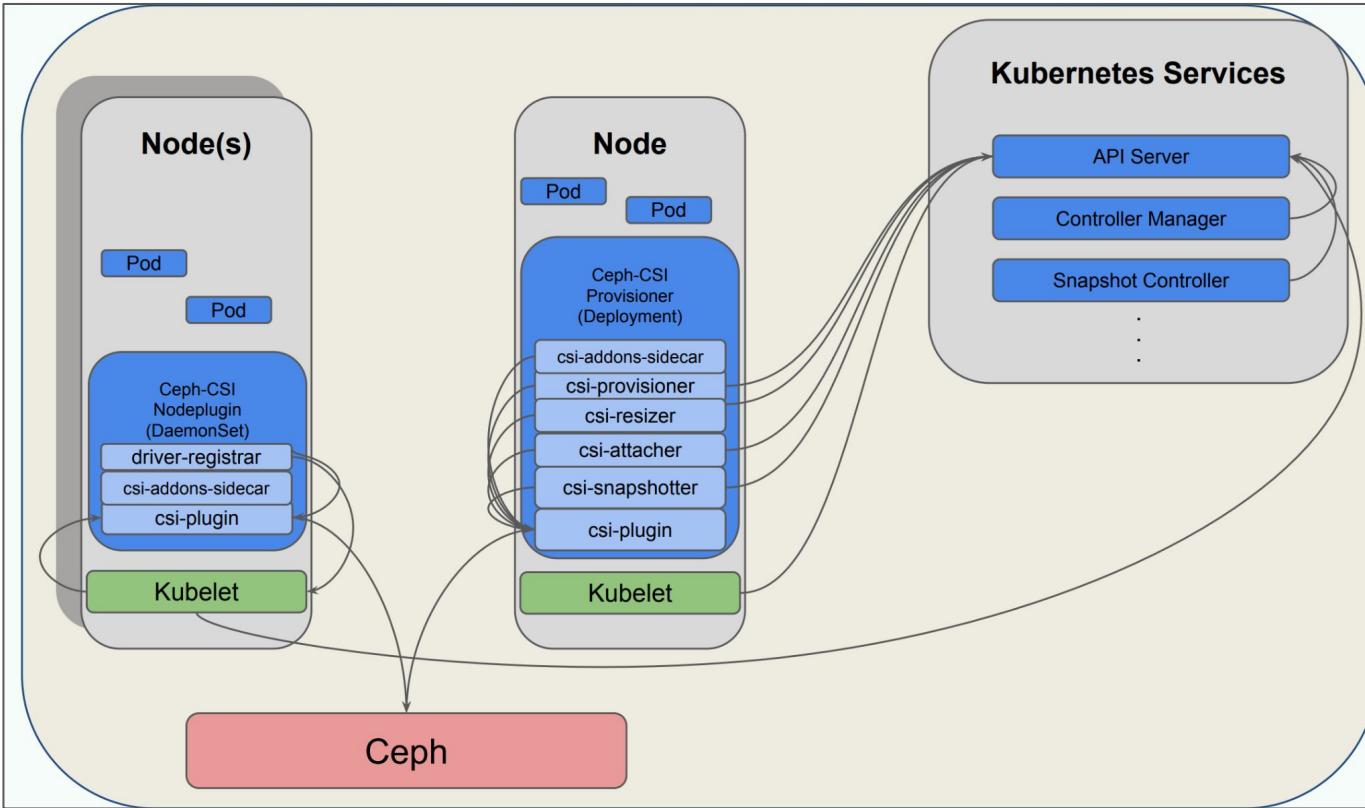
- CEPH is an open source, massively scalable, intelligent, reliable and highly available distributed software defined storage solution
- It is an all in one unified storage system, supporting
 - Object Storage: RADOS GATEWAY (RGW)
 - Block storage: RADOS Block Device (RBD)
 - Filesystem: Ceph Filesystem (CephFS)



CEPH Components



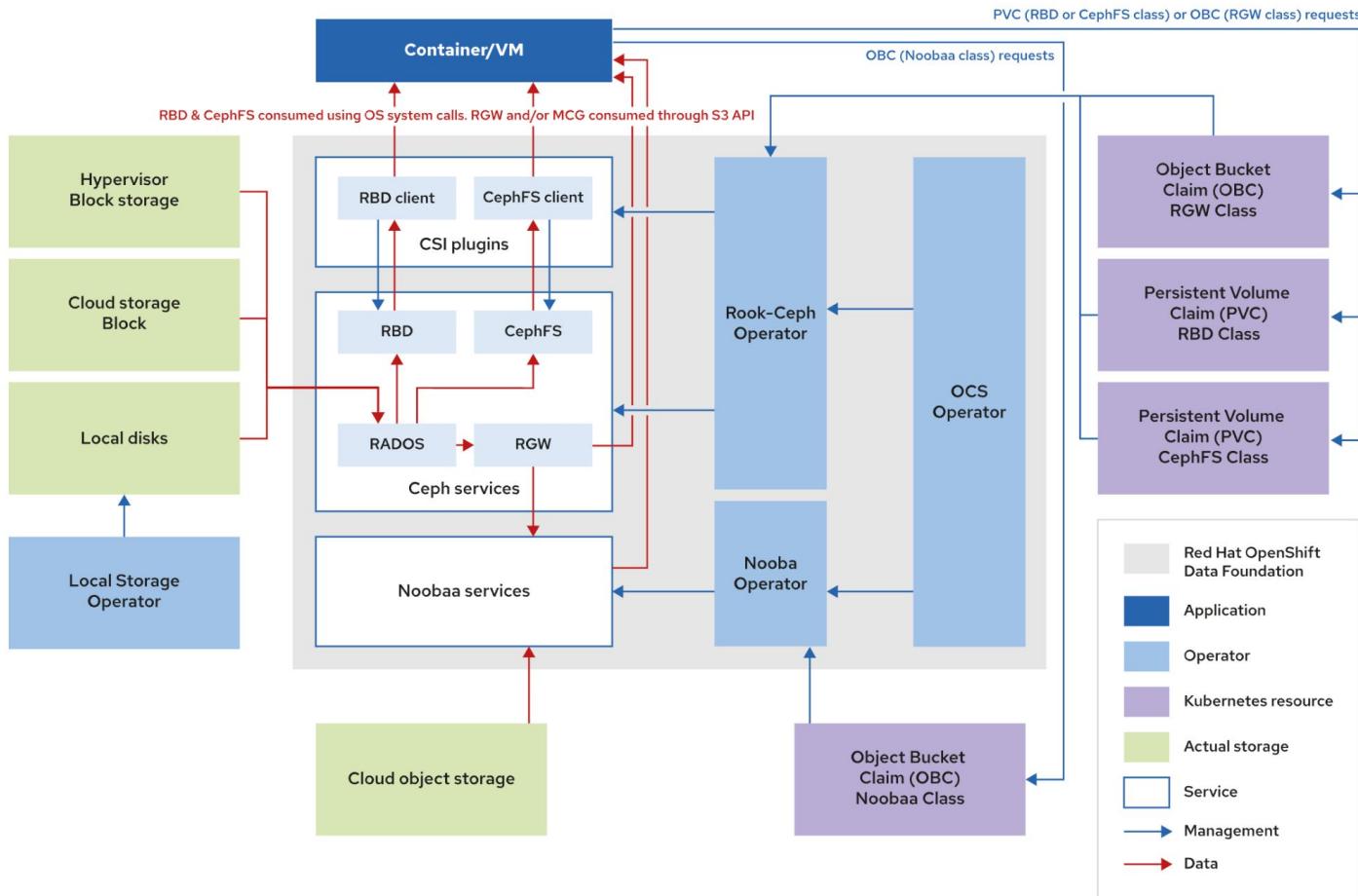
CEPH CSI

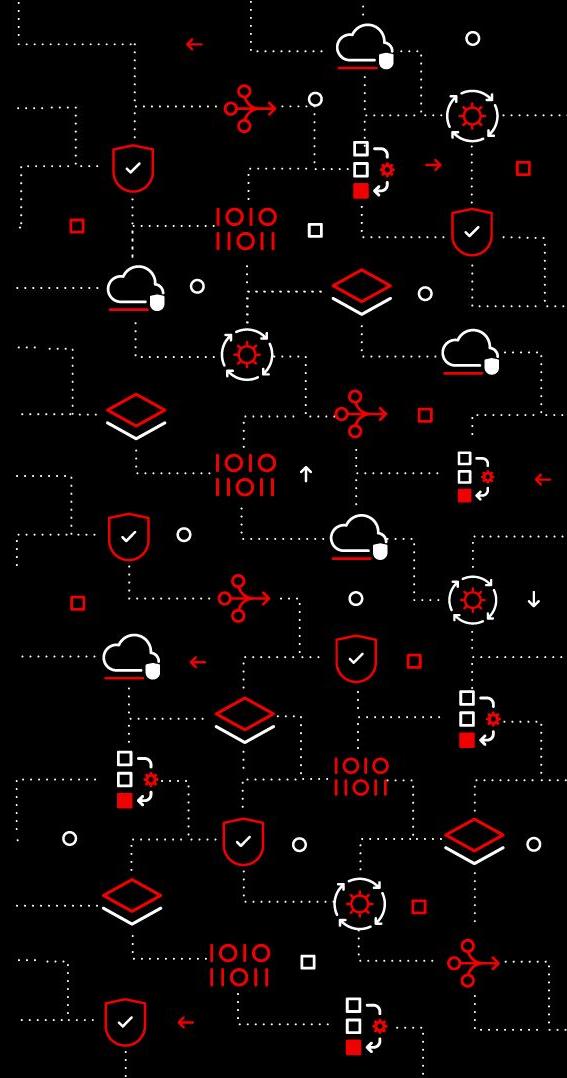


CEPH CSI Driver:

- **Provisioner Deployment**
 - For Volume / Snapshot Creation, Expansion and Deletion
 - Usually deployed with count 2 and leader election enabled for HA
- **Nodeplugin Daemonset**
 - For Volume Mounting and Unmounting
 - Deployed one per node

OpenShift Data Foundation Architecture Overview



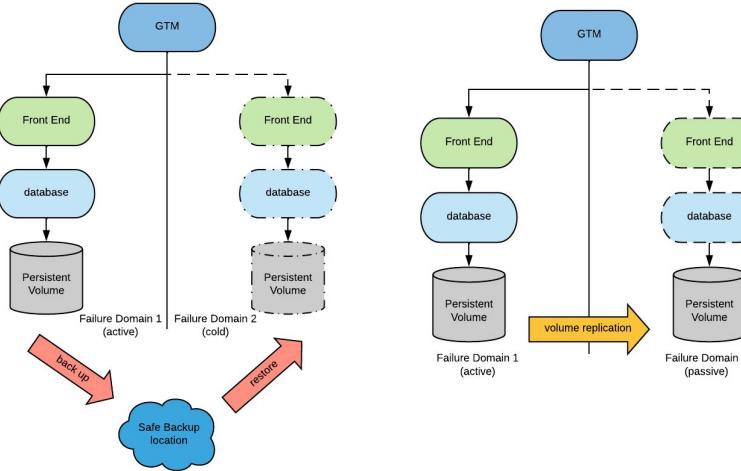


DR / HA

High-level DR Approaches

Failure Domain is either a data center or a cloud region

Active/Passive



Backup / Restore

RPO \approx frequency of backup
RTO \approx hours

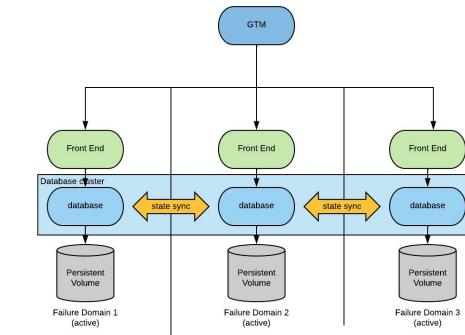
Storage-layer Replication

- Asynchronous:
 - RPO \approx unbounded (typically ms)
 - RTO \approx typically minutes *
- Synchronous:
 - RPO = 0
 - RTO \approx typically minutes*

Application-layer Replication

- Asynchronous:
 - RPO \approx unbounded (typically ms)
 - RTO \approx typically minutes *
- Synchronous:
 - RPO = 0
 - RTO \approx typically minutes*

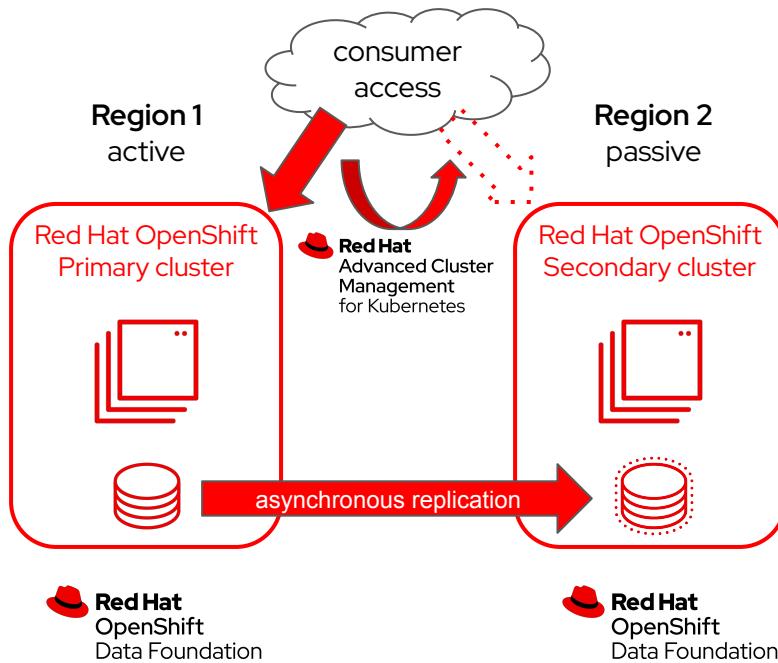
Active/Active



Distributed Stateful Workloads

- Strong Consistency:
 - RPO = 0
 - RTO \approx seconds
- Eventual Consistency (**)
 - RPO \approx 0
 - RTO \approx seconds

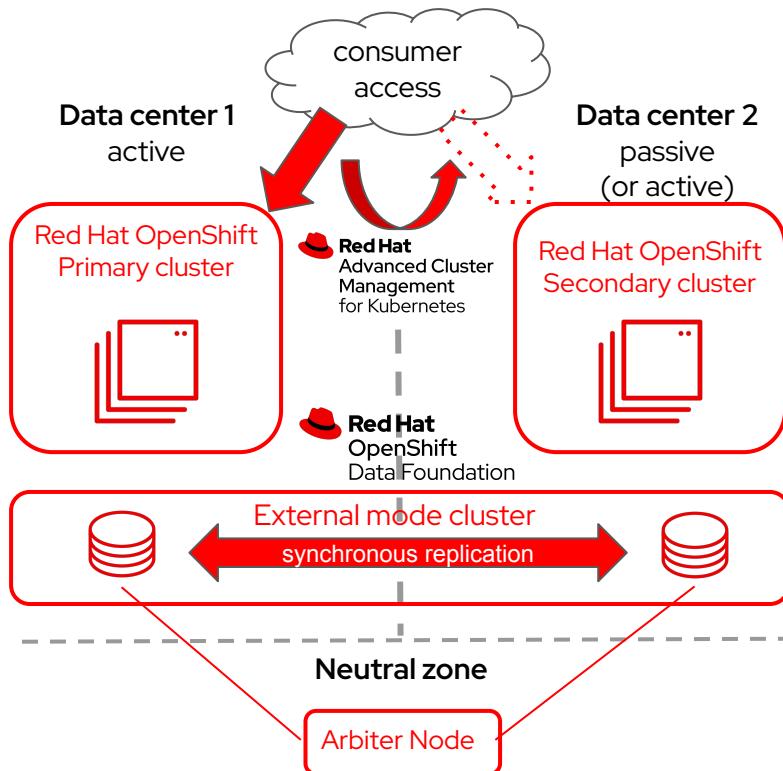
Red Hat OpenShift-Regional Disaster Recovery



Protection against geographic scale disasters

- ▶ OpenShift Data Foundation enables cross cluster replication of data volumes
- ▶ Storage operators synchronize both volume persistent data and kubernetes metadata
- ▶ Enables failover and fallback automation at application granularity, orchestrated by Red Hat Advanced Cluster Management

Red Hat OpenShift-Metropolitan Disaster Recovery

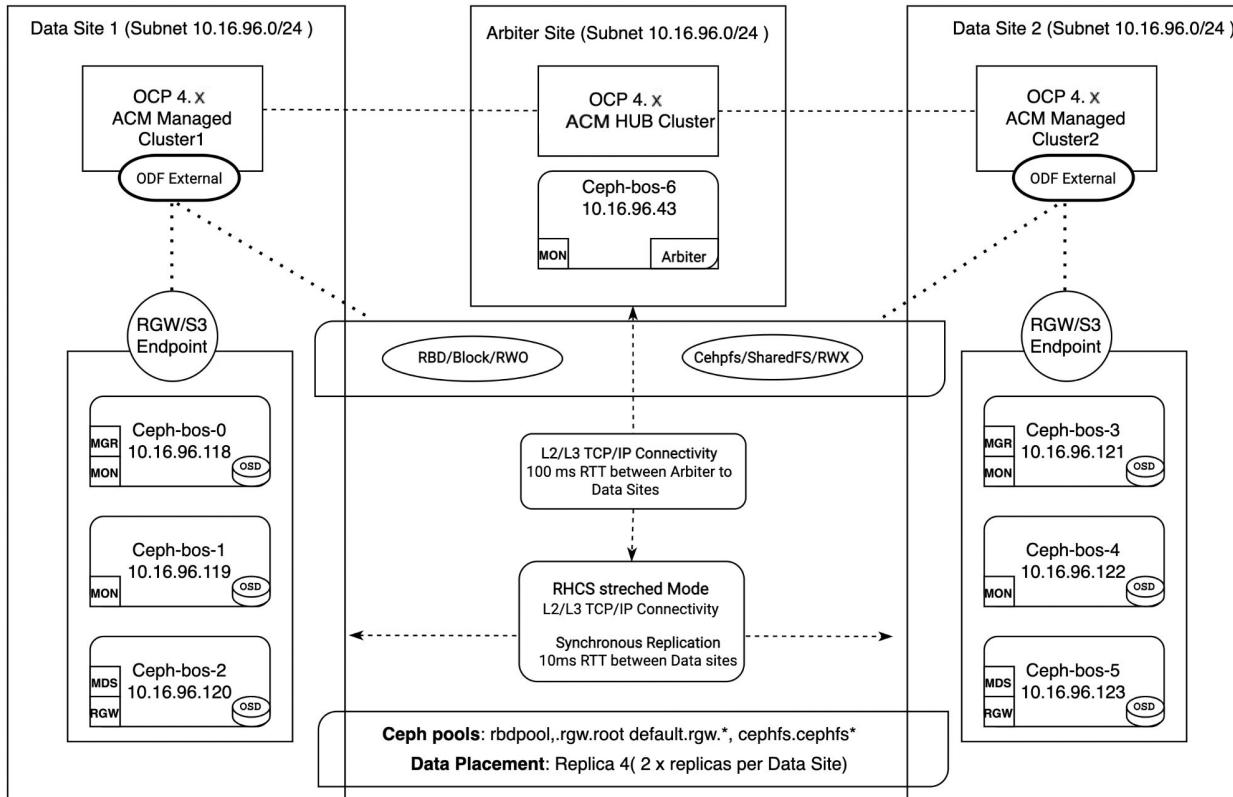


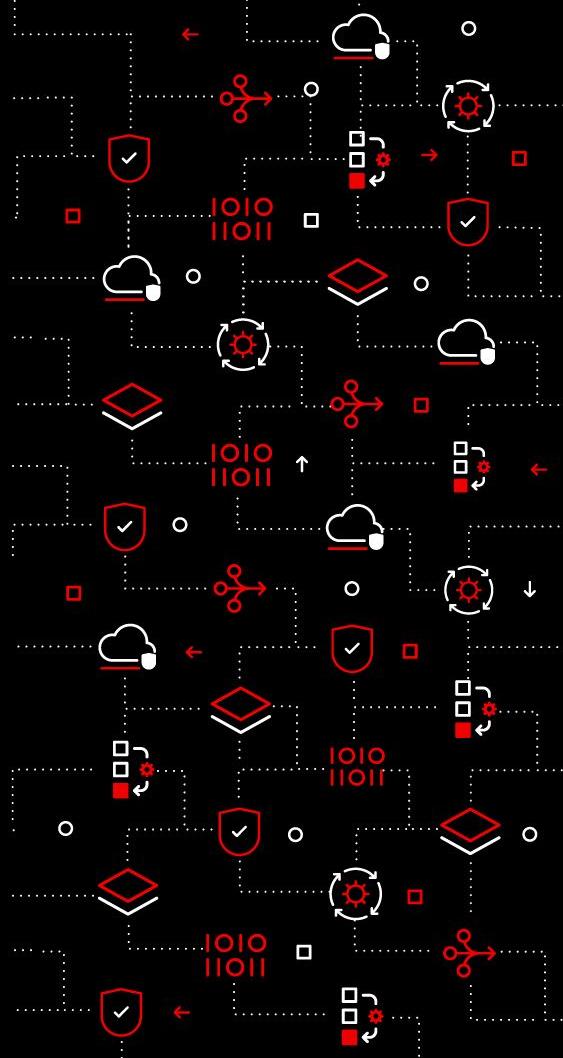
Protection against data loss across multiple clusters with Metropolitan disaster recovery

- ▶ Clusters deployed in different datacenters provide a fault isolated configuration
- ▶ External mode OpenShift Data Foundation cluster provides synchronous replicated volumes across the datacenters
- ▶ Enables failover and fallback automation at application granularity, orchestrated by Red Hat Advanced Cluster Management

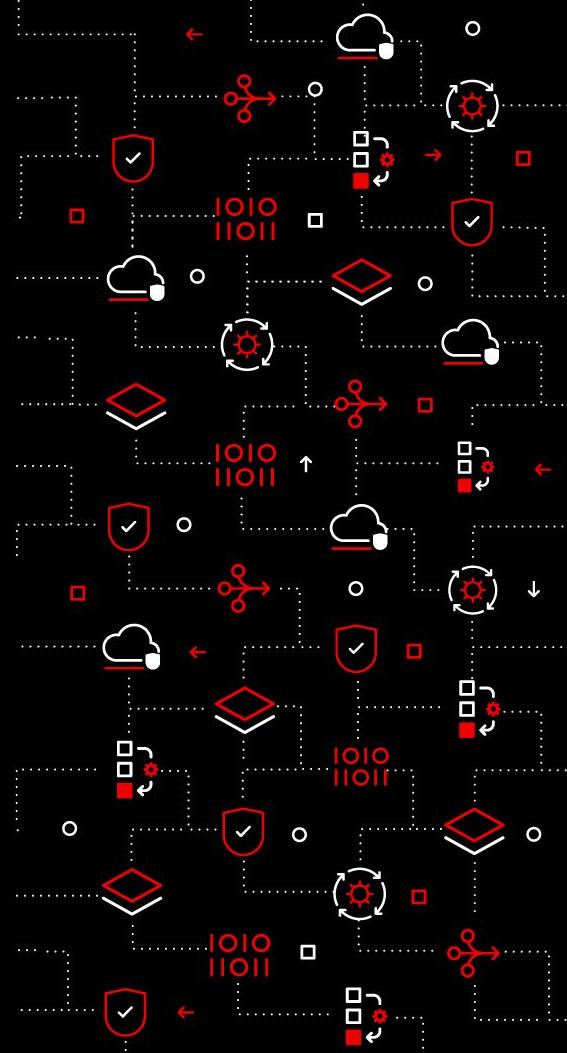
Disaster Recovery for Red Hat OpenShift workloads

Stretched Ceph Storage Deployment Architecture



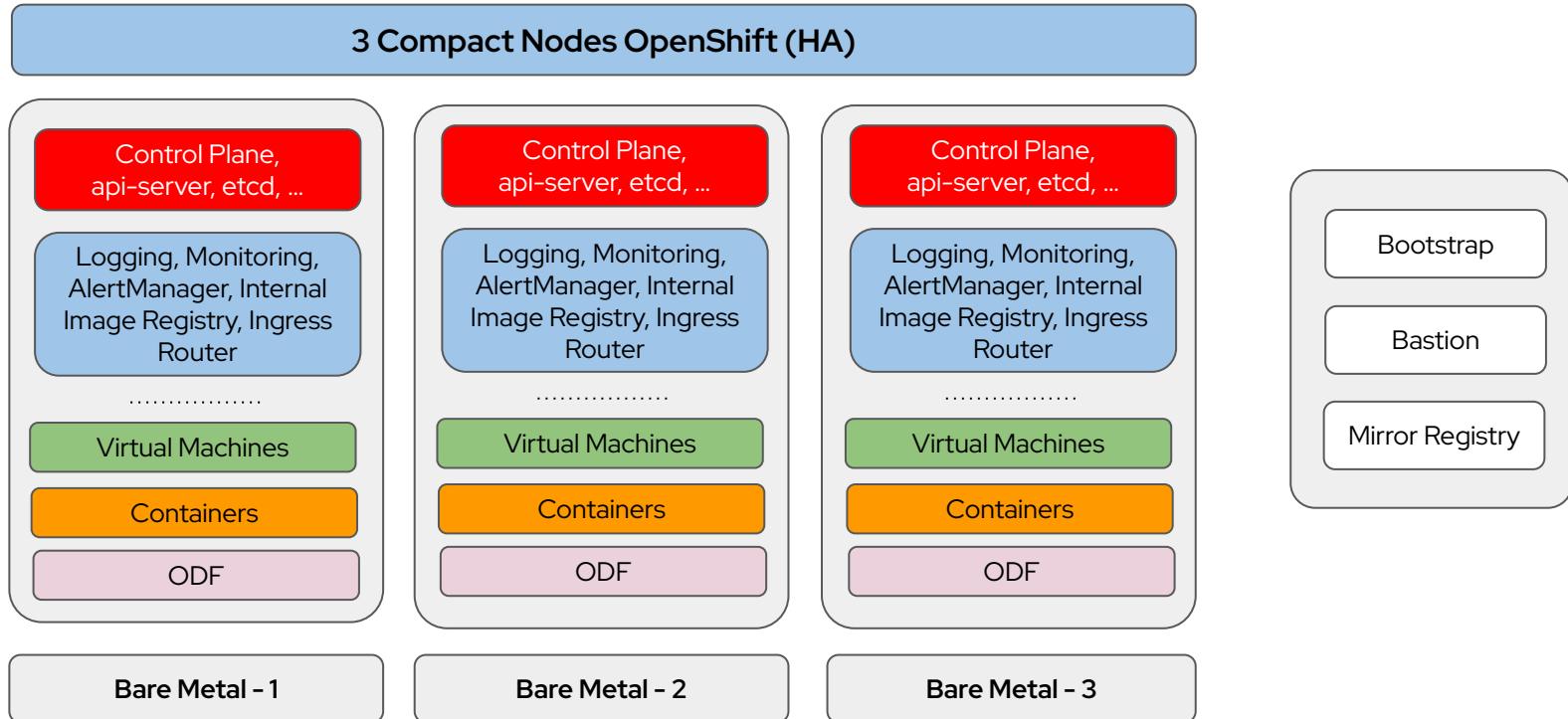


BREAK
till 11:30 CEST

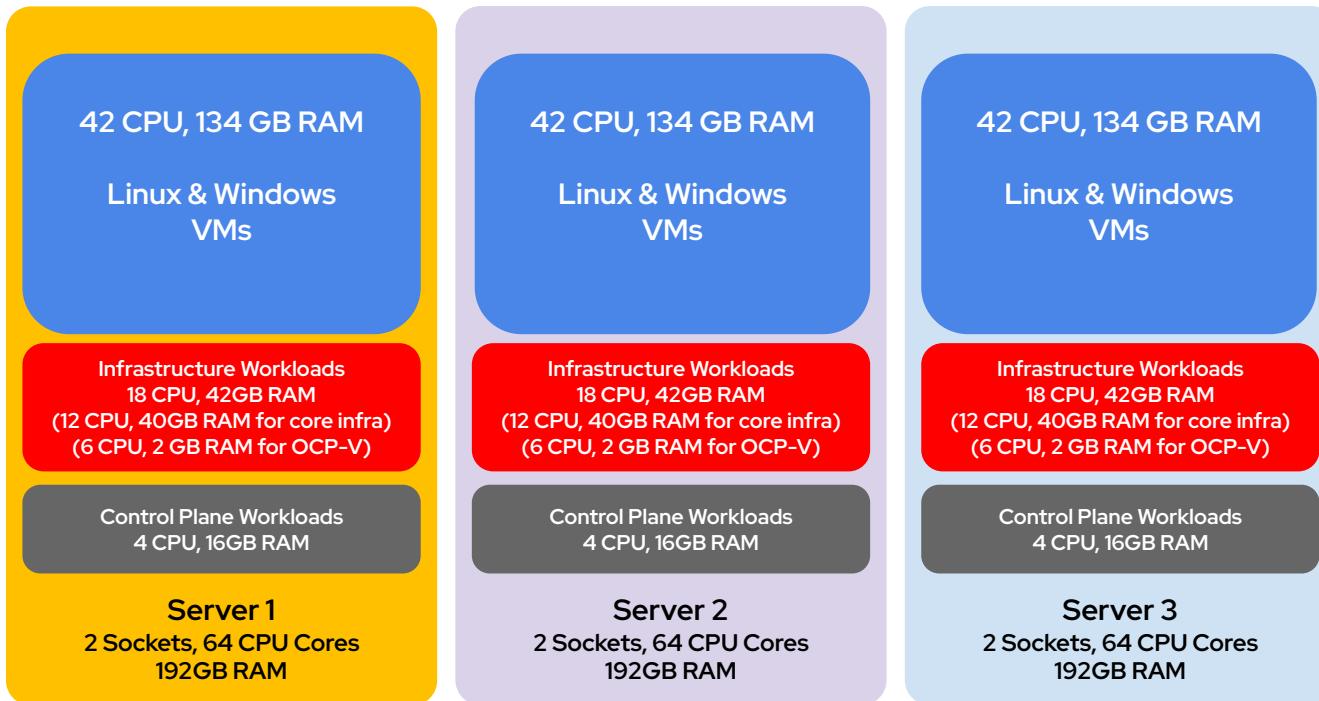


Sample Server Specifications

Minimal Deployment Architecture (3 Nodes Compact)

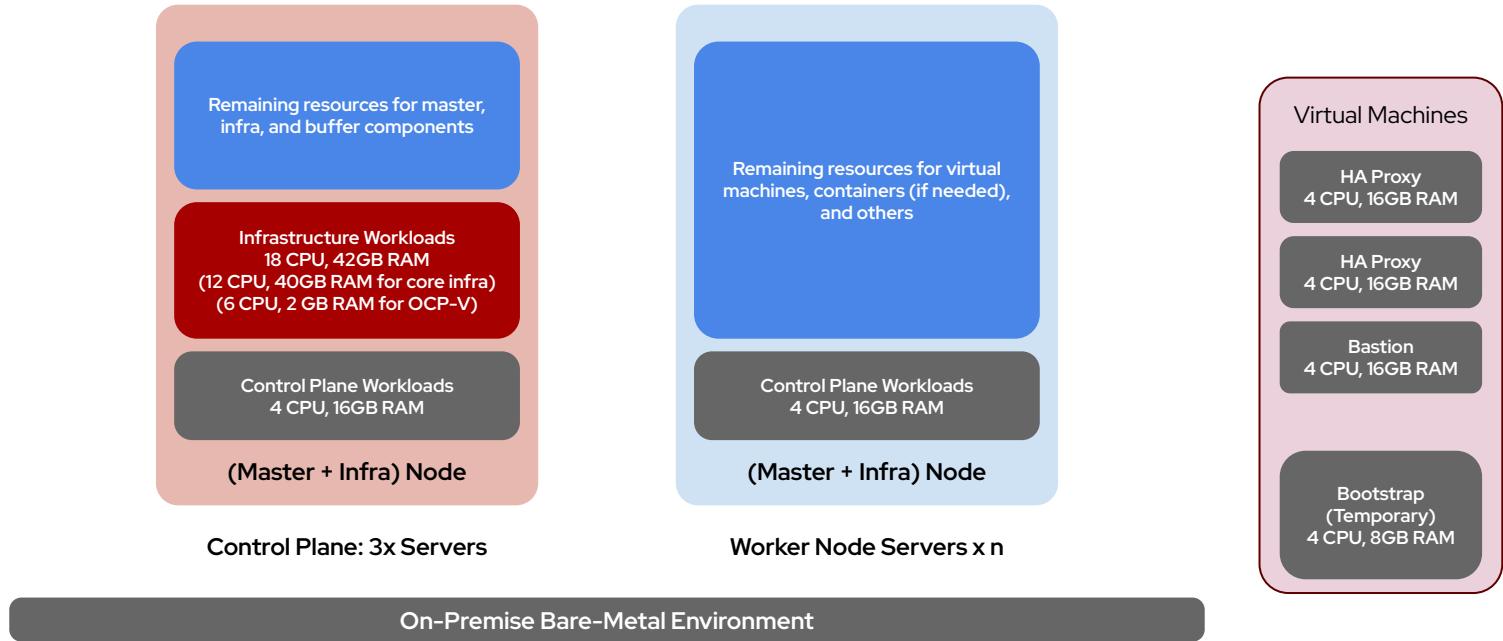


Baseline Production Workload Requirements

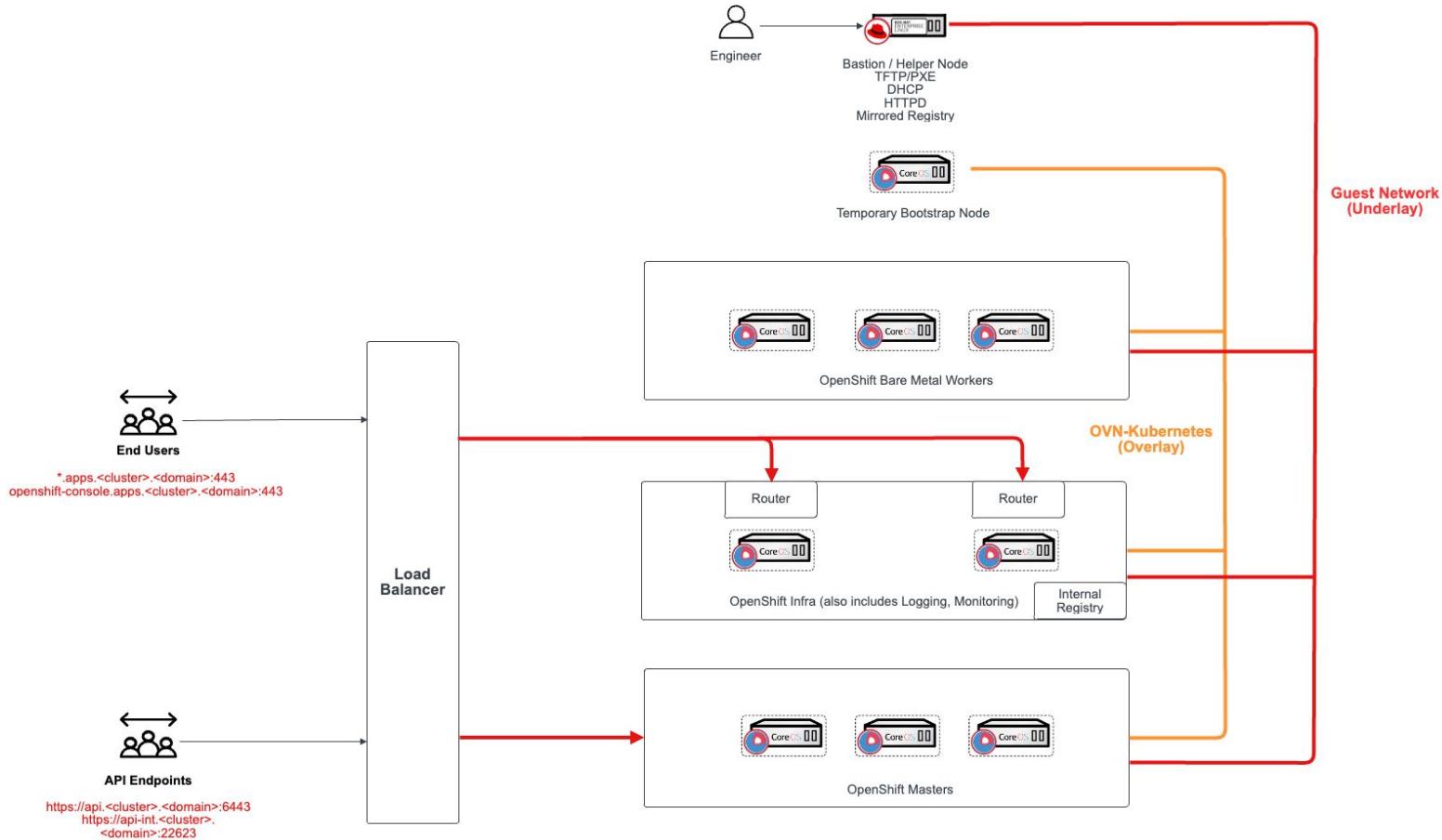


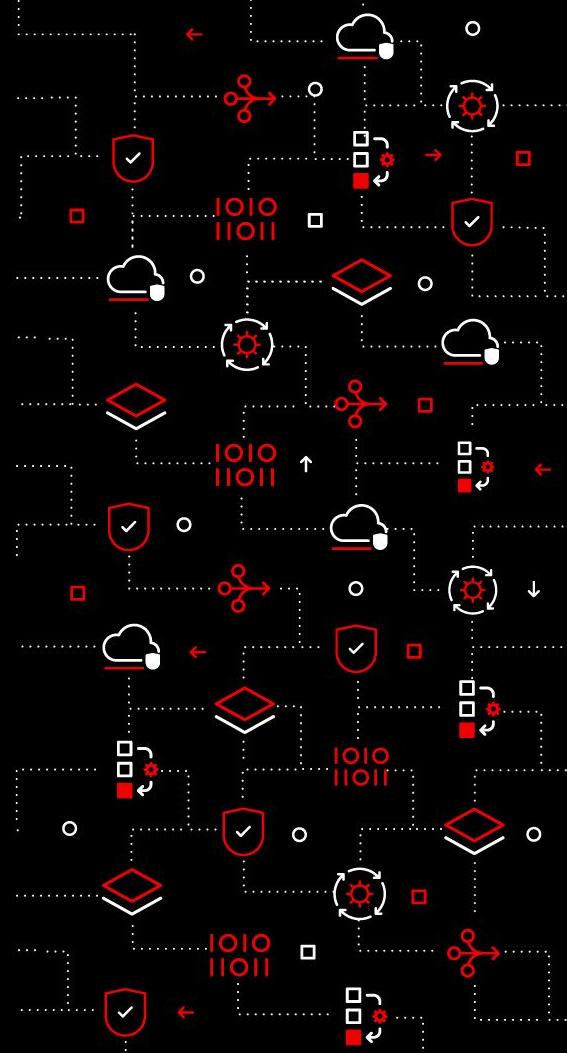
OpenShift 3-Node Compact Cluster Configuration (Bare-Metal)

Alternative/Larger Production Workload Requirements



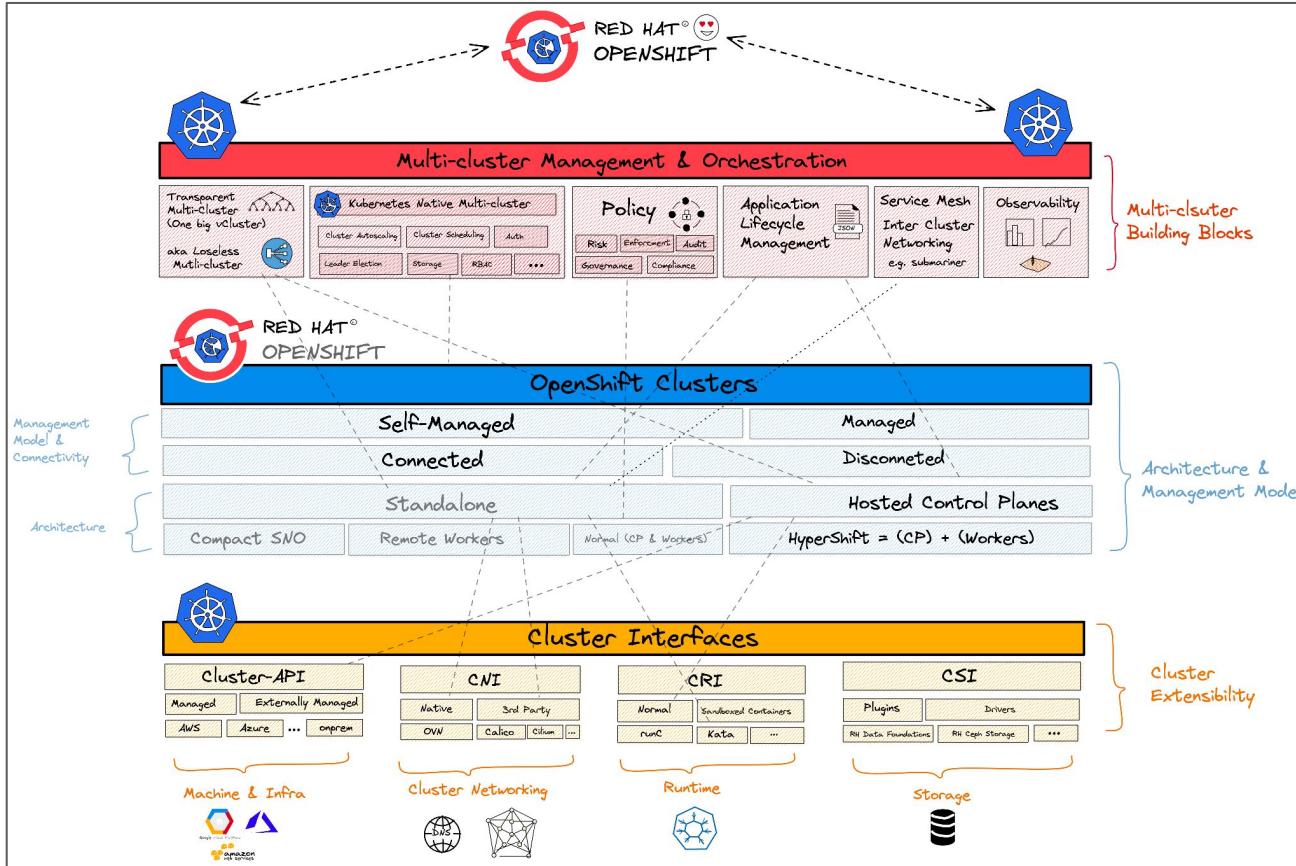
Sample Full Cluster Logical Layout





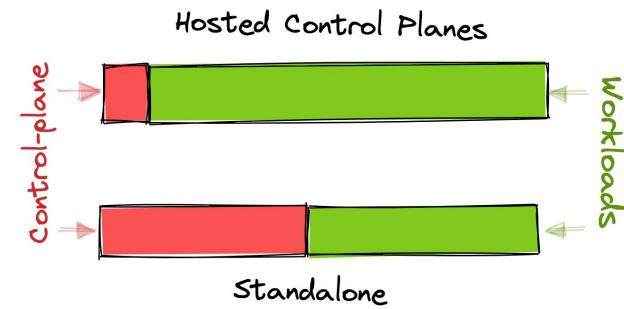
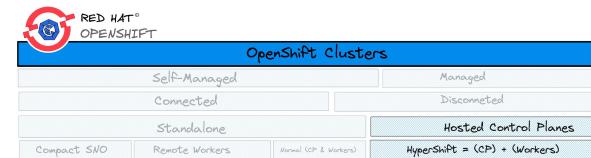
Hosted Control Plane

The Big Picture - Dream Maker (aka OpenShift) Tech Stack

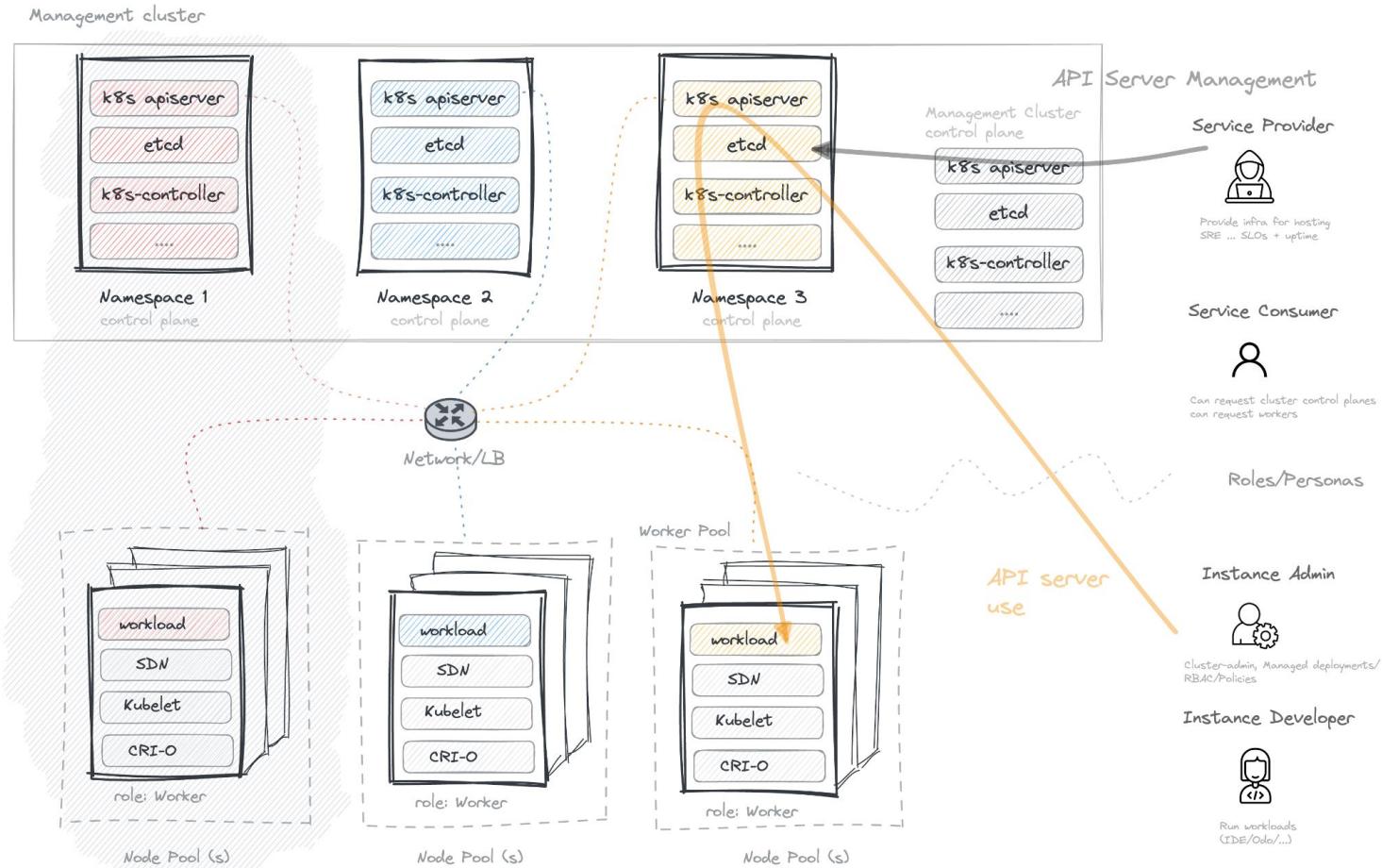


Hosted Control Planes (HCP)

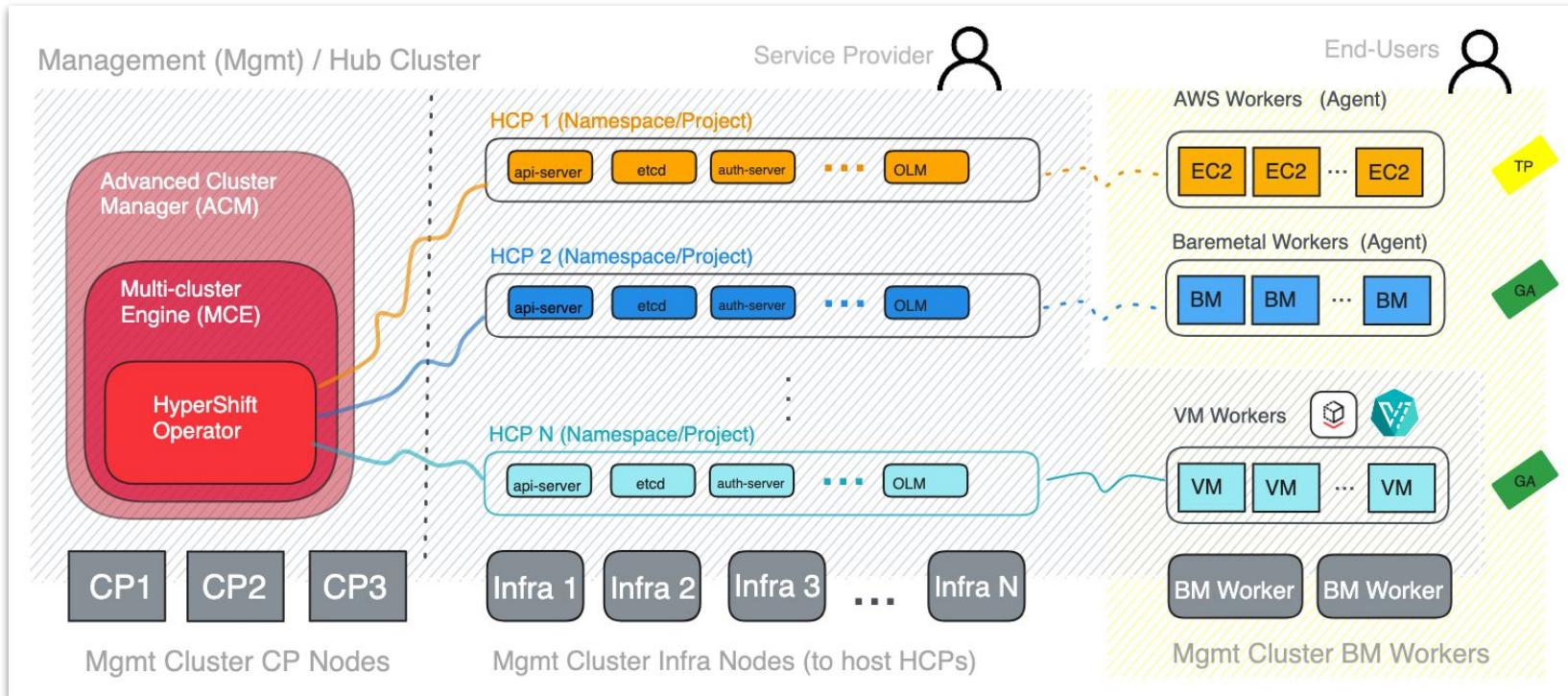
- An **OpenShift** Topology
- Service for **hosting OpenShift control planes at scale**
- Solves for **cost** and **time to provision**
- Portable **across clouds**
- Provides **strong separation of concerns** between management and workloads.



Platform / Tenant segregation with HCP



Hosted Control Plane



Utilizing OpenShift Virtualization to Consolidate OpenShift Clusters

Hosted Control Planes with KubeVirt provider



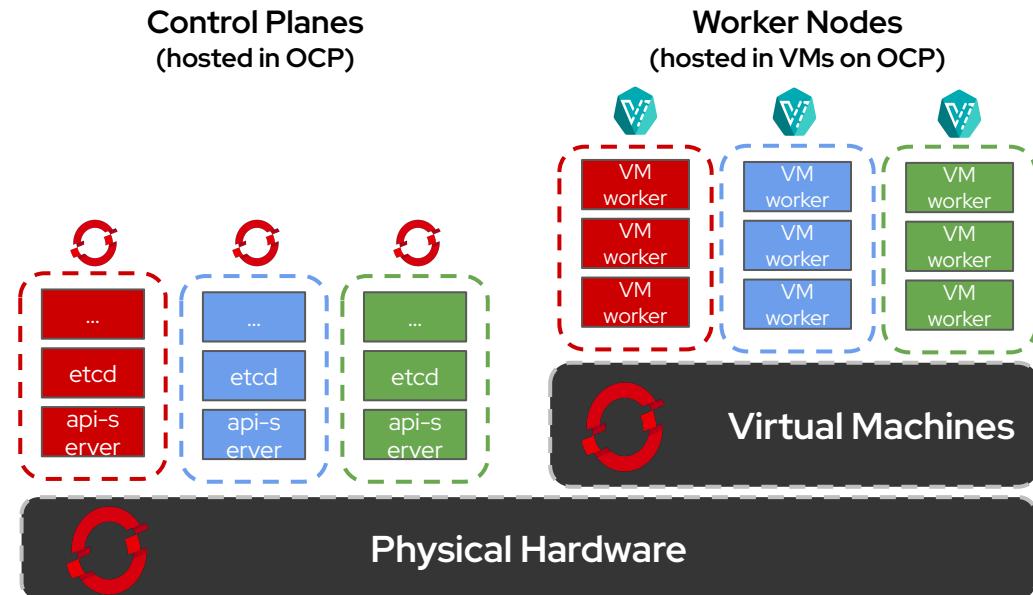
Increase Utilization of Infrastructure

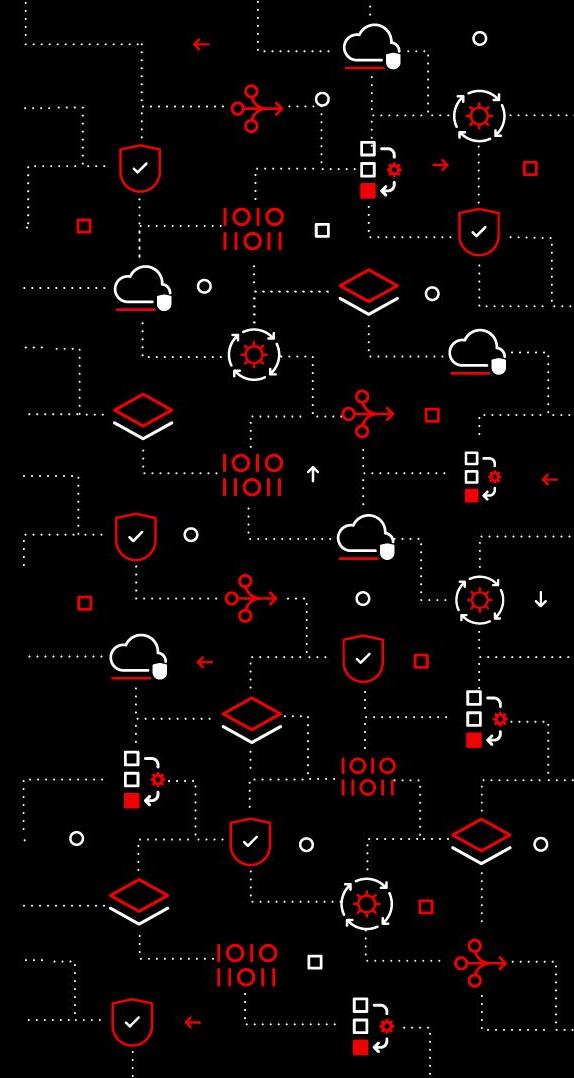
- Consolidate multiple control planes to reduce unused and underutilized infrastructure
- Increase bare metal node utilization by hosting virtual worker nodes for multiple clusters



Reduce Dependency on Legacy Virtualization

- Eliminate the need to have legacy hypervisor layer to host your containerized infrastructure
- Underlying virtualization layer is included with hosted OpenShift cluster entitlements

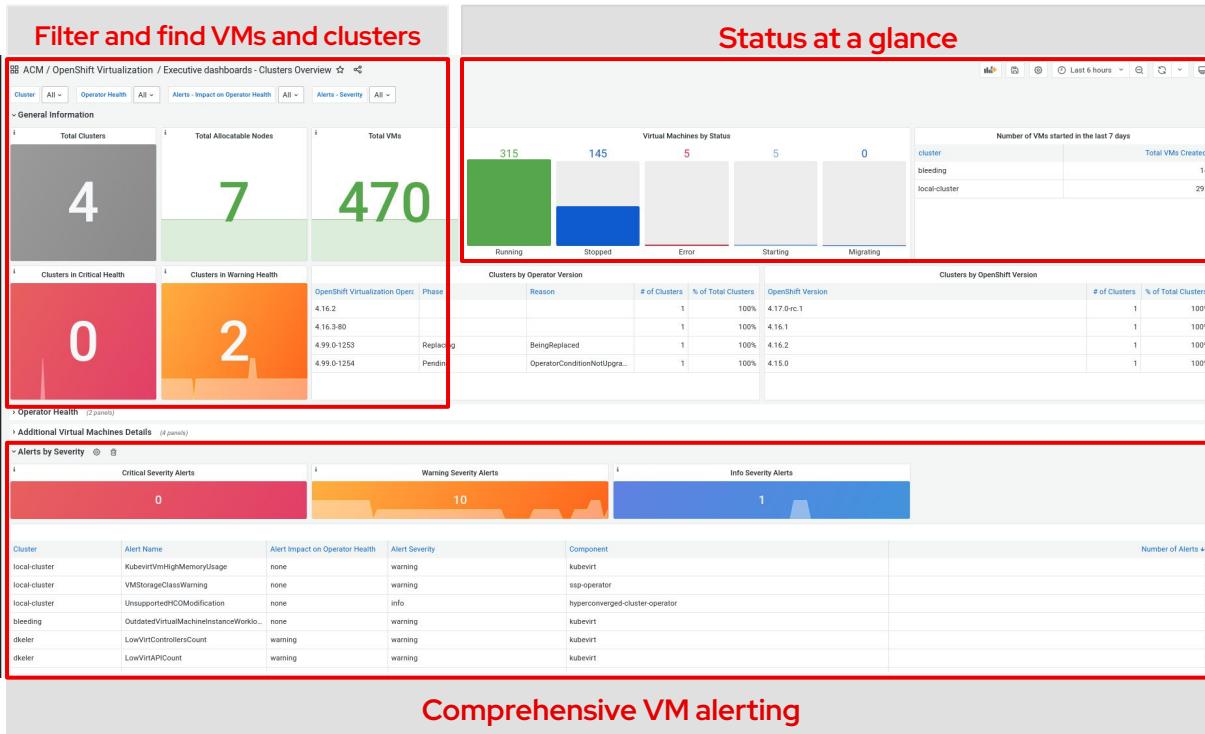




OpenShift Platform Plus & Advanced Cluster Management for Kubernetes (ACM)

OpenShift Virtualization & RHACM

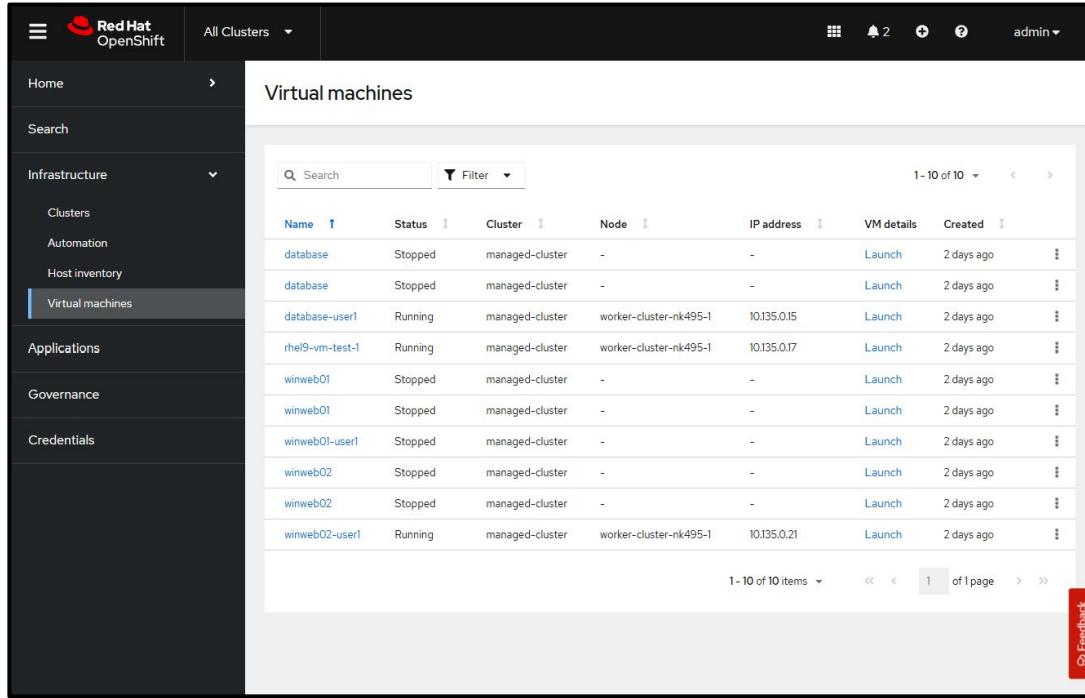
Multi-Cluster Virtual Machine Observability with RHACM



- ▶ Comprehensive set of dashboards addressing important use cases
 - ▶ Flexible Single VM/Single-Cluster view versus Multi VM/MultiCluster view
 - ▶ Based on a rich set of metrics to retrieve valuable status of individual VM's and inventories
 - ▶ GA with OCP-V 4.17 & RHACM 2.12

OpenShift Virtualization & RHACM

Direct VM View from RHACM Console



The screenshot shows the Red Hat OpenShift Virtualization & RHACM console interface. The left sidebar has a dark theme with the following navigation items:

- Home
- Search
- Infrastructure
 - Clusters
 - Automation
 - Host inventory
 - Virtual machines** (selected)
- Applications
- Governance
- Credentials

The main content area is titled "Virtual machines" and displays a table of 10 items. The table columns are: Name, Status, Cluster, Node, IP address, VM details, and Created. The data is as follows:

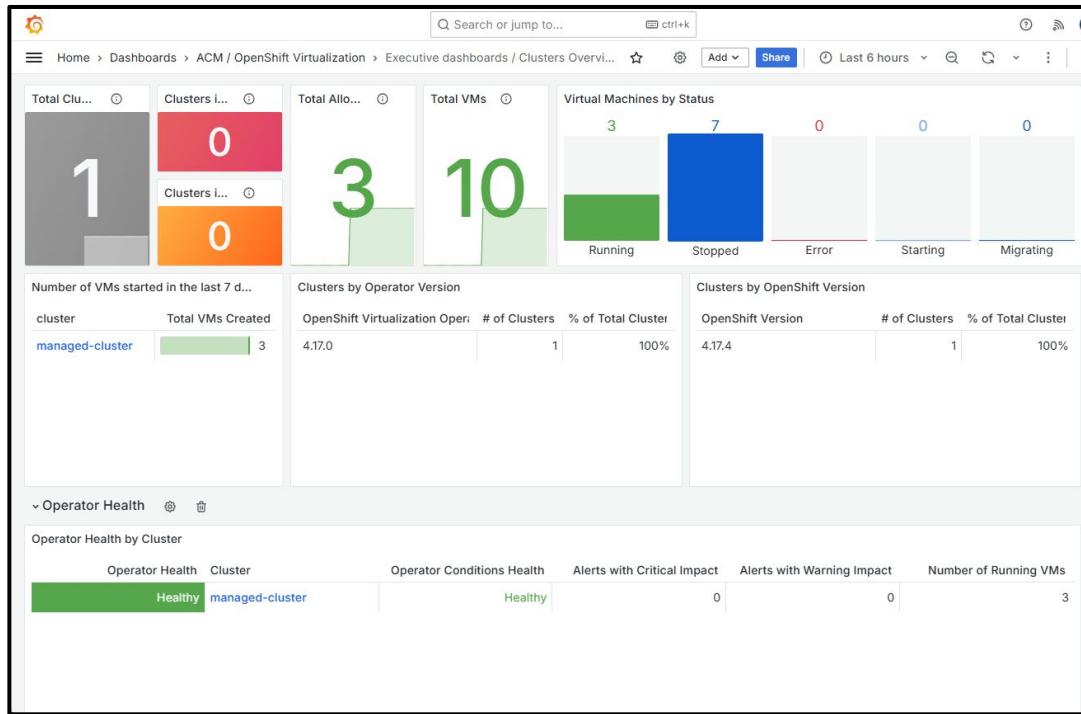
Name	Status	Cluster	Node	IP address	VM details	Created
database	Stopped	managed-cluster	-	-	Launch	2 days ago
database	Stopped	managed-cluster	-	-	Launch	2 days ago
database-user1	Running	managed-cluster	worker-cluster-nk495-1	10.135.0.15	Launch	2 days ago
rhel9-vm-test-1	Running	managed-cluster	worker-cluster-nk495-1	10.135.0.17	Launch	2 days ago
winweb01	Stopped	managed-cluster	-	-	Launch	2 days ago
winweb01	Stopped	managed-cluster	-	-	Launch	2 days ago
winweb01-user1	Stopped	managed-cluster	-	-	Launch	2 days ago
winweb02	Stopped	managed-cluster	-	-	Launch	2 days ago
winweb02	Stopped	managed-cluster	-	-	Launch	2 days ago
winweb02-user1	Running	managed-cluster	worker-cluster-nk495-1	10.135.0.21	Launch	2 days ago

At the bottom right of the main area, there is a red "Feedback" button.

- ▶ Direct, straightforward view of virtual machine status across all managed clusters
- ▶ View name, VM status, hosted cluster, hosted node, IP address
- ▶ Access VM(s) directly from RHACM
- ▶ GA with OCP-V 4.17 & RHACM 2.12

VM Focused Observability with RHACM

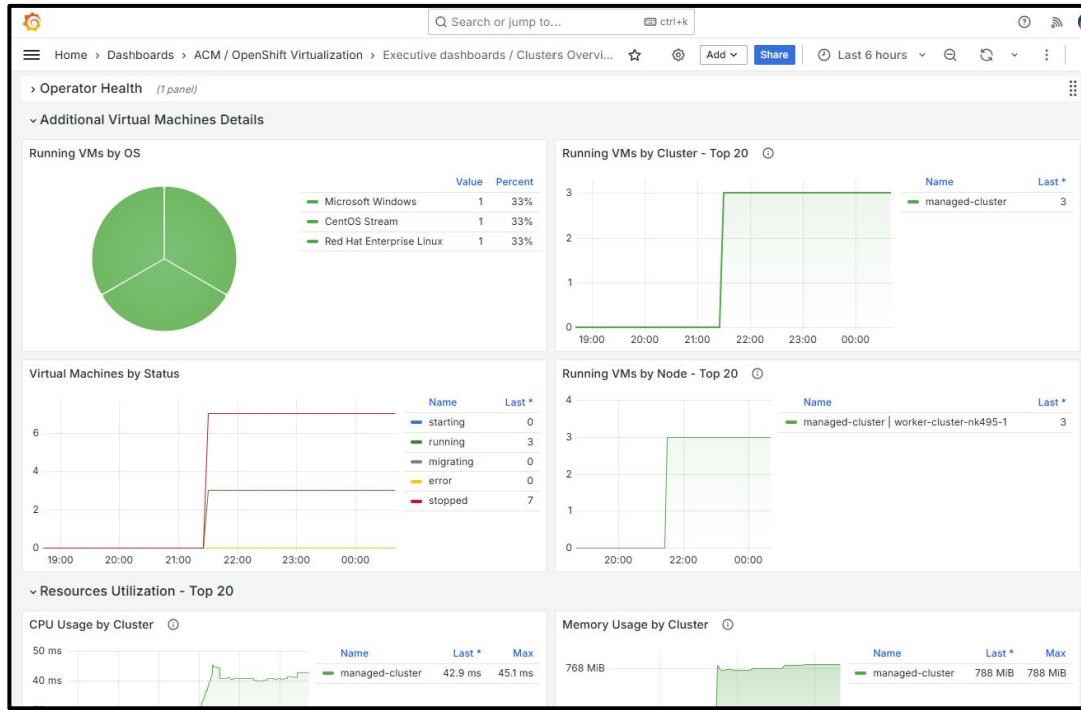
Advanced & Customizable Grafana Dashboard



- ▶ Centralized, VM-centric, command view of all clusters
- ▶ Total cluster & node quantity & their health status
- ▶ Total VM quantity & health
- ▶ Breakdown of cluster & operator version
- ▶ OCP-V operator health in each cluster & breakdown of alerts
- ▶ GA with OCP-V 4.17 & RHACM 2.12

VM Focused Observability with RHACM

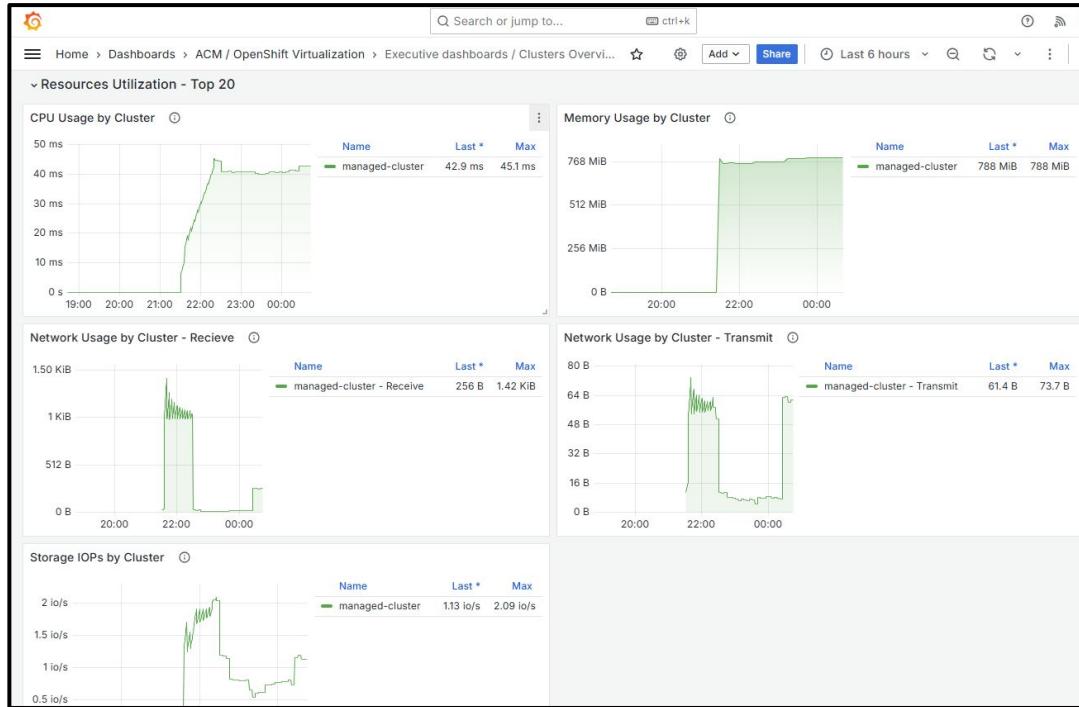
Advanced & Customizable Grafana Dashboard



- ▶ Breakdown of all virtual machines by OS, cluster(s) & nodes
- ▶ Detailed breakdown & time-graph of virtual machine state
- ▶ GA with OCP-V 4.17 & RHACM 2.12

VM Focused Observability with RHACM

Advanced & Customizable Grafana Dashboard



- ▶ Detailed time-graph of cluster resource utilization & trends
- ▶ Default covers CPU, memory, network, and storage IOPS use
- ▶ GA with OCP-V 4.17 & RHACM 2.12

OpenShift Kubernetes Engine (OKE) vs OpenShift Container Platform (OCP)

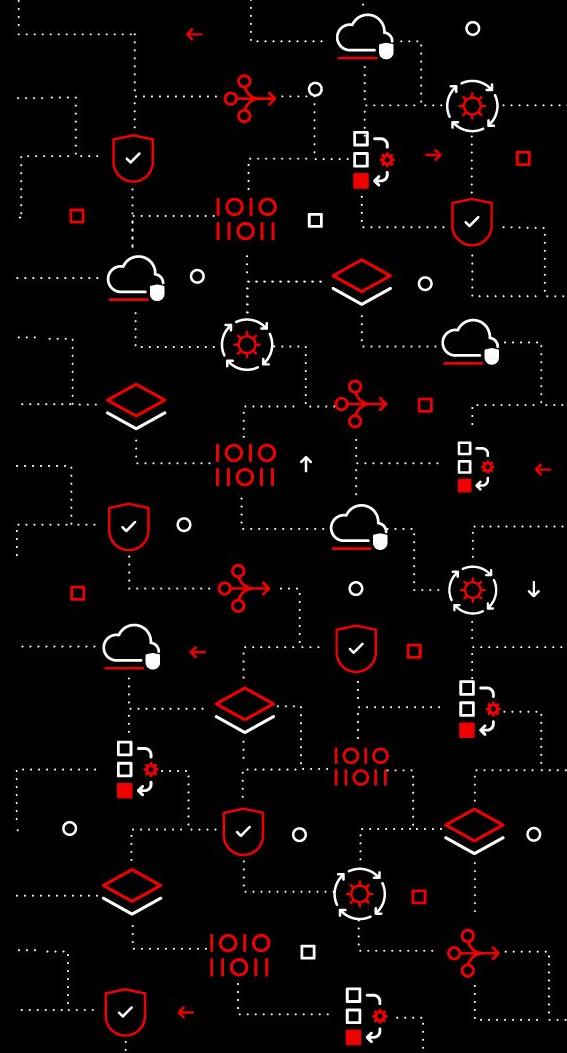
	OpenShift Kubernetes Engine (OKE)	OpenShift Container Platform (OCP)	OpenShift Container Platform Platform Plus (OPP)
Fully Automated Installers	✓	✓	✓
Over the Air Smart Updates	✓	✓	✓
Enterprise Secured Kubernetes	✓	✓	✓
Kubectl and oc automated command line	✓	✓	✓
Operator Lifecycle Manager (OLM)	✓	✓	✓
Administrator Web Console	✓	✓	✓
OpenShift Virtualization	✓	✓	✓
Cluster Monitoring	✓	✓	✓
Cost Management SaaS Services	✓	✓	✓

OpenShift Kubernetes Engine (OKE) vs OpenShift Container Platform (OCP)

	OpenShift Kubernetes Engine (OKE)	OpenShift Container Platform (OCP)	OpenShift Container Platform Plus (OPP)
User Workload Monitoring	✗	✓	✓
Platform Logging	✗	✓	✓
Developer Web Console	✗	✓	✓
Developer Application Catalog	✗	✓	✓
Source to Image and Builder Automation (Tekton)	✗	✓	✓
OpenShift Service Mesh (Maistra, Kiali and Jaeger)	✗	✓	✓
OpenShift Distributed tracing (Jaeger)	✗	✓	✓
OpenShift Serverless (Knative)	✗	✓	✓
OpenShift Pipelines (Jenkins and Tekton)	✗	✓	✓

OpenShift Kubernetes Engine (OKE) vs OpenShift Container Platform (OCP)

	OpenShift Kubernetes Engine (OKE)	OpenShift Container Platform (OCP)	OpenShift Container Platform Plus (OPP)
Embedded Component of IBM Cloud Pak and RHT MW Bundles	✗	✓	✓
OpenShift sandboxed containers	✗	✓	✓
Red Hat Advanced Cluster Management for Kubernetes	✗	✗	✓
Red Hat Advanced Cluster Security for Kubernetes	✗	✗	✓
Red Hat Quay	✗	✗	✓
Red Hat OpenShift Data Foundation	✗	✗	✓



Lunch Break till
13:30 CEST

Agenda

9:30 Welcome and Intro

9:45 OCP Virt Overview

10:30 Deeper into the Technologie (storage / Networking)

11:15 LABTIME (1)

11:30 BREAK

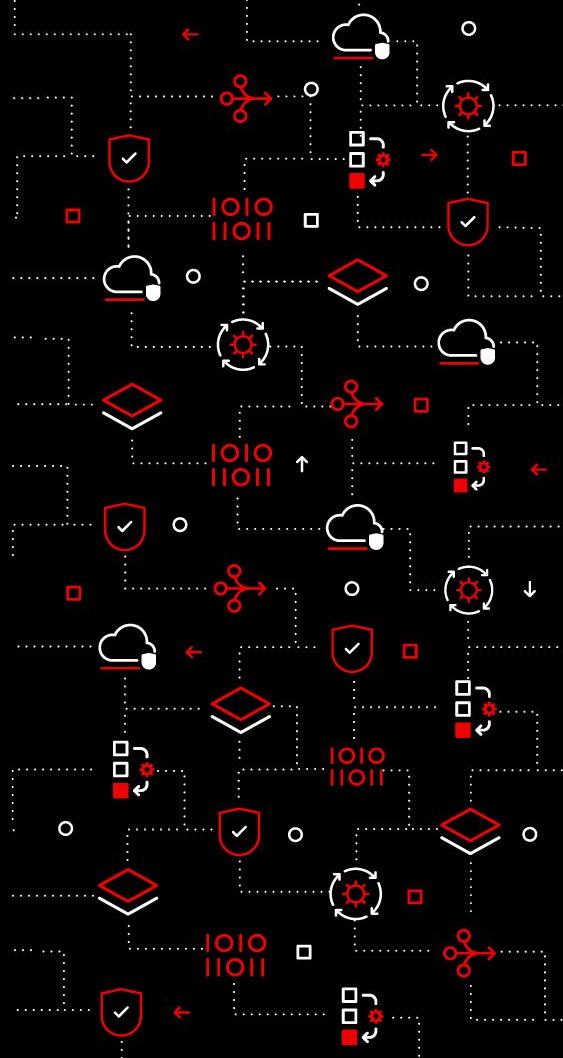
11:15 Server Configurations and HostetControlPlane & ACM

12:30 LUNCH BREAK

13:30 Guidelines and Considerations for Migration

14:15 Partner Ecosystem

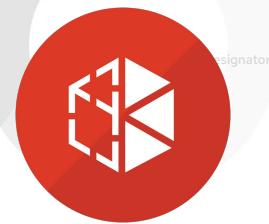
15:00 Q&A



Guidelines and Considerations for Migration

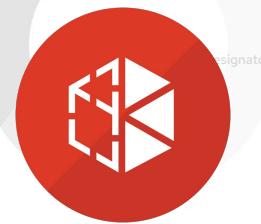
Modernization Strategies

Strategy	Definition / Example	Time	Migration Cost	Operational Cost	Business Benefit
Retire	Sunsetting the application.				
Retain	Continue running the application as-is.				
Rehost	Migrating an application as-is to a new platform. Example: Migrating virtual machines as is to a new virtualization platform.				
Replatform	Making optimizations to the application that do not require re-architecture or significant code changes in order to achieve business or technical benefits. Example: Migrating an application into a container				
Refactor	Changing how an application is developed and/or architected, typically to be more cloud-native. Example: Strangling a monolith into microservices.				
Repurchase	Moving to SaaS or Replacing portions of an application with as a service offerings. Example: Consuming Kafka as a Service within an existing application.				



Workloads to go with

- Generally all legacy applications are fine:
 - ✓ Application servers
 - ✓ Java applications
 - ✓ Windows applications
 - ✓ ...
- VMs that will be split up into microservices/containers:
 - ✓ paving the path to an Infrastructure Migration Journey
- VMs that have no special requirements:
 - ✓ everything that needs special attention (e.g. realtime kernel) has to be discussed and tested, although it is likely to work



Workloads to Avoid

- Oracle DB
 - No certification so far. Licensing concerns.
- SAP HANA
 - No certification so far. Licensing concerns.
- VDI (Virtual Desktop)
 - Currently not supported. Partnership with Citrix; ongoing testing at the moment.
- Uncertified workloads
 - All workloads which are not sufficiently certified with KVM/libvirt
- Not configurable workloads
 - e.g. VMs where the libvirt XML has to be patched before starting the VM as a lack of proper config options

Is my virtual machine compatible with Red Hat OpenShift Virtualization?

Updated June 17 2024 at 4:05 AM - English ▾

Red Hat OpenShift Virtualization allows workloads to run in virtual machines, running alongside containers on the same cluster nodes. OpenShift Virtualization is based on the open source KubeVirt project; built upon the foundation of KVM and Red Hat Enterprise Linux. A broad ecosystem of software applications and hardware platforms support these technologies.

Most workloads in virtual machines have their runtime dependencies satisfied by the guest operating system on virtual hardware. These workloads are expected to run as guests on OpenShift without modification, as long as they don't have hypervisor dependencies or require specific features of the virtualization platform.

Red Hat and partners conduct extensive testing with a broad set of guest operating systems to ensure their interoperability with OpenShift Virtualization, and provide Tier 1 support for [certified guest operating systems in OpenShift Virtualization](#). OpenShift Virtualization is certified in [Microsoft's Windows Server Virtualization Validation Program \(SVVP\)](#) to run Windows Server workloads. It is highly recommended to [install the QEMU guest agent and VirtIO drivers](#) for enhanced compatibility.

For workloads that are not installed on a certified guest operating system, [Red Hat will assist customers](#) with issues specific to the hypervisor and other capabilities of the OpenShift platform.

SBR [Virtualization](#)

Product(s) [Red Hat OpenShift Container Platform](#)

Category [Supportability](#)

Component [cnv](#)

Tags [openshift](#) [virtualization](#)

Internal Tags [cnv](#)

Article Type [General](#)

Scaling Migration with Ansible Automation Platform

Goal: Scaling the Migration with AAP

Create a framework that's built to accelerate from Day-0 to Day-2



Discover & Analyze

- VMware env fact gathering
- VM inventorying
- Network underlay and discovery
- Bios discovery & configuration



Migrate & Validate

- Pre- and post-flight MTV hooks
- Orchestrate and validate MTV activities at scale
- Hardware provisioning and deprovisioning

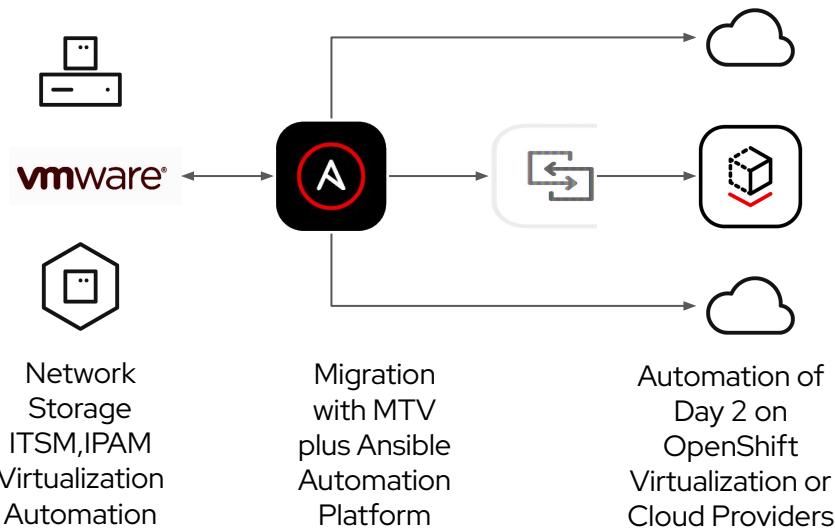


Operate

- Integration of mission-critical observability and ITSM tools
- Full Day-2 automation operations intra- and inter-cluster
- Network and VM OS automation

Hybrid Cloud Migration Automation

Why should you choose Ansible Automation Platform for Virtualization automation?



Why is it important?

- ▶ Manage infrastructure outside Clusters
- ▶ Migrate from VMware to OpenShift Virtualization or Cloud
- ▶ Perform Day 2 operations
- ▶ Integrate with public/private cloud services
- ▶ Security and compliance across your entire infrastructure

Why Red Hat Ansible Automation Platform?

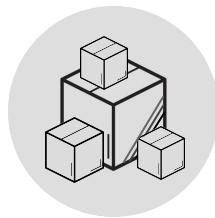
- ▶ Large ecosystem of content to support entire infrastructure
- ▶ Integration with common logging to capture deviations
- ▶ Event Driven Capabilities to react to Observability

The Migration Challenge

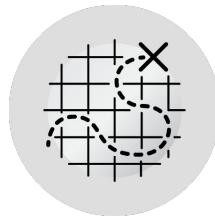
Where are the roadblocks?



Your teams “know”
and are invested in
the VMWare
ecosystem



Servers and apps
designed, deployed,
and forgotten across
years and acquisitions



Majority of
standards and
documentation are
institutional
knowledge

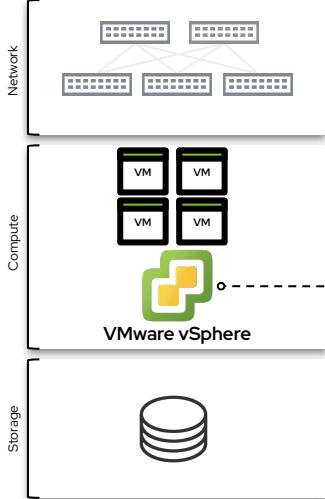
Ansible Automation Platform

Discover / Prepare

Automate & Orchestrate

Day 2 Automation & Management

0 Existing



1 Migrate



Migration Toolkit for Virtualization



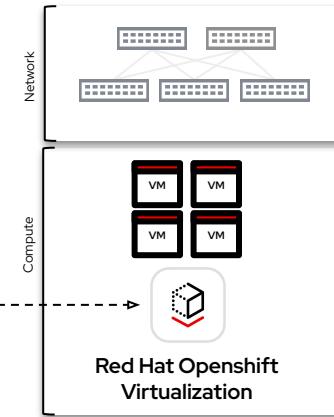
e.g. Kafka, Prometheus, Dynatrace

Events

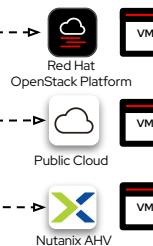
e.g. ServiceNow

ITSM

2 Steadystate



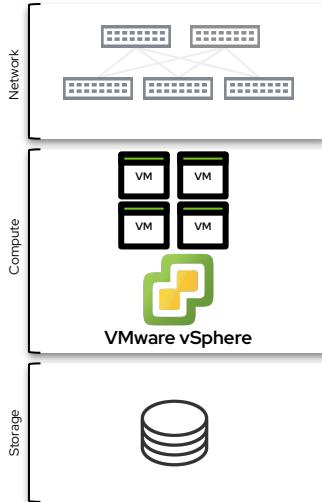
Alternative hosting options





Day-0 Use Cases

0 Existing



Discover / Prepare

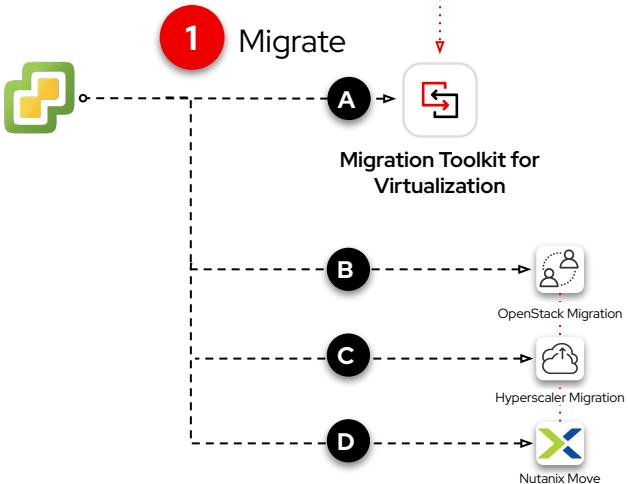
- Inventorying of all existing and/or replacement hardware
- VM introspection
 - State management of existing VMs and services using the supported `vmware.*` Ansible Content Collections
 - SSH connectivity to Linux systems
 - WinRM and remotedesktop connectivity to Windows systems
- Network
 - Bulk backing up of network configurations
 - DNS / IPAM management
 - Security controls
 - VLAN configuration needs
 - Top-of-rack Switching, routing, load balancing, firewall hardware provisioning and configuration management
- External storage
- Network configurations: EVPN-BGP, VRFs, VPCs from Datacenter to Cloud



Automate & Orchestrate

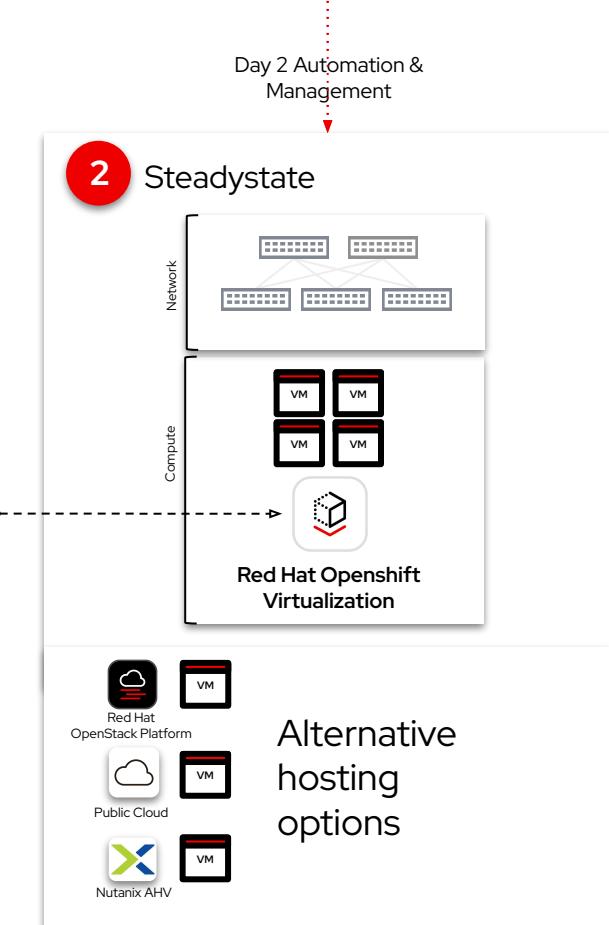
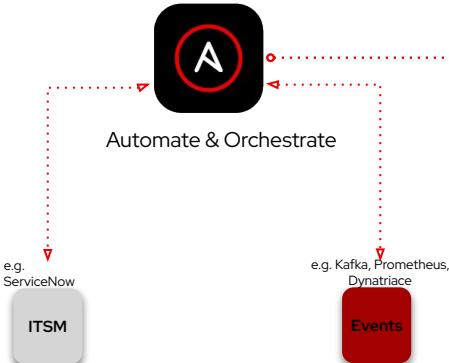
Day-1 Use Cases

- MTV automation
 - Batch migrations via `redhat.openshift_virtualization` certified Ansible Collection
 - Dynamic post-install hooks via Event-driven Ansible (k8s EDA source plugin)
- OpenShift Virtualization
 - Load Balancer configuration in OpenShift Virt
 - OpenShift Virt "config-as-code"
- Existing VM activities
 - VMW agent install/remove
- Open ports needed to enable at the hypervisor
- VM snapshots or backup of VM for rollback
- Shutdown of VMs, VM hibernation management
- Post migration validation of applications and services working
- Rollbacks/workflows if migrations fail



Day-2 Use Cases

- VMW agent install/remove
- Open ports needed to enable at the hypervisor
- Virtual Machine activities / life cycle
 - Patching and audit of servers
 - Patching of OS/applications
 - Audit of servers
 - Deprovisioning of Virtual Machines and delete all the associated resources
 - power off, reboot, power on, snapshot create and destroy, run commands on a vm
- Integration with ServiceNow and Observability tools
 - Event-Driven Ansible!
- Memory, storage, vCPUs allocation, network adapter settings, BIOS/UEFI, Migrate to another ESXi host, tags, installing VMware tools)
- Business Continuity/Disaster Recover/Cyber Recovery



Automating with Certified and Validated Content

Certified Signed

vmware_rest
Provided by [VMware](#)

VMware collection for Ansible

132	0	10	1
Modules	Roles	Plugins	Dependency

validated Signed

vmware_ops
Provided by [Red Hat](#)

Collection to manage VMware

0	2	0	2
Modules	Roles	Plugins	Dependencies

Certified Signed

openshift_virtualization
Provided by [Red Hat](#)

Lean Ansible bindings for OpenShift Virtualization

2	0	4	1
Modules	Roles	Plugins	Dependency

Certified Signed

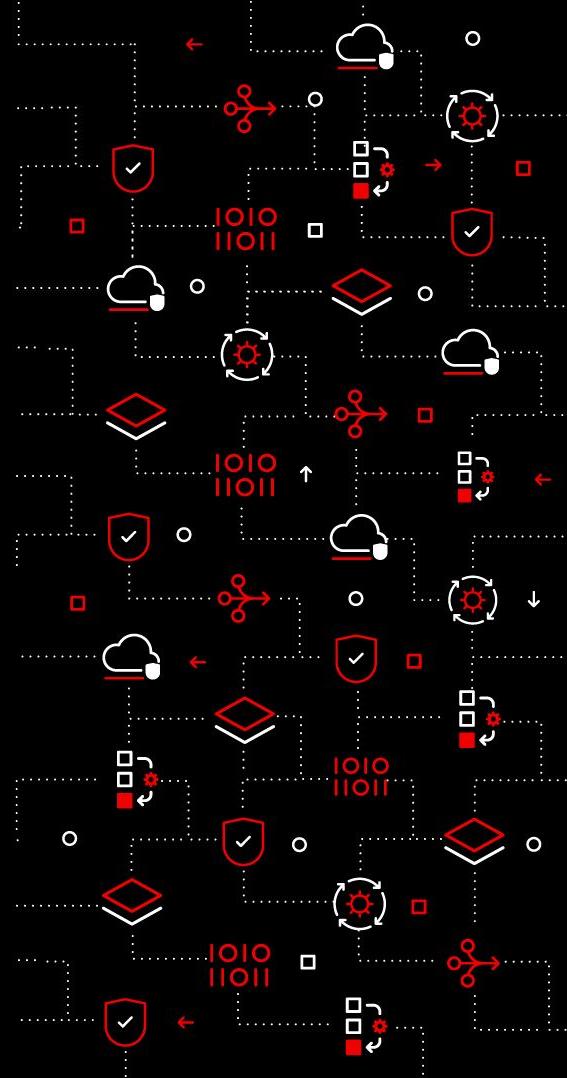
openshift
Provided by [Red Hat](#)

OpenShift Collection for Ansible.

13	0	15	1
Modules	Roles	Plugins	Dependency

NEW

Coming Soon: A comprehensive `vmware` Ansible Collection!
(Will do the SOAP and REST stuff together!)



Partner Ecosystem

ISV Partners*

Storage

Products for OpenShift Virt using CSI (container storage interface)



Backup/DR

Products for OpenShift



Networking

Products for OpenShift Virt using CNI (container networking interface)



Cloud Services

Current public cloud providers offering OpenShift virtualization



Additional Information

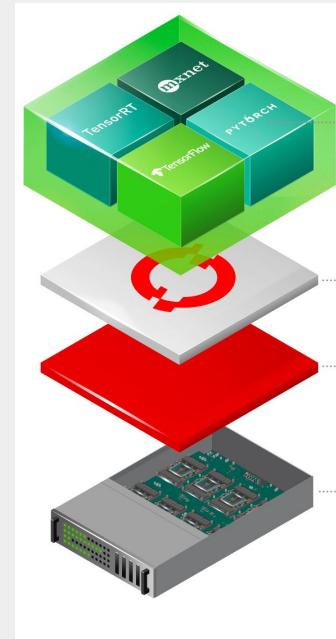
 [Listings](#) of current partner products that are certified or completed statement of support.

Visit this [source page](#) to see the current 'in progress integrations' and to submit requests for additional partner product integrations.



Orchestrating NVIDIA GPU accelerated Virtual Machines with OpenShift

- ▶ GPU-accelerated applications running in virtual machines can be orchestrated by OpenShift, just like ordinary enterprise applications, enabling unified management
- ▶ In addition to AI, enabling OpenShift Graphics GPU use cases
- ▶ The NVIDIA vGPU Manager allows multiple virtual machines to share access to a single physical GPU, enabling simultaneous utilization with Time-sliced vGPUs (no MIG support for now)
- ▶ The NVIDIA GPU Operator automates deployment, configuration, and lifecycle management of GPU-accelerated workloads



OpenShift Data Foundation

- ▶ Allows customers to **scale storage and compute independently**
 - Storage - Scale **UP or OUT**
 - Compute - Scale number of VMs or expand VMs
- ▶ Disaster recovery
 - VMs can live-migrate within cluster
 - VMs can live migrate across data centers with Metro DR
- ▶ Networking
 - Multus - separate data networks and storage networks.
- ▶ Flexible deployment
 - Block, File, NFS, Object or just Block
- ▶ Data Transfer optimization using local read affinity
- ▶ Security - Encryption at rest and in-transit



VMs

Containers

OpenShift Data Foundation Block, File, NFS, Object



Bare metal

Virtual

Private
cloud

Public
cloud



Pair IBM Data Services with Red Hat OpenShift Virtualization

Manage VMs with operators and CRDs

- Windows and Linux VMs
- Common GitOps management tools
- Common Fusion container-native storage layer

Define application-aware backups with “recipes”

- A Fusion recipe defines workflow to backup and restore application state
- Enforce consistency to ensure recoverability (e.g., *database dump and restore*)
- Orchestrate Fusion backup policies from a central hub

Flexible deployment options

- Deploy Fusion data services in any OpenShift cluster
- IBM Storage Fusion HCI System – an integrated system purpose built for OpenShift applications
- Single point of contact for support



Fusion data services for OpenShift, everywhere



Consistent experiences

- APIs
- Fusion Console
- Data Protection
- Disaster Recovery

- Fusion Data Foundation*
- *Fusion Data Foundation available on Fusion HCI in 2Q23 via IBM Satellite/ROKS



watsonx



All IBM
Cloud Paks



IBM Cloud
Satellite



Databases



Off the shelf
(COTS)

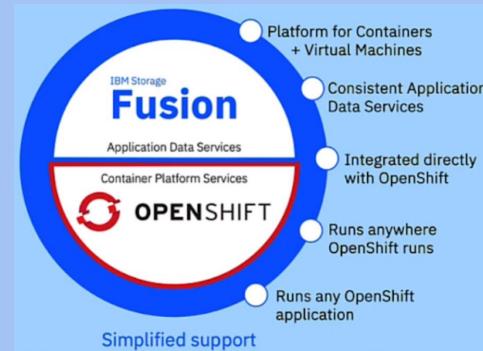
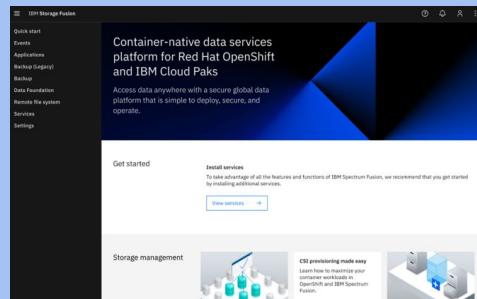


Custom apps

2 Fusion Product Offerings!

Fusion Software

Simple: Runs anywhere and everywhere



vmware



Power
Systems



OpenShift Appliance



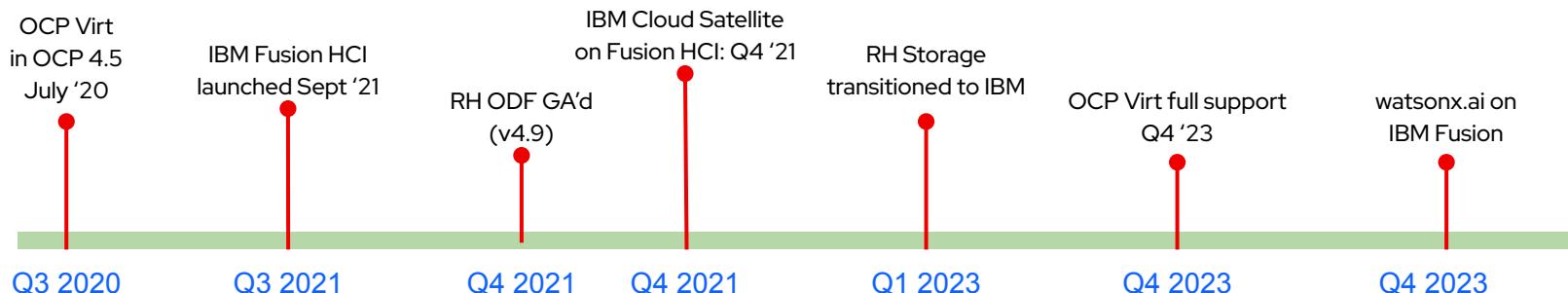
Hyper-Converged Infrastructure for OpenShift

Switches, x86 Servers, Storage, Rack
With full OpenShift Virtualization support!

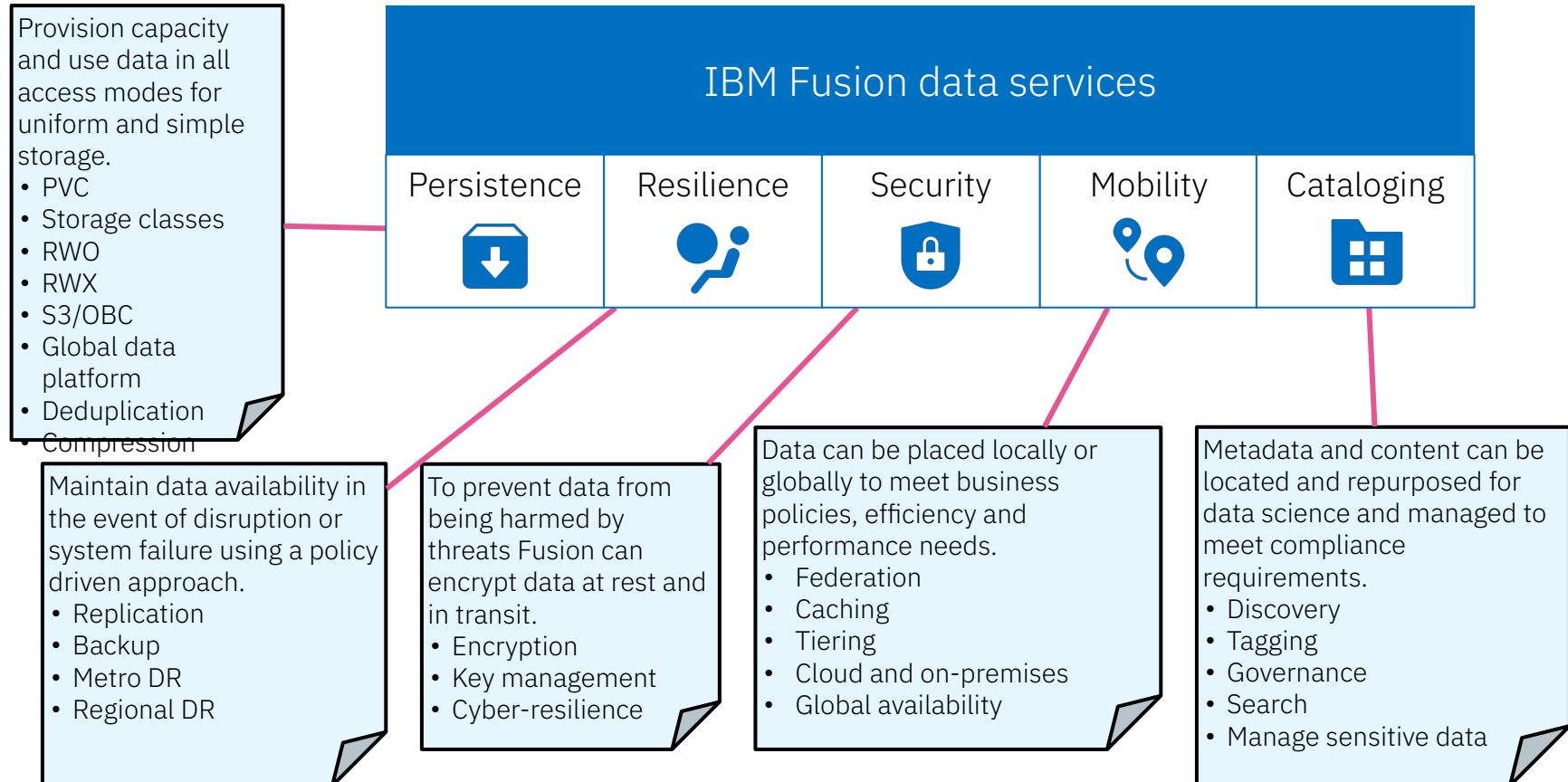
IBM Fusion & Red Hat - Key Milestones

Fusion wasn't just born yesterday

- OpenShift Virtualization: OCP 4.5 July '20
 - In OCP 4.4 and prior was named Container Native Virtualization (CNV)
- IBM Fusion HCI (SW v2.1.0): Sept '21
 - with full OCP Virtualization support right from the start
- Red Hat ODF 4.9 GA'd: Q4 '21
 - Previously OCS (OpenShift Container Storage)
- Fusion HCI adds support for IBM Cloud Satellite: Q4 '21
- Transition of RH Ceph, RH Gluster, RH ODF to IBM: Effective Jan 1, 2023
- Rebrand "IBM Spectrum" to "IBM Storage": Q3 '23
- OCP Virtualization full support in Fusion HCI: Q4 '23
- watsonx.ai on IBM Fusion: Q4 '23
- Rebrand "IBM Storage Fusion" to "IBM Fusion": Q1 '24



The Fusion 5



Comparison Chart:

Each next level
builds up capability
from ODF to FDF

FDF = Fusion Data Foundation, a.k.a. Fusion SDS, Fusion Software (SW)

ODF & FDF available on
all major platforms!

x86, IBM Power, IBM Z & LinuxONE

RH ODF Essentials, ODF Advanced, IBM Fusion FDF (SW, SDS) compared			
SDS = Software Defined Storage			
Features	ODF Essentials	ODF Advanced	IBM Fusion FDF
Block & File Storage	✓	✓	✓
Object Storage	✓	✓	✓
Multicloud Gateway	✓	✓	✓
Node & Disk Resiliency	✓	✓	✓
Storage Operations Based Automation	✓	✓	✓
Compression	✓	✓	✓
Deduplication for Multicloud Object Gateway	✓	✓	✓
Local Snapshots & Clones	✓	✓	✓
Basic Cluster-wide Encryption	✓	✓	✓
Cross-Availability Zone HA (3 zones)	✓	✓	✓
Internal Deployment Mode	✓	✓	✓
Stretch Cluster (OCP & ODF stretched over 2 zones + arbitrator)		✓	✓
Advanced Encryption & KMS Support		✓	✓
Metro DR (sync replication)		✓	✓
Regional DR (async replication)		✓	✓
External Deployment Mode		✓	✓
Multi-Cluster Support		✓	✓
Mixed Workload Support		✓	✓
Catalog Backup & Restore			✓
Searchable Restore			✓
Restore to an Alternate Location (DR)			✓
Non-Disruptive Application Aware Backup			✓
IBM Storage Fusion Discover: - Identify Unstructured Data - Regulatory Compliance - Faster Time to Insights - Identification of Redundant Data to Reduce Costs - Governance1			✓

FDF
is like
ODF++!

Fusion HCI System

Integrated system
designed for OpenShift
applications



Solution components

Hardware

- Hyperconverged x86 appliance
- Self-contained internal high-speed storage network
- Factory integrated

Operating System

- OpenShift Container Platform
- Bare metal deployment
- Support Windows and Linux VMs with OCP Virtualization
- Integrated support for Hosted Control Planes

Fusion data services

- Persistent Volumes (PV)
- Backup/Restore (B/R)
- Replication and mobility
- Data cataloging

Lifecycle management

- Version management
- Health and maintenance
- Non-disruptive scale-out

Solution value

Accelerate and de-risk container projects

- Fast set-up
- Engineered for performance
- Fault tolerant architecture

Eliminate risk of poor cluster design and missed SLOs.

Cost Effective

- Unified management of hardware and software
- Non-disruptive version upgrades and scale-out
- Single-point-of-contact for support from IBM

Enable Platform teams to efficiently deliver application services

Complete data services

- PV: RWO/RWX file, S3 object, optional block support
 - B/R: Snapshots and application consistent backup / restore
 - HA: Metro DR and Regional DR data replication
- Production ready data services**

Dell CSI Storage Portfolio



The [CSI Drivers by Dell](#) implement an interface between OpenShift and Dell Storage Arrays

	PowerFlex	PowerScale	PowerStore	PowerMax	Unity
Static Provisioning	✓	✓	✓	✓	✓
Dynamic Provisioning	✓	✓	✓	✓	✓
Expand Persistent Volume	✓	✓	✓	✓	✓
Create/Delete Volume Snapshot	✓	✓	✓	✓	✓
Create Volume from Snapshot	✓	✓	✓	✓	✓
Volume Cloning	✓	✓	✓	✓	✓
Raw Block Volume	✓		✓	✓	✓
Ephemeral Volume	✓	✓	✓		✓

Dell APEX Cloud Platform (ACP) Dashboard Overview

You are logged in as a temporary administrative user. Update the [cluster OAuth configuration](#) to allow others to log in.

Dell APEX Cloud Platform

Overview Inventory Updates Security Settings Support

Details

Compute Cluster ID
b8bfc0dc-4736-40e2-b209-d243b350cb2a

APEx Cloud Platform Foundation Software Version
03.00.00.00

Red Hat OpenShift Container Platform Version
4.13.12

[View Cluster](#)

Inventory

4 Compute nodes ✓
4 Storage nodes 1⚠

Status

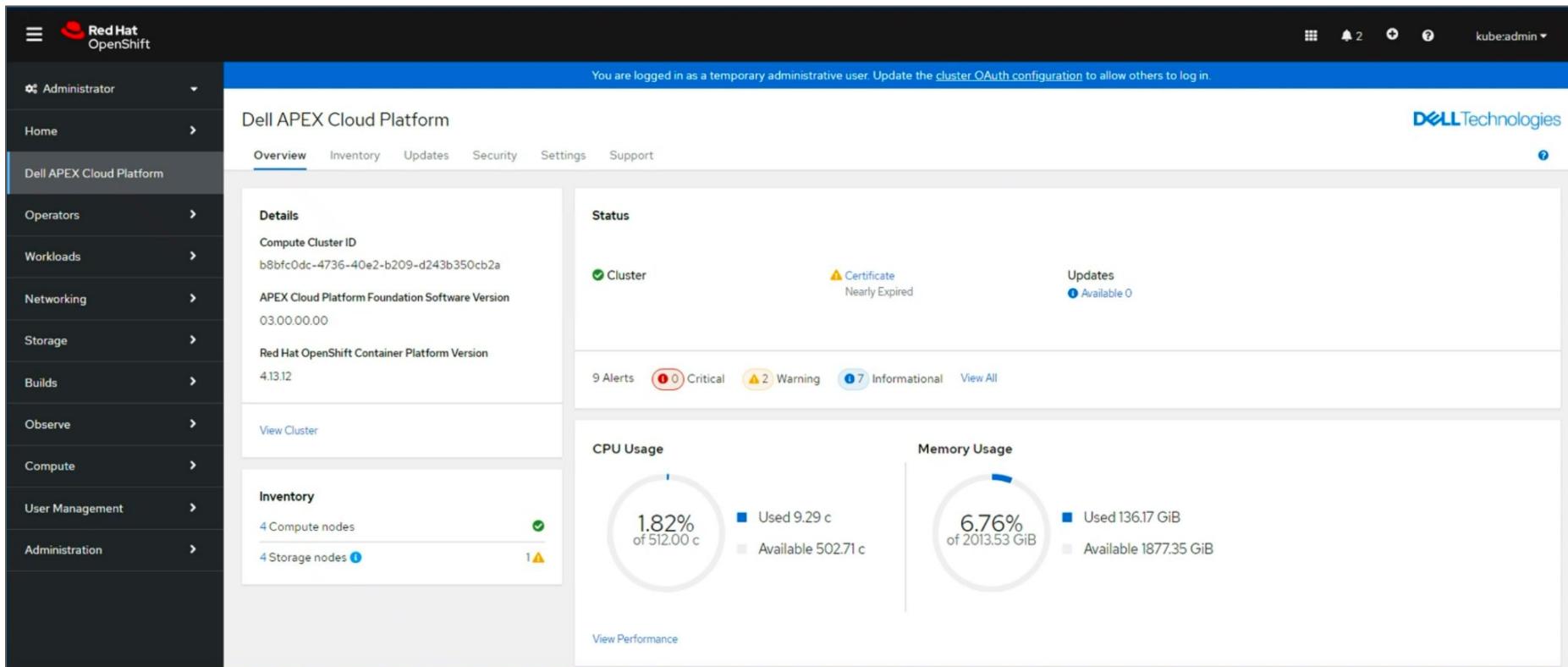
Cluster ✓ Certificate ⚠ Nearly Expired Updates 0 Available

9 Alerts 0 Critical 2 Warning 7 Informational [View All](#)

CPU Usage
1.82% of 512.00 c
Used 9.29 c Available 502.71 c

Memory Usage
6.76% of 2013.53 GiB
Used 136.17 GiB Available 1877.35 GiB

[View Performance](#)



Dell APEX Cloud Platform (ACP) Inventory View

You are logged in as a temporary administrative user. Update the cluster OAuth configuration to allow others to log in.

Dell APEX Cloud Platform

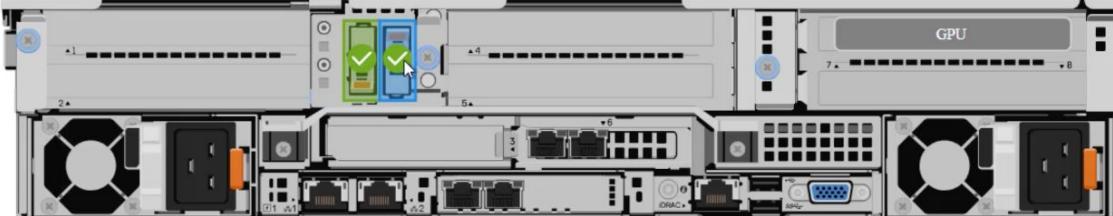
Overview Inventory Updates Security Settings Support

u23-appl-cl-raven.ravencse.local > 35RLCX3

Physical View

Actions

Front View Back View



GPU

Overview Boot Devices Alerts

Server health Warning

System LED Healthy

Power state On

Service tag 35RLCX3

Role node Control plane, Master, Worker

Manufacturer Dell Inc.

Server slot 1

Server model APEX MC-760

Management IP address 172.18.30.52

iDRAC IP address 192.168.101.19

Location

Rack name U23

Activate Windows

Rack position 2

Go to Settings to activate Windows.

Firmware versions

BOSS Information

Overview Alerts

Boss Controller

Device model	Status	Firmware version
BOSS-N1 Monolithic	HEALTHY	2.1.13.2021

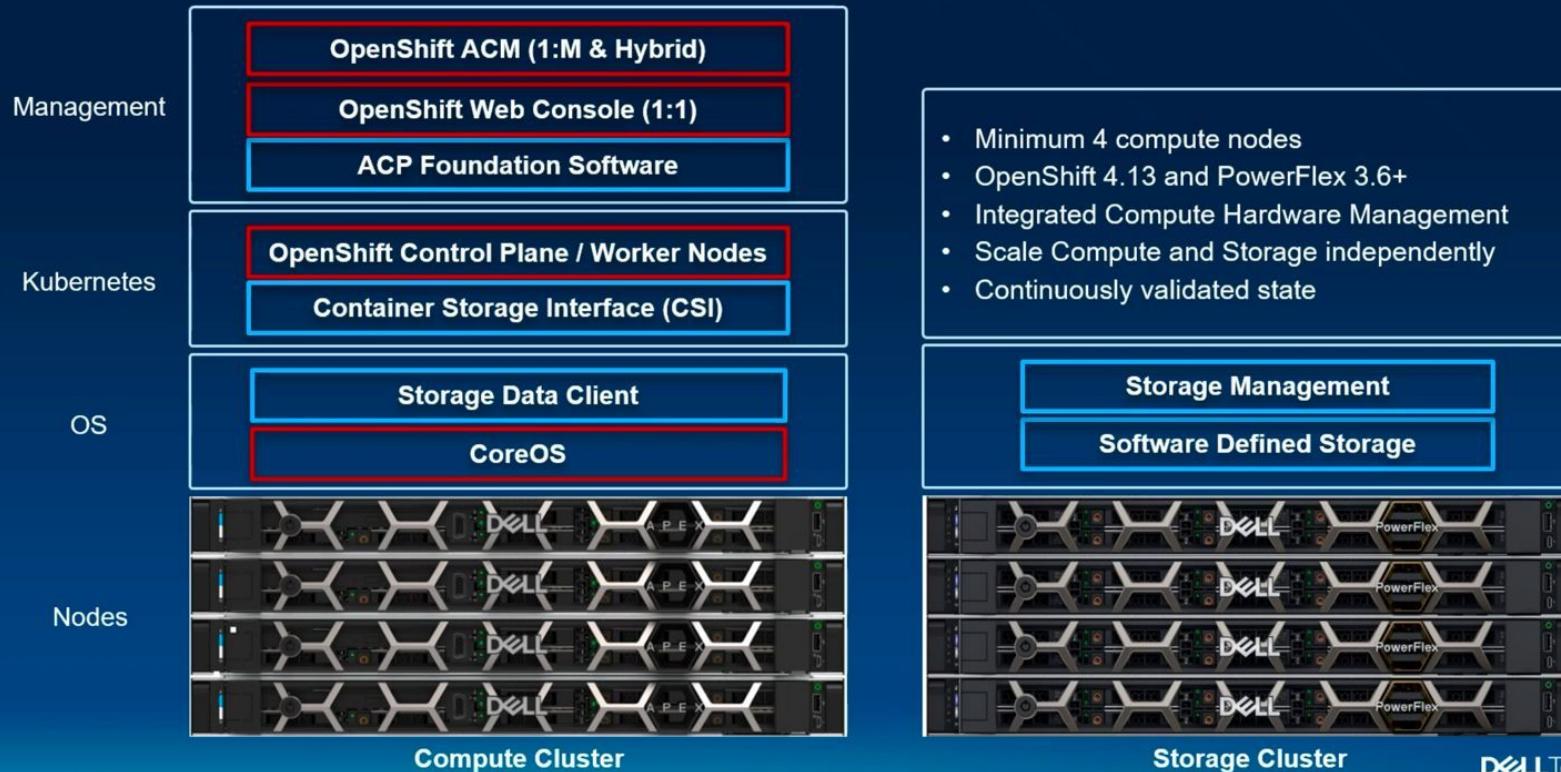
Active Boot Device

Slot	Device model	Protocol	Capacity
0	Dell NVMe PE8010 RI M.2 960GB	PCIe	894.25GB

Dell APEX Cloud Platform (ACP) Architecture

Two-Layer Architecture

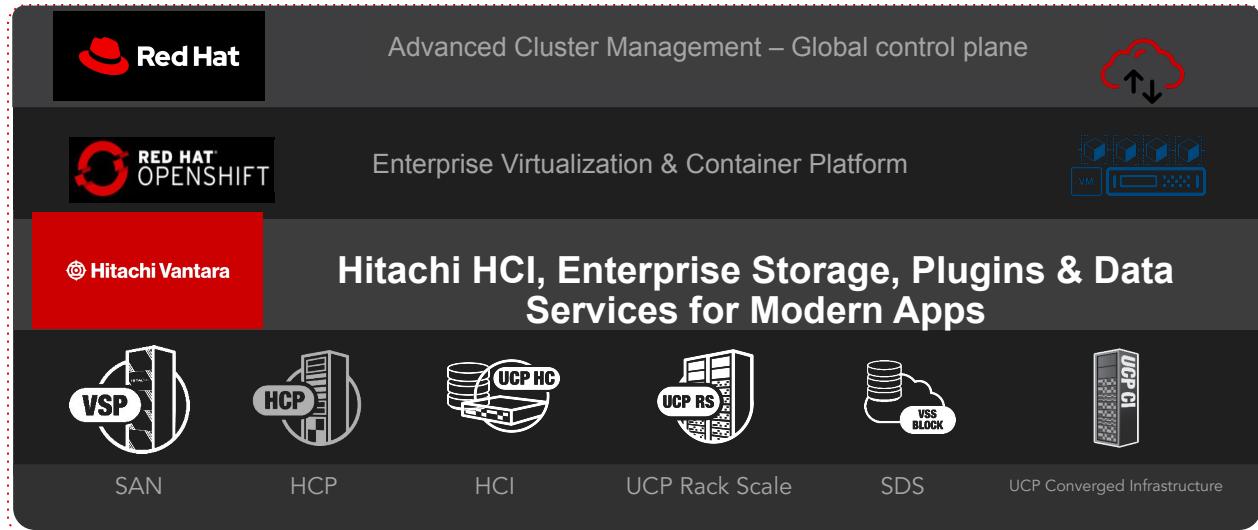
Disaggregated architecture allows compute and storage to scale independently



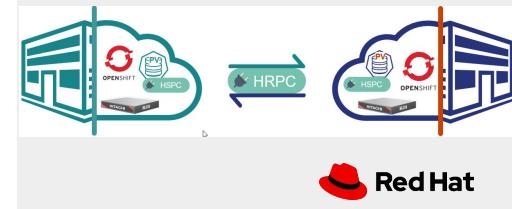
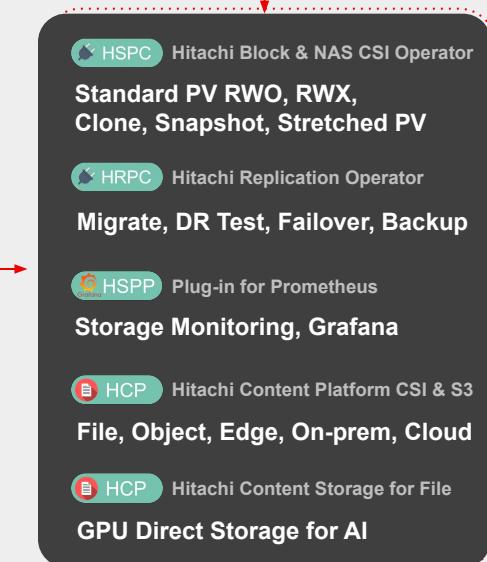
OpenShift Virtualization with Hitachi

Hyperconverged, Storage Operators & Data Services for Apps

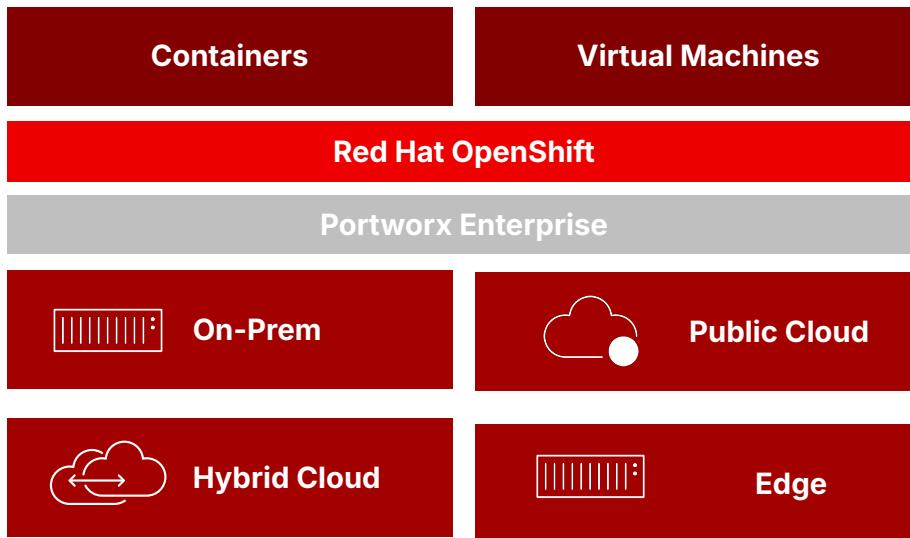
Hitachi Vantara



- High Performance CSIs
- Reliable Hyperconverged
- Multi Site Replication and DR
- GitOps for Edge-Core automation



Storage Automation for VMs and Containers



Storage for application layer for containers & VMs

Enables performance and HA for containers & VMs

Comprehensive DR for VMs and containers

Live migration of VMs and containers



Protect OpenShift Virtualization VMs and Containers side by side

K10 5.5 launched in October 2022 with VM capabilities:

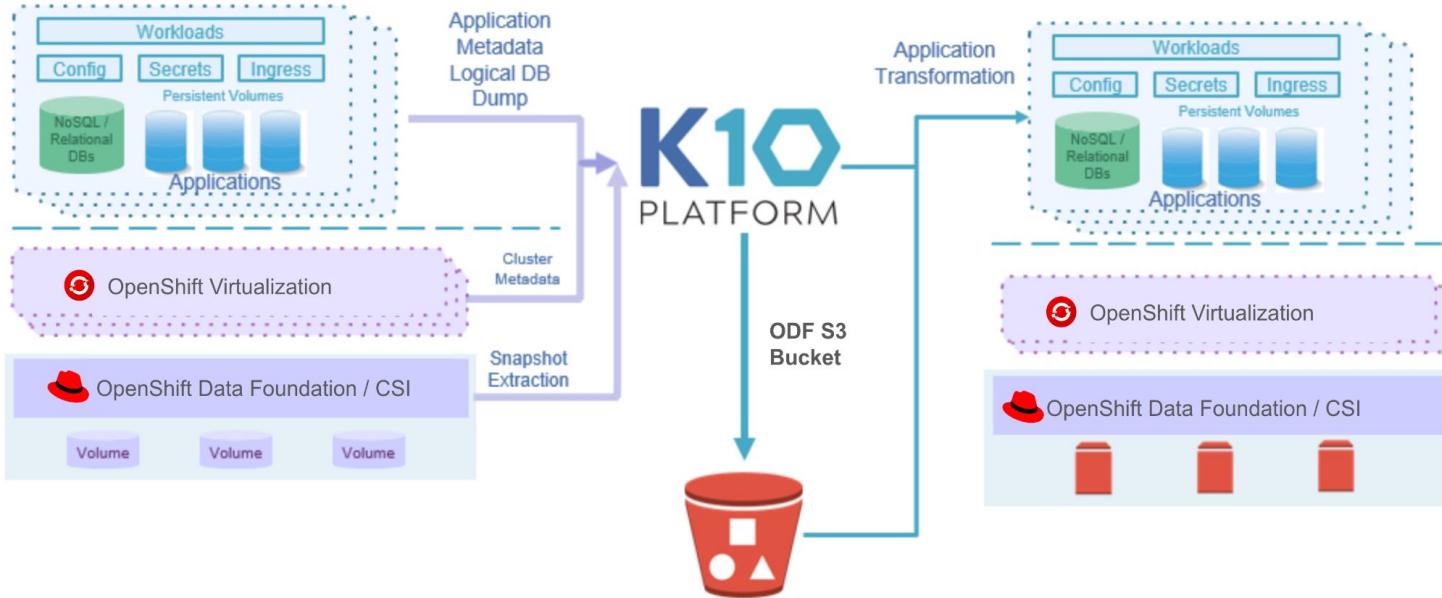
- Discover VMs: snapshot VM configuration and VM storage
- Freeze a VM before snapshot (optional annotation) w/ timeouts and unfreeze
- Restore VM snapshots with resource transforms and automatic orchestration

K10 enterprise features apply to VM workloads for automated data protection:

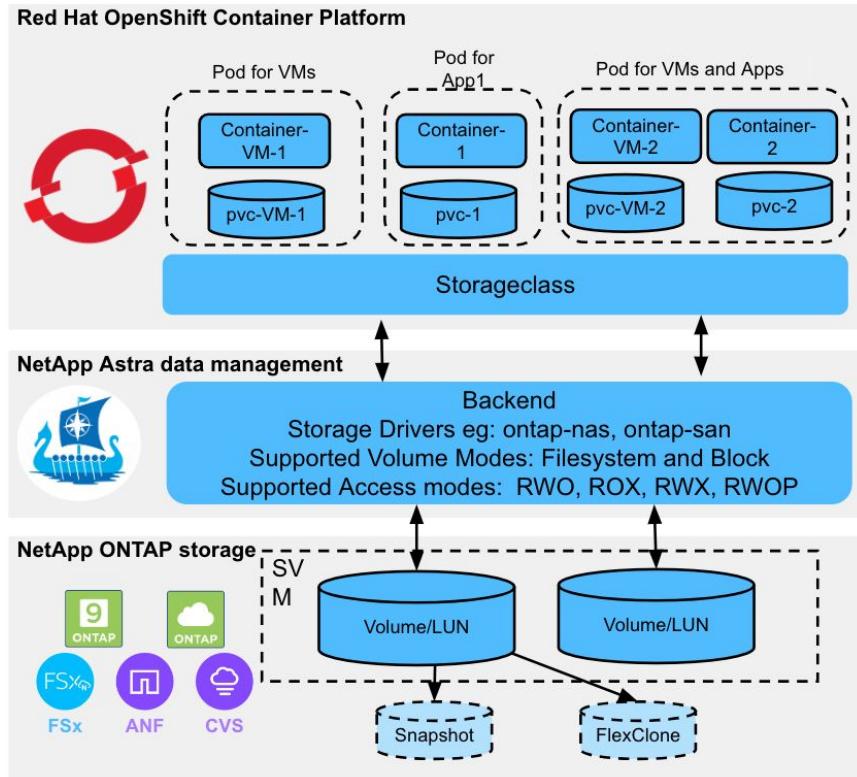
- Apply K10 policies to vms
- Export and import VMs for disaster recovery and VM mobility between clusters



Kasten K10 Backup/Restore Solution



Industry leading storage and data management functionality for modern workload deployments



Support both virtualized and containerized apps in a single infrastructure

VM live migration, CSI topology awareness and storage offload

Fast and efficient, best-in-class snapshots & clones

NetApp Astra provides functionality to protect, move, and store apps

Data protection for VMs is coming in Q4 2023

20+ years of partnership and joint support between Red Hat and NetApp



Disaster and Recovery

- Operator based cloud native solution
- Trilio Treats VMs as K8S first class citizens
 - VMs are automatically backed up irrespective they are provisioned
 - Labels, Namespaces, Operators, Helm Release
- Disaster recovery through Trilio's Intelligent Recovery
- Quiesce and thaw hooks for application consistency backups
- Backups are QCOW2 images which are space efficient
- Full and forever incremental backups
- Wide range of recovery options to recover to multiple clouds

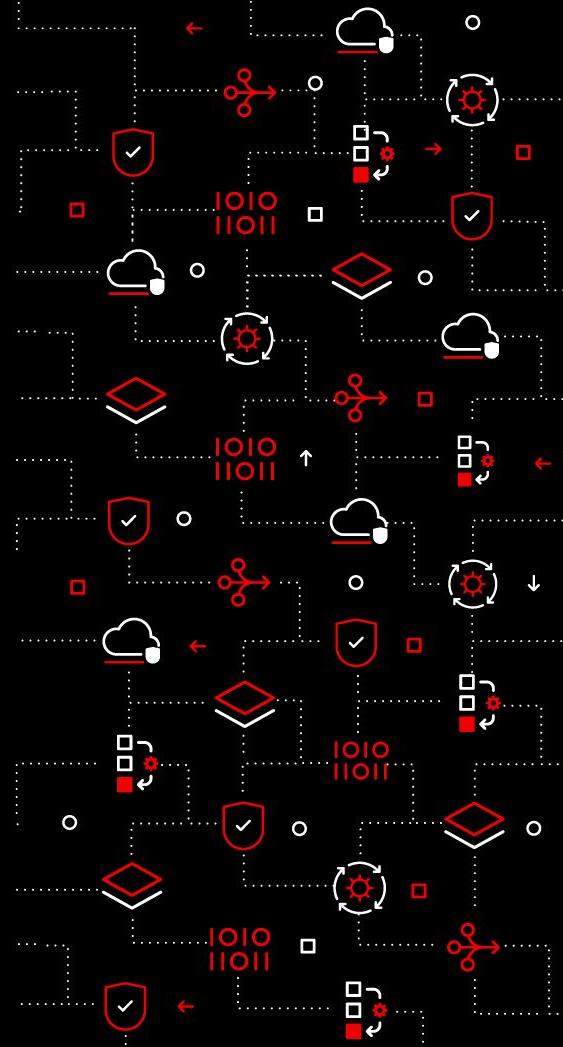


Storage Automation for VMs and Containers

Discover enterprise-grade data protection for the Red Hat ecosystem. Now with OpenShift Virtualization support.

- Automated and Scheduled Backups
- Policy-Driven Backup and Recovery
- Incremental Backups and Deduplication
- Backup Catalog and Metadata Management
- Granular Recovery Options
- Recovery Verification
- Encryption and Data Integrity
- Role-Based Access Control
- Wide range of backup destination options including file system/object storage, tape pools and legacy backup systems (IBM/Dell/Micro Focus and others)





Reference Customers and Ongoing Proof of Concepts

Customers are Realizing the Power of OpenShift Virtualization

Production (or moving in)



POC / Evaluation



Who uses KubeVirt?

End-user Adoption



K L L R
C O D A



Vendor Adoption



Anthos



spectro cloud



Financial Services Firm Builds Unified Private Cloud



Challenge

- ▶ Multiple internal clouds to handle virtual machines (VMs) and containers separately.
- ▶ Disjointed teams with limited knowledge sharing.

Solution

- ▶ Large scale PaaS solution for multiple divisions
- ▶ OpenShift based cloud with 100s of nodes hosting both VMs and containers

Results

- ▶ Transitioned from multiple platforms into one platform
- ▶ Teams standardized on a common solution
- ▶ Add in new use cases like AI/ML
- ▶ Modernize workload flows using HELM and exploring Tekton



Global Investment Bank

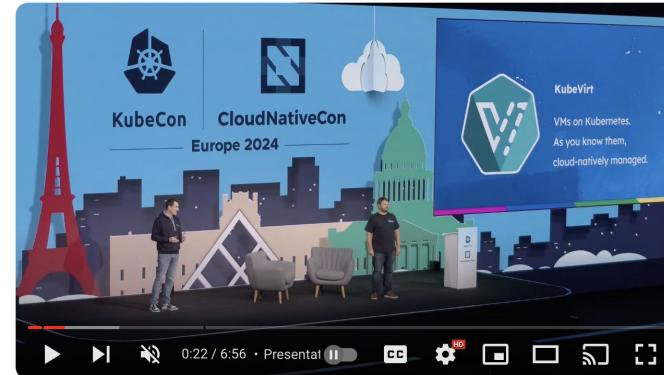
Highlights:

- ▶ Improved operational life cycle provides "pet" levels of application availability with the benefits of a cloud-native environment.
- ▶ OpenShift Data Foundation allows live OpenShift upgrades with low impact to application availability.



*"...it allowed folks who spent the **last decade or so on existing technologies** to get up to speed with a newer subset of technologies to really help drive to **create a single solution** where we deploy one set of capacity and then burn down that capacity whether it becomes a VM or it becomes a container...a **big thanks to Red Hat team that's stuck with the project**, worked with us day in day out, and really helped enable a solution to help **modernize our underlying compute platform.**"*

- VP Tech Fellow, Global Investment Bank



NOAA AWIPS is deploying 150+ OpenShift clusters

122 Weather Forecast Offices, 13 River Forecast Centers



Advanced Weather Interactive Processing System

YAML manifests describe storage, networking, security, and other settings



Red Hat
Advanced Cluster Management
for Kubernetes



Managing 150+ sites - consistency is key

- ▶ Advanced Cluster Manager to apply org policies
- ▶ Advanced Cluster Security to ensure security

Current VM-based infrastructure

- ▶ Take advantage of OpenShift Virtualization

Get ready for cloud

- ▶ Remove overhead with large VMs
- ▶ Separate functions into containers (postgres, qpid, satellite ingest, python, httpd, java, etc...)
- ▶ Decompose monolithic app
- ▶ Move plugins to microservices for better scaling

Our Customer Success Stories



[Israeli Ministry of Defense offers private cloud services using Red Hat OpenShift Virtualization](#)

The Israel Defense Forces (IDF) Center of Computing and Information Systems, or Mamram, selected OpenShift as the new internal cloud solution, to run both VMs and containers on a unified platform with a single coherent API.



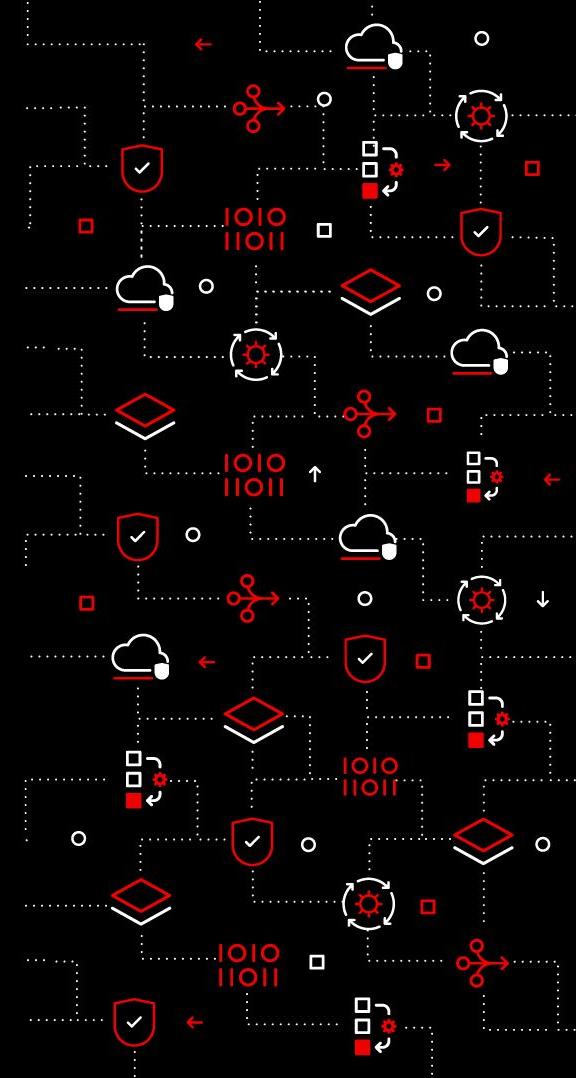
[NOAA- Safely navigating storm clouds with Red Hat OpenShift Virtualization](#)

National Oceanic and Atmospheric Administration (NOAA) to analyze weather data to help pilots know when it's safe to fly and when to alert the public of upcoming tornado and flood situations. With over 150 clusters deployed from Guam, Hawaii, and Puerto Rico to Pennsylvania, New Jersey, and New York, their work preserves and even saves lives.



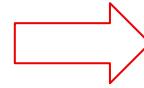
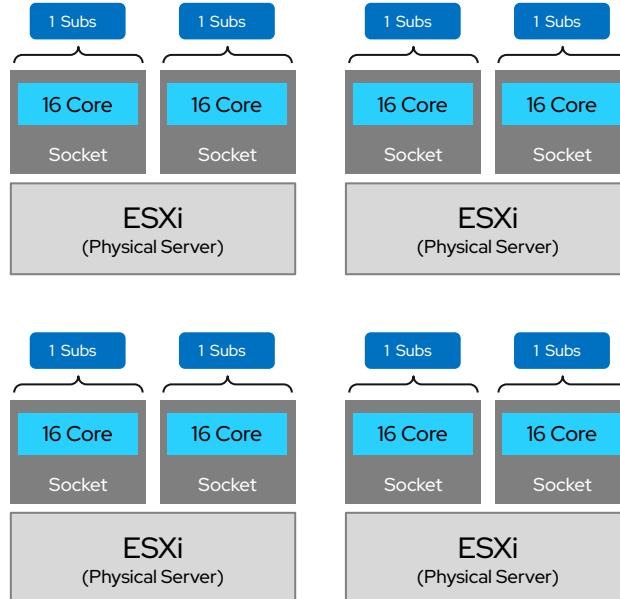
[Kubernetes Operational Excellence with GitOps using OCP, RHACM and AAP at Morgan Stanley](#)

Morgan Stanley needed to meet rigid security and resiliency requirements while respecting legacy services. Their modern application platform enables developer innovation with effective management of regulatory and operational risks. At production scale, a small number of engineers deploy new features with consistency and adherence to investment banking [security]standards.

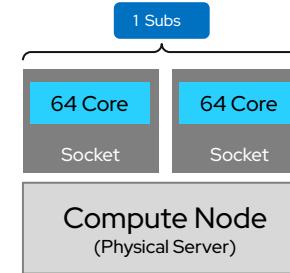


Pricing Simulation

Why not suggest consolidation of old-type servers to new high-spec servers?

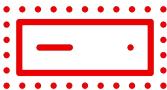


OVE, OKE, OCP, OPP Bare Metal nodes



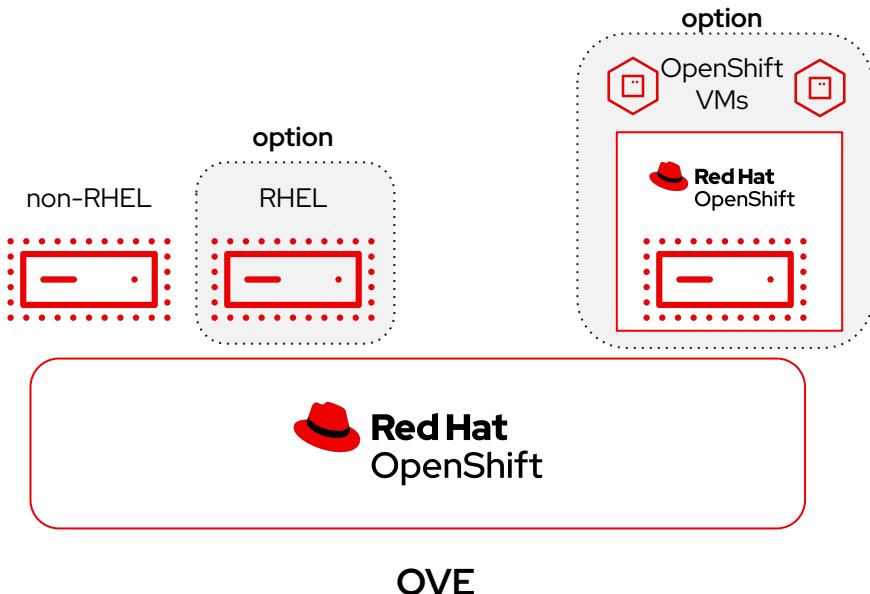
OVE: Focusing on Cloud Native Virtualization, None containers
OKE Bare Metal: unlimited containers, unlimited VMs together
OCP Bare Metal: Add OpenShift as Application Platform
OPP Bare Metal: Add Hybrid Containers Management Solutions

non-RHEL



OVE

Workload types	Can I run ?	notes
non-RHEL	Yes	
RHEL	No(*)	* You can optionally add RHEL Server or RHEL VDC.
Customer Containers	No	
OpenShift VMs	No(*)	*You can optionally add an OpenShift Core subscription.

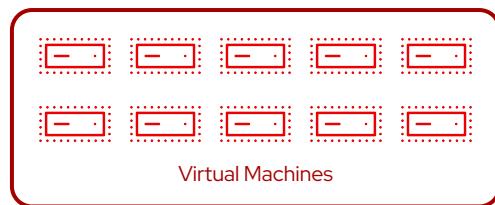


Workload types	Can I run ?	notes
non-RHEL	Yes	
RHEL	Yes (*)	* You can optionally add RHEL Server or RHEL VDC.
Customer Containers	No	* It should be deployed on OpenShift VMs.
OpenShift VMs	Yes (*)	* You can optionally add an OpenShift Core subscription.

Full VM Workload

Pricing Simulation

400 x Virtual Machines
(approx. 5000 vCPU)

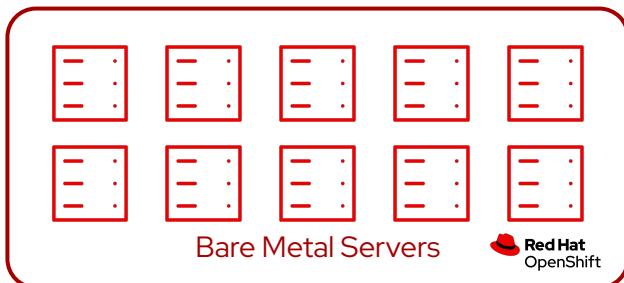


66%

86%

Savings on OVE + ACM for Virt
vs VMware equivalent
(vSphere Enterprise Plus)

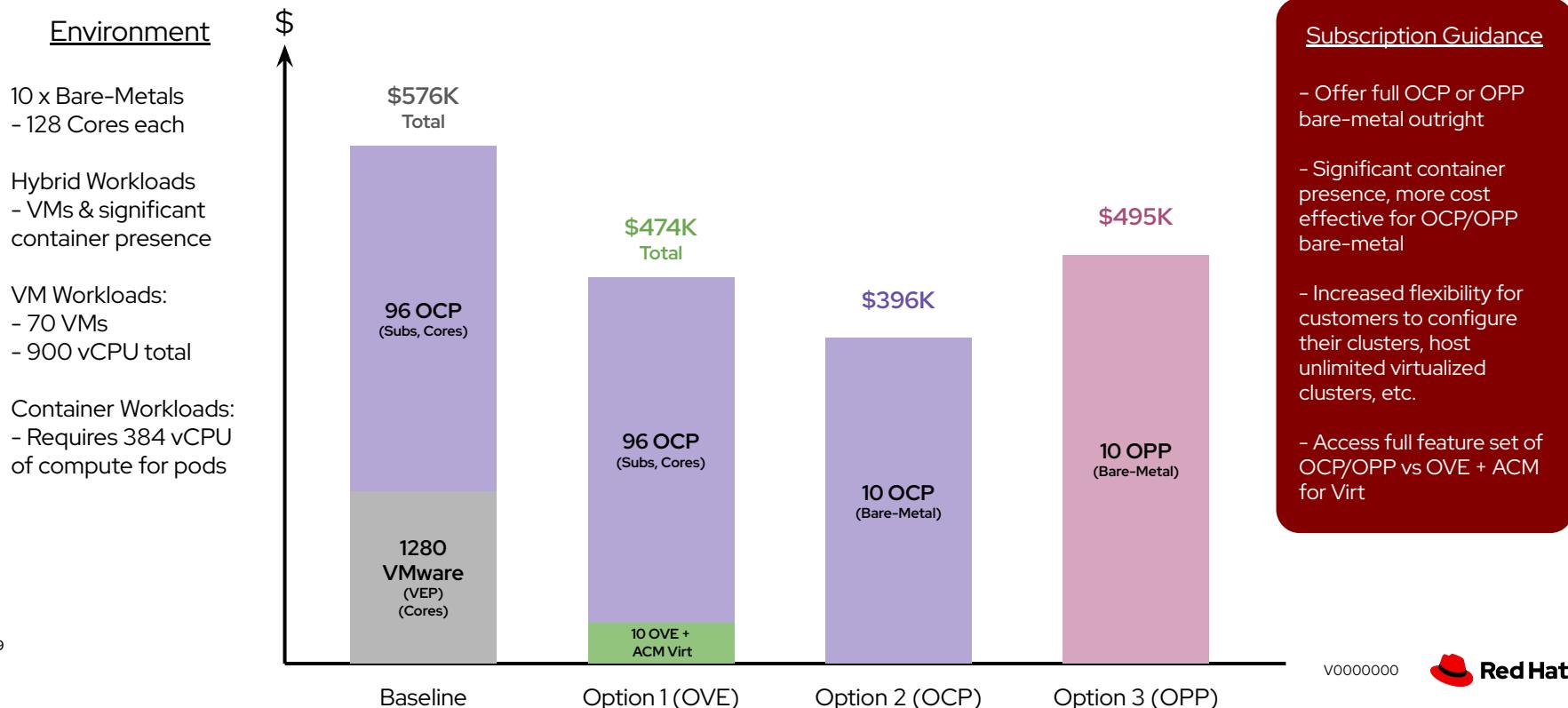
Savings on OVE + ACM for Virt
vs OCP bare-metal



20 x Bare-Metals

Decision Matrix

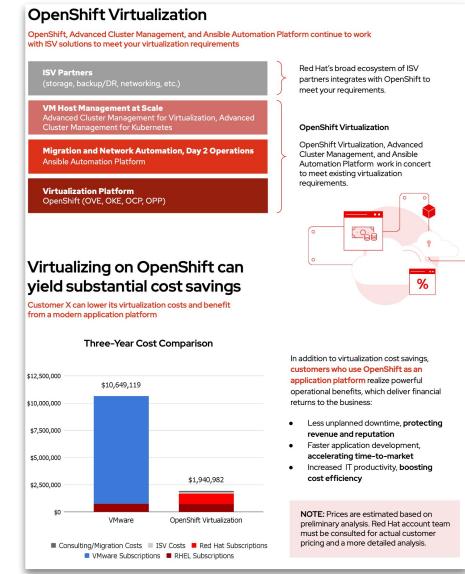
Pricing Chart, Rule of 8, Large/Significant Container Workloads



Red Hat OpenShift Virtualization vs VMware TCO Estimator

This [TCO estimator](#) is an easy-to-use tool to give account teams high-level guidance about positioning OpenShift Virt. with their customers.

- Available to all Red Hatters and [select partners](#) at launch
 - Contact Ben Cohen and Josh Monks to request additional partners to be added
- Partner view does not include ability to see/change discounts
- Outputs are delivered via email
 - Red Hatters receive PDF, editable slides, spreadsheet
 - Partners receive PDF



Thank you

Red Hat is the world's leading provider of enterprise open source software solutions.

Award-winning support, training, and consulting services make

Red Hat a trusted adviser to the Fortune 500.



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