OpenShift Virtualization
For Capgemeni

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Field Partner and Learning Team

Red Hat

OpenShift virtualization

Modernize workloads and support mixed applications

Start bringing VMs to OpenShift now

Support Linux and Windows apps and services in OpenShift as virtual machines with native Kubernetes tools and the security of the Red Hat platform

Deliver mixed applications on one platform

Add VM-based services such as databases to new and existing applications consisting of VMs, containers, and serverless

Modernize VMs to containers over time, or not

Refactor VMs to containerized services, or maintain as VMs. Your choice.

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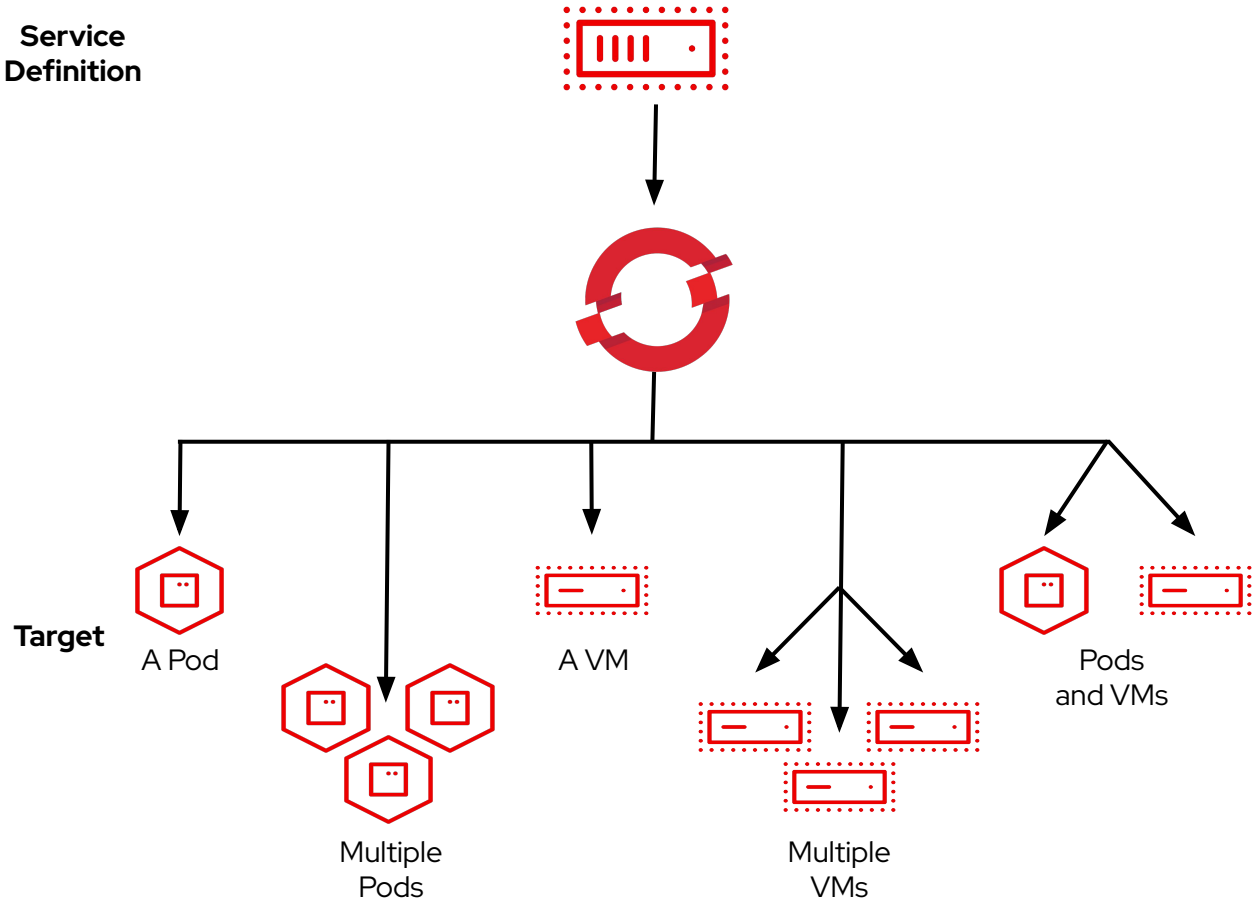
OpenShift Application-centric Technologies with Virtual Machines

- Virtual machines utilize OpenShift and Kubernetes functionality natively:
  - Service, Route
  - GitOps
  - Pipelines / Tekton
  - and others
- Containerized and virtualized app components don't know whether the other is virtual or containerized
- OpenShift Virtualization brings the benefits of Kubernetes without containerizing the application



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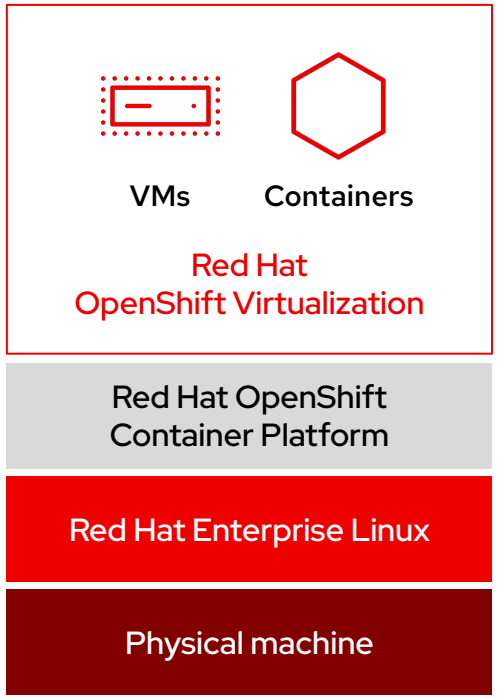
Red Hat OpenShift Virtualization

Modern virtualization option for general purpose virtualization customers



- **Unified application platform**
  Consistent management, tooling, diverse ecosystem
- **Performance and stability**
  The industry standard Kernel Virtual Machine (KVM) hypervisor
- **Built on KubeVirt**
  Top 10 CNCF active project
- **Included capability**
  of the Red Hat OpenShift application platform
- **Supports Microsoft Windows guests**
  Microsoft Server Virtualization Validation Program (SVVP)
- **Includes Red Hat Enterprise Linux**
  guest entitlements

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Benefit of Standardizing on a Single Modern Platform

Unified tools, process and pipelines for all apps

Teams can embrace DevOps with the same tools, pipelines, and platform for building and operating applications

Talent Retention and Growth

Path for VM admins to upskill their talent keeping them current and valuable

Attract new talent to work on modern technologies

Acceleration Application Delivery

Teams can replatform or modernize applications based on business needs.

Virtualized application provisioning - the cloud native way

A matter of minutes

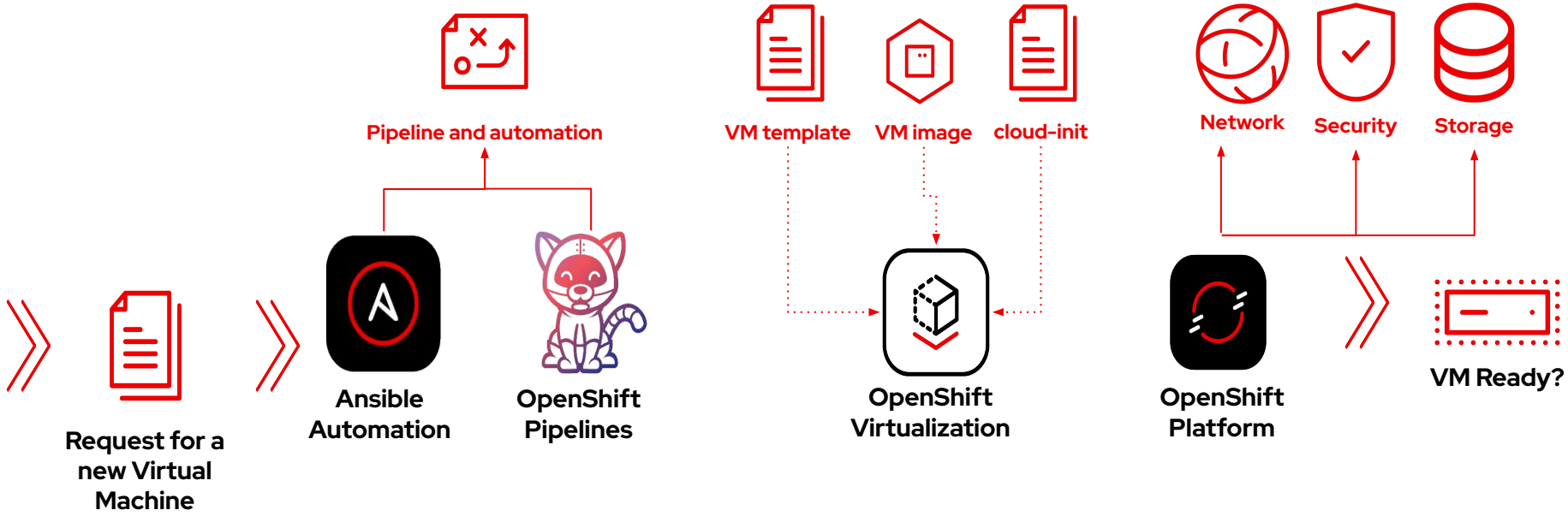
Virtual Machine
- CPU: 4 vCPU, 1 core
- Memory: 16GB
- Disk: 30 GB
- OS: RHEL

Additional filesystems
- data: 500GB, disk
- logs: 100GB, partition

Application platform
- JBoss 7.4 Update 11

Firewall rules
- Ingress: SSH, HTTPS
- Egress: *.redhat.com

DNS & LB
- api.service.org
- Healthcheck: HTTPS port



Automate VM image builds & updates

Automatically deploy VMs from code (Git repos)

Manage networks, storage, load balancers, etc.

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Bring traditional VMs into OpenShift

Traditional VM behavior in a modern platform

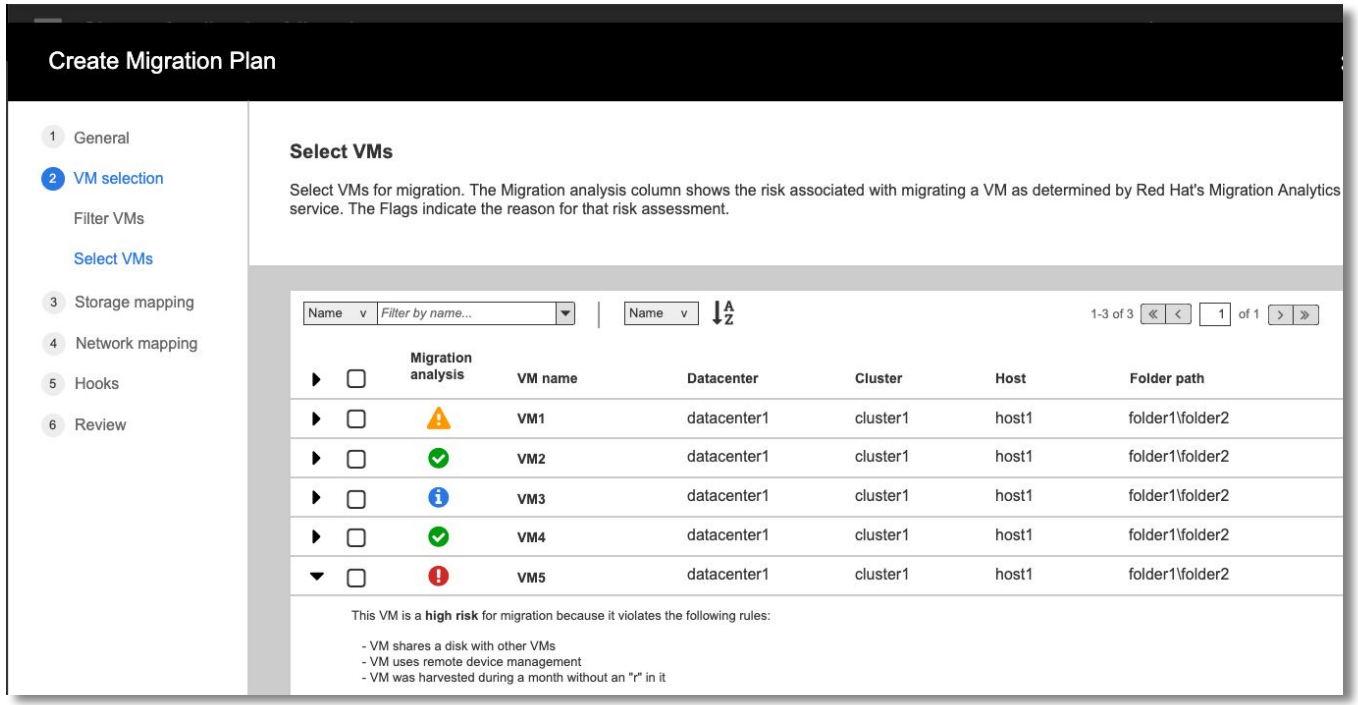
- Administrator concepts and actions
- Network connectivity
- Live migration

Leverage existing VM roles and responsibilities

- Maintain business critical application components
- Modernize skill sets over time

Migration Tooling

- **Migration Toolkit for Virtualization** (MTV)
- Warm migration of VMs at scale



Creating a migration plan with MTV

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Additional Benefits

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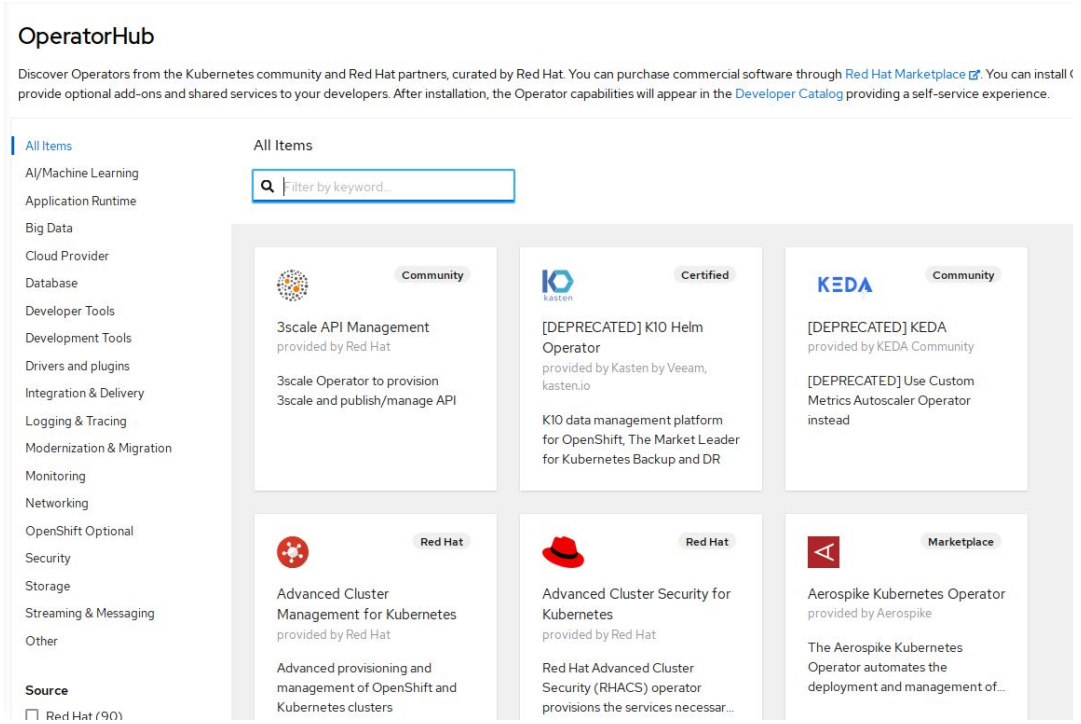
But wait … there's more!

A plethora of features

By making virtual machines "good citizens" of Kubernetes, OpenShift Virtualization allows virtualized workloads to leverage the huge ecosystem of OpenShift (and Kubernetes) features and products.

- ServiceMesh
- Network policy
- Multus for multiple networks
- Storage classes and CSI drivers
- Metrics and observability
- … plus the huge ecosystem



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Utilizing OpenShift Virtualization to Consolidate OpenShift Clusters

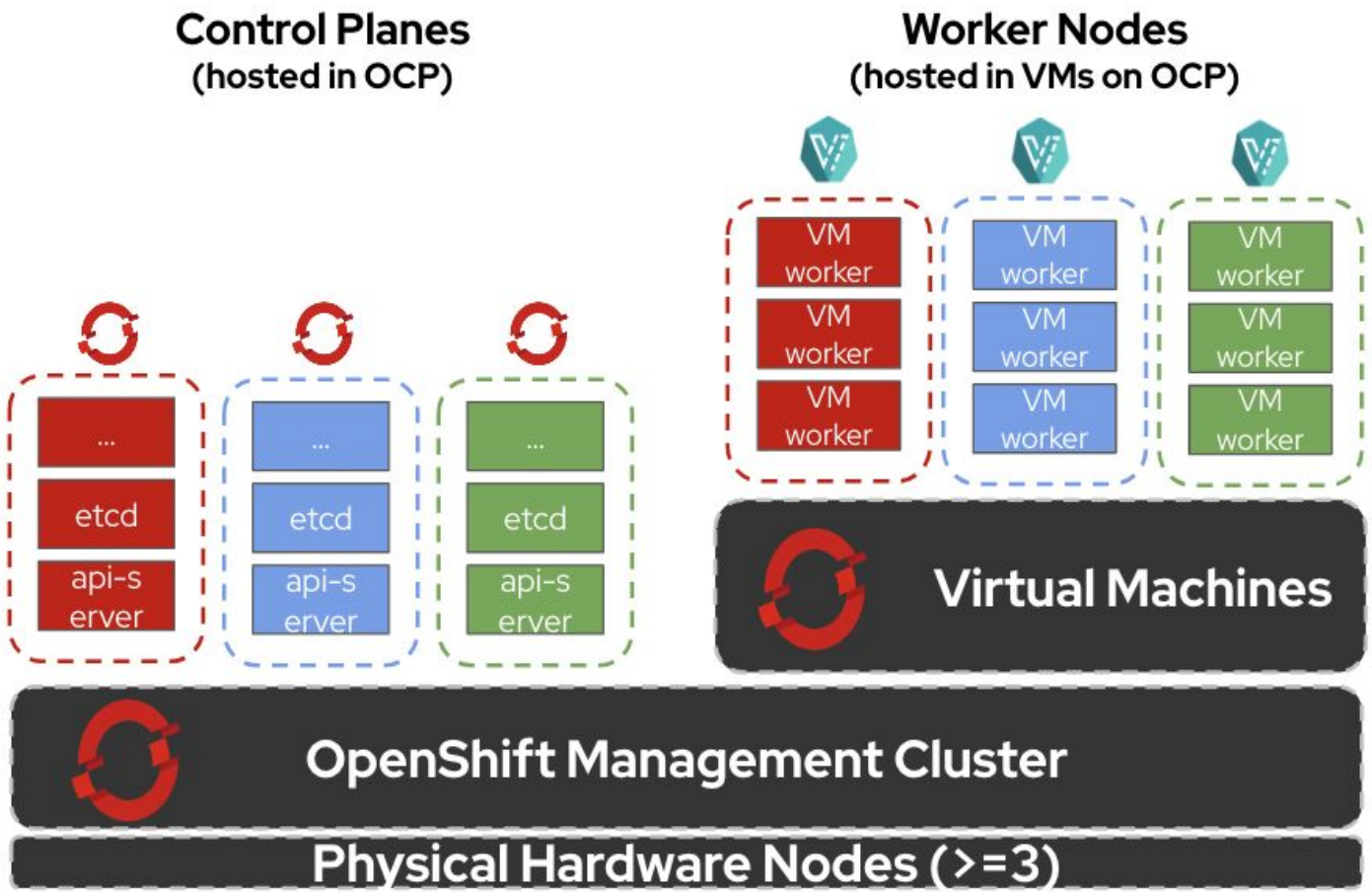
Hosted Control Planes with KubeVirt provider

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

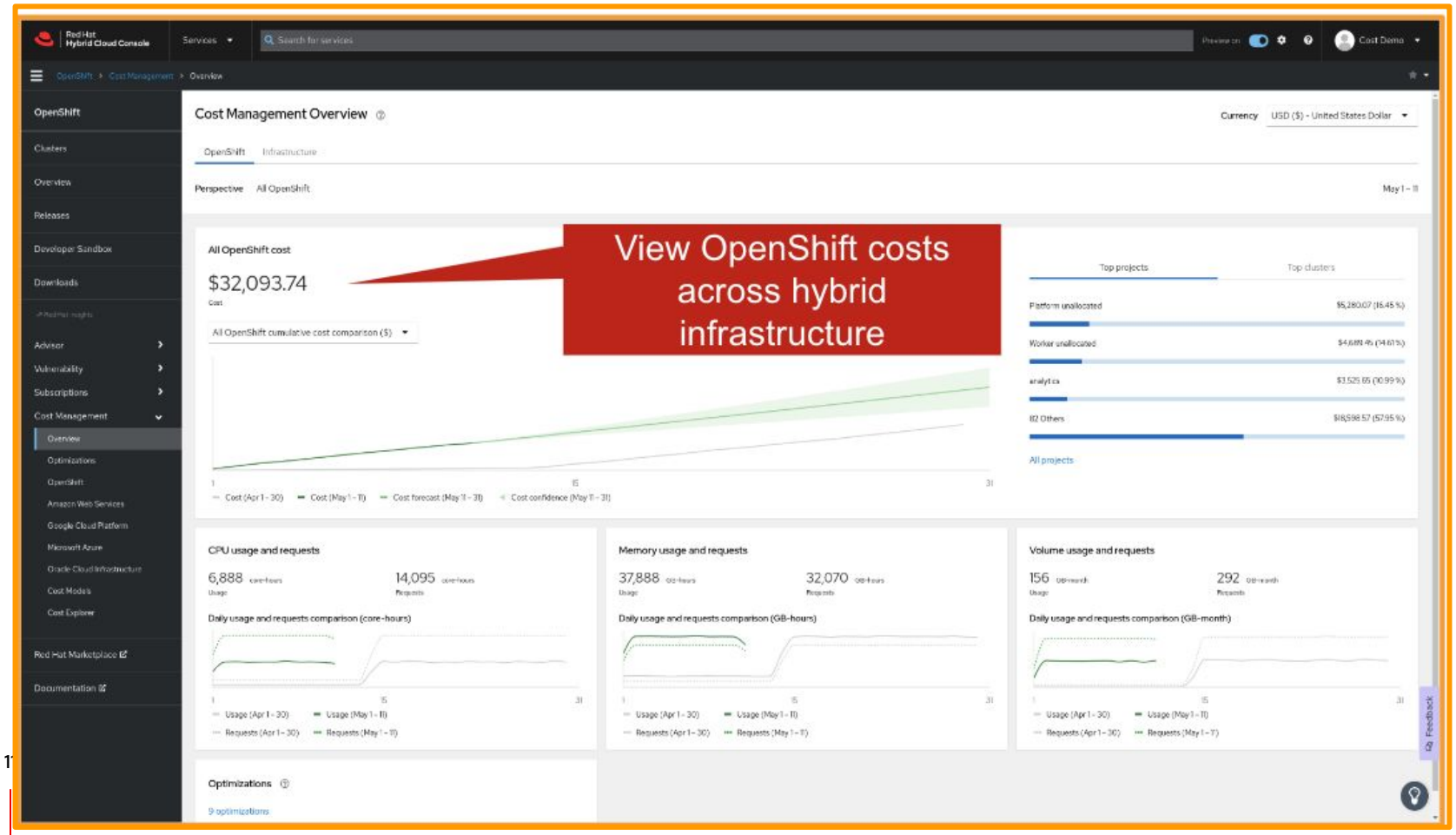
Reduce Dependency on Legacy Virtualization

- Eliminate the need to have legacy hypervisor layer to host your containerized infrastructure
- Underlying virtualization layer is included with hosted OpenShift cluster entitlements (no separate licensing needed)



Red Hat Cost Management

Red Hat Cost Management's SaaS offering allows customers to have visibility into the costs of OCP clusters on-premises and in the cloud.



- Visualize hybrid cloud infrastructure costs
- Track cost trends
- Associate fees with projects, labels and organizations. Slice the data using filters
- Generate showback exports to build your chargeback reports.

Customer journey

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Customer Journey

Assess workloads and devise migration strategy	Create Pilot Migration	Scale Migration	Results
2,400 VM's	Migrate initial batch of VM's	Migrate VM's at scale	Decreased system reliability incidents by 97%
Two datacenters, active-passive	Establish microservices development environment	Train staff and build skills	Combined VM and container management
		Modernize selected applications	Two datacenters, active-active

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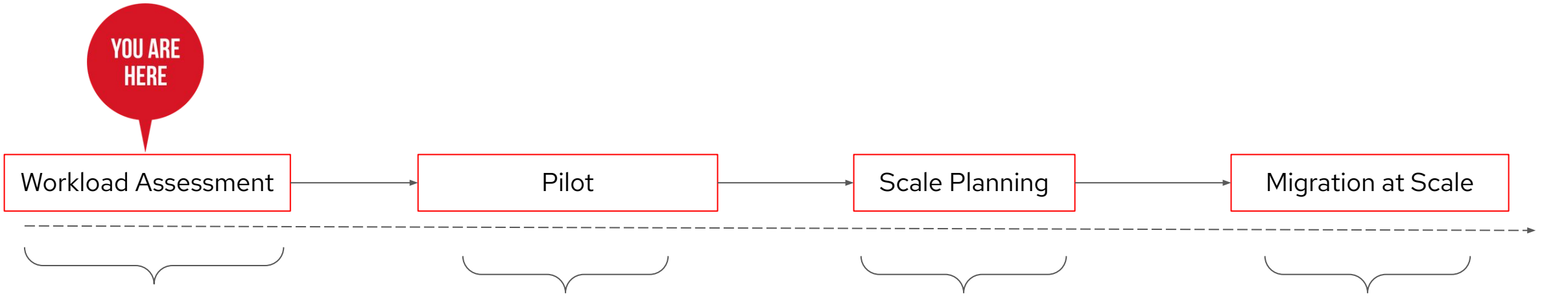
“Path to Production”



- Identify VM workloads
- Define integrations
- Architecture Review

- Build Bare Metal Nodes
- Migrate VM workloads
- “Go live” and Internal testing (~2 weeks)
- Pilot Retrospective
- Discuss scale plan (self-driven or services)

- Portfolio Evaluation
- Plan the migration / modernization at Scale
- Discuss scale plan (self-led or services-led)

- Migrate first batch of workloads
- Repeat
- Retire Legacy Platform

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Reference customers

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Proven performance and scale with KubeVirt

NVIDIA GEFORCE NOW™

28 million
Users

1500+
Games

100+
Countries

30+
Data centers

Source: Powering GeForce NOW with KubeVirt, from OpenShift Commons Gathering, Amsterdam 2023

OpenShift Virtualization Momentum Continues

Red Hat Summit Sessions - May 2023

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.

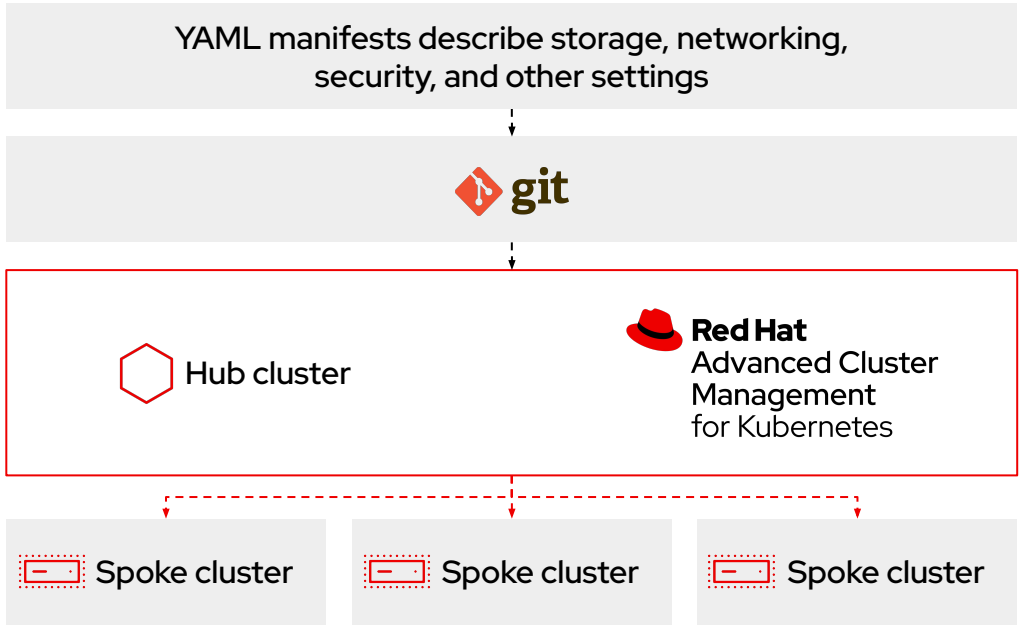
Kubernetes Operational Excellence with GitOps using OCP, RHACM and AAP at Morgan Stanley

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

NOAA AWIPS is deploying 150+ OpenShift clusters

122 Weather Forecast Offices, 13 River Forecast Centers

Advanced Weather Interactive Processing System



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

Source:
https://www.youtube.com/watch?v=QXZZsdgUHhI

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Financial services: NA

Global Investment Bank

"During Red Hat Summit, in 2018, we talked about KubeVirt and we could see KubeVirt would slot very well into their [customer's] existing environment. It could replace the hypervisor control, and also, since we could do this in a very controllable API and CLI controllable method, it would fit with the existing home-built selection infrastructure that was already in place."
Principal Solution Architect, Red Hat

"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

One of the largest investment banks in the world, is migrating their applications from traditional virtualization to Red Hat OpenShift Container Platform with container-native OpenShift Virtualization. Many of these applications are crucial, with expectations of long life cycles and minimal downtime

Highlights

- 40k servers supporting over 250k VMs
- 70 / 30 Linux / Windows split
- 60k stateless virtual Windows desktops
- OpenShift Data Foundation allows live OpenShift upgrades with low impact to application availability
- Over 1,000 servers across multiple geos running containerized applications
- Improved operational life cycle provides "pet" levels of application availability with the benefits of a cloud-native environment

Products and services

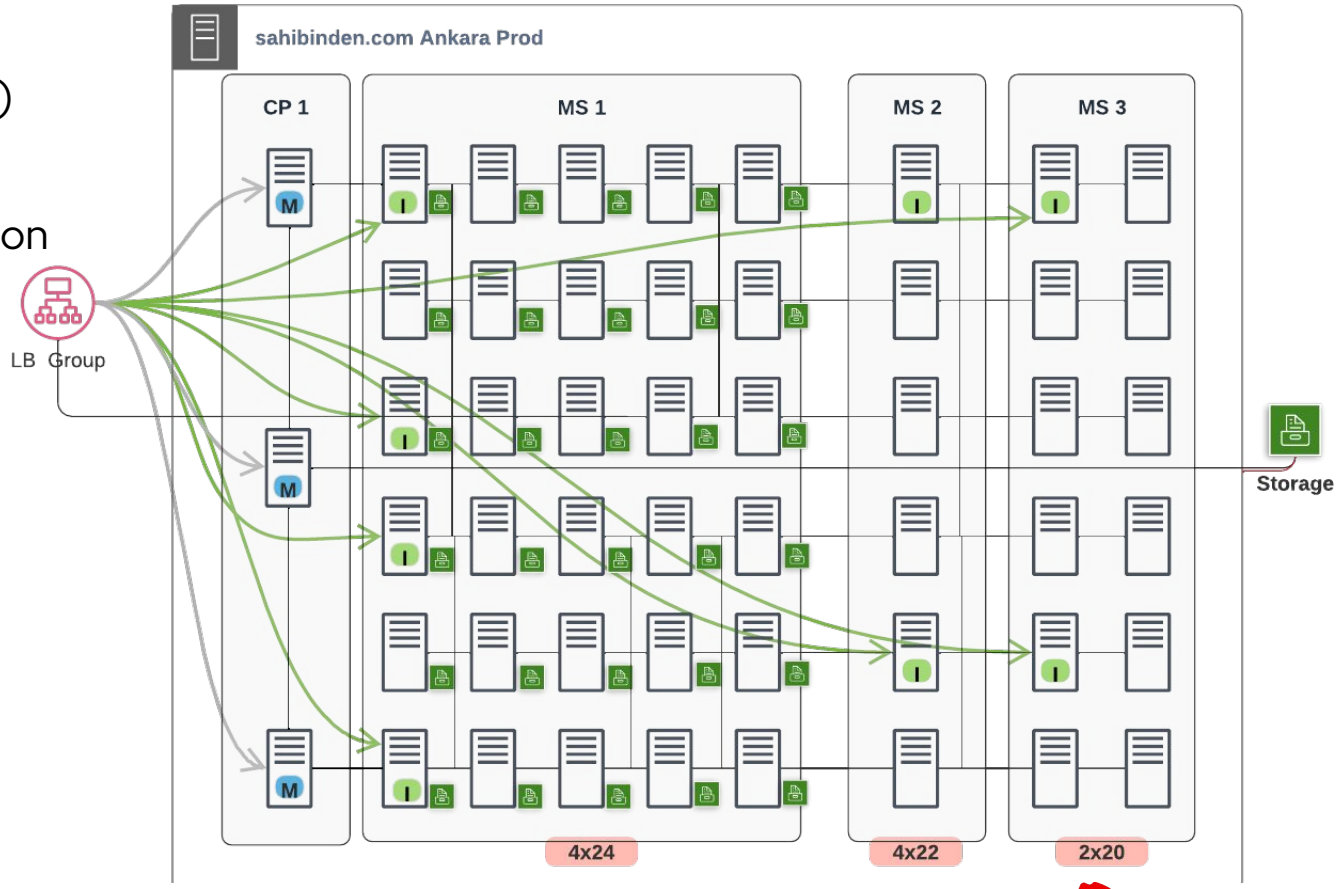
Red Hat® OpenShift® Container Platform
Red Hat® OpenShift® Virtualization
Red Hat® OpenShift® Data Foundation

Source: Operationalizing Virtualization for Key Applications Using Red Hat OpenShift Container Platform at 2022 Red Hat Summit, May 2022.

Sahibinden – a large web retailer in EMEA

Online platform for real estate, cars and a broad variety of goods and services.

- 4th most visited site in region (After GOOG, FB, YT)
- Aggressive deployment of OpenShift & OpenShift Data Foundation in 6 months to production
- Modernize existing infrastructure & VM apps to containers
- Innovative technology to attract & retain IT talent
- Currently running >2000 VMs on >200 hosts
- Second data center for DR



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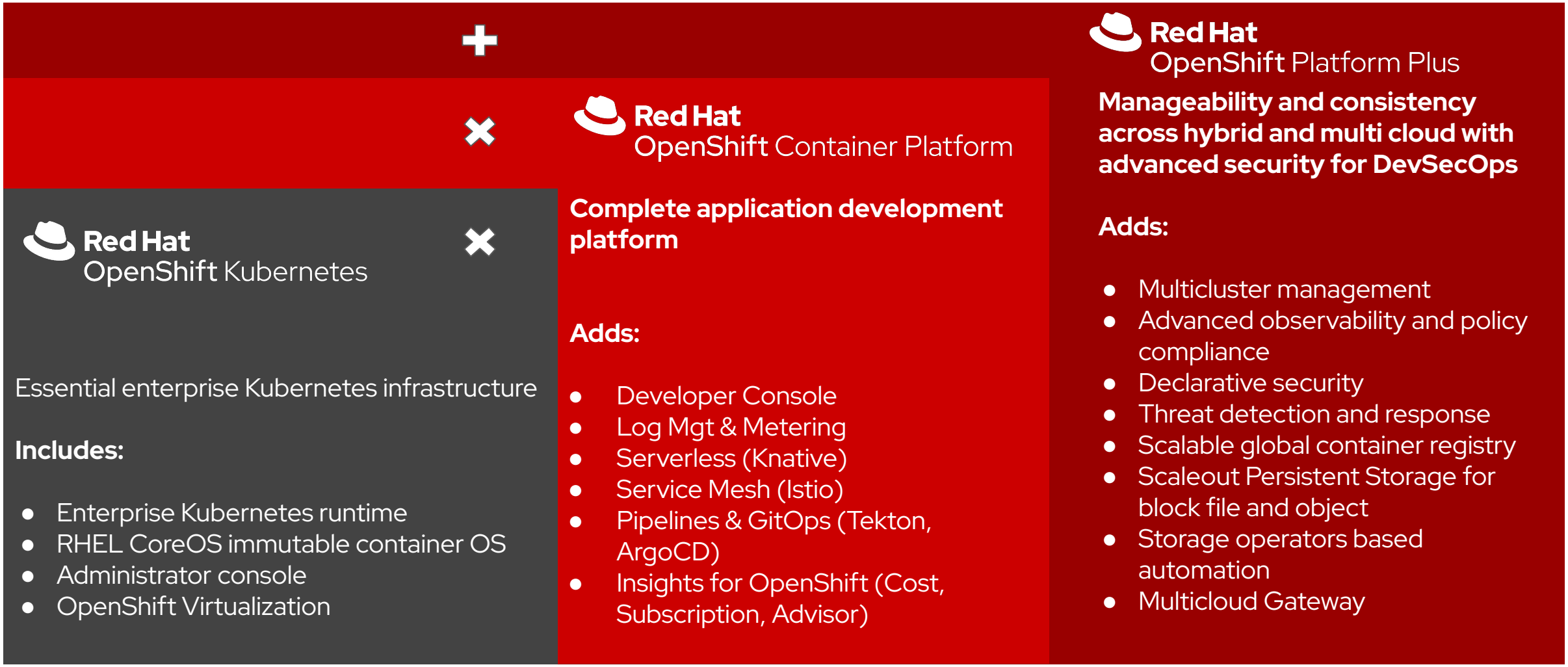
Summary

Not all use cases are the same !



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OpenShift Virtualization Unlocks Tangible Value

COST EFFECTIVENESS

Lower TCO

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

Up to 21% Higher Operational Infrastructure Efficiency*

RISK MANAGEMENT

Highly resilient and scalable

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

Consistency of Management

ITERATIVE MODERNIZATION

Flexibility of approach

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

Up to 42% reduction of Unplanned Outages*

*Forrester "Total Economic Impact of OpenShift Platform Plus 2023

Red Hat OpenShift Virtualization Overview

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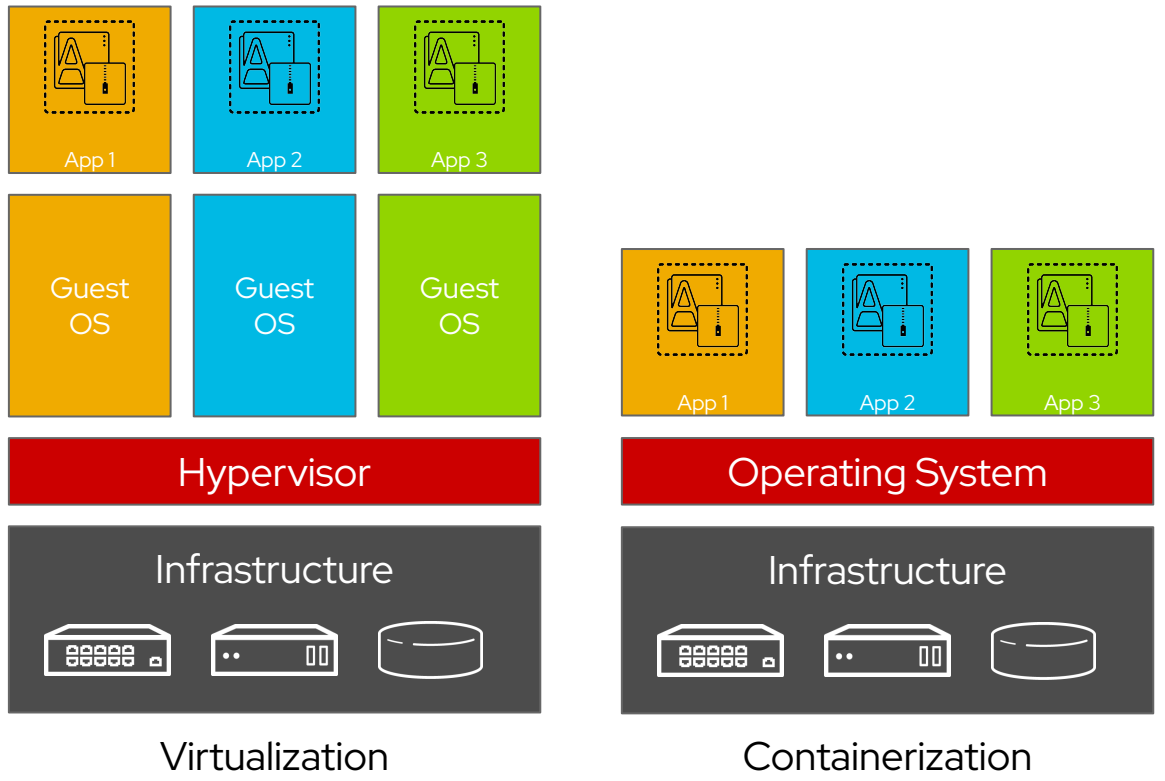
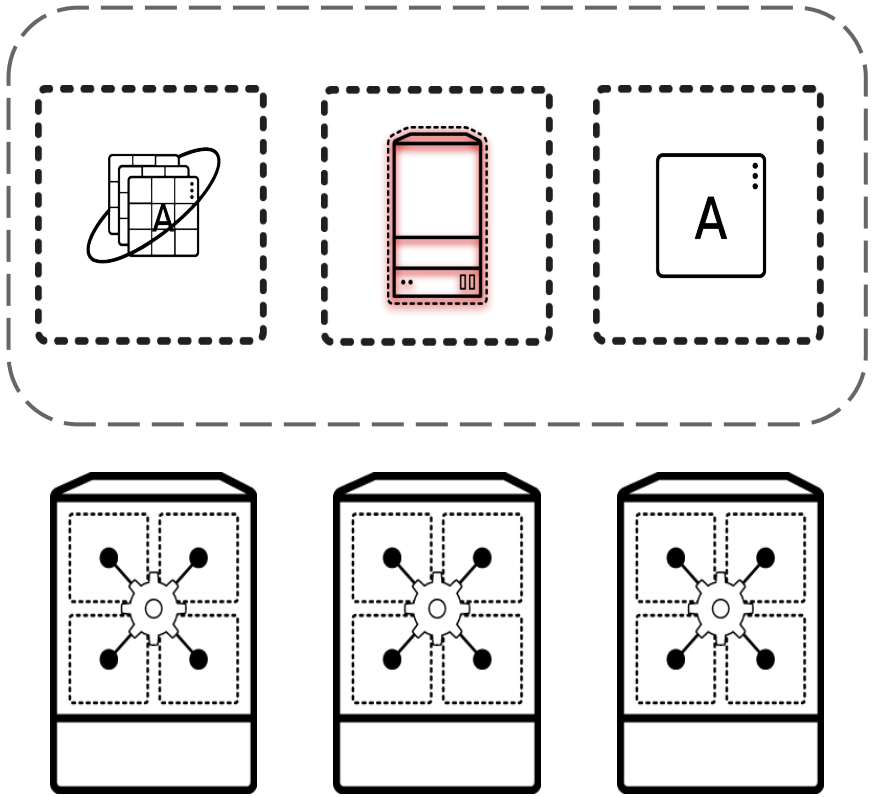
Containers are not virtual machines

- 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



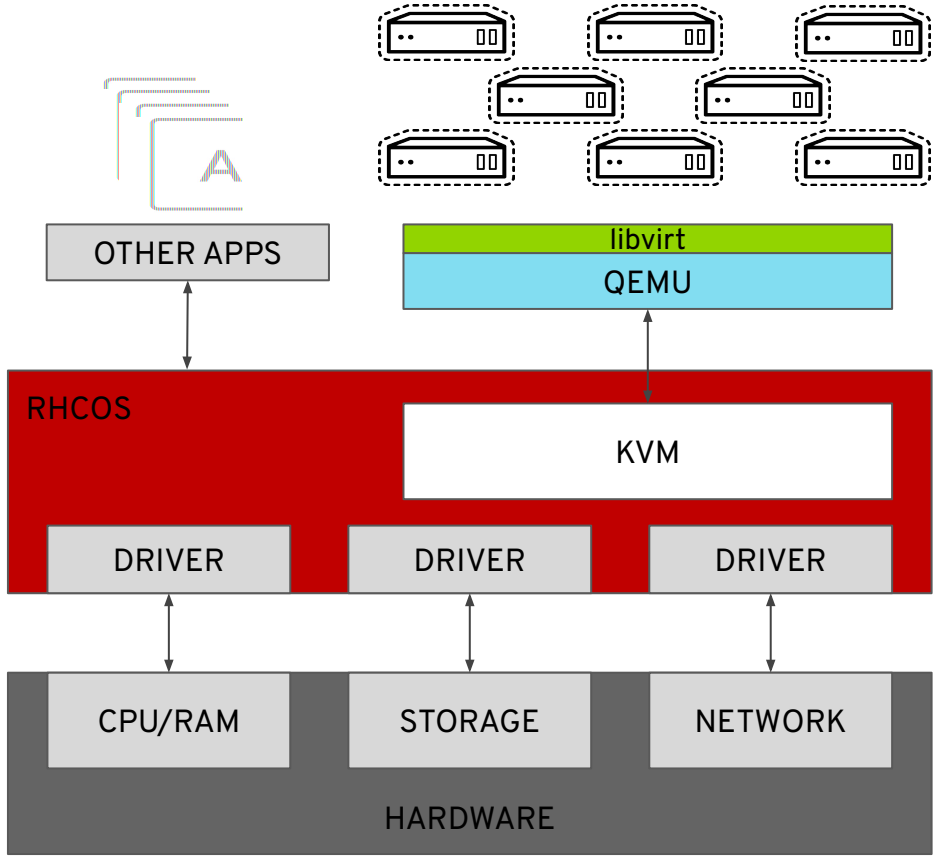
Virtual machines can be put into containers

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



VM containers use 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



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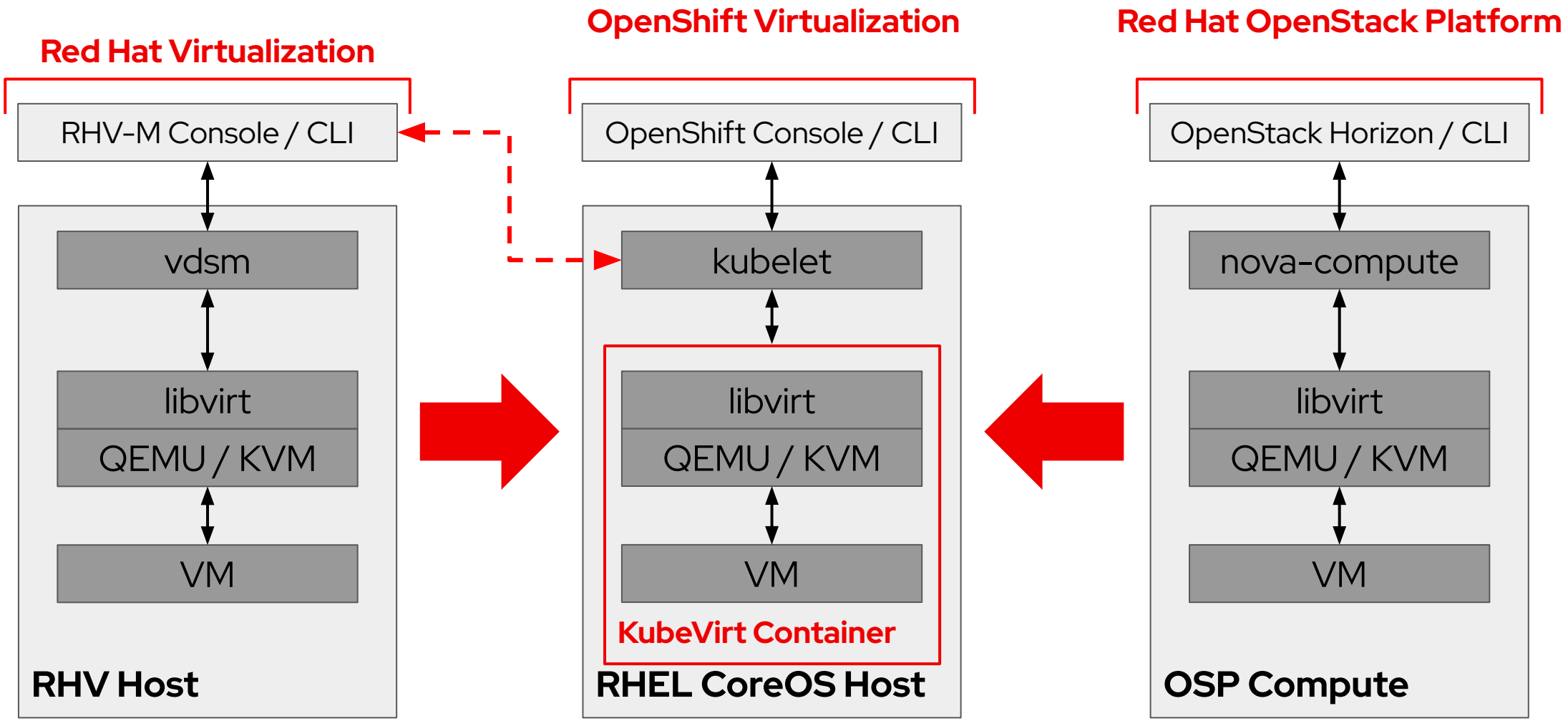
Containerizing KVM

Trusted, mature KVM wrapped in modern management and automation



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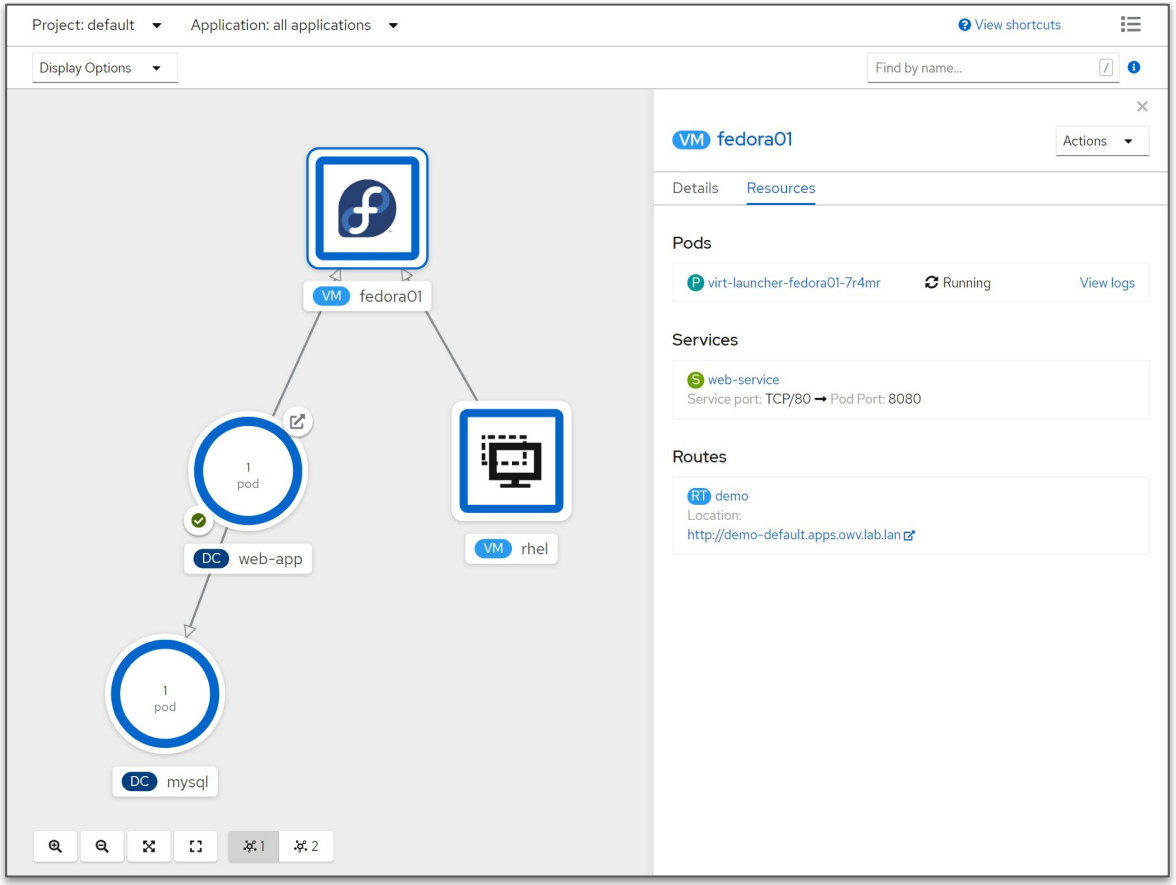
Using VMs and containers together

- 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



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Advantages of running VMs on OpenShift

We already have xyz - why should we care?

- integrated fully functional SDN
- integrated DNS/IPAM
- integrated RHEL subscriptions
- integrated Health Checks and workload aware HA
- integrated Automation
- integrated flexible Load Balancer
- 100% API-first approach

Terminology comparison

Feature	RHV	OpenShift Virtualization	vSphere
Where VM disks are stored	Storage Domain	PVC / PV	Datastore
Policy based storage	None	StorageClass	Storage Policy Based Management (SPBM)
Non-disruptive VM migration	Live migration	Live migration	vMotion
Non-disruptive VM storage migration	Storage live migration	Storage class migration	Storage vMotion
Active resource balancing	Cluster scheduling policy	Pod eviction policy, descheduler	Dynamic Resource Scheduling (DRS)
Physical network configuration	Host network config (via nmstate w/4.4)	NMState Operator, Multus	vSwitch / DvSwitch
Overlay network configuration	OVN	OCP SDN (OpenShift-SDN, OVN-Kubernetes, CNI partners), Multus	NSX-T
Host / VM metrics	Data warehouse + Grafana (RHV 4.4)	OpenShift Metrics and Monitoring	vCenter, vRealize Operations

HA-DR Solutions

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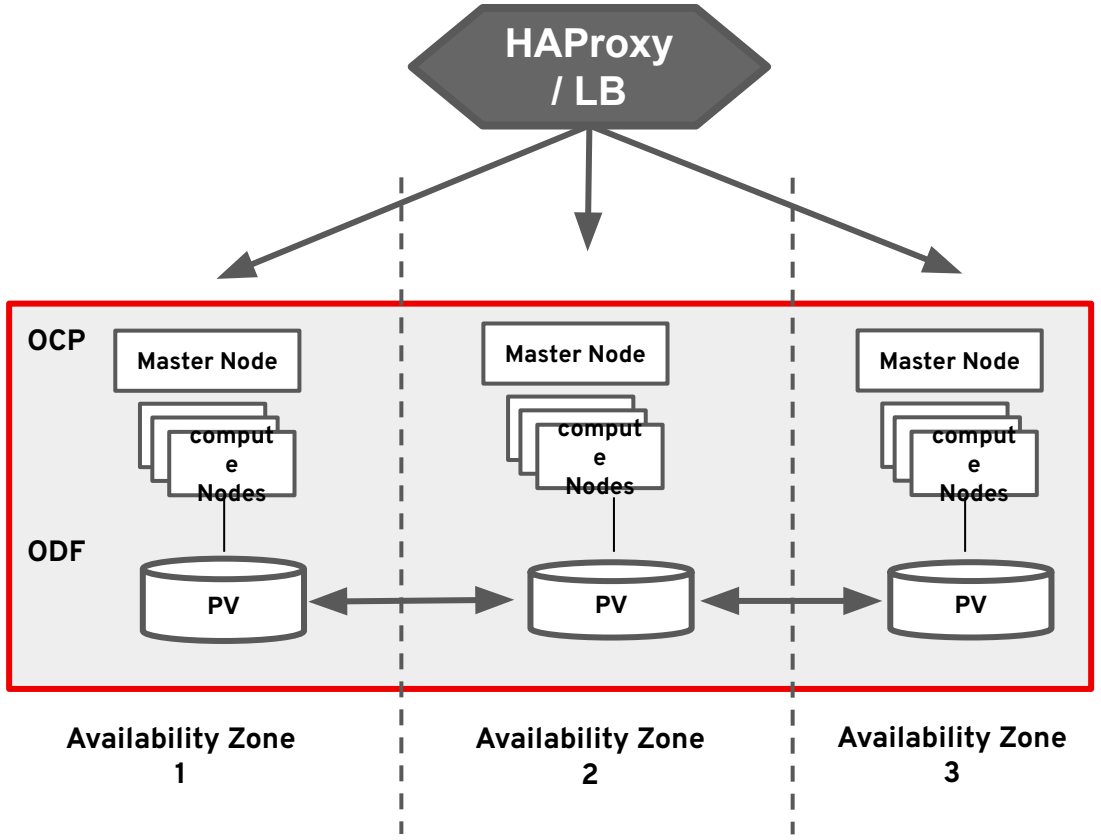
First things first

- **Recovery Point Objective** (RPO) - the maximum acceptable amount of data that can be lost after recovery from disaster - expressed in time

- **Recovery Time Objective** (RTO) - the maximum acceptable time than service can be down after disaster event before being recovered

Multi-Zone spanning Cluster for local HA

Application HA

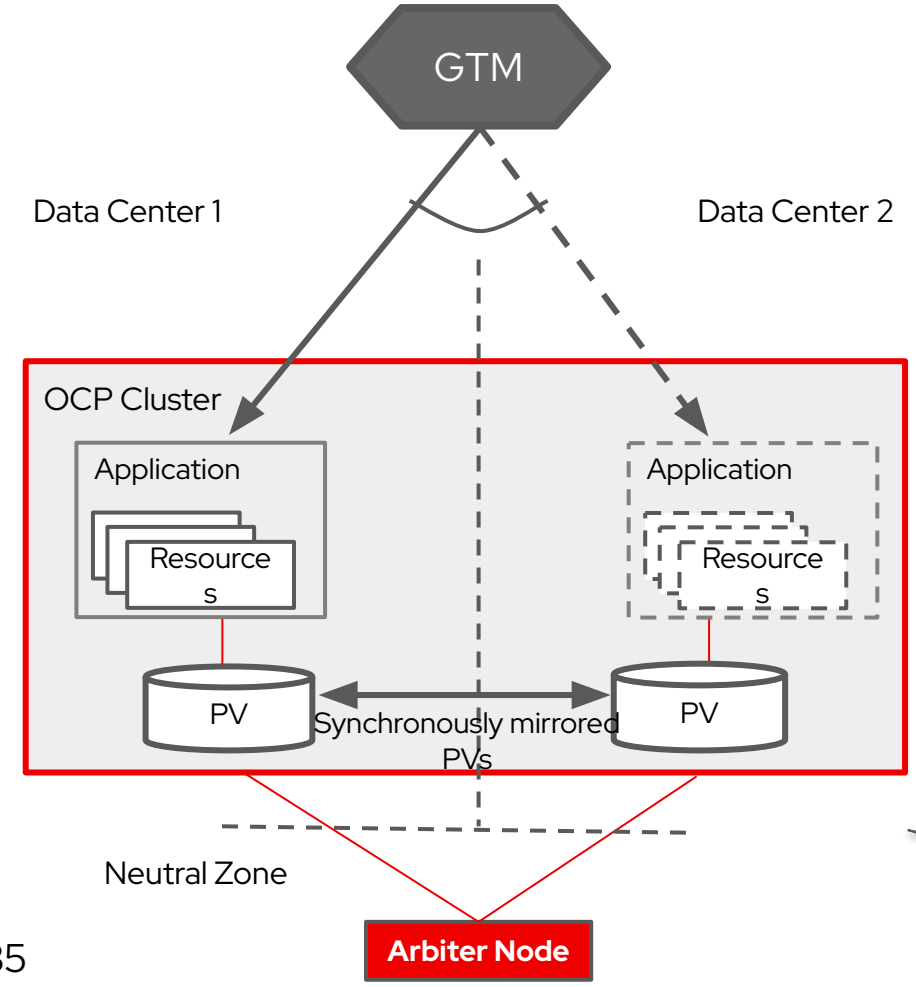


- HA for Stateful Applications deployed on cluster that is stretched across **Availability Zones within a region**
- Installer ensures that resources are deployed across all AZs making the cluster resilient against **failures of any single AZ**
- ODF provides synchronous consistent copies in all AZs ensuring **no data loss during zone failure**
- Suitable for public cloud platforms with Regions supporting 3 or more AZs
- Can be **deployed on-prem** when AZs are connected by networks with <1

RTO = 0
RPO = 0

No Data loss Data Mirroring, with single stretched OCP cluster

Stretch Cluster-DR

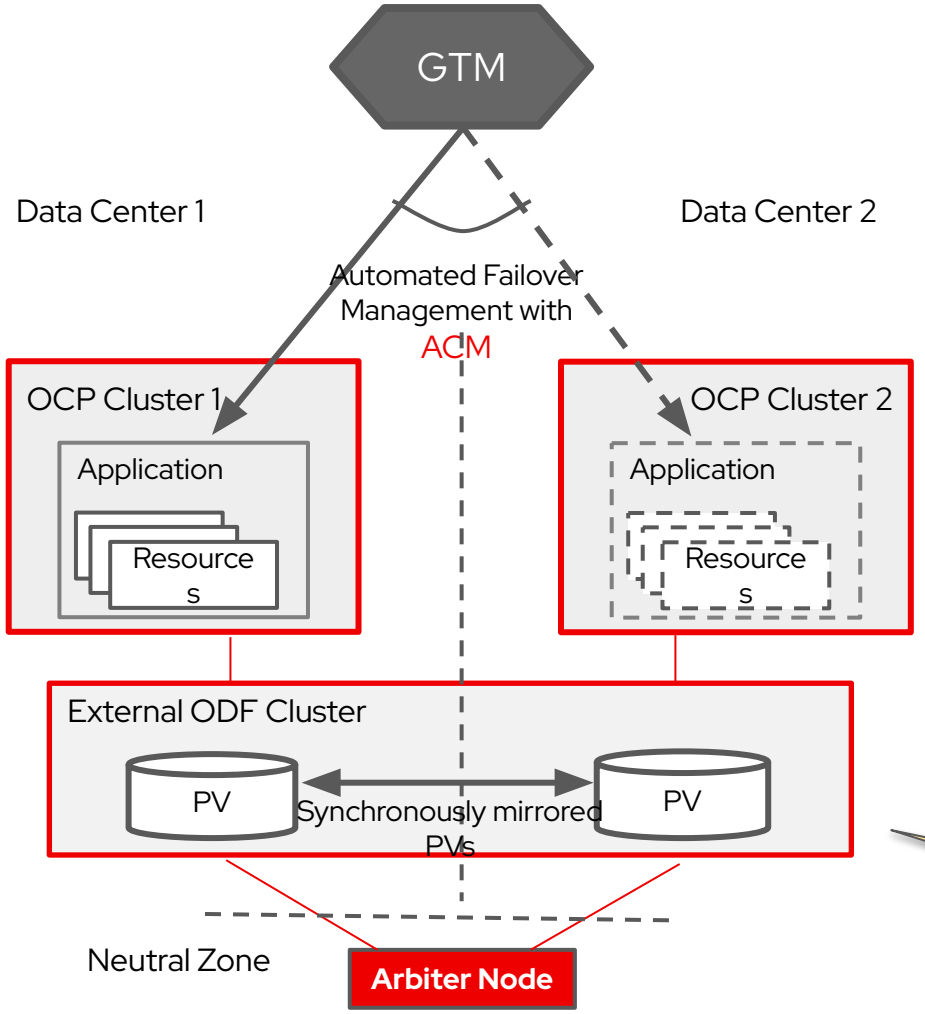


- A **single OCP and ODF Cluster** is deployed in different AZs or data centers to provide a complete fault isolated configuration
- Ceph storage cluster provides **persistent synchronous mirrored volumes** across two data centers enabling **zero RPO**
- Applications recover automatically on surviving nodes in the other data center ensuring **very low RTO**
- Requires **arbiter node in a third site** for storage cluster and OCP Master node
- **Low latency high throughput link** between DC1 and DC2

RTO ~ seconds
RPO = 0

No Data loss Data Mirroring, across multiple OCP clusters

Metro-DR

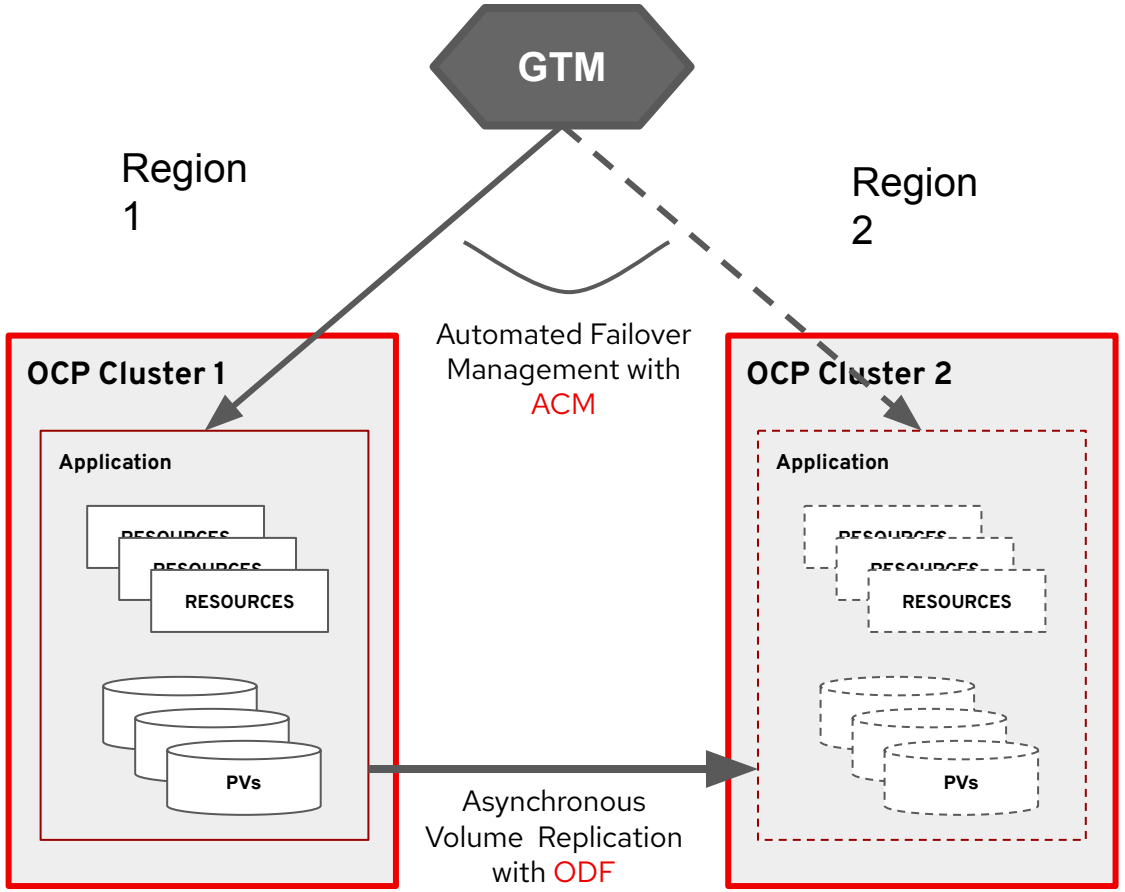


- **Multiple OCP clusters** deployed in different AZs provide a complete fault isolated configuration
- **External** Ceph storage cluster provides persistent synchronous mirrored volumes across multiple OCP clusters enabling **zero RPO**
- ACM managed automated Application failover across clusters **reduces RTO**
- Requires **arbiter node in a third site** for storage cluster
- **Low-latency high-throughput link** between DC1 and DC2
- Arbiter node can be deployed over higher latency networks provided by public clouds

RTO ~ minutes
RPO = 0

Protection against Geographic Scale Disasters

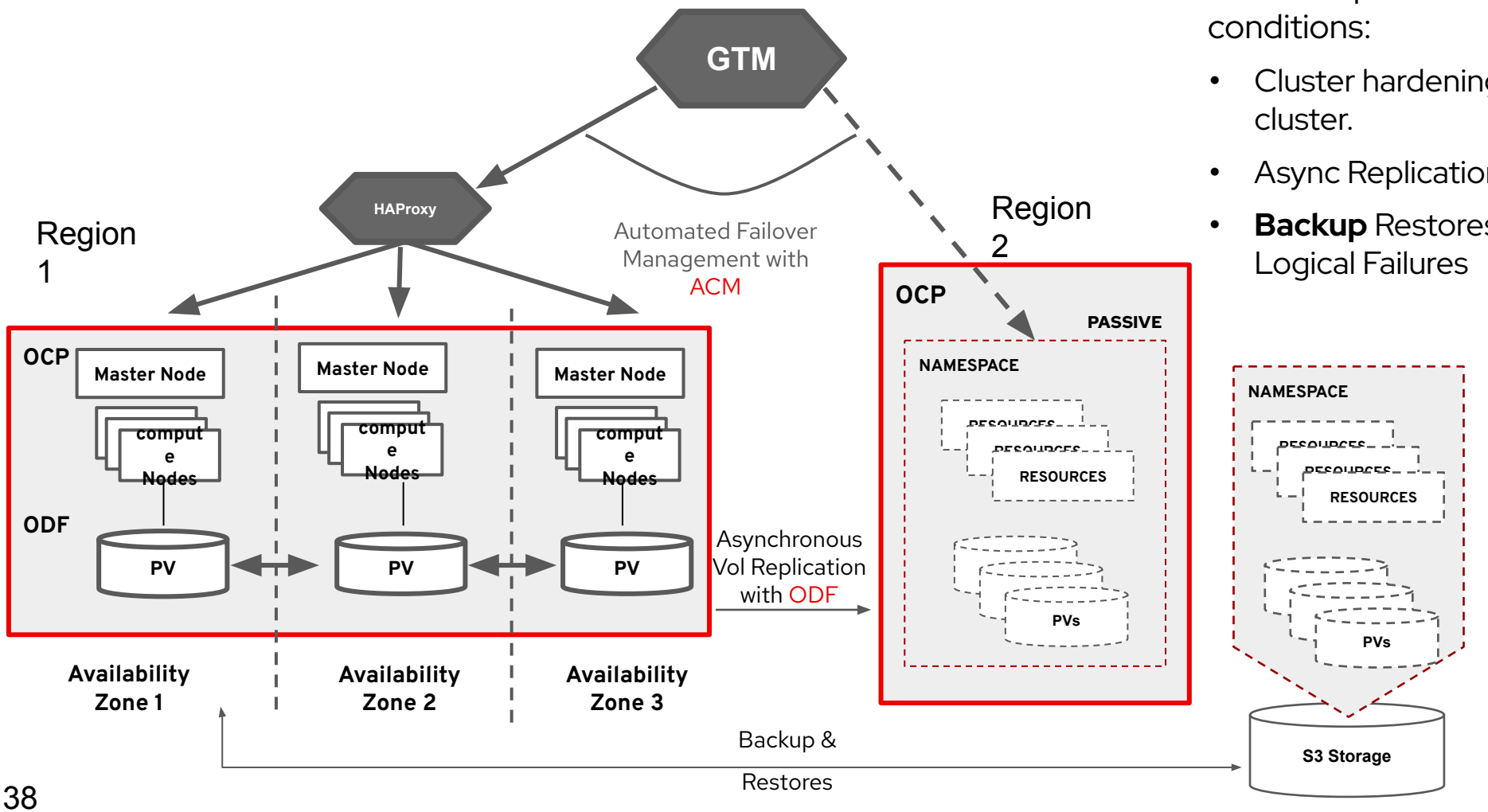
Regional-DR with Failover Automation



- Asynchronous Volume Replication => **low RPO**
  - ODF enables cross cluster replication of data volumes with replication intervals as low as **1 min**
  - ODF Storage operators synchronizes both App data PVs and Cluster metadata
- Automated Failover Management => **low RTO**
  - ACM Multi-Cluster manager enables failover and failback automation at application granularity
  - **Both clusters remain active** with Apps distributed and protected among them

RTO ~ minutes
RPO ~ minutes

Comprehensive & Flexible Data Protection for the desired SLO (RPO+RTO)



Multi-tier protection against various failure conditions:

- Cluster hardening with Multi-Zone spanning OCP cluster.
- Async Replication for HW and Data Center Failures
- **Backup** Restores from Snapshots for Software & Logical Failures

Thank you

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