**Red Hat
OpenShift**
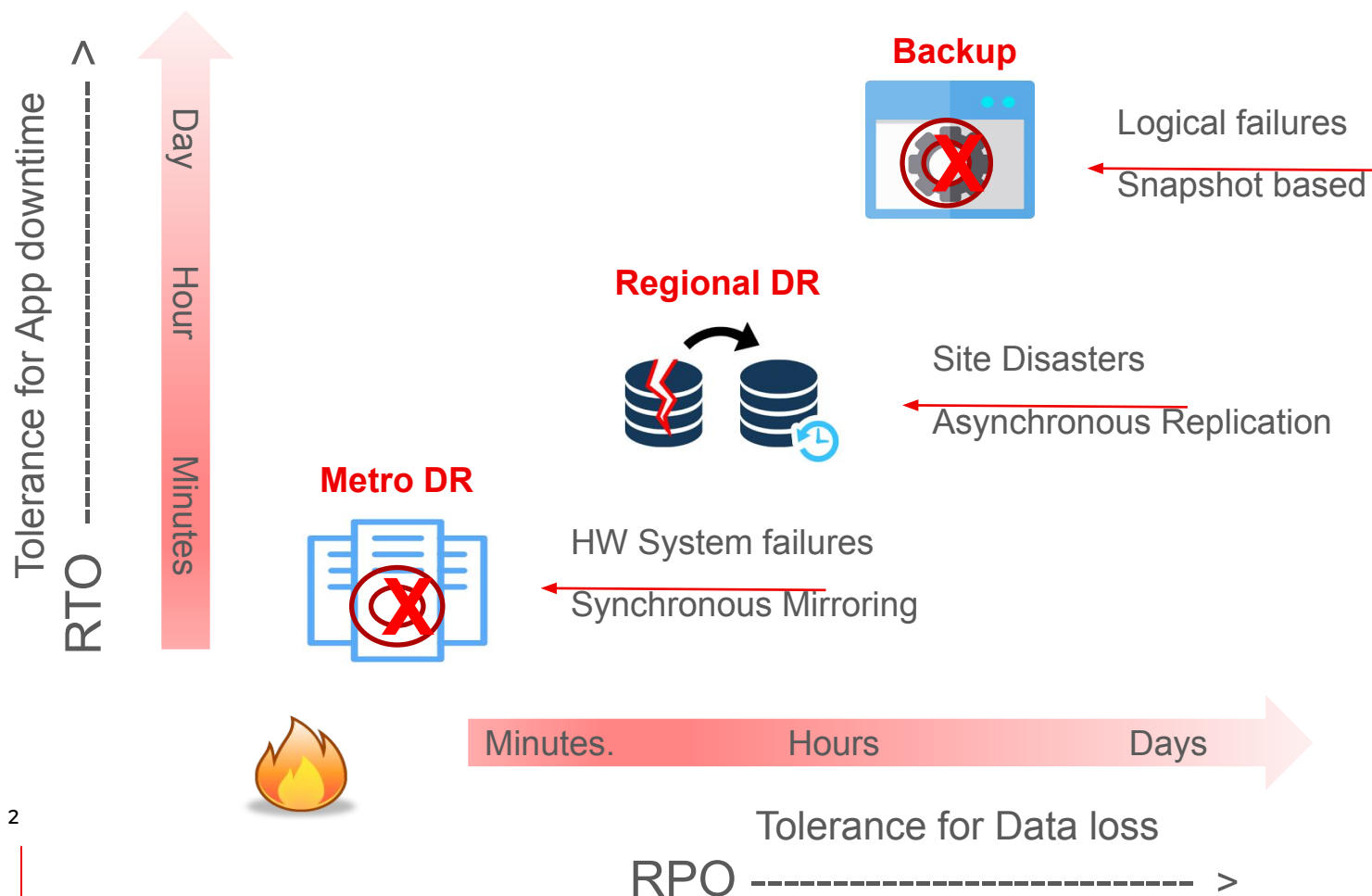
HA-DR for Stateful Applications on OpenShift

we start at 11:30

Red Hat

Resiliency Solutions for different service level objectives

Tolerance for App downtime

RTO ---------->

Day

Hour

Minutes

Backup

Logical failures

Snapshot based

Regional DR

Site Disasters

Asynchronous Replication

Metro DR

HW System failures

Synchronous Mirroring

Minutes.   Hours   Days

Tolerance for Data loss

RPO --------------------------- >

‣ Comprehensive protection solutions against wide spectrum of failures

‣ Beyond Data Protection --> Full Application protection

‣ Resiliency built into the platform – Available to all stateful and stateless applications on OpenShift

‣ OCP + ODF + ACM integrated stack lends towards Automated and Simplified Application granular protection

2

V0000000

Red Hat

OCP Integrated, Full Stack DR Protection

Multi-Site Multi Cluster Manager

RHACM
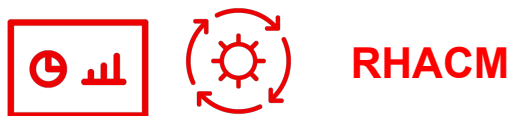
- ODR Hub Operator – Orchestrates & Automates DR operations across clusters

Platform

Red Hat OpenShift

- ODR Cluster Operator - Manages and synchronizes cluster meta data and application data

Persistence Layer

Red Hat OpenShift Data Foundation

- Asynchronous replication of Application volumes – or-
- Synchronous Mirroring of Application volumes

- Easy configuration DR across cluster and sites as part of application deployment

- Automated DR Failover and Failback operations reduces RTO

- Manage and Monitor DR across clusters and Apps

- Same consistent DR operations for both Metro-DR and Regional-DR

- Both Application Data and State is protected and used for Application granular protection

- Consistent Data replication or mirroring or both based on infrastructure and desired protection.

Red Hat

OCP Cluster HA + DR for stateful Applications
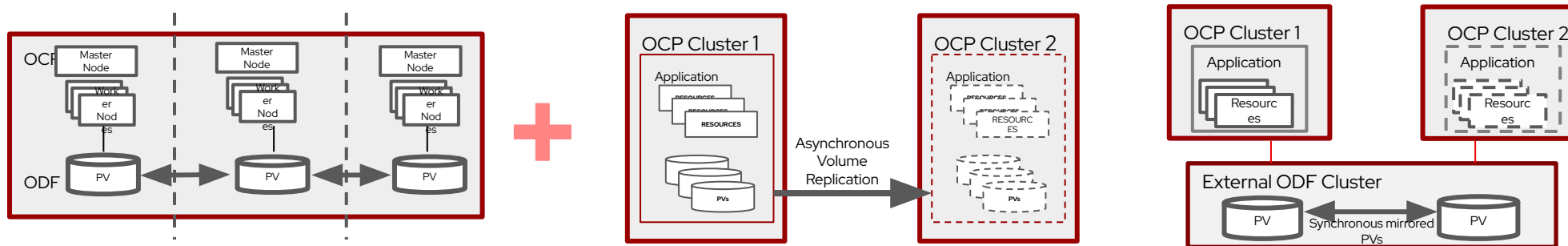
|	**Cluster HA**	**Regional-DR**	**Metro-DR**
Topology	Single OCP+ODF clusters deployed over multiple AZs in a single region	Multi OCP + ODF clusters spread over multiple regions	Multi OCP clusters + single external ODF stretched cluster deployed over low latency networks
RTO (Downtime)	RTO=0 (Continuous)*	RTO = minutes DR Automation from ACM+ODF reduces RTO	RTO = minutes DR Automation from ACM+ODF reduces RTO
RPO (Data loss exposure)	RPO=0 No Data loss due due to Synchronous mirroring of ODF data	RPO > 0; Usually 5 min or higher Depends upon network bandwidth & change rate	RPO=0 No Data loss due due to Synchronous mirroring of ODF data
Infra Requirements	Multi-AZ supported public clouds (vSphere support in OCP 4.10)	All ODF supported platforms No network latency limits	On-prem only (vSphere, bare metal) <10ms network latency between sites

V0000000

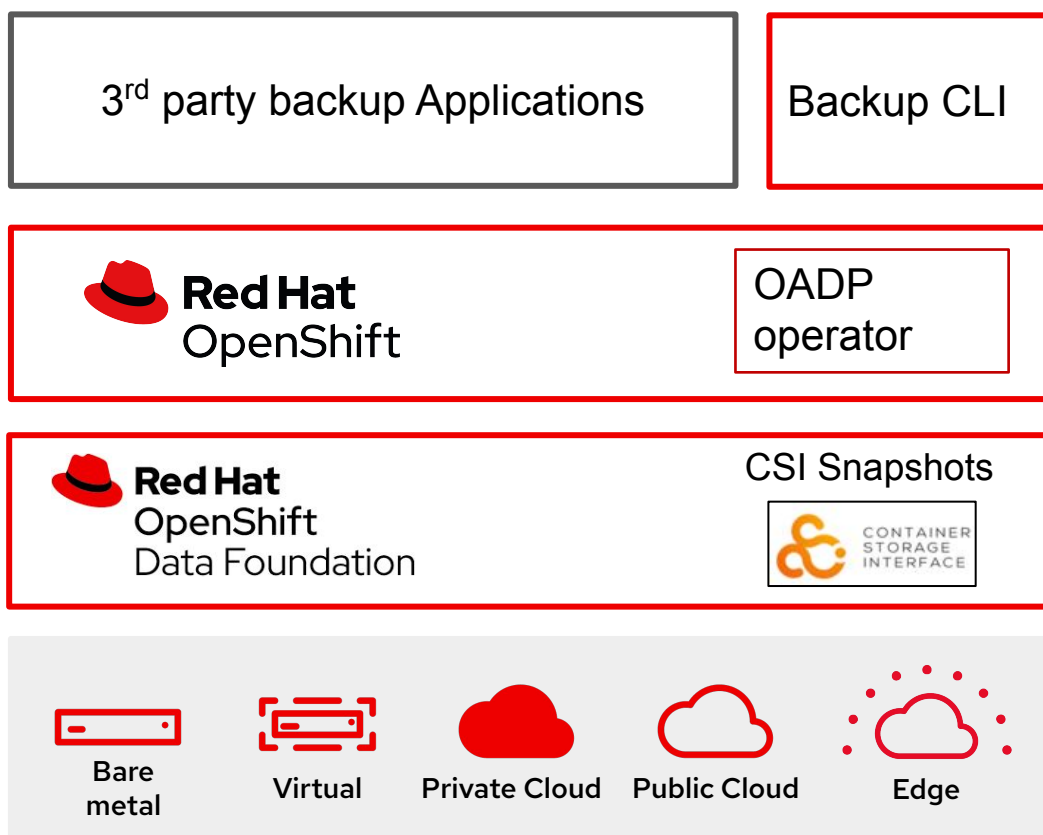* Subject to RWO PV limitations

Solution Overview

V0000000

Red Hat

OpenShift Backup Solution

OADP – OpenShift API for Data Protection
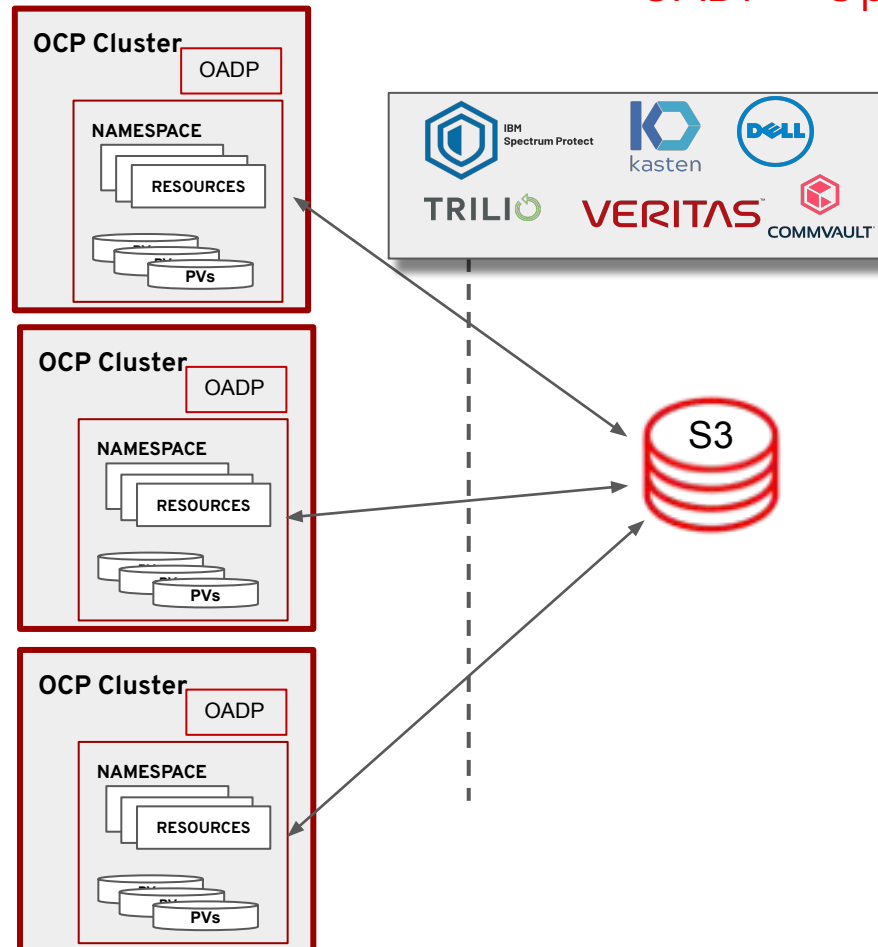
▸ Application granular, cluster consistent backups with OADP

▸ OpenShift App backup protection with eco-system of broad Backup Partner ISV partners

▸ Snapshots with CSI interface from ODF ensures backups with open standards

V0000000

Red Hat

OCP Application Backup – Key Components

3rd party backup Applications

Backup CLI

Red Hat
OpenShift

OADP operator

Red Hat
OpenShift
Data Foundation

CSI Snapshots

CONTAINER STORAGE INTERFACE

Bare metal

Virtual

Private Cloud

Public Cloud

Edge

- Third party backup Applications /native CLI
  - Handles Backup policy management, backup scheduling, retention and restore management and data movement

- OADP – OpenShift App Data Protection API
  - Enables namespace or label scoped backups with all ensuing cluster resources and application data (PVs)
  - Ensures OCP version independence and works across storage providers (via plug-ins)

- ODF PV Snapshots via CSI
  - PV/PVC backups of ODF volumes through standard CSI interfaces
  - Can be used with or without OADP

Red Hat

Application HA

Multi-Zone spanning Cluster for local HA

HAProxy / LB
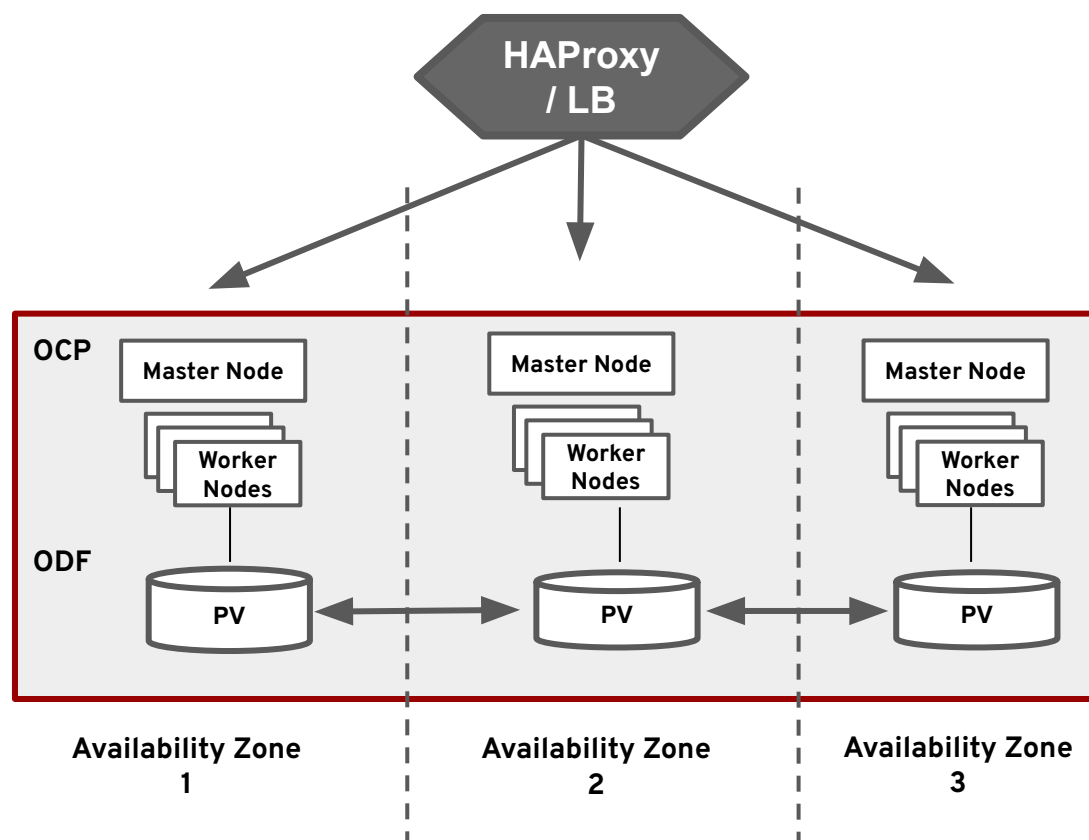
‣ HA for Stateful Applications deployed on cluster that is stretched across Availability Zones within a region

‣ 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 failures

‣ Suitable for public cloud platforms with Regions supporting 3 or more AZs

· Can be deployed on-prem when AZs are connected by networks with <10ms latency
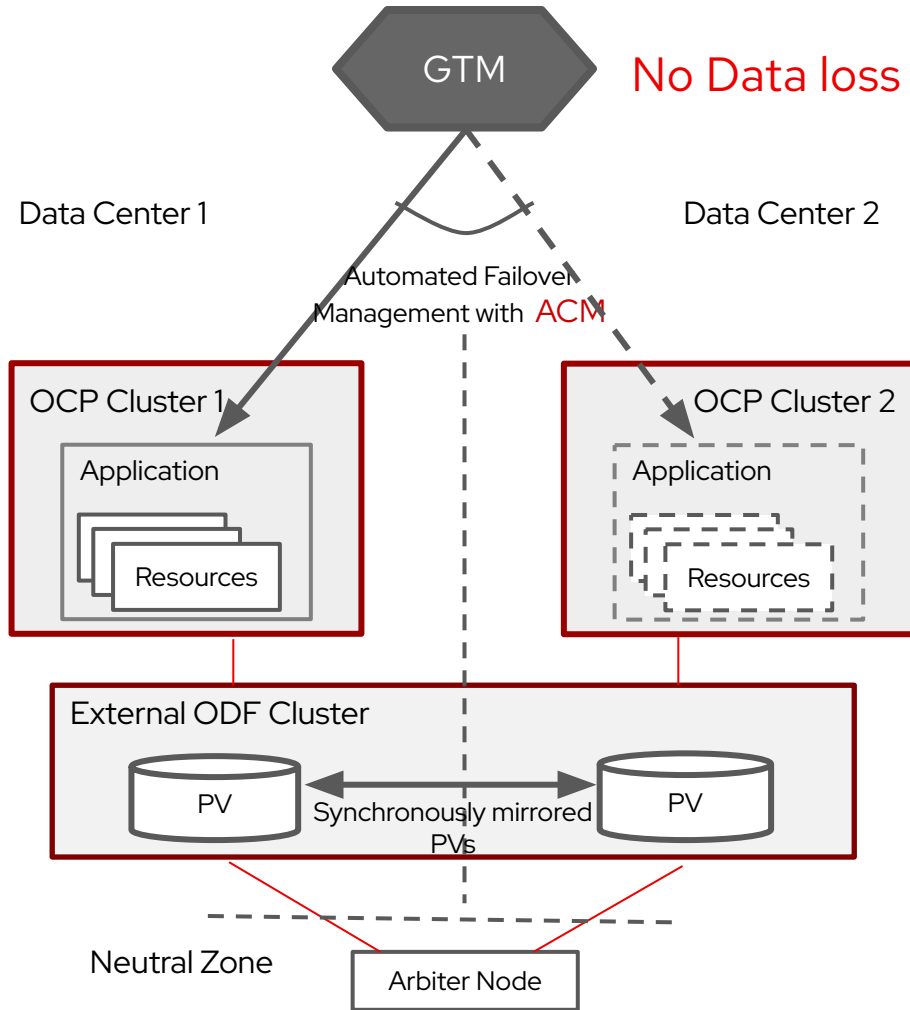
OCP

Master Node

Worker Nodes

Master Node

Worker Nodes

Master Node

Worker Nodes

ODF

PV

PV

PV

Availability Zone 1

Availability Zone 2

Availability Zone 3

8

V0000000

Red Hat

RPO – Mins
RTO – Mins

Regional-DR with Failover Automation

Protection against Geographic Scale Disasters
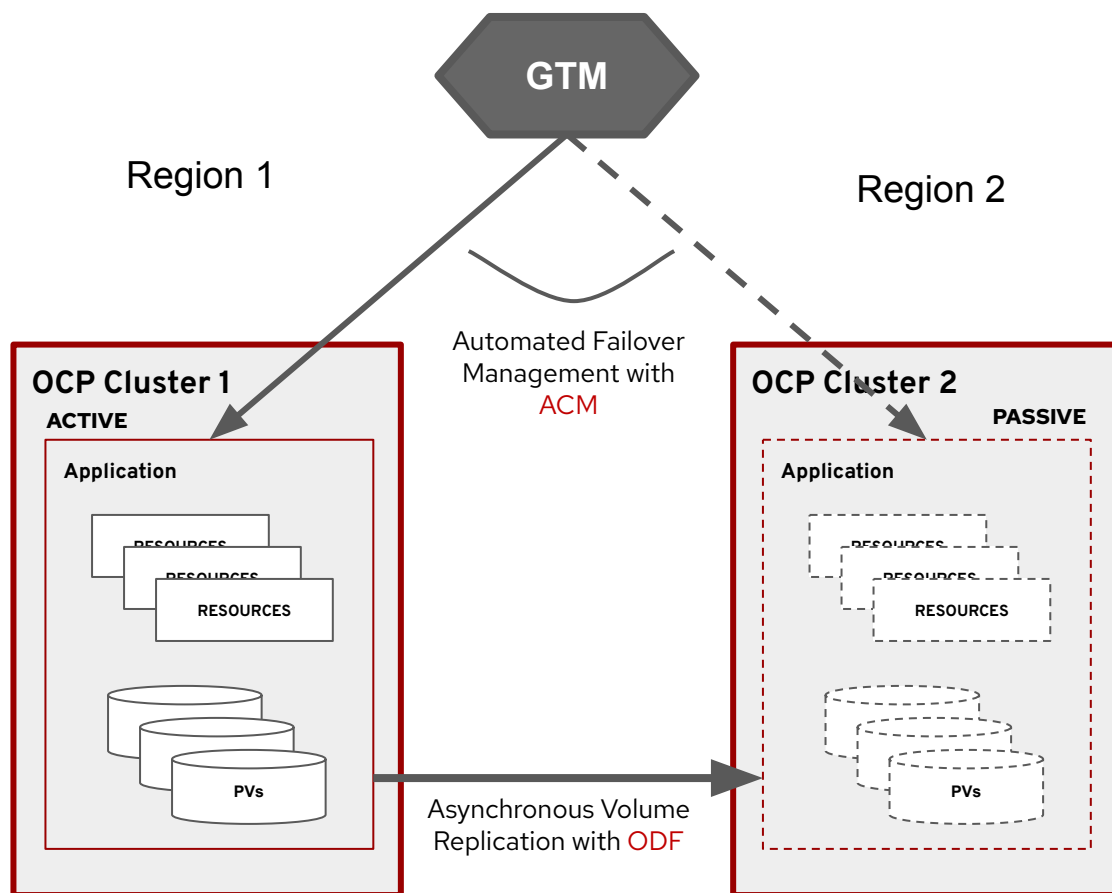
- ▶ Asynchronous Volume Replication => low RPO
  - • ODF enables cross cluster replication of data volumes with replication intervals as low as 1 min
  - • ODF Storage operators synchronizes both App data PVs and Cluster metadata

- ▶ 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

V0000000

Red Hat

RPO – 0
RTO – Mins

Metro-DR – Multi Cluster

GTM

No Data loss Data Mirroring, across multiple OCP clusters

Data Center 1

Data Center 2

Automated Failover Management with ACM

OCP Cluster 1

Application

Resources

OCP Cluster 2

Application

Resources

External ODF Cluster

PV

Synchronously mirrored PVs

PV

Neutral Zone

Arbiter Node

- Multiple OCP clusters deployed in different AZs provide a complete fault isolated configuration

- External RHCS 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

    - Arbiter node can be deployed over higher latency networks provided by public clouds

V0000000

Comprehensive & Flexible Data Protection for the desired SLO (RPO+RTO)
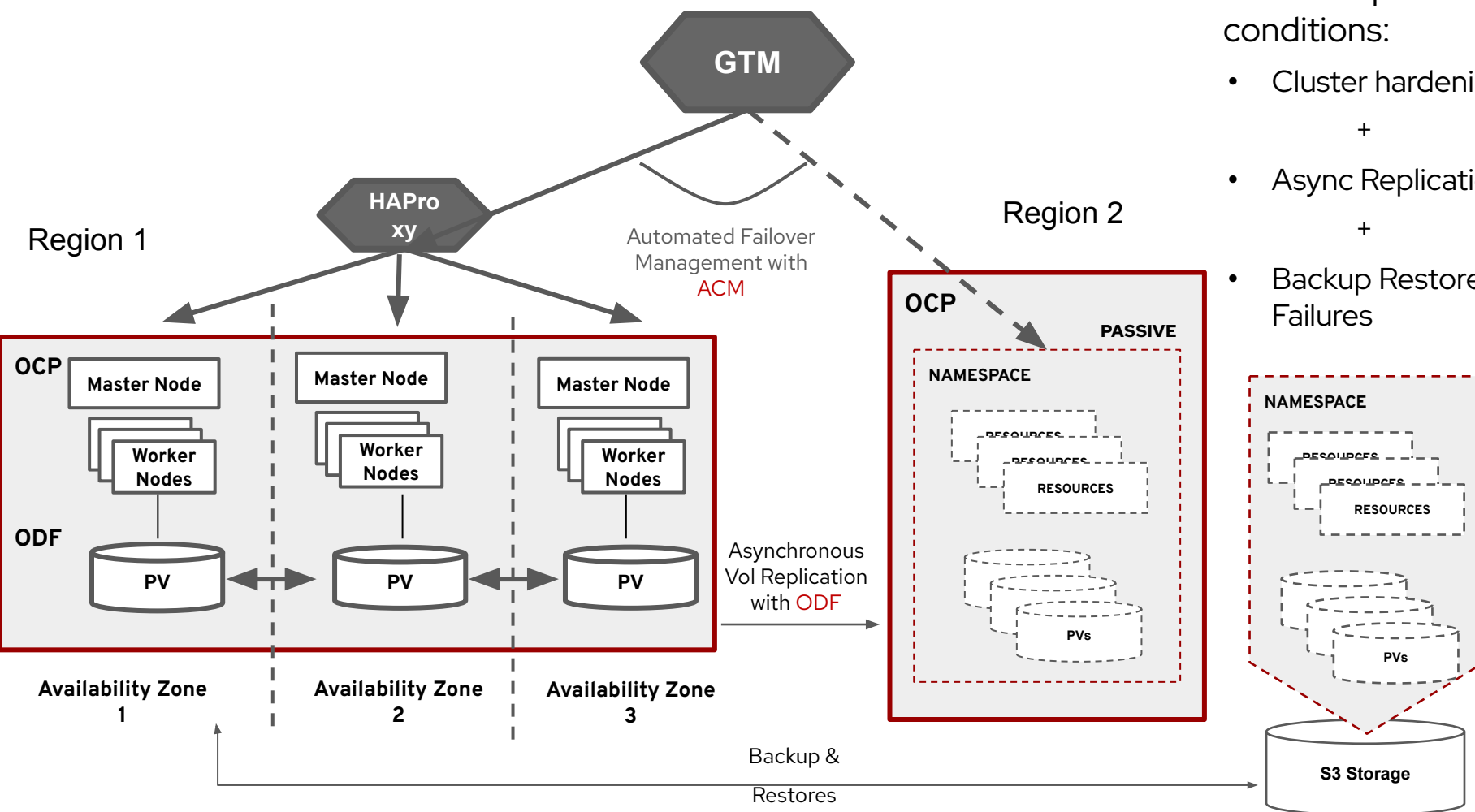
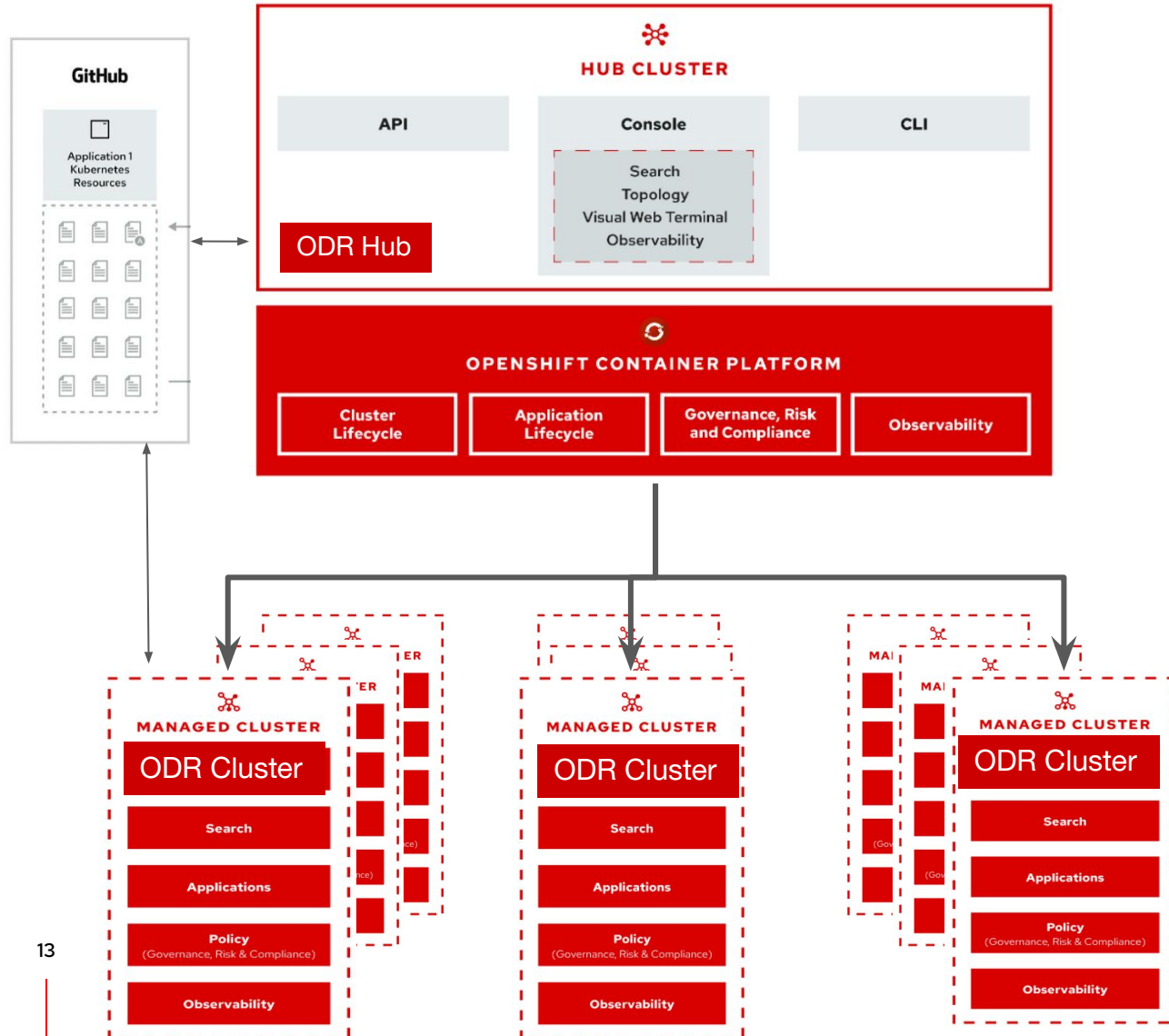Multi-tier protection against various failure conditions:

- Cluster hardening with Multi-Zone spanning OCP cluster.

  +

- Async Replication for HW and Data Center Failures

  +

- Backup Restores from Snapshots for Software & Logical Failures

GTM

HAProxy

Automated Failover Management with **ACM**

Region 1

Region 2

OCP

PASSIVE

NAMESPACE

RESOURCES
RESOURCES
RESOURCES

PVs

NAMESPACE

RESOURCES
RESOURCES
RESOURCES

PVs

OCP

Master Node
Master Node
Master Node

Worker Nodes
Worker Nodes
Worker Nodes

ODF

PV
PV
PV

Availability Zone 1
Availability Zone 2
Availability Zone 3

Asynchronous Vol Replication with **ODF**

Backup & Restores

S3 Storage

11

Red Hat

RH-ACM Based DR Automation

DR Automation reduces
RTO

Red Hat

RHACM Managed DR Automation
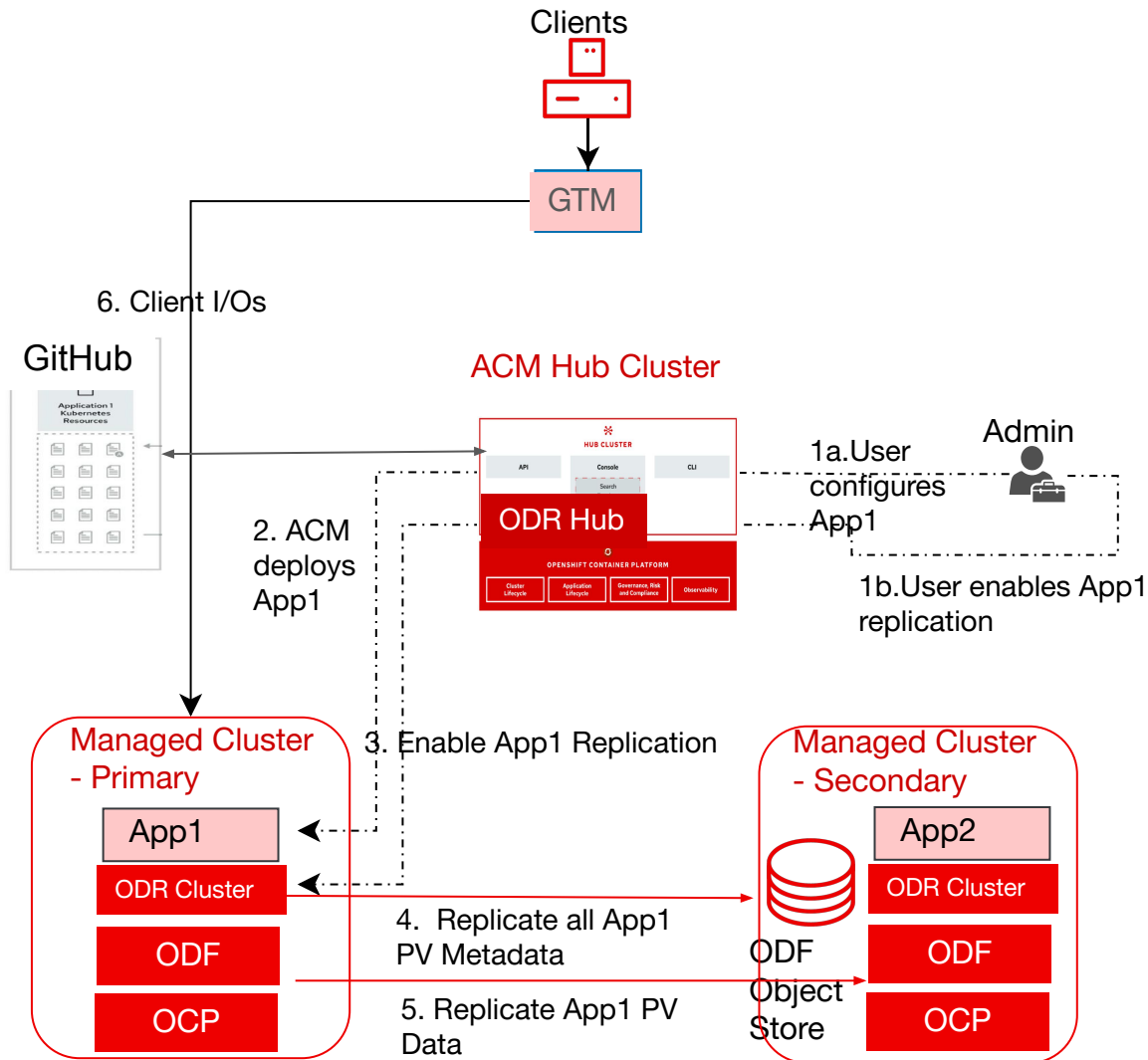
- ▶ ACM provides DR management and monitoring across multiple clusters.

- ▶ ACM drives placement of DR enabled applications based on capacity and policy

- ▶ DR Orchestration through the centrally managed RH-ACM Hub via ODR Hub operator

- ▶ ODR Cluster Operator on each managed (workload) cluster manages data replication and synchronization

- ▶ ACM Hub cluster is recommended to be placed in a zone neutral to managed clusters

V0000000

ODF & ACM enables easy DR Configuration

Clients

GTM

6. Client I/Os

GitHub

Application 1 Kubernetes Resources

ACM Hub Cluster

HUB CLUSTER

| API | Console | CLI |

Search

ODR Hub

OPENSHIFT CONTAINER PLATFORM

| Cluster Lifecycle | Application Lifecycle | Governance, Risk and Compliance | Observability |

2. ACM deploys App1

1a. User configures App1

Admin

1b. User enables App1 replication

Managed Cluster - Primary

3. Enable App1 Replication

Managed Cluster - Secondary

App1

ODR Cluster

ODF

OCP

4. Replicate all App1 PV Metadata

App2

ODR Cluster

ODF Object Store

ODF

OCP

5. Replicate App1 PV Data

A Centrally deployed ACM Hub managing DR between a pair of Managed clusters deployed at different regions

- ▸ Ensures both Application state and Data are replicated and protected
  - · Uses ODF Object Store to capture App meta data
- ▸ Provide active-active use of both sites, where different applications can be deployed to each site cross replicating to each other
- ▸ Flexibility for replica copy to have different storage configuration than primary
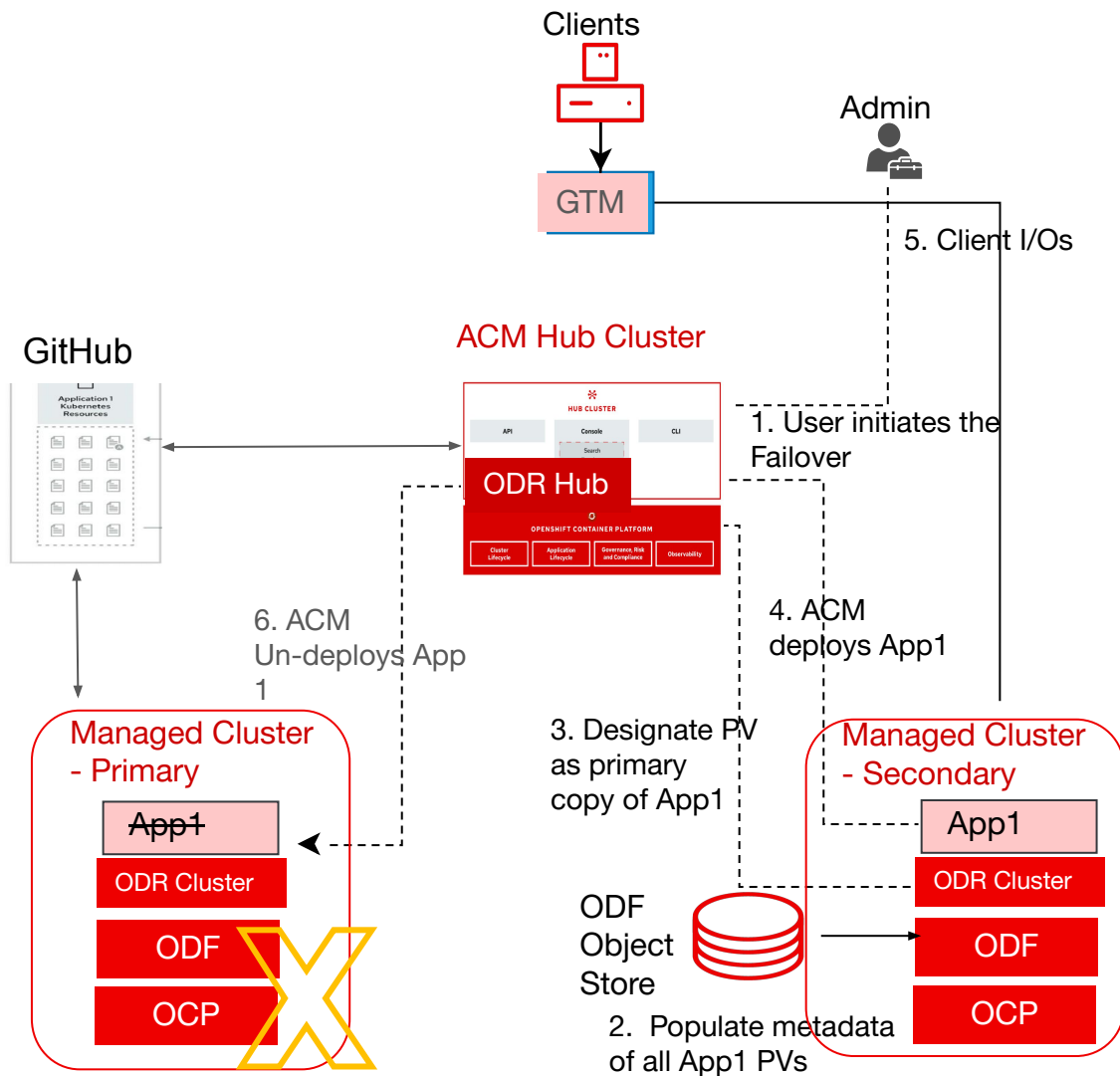
V0000000

Red Hat

Automated DR Failover reduces RTO

Clients

Admin

GTM

5. Client I/Os

GitHub

ACM Hub Cluster

HUB CLUSTER

API | Console | CLI

Search

ODR Hub

OPENSHIFT CONTAINER PLATFORM

Cluster Lifecycle | Application Lifecycle | Governance, Risk and Compliance | Observability

Application 1 Kubernetes Resources

1. User initiates the Failover

6. ACM Un-deploys App 1

4. ACM deploys App1

Managed Cluster - Primary

App1

ODR Cluster

ODF

OCP

3. Designate PV as primary copy of App1

ODF Object Store

2. Populate metadata of all App1 PVs

Managed Cluster - Secondary

App1

ODR Cluster

ODF

OCP

- ▶ Failover process automation – Increases application availability and reduces user errors

- ▶ Application(s) granular Failovers and Policy based prioritized failovers

- ▶ Failovers are always user initiated and controlled, eliminates un-intended switch and data loss.

- ▶ ODR Hub ensures App metadata is populated before the failover to ensure Apps binds to the right PVs

Red Hat

DR Failback ensures smooth recovery to Primary

Clients

Admin

GTM

6. Client I/Os

GitHub

Application 1
Kubernetes
Resources

ACM Hub Cluster

HUB CLUSTER

API   Console   CLI

Search

ODR Hub

OPENSHIFT CONTAINER PLATFORM

Cluster
Lifecycle | Application
Lifecycle | Governance, Risk
and Compliance | Observability

1. User initiates the
Failback

5. ACM deploys
App 1

4. ACM un-deploys
App1

Managed Cluster
- Primary

App1

ODR Cluster

ODF

OCP

Managed Cluster
- Secondary

~~App1~~

ODR Cluster

ODF

OCP

2. Restore metadata
of all App1 PVs

3. Resync App1 PVs
data

▸ PV Data changes and meta data changes are restored to primary cluster before the fail-back is complete

▸ Fail-back operations are user initiated and controlled

▸ Workload migrations across hybrid platforms are also enabled with the same process
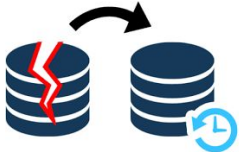
Red Hat

OpenShift Resiliency Solution Roadmap

	1H 2022	2H 2022
Backup	• RedHat OADP Operator (Feb '22)	• Native OCP DP • Differentiated from Partner solutions

Regional DR	• Regional DR (GA) - May '22
	  • Block (RBD) only
	  • Simplified Orchestration
	  • Resilient ACM Hub	

Metro DR		• Metro-DR (GA) • Multi-Cluster, ACM Managed

Source:
Insert source data here
Insert source data here
Insert source data here

V0000000

Alternate DR Solutions

Red Hat

Two Zone Stretch Cluster

RPO – 0
RTO – Mins
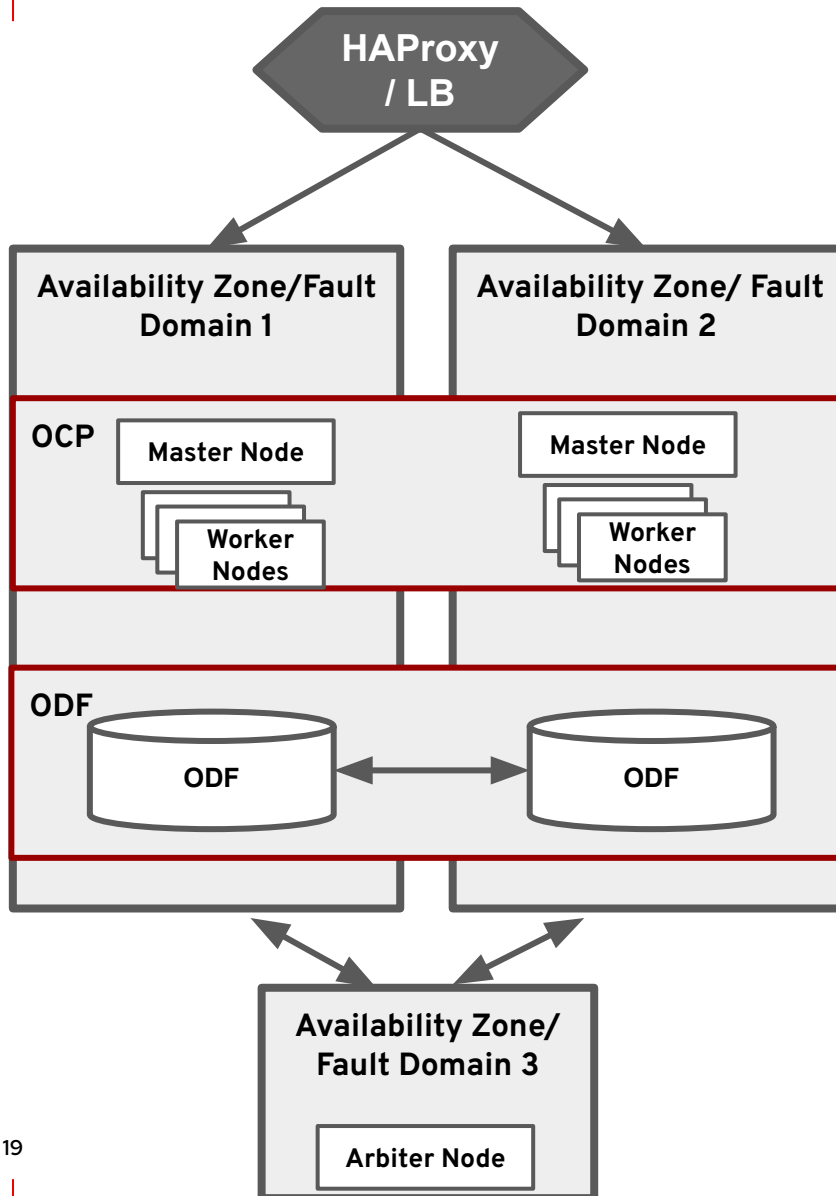
No Data loss Data Mirroring, across 2 sites

HAProxy / LB

Availability Zone/Fault Domain 1

Availability Zone/ Fault Domain 2

OCP

Master Node

Worker Nodes

Master Node

Worker Nodes

ODF

ODF

ODF

Availability Zone/ Fault Domain 3

Arbiter Node

▸ Stretch OCP-ODF Cluster across 2 AZs

- Data replicated across 2 AZ/sites connected by low latency networks

- Arbiter for Cluster quorum in a neutral AZ/site

- Minimal resource requirements for Arbiter node - contains ODF Mon process and OCP Master node

- Failure of any node or resource on one AZ triggers automatic redirection of traffic to its cluster pair.

V0000000

Red Hat

Stretch Cluster Configuration
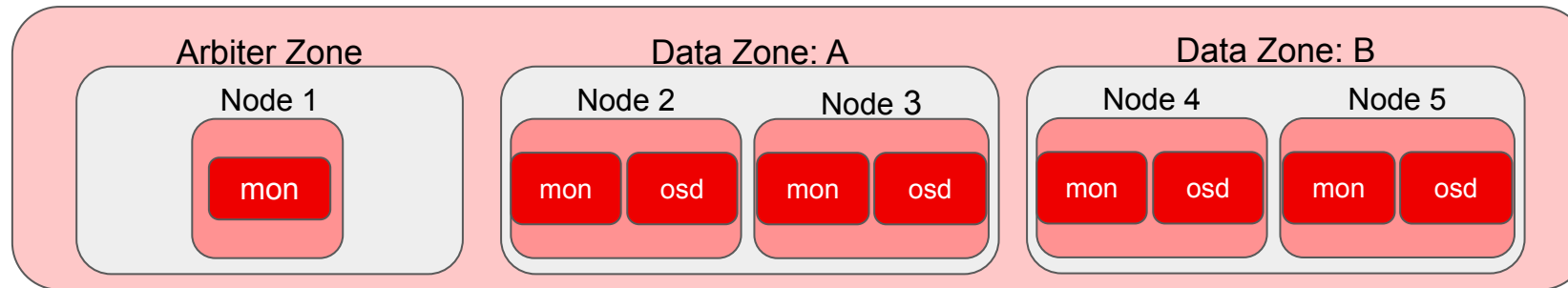
▸ Two local copies per data zone for local HA.

- Requires Replica 4 configuration

▸ Two Monitors are required for each data zone

- A zone is considered down by ODF when all the mons in the zone are unavailable.

▸ Rook to detect the topology labels of the nodes set by the user and manages ODF resources accordingly

Thank you!

in linkedin.com/company/red-hat

▶ youtube.com/user/RedHatVideos

f facebook.com/redhatinc

🐦 twitter.com/RedHat

Red Hat