OpenShift Commons

Joining Kubernetes clusters with Submariner

Community, research, product

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Agenda

What we'll discuss today

- Why is multi-cluster connectivity important?
- Community: Submariner project
- Research: Optimized Service Discovery Across Clusters
- Product: Advanced Cluster Management for Kubernetes
- Resources

Why is multicluster networking important?

Where is the growth in cluster deployments?

Small Scale Dev Teams

Managing clusters across Dev/QA/Prod clusters

Medium Scale Organizations

Local retails with clusters across 100s of locations

Large Scale Organizations

Global organizations with 100s of clusters, hosting thousand of applications

Edge Scale Telco

100s of zones, 1000s of clusters and nodes across complex topologies

Reasons for deploying multiple clusters

Application availability

Reduced latency

Address industry standards

Geopolitical data residency guidelines

Disaster recovery

Edge deployments

CapEx cost reduction

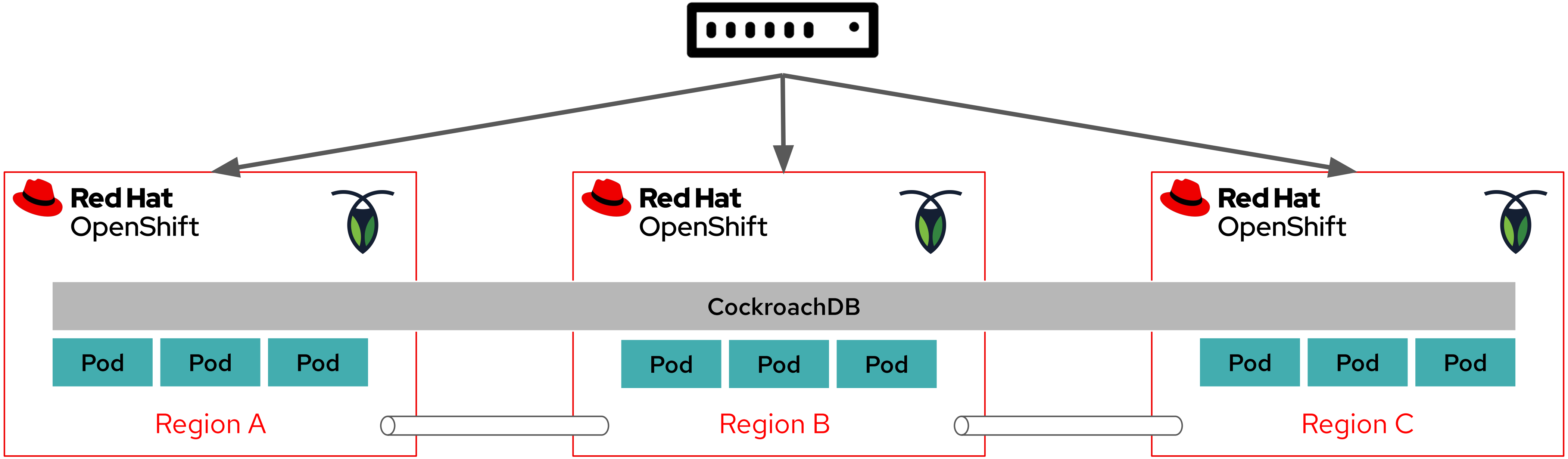
Avoid vendor lock-in

Multicluster networking

- Multi-cluster *connectivity* is at the core of Red Hat's open hybrid cloud strategy and required for a wide range of use cases
- Our customers demand choice: a robust solution that works across different infrastructure providers and network (CNI) plug-ins
- Complement Red Hat's product portfolio:
  - Red Hat OpenShift
  - Advanced Cluster Management for Kubernetes (ACM)
  - Red Hat OpenShift Data Foundation (previously known as OCS)
  - Red Hat Service Mesh (Istio)

Example use case: Distributed Data

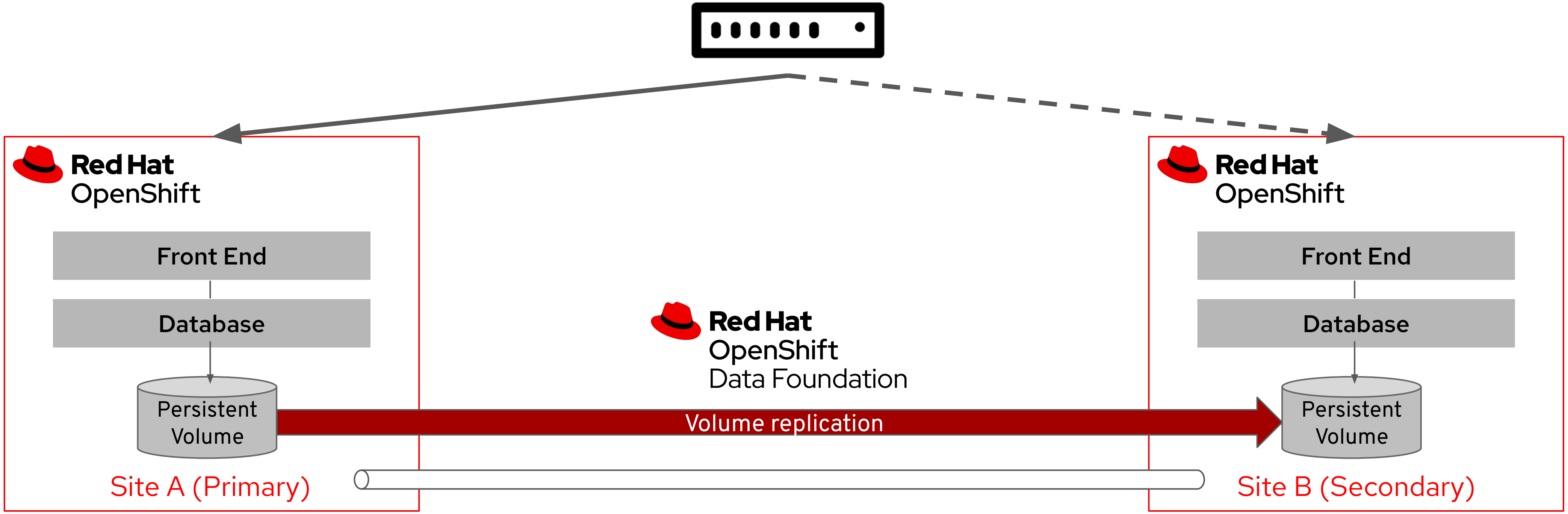
Multi-region CockroachDB cluster



- OpenShift clusters in multiple regions, with replicas of the same service running in each cluster
- Goal: keep data close to the user, while reducing latency and fault tolerance to improve user experience
- Blog post | demo

Example use case: Disaster Recovery (DR)

Cross-cluster volume replication with OpenShift Data Foundation



- Automated per application failover management through ACM
- Goal: protection against geographic disasters
- Documentation | demo

Community: Submariner project

Submariner project

"Directly connect all your Kubernetes clusters, no matter where they are in the world"

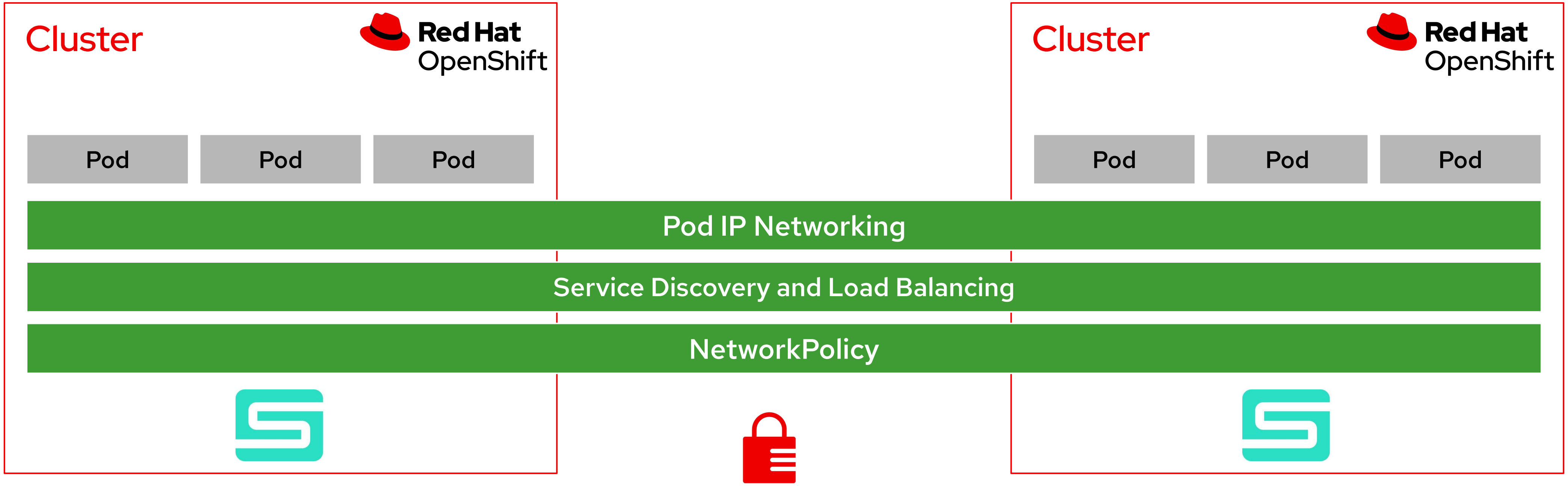
https://submariner.io

https://github.com/submariner-io

SUBMARINER

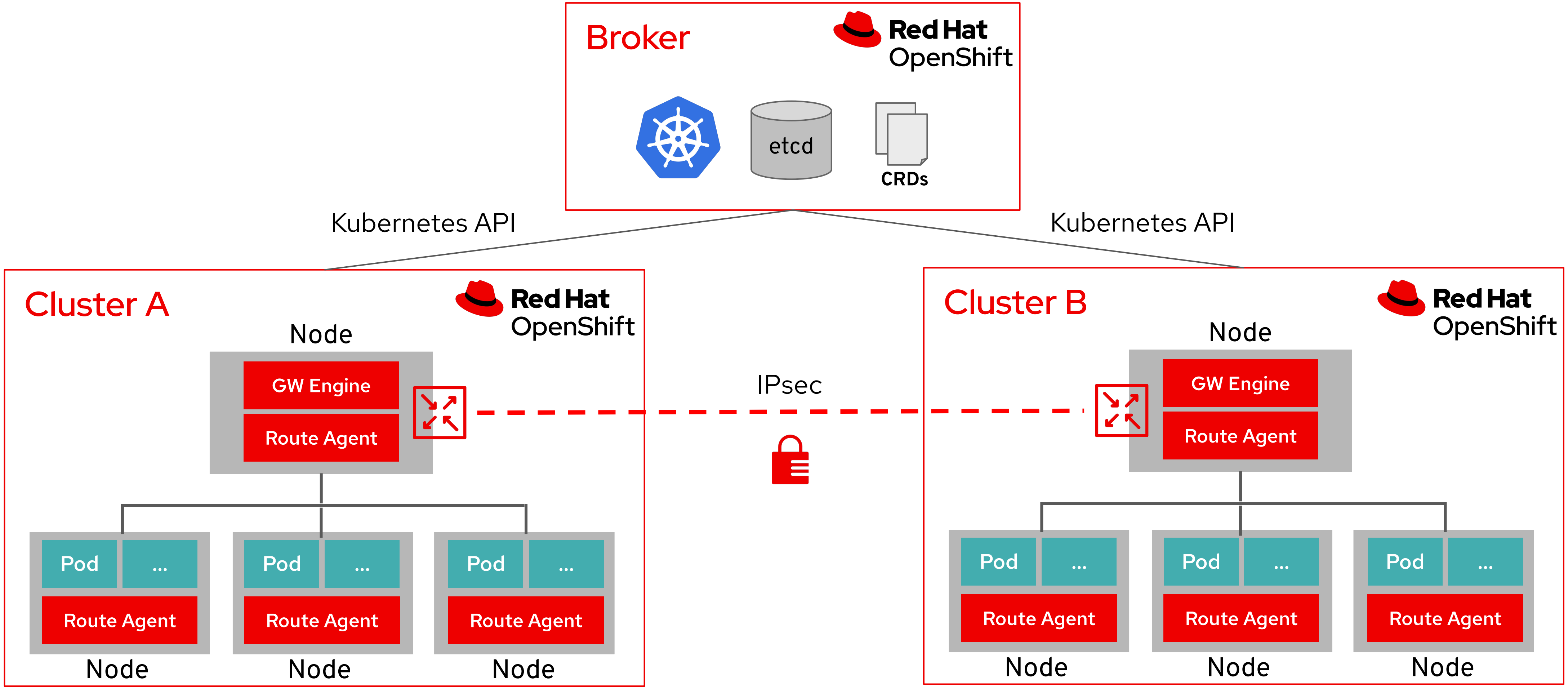
CLOUD NATIVE
COMPUTING FOUNDATION

Kubernetes cluster networking with Submariner



- Different regions of the same public cloud provider
- Multiple public clouds
- Multiple on-prem sites
- Hybrid cloud, including a mix of on-prem and public cloud

Architecture



Benefits

Pod-to-pod and pod-to-service routing with native performance

Direct network tunnel to support any application on top; eliminate the need for proxies, external load-balancers or ingress gateways

Enhanced security

All traffic flow between clusters is encrypted using IPsec by default

Deploy services across clusters

Beyond connectivity, also address the challenge of cross-cluster service discovery and network policy (roadmap)

Extend existing OpenShift deployments

Compatible with different infrastructure providers and network (CNI) plugins; benefit the wider OpenShift ecosystem

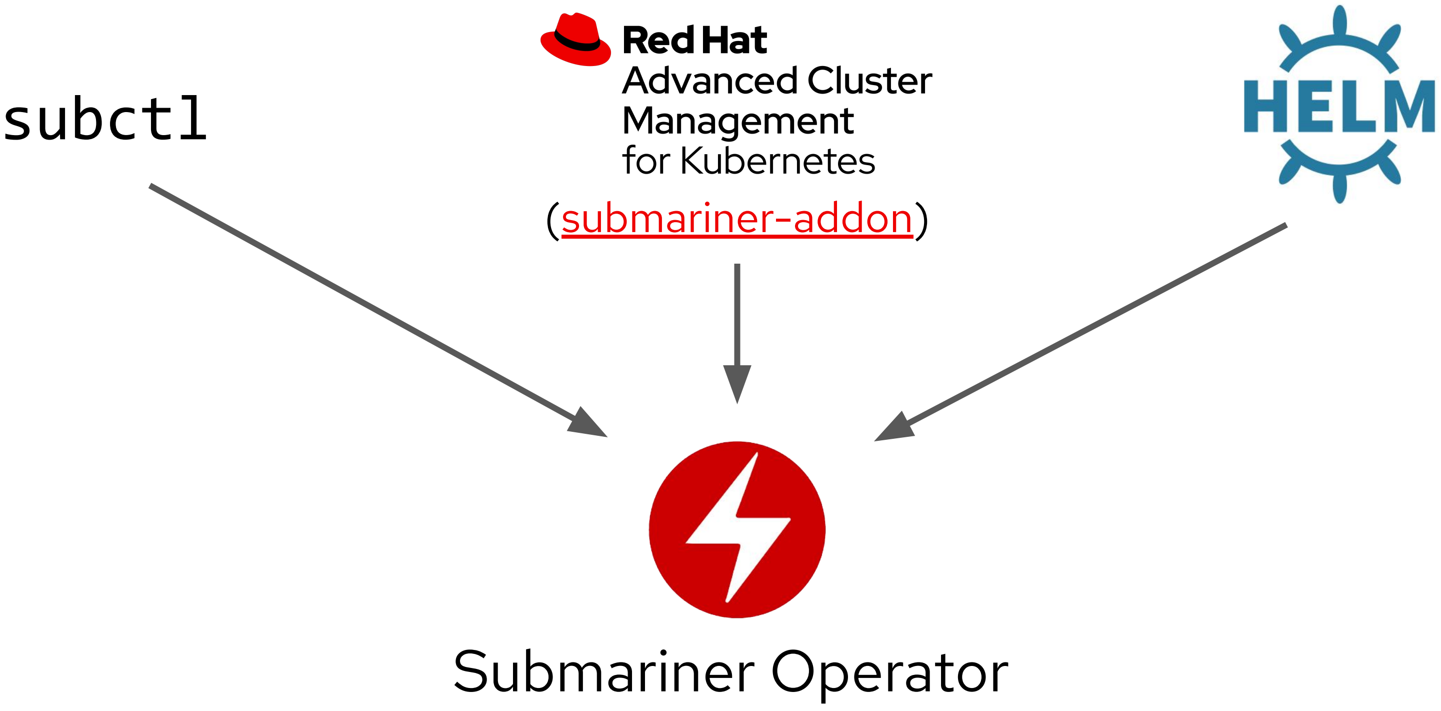
Usage

1. Admin joins two or more clusters
   - Submariner provides full IP reachability between pods and services among the participating clusters, aka ClusterSet

2. Application developers then **export** selected **services** to expose them across the ClusterSet
   - Submariner automatically sets up DNS for the exported services

> ! Step 1 is done once to create cluster-level connectivity. Step 2 (service export) can then be performed on-demand, leveraging the underlying connectivity.

Deployment and management



subctl

Red Hat Advanced Cluster Management for Kubernetes

(submariner-addon)

Submariner Operator

Research: Optimized Service Discovery Across Clusters

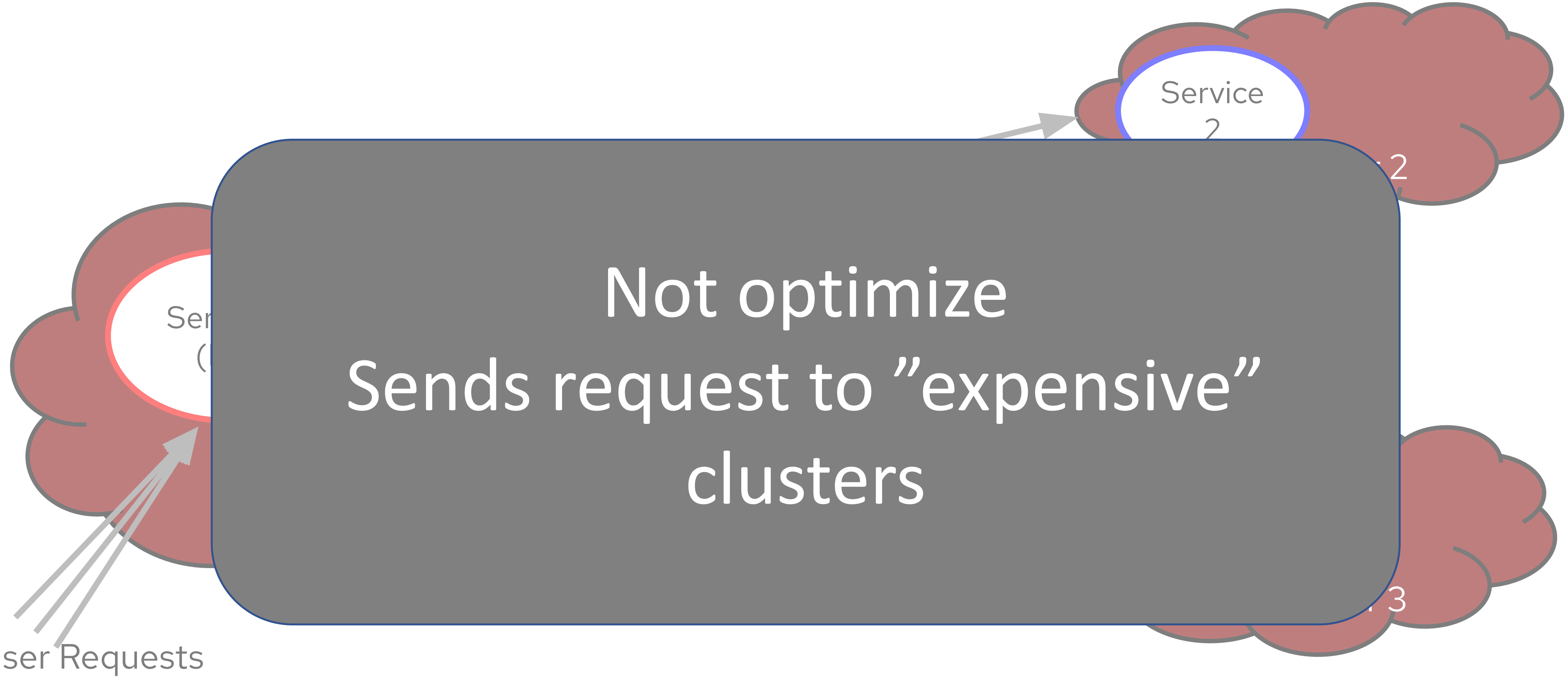
Research: Optimized Service Discovery Across Clusters

Multi-Cluster Deployment

Multi-cluster deployment introduces traffic pricing and performance challenges.

Research: Optimized Service Discovery Across Clusters

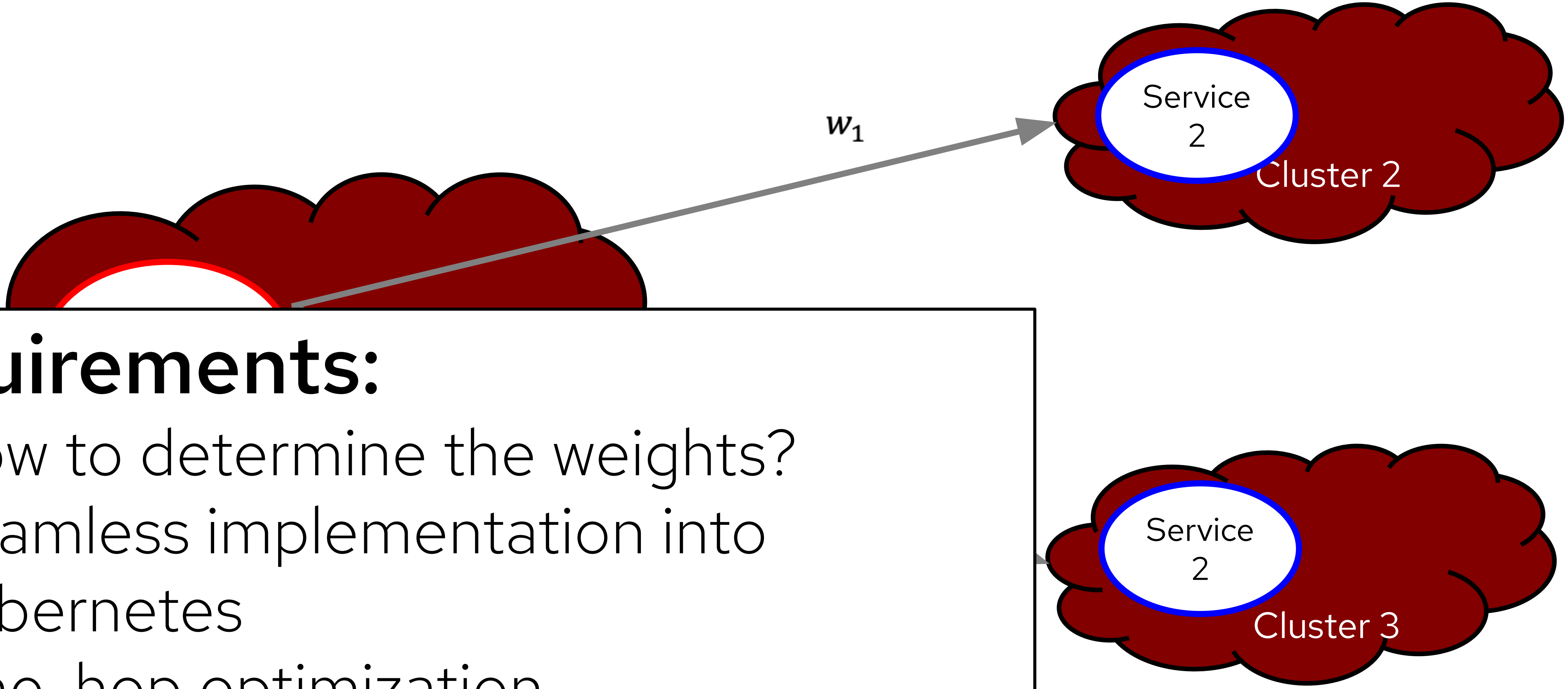
Request Distribution – Round Robin



Not optimize

Sends request to ”expensive” clusters

Solution - Weighted Round Robin



Requirements:

- How to determine the weights?
- Seamless implementation into Kubernetes
- One-hop optimization

Request Distribution – Round Robin

$c \in C$ - *Clusters*
$s \in S$ - *Services*

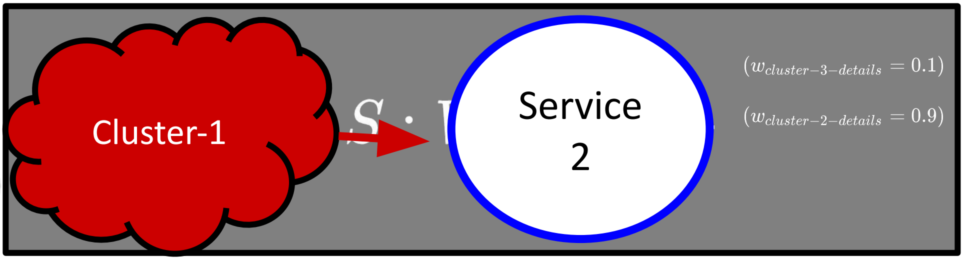
$cost(c, s)$
$F(Price, Latency)$

$n_{s,t} \in \mathbb{N}$ (RPS)

Minimize requests cost

$$\text{Min} \sum_{c \in C} \sum_{s \in S} n_{c,s} \cdot cost(c, s)$$

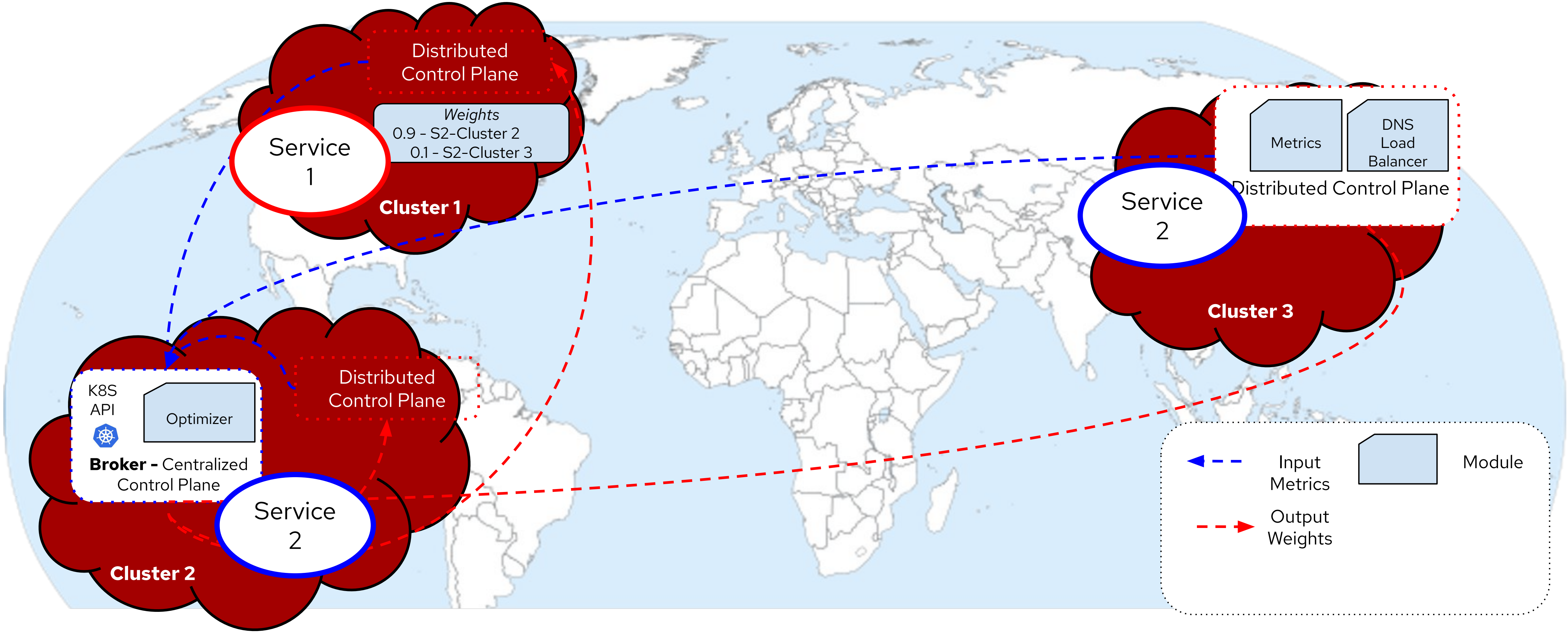
Subject to:


Cluster-1
Service 2
$(w_{cluster-3-details} = 0.1)$
$(w_{cluster-2-details} = 0.9)$

- Requests cannot b $= N_c$
- Target capacity $\sum_{c \in C} n_{c,s} \leq cap(s)$
- Liveness* $\sum_{c \in C} n_{c,s} \geq \alpha(c, s)$

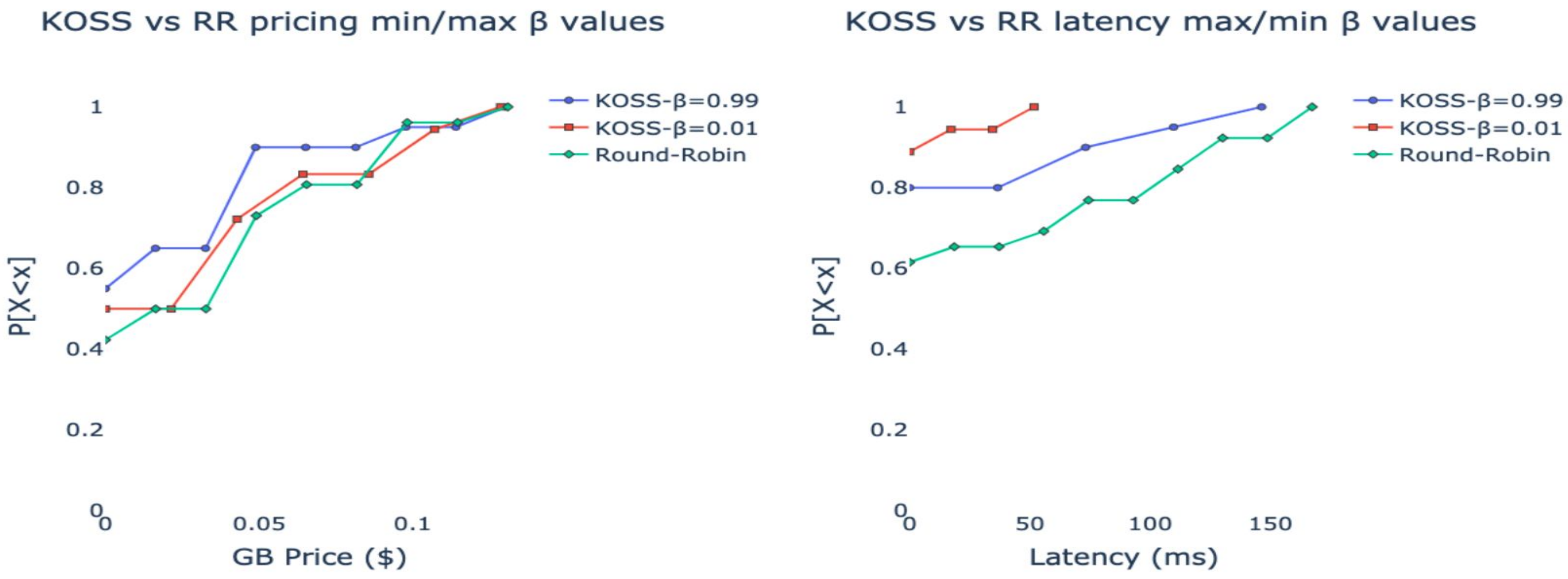
Research: Optimized Service Discovery Across Clusters

Architecture



Research: Optimized Service Discovery Across Clusters

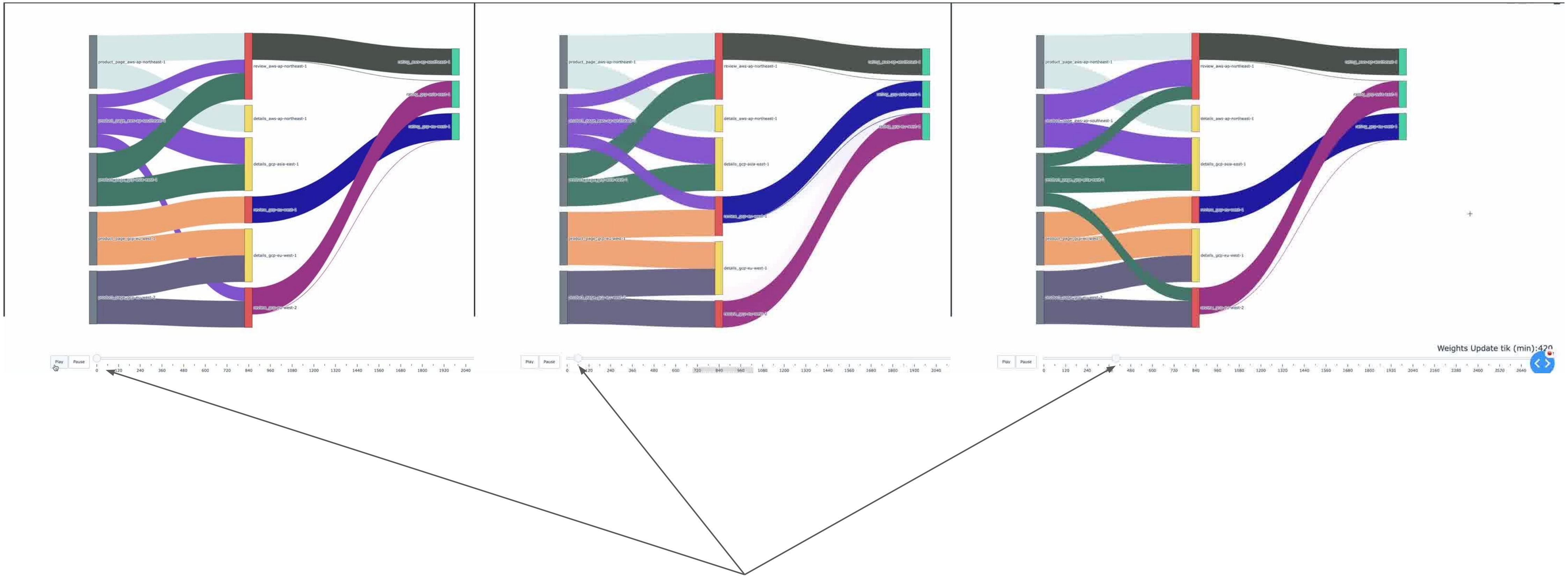
Results



(c) (d)

Research: Optimized Service Discovery Across Clusters

Results


product_page_aws-ap-northeast-1
product_page_aws-ap-southeast-1
product_page_gcp-asia-east-1
product_page_gcp-eu-west-1
product_page_gcp-eu-west-2
review_aws-ap-northeast-1
details_aws-ap-northeast-1
details_gcp-asia-east-1
review_gcp-eu-west-1
details_gcp-eu-west-1
review_gcp-eu-west-2
rating_aws-ap-southeast-1
rating_gcp-asia-east-1
rating_gcp-eu-west-1
Play
Pause
0
120
240
360
480
600
720
840
960
1080
1200
1320
1440
1560
1680
1800
1920
2040
Weights Update tik (min):420

Adaptive over time and load

Product: Advanced Cluster Management for Kubernetes

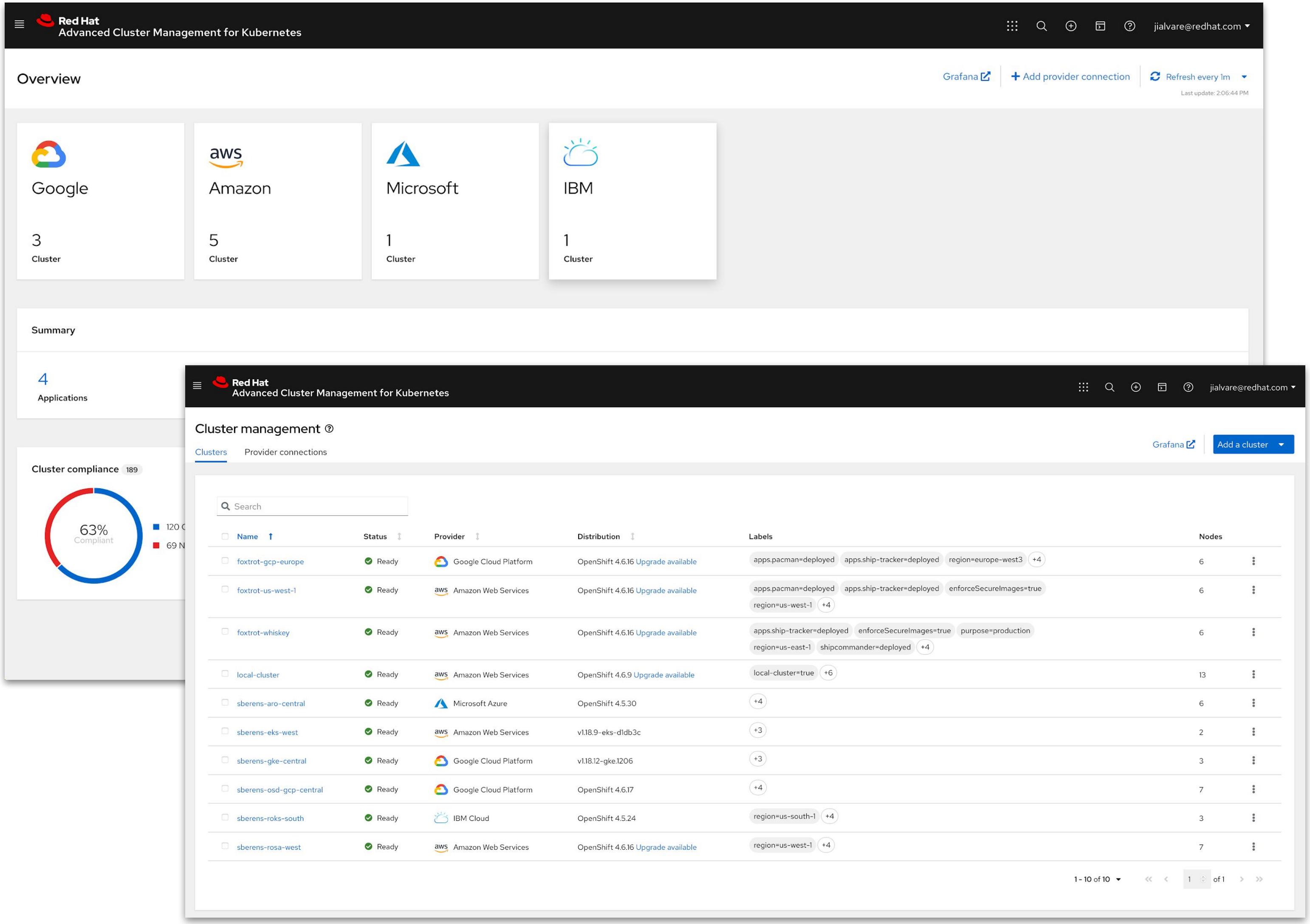
Product: Advanced Cluster Management for Kubernetes

Multicluster lifecycle management

Policy driven governance, risk, and compliance

Advanced application lifecycle management

Multicluster observability for health and optimization



Red Hat
Advanced Cluster Management for Kubernetes

jialvare@redhat.com

Overview

Grafana | + Add provider connection | Refresh every 1m

Last update: 2:06:44 PM

Google	Amazon	Microsoft	IBM
3 Cluster	5 Cluster	1 Cluster	1 Cluster

Summary

4
Applications

Cluster compliance 189

63%
Compliant

🟦 120 C
🟥 69 N

Red Hat
Advanced Cluster Management for Kubernetes

jialvare@redhat.com

Cluster management

Clusters | Provider connections

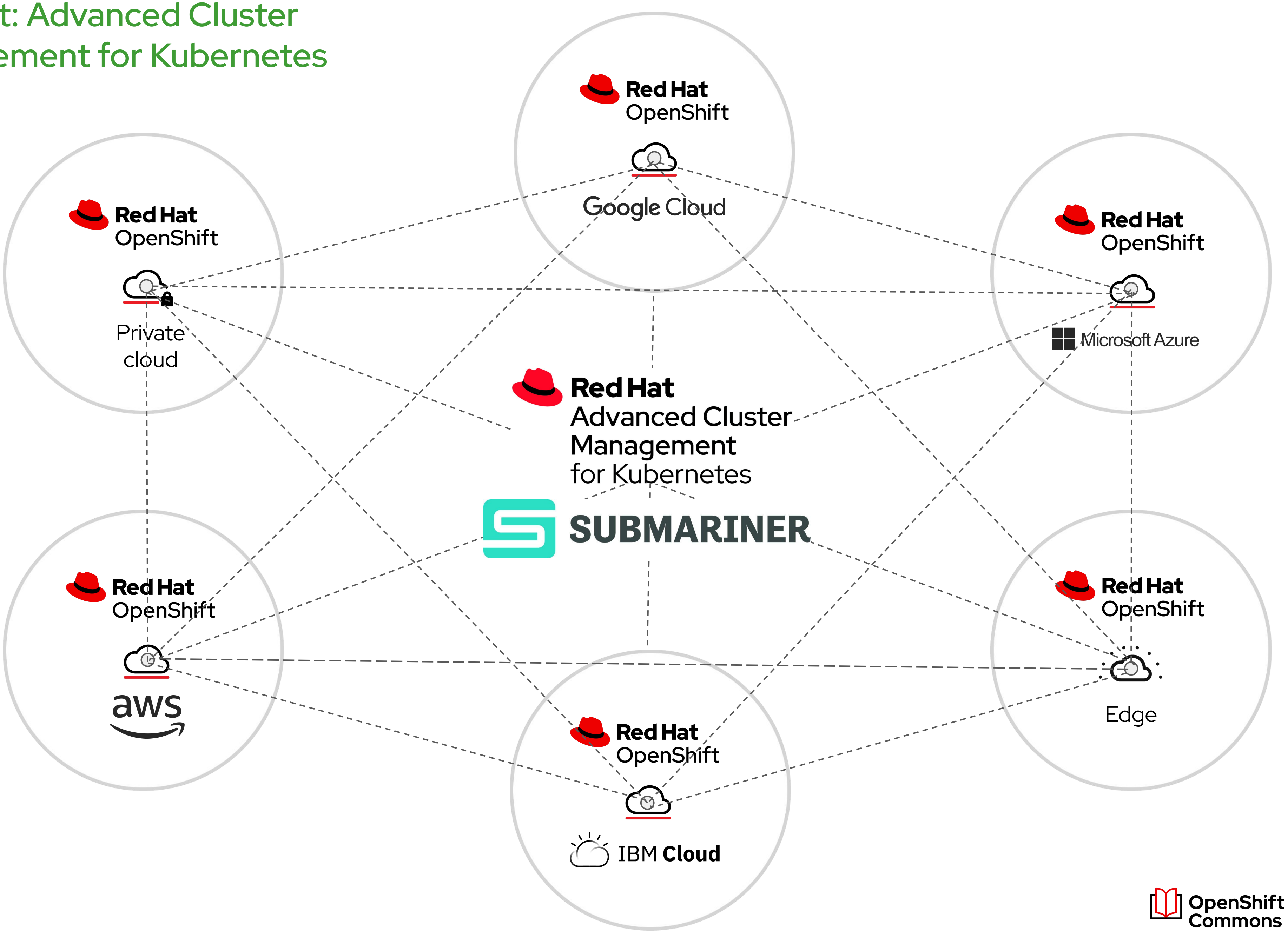
Grafana | Add a cluster

Search

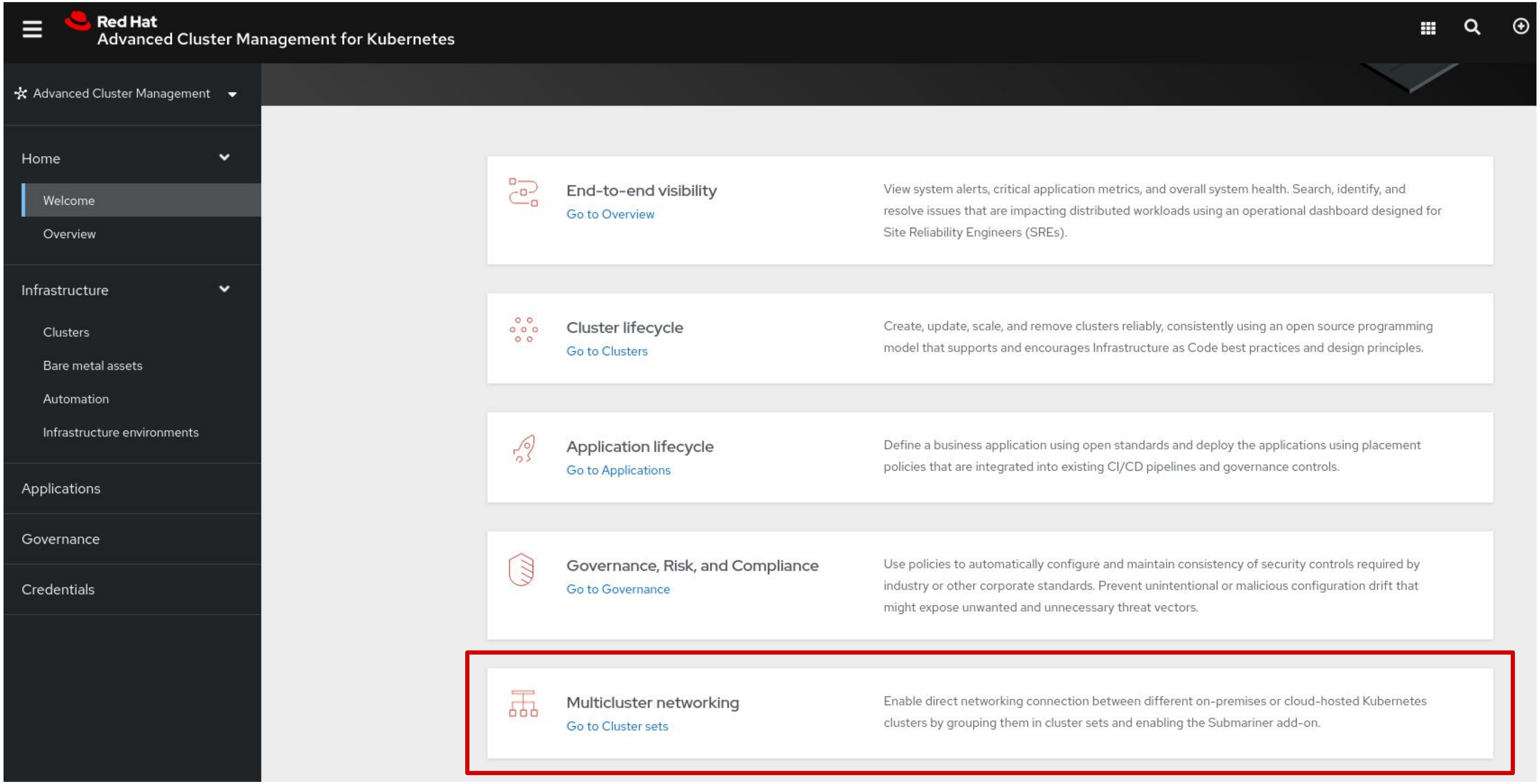
Name	Status	Provider	Distribution	Labels	Nodes
foxtrot-gcp-europe	✓ Ready	Google Cloud Platform	OpenShift 4.6.16 Upgrade available	apps.pacman=deployed apps.ship-tracker=deployed region=europe-west3 +4	6
foxtrot-us-west-1	✓ Ready	Amazon Web Services	OpenShift 4.6.16 Upgrade available	apps.pacman=deployed apps.ship-tracker=deployed enforceSecureImages=true region=us-west-1 +4	6
foxtrot-whiskey	✓ Ready	Amazon Web Services	OpenShift 4.6.16 Upgrade available	apps.ship-tracker=deployed enforceSecureImages=true purpose=production region=us-east-1 shipcommander=deployed +4	6
local-cluster	✓ Ready	Amazon Web Services	OpenShift 4.6.9 Upgrade available	local-cluster=true +6	13
sberens-aro-central	✓ Ready	Microsoft Azure	OpenShift 4.5.30	+4	6
sberens-eks-west	✓ Ready	Amazon Web Services	v1.18.9-eks-d1db3c	+3	2
sberens-gke-central	✓ Ready	Google Cloud Platform	v1.18.12-gke.1206	+3	3
sberens-osd-gcp-central	✓ Ready	Google Cloud Platform	OpenShift 4.6.17	+4	7
sberens-roks-south	✓ Ready	IBM Cloud	OpenShift 4.5.24	region=us-south-1 +4	3
sberens-rosa-west	✓ Ready	Amazon Web Services	OpenShift 4.6.16 Upgrade available	region=us-west-1 +4	7

1 - 10 of 10 · 1 of 1

Product: Advanced Cluster Management for Kubernetes



Product: Advanced Cluster Management for Kubernetes



End-to-end visibility
Go to Overview

View system alerts, critical application metrics, and overall system health. Search, identify, and resolve issues that are impacting distributed workloads using an operational dashboard designed for Site Reliability Engineers (SREs).

Cluster lifecycle
Go to Clusters

Create, update, scale, and remove clusters reliably, consistently using an open source programming model that supports and encourages Infrastructure as Code best practices and design principles.

Application lifecycle
Go to Applications

Define a business application using open standards and deploy the applications using placement policies that are integrated into existing CI/CD pipelines and governance controls.

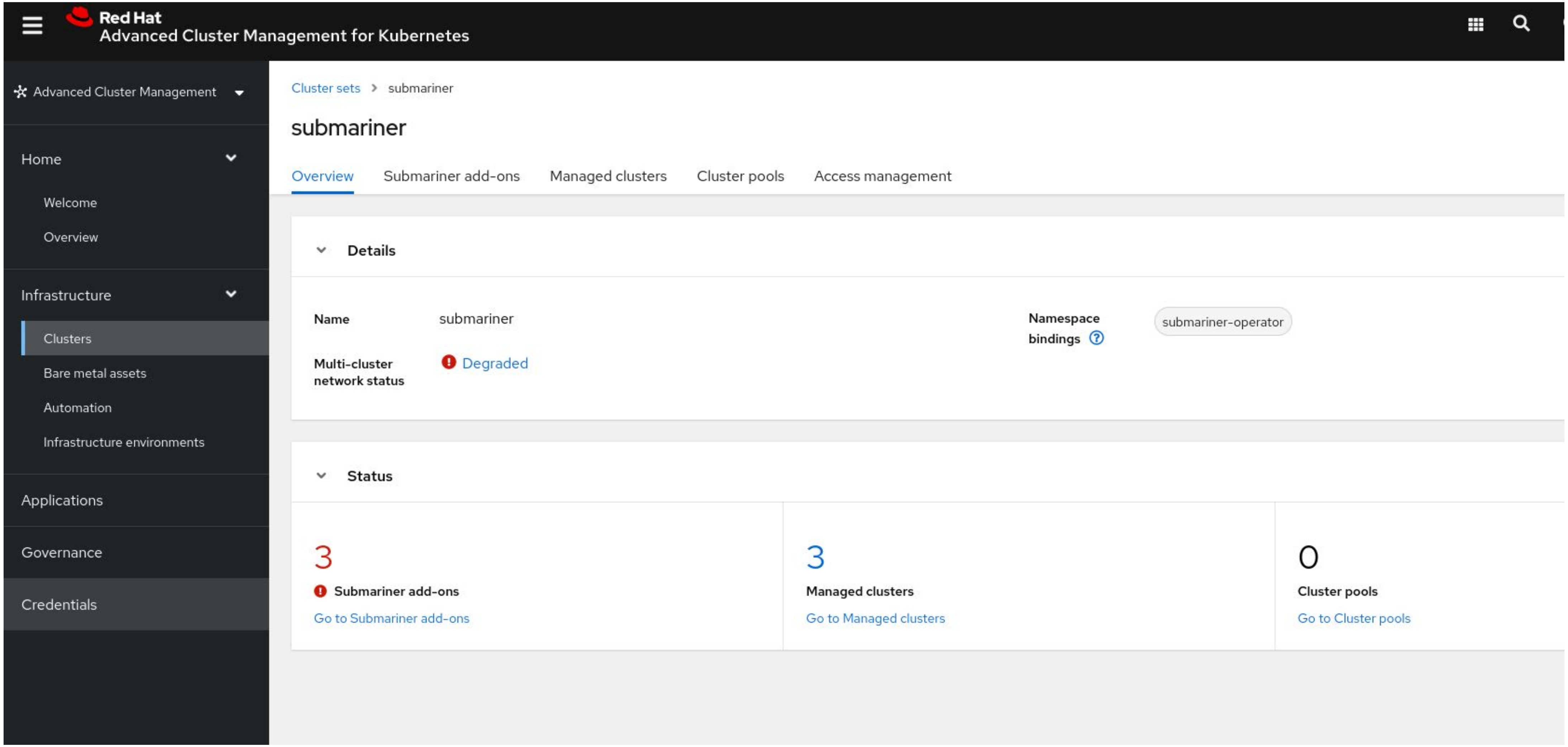
Governance, Risk, and Compliance
Go to Governance

Use policies to automatically configure and maintain consistency of security controls required by industry or other corporate standards. Prevent unintentional or malicious configuration drift that might expose unwanted and unnecessary threat vectors.

Multicluster networking
Go to Cluster sets

Enable direct networking connection between different on-premises or cloud-hosted Kubernetes clusters by grouping them in cluster sets and enabling the Submariner add-on.

Product: Advanced Cluster Management for Kubernetes



Red Hat
Advanced Cluster Management for Kubernetes

Cluster sets > submariner

submariner

Details

Name: submariner

Multi-cluster network status: Degraded

Namespace bindings: submariner-operator

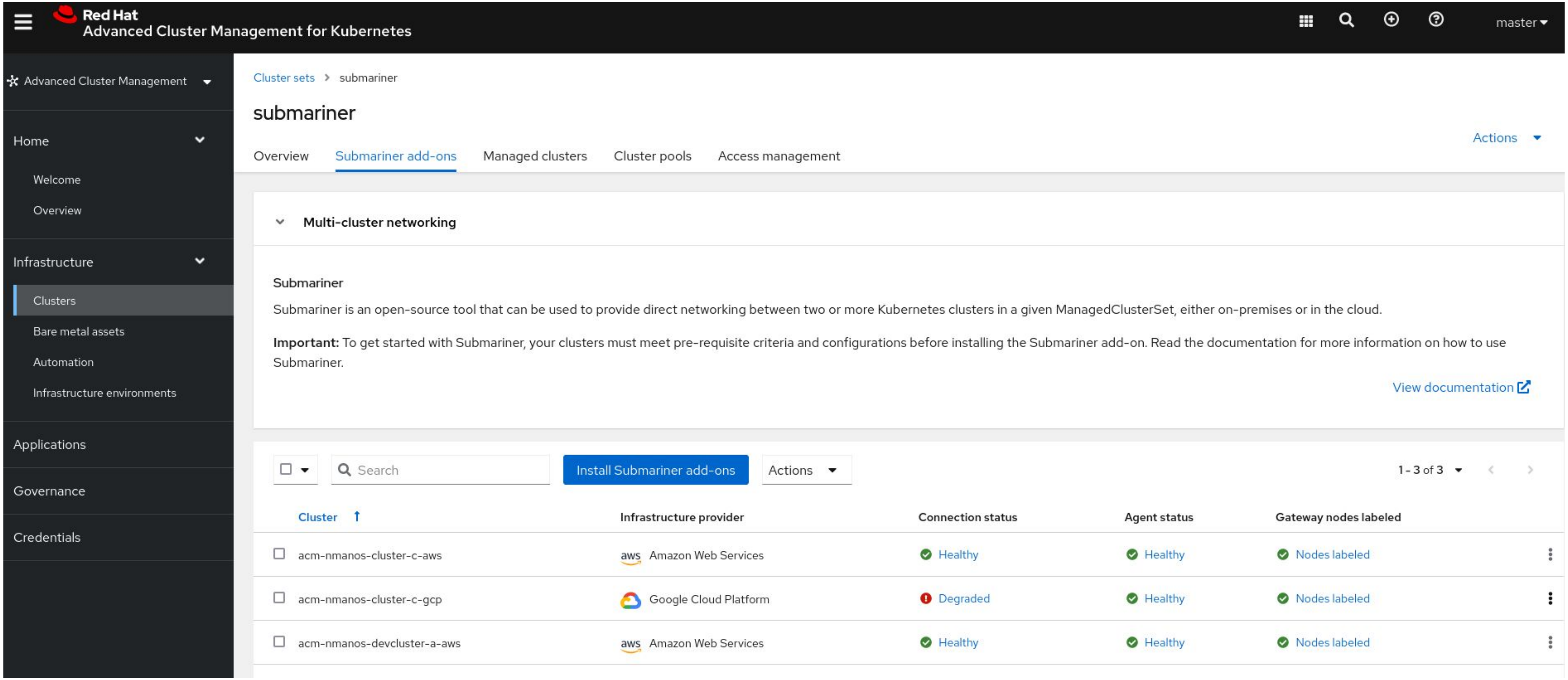
Status

3 Submariner add-ons
Go to Submariner add-ons

3 Managed clusters
Go to Managed clusters

0 Cluster pools
Go to Cluster pools

Product: Advanced Cluster Management for Kubernetes



submariner

Submariner

Submariner is an open-source tool that can be used to provide direct networking between two or more Kubernetes clusters in a given ManagedClusterSet, either on-premises or in the cloud.

Important: To get started with Submariner, your clusters must meet pre-requisite criteria and configurations before installing the Submariner add-on. Read the documentation for more information on how to use Submariner.

	Cluster	Infrastructure provider	Connection status	Agent status	Gateway nodes labeled
□	acm-nmanos-cluster-c-aws	aws Amazon Web Services	✓ Healthy	✓ Healthy	✓ Nodes labeled
□	acm-nmanos-cluster-c-gcp	Google Cloud Platform	! Degraded	✓ Healthy	✓ Nodes labeled
□	acm-nmanos-devcluster-a-aws	aws Amazon Web Services	✓ Healthy	✓ Healthy	✓ Nodes labeled

Resources

Give it a try

- Community project
  - Website: https://submariner.io
    - https://submariner.io/getting-started/quickstart/
    - https://submariner.io/operations/usage/
  - GitHub: https://github.com/submariner-io
  - YouTube: https://tinyurl.com/submariner-youtube
  - Slack (Kubernetes space): #submariner
- Red Hat product
  - ACM+Submariner product documentation

Further reading

- https://submariner.io/other-resources/
- Red Hat blogs:
  - https://cloud.redhat.com/blog/geographically-distributed-stateful-workloads-part-one-cluster-preparation
  - https://cloud.redhat.com/blog/geographically-distributed-stateful-workloads-part-two-cockroachdb
  - https://cloud.redhat.com/blog/geographically-distributed-stateful-workloads-part-3-keycloak
  - https://cloud.redhat.com/blog/geographically-distributed-stateful-workloads-part-four-kafka
  - https://cloud.redhat.com/blog/geographically-distributed-stateful-workloads-part-five-yugabytedb

OpenShift Commons

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