Building a Multi Cluster/Env Service Mesh at Airbnb

Weibo He & Stephen Chan, 10/13/2021, KubeCon + CloudNativeCon 2021

Agenda

- Introduction
- Support Multi Cluster
- Support Multi Environment
  - Multi Tier
  - Mesh Expansion
  - External Services
- Takeaways

Introduction

Airbnb's Istio Journey

2019

- Search of a modern Service Mesh started
- Evaluated and landed on Istio

2020

- Productionize Istio
- Feature Parity

2021

- Feature Parity cont.
- Migrate production workloads onto Istio

https://bit.ly/3z6i0gw

Multi Cluster

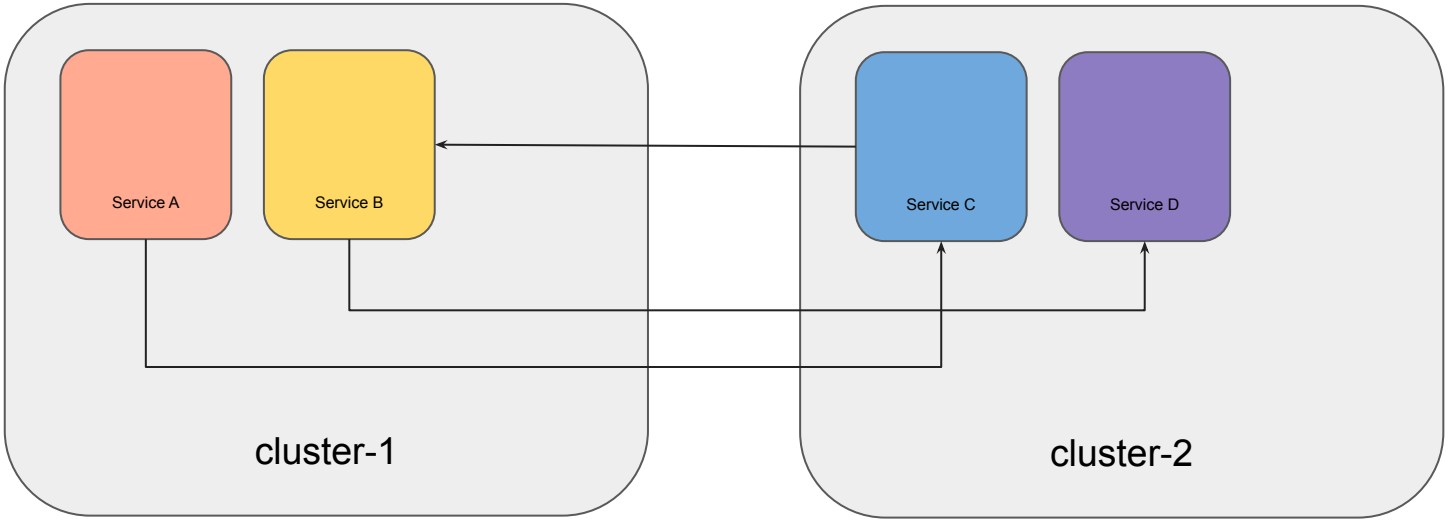
Multi Cluster

- Horizontally scale # of clusters instead of vertically scaling # of nodes in each cluster
- Keep each k8s cluster under 1k nodes and scale out by adding more clusters

https://bit.ly/38XJUkx

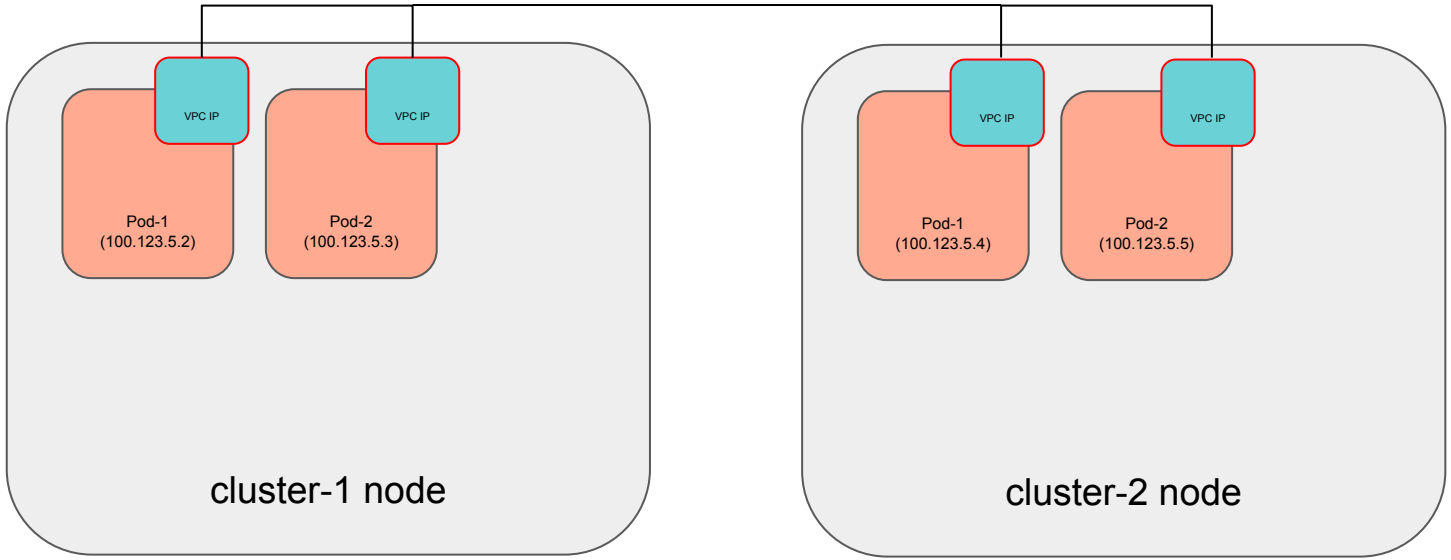
Workload Placement

- Clusters are just pools of compute and memory
- Workloads are randomly assigned to clusters



Flat Network

- AWS VPC CNI assign individually addressable VPC IPs to pods
- Direct pod to pod communication cross clusters



Flat Network Requirements

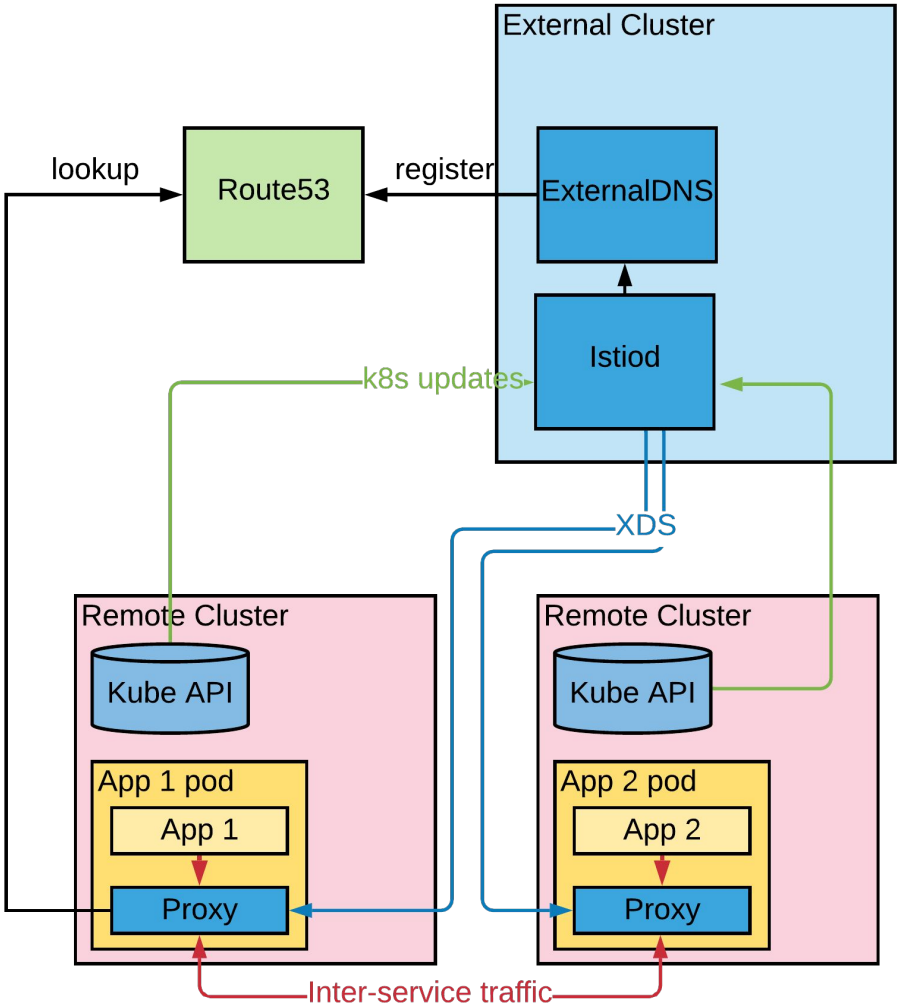
- Not relying on network boundary for security
  - Security Groups & mTLS
- Non-overlapping IP address space.
  - Centrally managed non-overlapping private IPv4 CIDRs
- Data plane scalability (VPC IP mapping limit)
  - With VPC CNI
    - 1 Node with 16 pods consumes **17** IP mappings (node IP + 16 pod IPs)
  - With VPC CNI + Prefix delegation
    - 1 Node with 16 pods consumes **2** IP mappings (node IP + 1 /28 prefix)

External Control Plane

- Clean separation of roles
  - Mesh Operator/Admin VS Mesh Users
- Tightened security
  - CA certs only installed on control plane cluster.
  - Tight access control for control plane cluster.
- Isolation from data plane workloads.
  - Bad deploys & outages does not affect control plane.
- Ease of operation.
  - Manage 1 deployment instead of N deployments.

Architecture

Single Mesh



Multi Environment

Multi Tier

Service Tiers

- Test
  - Unstable environment for testing
- Staging
  - Stable pre-prod environment
- Production
  - Powers Airbnb.com

Multi-Tiered Mesh & Release

Sandbox Mesh

Single cluster deployment

- Run functional tests
- Run performance tests

Test Mesh

Multi Cluster Setup

- Test integration with Airbnb systems
- Integration test workloads

Prod Mesh

Identical Setup as Test Mesh

- New Istio version tested on staging environment for 2 weeks
- Gradual release to production environment

Standalone Mesh

- Functional
  - Authorization
  - Locality based load balancing
  - Regression tests
- Performance
  - Validate latency & resource consumption of istio-proxy with Nighthawk

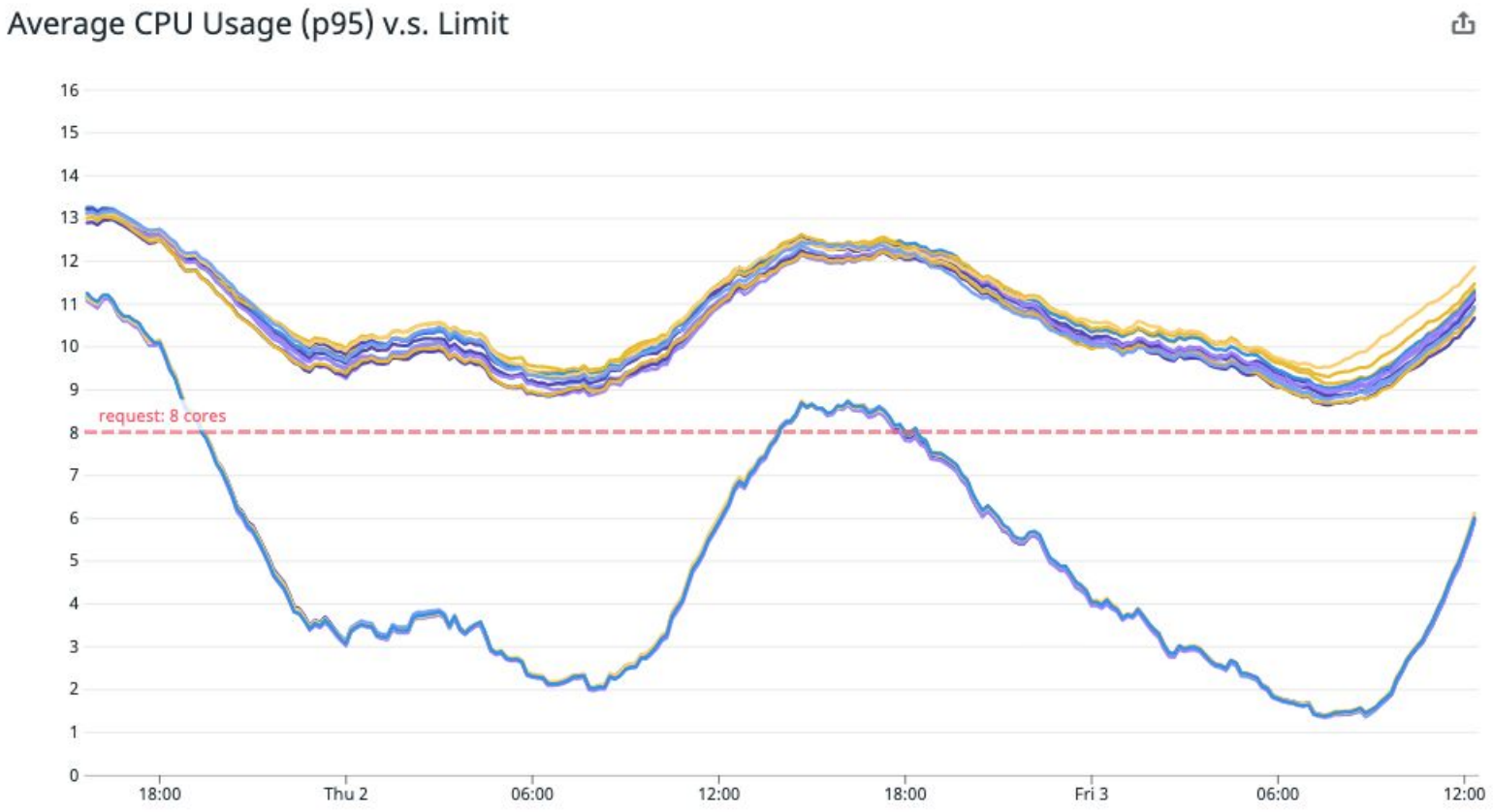
Test Mesh

- Integration with Airbnb systems
  - InternalCA
  - K8s clusters
  - Istio resources generation
  - Custom extension like Mesh expansion & External Services

Production Mesh

- Deploy new version of Istio with revision label
- Services pick up new istio-proxy & new control plane after a deploy
- Increasing scope of services connecting to the new version
  - Verification Fleet
  - Staging services
  - 25%, 50%, 100% of production services
- Clean up the old version

Production Mesh (Old vs New)

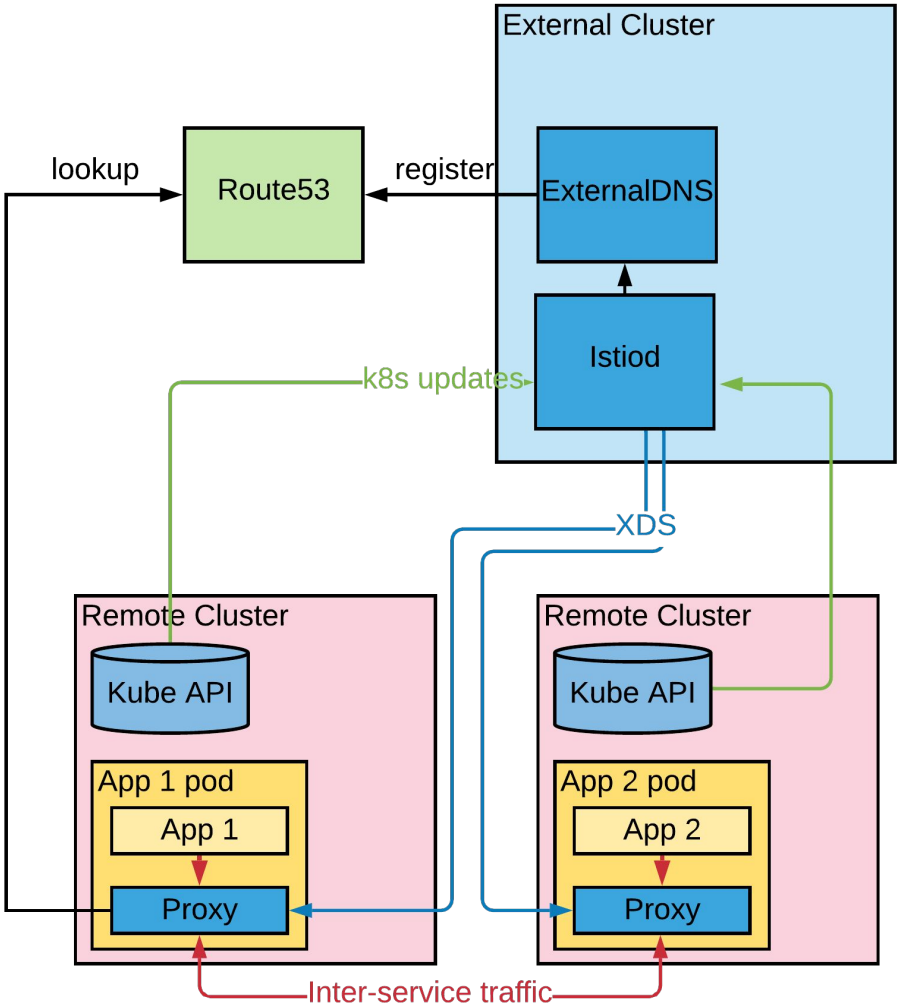


Multi Environment

Mesh Expansion

Architecture

Single Mesh



Architecture

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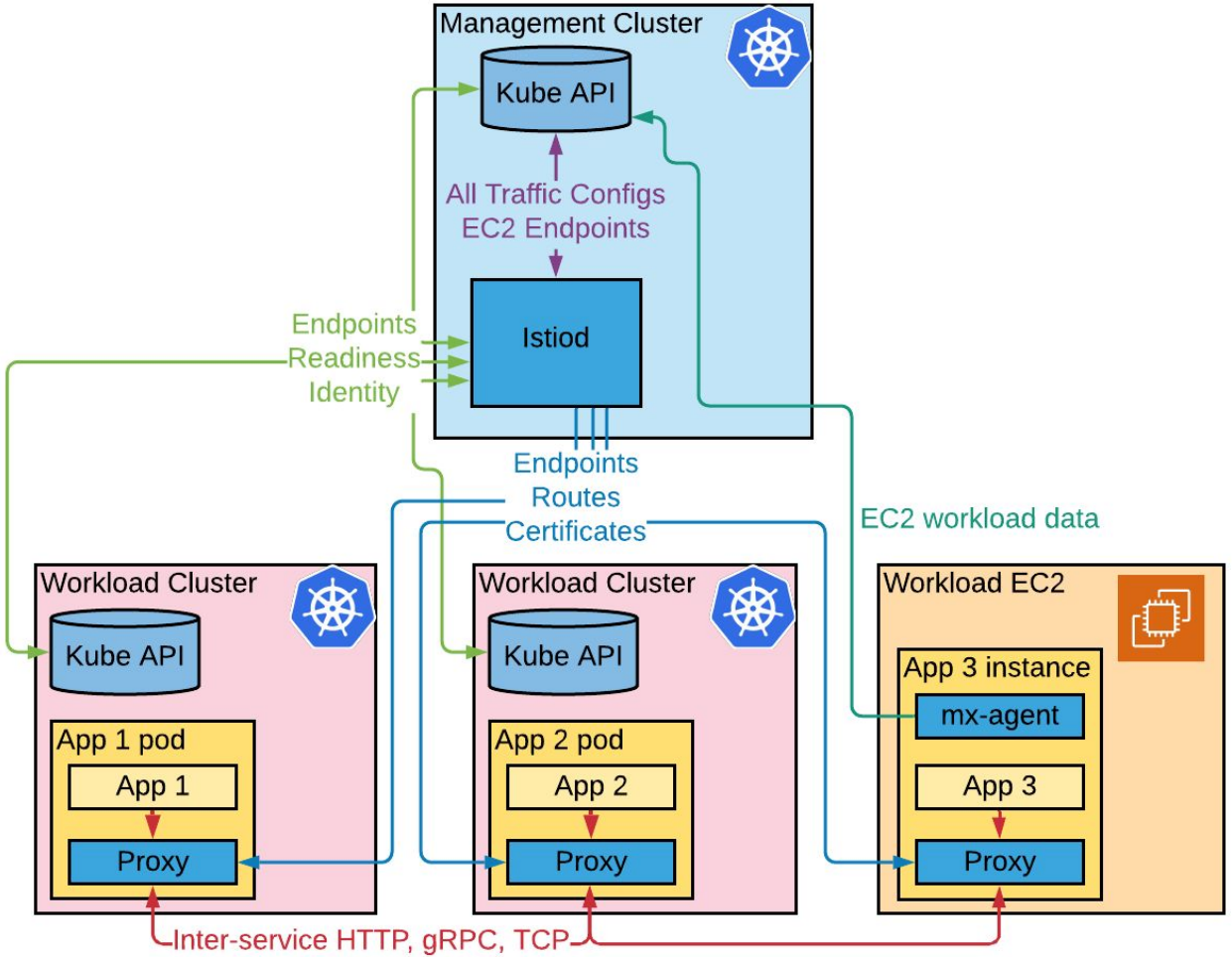


EC2 Support

Requirements

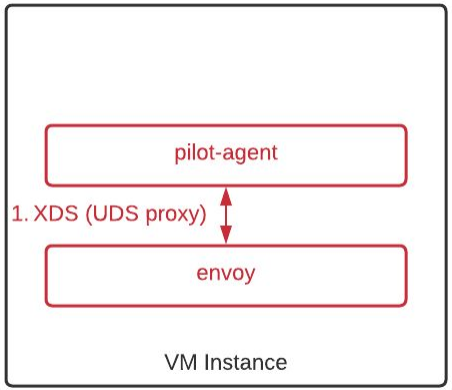
- Feature parity with Kubernetes
  - Automated endpoint registration
  - Server-side health checks
  - TLS
  - Transparent proxy injection
  - Gradual, automated Istio version upgrades
- Allow future migration to Kubernetes

EC2 Support

Endpoint Registration

EC2 Support

Endpoint Registration



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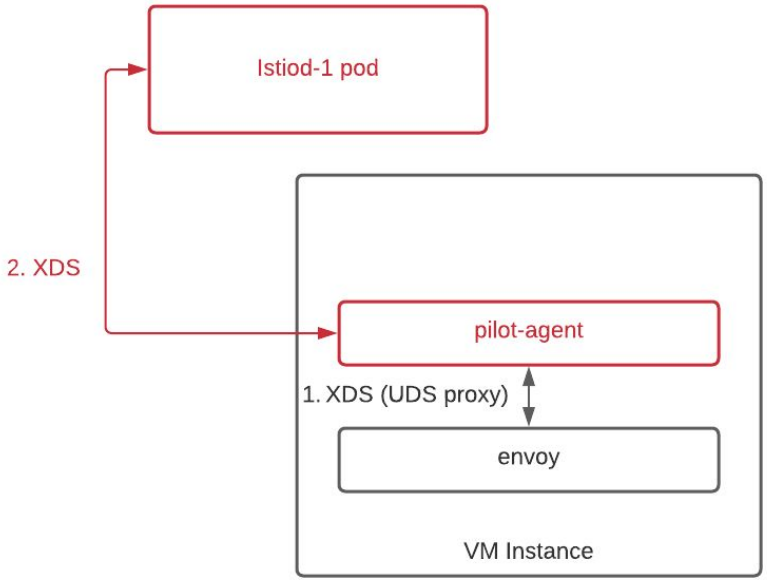

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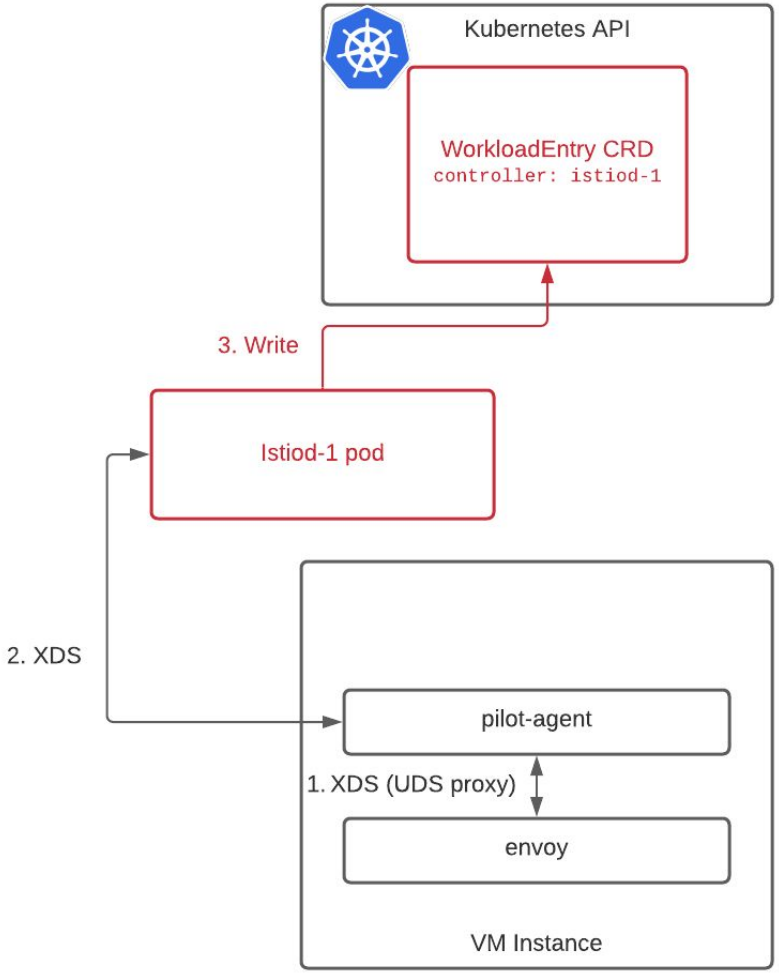

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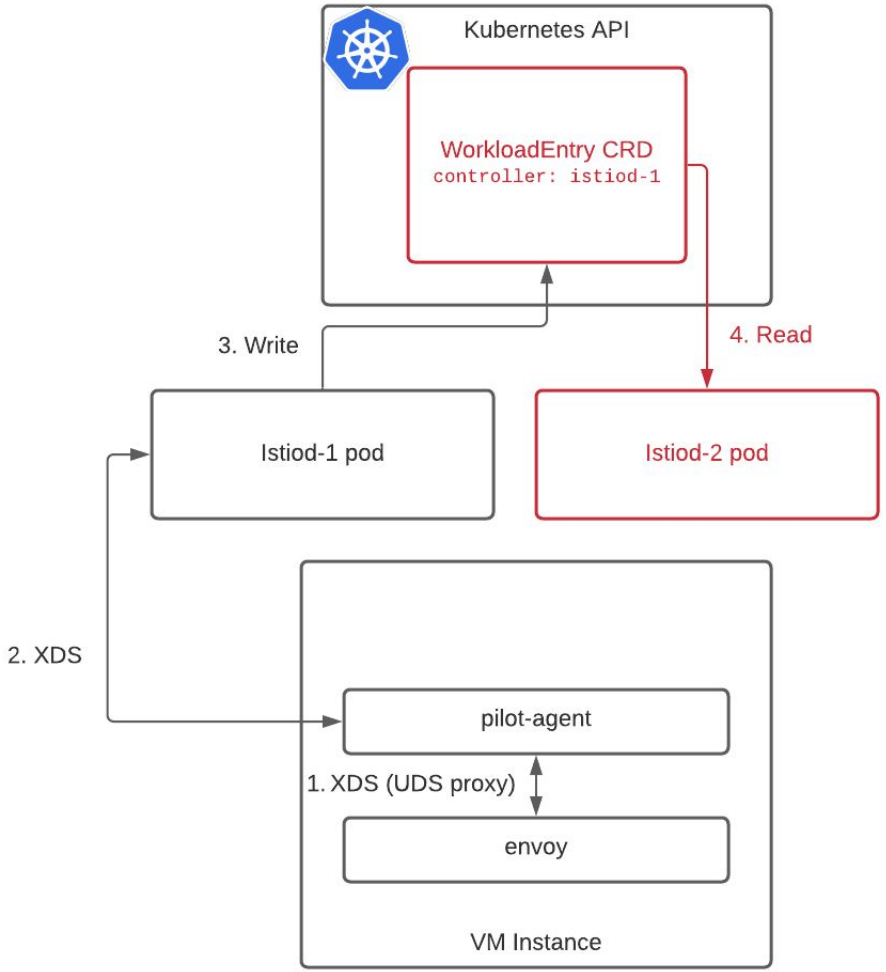

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Server-side Health Checks

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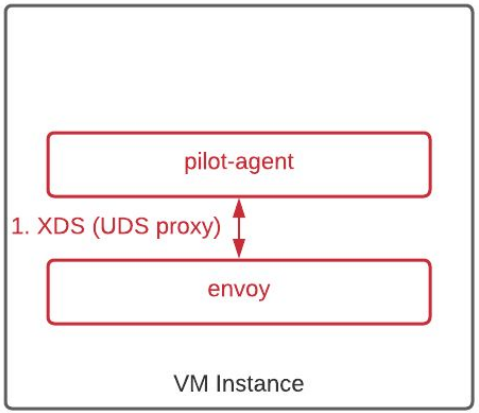

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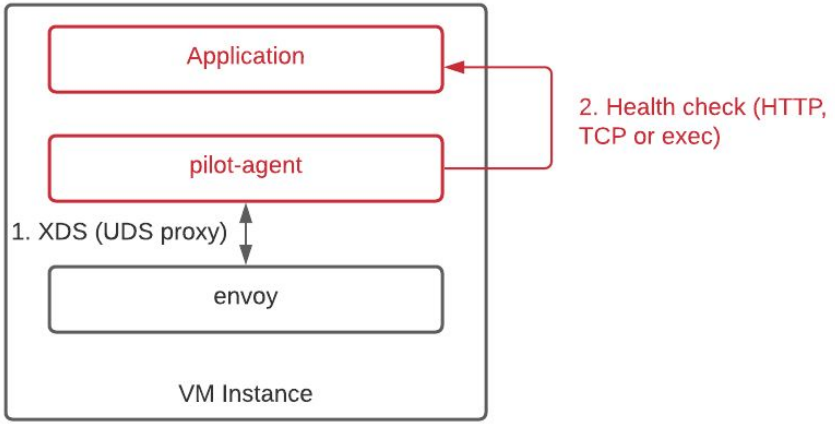

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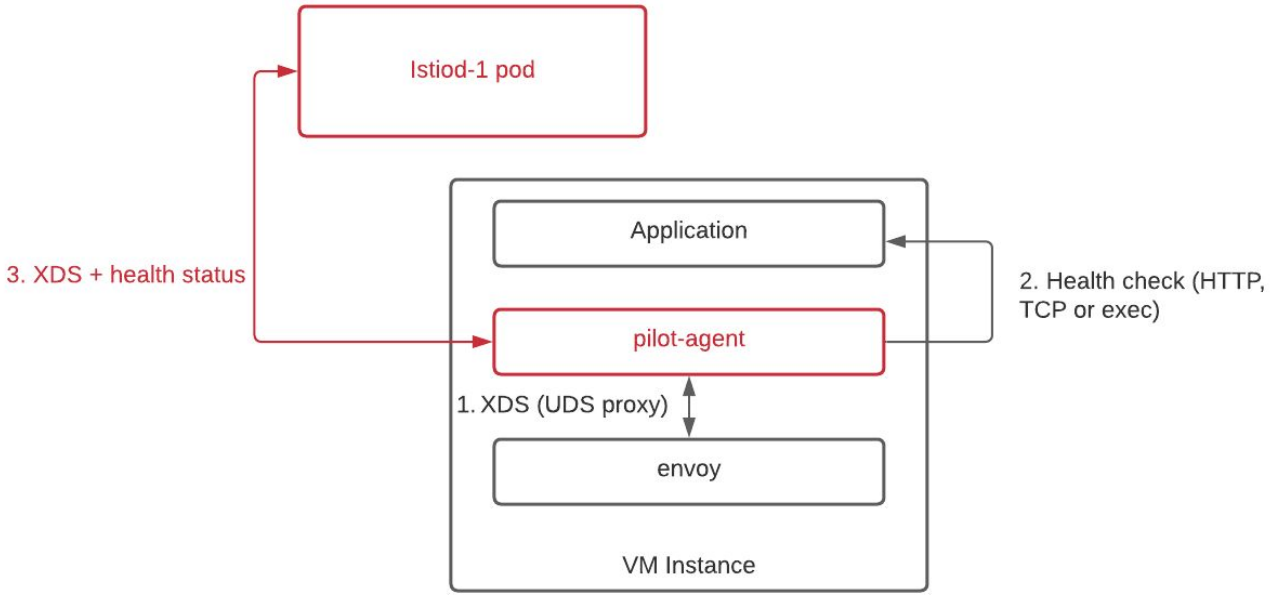

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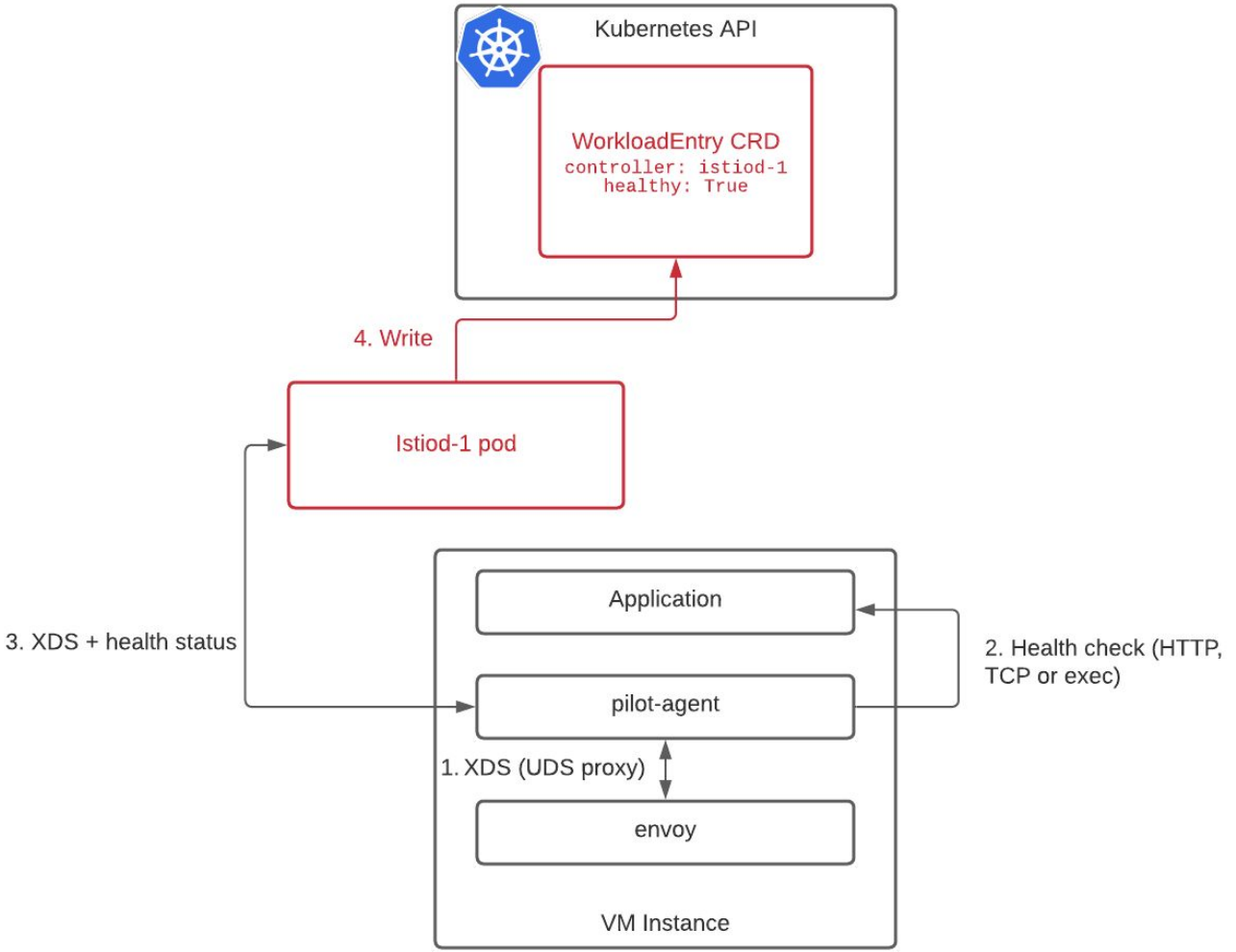

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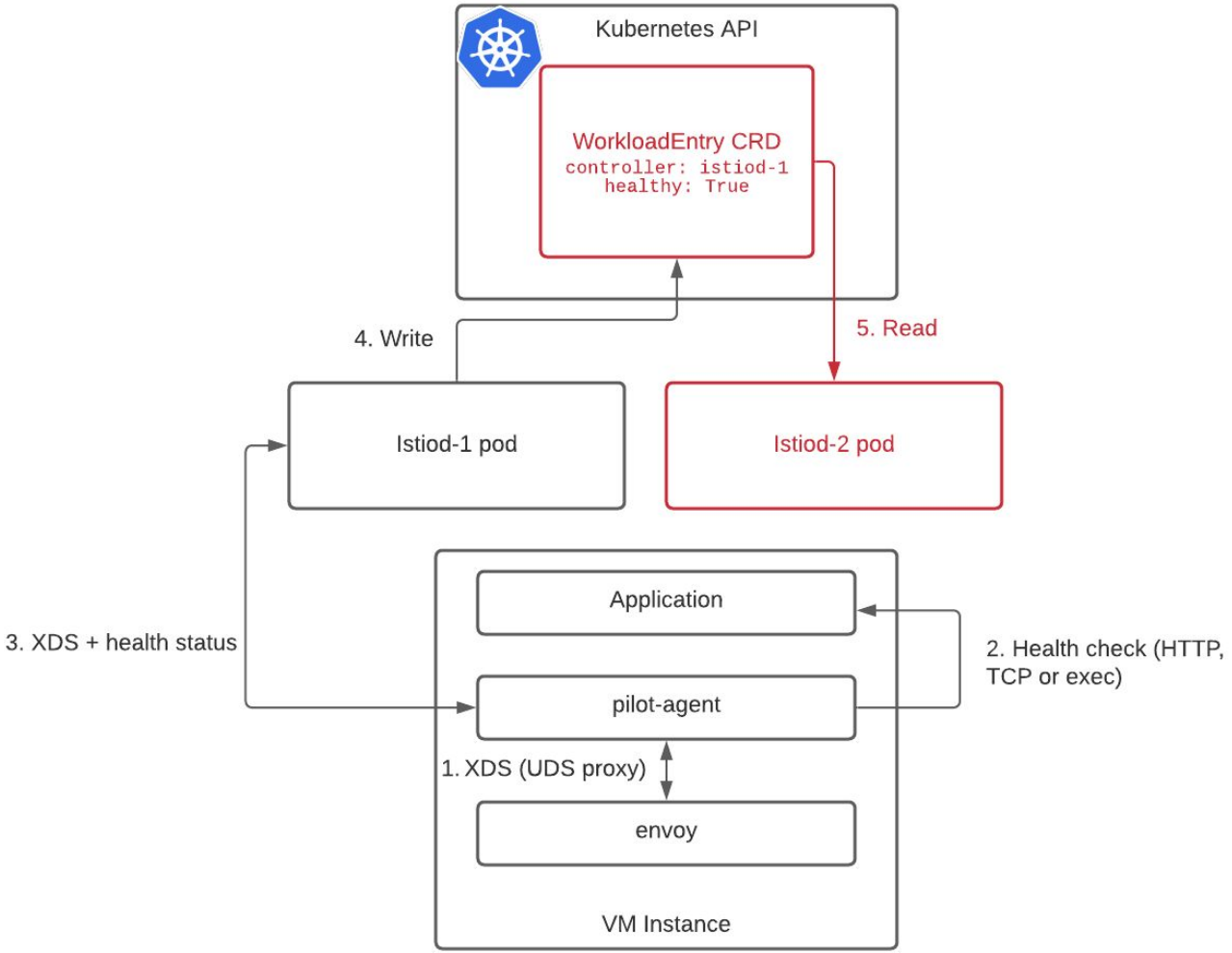

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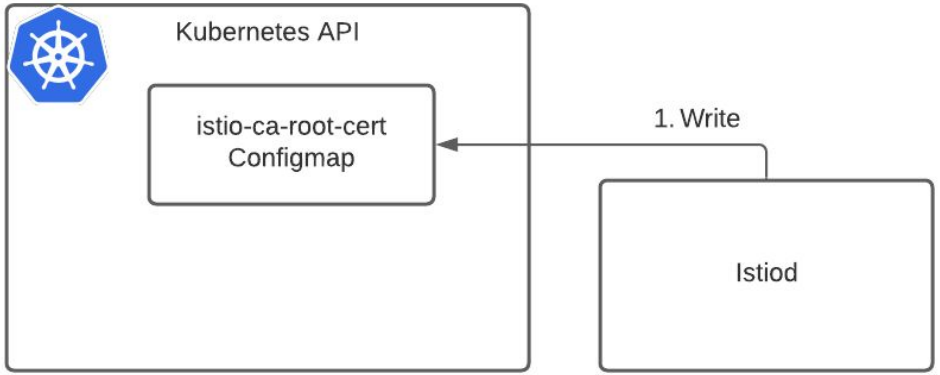

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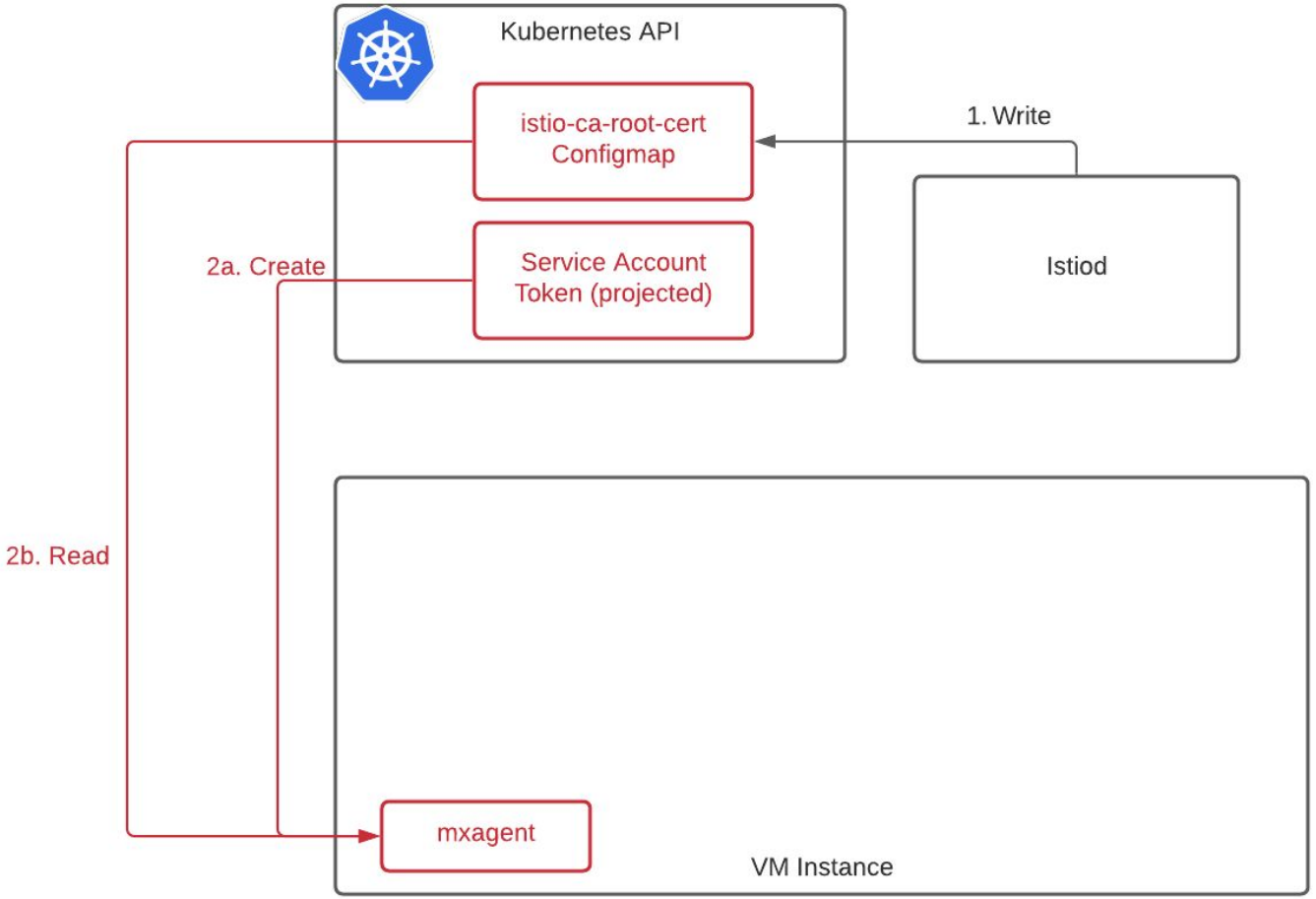

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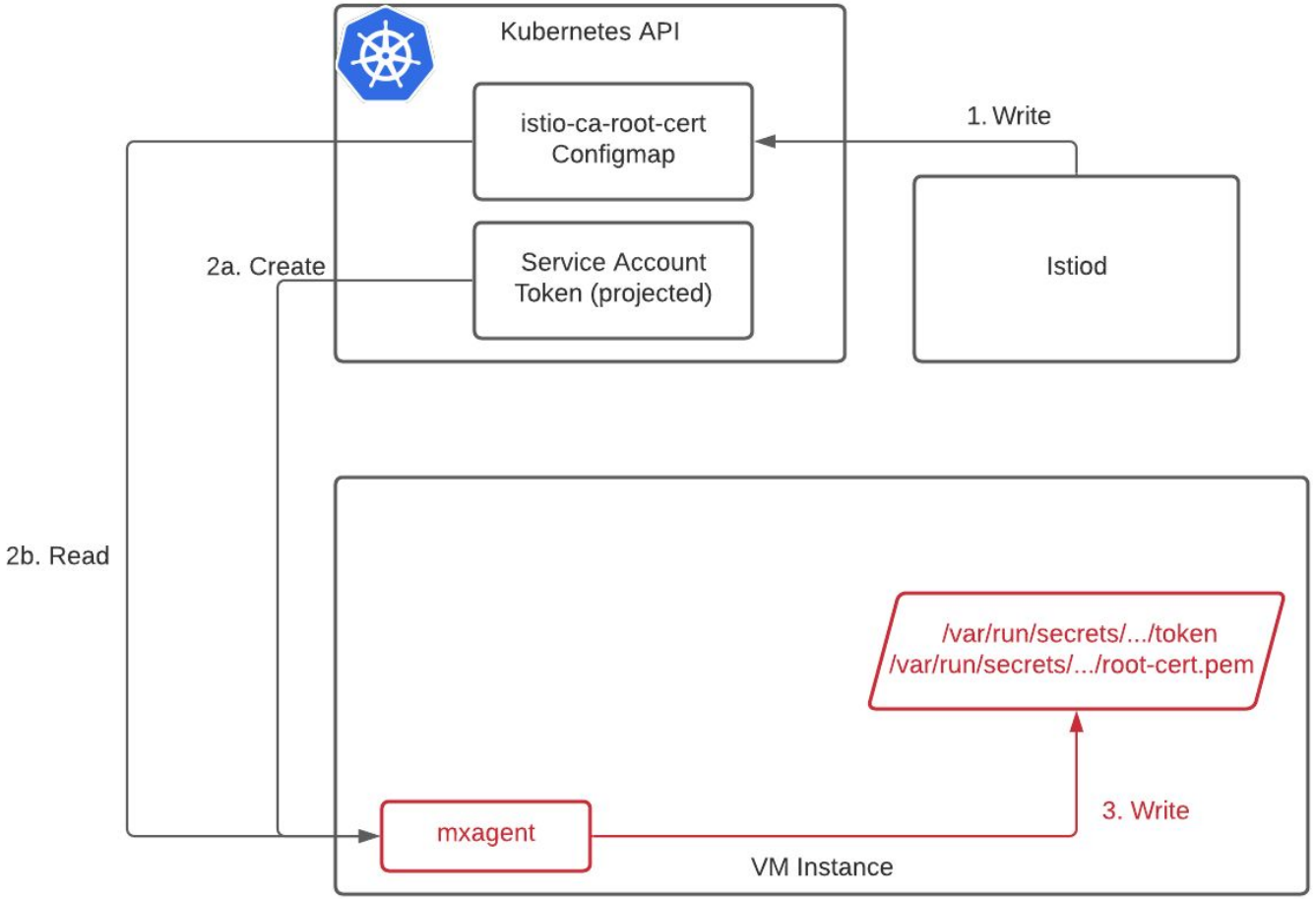

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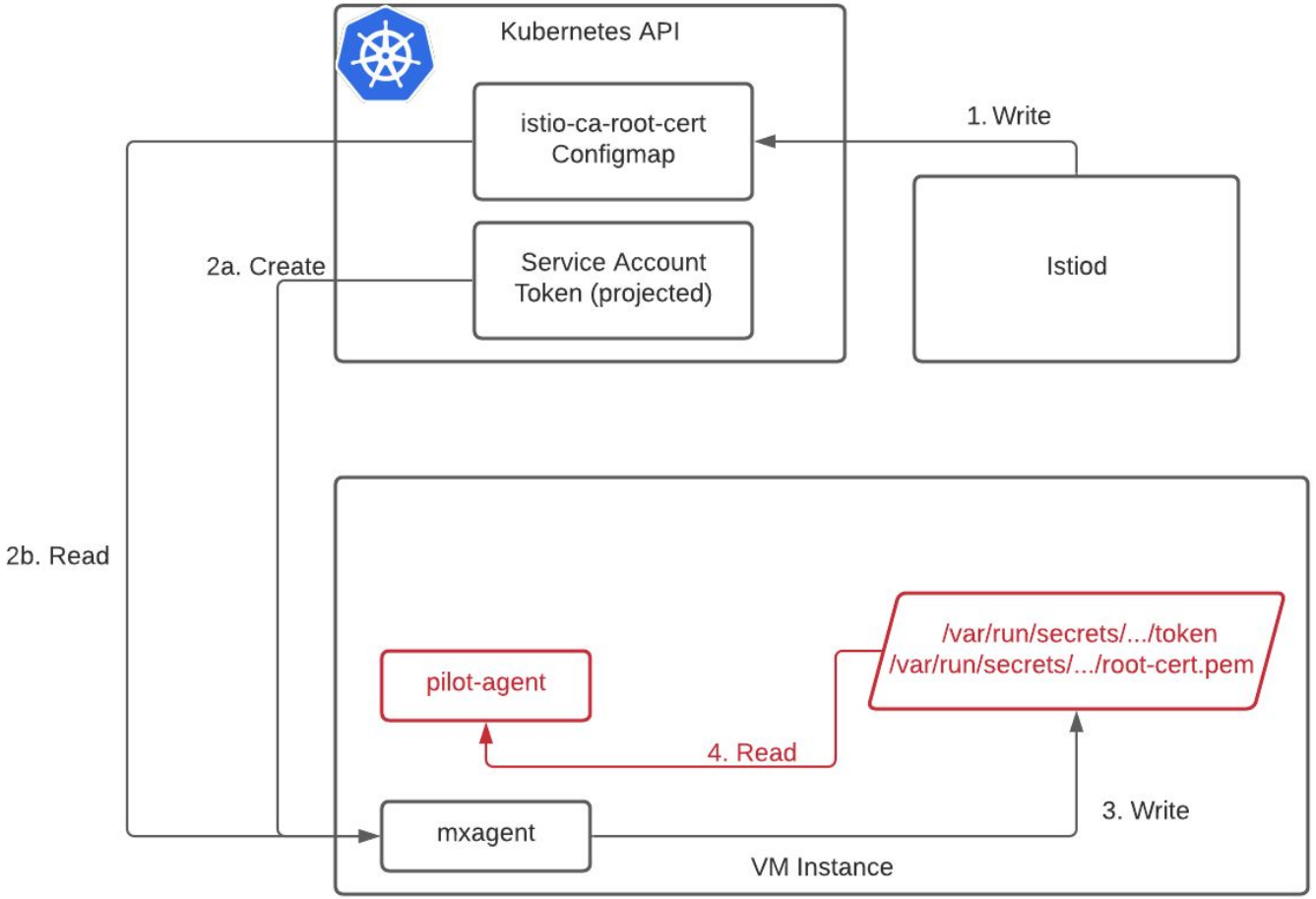

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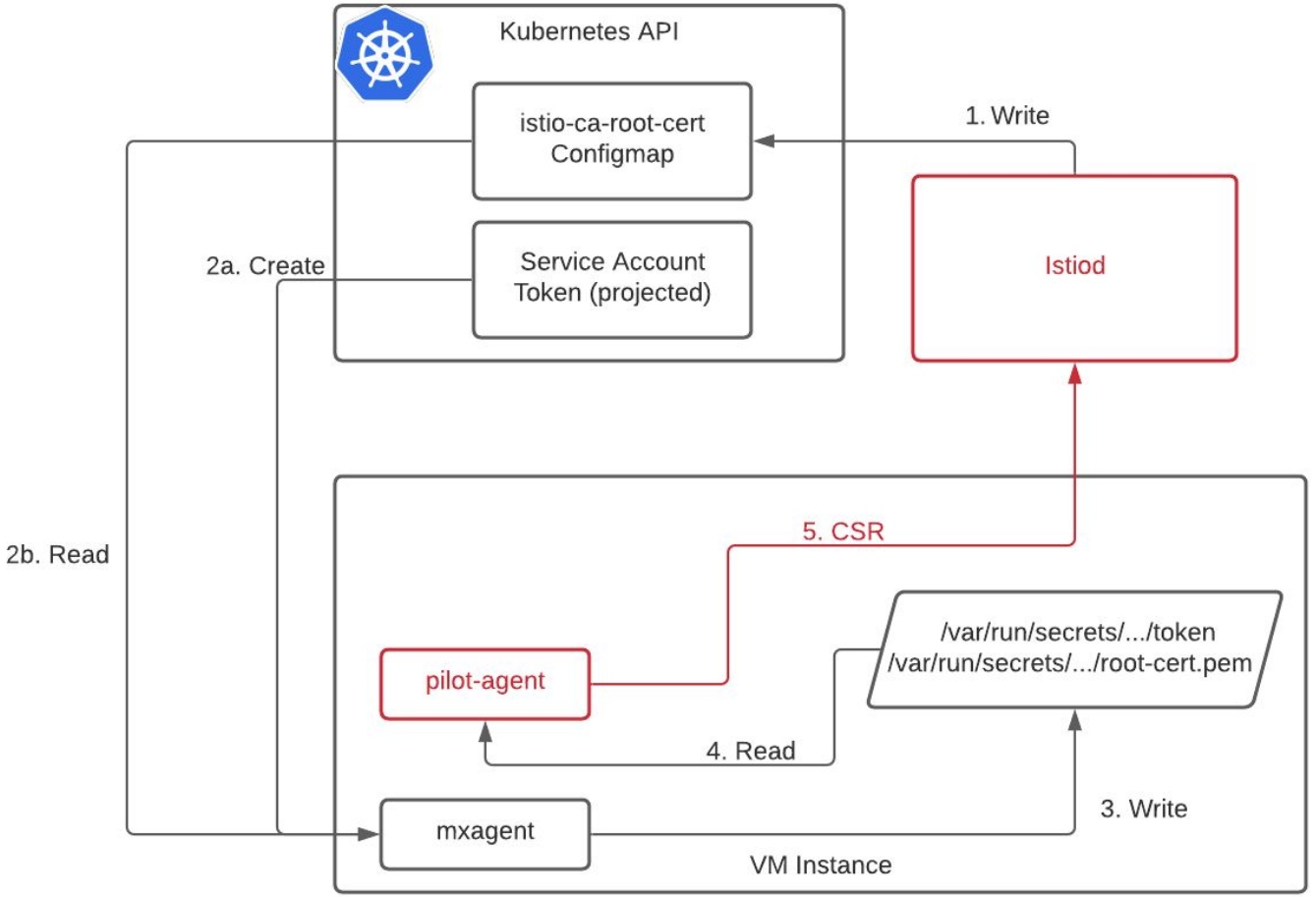

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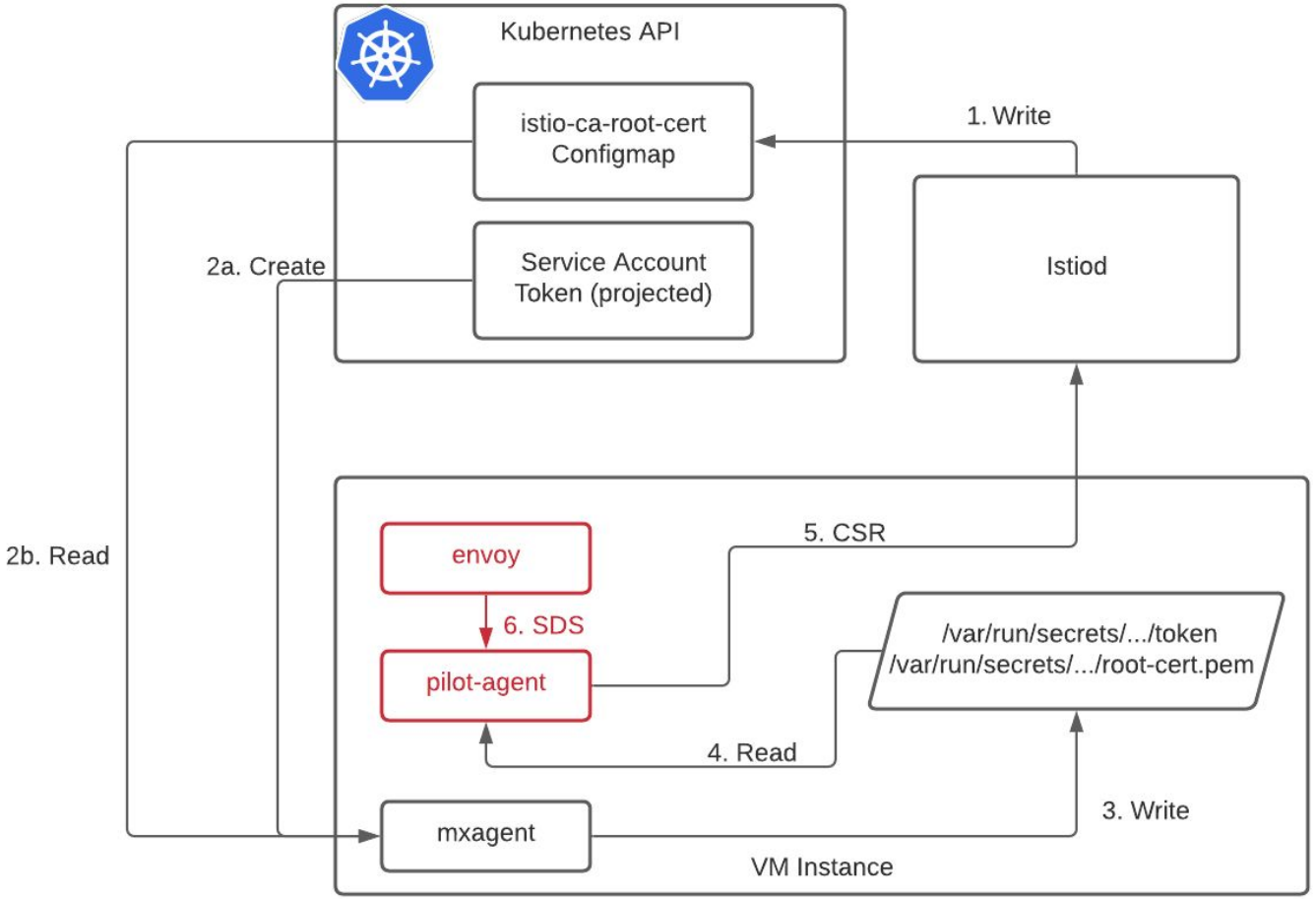

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Proxy Injection and Istio Version Upgrade

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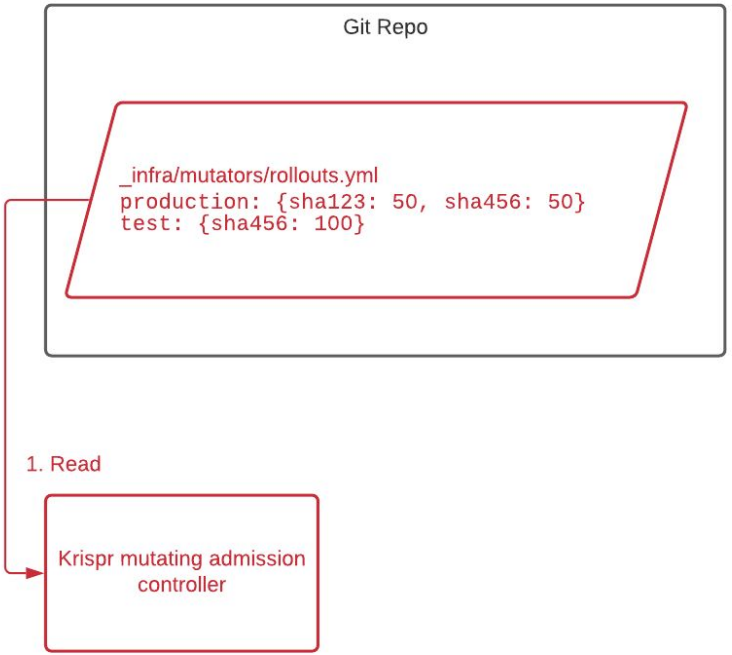

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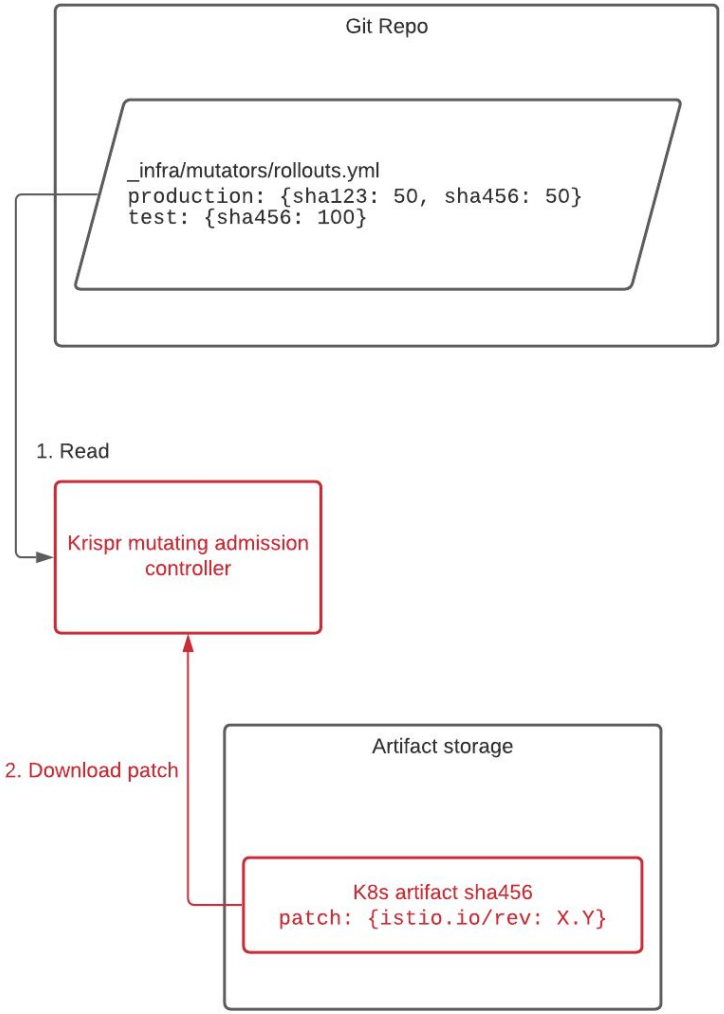

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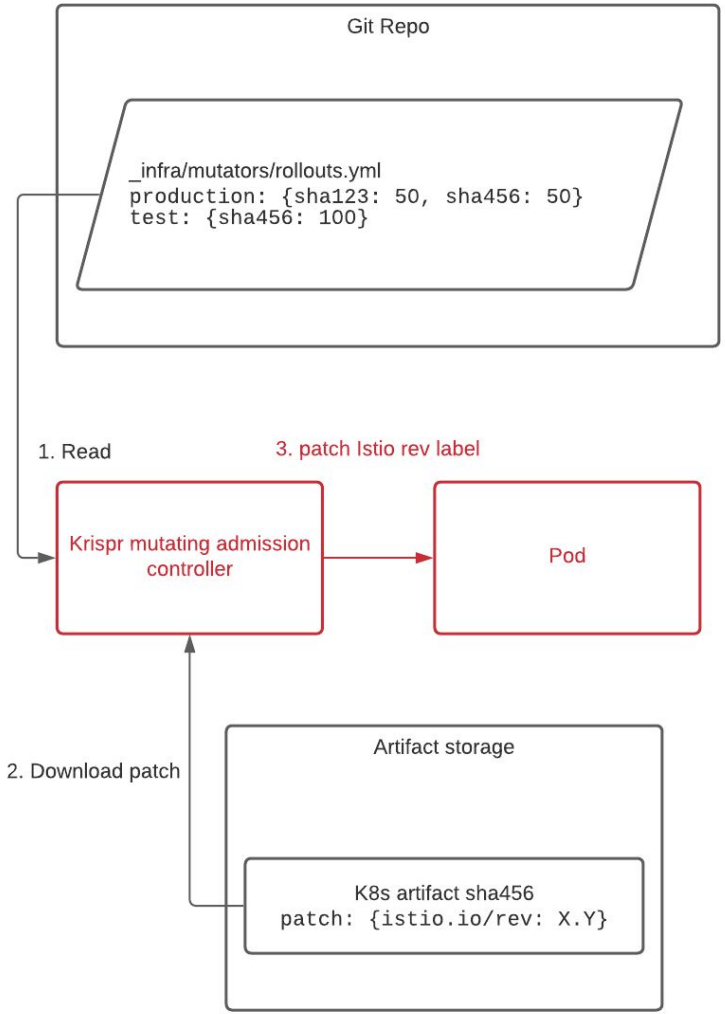

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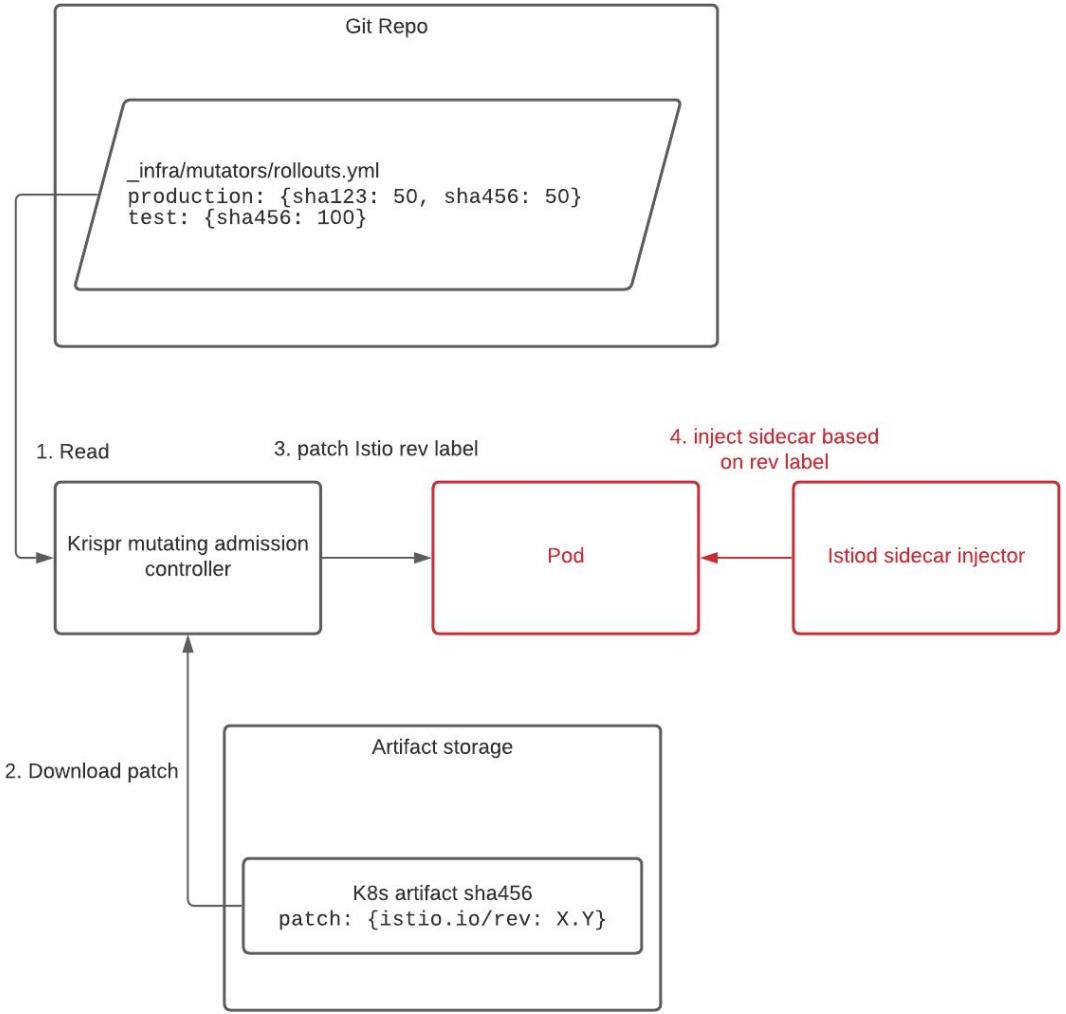

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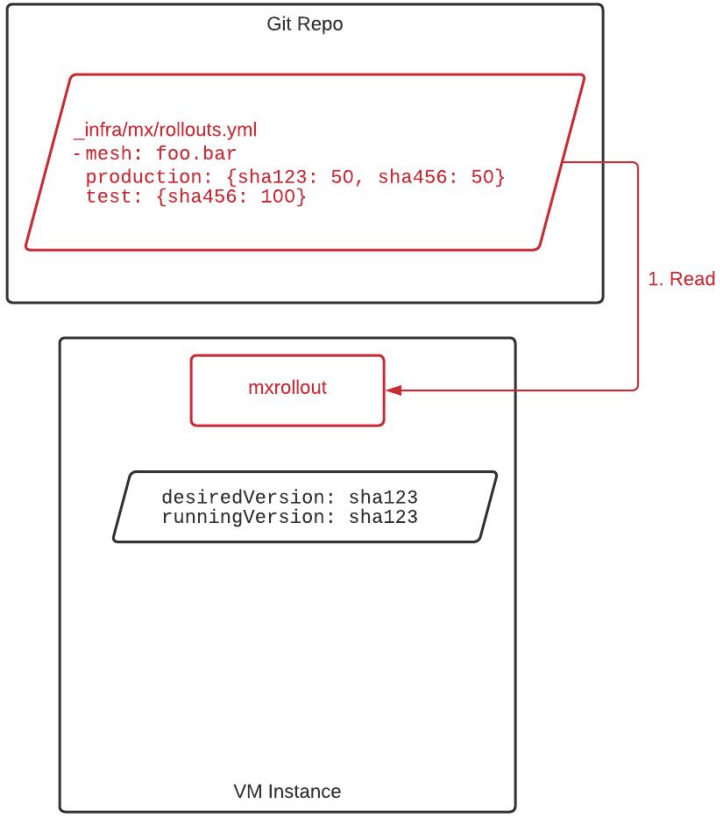

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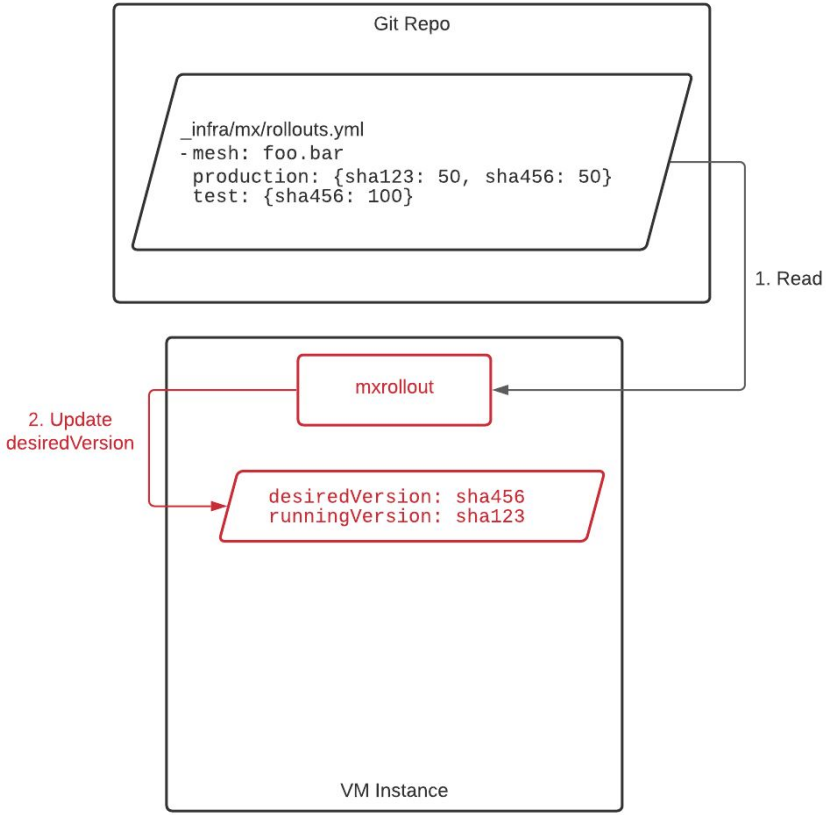

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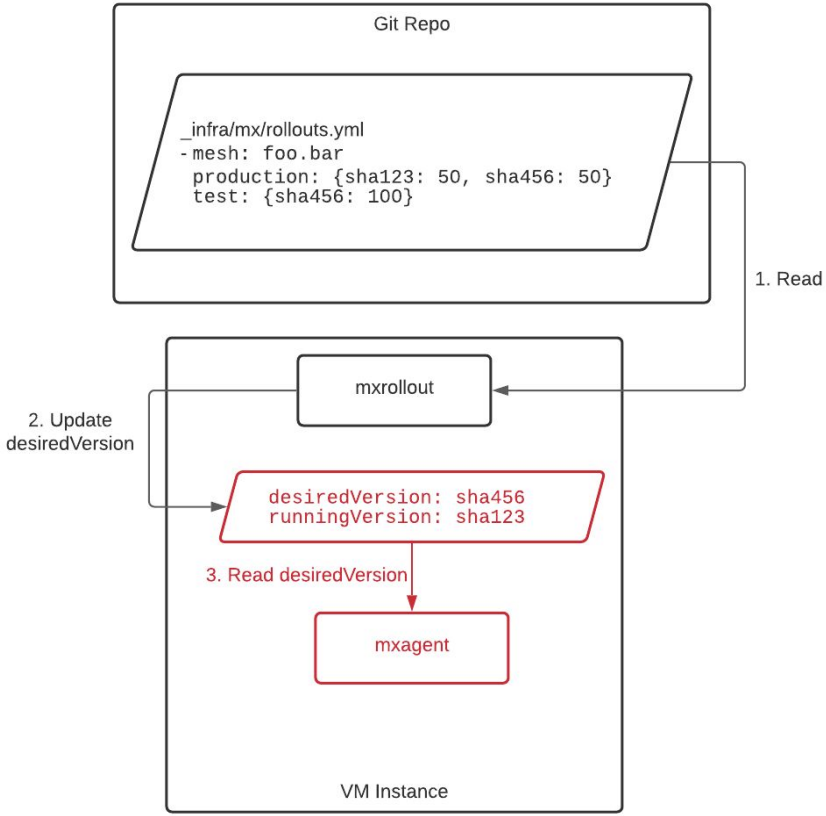

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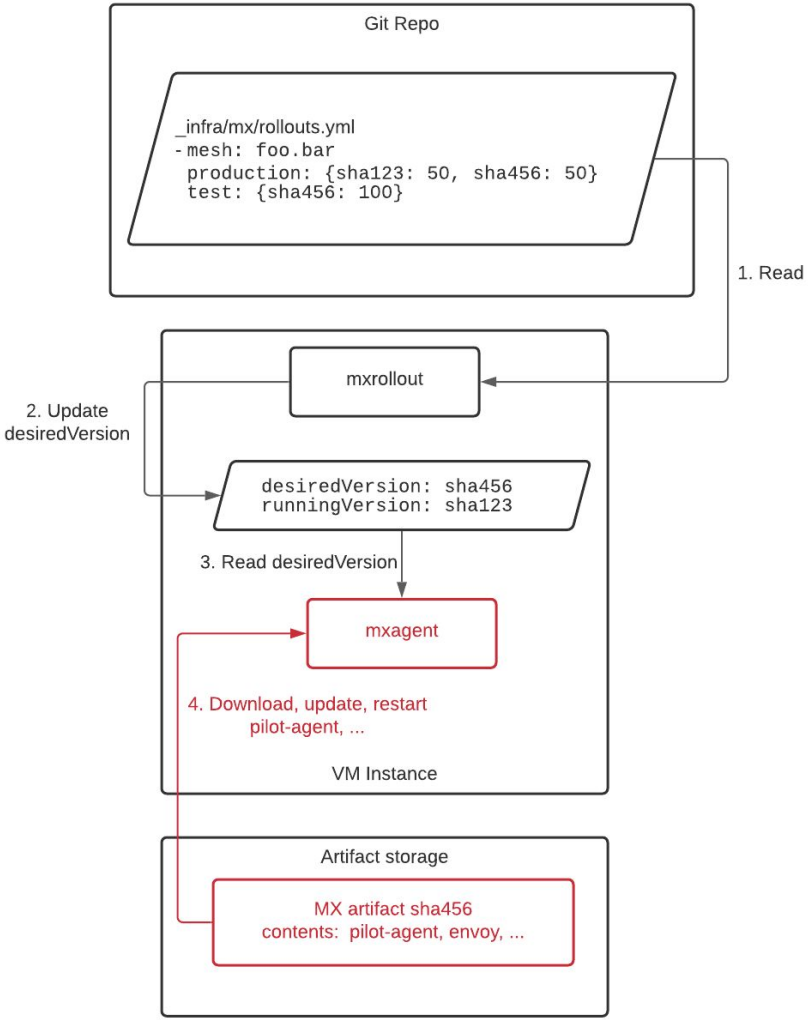

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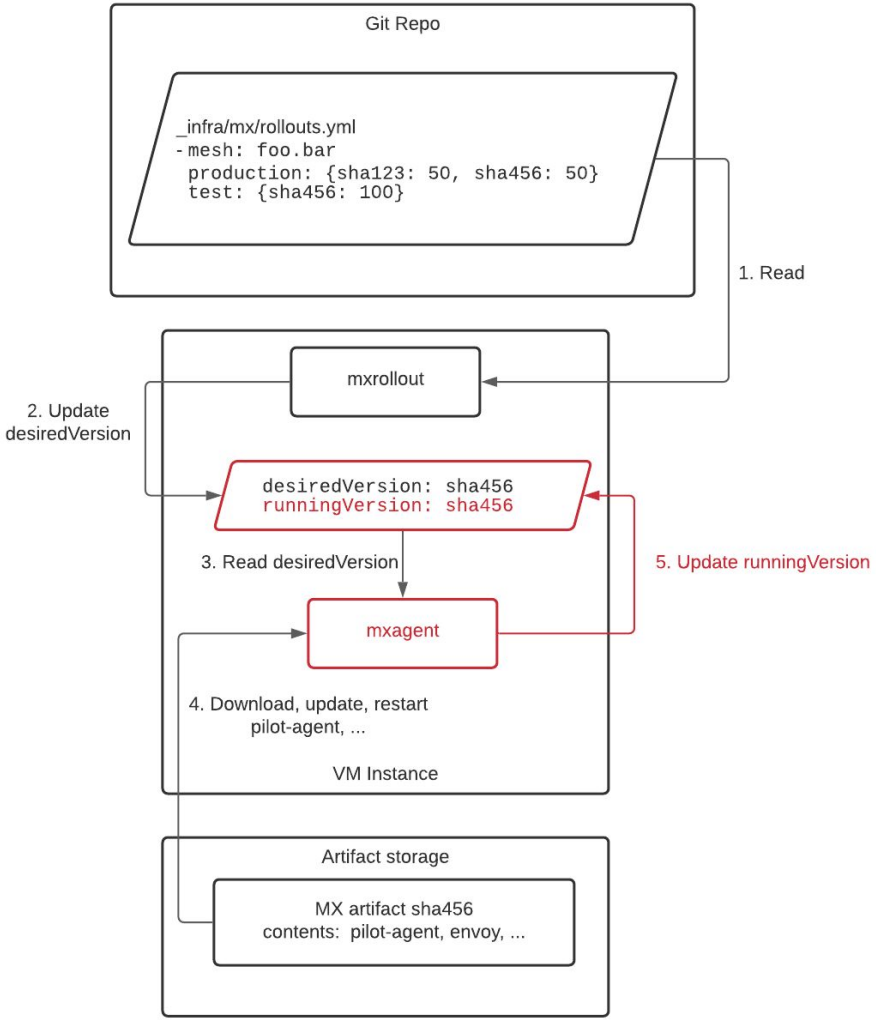

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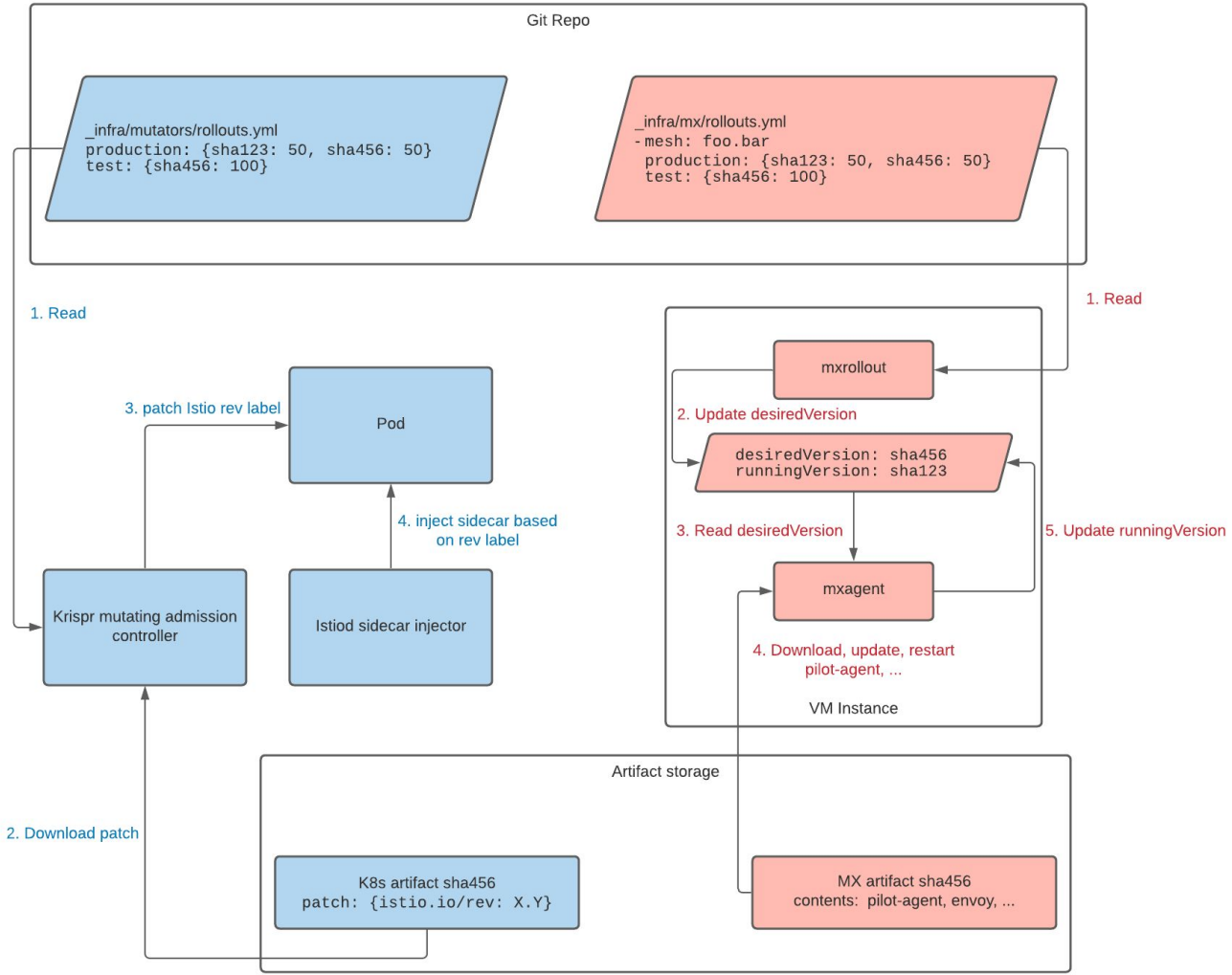


Multi Environment

External Services

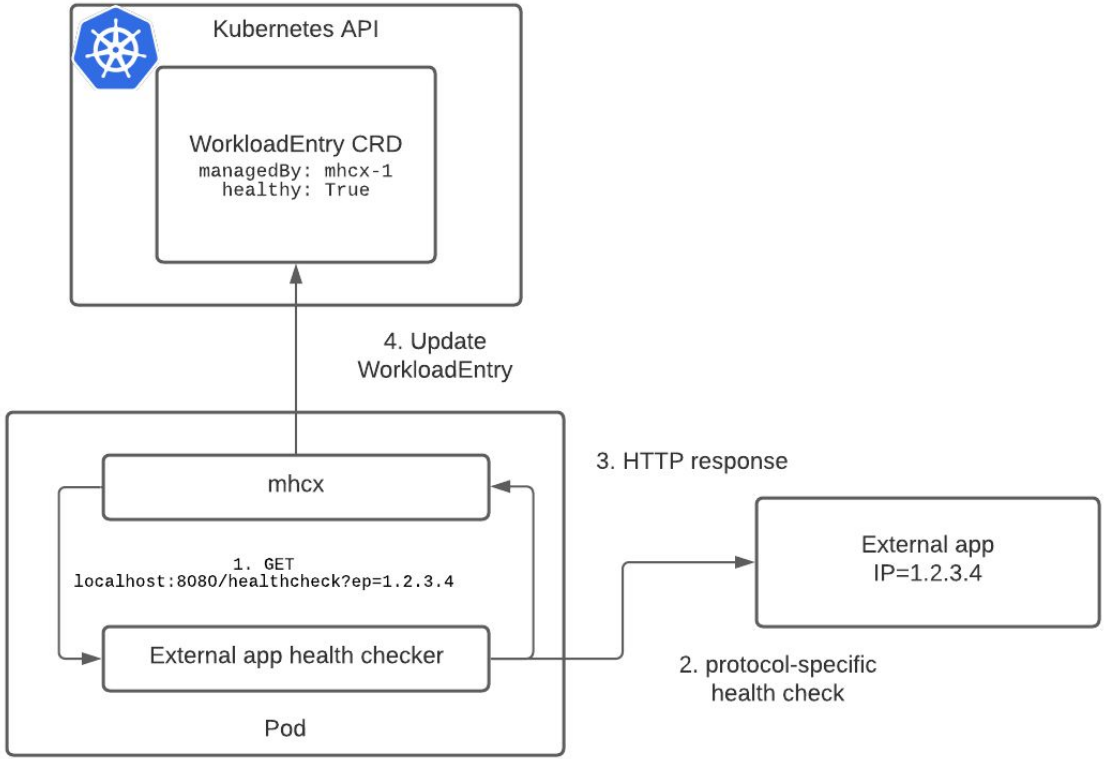
External Service Support

Requirements

- Server-side health checks
  - Clear ownership model for non-http health checks
- DNS name resolves to management cluster service IP
- Removal of stale endpoints

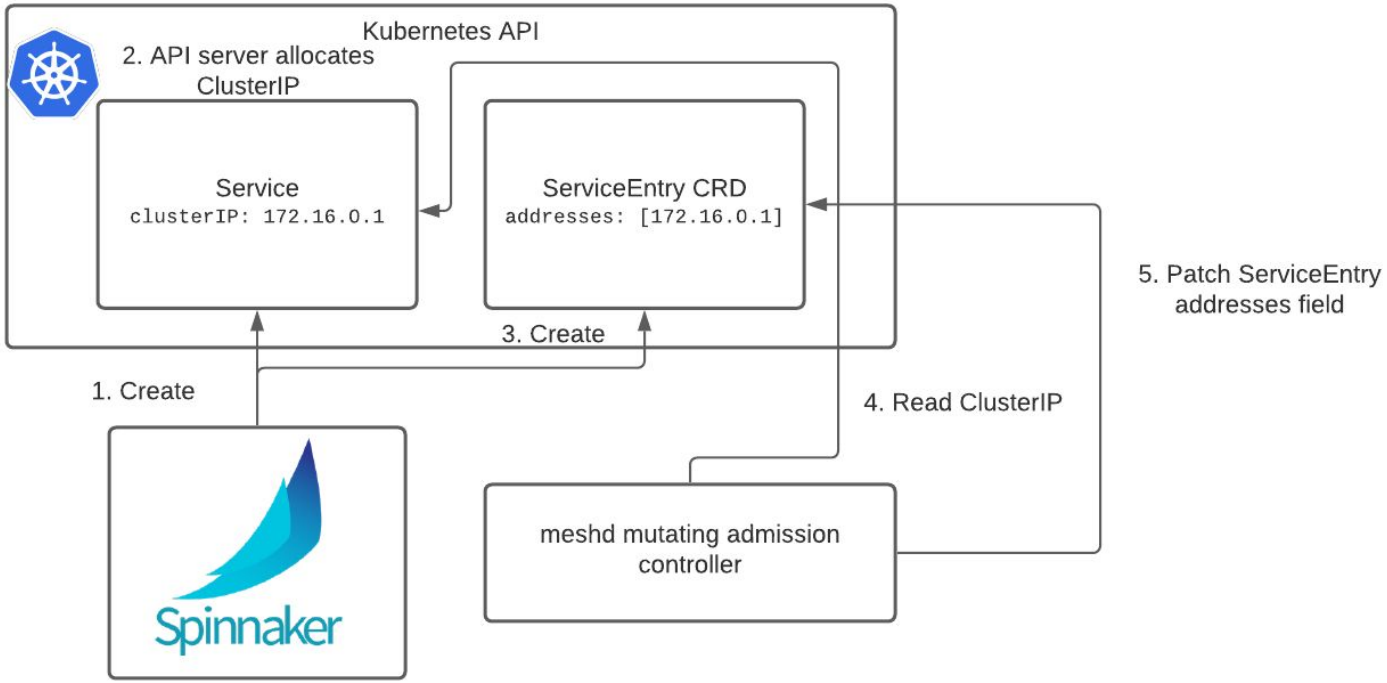
External Service Support

Server-side health checks



External Service Support

DNS ClusterIP setup



Key Concepts

Key Concepts

1. Globally flat IPv4 network
2. Single, external management cluster
3. Multiple tiers of pre-production meshes
4. Full feature parity for EC2, and path to migration to k8s
5. Generic mechanisms for adding non-http and external services

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