Horizon Europe Projects

Working on the Cloud Edge Continuum

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Funded by
the European Union

Horizon Europe (HE)

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What is Horizon Europe (HE)?

EU's research and innovation funding programme from 2021-2027 with a budget of €95.5 billion ($107 billion).

- Instrument to drive innovation.
- Strengthen the EU's position as a world leader in science, innovation, and technology.
- Help Europe become more attractive for research and innovation investment.
- Facilitate the collaboration of the public and private sectors in finding solutions to major challenges in Europe.

What?

How?

Funding Programmes / Opportunities

International cooperation

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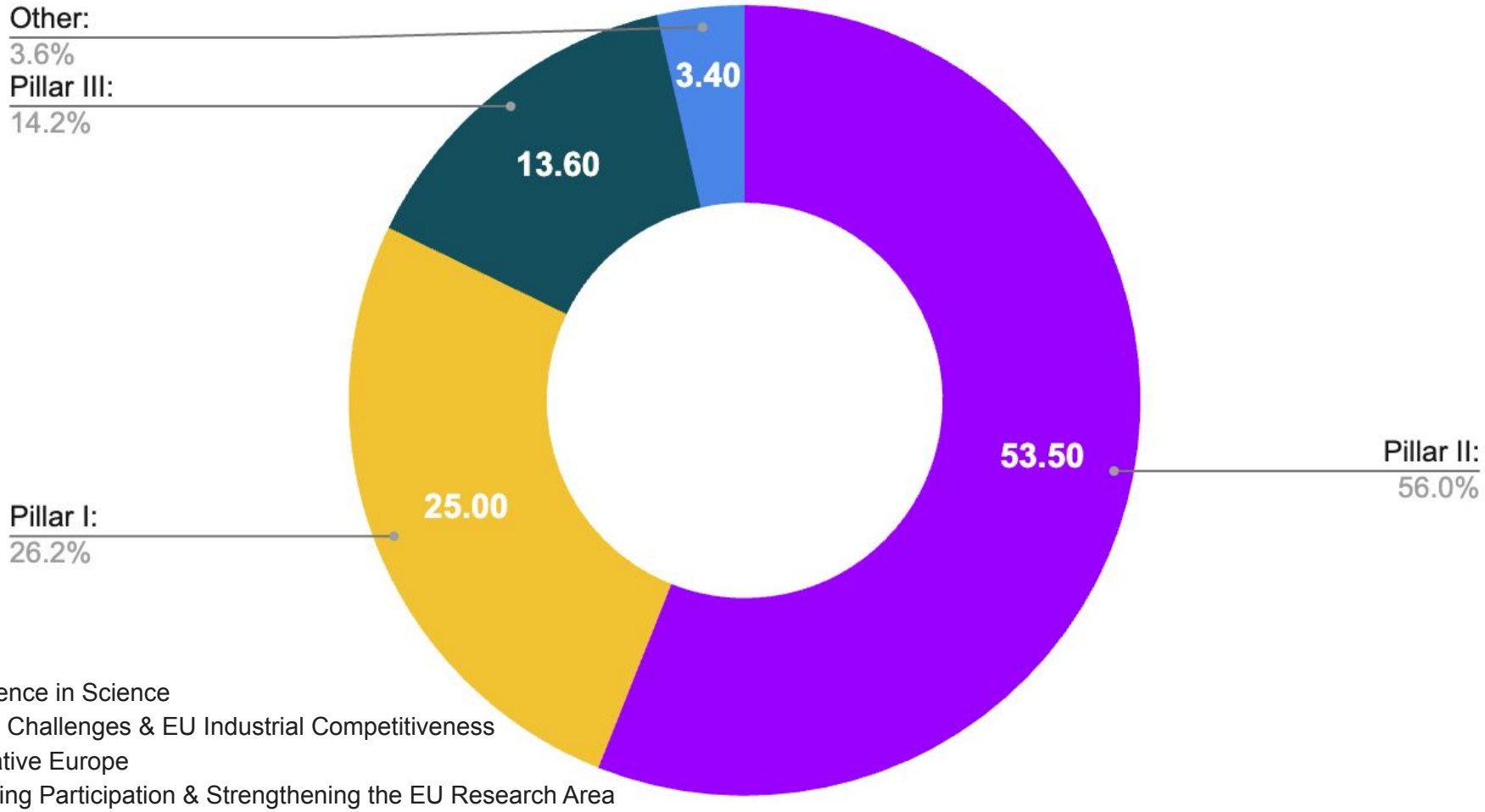
Horizon Europe Budget €95.5 billion / $107 billion (2021-2027)



Pillar I: Excellence in Science
Pillar II: Global Challenges & EU Industrial Competitiveness
Pillar III: Innovative Europe
Other: Widening Participation & Strengthening the EU Research Area

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Key stages for Horizon Europe (HE) funding success

1. Develop Project Ideas for HE Calls

Backlog / Future POCs

EU Funding & Tenders Portal

2. Consortium

Typically 15 public / private partners

3. Proposal

(6 months)

Detailed work plan, Budget, Impact strategy.

Register on the Portal & Submit

4. Evaluation

(3 months)

Threshold 10/15

5. Signing

Declaration of Honour

Grant Agreement (GA) with EU

Consortium Agreement (CA) between partners

6. Project Implementation & Administration

(3 years)

Execute project according to the CA.

Collaborate with partners, report progress.

Red Hat Horizon Europe (HE) Projects

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Who

- Red Hat **Office of the CTO**
  - Red Hat Research
  - Emerging Technologies
- Engineers from **RH Product Teams**

Where

- Beneficiaries and Affiliate Entities
- **RH Locations**
  - Ireland (Waterford)
  - Czechia (Brno)
  - Israel
  - Spain
  - Sweden
  - Italy

Map by Free Vector Maps

Where – Partners

- France,
- Spain,
- Greece,
- Italy,
- Ireland,
- UK,
- Germany,
- Czechia
- Finland,
- Israel,
- Portugal,
- Netherlands,
- Luxembourg,
- Romania,
- Cyprus,
- Bulgaria

Map by Free Vector Maps

What


AI


Cloud

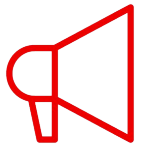

Edge


Open Source


Security

- 7 Active Projects
- 3 year duration
- 15 public / private partners in each
- 3 successful proposals at signing stage currently

Why



Promote

- Open Source
- OS Communities
- Red Hat technologies anchoring projects

Influence

- Public / private partners
- Technologies used in academia
- Technologies used by commercial partners

Standards

- EU standards become world standards
- Embed RH in Open Research

Innovation

- New features
- Intersection with a product's roadmap

Red Hat HE Projects

Project	Call	Start	Duration / Months
AC3	HORIZON-CL4-2022-DATA-01-02 Cognitive Cloud: AI-enabled computing continuum from Cloud to Edge	Jan 2023	36
CODECO	HORIZON-CL4-2022-DATA-01-02 Cognitive Cloud: AI-enabled computing continuum from Cloud to Edge	Jan 2023	36
Green.Dat.AI	HORIZON-CL4-2021-DATA-01-03 Technologies for data management (AI, Data and Robotics Partnership) (IA)	Jan 2023	36
P2CODE	HORIZON-CL4-2022-DATA-01-03 Programming tools for decentralised intelligence and swarms (RIA)	Sep 2022	36
CHESS	HORIZON-WIDERA-2022-ACCESS-04-01 Excellence Hubs	Jan 2023	48
AERO	HORIZON-CL4-2022-DIGITAL-EMERGING-01-26 Open source for cloud-based services (RIA)	Jan 2023	36
CONNECT	HORIZON-CL5-2021-D6-01-04 Cyber Secure and Resilient CCAM	Sep 2022	36

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OCTO Emerging Technologies Projects * 3

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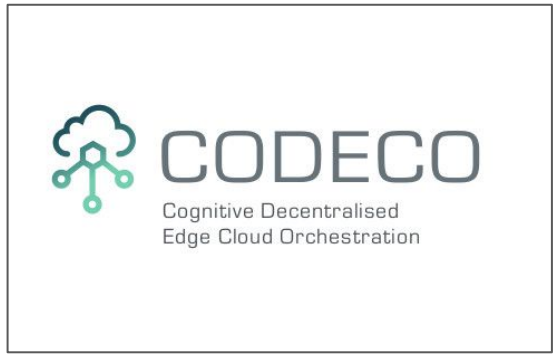
OCTO - Emerging Technologies - HE Projects



CODECO

Hybrid Cloud, Edge, IoT, AI

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AC3

Hybrid Cloud, Edge, IoT, AI

Funded by
the European Union

P2CODE

Hybrid Cloud, Edge, IoT, AI

Funded by
the European Union

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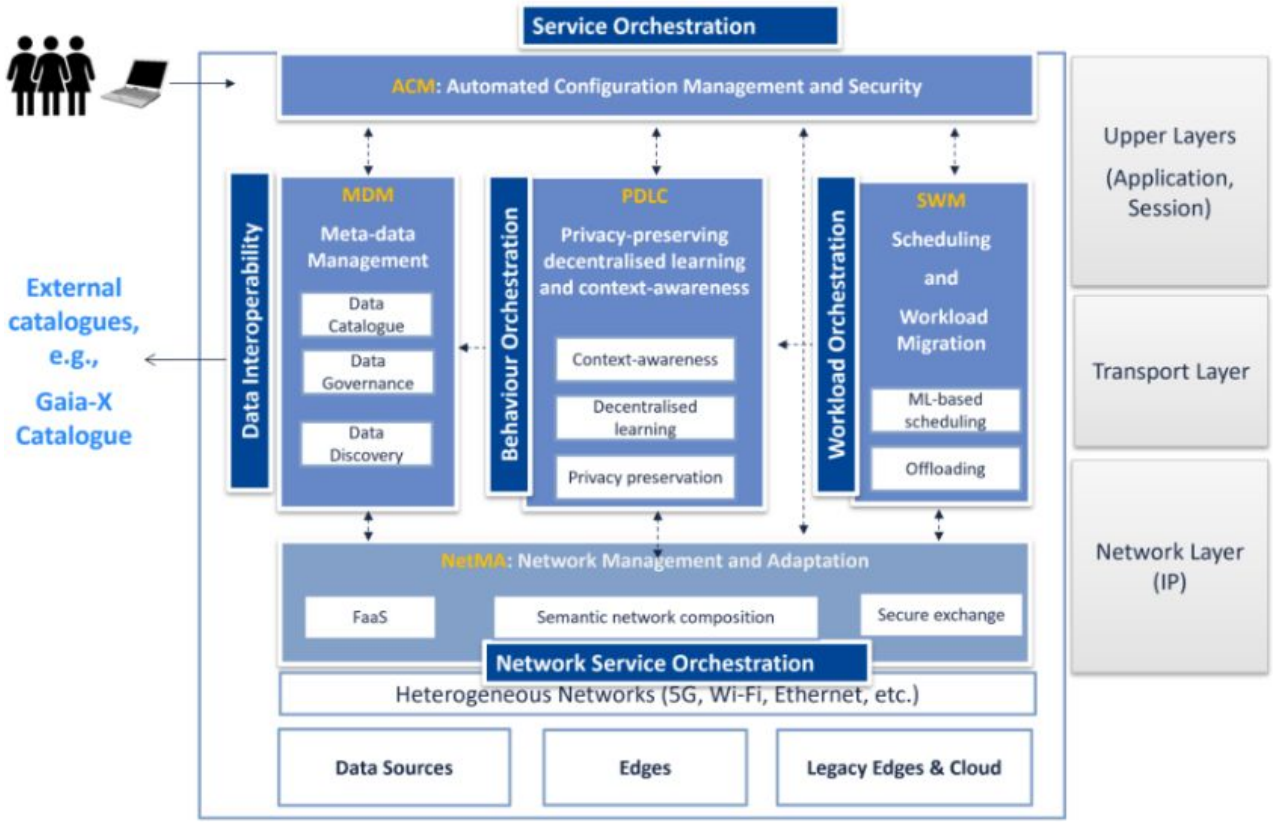
CODECO – Cognitive Decentralised Edge-Cloud Orchestration

The aim of **CODECO** is

- To contribute to a smoother and more flexible support of services across the Edge-Cloud continuum
- via the creation of a novel, cognitive Edge-Cloud management framework.
- Using a unique, smart, and cross-layer orchestration
  - between the decentralised data flow, computation, and networking services,
  - to address Edge-Cloud challenges derived from the rising Internet and IoT service decentralisation.



Overview of CODECO's framework and key components

Associated Red Hat Product Area:

- **OKD/OLM/OCM**

GitHub Repo

CODECO Cognitive Decentralised Edge Cloud Orchestration
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CODECO Partners

- **16 partners**
- Red Hat's main contacts include:
  - **Fortiss**
    - the project coordinators (Prof. Rute Sofia).
  - **IBM**
    - Infrastructure support
  - **Siemens**
    - Multi cluster scheduling

CODECO Cognitive Decentralised Edge Cloud Orchestration
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AC3

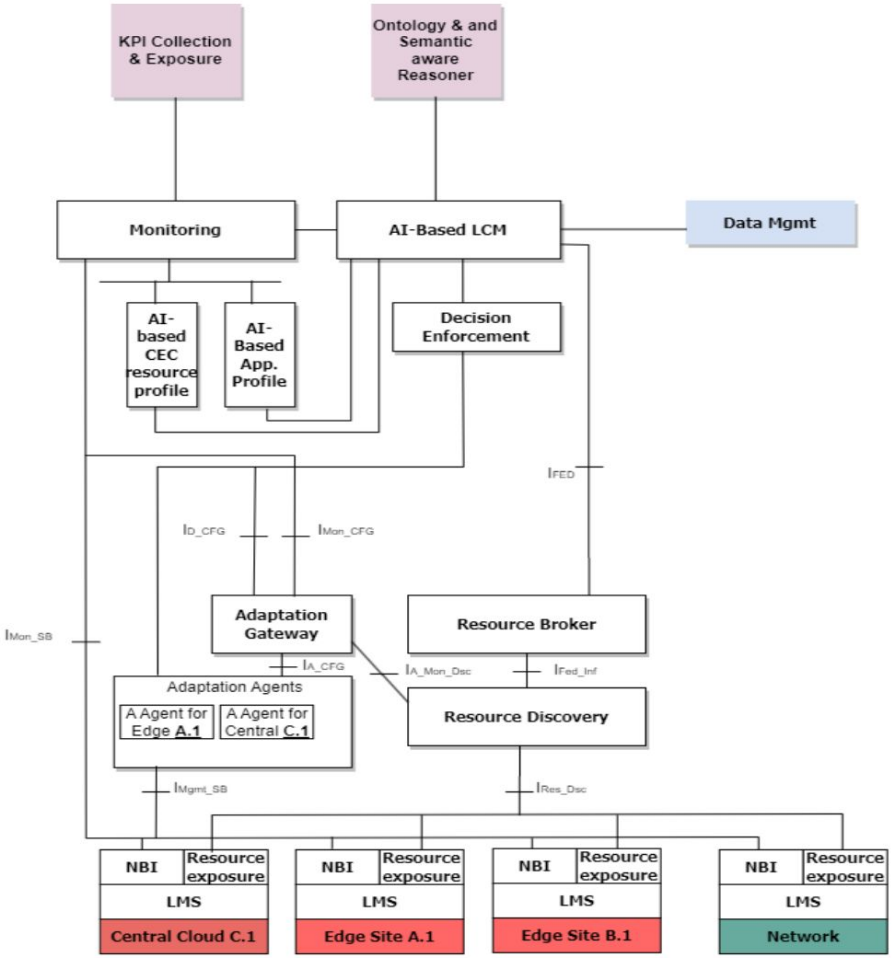
The aim of the **AC3** project is to

- create an agile and intelligent framework
- for efficiently managing and optimizing resources
- across the cloud edge computing continuum,
- ensuring low latency,
- high data transfer rates,
- and reduced energy consumption
- while maintaining service quality and adaptability
- to changing network conditions.

Associated Red Hat Product Area:

- **Openshift**
- **Red Hat Service Interconnect**

ac3-project.eu



AC3 architectural overview (components interaction)

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AC3 Partners

- **12 partners**
- Red Hat's main contacts include:
  - **IBM**,
    - work package leaders (WP4) of our main task - network programmability
  - **UCM** (University of Madrid)
    - scalable processing of Astronomy observations
  - **Eurocom**
    - Main contact point and project coordinator (Prof. Adlen Ksentini)

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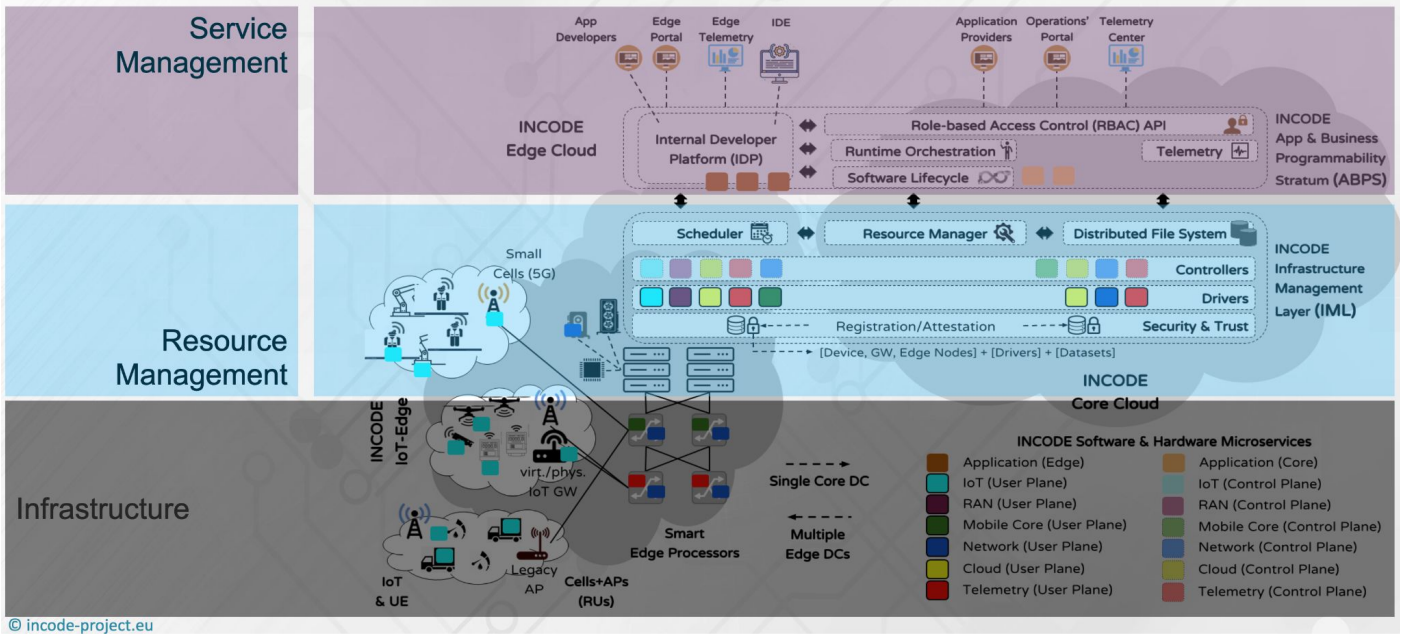
P2CODE – Programming Platform for Intelligent Collaborative Deployments

The aim of the **P2CODE** project is to create

- a developer platform
- with built in CI/CD
- for building cloud native applications
- to be deployed on edge devices dynamically.

Associated Red Hat Product Area:

- **OKD**
- **OpenShift**
- **ODF**
- **OCM**
- **BootC**



A horizontal view of the layers within P2CODE and the component interactions

[More about this project]

P2CODE
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P2CODE Partners

- 19 partners
- Red Hat's main contacts include:
  - **University of Patras**
  - **MADE**
  - **UbiTech**
- As the leaders of work package 3, we have a key role in partner coordination and tracking task progression.

P2CODE
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Innovations * 3

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1. developer-focused multi-cluster scheduler

Multi-cluster scheduler

Using Custom Annotations & Node Feature Discovery (NFD).

Custom Annotations

Help tailor placement strategies

based on:

- workload characteristics
- cluster health
- and resource availability

Node Feature Discovery (NFD)

Exposes detailed node-level features including:

- hardware specs
- availability
- or specific capabilities

Multi-cluster scheduler

Key Benefits

Improved Resource Utilization:

Smarter workload placement based on NFD discovery

using both workload characteristics:

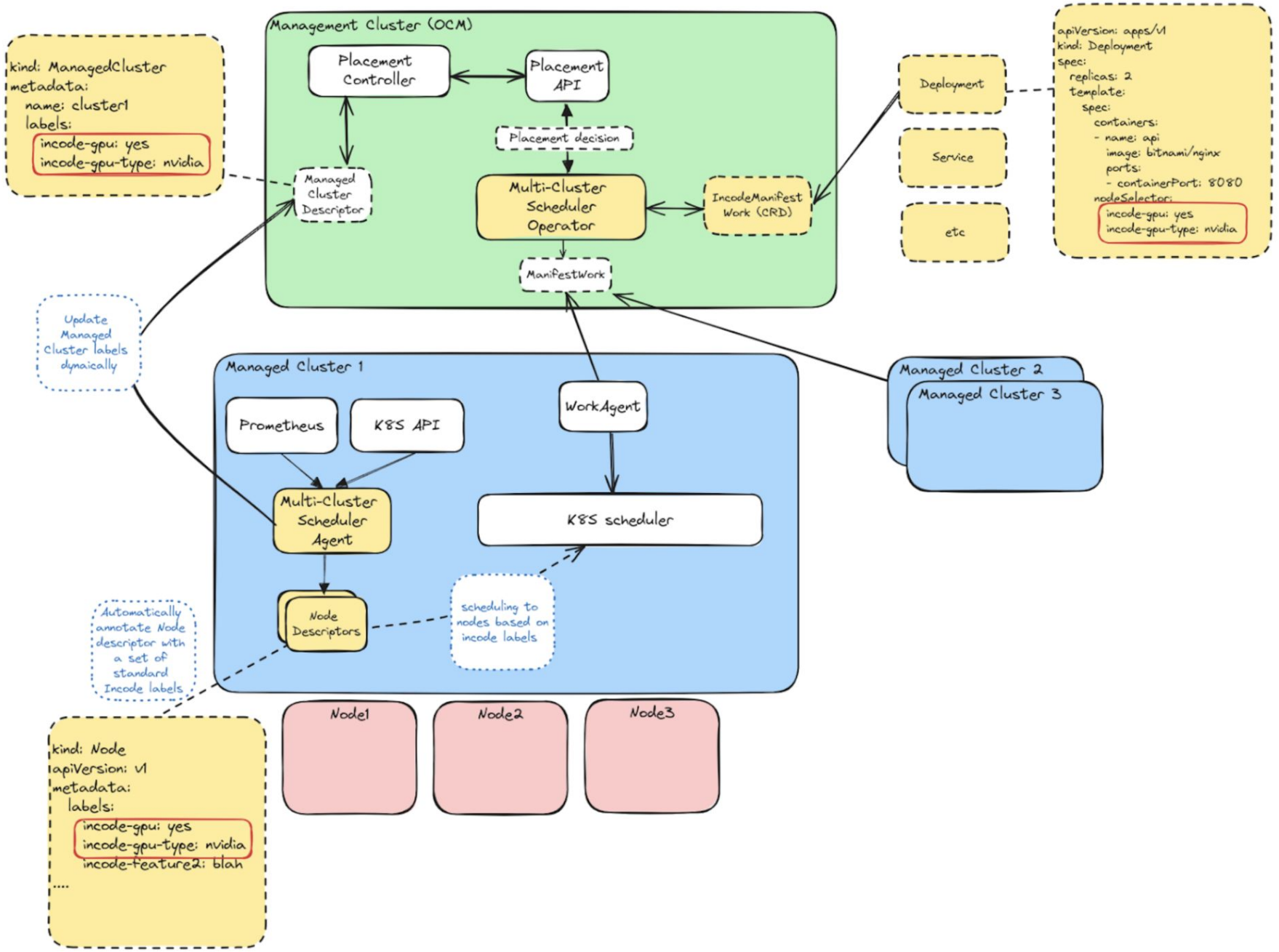
- Resource availability
- And node-level features

Reduced Latency

Latency reduced from:

- Optimal geographic placement
- and avoiding, overloading clusters

1. developer-focused multi-cluster scheduler



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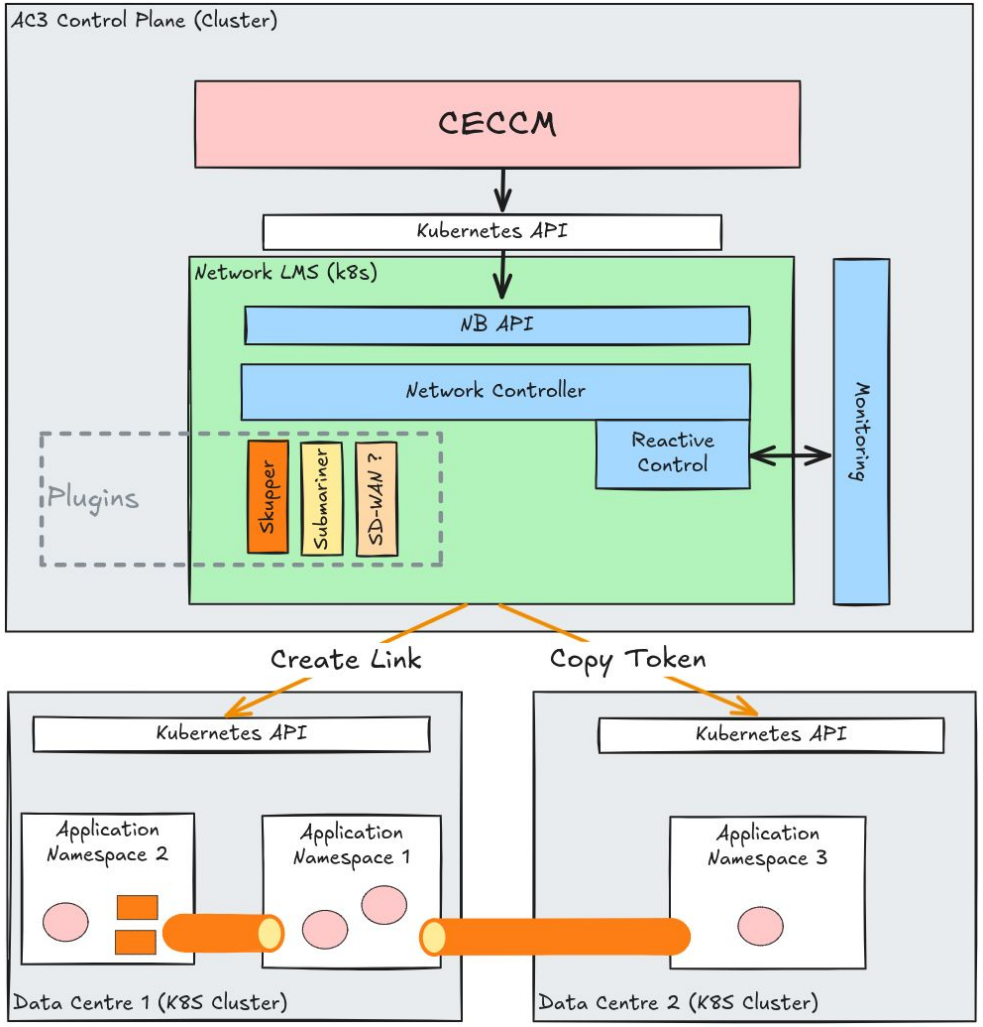
2. multi-technology network operator

Red Hat's Contribution on AC3

Network Programmability



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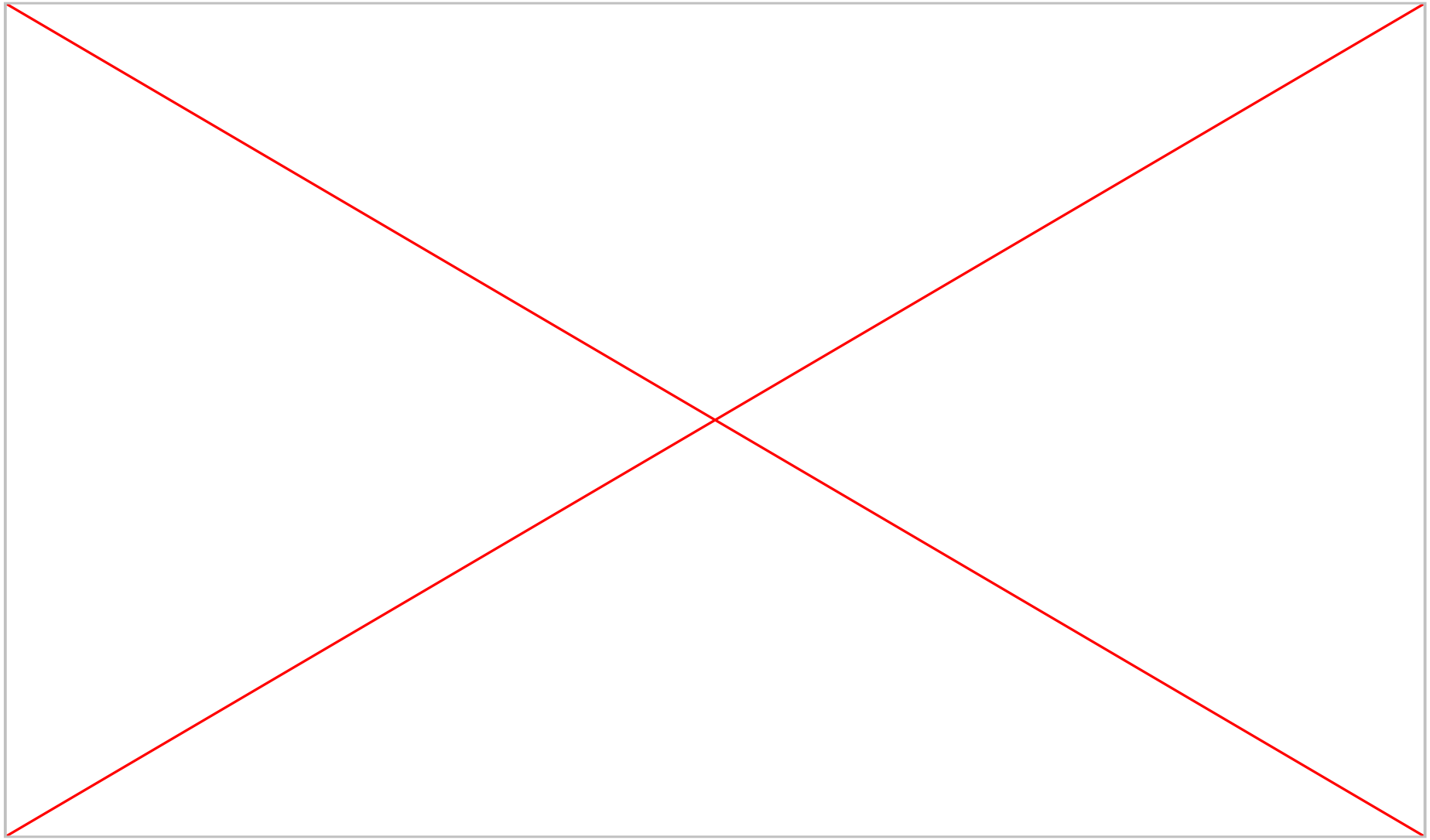
Challenges in Multi-Cluster Networking

- Cluster Isolation & Security
- Network Policies & Firewall Rules
- Latency & Reliability
- Multi-Cluster Context Switching

Operator **Workflow**

- Reconcile loop kicks off
- Fetch our Custom Resource
- Access Cluster Configurations
- Manage Skupper ConfigMaps
- Copy and Update Secrets
- Annotate Deployments for Skupper
- Sync Secrets Between Clusters

DEMO



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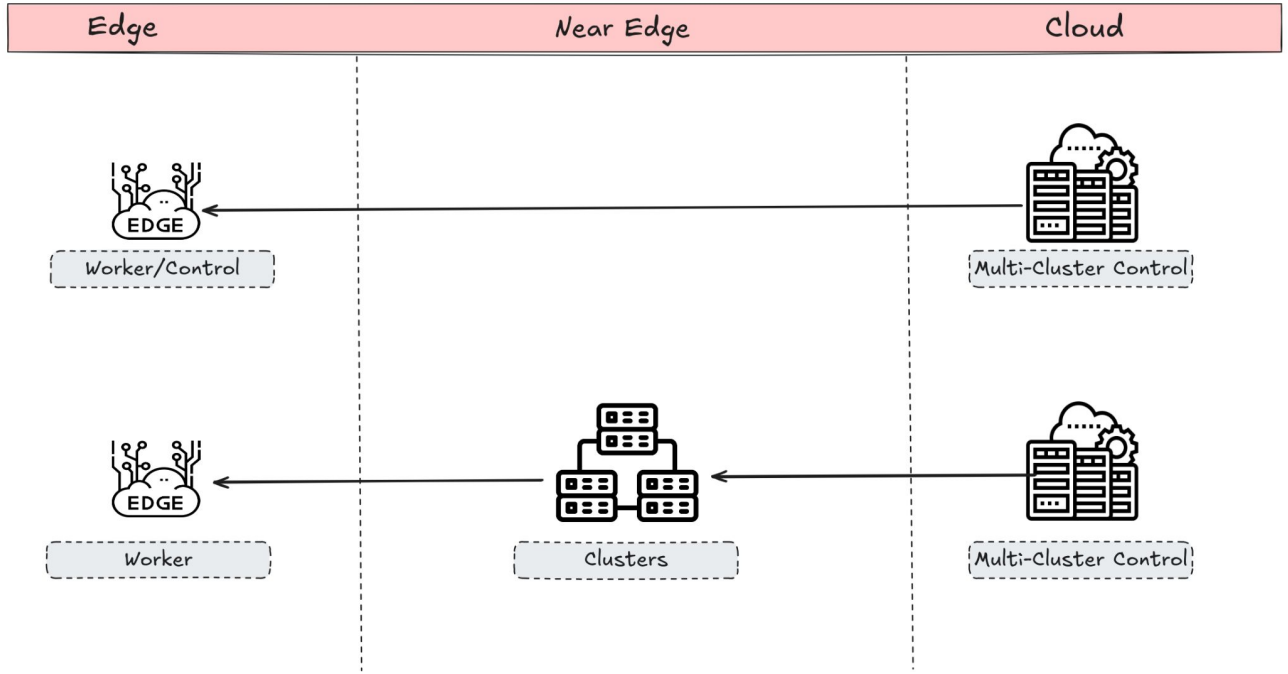
3.
edge device controller

K8s Edge Architectures

Background



K8s **Cluster** @ Edge

- Cut-down K8s distro, single or multi-node
- e.g. MicroShift, K3s, MicroK8s

K8s **Nodes** @ Edge

- Worker nodes at the edge, control plane in the DC
- e.g. KubeEdge
- We are here, sort of!
  Spoiler: It's NOT kubernetes!

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Edge Device Controller

How do we manage edge devices across the CEC?

Problem

- Plethora of devices with varying level of (limited) resources
- Devices often have niche/specialist hardware
- And, we need an integrated Cloud-Edge deployment platform

Approach

- Strip away kubernetes/container engine overhead
- Give applications native OS access
- Manage non-kubernetes nodes as Kubernetes resource

Edge Device Controller

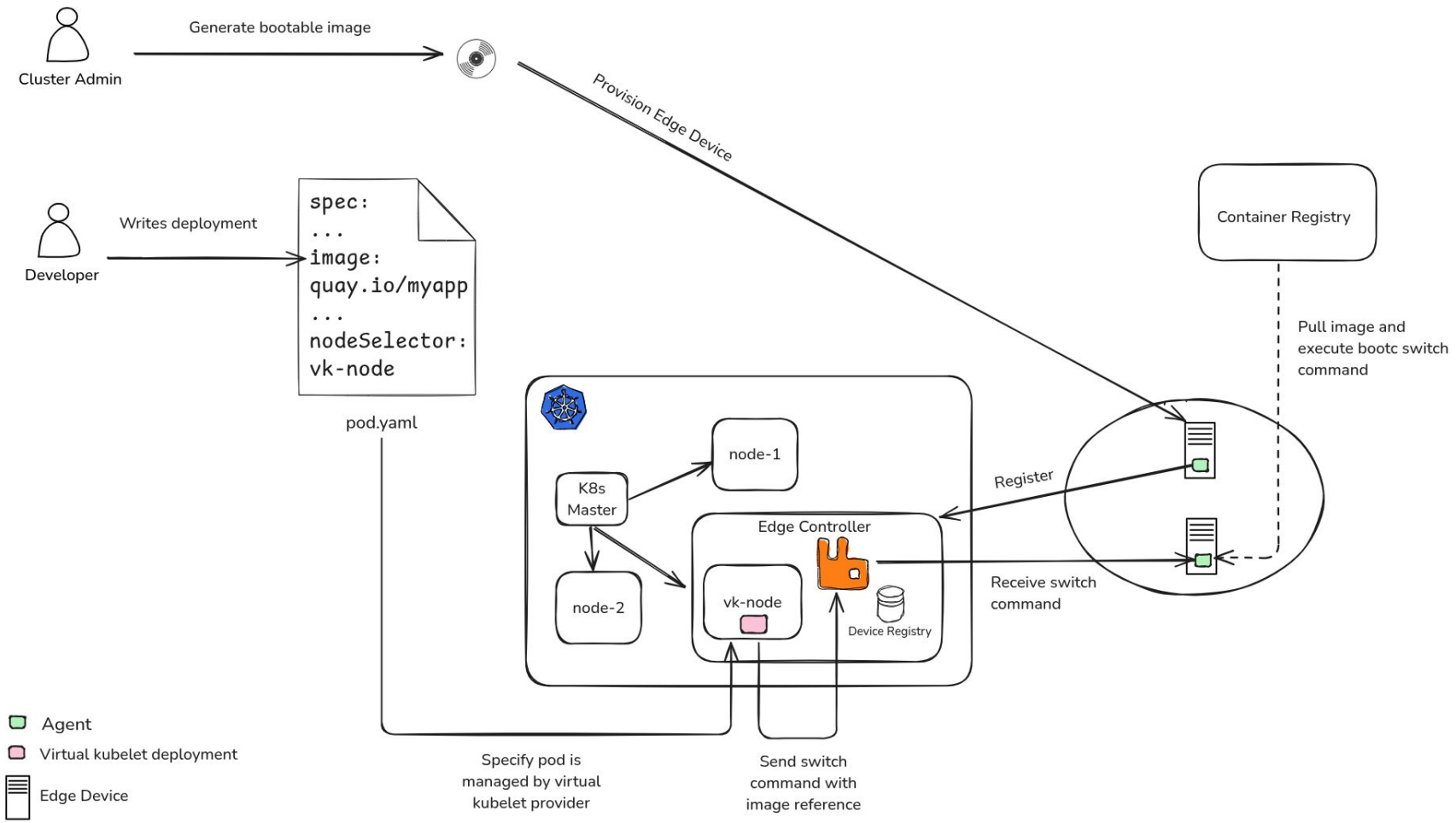
Key Technologies

BootC

- Bootable container images (OS + App)
- Enables us to build and deploy OS-native applications

Virtual-Kubelet

- Mimics the K8s kubelet
- Enables K8s to manage non-kubernetes resources



Developer Workflow

1. Create Dockerfile
2. Build and upload image
3. Create pod manifest
4. Apply pod manifest
5. Verify application running on edge device

Preview README.md

The cluster admin builds the raw image(s) needed for the edge devices to be brought into the cluster
There are scripts/make commands for building for linux machines and specific raspberry pis

Steps

1. Copy `amqp-config.sample.yaml` to `amqp-config.yaml` and fill in the details of the Rabbitmq cluster that the agent should connect to
2. Copy `sample-config.toml` to `config.toml` and populate with your credentials to log into the system once booted
3. `sudo podman build -t <image> .`
4. `mkdir output`
5. Generate bootable artifact where type is one of qcow2, iso, ami

```
sudo podman run --rm  -it --privileged --pull=newer --security-opt label=type:unconfined_t -v $(pwd)/config.toml:/config.toml:ro -v $(pwd)/output:/output -v /var/lib/containers/storage:/var/lib/containers/storage quay..
```

PROBLEMS DEBUG CONSOLE TERMINAL GITLENS SPELL CHECKER

TERMINAL bash - agent

```
[clwalsh@fedora agent]$ ls
agent.go  amqp-config.sample.yaml  amqp-config.yaml  config.toml  Dockerfile  go.mod  go.sum  rabbitmq-listener.service  README.md  sample-config.toml
[clwalsh@fedora agent]$ sudo podman build -t quay.io/clwalsh/edge-agent-demo
```

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