

SONY

ROS / ROS 2
with
Kubernetes and KubeEdge

Oct.19th.2023

ROSCon 2023 @ New Orleans, US

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Agenda

- Who are we?
- Background
- Problems
- Goals / Requirements
- Kubernetes
- KubeEdge
- Sample Deployment
- What's missing? Next-gen proposal
- Community

Who are we?

- Tomoya Fujita (Presenter)

- Software Engineer, Sony R&D US Laboratory
- ROS TSC (Technical Steering Committee)
- KubeEdge SIG Robotics Chair
- fujitatomoya@github , tomoyafujita@linkedin



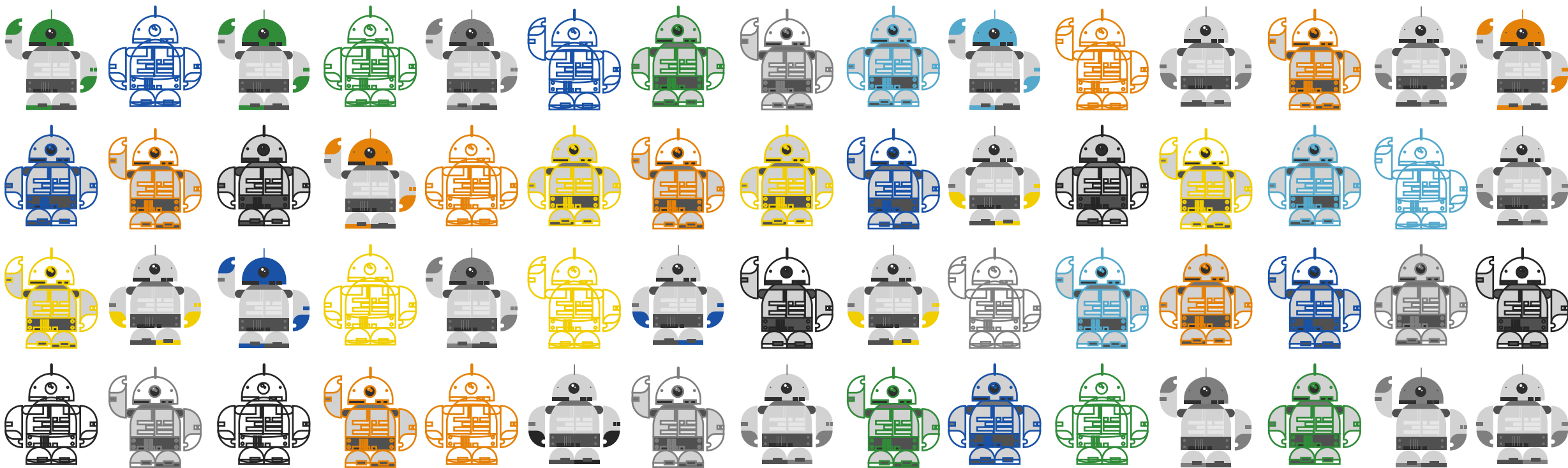
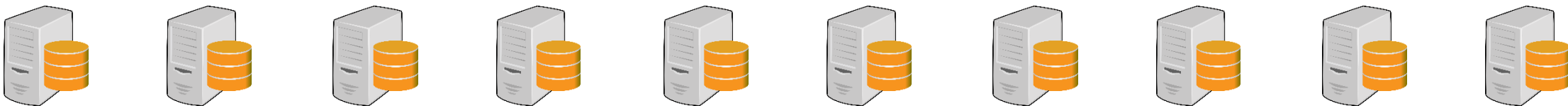
- Co-Authors

- Yin Ding (Engineering Manager, Google)
 - KubeEdge TSC, Co-Founder of KubeEdge Project
 - Leading the Kubernetes Hardening team
- Kevin Wang (Lead of Cloud Native Open Source Team, Huawei)
 - KubeEdge TSC, Co-Founder of KubeEdge Project
 - CNCF Ambassador, TOC contributor
- Fei Xu (Senior Engineer, Huawei)
 - KubeEdge TSC, Maintainer



Background

- Broad use cases.
- Distributed and Connected System.
- Collaborative and Orchestrated Application.
- Circulatory Functioning System and Development
- Specific Hardware Acceleration.
- Security. (Device, Data, Network)

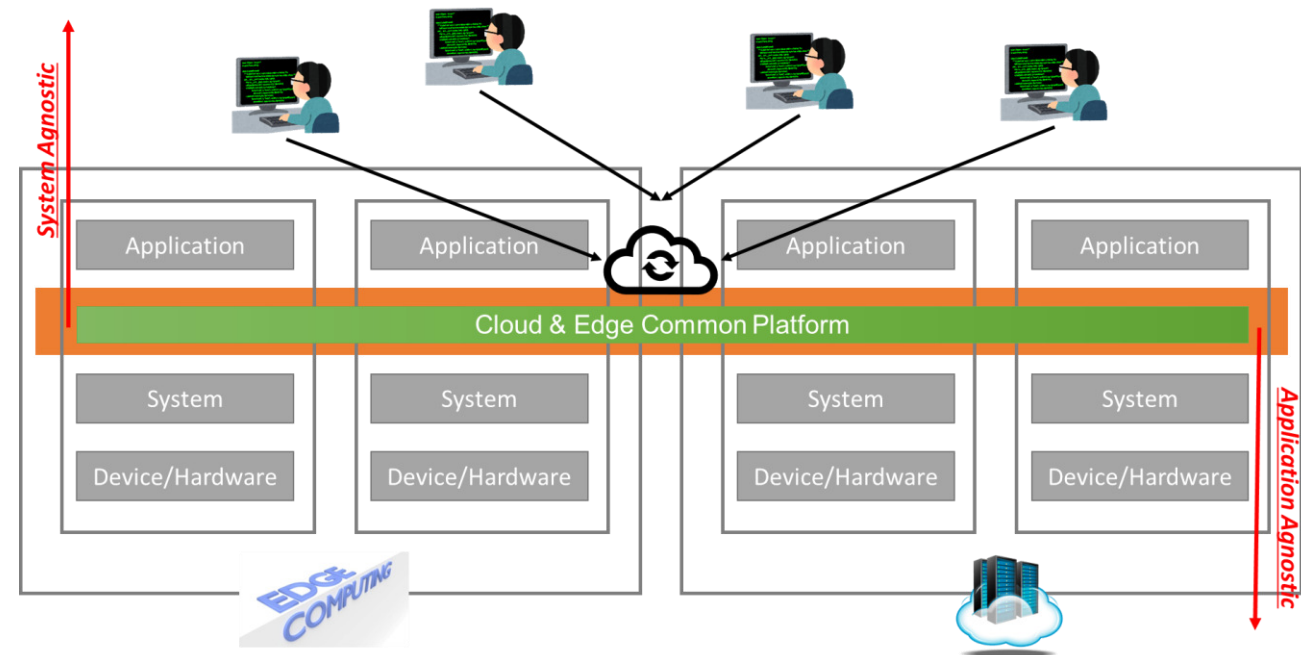


What is the pain?

- Platform Dependencies.
- Proprietary hardware support.
- Application Modularity.
- System and Security Integration.
- Application Specific Network Bridge.
- Application Developer Friendly.

Goal / Requirements

- Flexible Application Deployment.
- Zero Trust Security Support.
- Application Agnostic Network Configuration.
- Extend Device Capability.
- System Global Observability.
- Platform Agnostic Device Abstraction.



Kubernetes (Service Mesh)

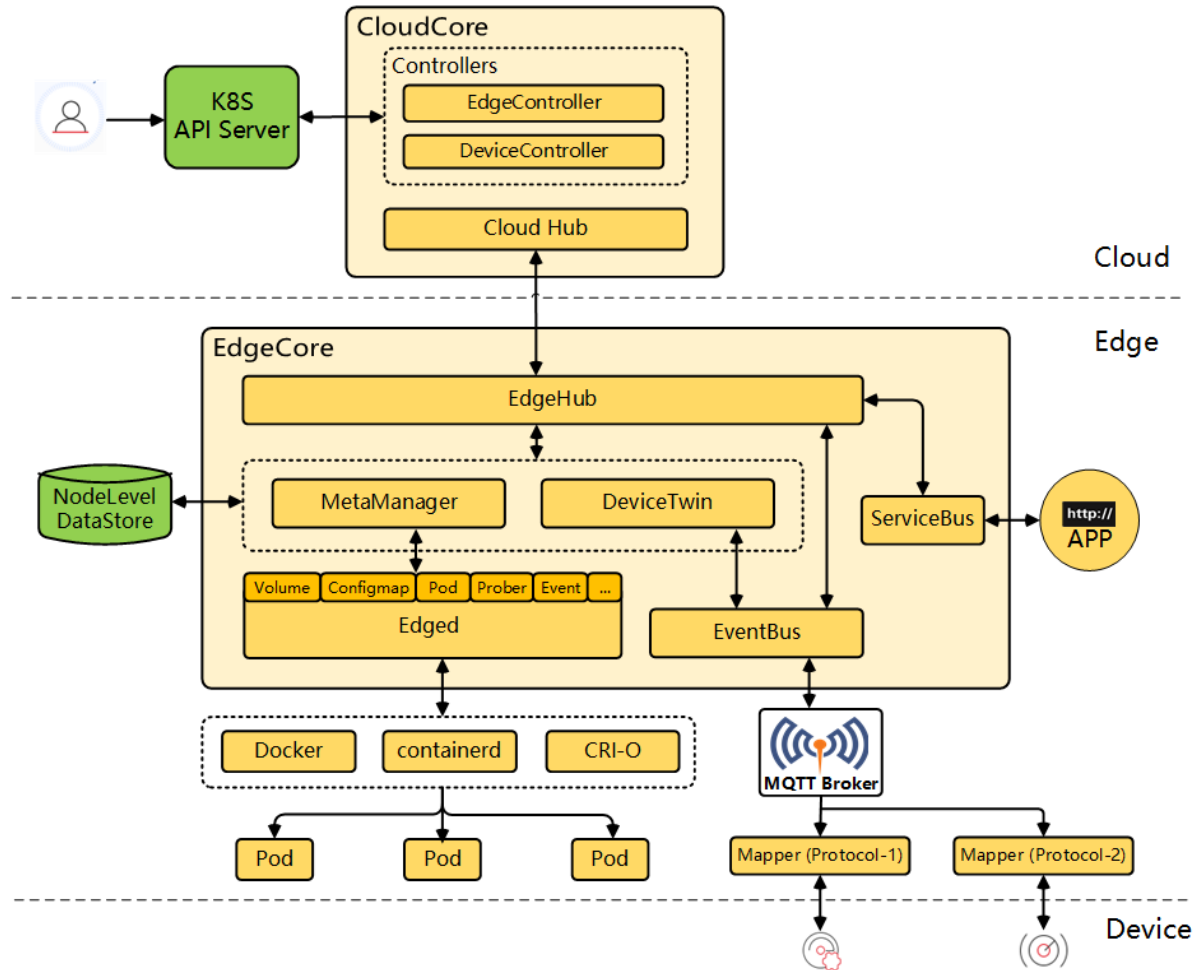
- **Application Deployment and Orchestration.**
- **Device Capability and Label Control.**
- Custom Resource Extension.
- **Auto- Scaling and Healing.**
- **Roll Up/Down, Canary Test.**
- **Role Based Access Control.**
- **Device-Plugin / Container Device Interfaces.**
- **Container Network Interfaces.**
- Traffic Management.
- Observability.
- Security Policy.



KubeEdge

is built upon Kubernetes and provides core infrastructure support for networking, application deployment and metadata synchronization between cloud and edge.

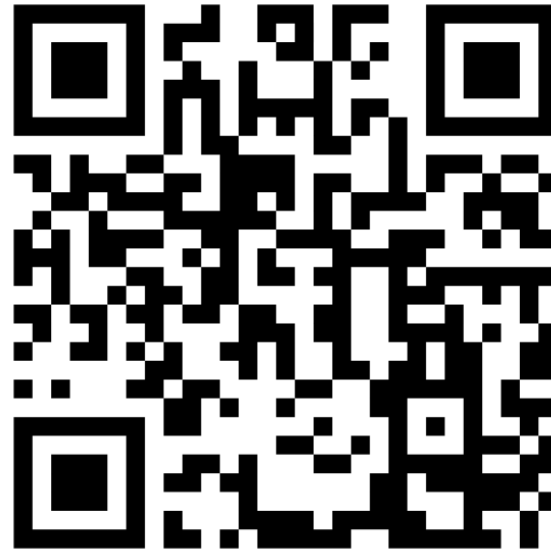
- Cloud-Edge Coordination
- Edge Computing
- Edge Autonomy
- Simplified Deployment
- Kubernetes-native Support
- Resource Efficient



Sample Deployment

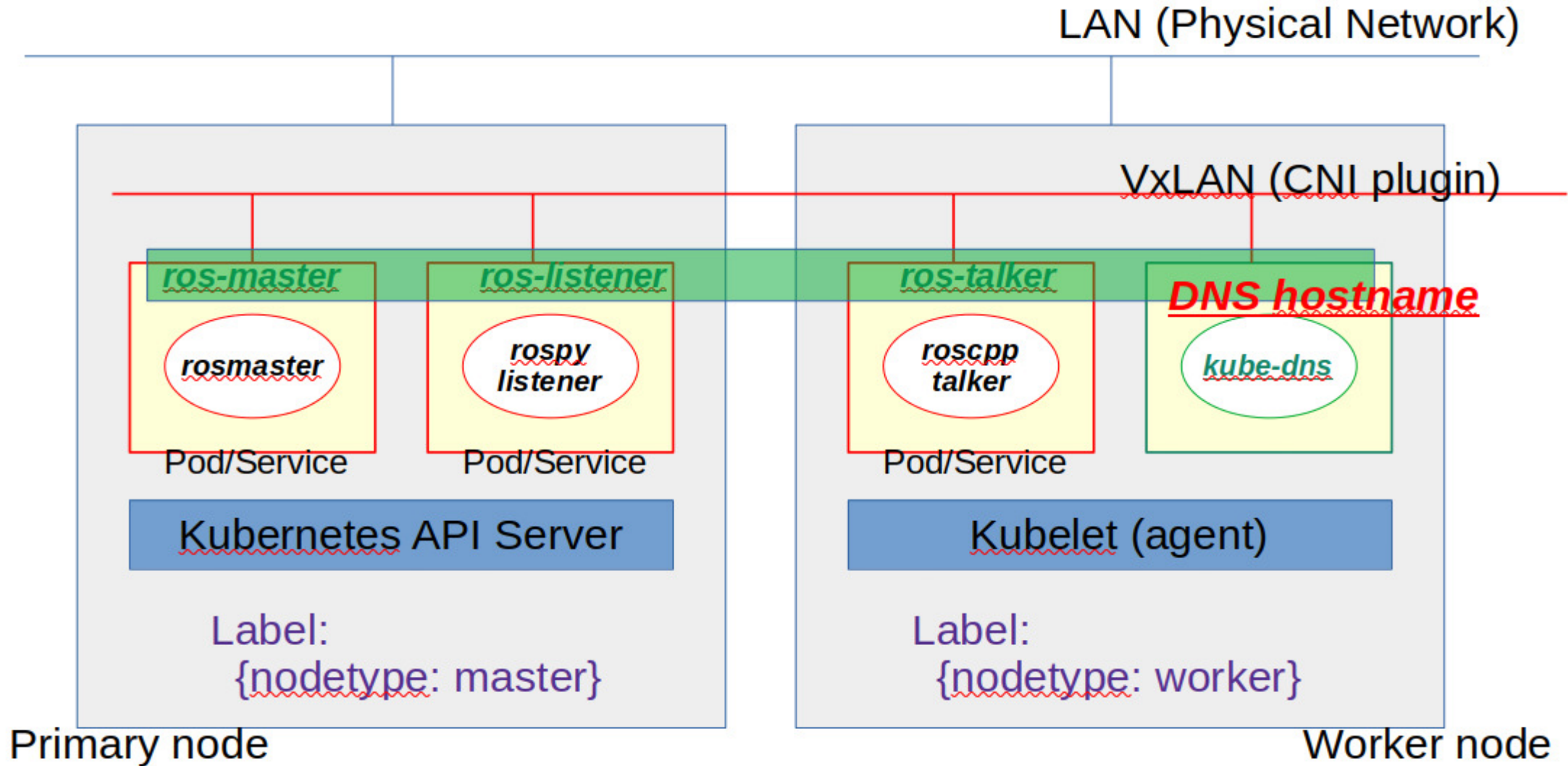
Theory is good, but please see how it works in the flesh!

ROS Kubernetes
Tutorials

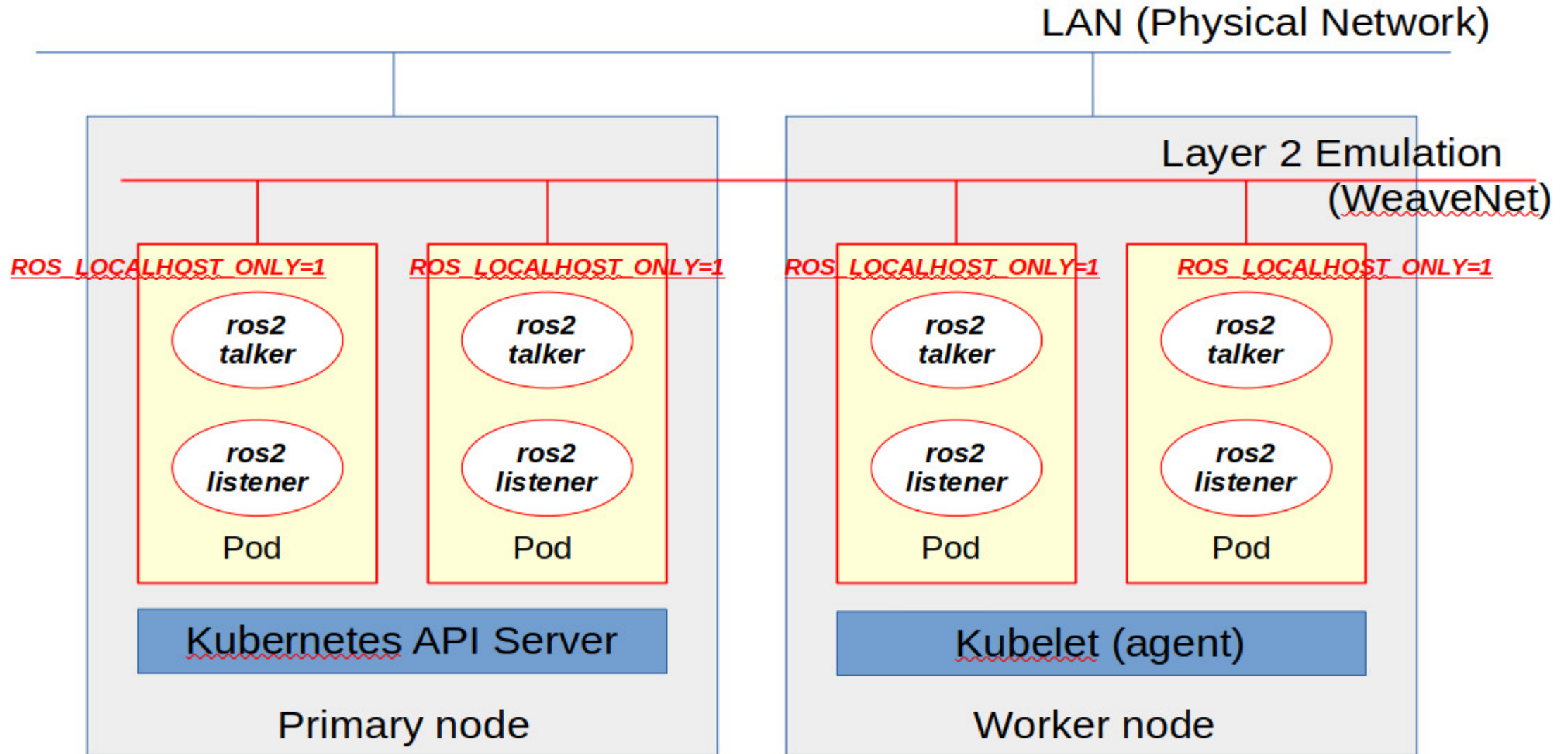


Contribution(Issues/PRs) always welcome!

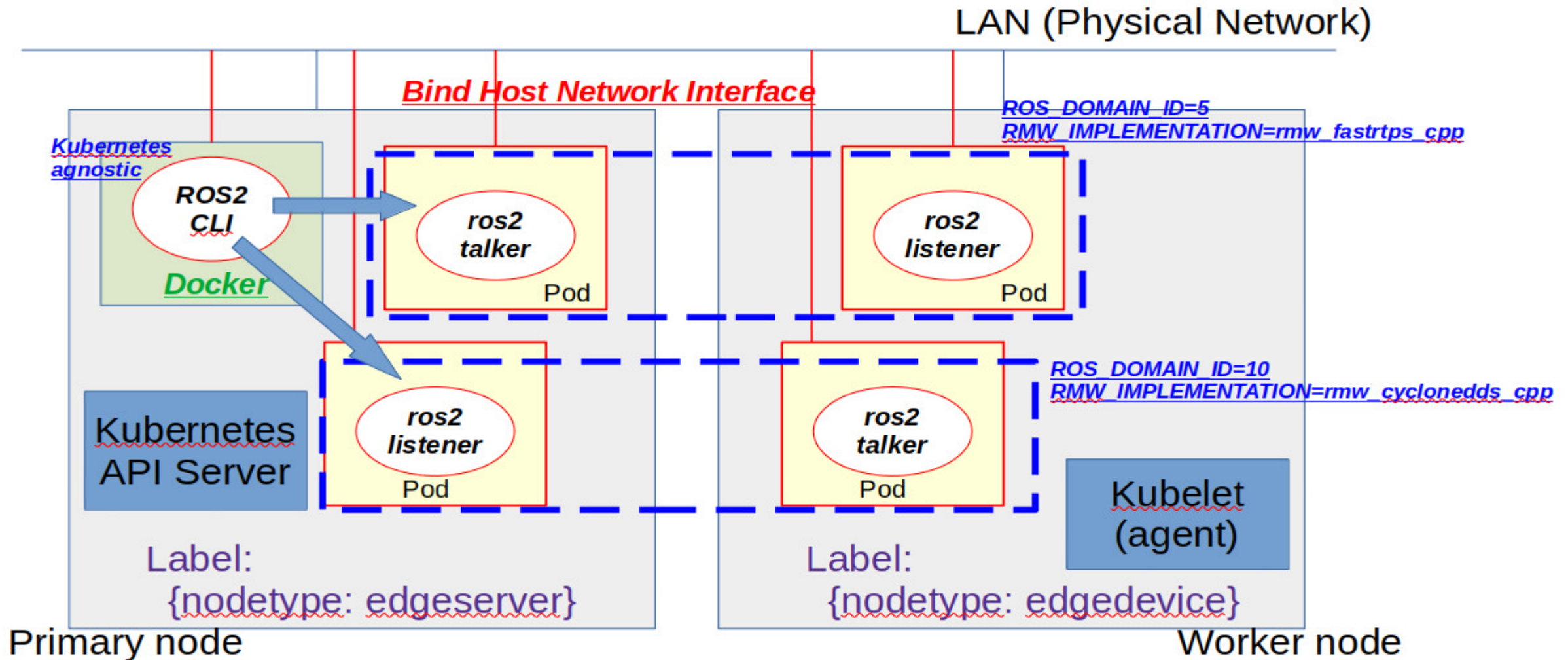
ROS Multi-Node Deployment



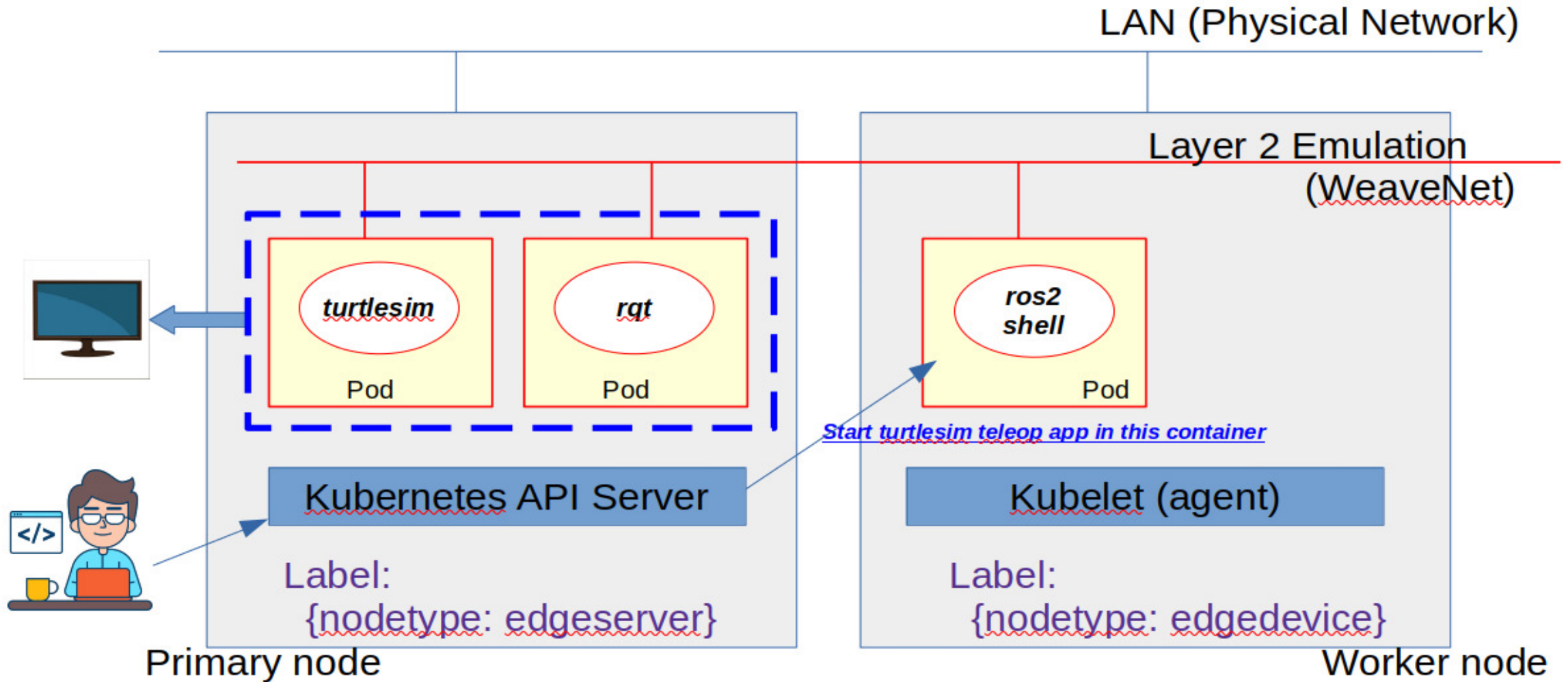
ROS 2 Localhost Only



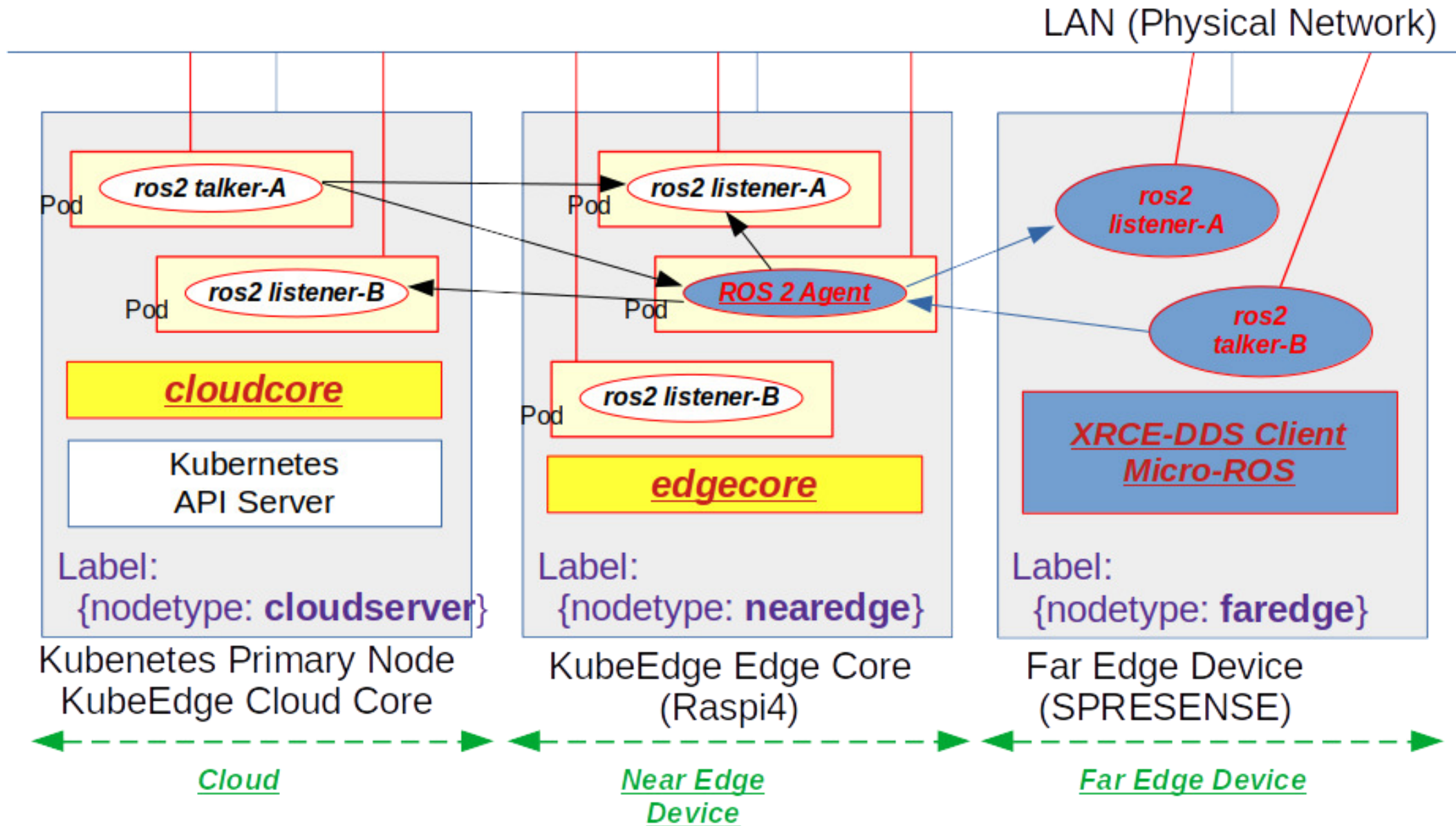
ROS 2 Logical Partition / Multiple RMW Implementation



ROS 2 Deployment Intermediate

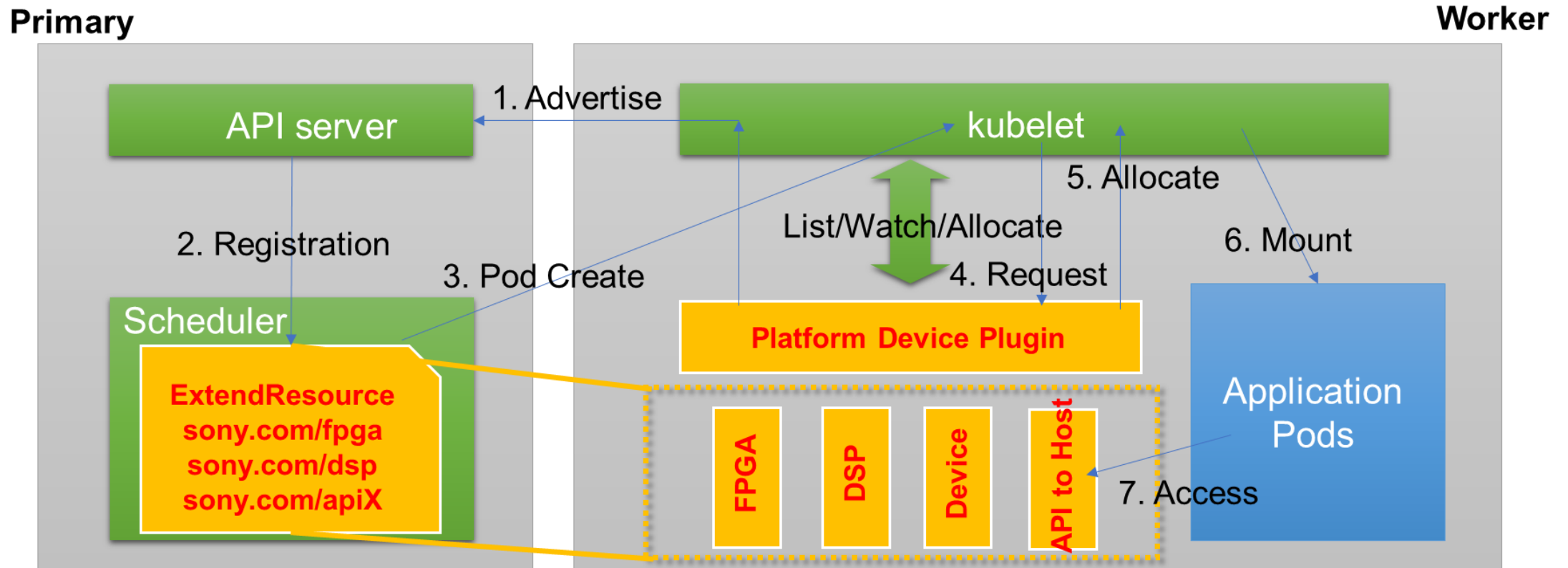


ROS 2 / Micro-ROS with KubeEdge (W.I.P)



Device-Abstraction (Device-Plugin, Container Device Interface)

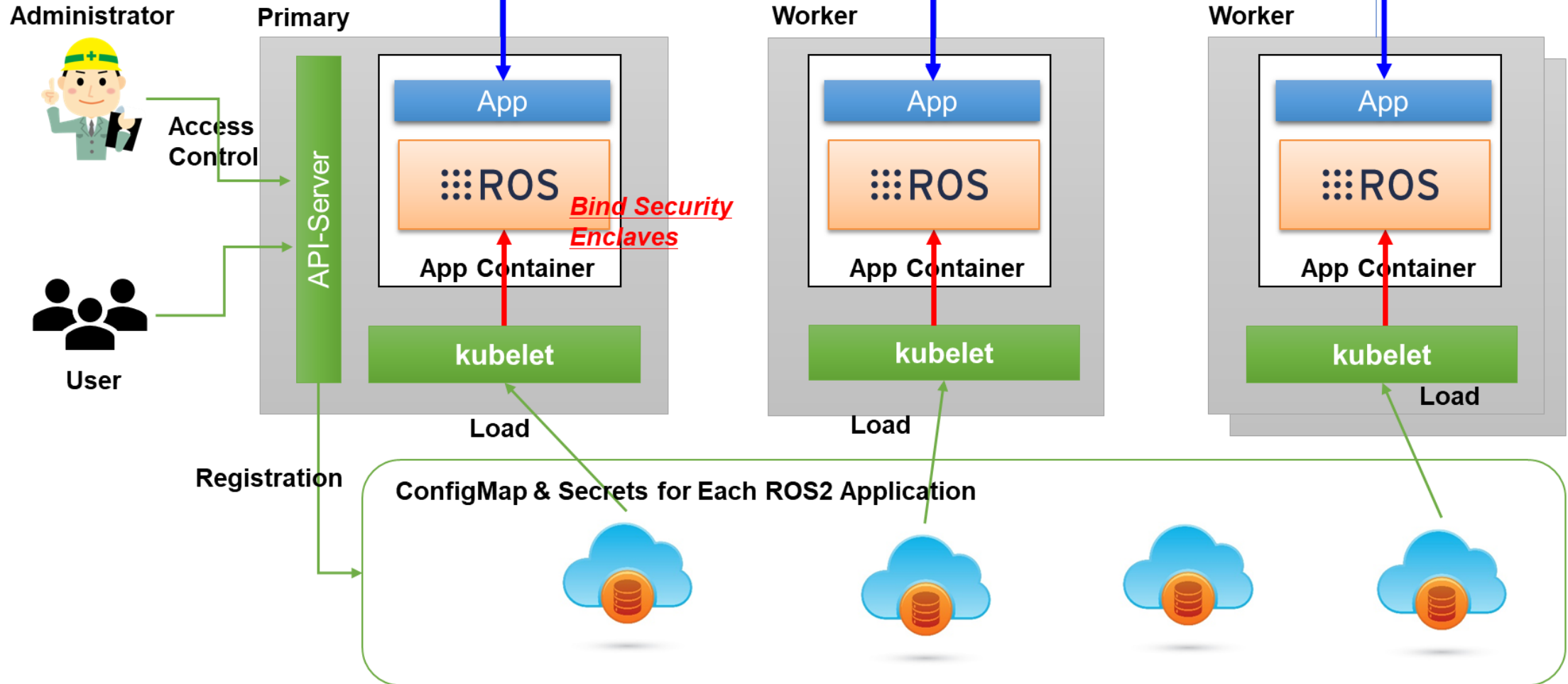
- Kubernetes Custom Resource Definition, that allows us to plugin vendor specific hardware and device to the containers.
- After advertising the custom resource to Kubernetes, Kubernetes controls those resources with workload based on application requirements.



Support SROS 2 security enclaves via ConfigMap

*Certificate to Join this entire distributed system,
Access permission for each topics and services*

LAN



What's missing? Proposals?

- ~~Device Abstraction Enhancement~~
 - ~~[KEP-3162: Add Deallocate and PostStopContainer to Device Manager API](#)~~
 - ~~[Add CDI devices to device plugin API](#) resolved this issue.~~
- KubeEdge CNI support (e.g [edgimesh](#), Cilium)
- More Edge Optimization / Configurable Options for Resource Constrained Device Support
- **Cloud-Native Robotics Management Solution**
 - `RoboDevOps` through Edge-Cloud Synergy
 - Cloud-Native Digital Twin for testing and data generation training
 - Robotics App Development Friendly
 - [Cloud Robotics Custom Resource Definition and Operator Proposal](#)
 - Edgimesh: adaptive cross-edge and edge-cloud data plane support
 - [VSLAM algorithm with KubeEdge](#)
 - [Building a Robot-Oriented Intelligent Monitoring System](#)

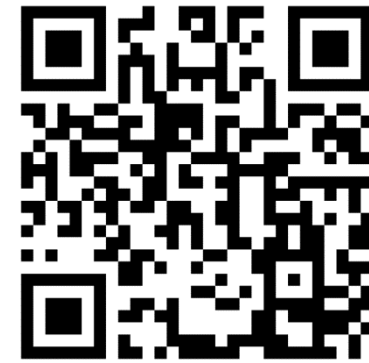
Community



[*Kubernetes*](#)
[*IoT Edge WG*](#)



[*KubeEdge*](#)
[*SIG Robotics*](#)



[*ROS Kubernetes*](#)
[*Tutorials*](#)

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