KOLE

Breaking the Scalability Barrier for Managing Far Edge Nodes in Cloud

Jie Zhang,Chen Jin,YuQi Huang ,Li Yi,Yu Ding,Fei Guo

阿里云

01 INTRODUCTION

02 DESIGN

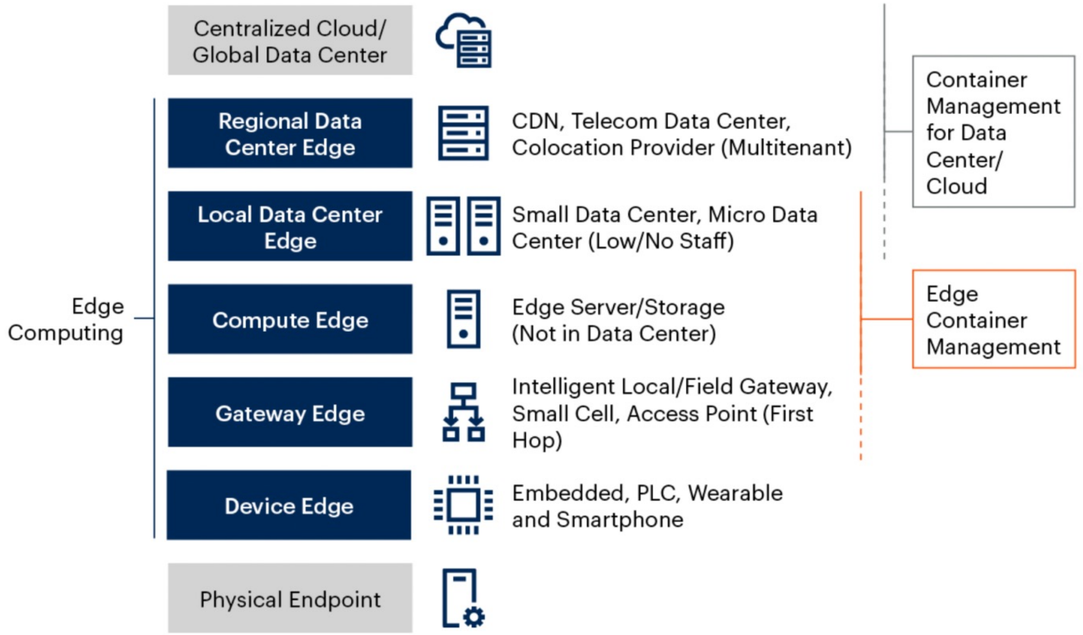
03 EVALUATION

04 CONCLUSION

INTRODUCTION

Edge Computing

The Coverage of Edge Container Management



Source: Gartner
Note: The dotted lines indicate partial support.
765918_C

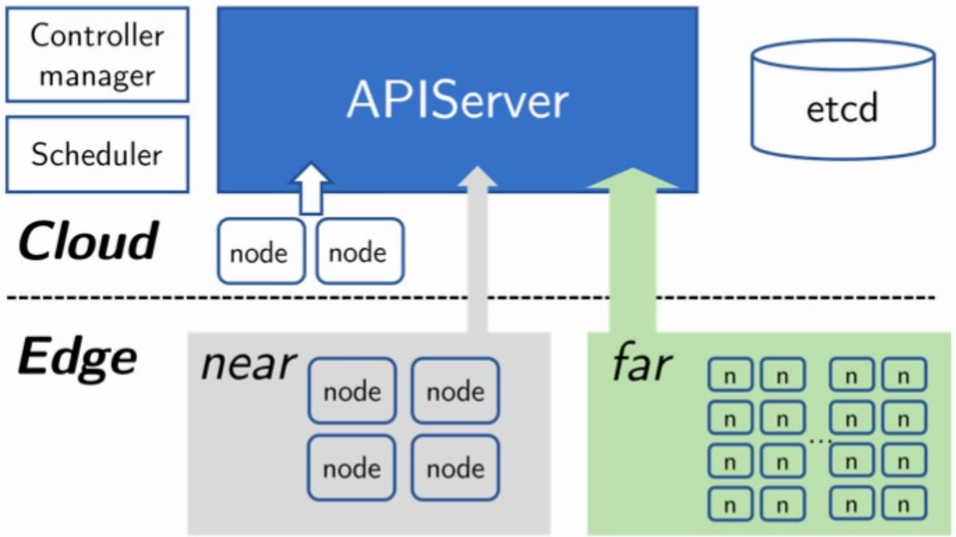
Gartner

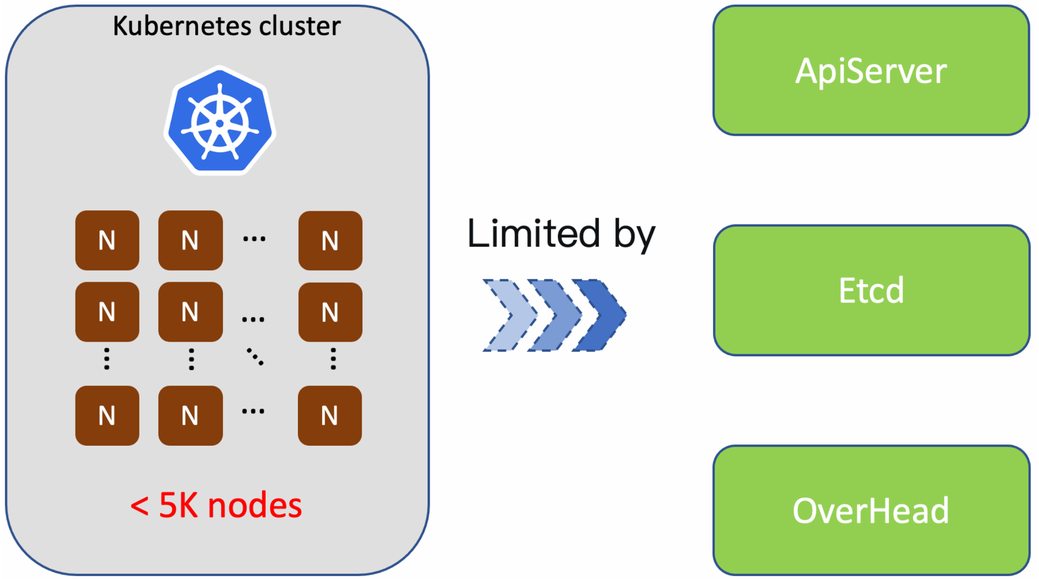
kubernetes

- Automated edge application deployment and rolling upgrade at scale.
- Enable consistent edge node management
- Provide a highly available cloud control plane
- Enable integration with modern CI/CD

INTRODUCTION

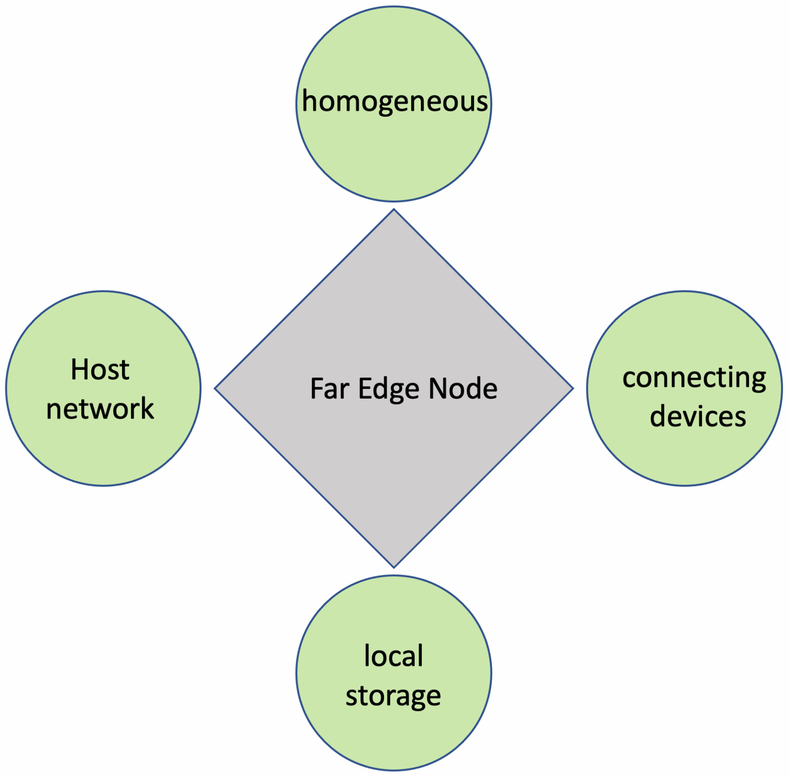
Kubernetes cloud to edge





INTRODUCTION

Kole motivation

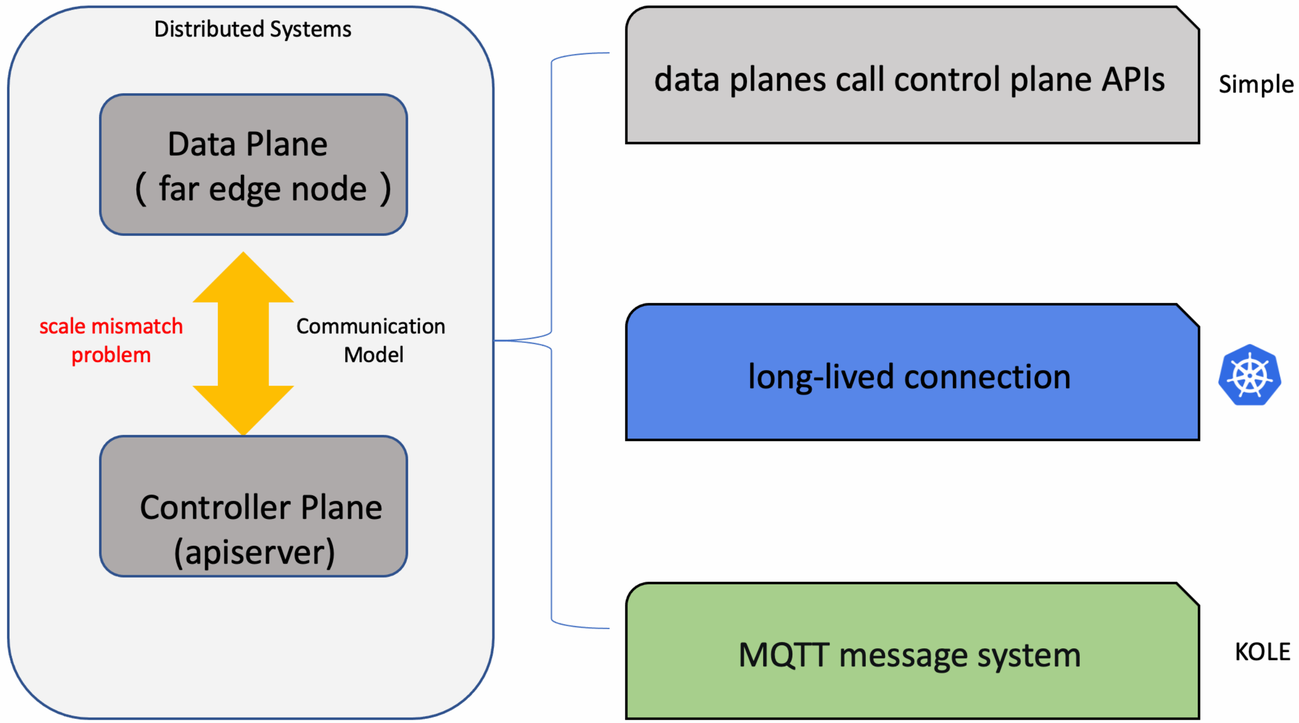


Kubernetes to Orchestrate Limitless (far) Edge nodes

- One million far edge nodes target
- Extension of the upstream kubernetes
- Change http to mqtt protocal
- Metadata reconciliation protocol

INTRODUCTION

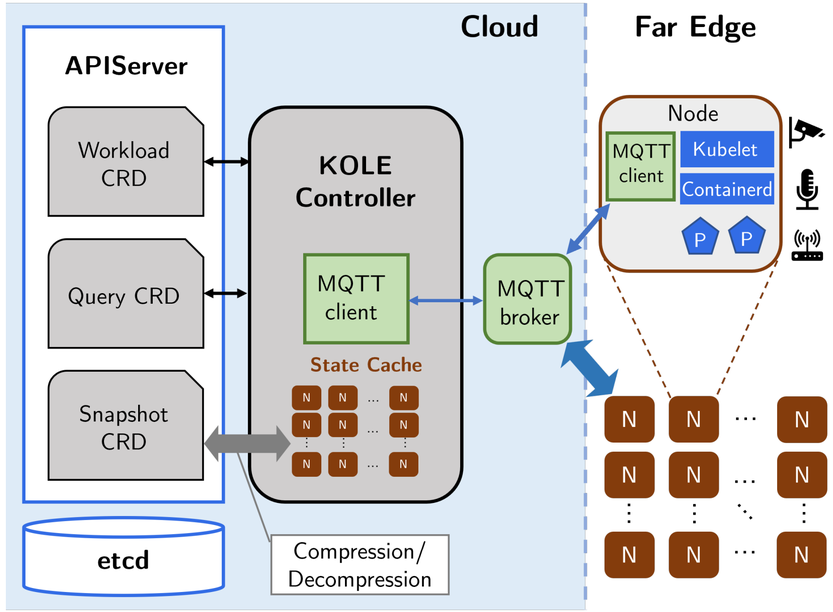
Problem to be resolved



DESIGN

Overview

- Avoid creating numerous objects
- Avoid keeping numerous HTTP connections
- Using Kubernetes CRDs



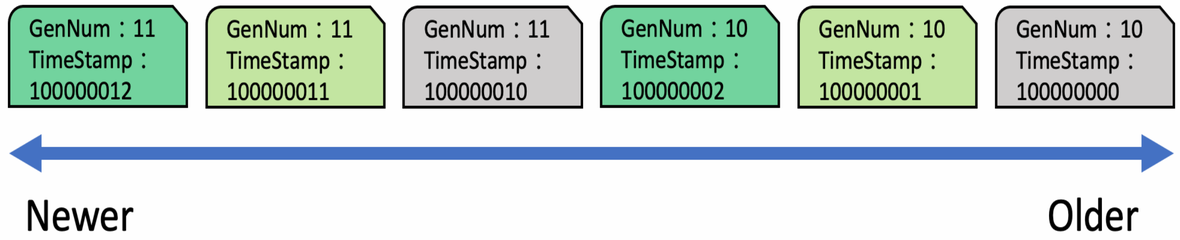
DESIGN

Metadata reconciliation protocol

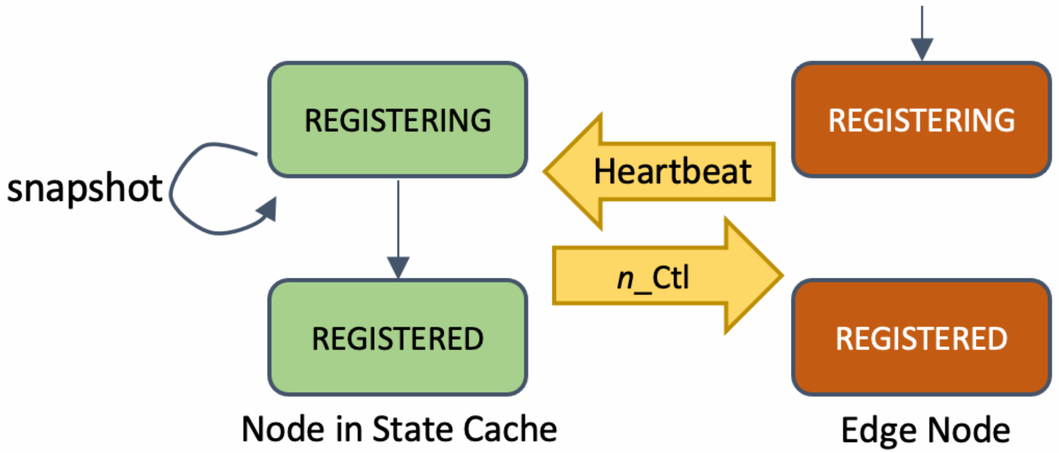
- Tracking message orders

GenNum

TimeStamp



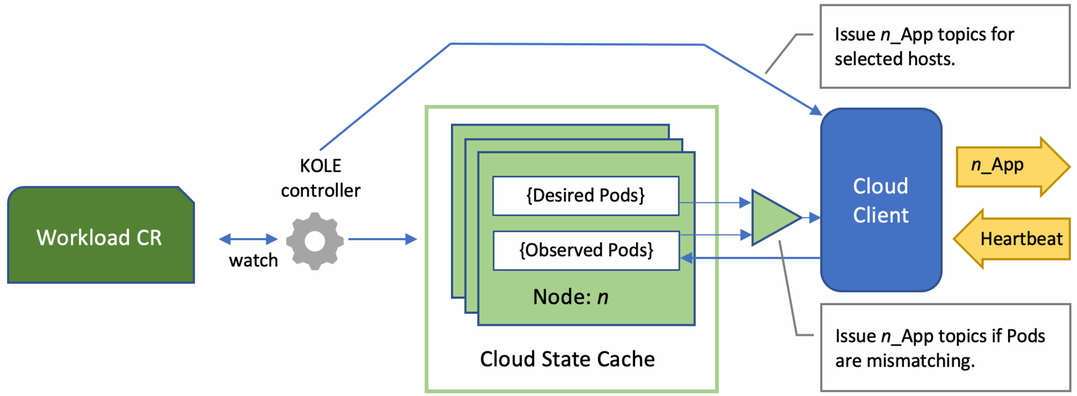
- Node registration



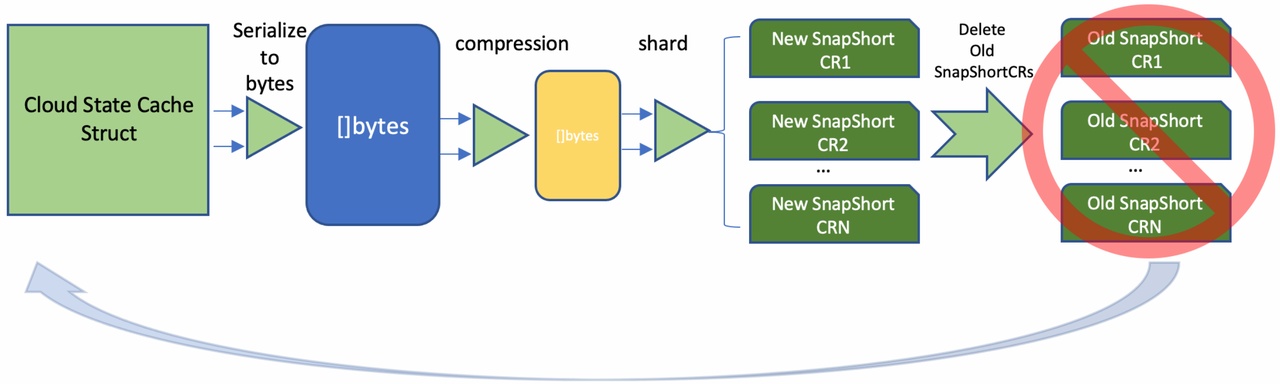
DESIGN

Pod specifications And Snapshoting

- Pod specifications

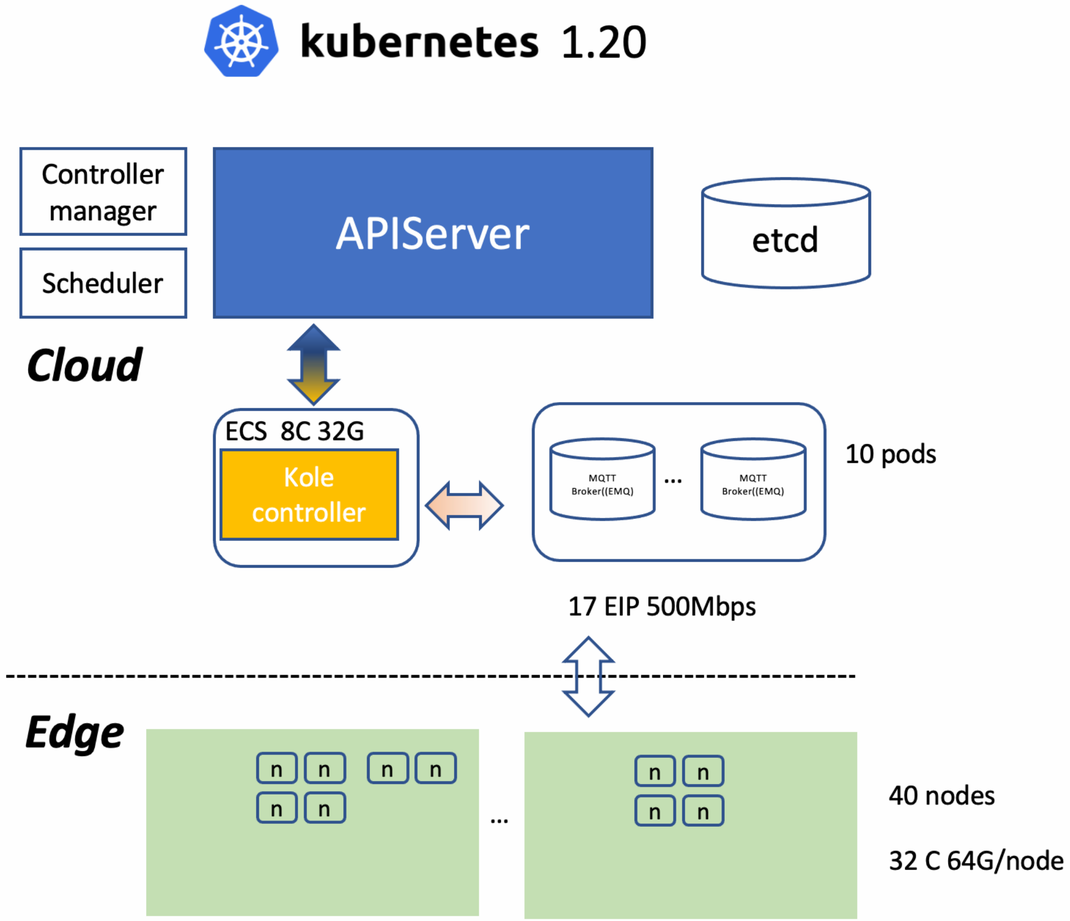


- Snapshot workflow



EVALUATION

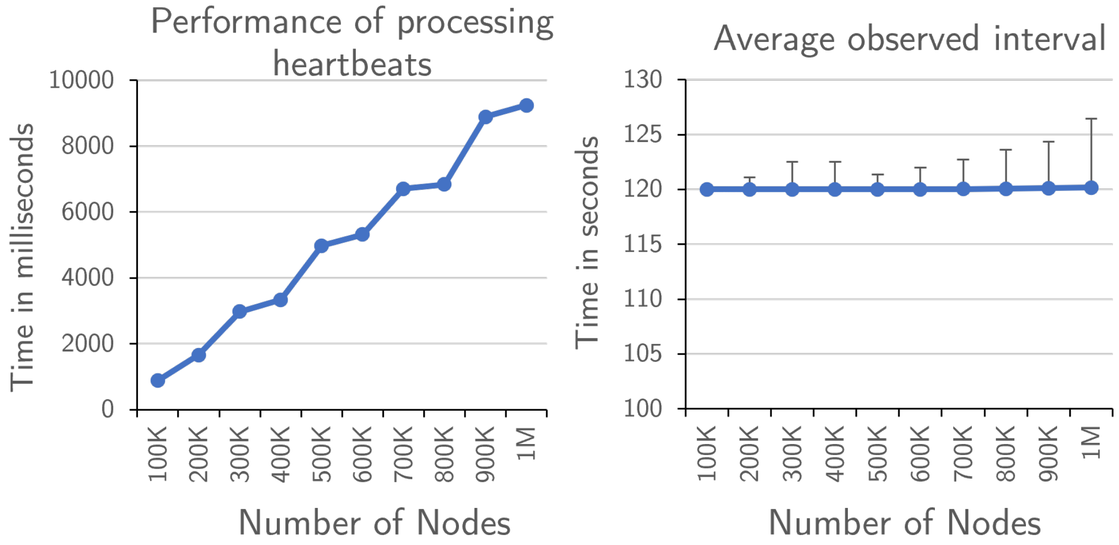
Environment



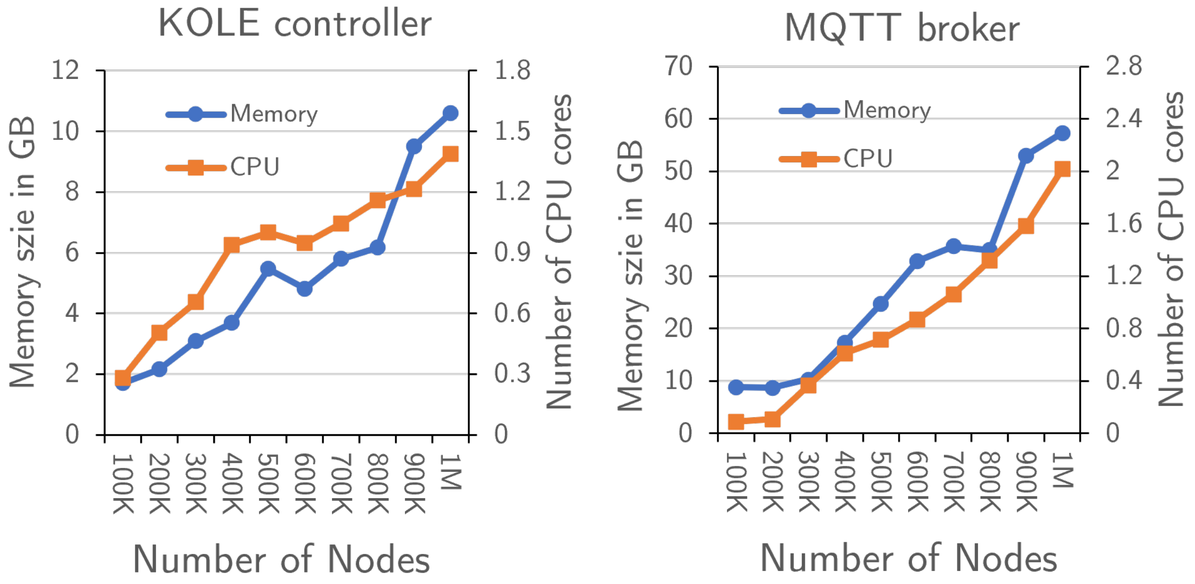
EVALUATION

Performance

- The performance of handling node heartbeats



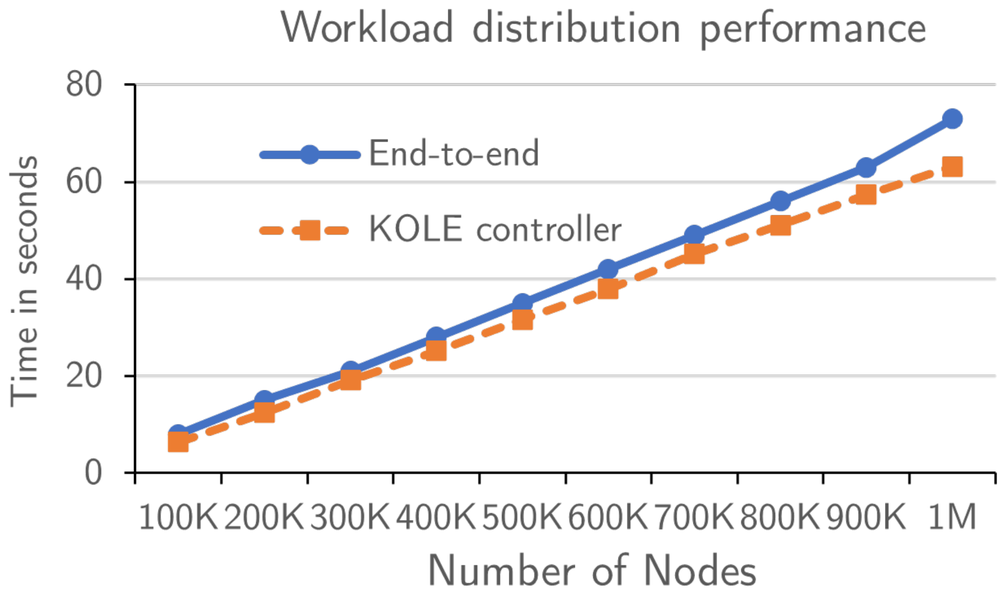
- The resource consumption of the cloud components



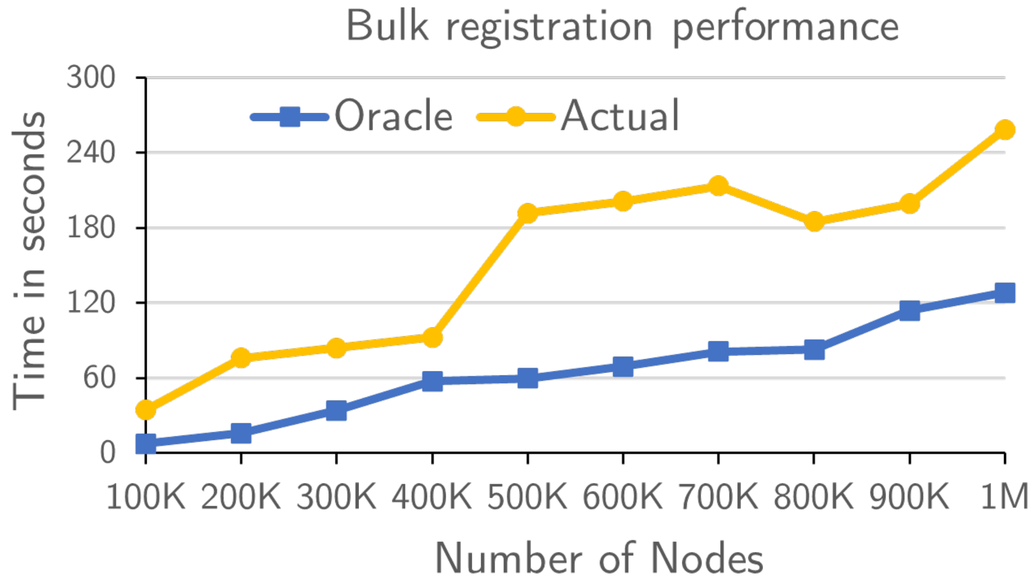
EVALUATION

Performance

- The performance of distributing workload



- The performance of the bulk registration



CONCLUSION

- Far edge use cases.
- MQTT system
- In-memory cloud state cache
- Snapshotted
- Scalable in distributing workload

KOLE is a Promising Framework

5,000 → 1,000,000