



# Developing Edge with Kubernetes

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# What is Edge Computing?

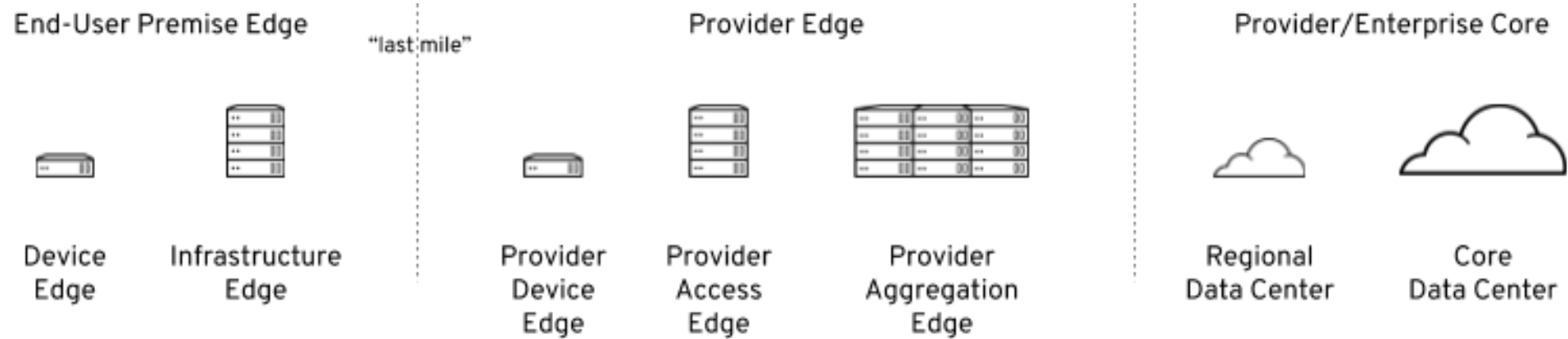


Edge is everything that's outside the cloud



Bring compute resources closer to the source

# THERE ARE MANY EDGES



# Why Edge?

# WHAT IS EDGE COMPUTING?



*Centralize where you can,  
distribute where you must*

# How?



# Challenges

- Infrastructure
  - How to manage resources (nodes and clusters) on the Edge?
- Control plane
  - How to manage workloads on the Edge?
- Data plane
  - How Edge sites communicate with the cloud and between themselves?

# Infrastructure

- Resource constraints
- Network limitations
- Unattended operation
- Physical security

# Challenges

- Resources
  - Limited number of nodes on the Edge
  - No “bursting” to newly provisioned capacity like a public cloud or large datacenter
  - Workloads typically have a wide range of priorities
  - Need more emphasis on prioritization, triage
- Network
  - Network capacity can be limited, and variable
  - Like resources, different workloads can have different network policies/priorities

# Security

- Purity of images
- Secure delivery of secrets
- Unauthorized microservices
- Controlled access to resources
- Guaranteed remote shutdown

# Microservices

- Deployment
- Resources
  - Pod priorities
- Communication
  - VPN
  - VAN
- Security
  - Matching microservices to edge hardware
  - Unauthorized outbound

# Toolkit

# GitOps

- Configuration as a code
- Use the same management process for your app resources
  - YAML definitions
  - Secrets
- Same development workflow
  - Pull requests
  - Branches
  - Testing
- Service running in the cluster watching and applying changes

# GitOps on the Edge

- Even more important for Edge environment
- OT people should be able just to kick off the process
- No external access to the cluster

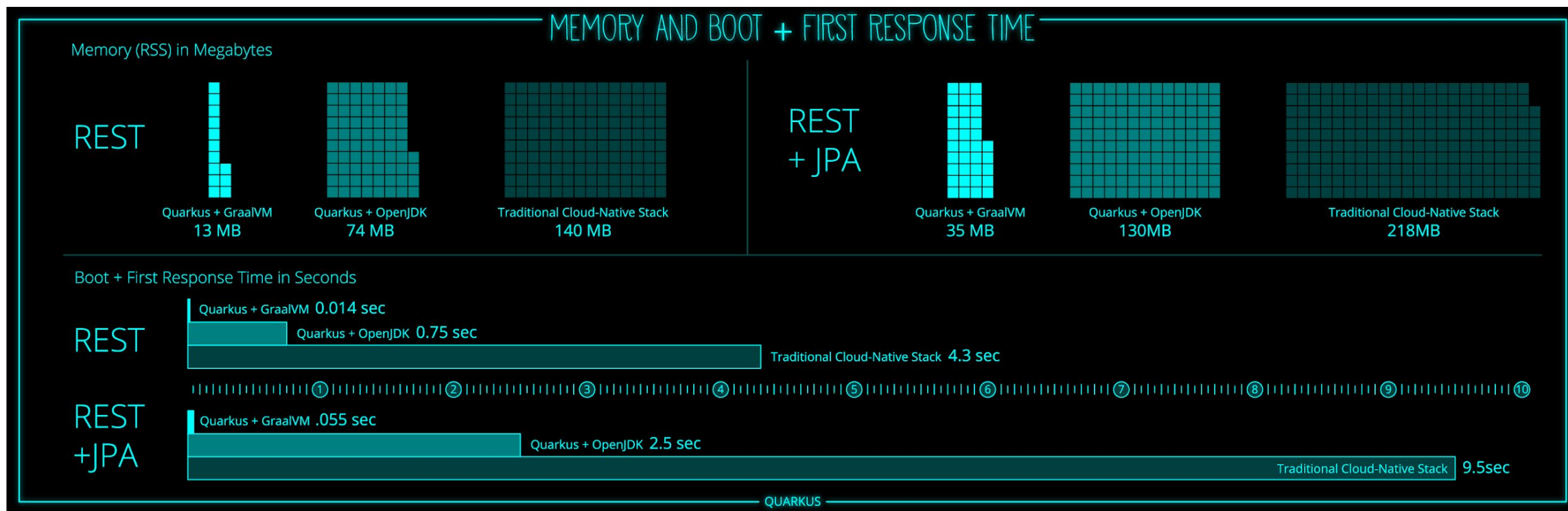


# GitOps tools

- GitOps Operator
  - Flux - <https://docs.fluxcd.io/en/stable/>
- Creating resources
  - Helm - <https://helm.sh/>
  - Fabrikate - <https://github.com/microsoft/fabrikate>
- Storing secrets
  - Sealed Secrets - <https://github.com/bitnami-labs/sealed-secrets>

# Quarkus

- quarkus.io
- Cloud-native Java



# Kubernetes prioritization toolkit

## Prioritization

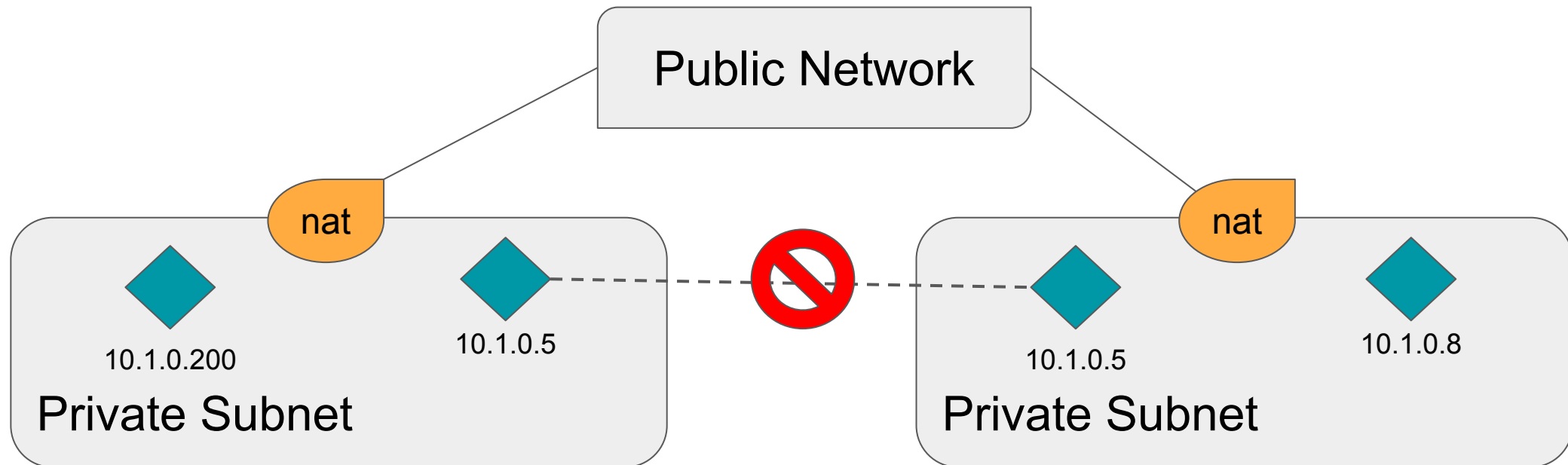
- Ranking of priority classes
- Input to pre-emption logic
- Applied to a pod, but acted on by node
- Different from resource based eviction

## Quality of Service

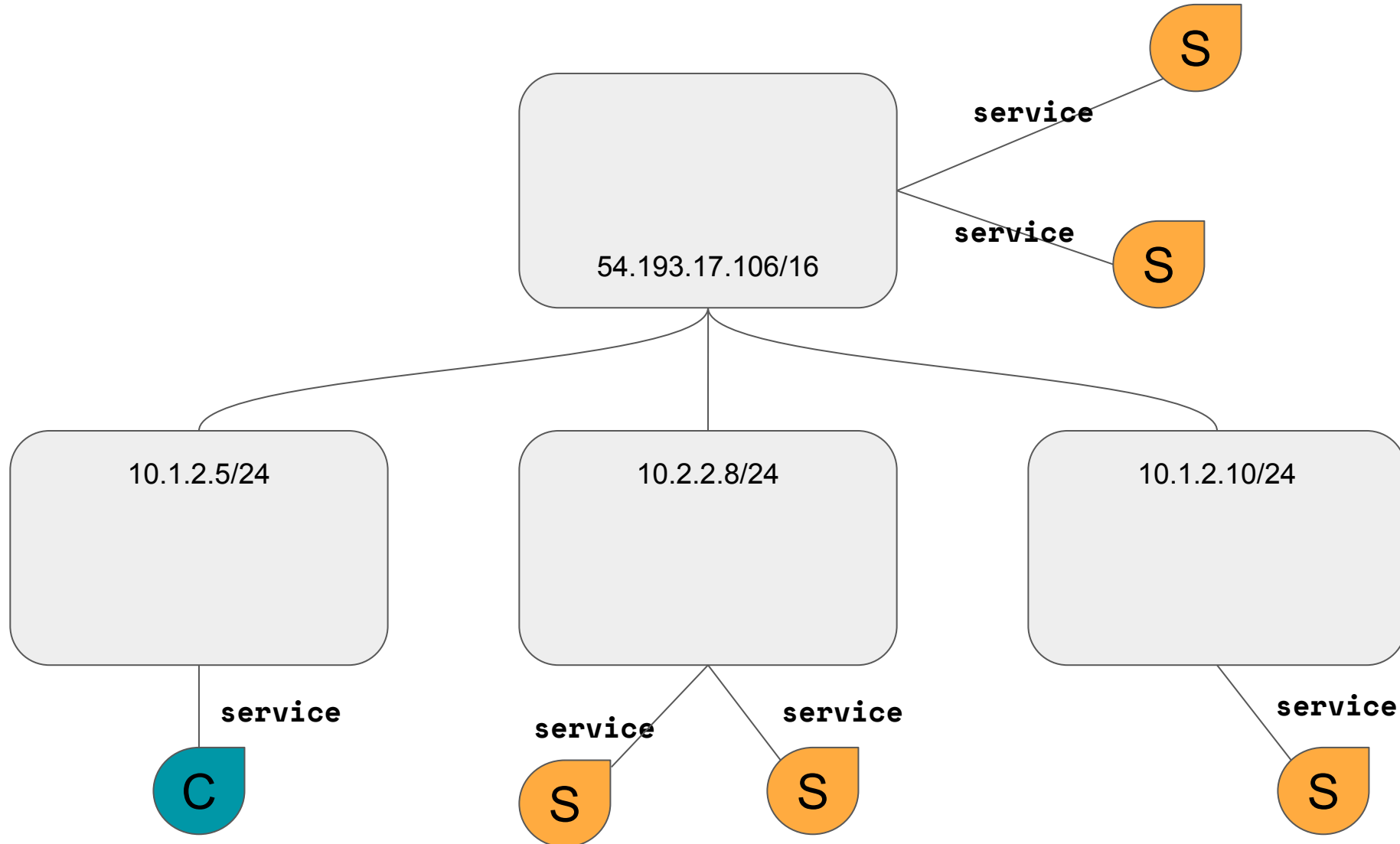
- Three levels
  - Guaranteed
  - Burstable
  - Best Effort
- These are implicit from pod spec
- Is NOT considered for preemption
- IS considered in the case of eviction
- preemption != eviction

# A word about networking...

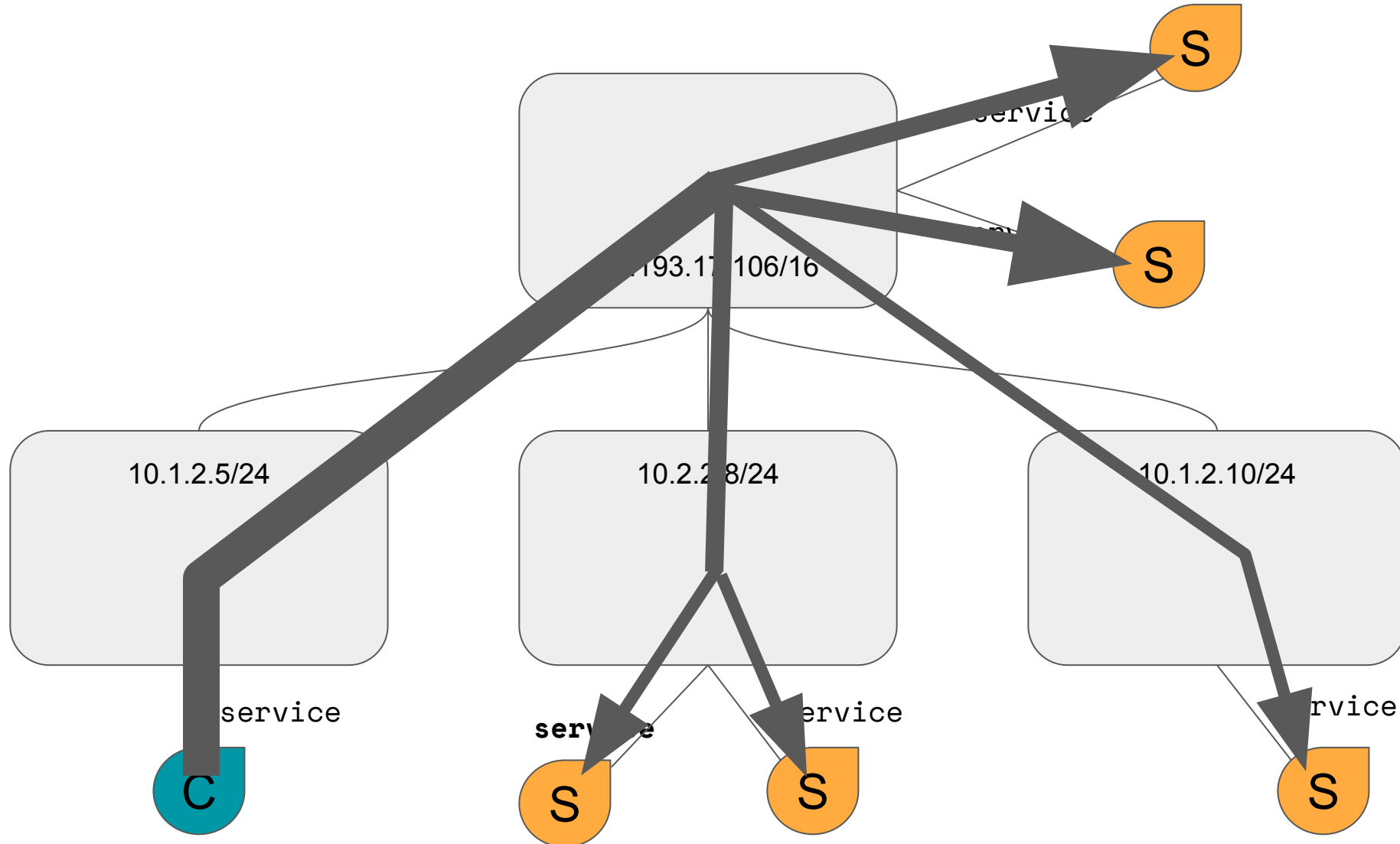
- Hybrid cloud, microservice architecture, agile integration, etc.
  - Not client/server
  - Services/processes want to be deployable and addressable everywhere (north/south/east/west)
  - Edge computing - Lots of private subnetworks



# Application Layer Addressing



# Application Layer Addressing



# Implications of Application Addressing

- Security
  - Access control for addresses - at the service/process/business resolution
  - Locked-down network membership - Mutual TLS for inter-site connections
  - Cross-cluster applications not exposed via Kube networking
    - Public exposure limited to ingress
  - Trusted and untrusted edges
- Management
  - Metrics collected at business resolution

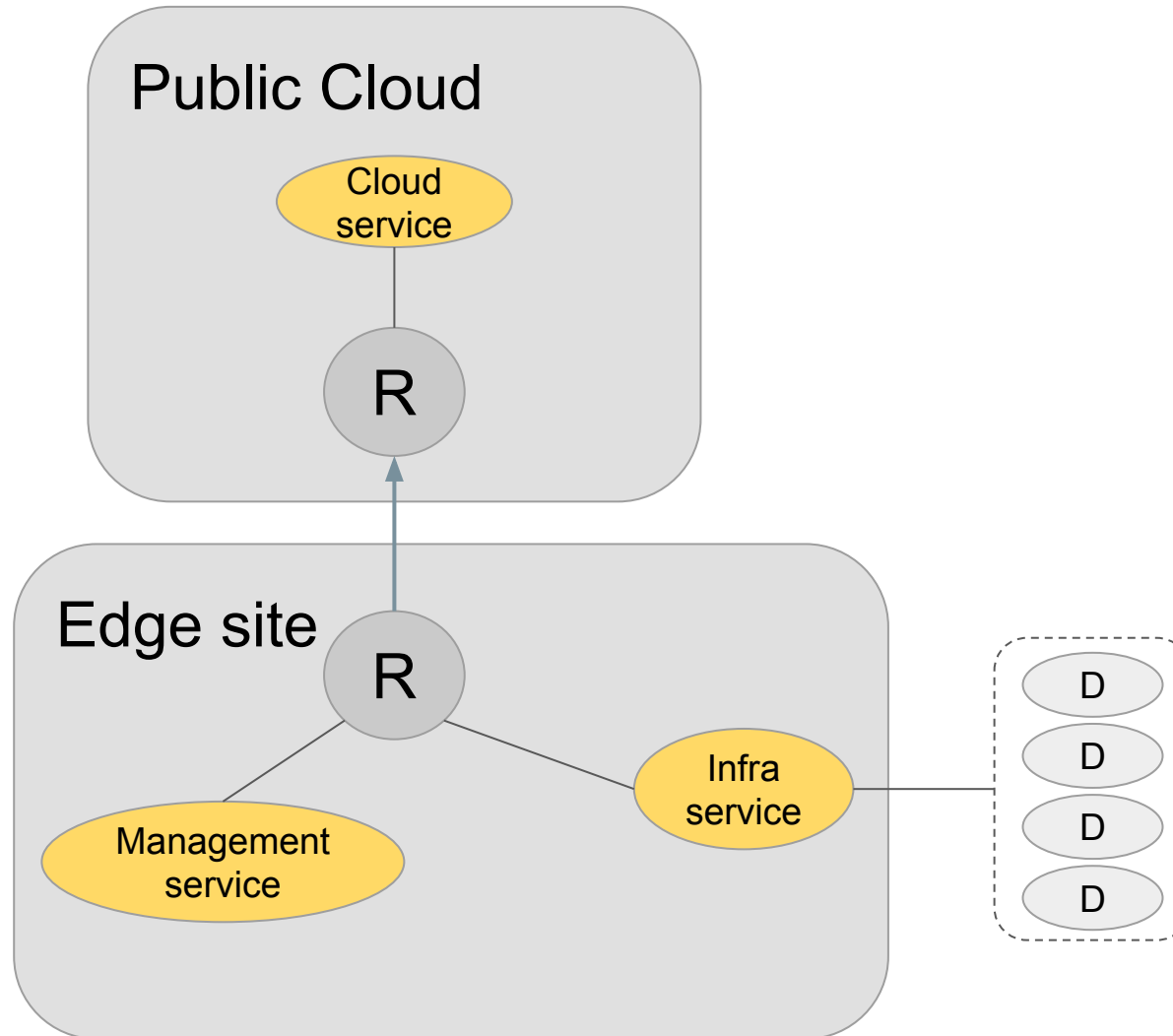
# Skupper.io

- Operational Ease
  - Easy to deploy in a multi-cluster network
  - No advanced networking (SDN, VPNs, Tunnels, Firewall rules, etc.)
  - No need for elevated or admin privileges
  - No problem with overlapping CIDR subnets or mixes of IPv4 and IPv6
  - No single point of failure - use redundant topology
- Not just for messaging
  - Proxy maps HTTP, TCP, UDP, etc. to AMQP
- <http://skupper.io>
  - Examples, demo-videos, etc.
  - New, emerging project

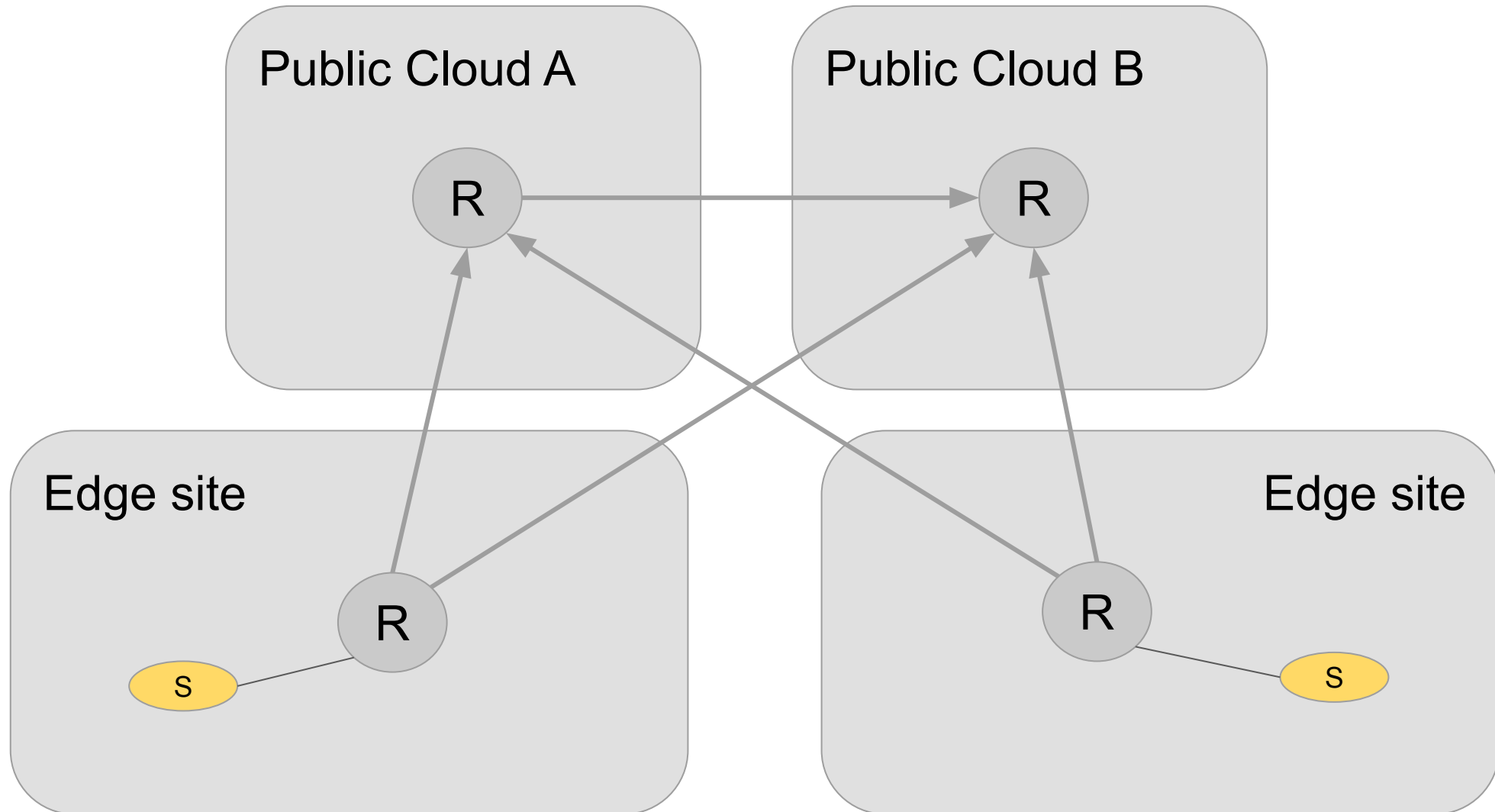


# Usecases

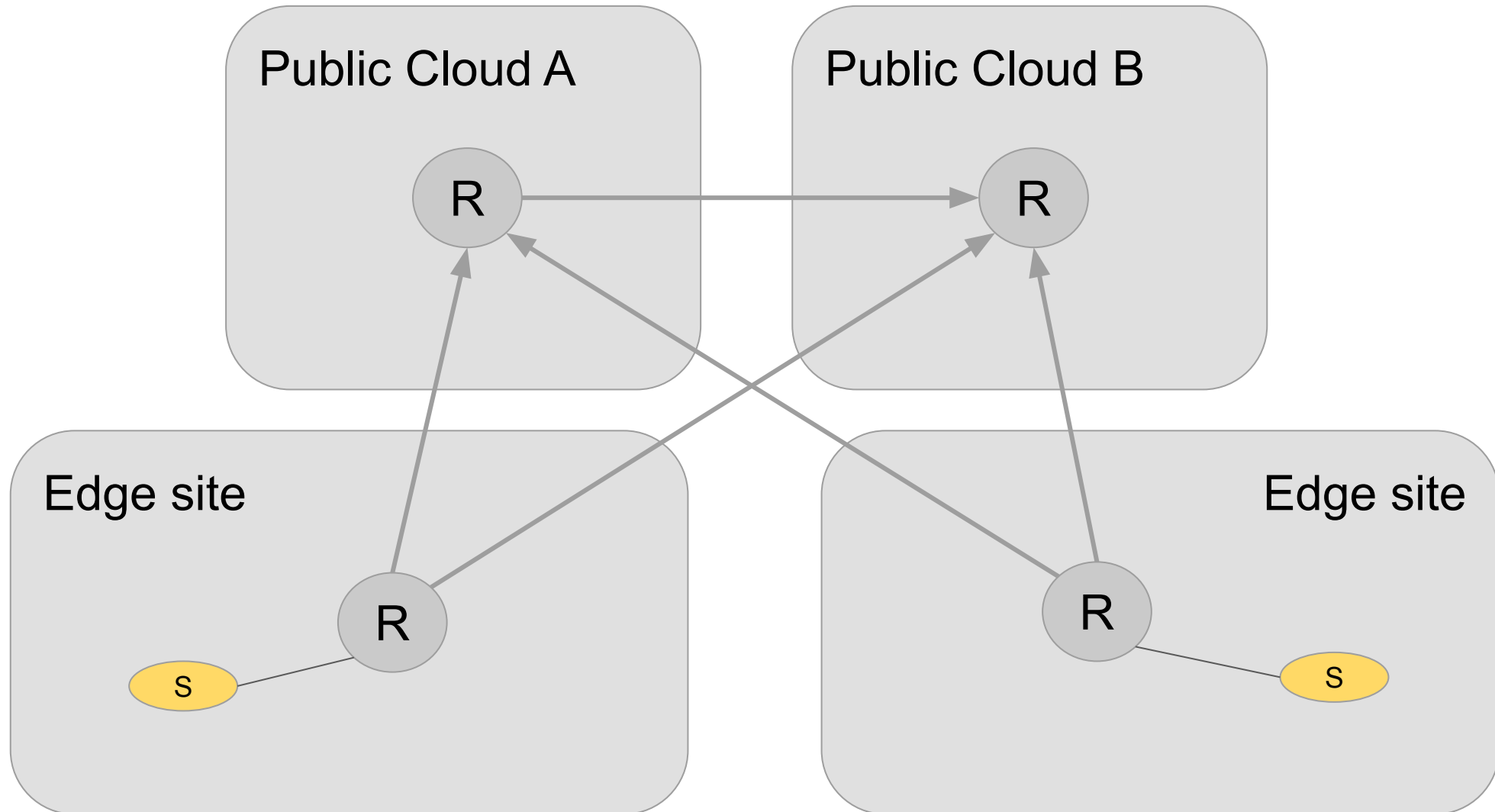
# Case - Highly available site



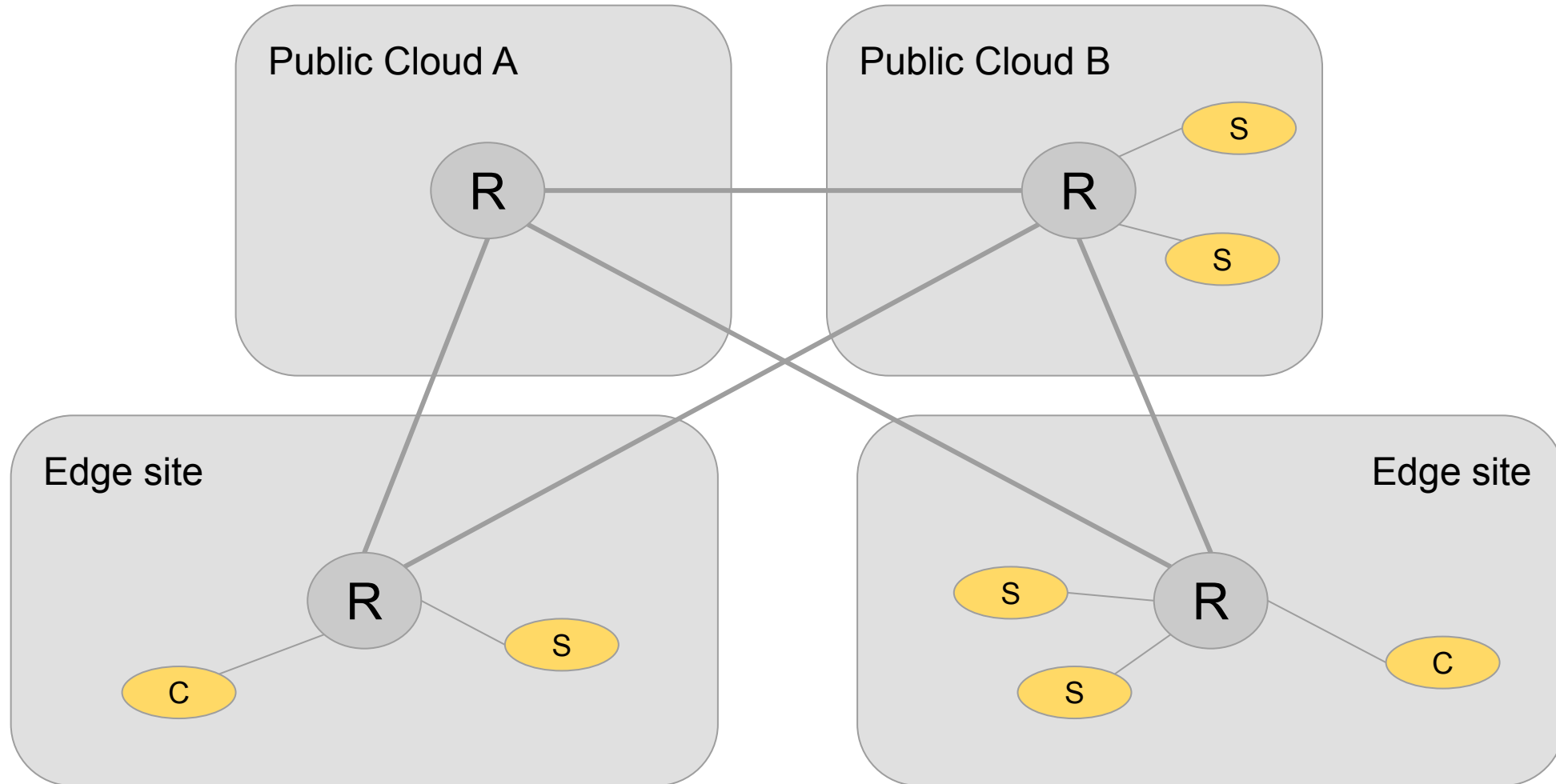
# Case - Edge to Edge integration



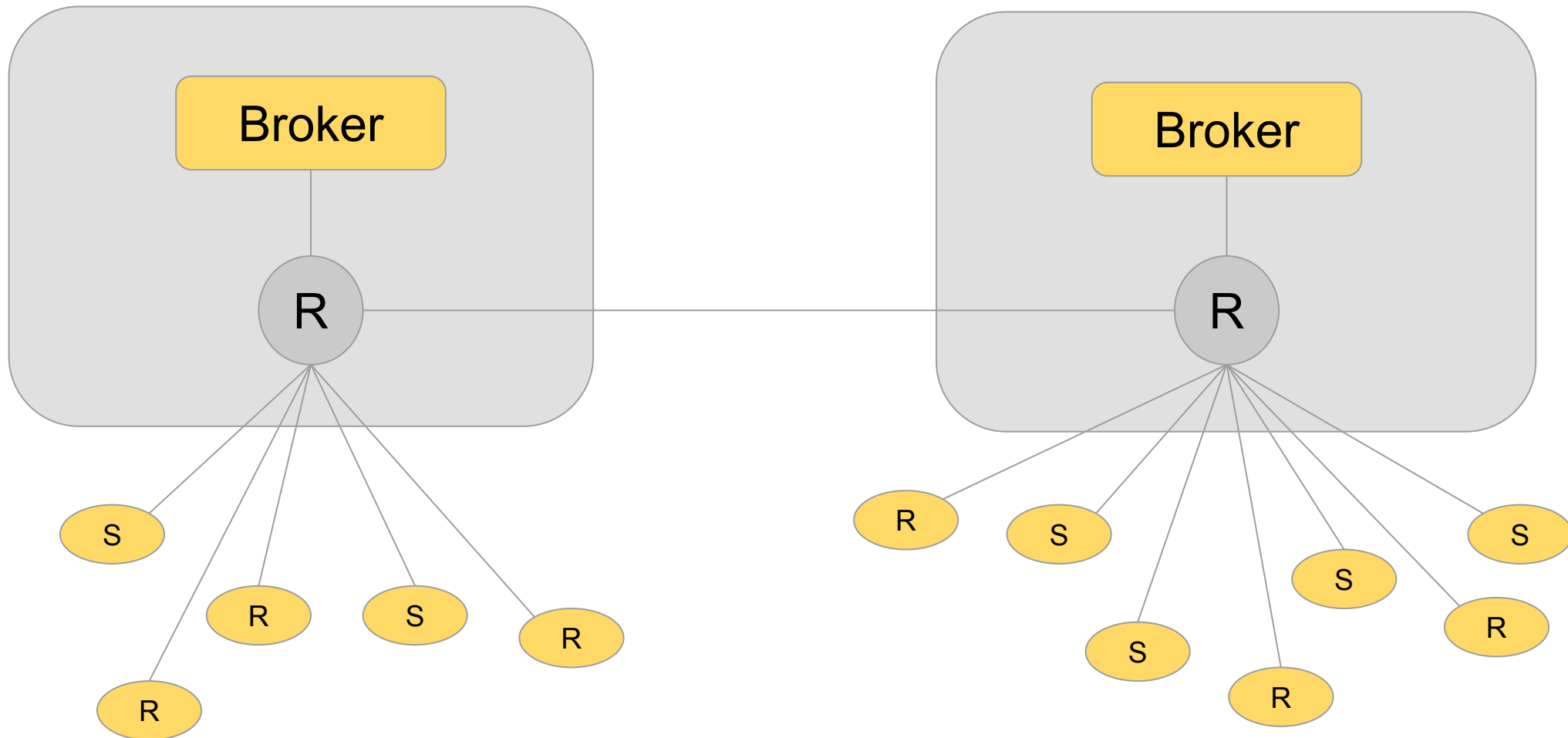
# Case - Edge to Edge integration



# Case - Ingress Load Balancing with Locality

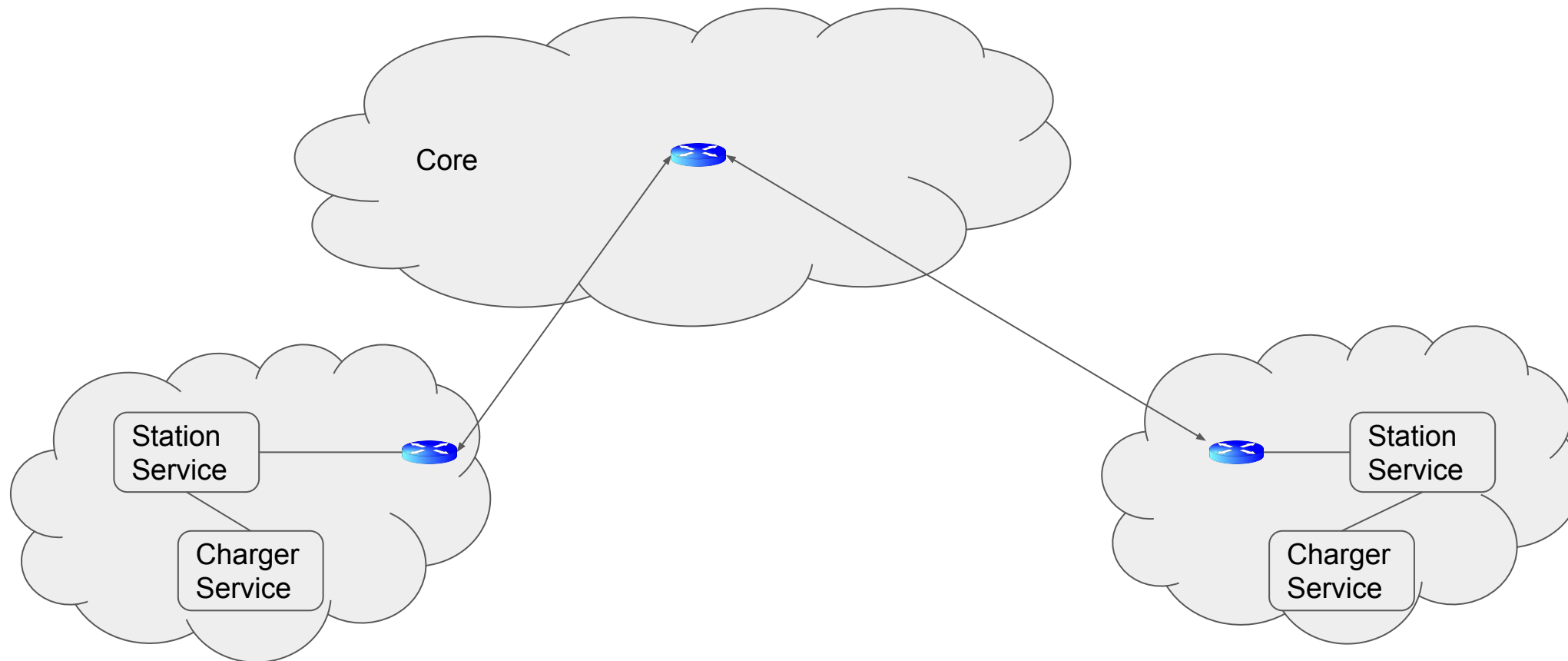


# Case - HA producing



# Demo

# Demo





# Takeaways


- Deployment considerations
  - Service size and priorities
  - Networking considerations
- 
- K8s IoT Edge working group - <https://github.com/kubernetes/community/tree/master/wg-iot-edge>
  - Thursday, November 21 • 4:25pm - 5:55pm - Intro + Deep Dive: Specialized Network Protocols for IoT+Edge with Kubernetes - <https://sched.co/UakM>

# Thank you

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