
KubeCon
CloudNativeCon
North America 2022
BUILDING FOR THE ROAD AHEAD
DETROIT 2022
TiKV
TiKV
HELM

BUILDING FOR THE ROAD AHEAD

DETROIT 2022

Kubernetes On the Edge With K3s For a Smart Metering Use Case

Harry Lee, Melio AI

Harry Lee

Co-founder & CTO

Melio AI

- DevOps Evangelist
- Working with Kubernetes for 5+ years
- CNCF Ambassador, South Africa
  - 3 years
- Organiser: Cloud Native Computing Johannesburg, South Africa
  - 4 years, 980 members
  - https://community.cncf.io/johannesburg/

@harryleesan

harry@melio.ai

Melio AI

- MLOps Consultancy
  - ML+ DevOps practices
- Helping data science teams build and deploy machine learning solutions reliably and efficiently
- Everything Cloud-native

https://melio.ai

https://www.linkedin.com/company/melio-consulting

Agenda

- Product
  - Background
  - Requirements
- Four Challenges
  - Challenge 1: Provisioning
  - Challenge 2: Networking
  - Challenge 3: High Availability
  - Challenge 4: Certificate Management
- Design

Why are we building this?

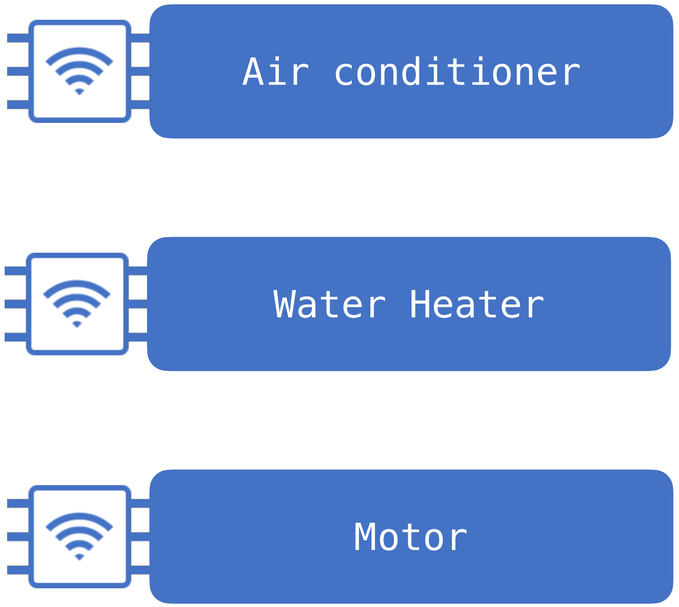
- South Africa’s energy crisis due to power shortage
  - 15+ years
  - “loadshedding”
    - Scheduled rolling blackouts to the national grid
    - Few days or few hours notice
- Economic impact on businesses
  - Output decreases
  - Electricity cost increases

Why are we building this?

- Opportunity for a smart energy management system
  - Big energy consumers: Offices and industrial factories
  - Use IoT devices to measure energy usage, estimate costs, optimise electricity usage with automation
    - e.g. Switch off appliances at night when no-one is using them
    - e.g. Recommend the best time (i.e. off-peak) to run heavy machinery to reduce electricity spending
- Why build and not buy?
  - Client is a hardware manufacturing business
    - Expertise in building low-cost energy measurement devices
    - Add-on service offering to existing customers
    - Capture the entire value chain

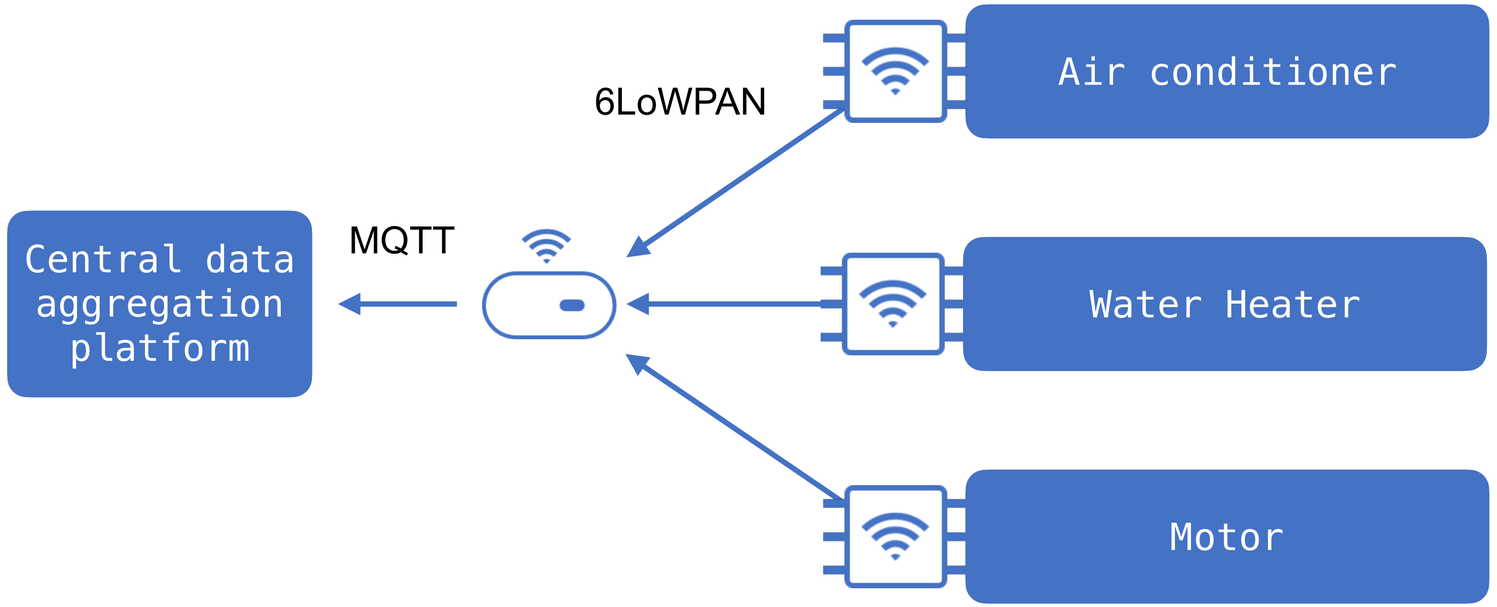
How does it work?

IoT devices are attached to the appliances



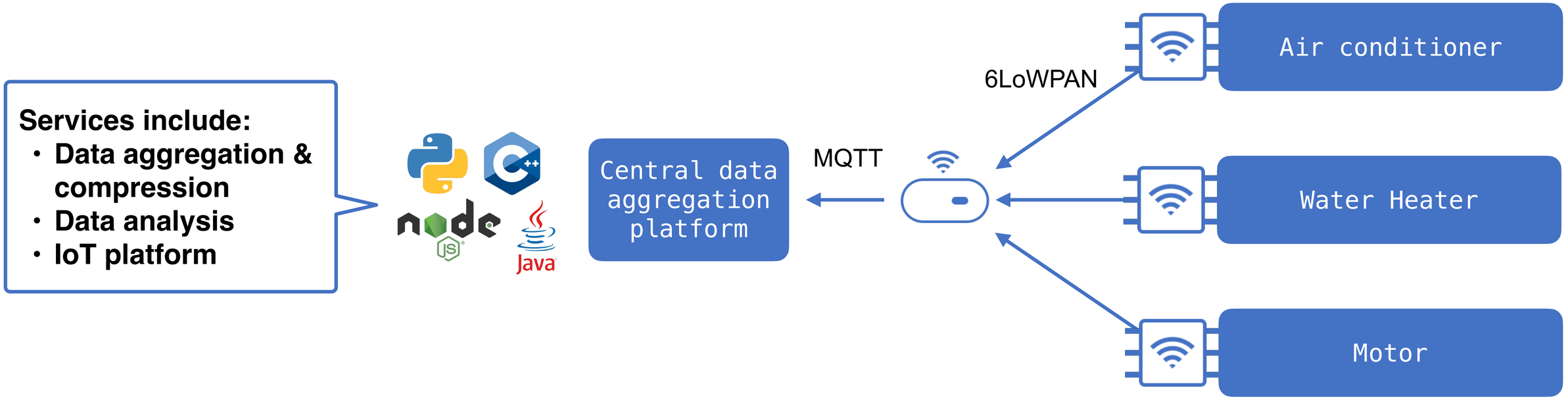
How does it work?

IoT devices then sends data to a Gateway which sends data to the data aggregation platform



How does it work?

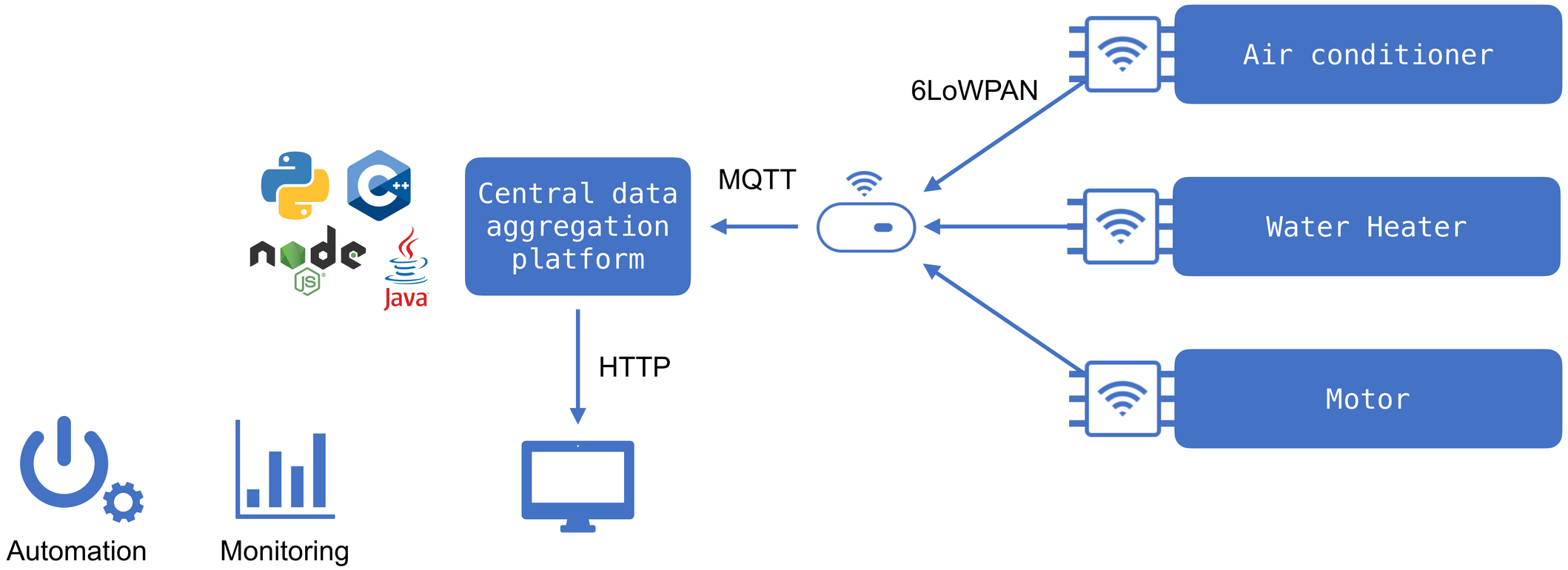
The central data aggregation platform is a server installed on-premise



How does it work?

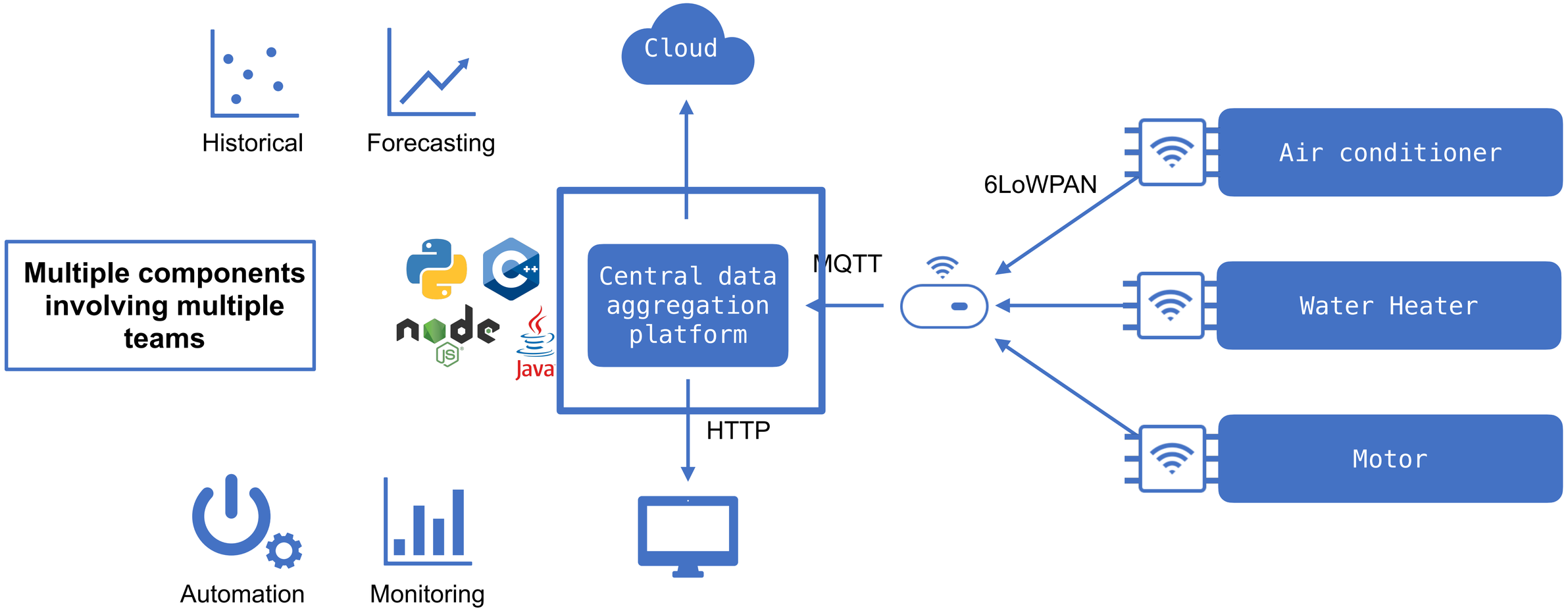
KubeCon CloudNativeCon North America 2022

On-premise monitor and control of IoT devices

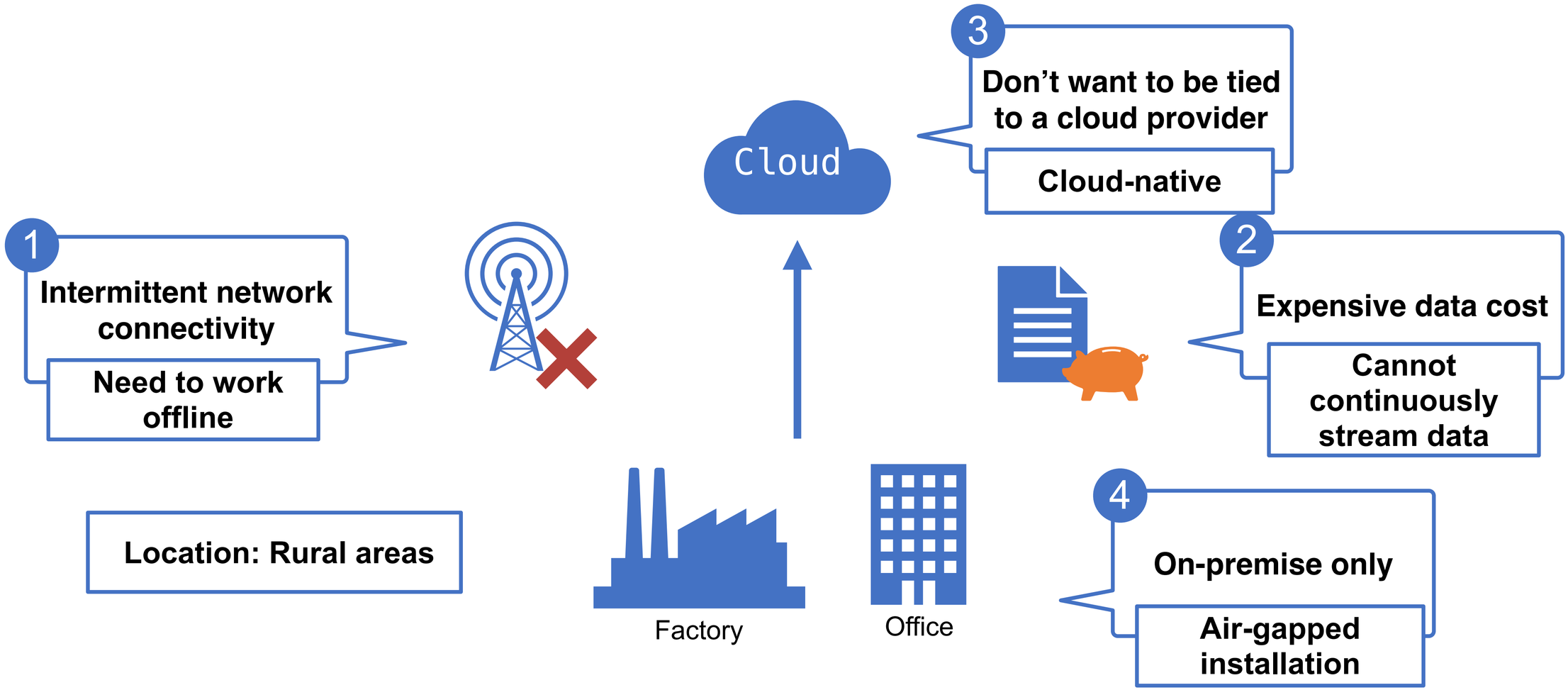


How does it work?

Cloud for data analytics and long term storage

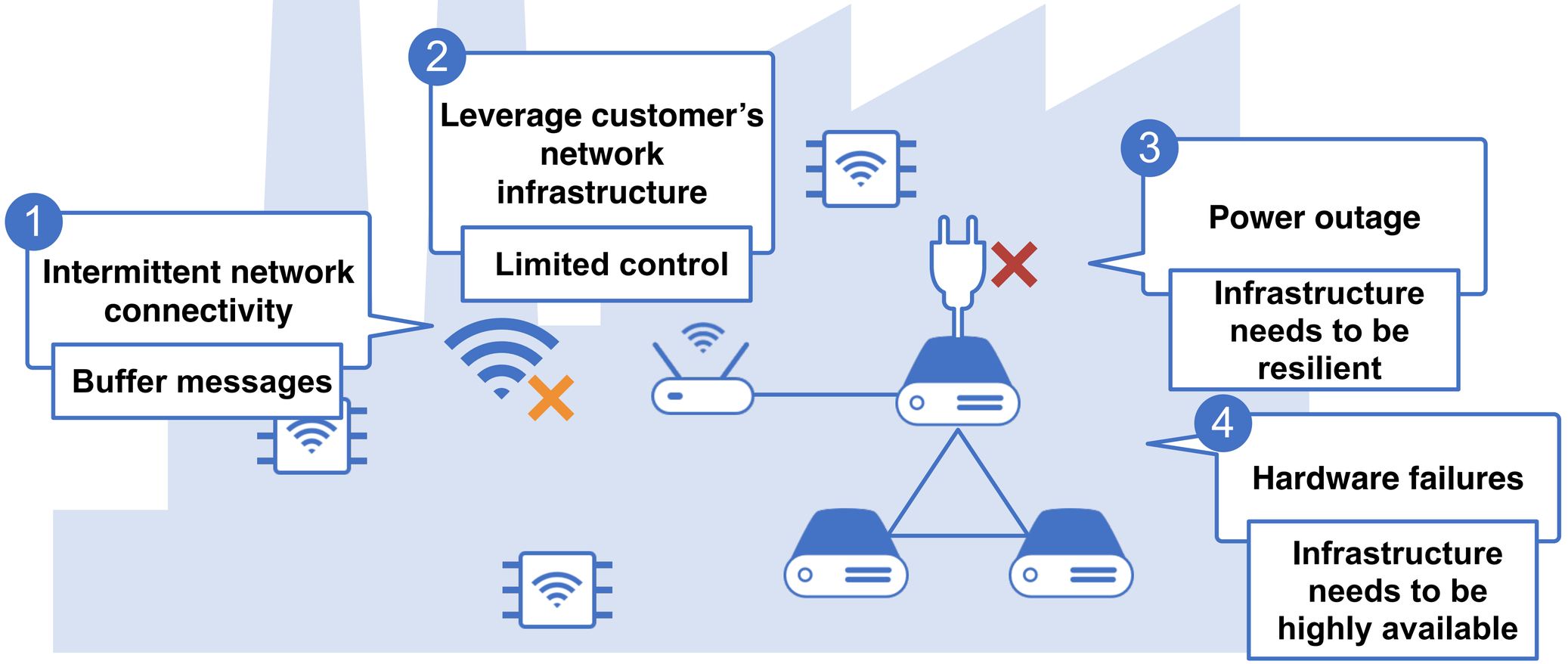


What are some considerations?



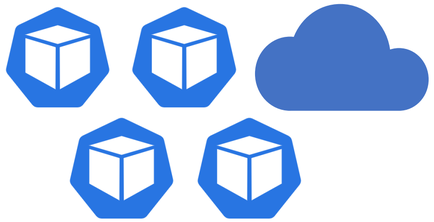
What are the considerations?

Infrastructure limitation on-premise

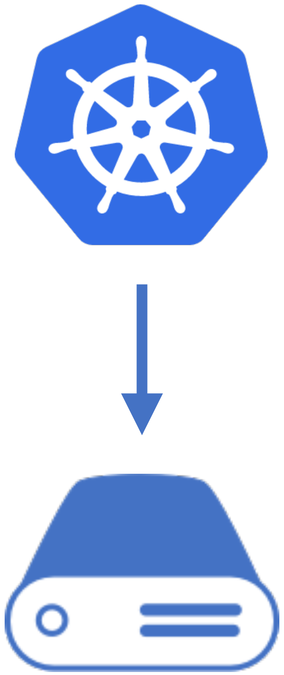


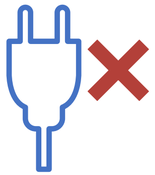
Why Kubernetes?

Standardisation



Ecosystem





Resilient

High Availability

Which Kubernetes distribution?

KubeEdge vs K3s

KubeEge

- Cloud and Edge components
  - But we need an isolated cluster
- Built-in MQTT broker (Eclipse Mosquito)
  - But another team already settled on using RabbitMQ
- Sync IoT device statuses to the cloud
  - But the IoT platform team already built this functionality
- Opinionated architecture
  - Needed something more flexible to cater to all the teams' needs

- Intel NUC Mini PC
- Core i5-10210U (4 cores)
- 8GB RAM
- 500GB SSD

K3S

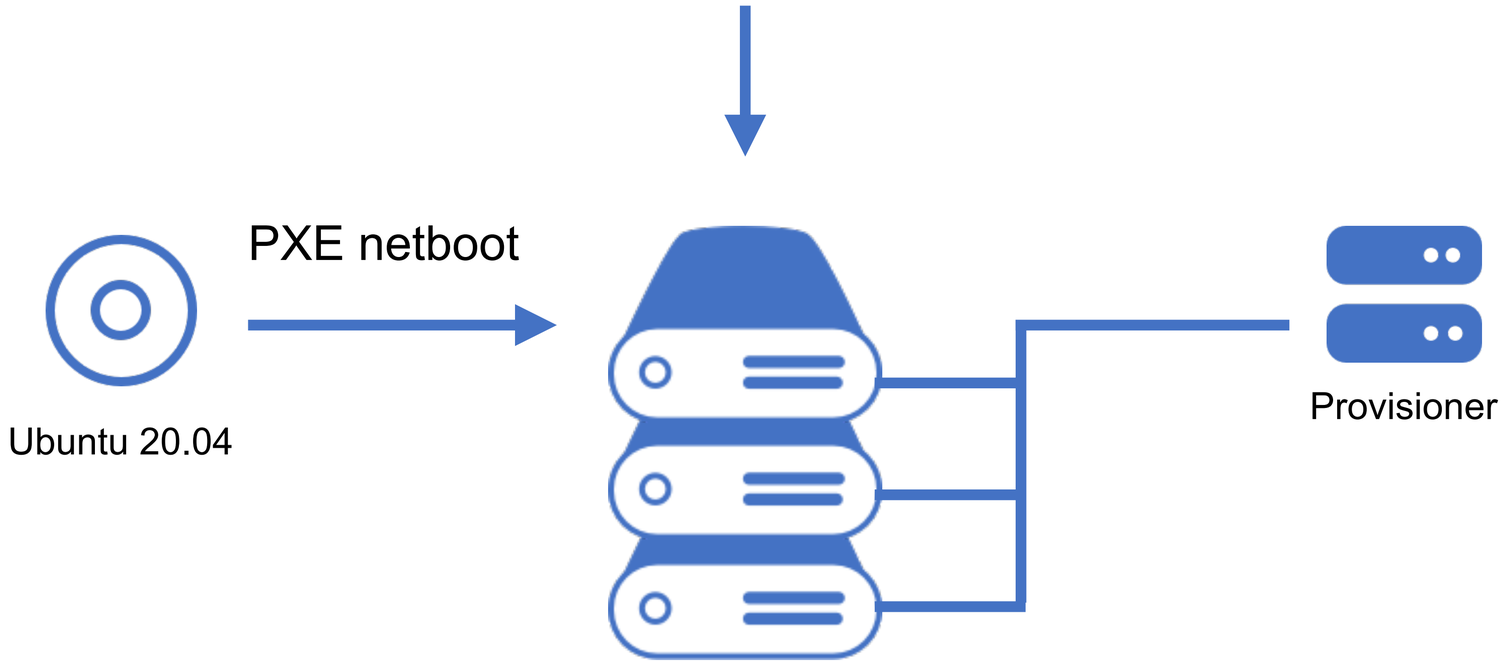
- Ended up choosing this for its flexibility
- Support Static Pods with Helm charts
- Support single node out of the box

Challenge 1: Provisioning K8s

How do we install Kubernetes on bare metal?

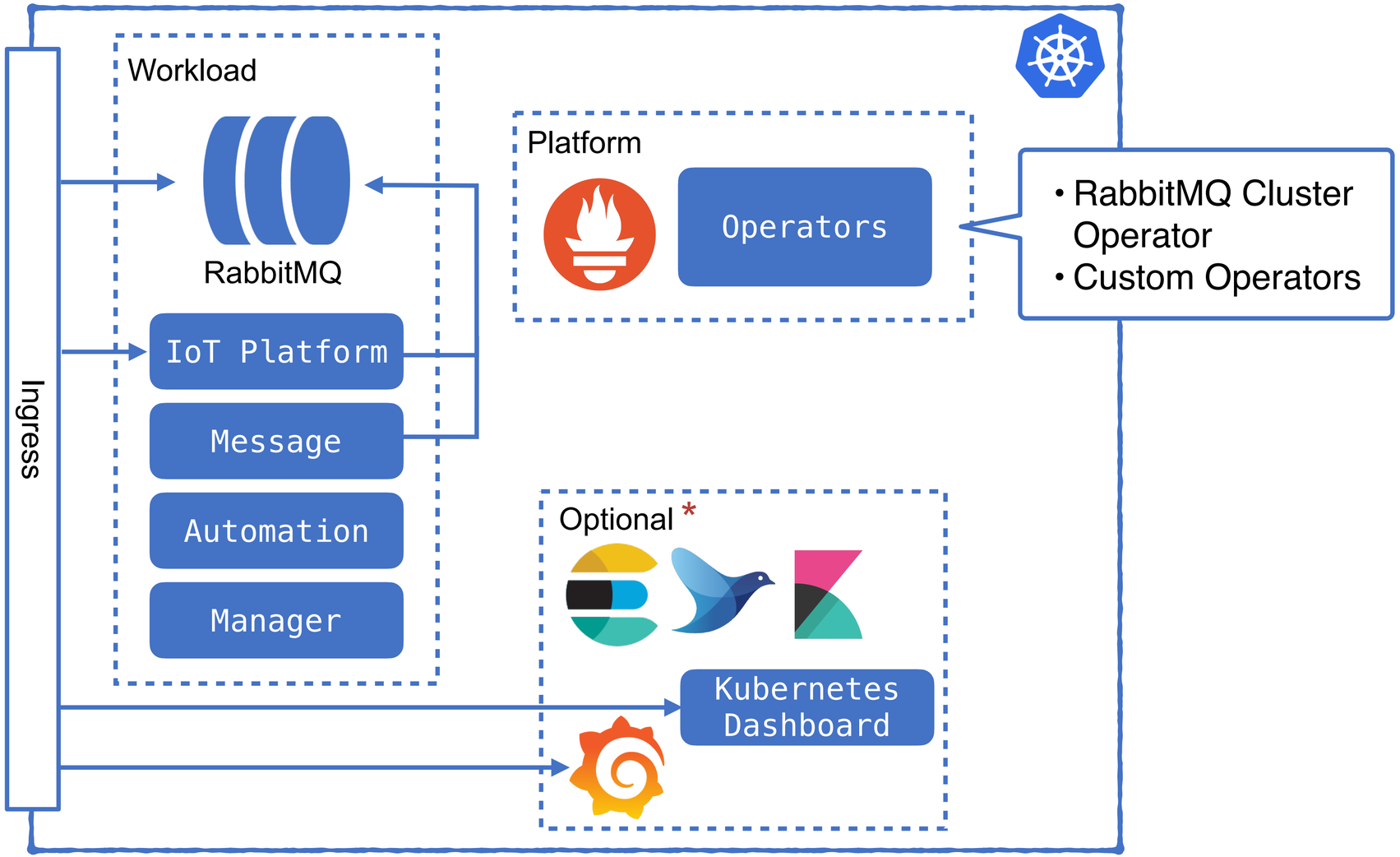
```
Github: PyratLabs/ansible-role-k3s
Version: 2.10.6
```

- Update and install OS packages
- Install Kubernetes (K3s)
- Install platform services (helm charts)
- Generate and copy configurations



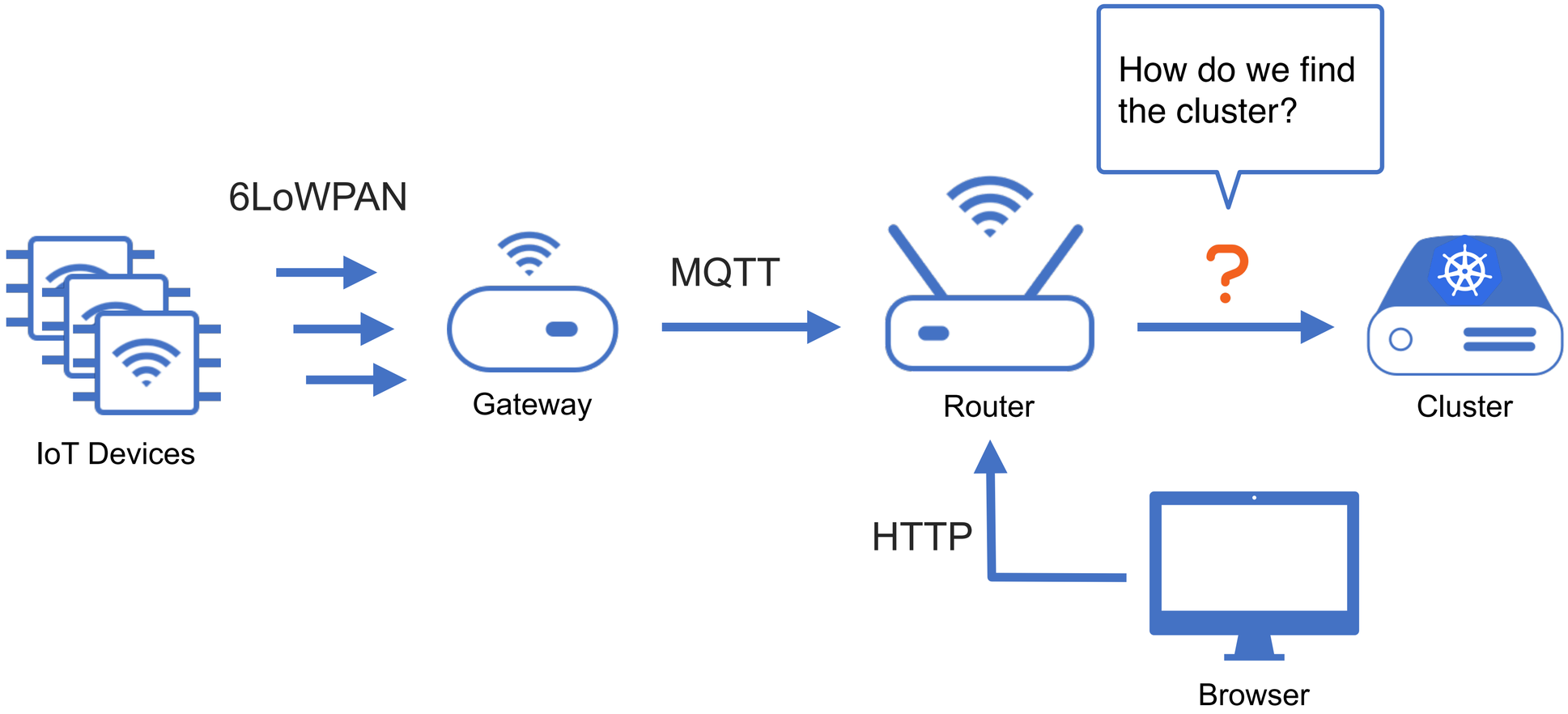
Challenge 1: Provisioning K8s

What is installed in Kubernetes?



Challenge 2: Networking

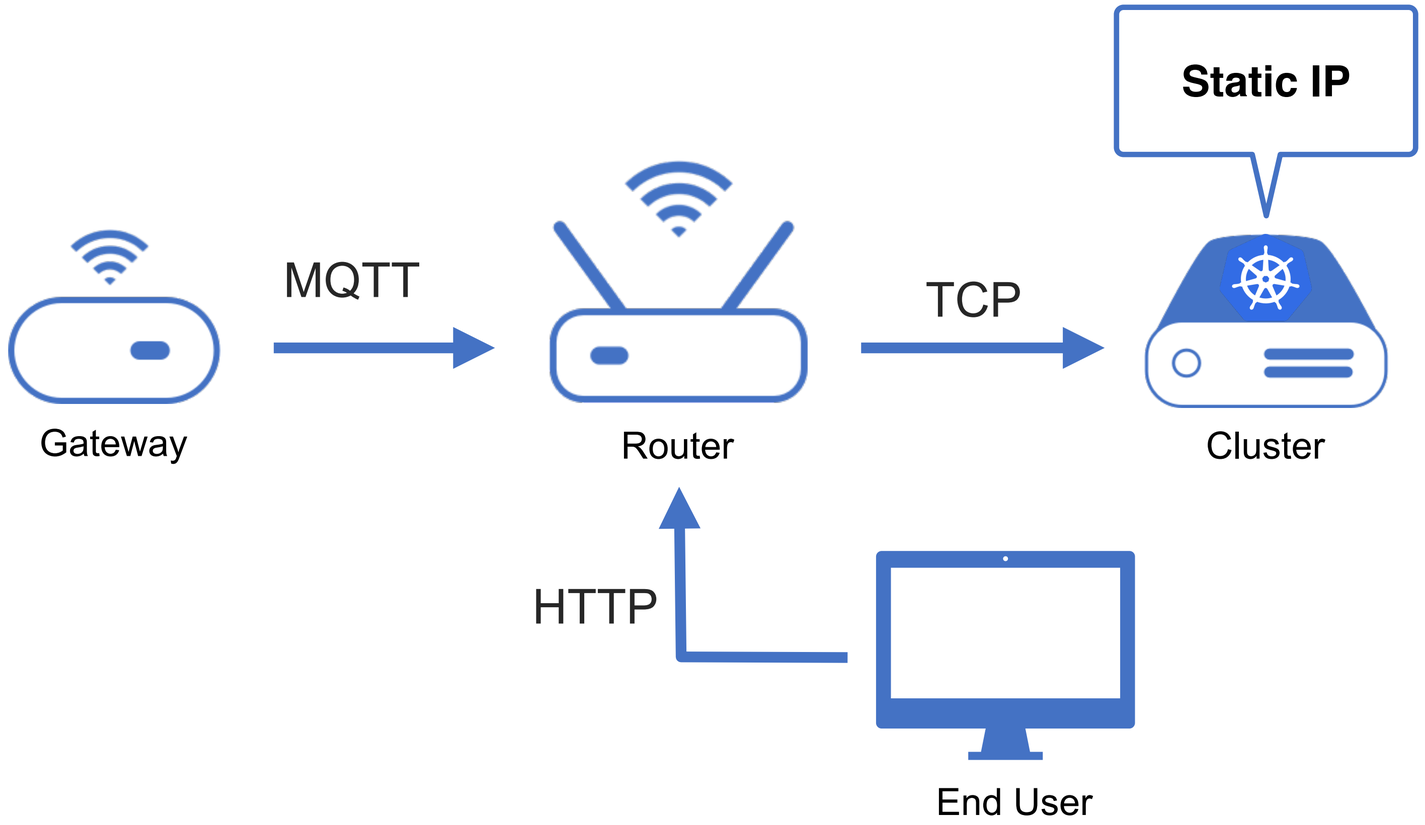
How does the data get to K8s?



Challenge 2: Networking

How do we do service discovery?

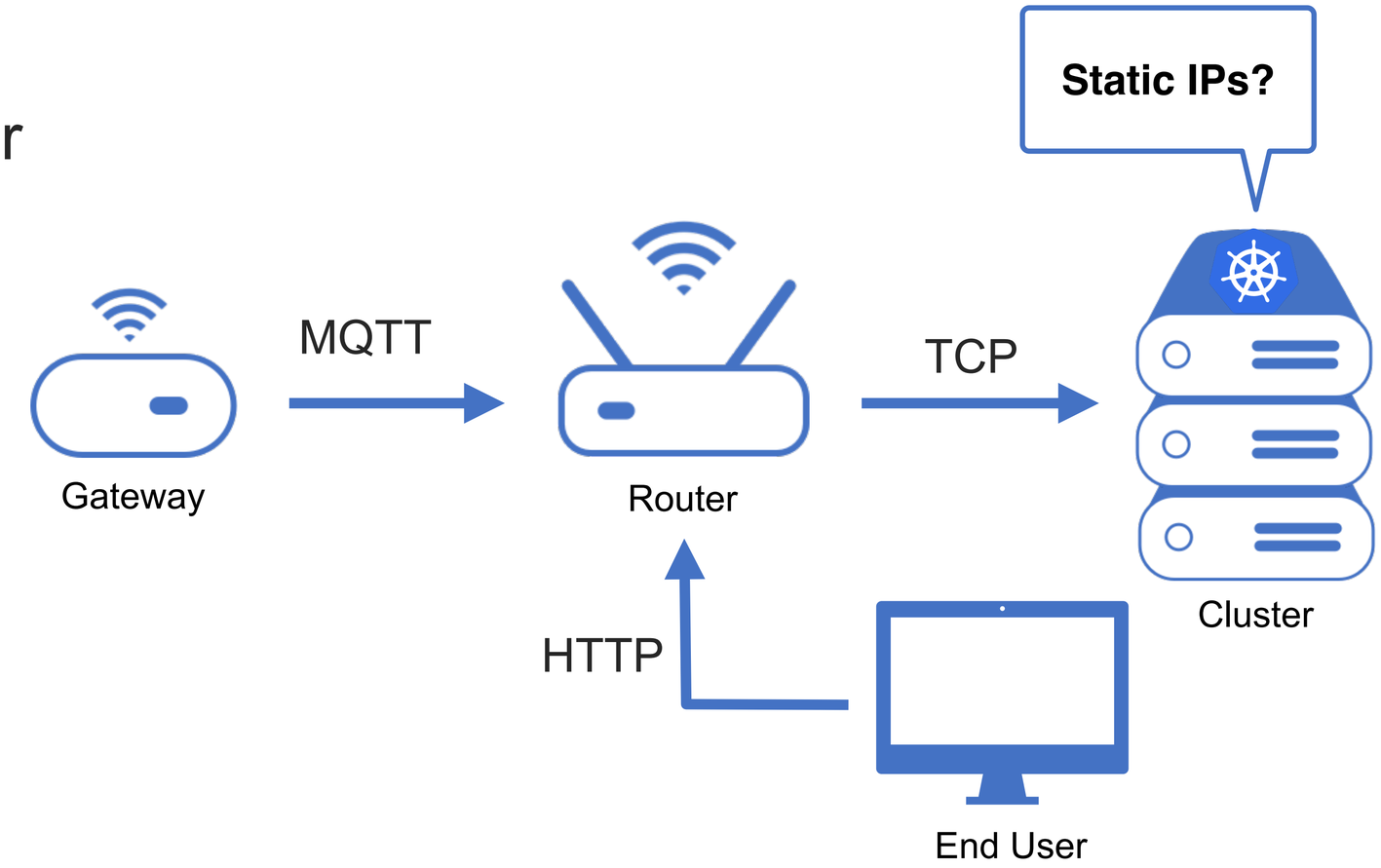
- Configure a static IP
  - Find an IP address not assigned by DHCP Server
  - Reserve IP address based on MAC address



Challenge 2: Networking

What if we have a multi-node cluster?

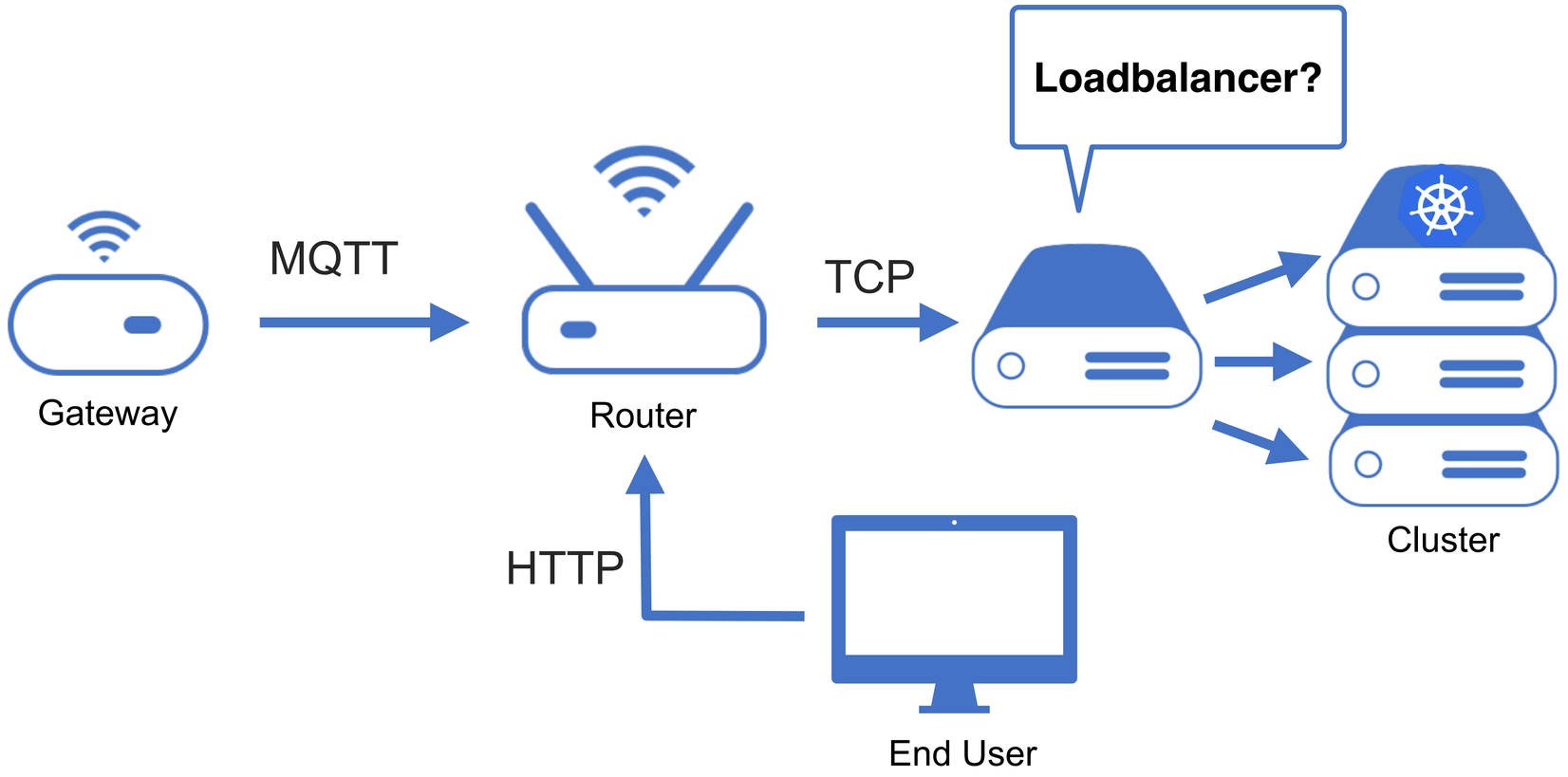
- Do we assign static IPs to each node?
- But how would failover work?



Challenge 2: Networking

What if we add a load balancer in front of the cluster?

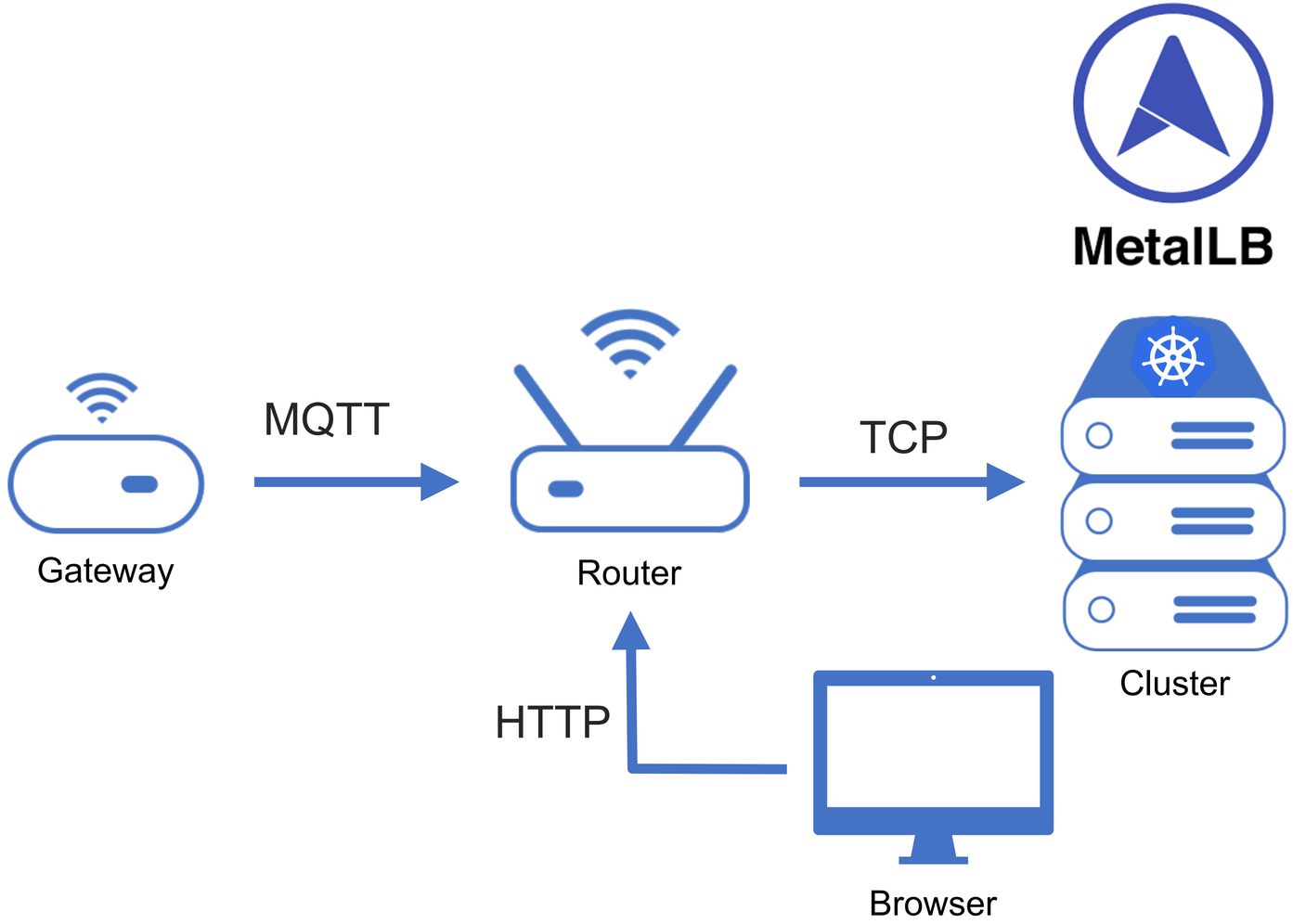
- Adding an extra server
  - Single point of failure
- Implement logic for service discovery



Challenge 2: Networking

Introducing MetalLB

- MetalLB needs an IP address pool reserved
  - Not part of DHCP
  - Can be handed out to services that need a loadbalancer
- Operate in “Layer 2” mode
  - Uses ARP
  - Universal - will work on any ethernet network

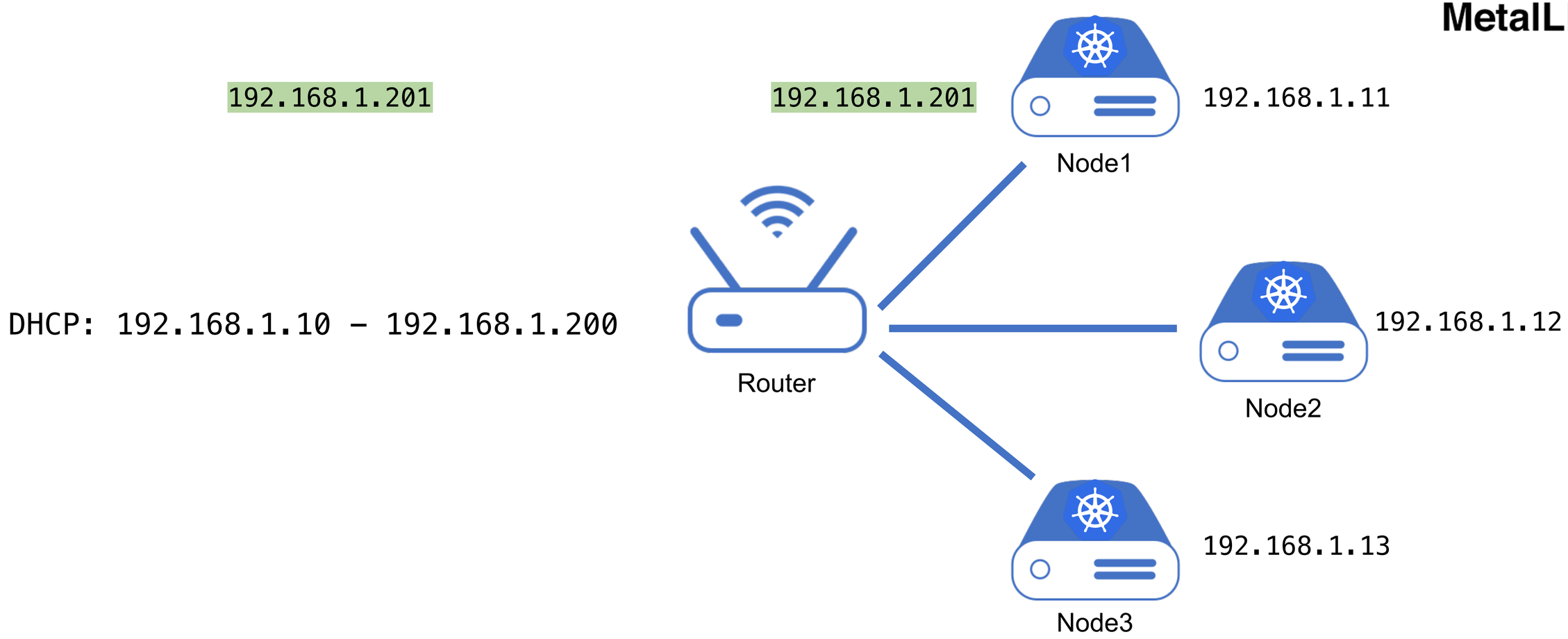


Challenge 2: Networking

KubeCon CloudNativeCon North America 2022

How does MetalLB work?

MetalLB

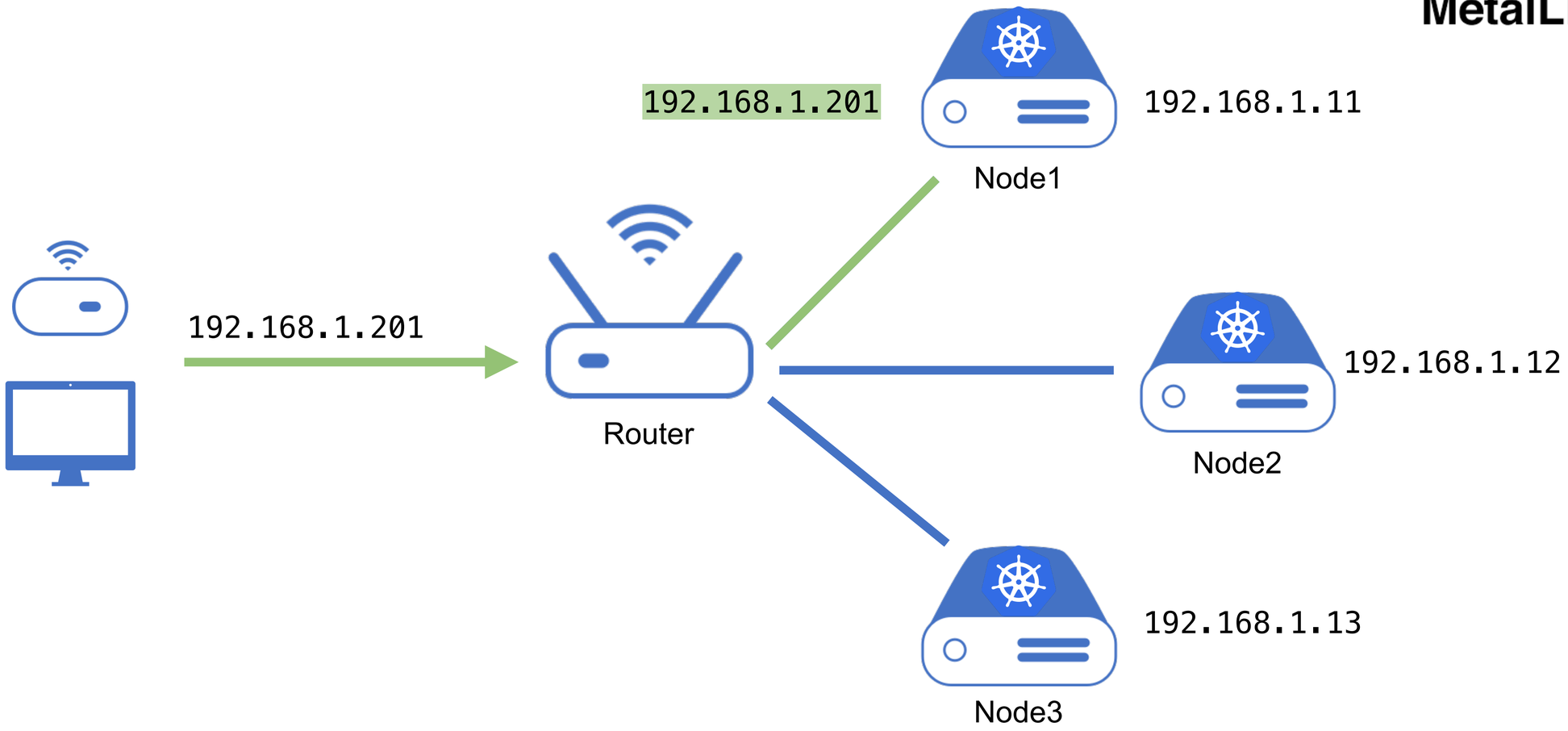


Challenge 2: Networking

KubeCon CloudNativeCon North America 2022

Introducing MetalLB

MetalLB



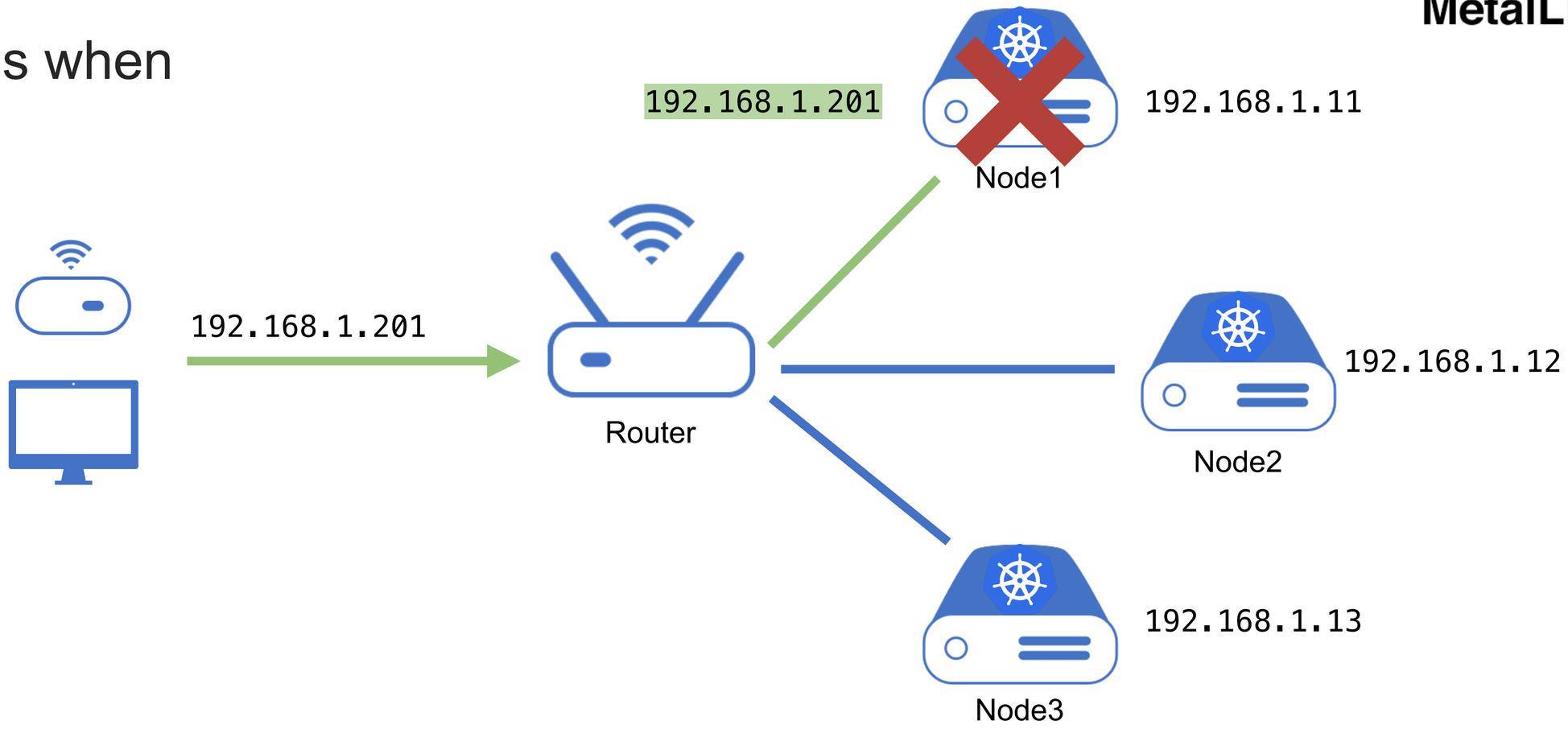
Challenge 2: Networking

KubeCon CloudNativeCon North America 2022

Introducing MetalLB

MetalLB

- What happens when Node1 fails?



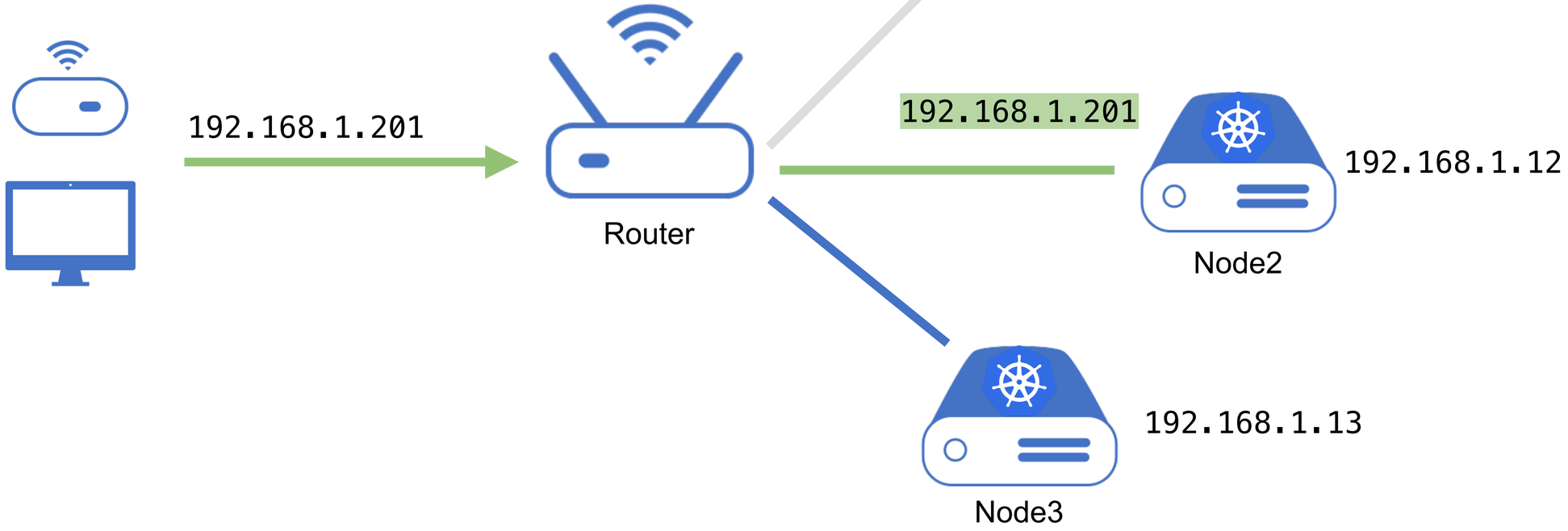
Challenge 2: Networking

KubeCon CloudNativeCon North America 2022

Introducing MetalLB

MetalLB

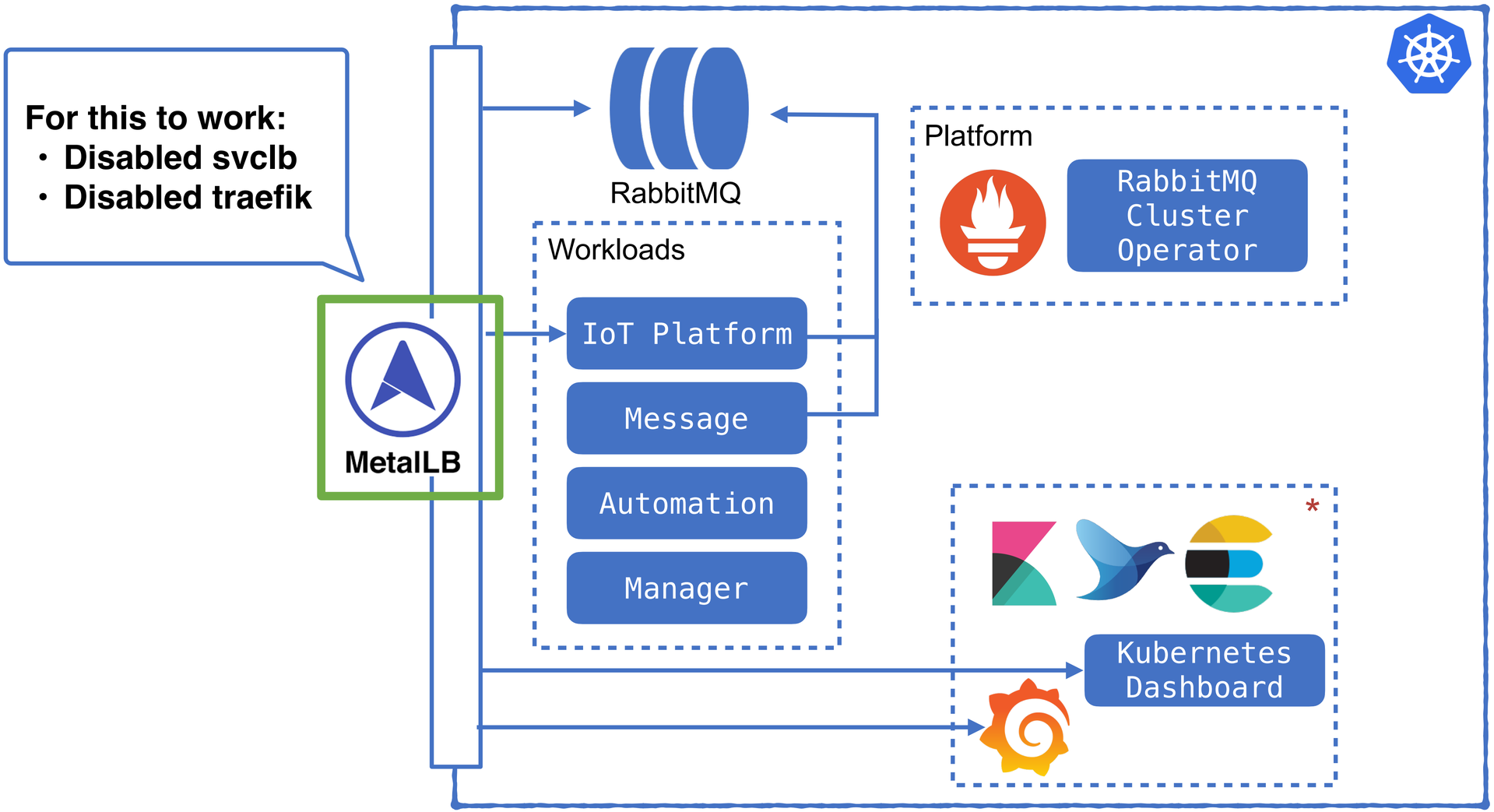
- MetalLB reassigns the IP address to another node (ARP)



Challenge 2: Networking

KubeCon CloudNativeCon North America 2022

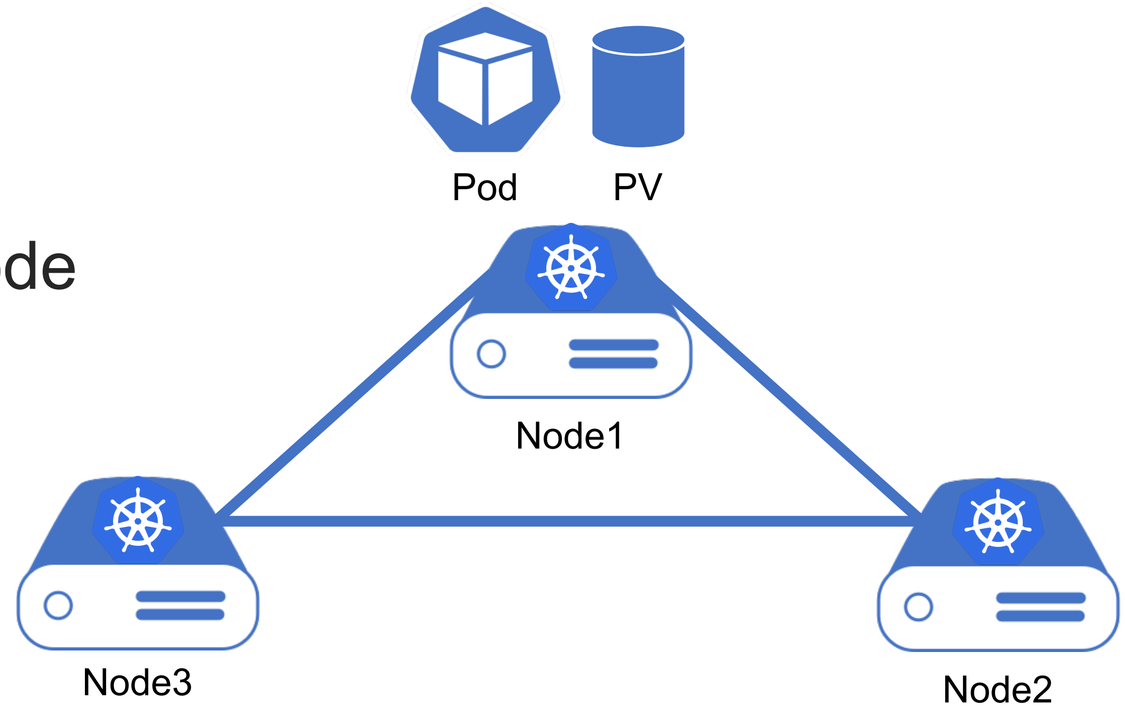
MetalLB added



Challenge 3: High Availability

How do we failover stateful applications?

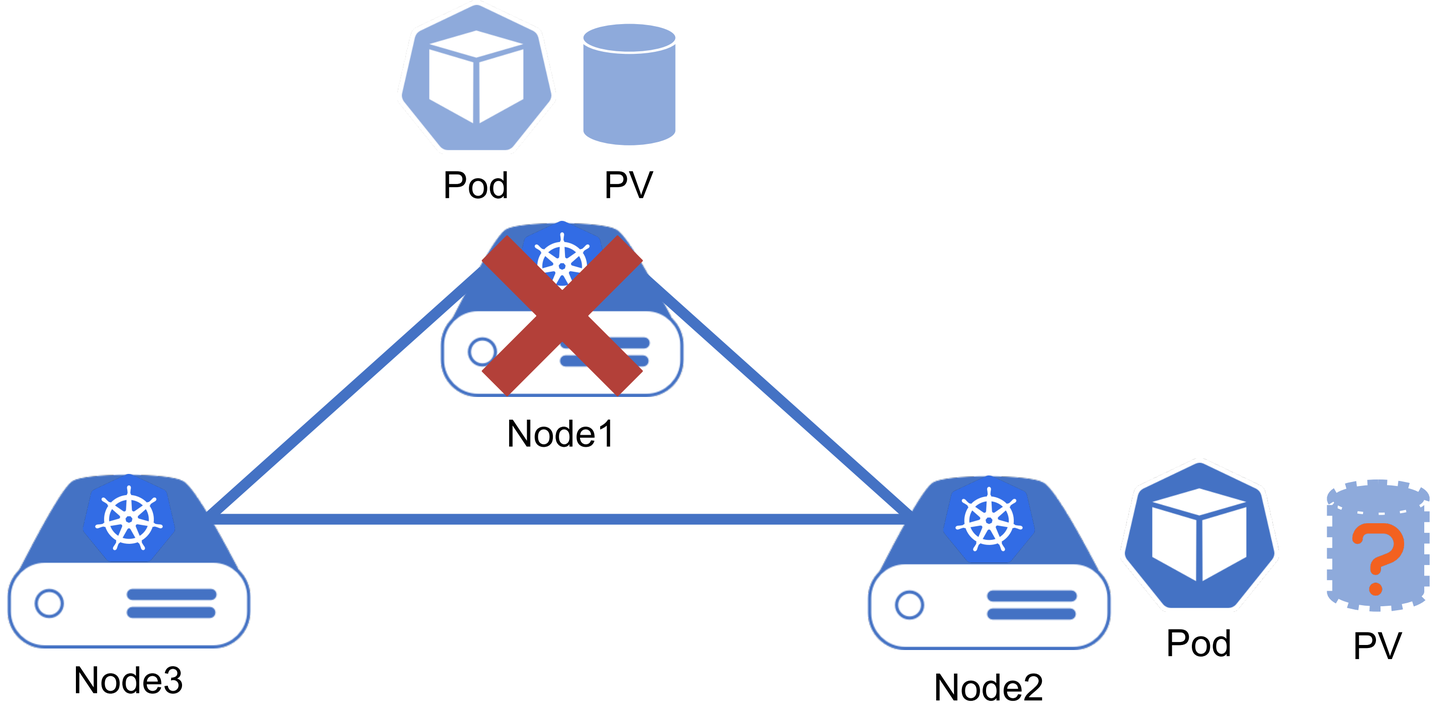
- K3s' default Local Path Provisioner only creates local volumes
  - But PVs will then only be available on the current node



Challenge 3: High Availability

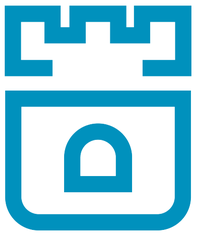
How do we failover stateful applications?

- PV also needs to be available on the node that the new pod is provisioned
- Need distributed persistent storage solution



Challenge 3: High Availability

Which distributed persistent storage should we use?



Rook

Longhorn

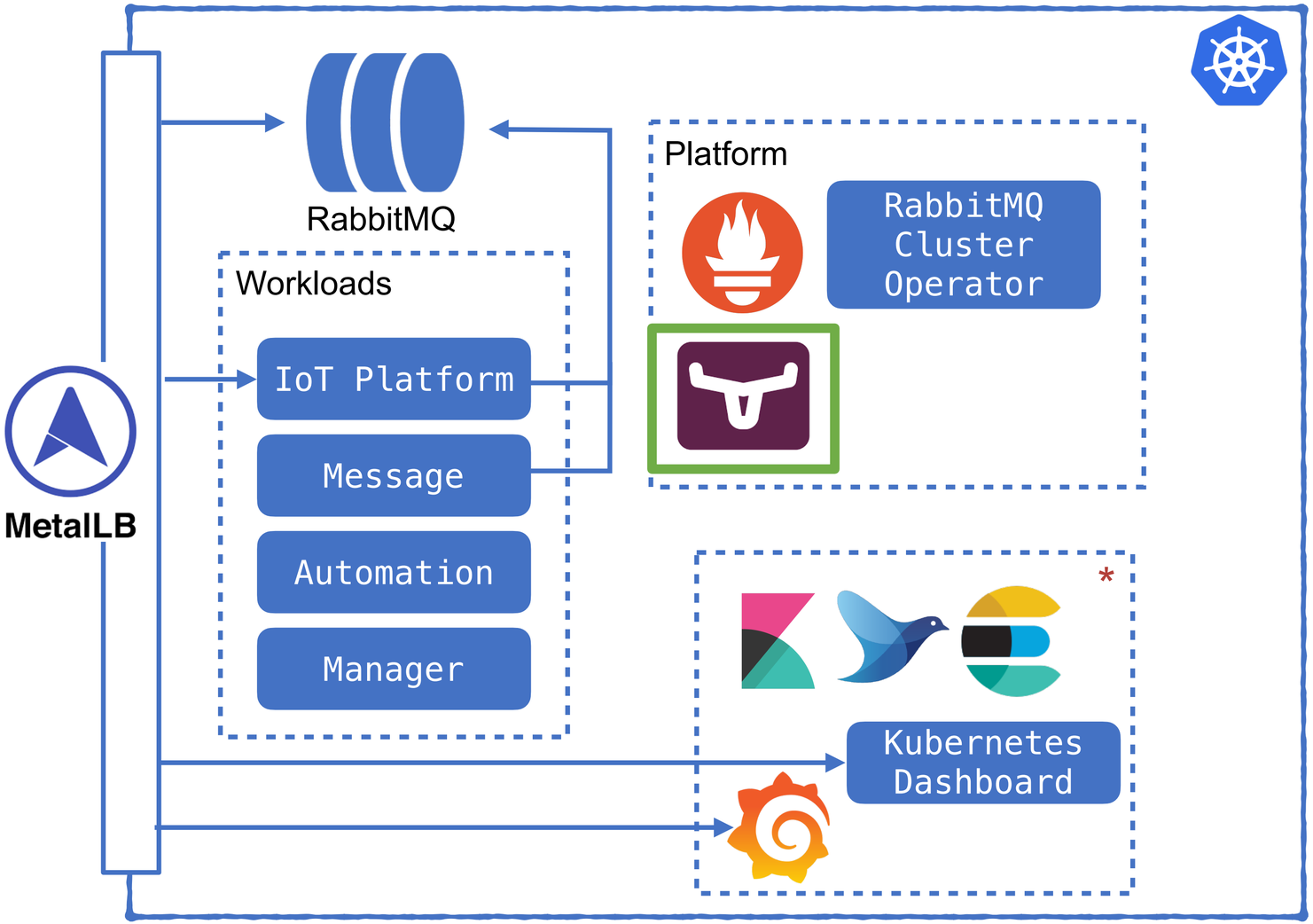
OpenEBS

- Team have experience
- Based on Ceph
- Feature rich and robust
- Too complex for our use case

- Both are easy to install
- Both support PV replication
- Both support incremental snapshots
- Both support backup and restore
- Selected Longhorn
  - Supported officially by K3s and Rancher

Challenge 3: High availability

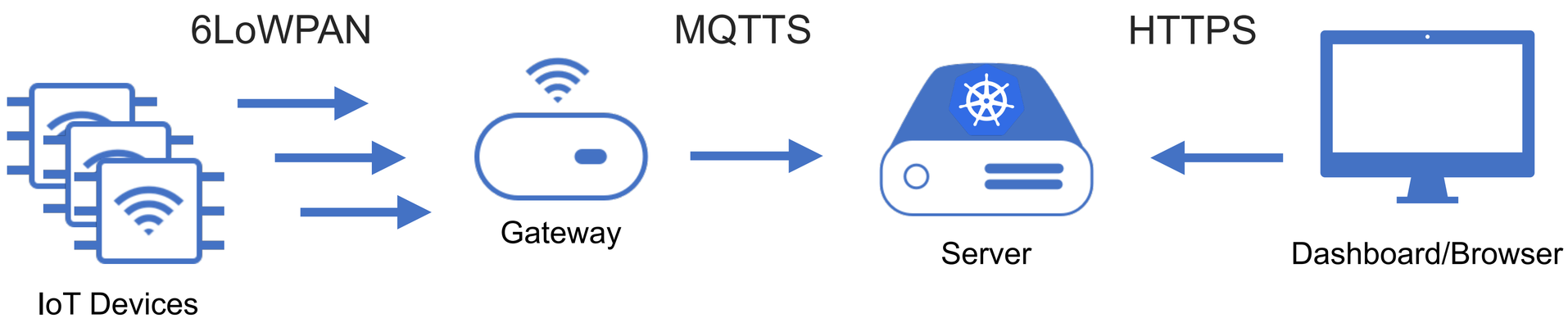
Longhorn added



Challenge 4: Certificate Management

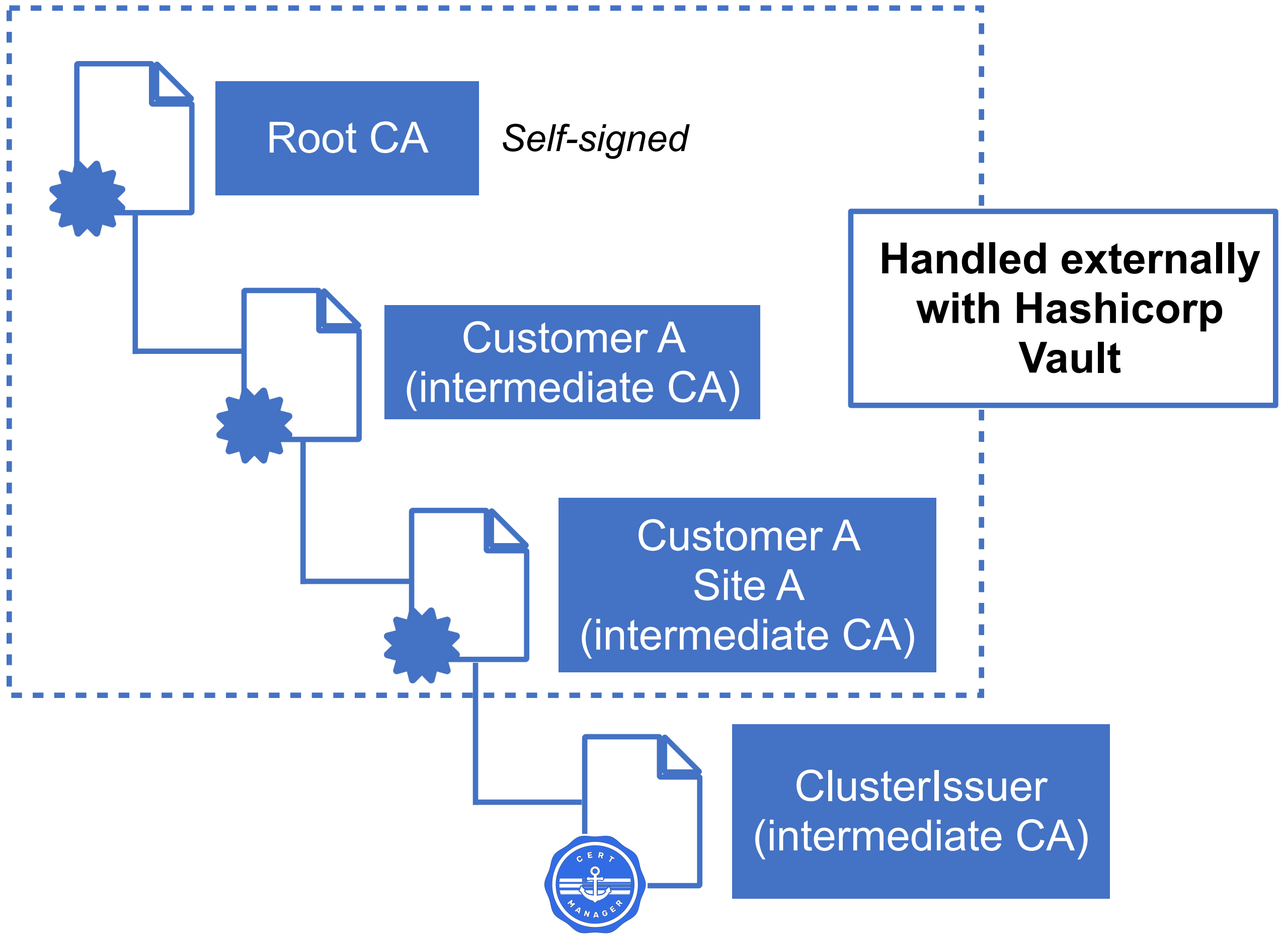
How do we access the services securely?

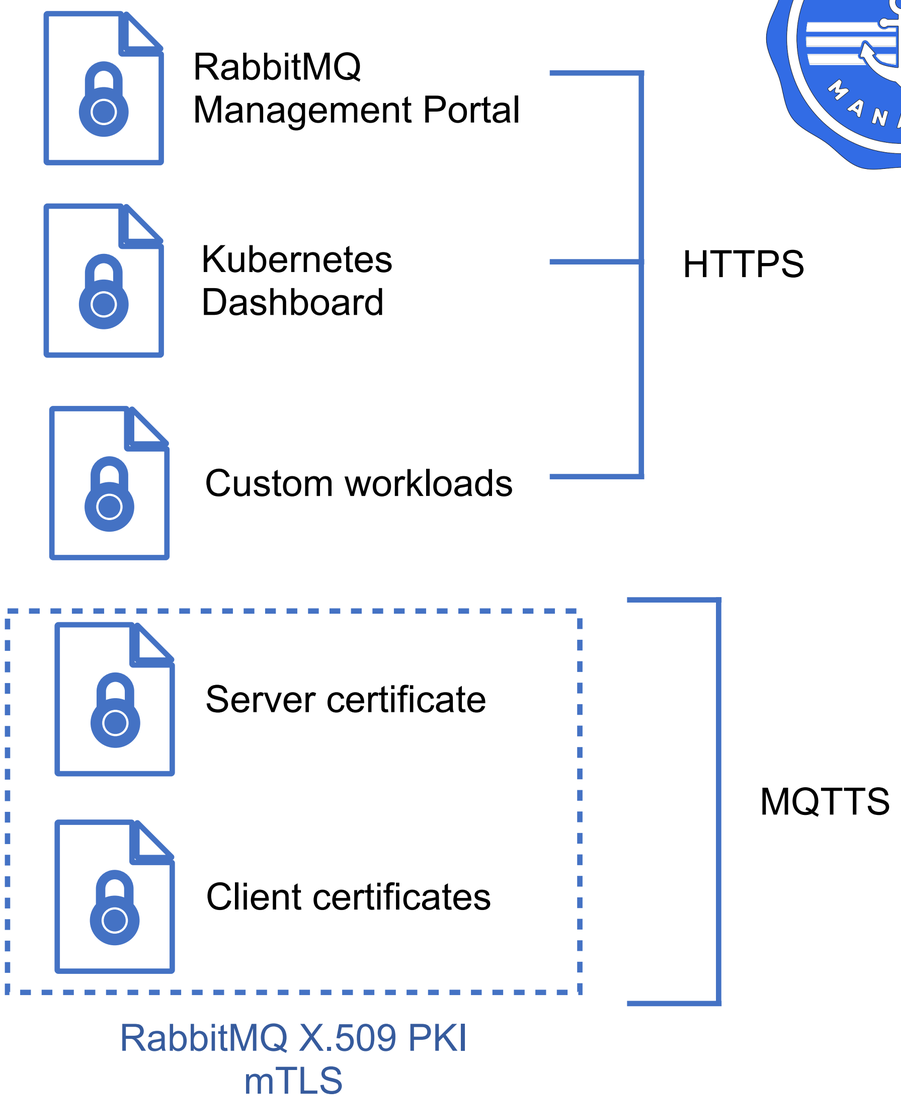
- Access to services on the cluster
  - Web services (dashboards, IoT platform)
  - Message Broker (RabbitMQ)
  - X.509 PKI



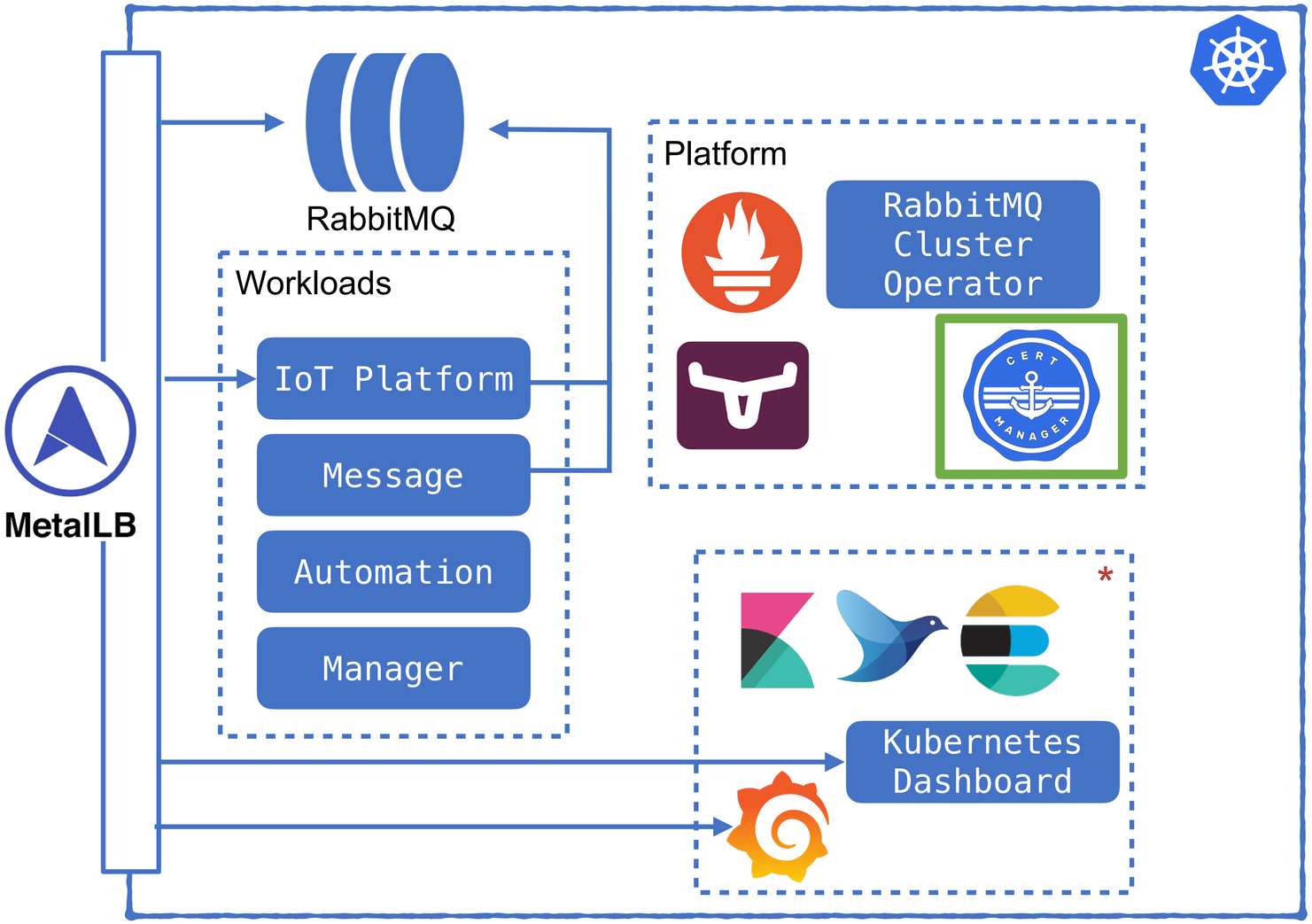
Challenge 4: Certificate Management

Certificate management Lifecycle





Final Implementation



What is installed?

Versions of mentioned tools

v1.20.6+k3s1

v2.4.0 (*Helm chart version*)

v1.1.1 (*Helm chart version*)

v1.3.1 (*Helm chart version*)

Conclusion

- Product
  - Considerations for an on-premise and edge use case
  - Central data aggregation platform using Kubernetes + CNCF projects
    - K3s, *MetalLB*, Longhorn, Cert-manager
- Design challenges along the way
- Four challenges
  - Provisioning, Networking, High Availability and Certificate management

KubeCon | CloudNativeCon
North America 2022

BUILDING FOR THE ROAD AHEAD

DETROIT 2022

Please scan the QR Code above to
leave feedback on this session