



COSCUP 2021

自動化 AIoT 機器學習循環 - Kubernetes

結合 KubeEdge 從雲端擴展至邊緣

蕭亦程 / Yi-Cheng

講者簡介

- NTHU SC Senior
- Cloud and Edge Computing
- High Performance Computing
- Machine Learning
- APAC HPC - AI 2020 Second Award
- ASC 20-21 Champion



Outline

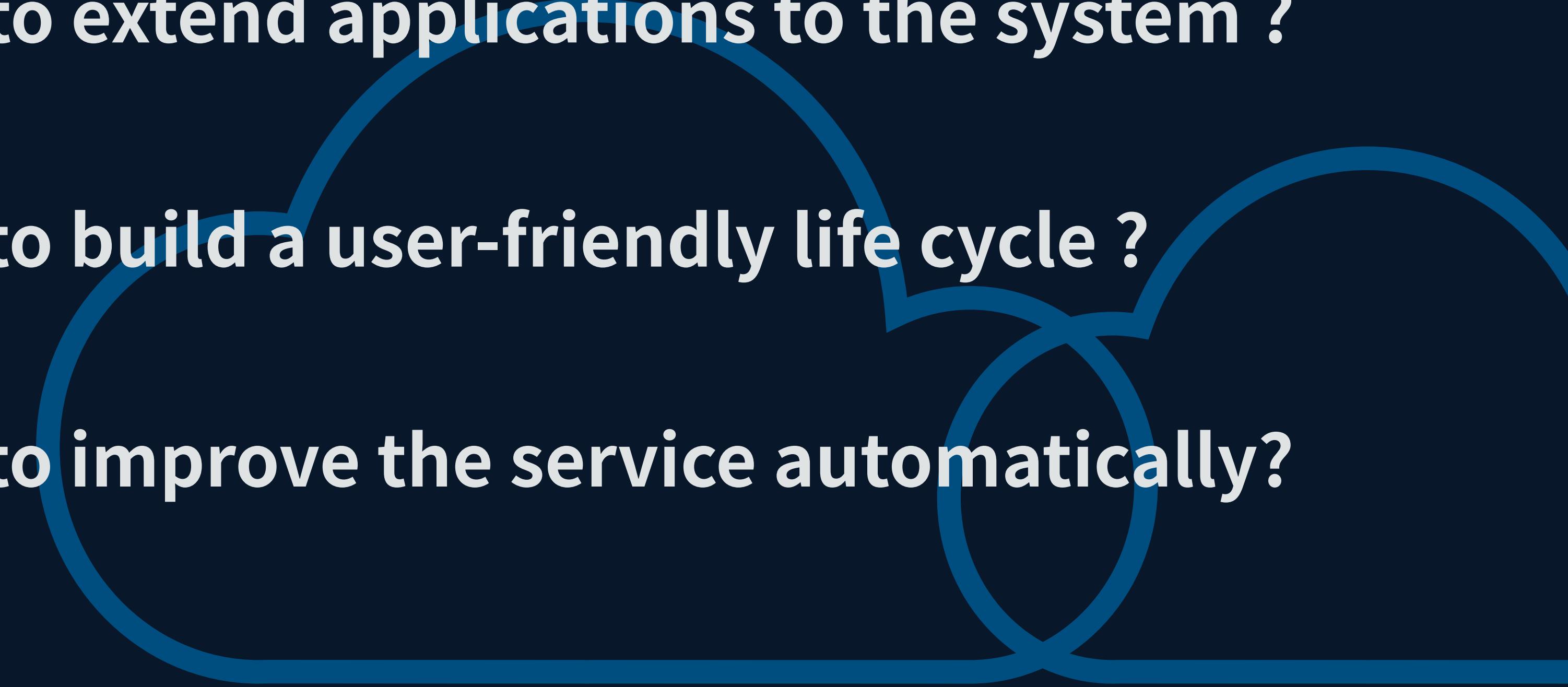
- Cloud computing & Edge computing
- AIoT
- Cloud Native
- Kubernetes
- KubeEdge
- Machine Learning

AI + IoT = AIoT

Artificial Intelligence Internet of Thing

“AIoT is the combination of AI with the IoT to achieve more efficient IoT operations, improve human-machine interactions and enhance data management and analytics.”





Computing resource is enough ?

How to extend applications to the system ?

How to build a user-friendly life cycle ?

How to improve the service automatically?

Challenge



Scalable

Containerized
Microservices



Automatic

Continuous Integration
Continuous Delivery



Heterogenous

Cross platform
(x86 , ARM)

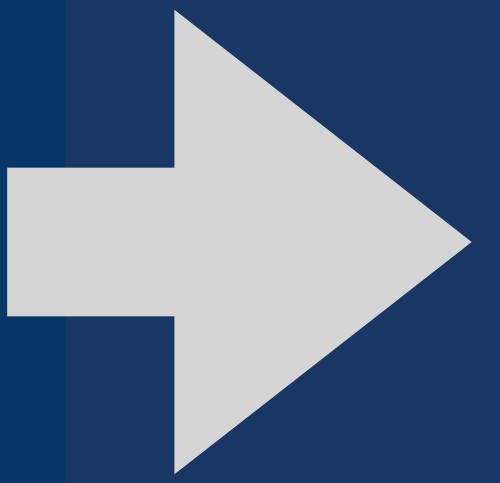
Private / Public / Hybrid
cloud

How to implement ?

Heterogenous

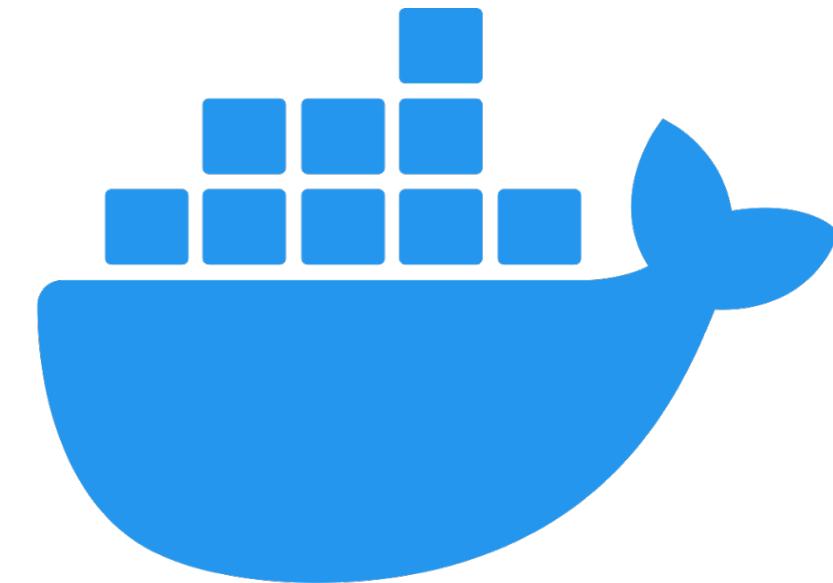


Heterogenous



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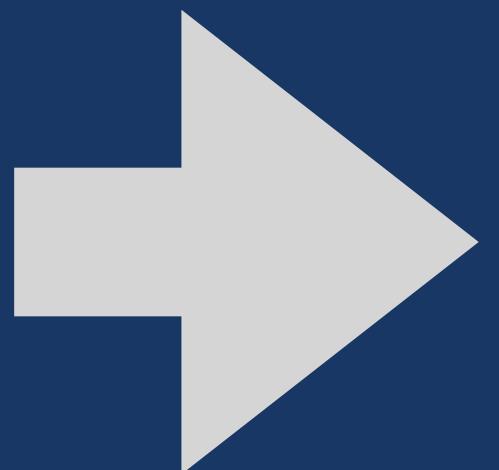


docker®

Scalable



Scalable



Containerized
Microservices



KubeEdge

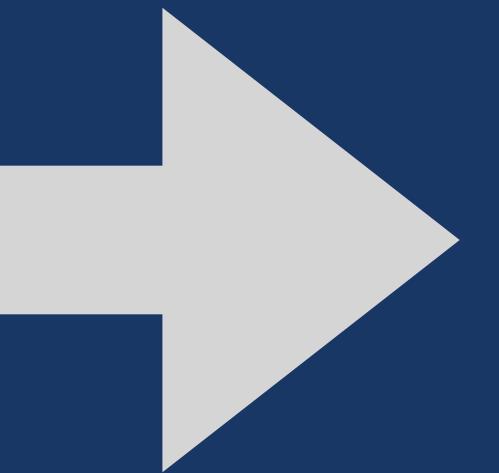


kubernetes

Automatic



Automatic



Continuous Integration

Continuous Delivery

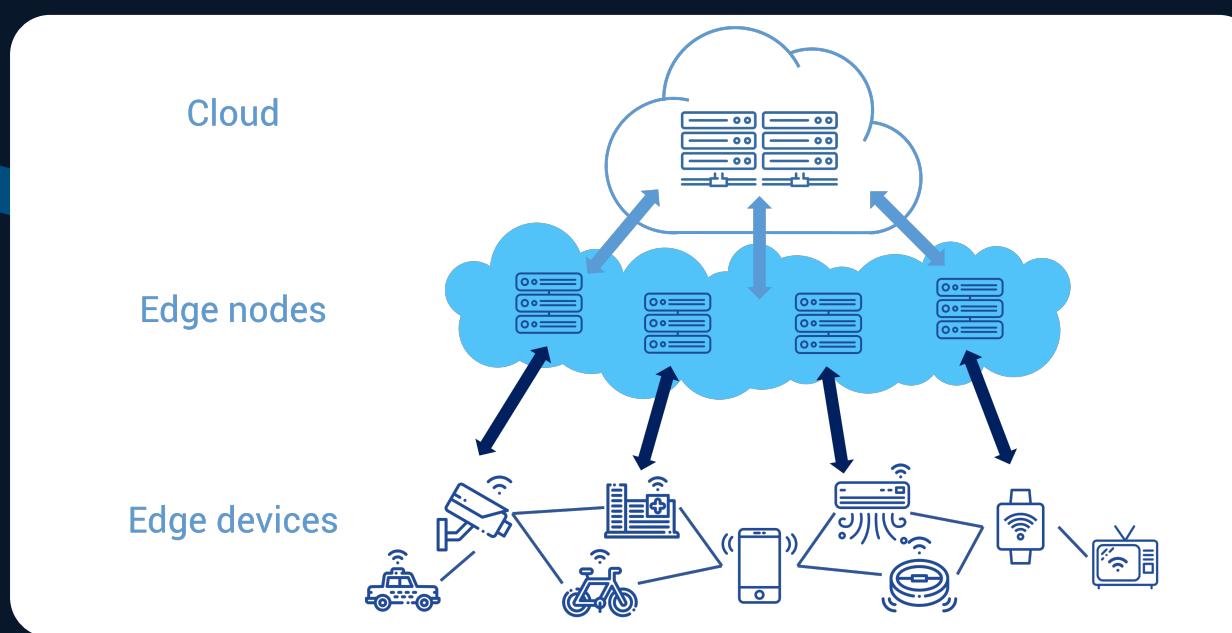


Kube + Edge



The capabilities of K8s

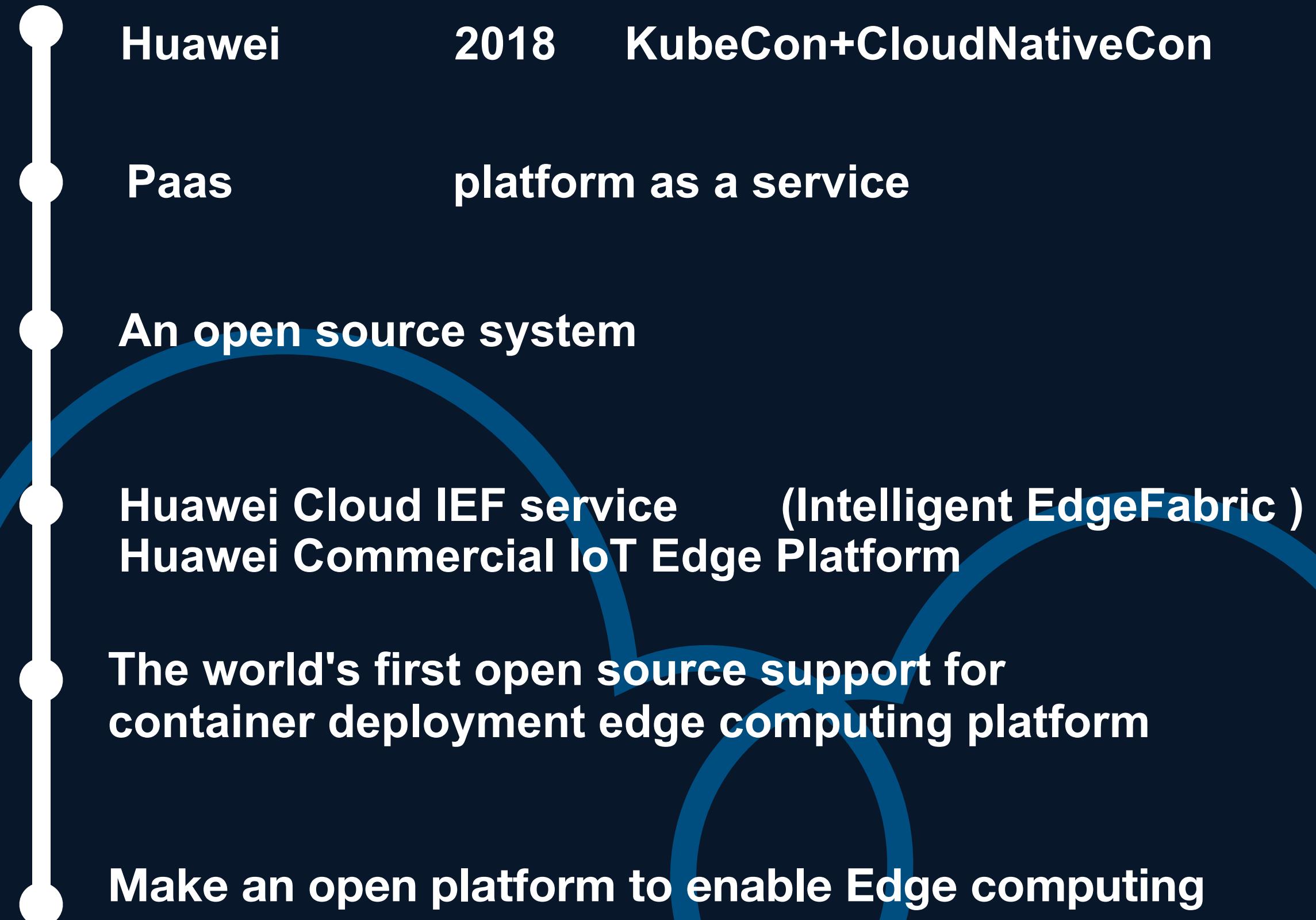
- Container orchestration
- Container scheduling



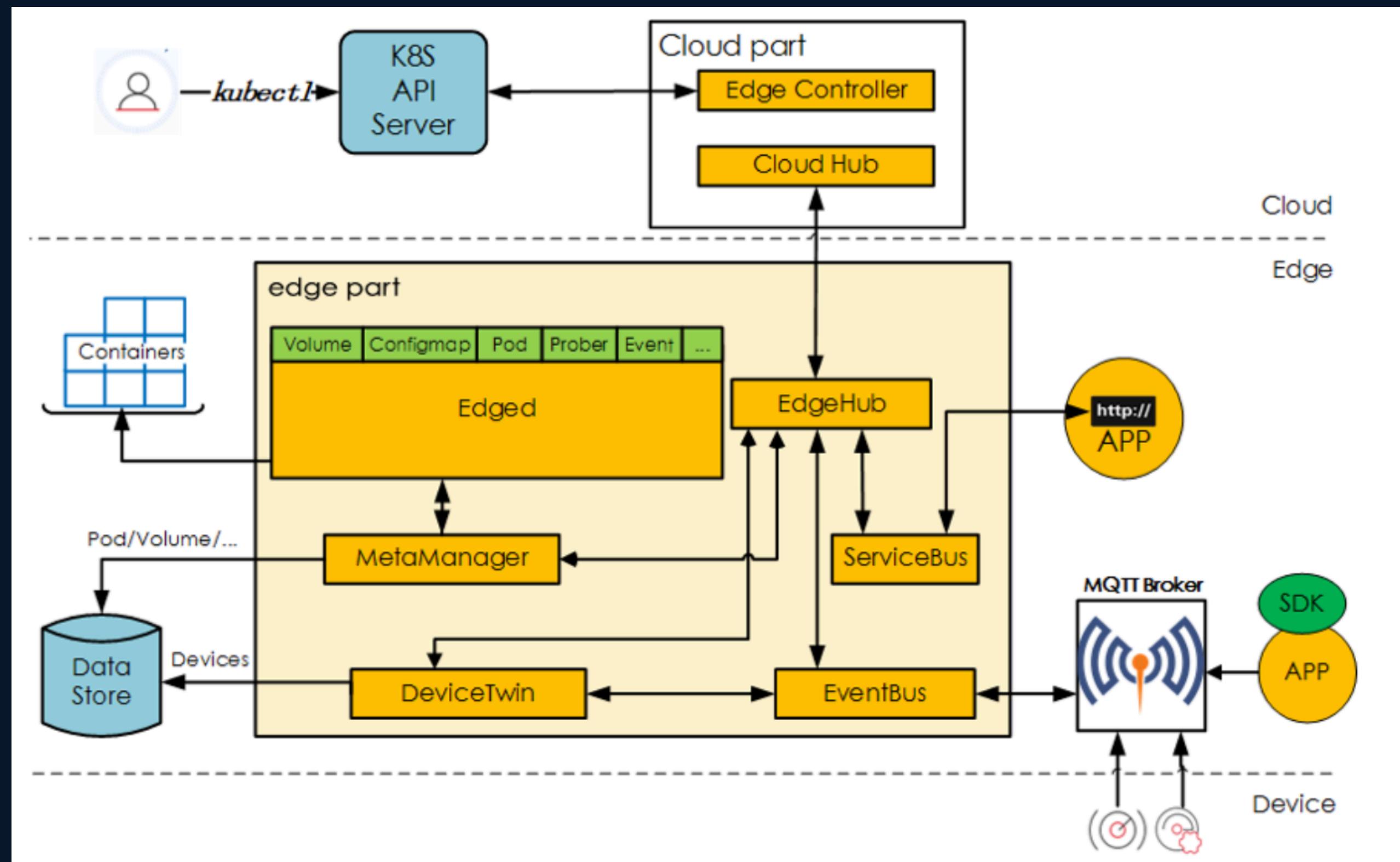
Edge Computing

- Extending to edge

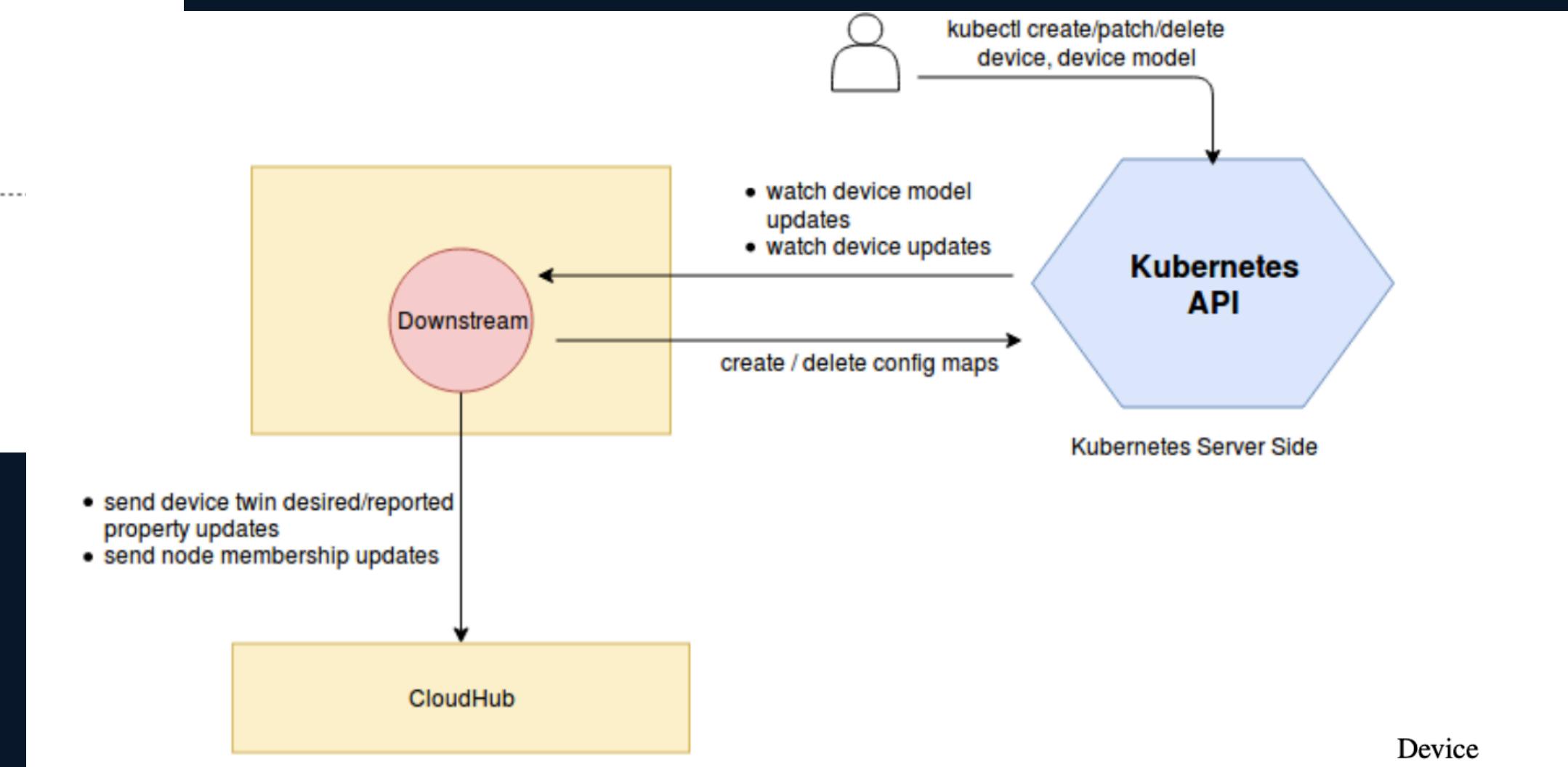
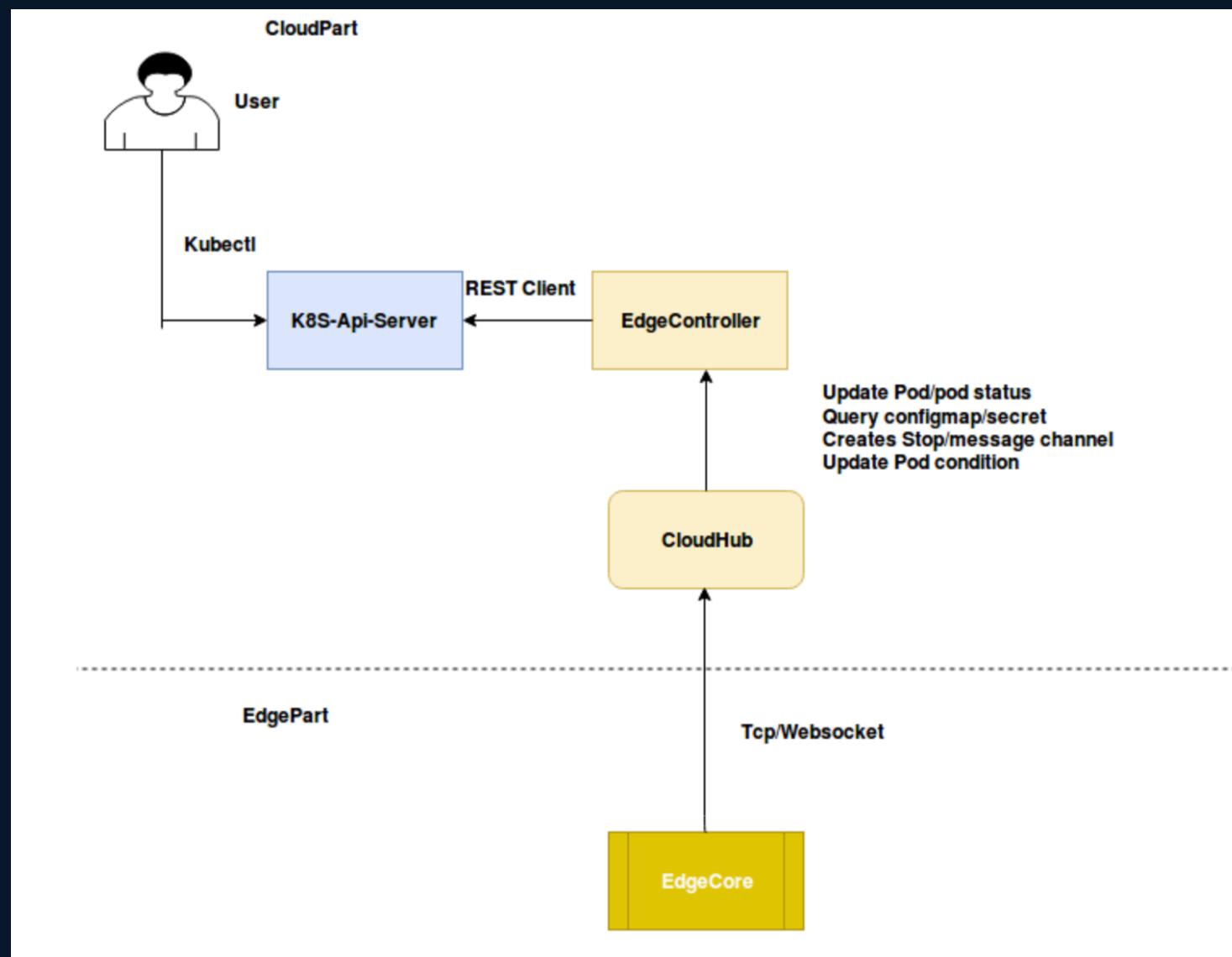
KubeEdge



KubeEdge - framework



KubeEdge

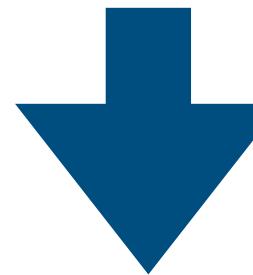


KubeEdge



Kubernetes

deployment and metadata synchronization between cloud and edge.

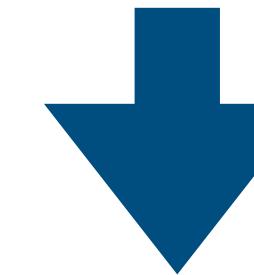


deployment and metadata synchronization between cloud and edge.

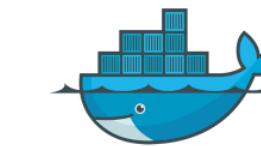


Mosquitto

handle communication channels between IoT devices and cloud services

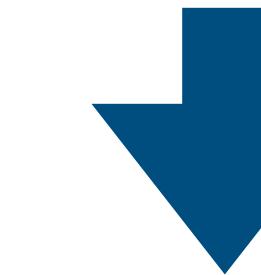


machine-to-machine communication and duplex communication between the edge



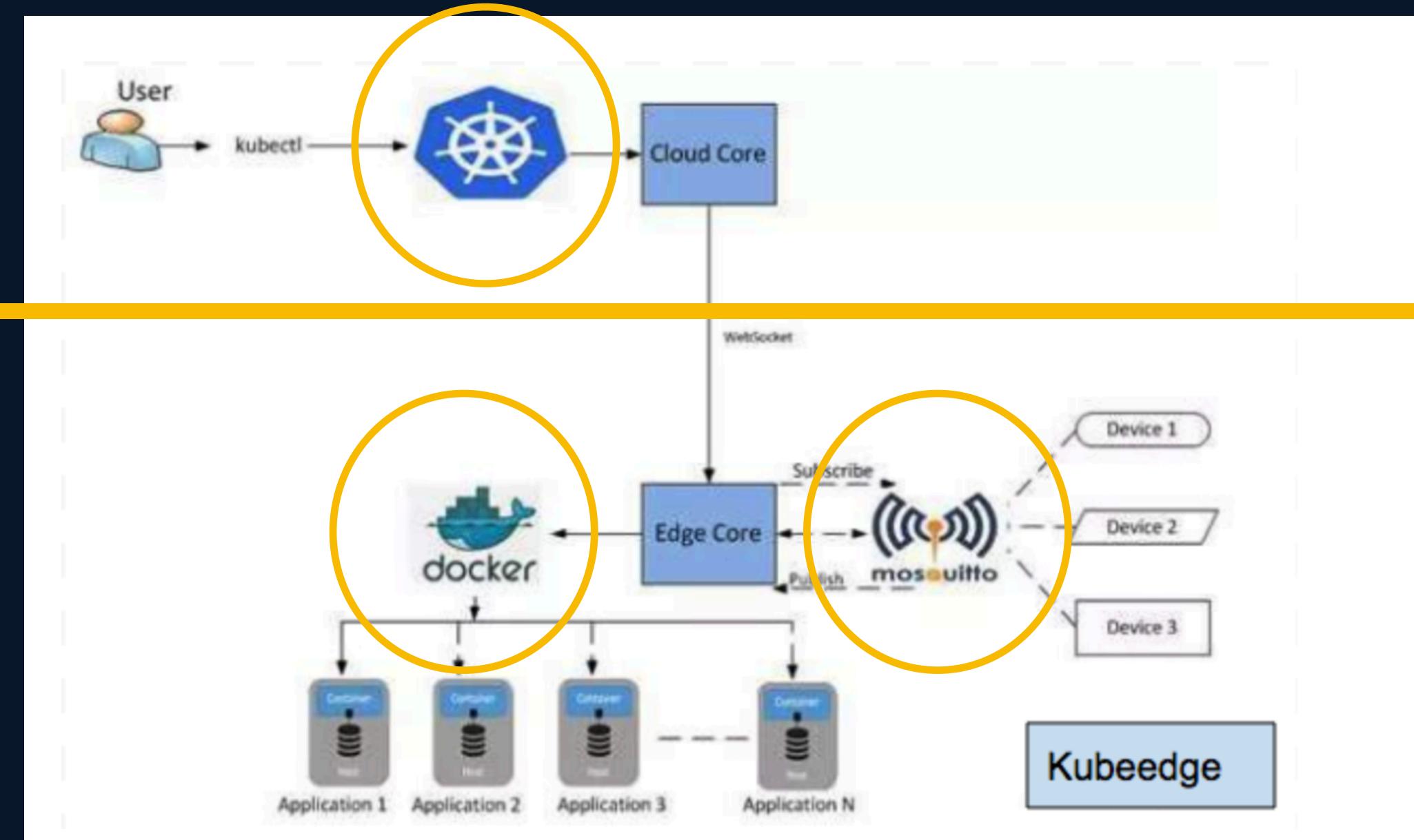
Docker

Building and deploying new applications is faster with containers



system tools and libraries

KubeEdge



Cloud Part

Edge Part

Kubernetes VS KubeEdge

	Kubenetes	KubeEdge
CPU usage	大	小
輕量化	差	佳
叢集架構	中心化	去中心化
邊緣運算	不適合	適合
雲協同的延伸	無	有
支援Mqtt溝通	無	有

KubeEdge - Advantages

Edge Computing

With business logic running at the Edge, much larger volumes of data can be secured & processed locally where the data is produced.

Simplified development

Developers can write regular http or mqtt based applications, containerize.

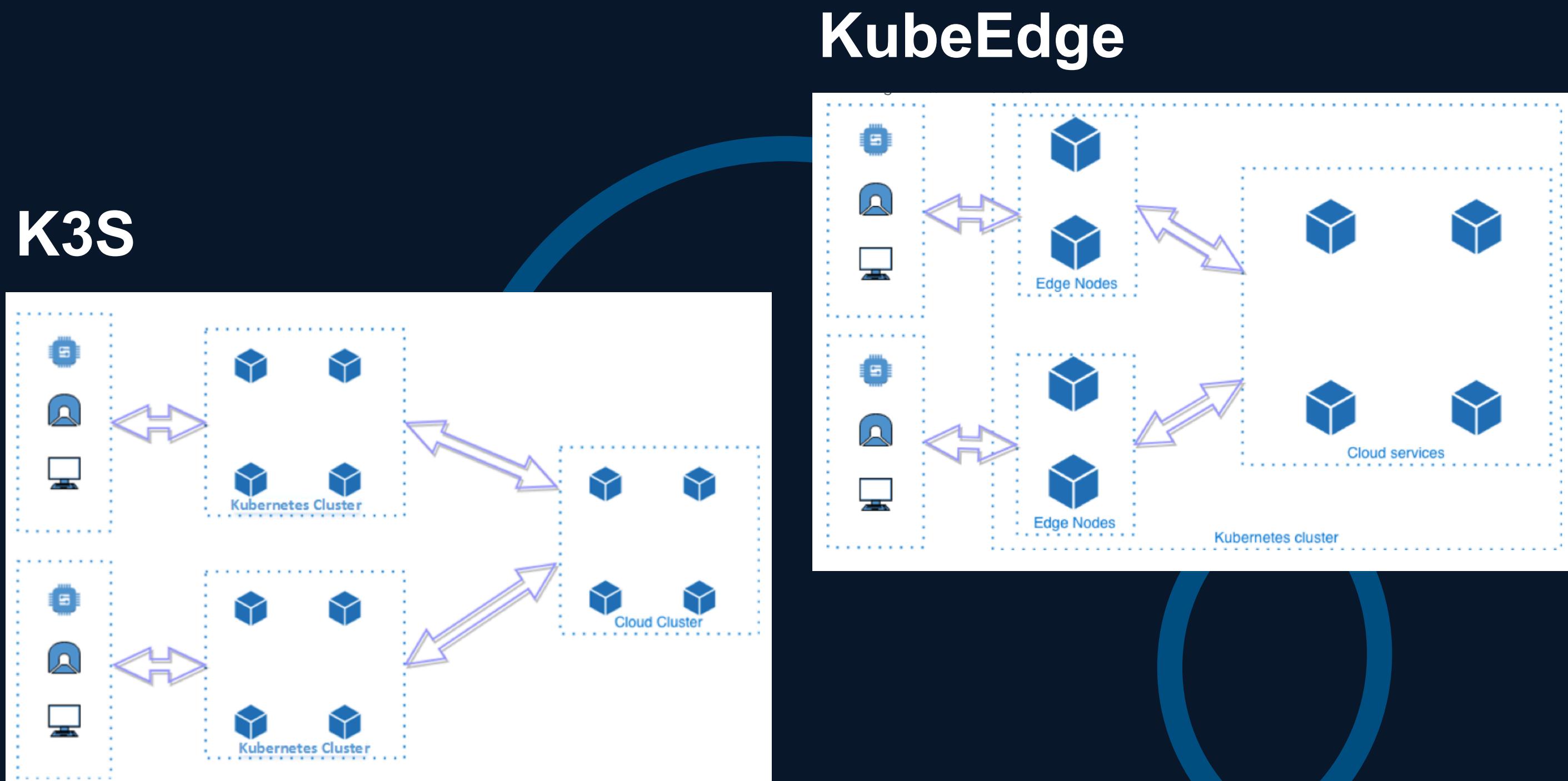
Kubernetes-native support

With KubeEdge, users can orchestrate apps, just like a traditional Kubernetes cluster in the Cloud

Abundant applications

It is easy to get and deploy existing complicated machine learning, image recognition, event processing and other high level applications to the Edge.

KubeEdge vs. K3S



Challenge



Scalable

Containerized
Microservices



Automatic

Continuous Integration
Continuous Delivery



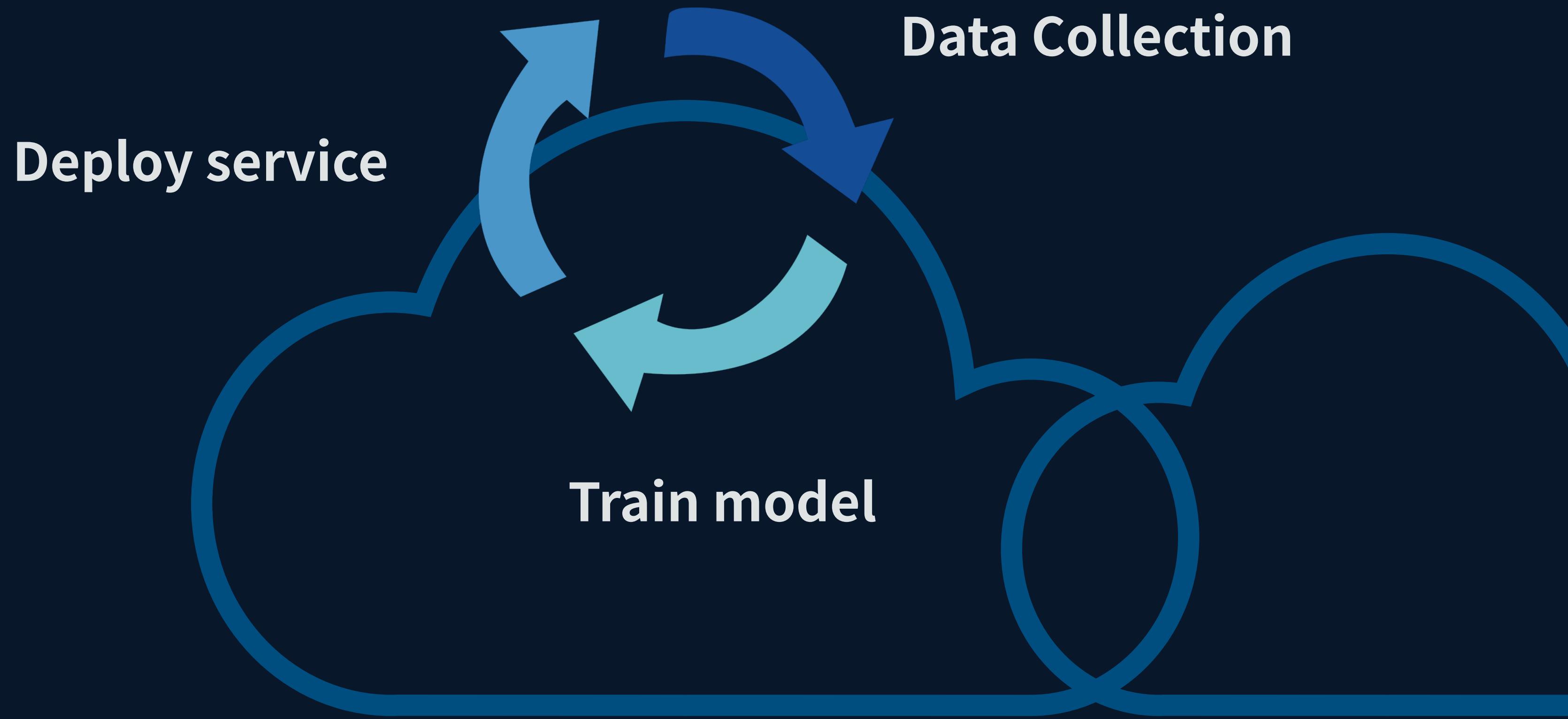
Heterogenous

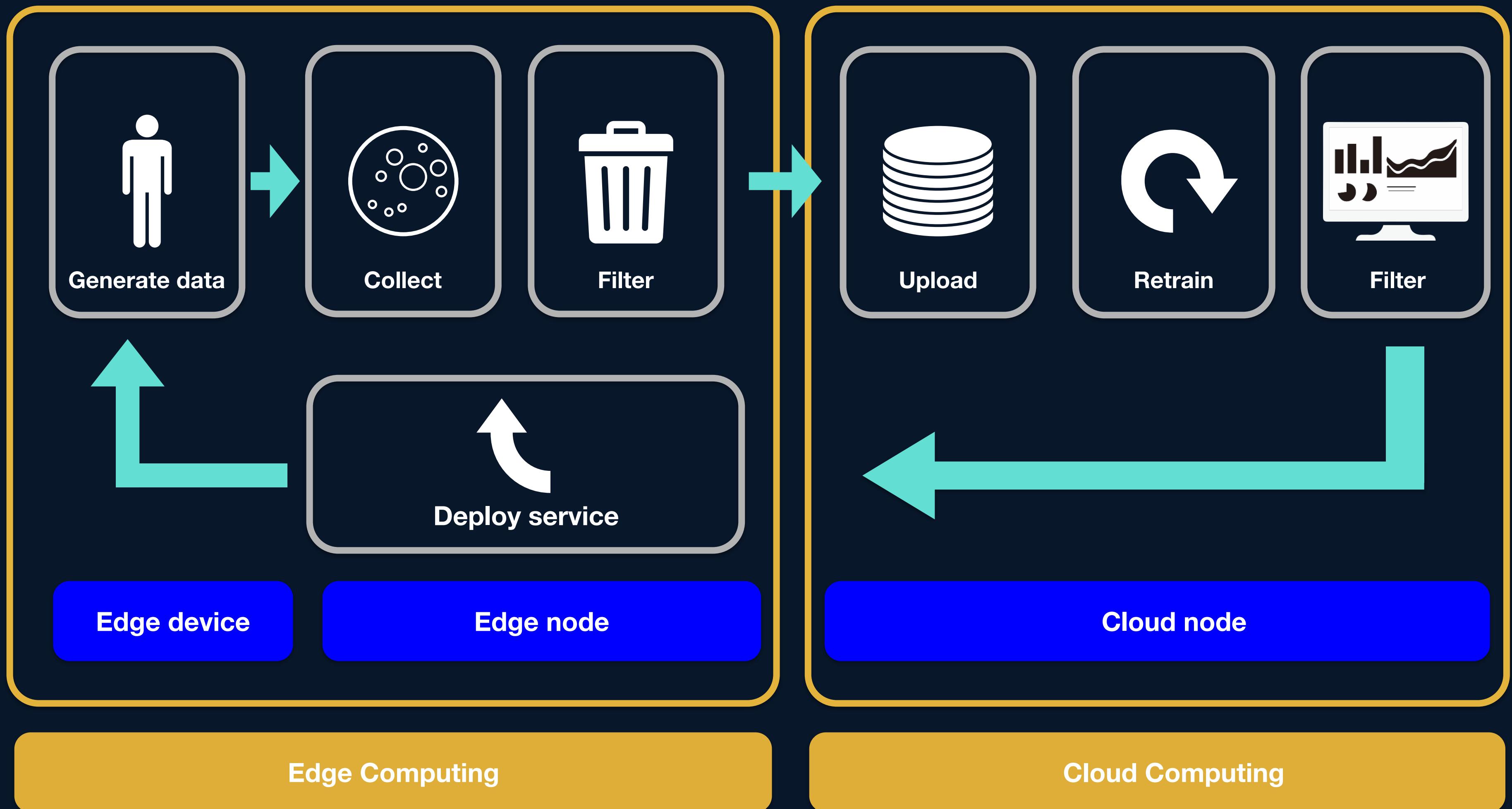
Cross platform
(x86 , ARM)

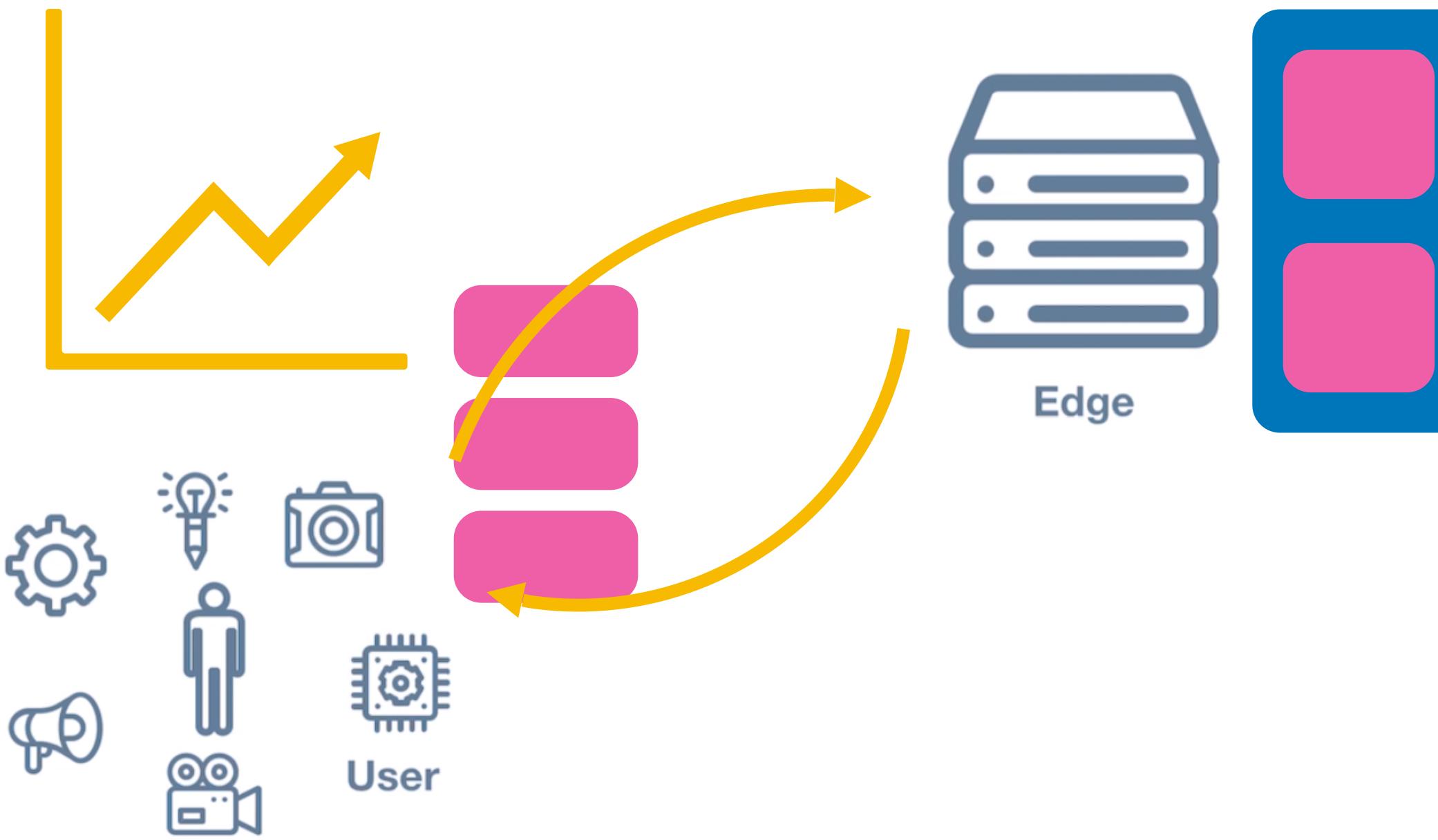
Private / Public / Hybrid
cloud

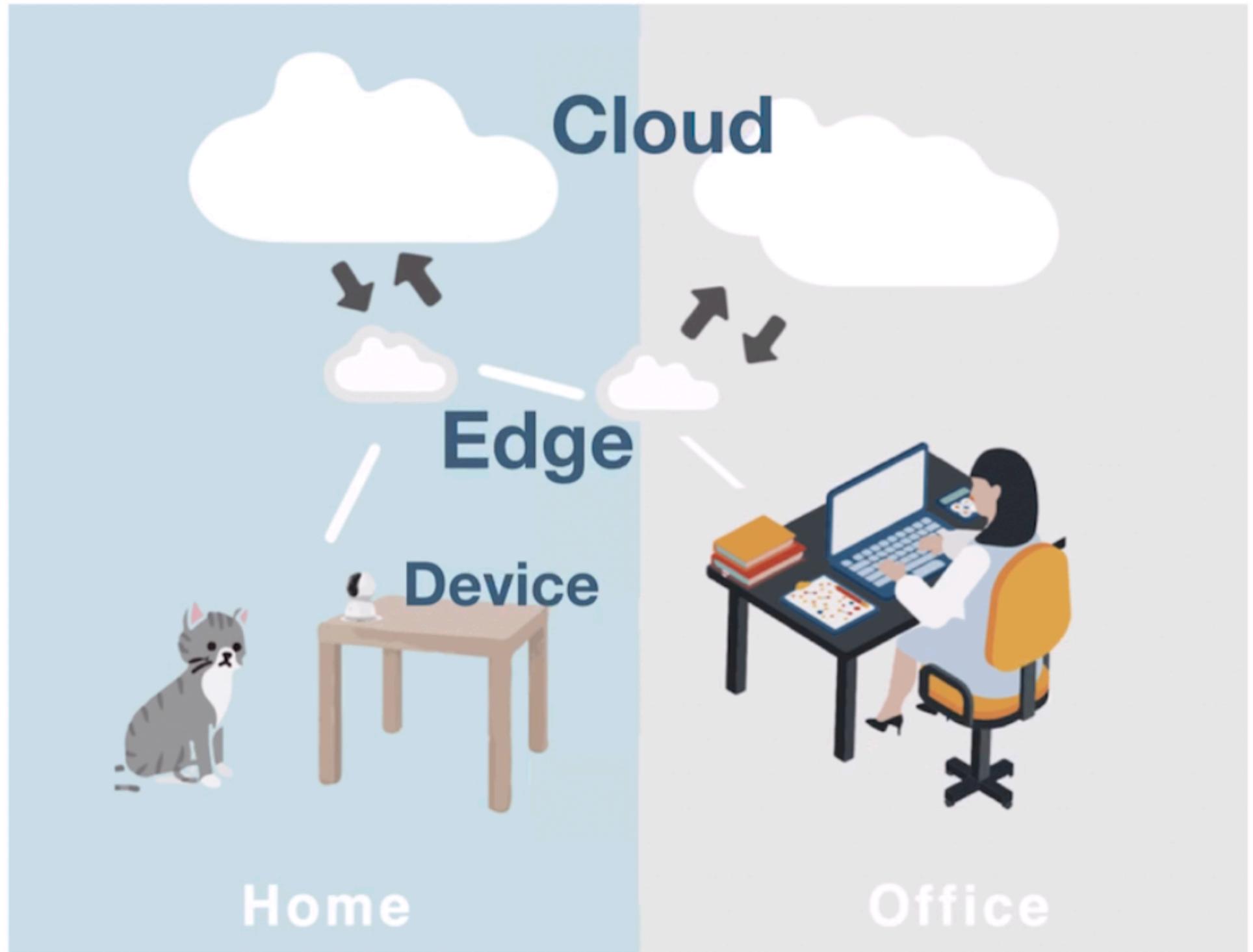
How to implement ?

End to end ML pipeline life cycle



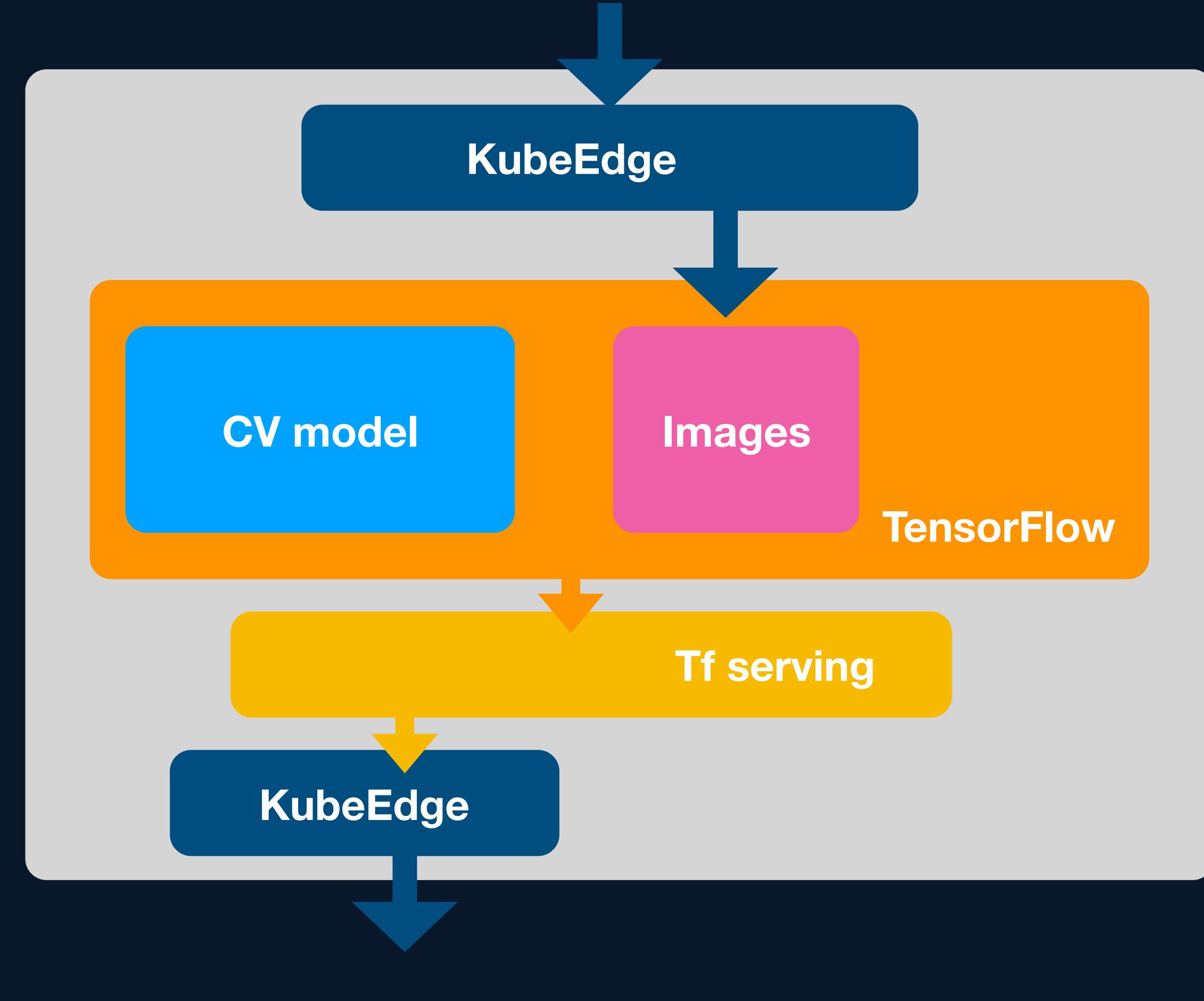






Watchman





TensorFlow

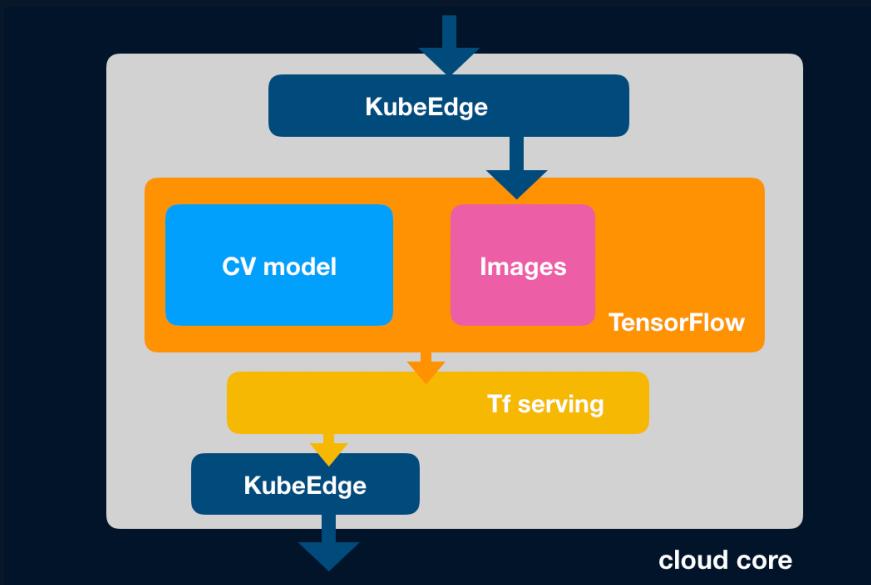
Model Training

Tf serving

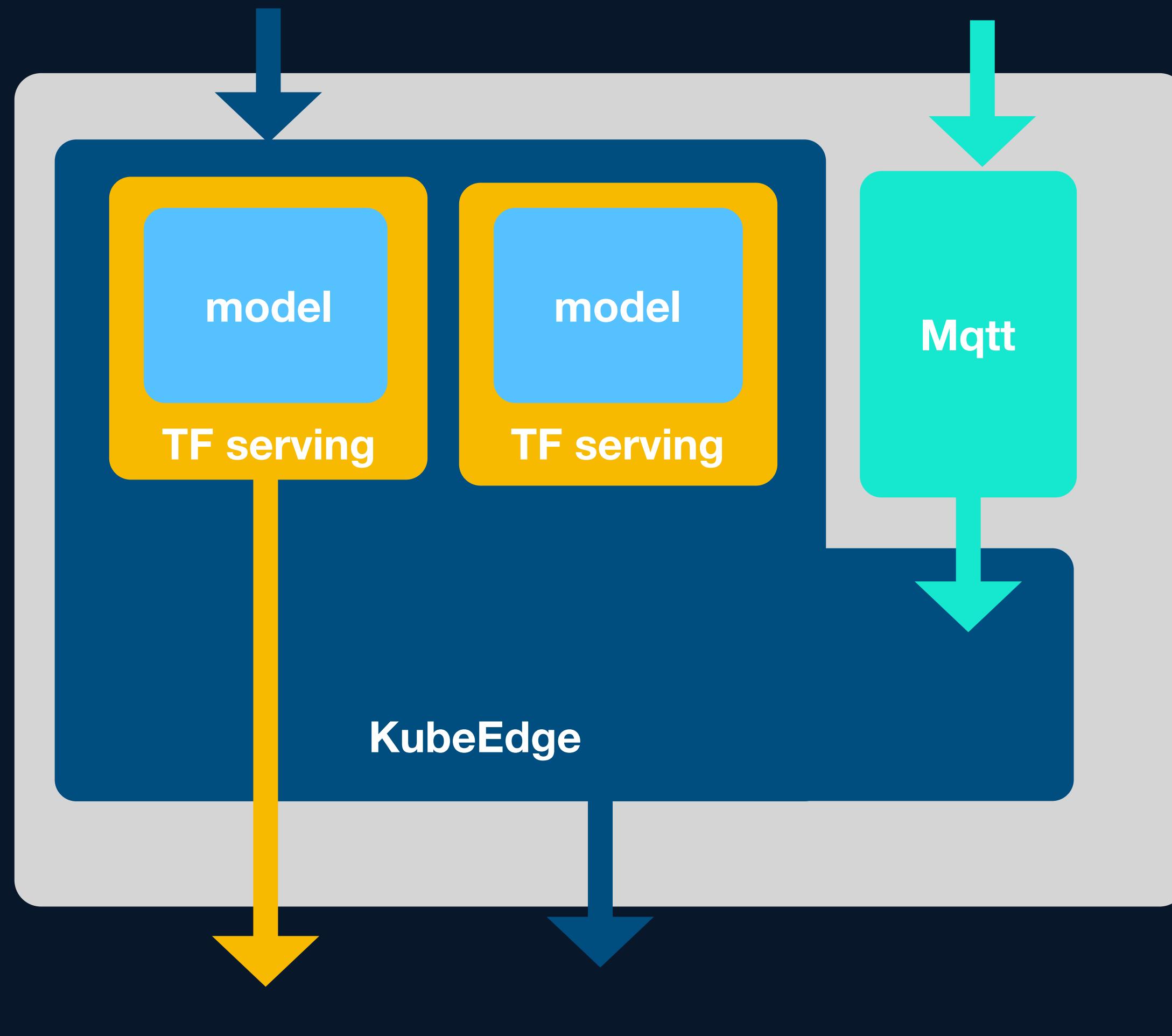
Model Deploying

KubeEdge

Service Communication with Edge node



Cloud node



TF serving

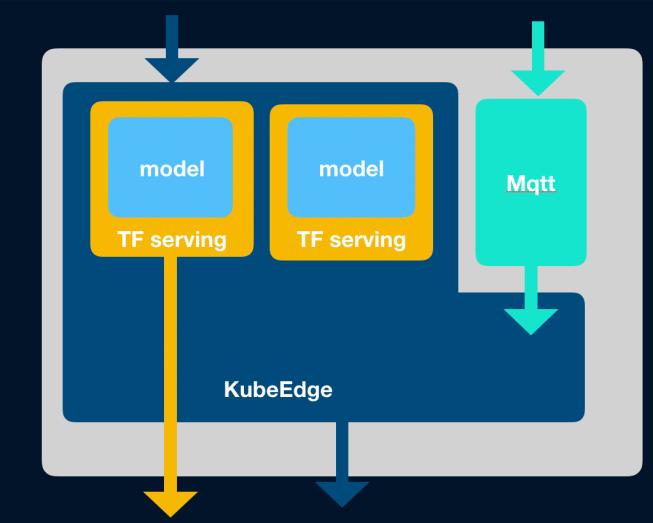
Model Inference

Mqtt

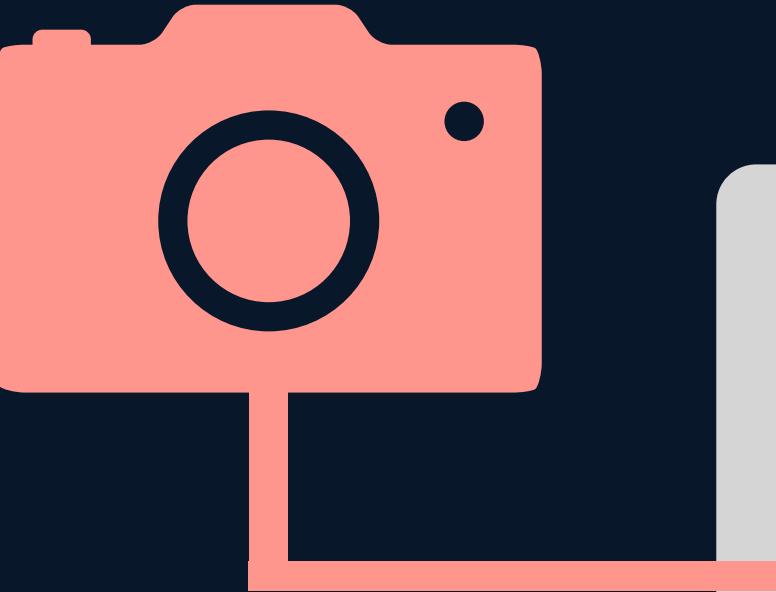
Data sending with Edge device

KubeEdge

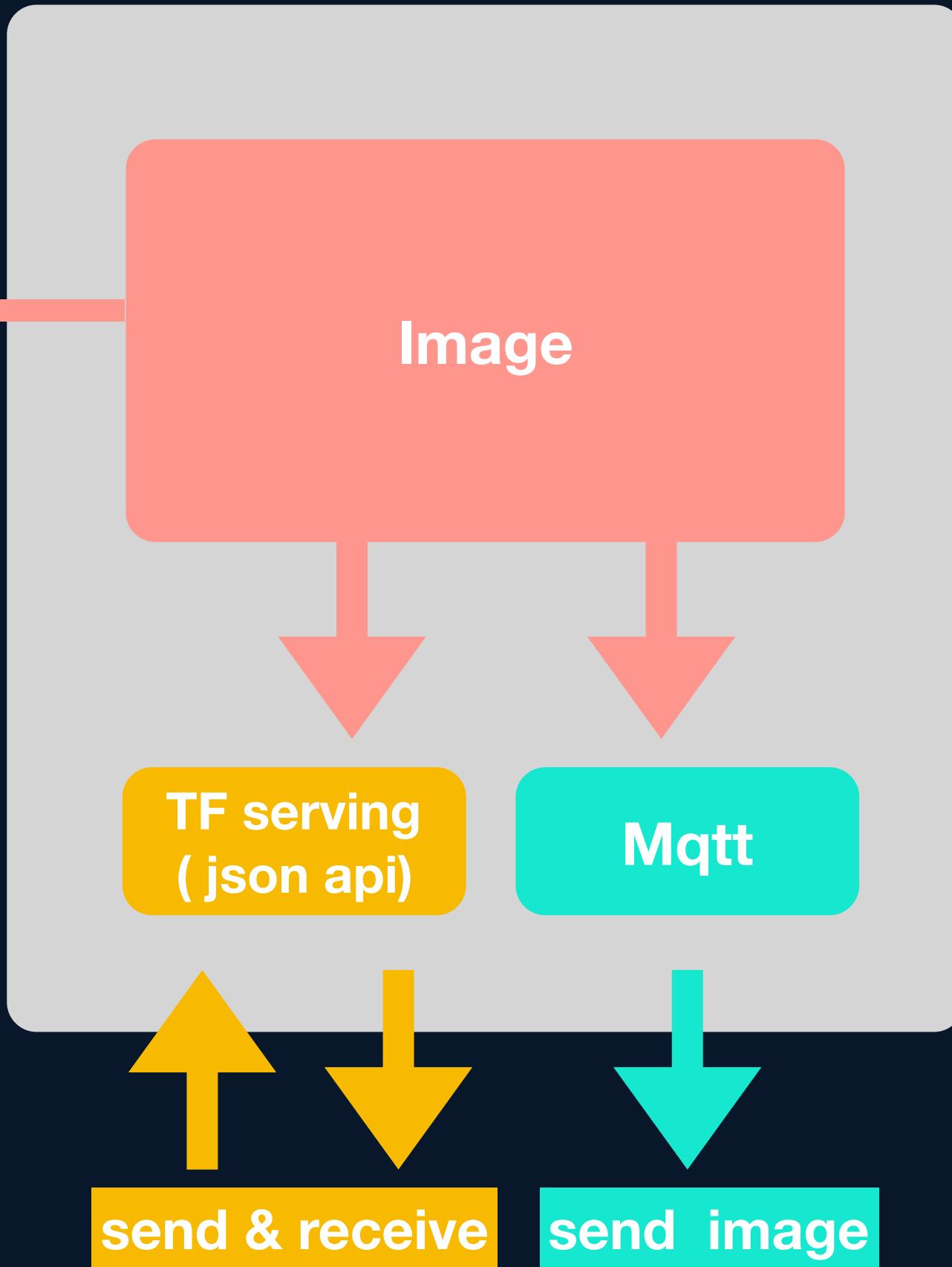
Service Communication with Cloud node



Edge node



USB camera



Edge device

Image

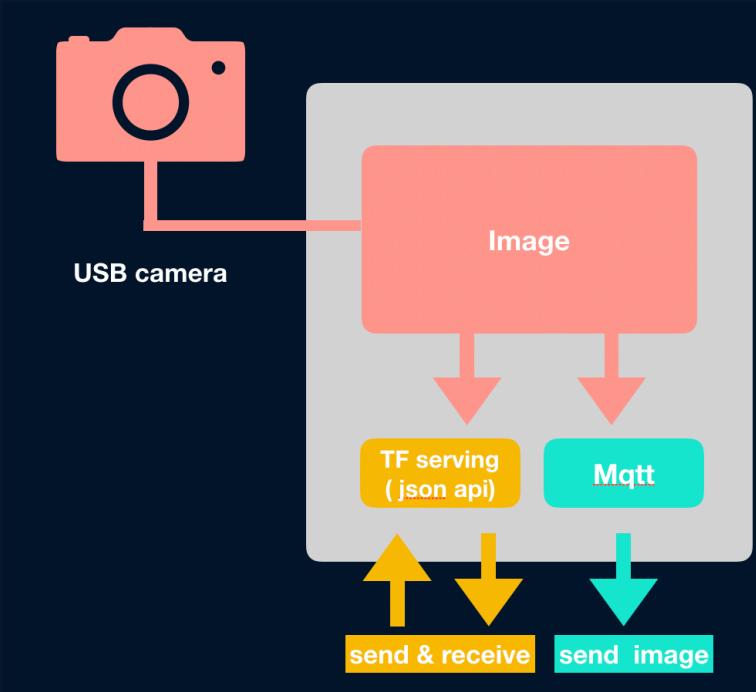
User data

Mqtt

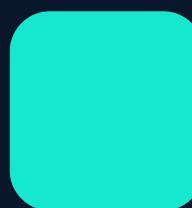
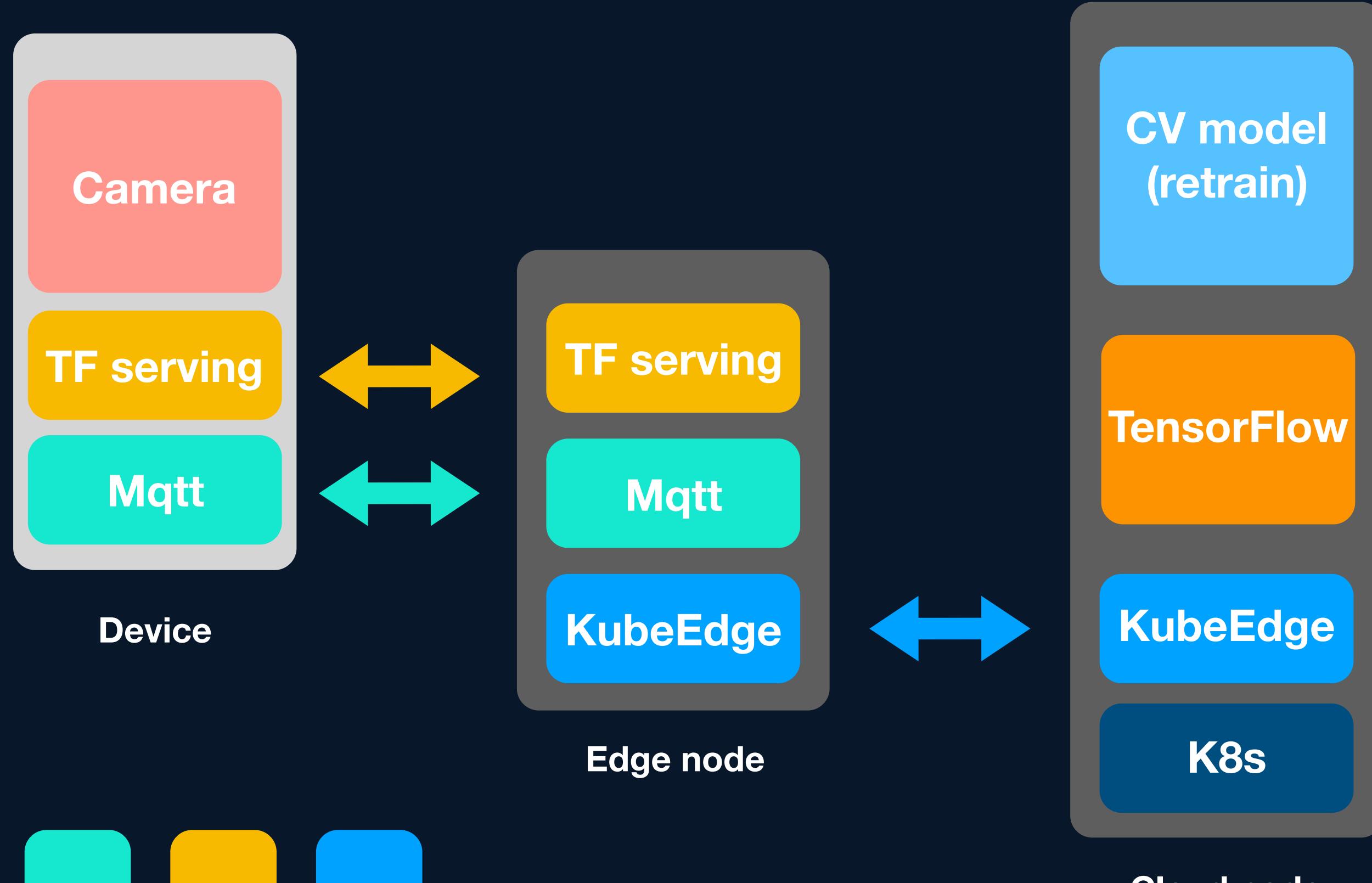
Data sending with Edge node

TF serving
(json api)

User service



Edge device



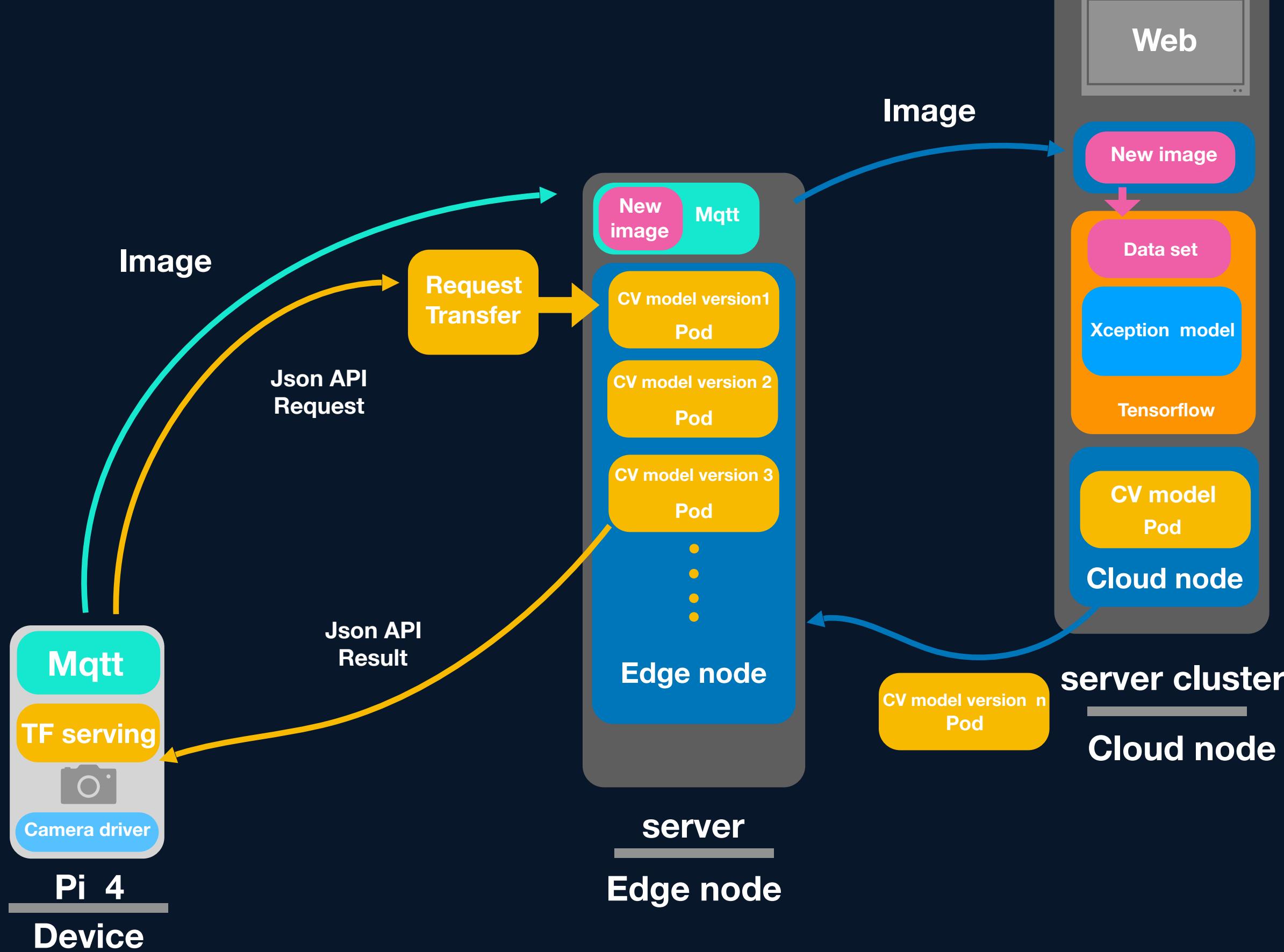
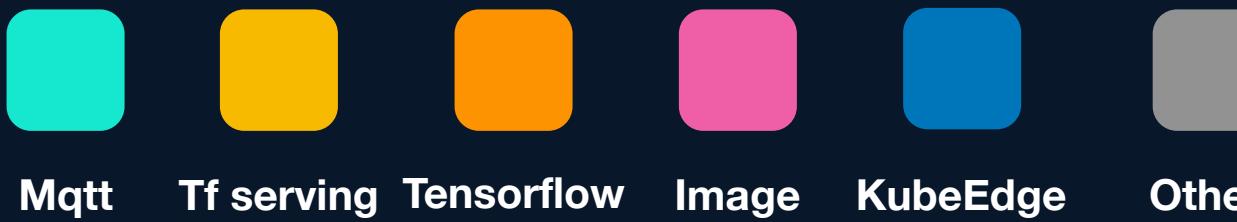
照片



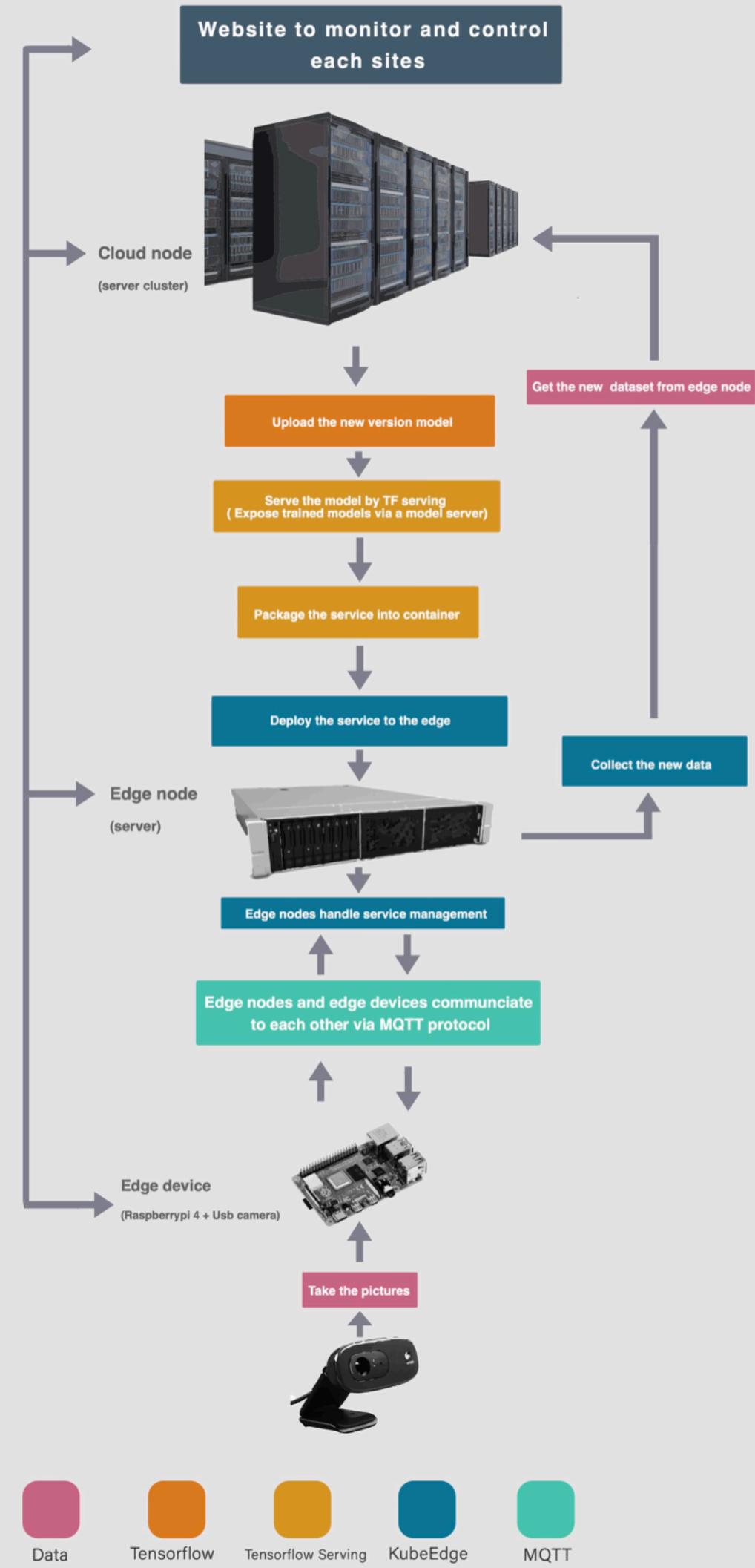
辨識



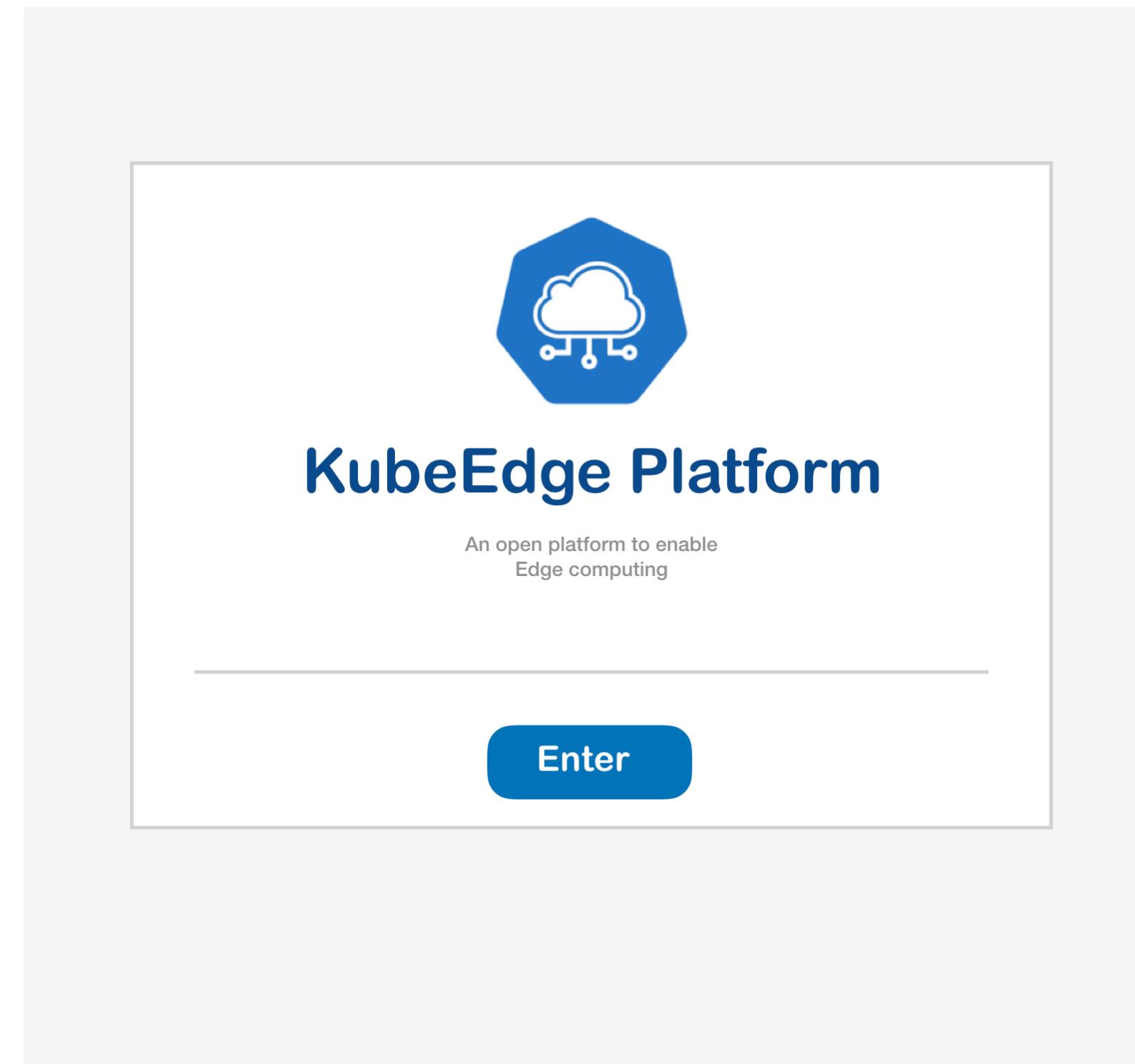
搜集的新照片



Flow chart



AIoT Platform Website



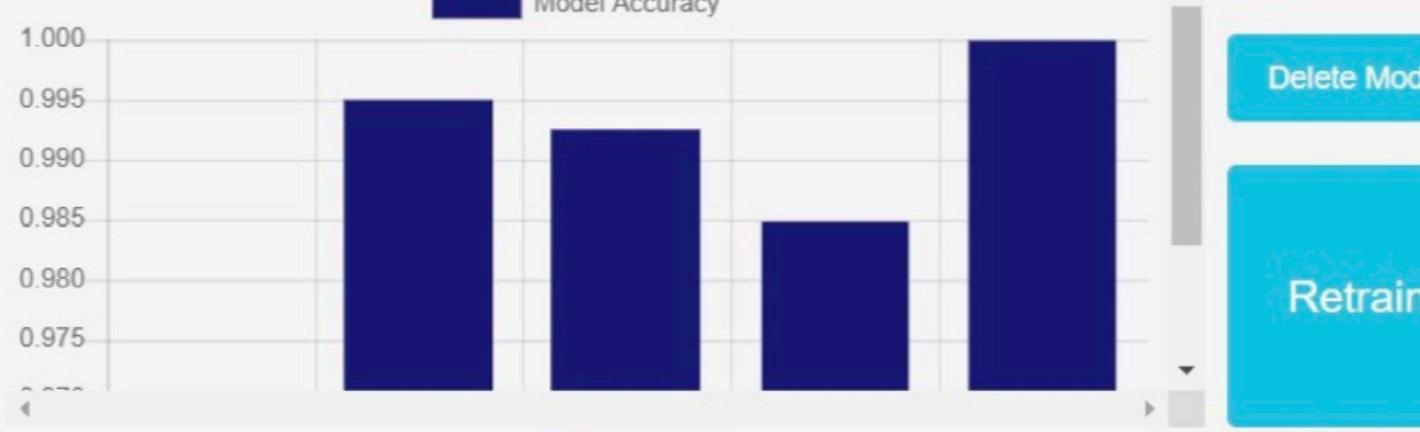
The image shows a placeholder for a website, featuring a central white rectangular box with rounded corners. Inside this box is a blue hexagonal icon containing a white cloud with network connections. Below the icon, the text "KubeEdge Platform" is displayed in a large, bold, dark blue font. Underneath that, a smaller line of text reads "An open platform to enable Edge computing". At the bottom of the white box is a blue button with the word "Enter" in white. The entire white box is set against a light gray background.

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Version 3

Model Version	Deploy Time
Version 3	2020-11-03 12:21:31
Version 4	2020-11-03 12:20:25
Version 5	2020-11-01 12:57:08

Model Accuracy



Deploy:	<input type="text"/>	Deploy	Delete:	<input type="text"/>	Delete
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Name	Accuracy	Dog_data_num	Cat_data_num	Train Time
Version 5	1.0000	203	201	2020-11-02 17:05:17
Version 4	0.9849	203	201	2020-10-31 16:48:31
Version 3	0.9925	203	201	2020-10-31 16:20:43
Version 2	0.995	200	200	2020-10-31 12:33:26
Version 1	0.9612	200	200	2020-10-31 12:32:52



Take Picture!
 Dog or Cat ▾
Label

Name	Dog	Cat	Classify	Time
11_13_18_9_26.jpg	0.999999523	0.000000449721256	Dog	2020-11-18 12:21:31
11_13_18_8_31.jpg	0.999999523	0.000000459681928	Dog	2020-11-18 12:20:25
11_13_18_4_11.jpg	0.999999523	0.00000047877694	Dog	2020-11-18 12:57:08
11_13_18_1_11.jpg	0.999999523	0.000000511206281	Dog	2020-11-03 12:21:31



Take Picture!

Dog or Cat

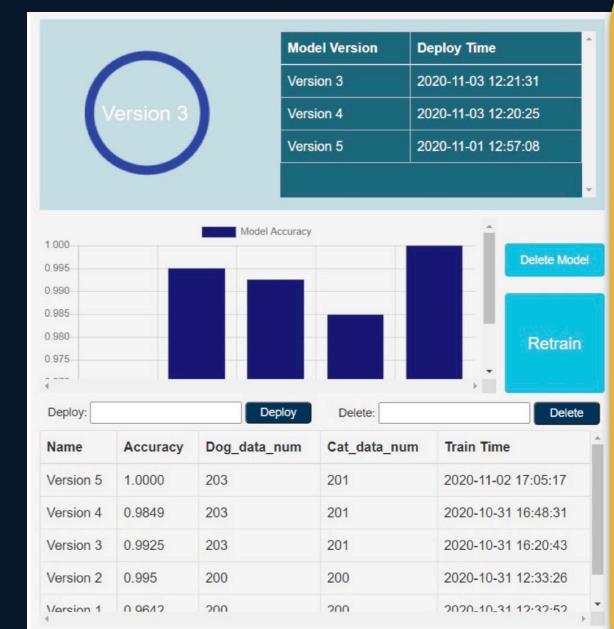
Label

Name	Dog	Cat	Classify	Ti
11_13_18_9_26.jpg	0.999999523	0.000000449721256	Dog	20 11 18
11_13_18_8_31.jpg	0.999999523	0.000000459681928	Dog	20 11 18
11_13_18_4_11.jpg	0.999999523	0.00000047877694	Dog	20 11 18
11_13_18_1_11.jpg	0.999999523	0.000000511206281	Dog	20 11 18

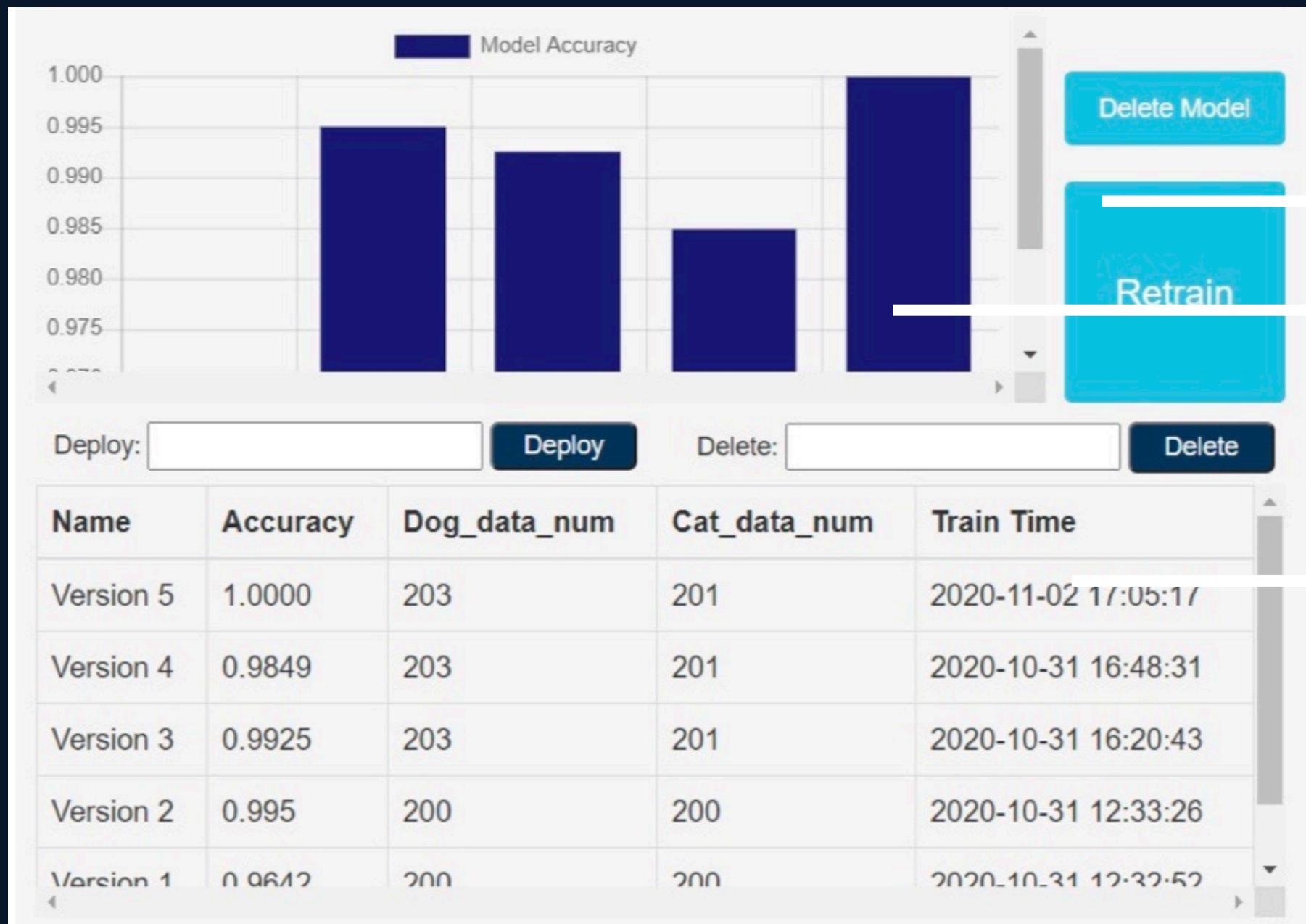
Image

控制 edge device
人工檢閱收集回來的 data

Data 資料細節



Cloud Node

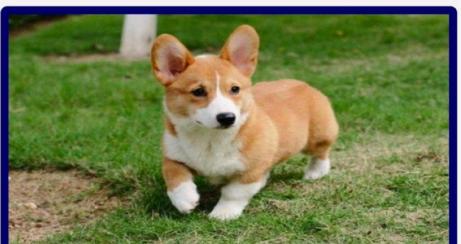
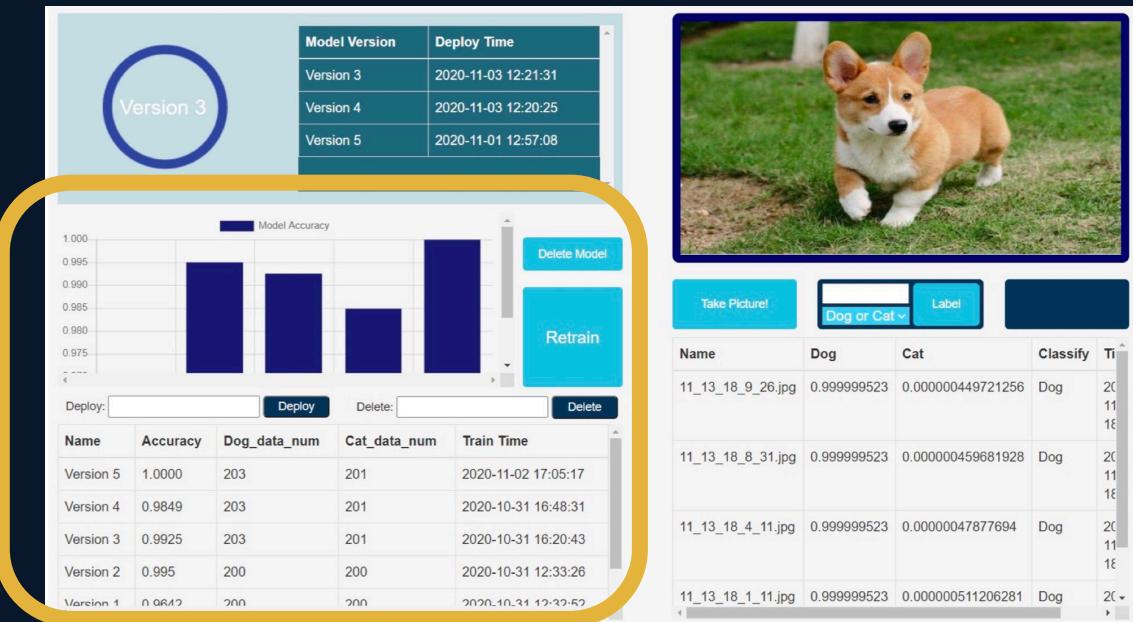


Model Training

Model accuracy 分析

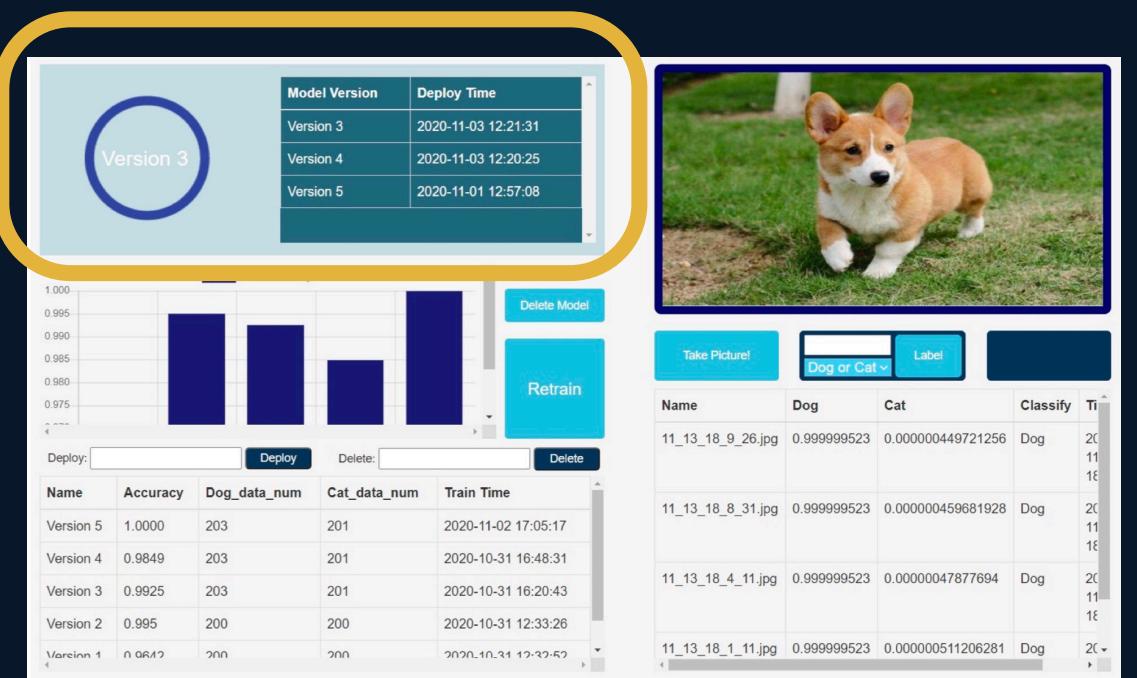
Model 資料細節

Edge Node



The diagram illustrates the deployment of a machine learning model from a central service to an edge device. A large blue circle at the bottom right represents the "Edge device". A white arrow points from the central service interface to the edge device, labeled "Model service 部署版本" (Deployed Model Version). The central service interface shows a table of deployed models:

Model Version	Deploy Time
Version 3	2020-11-03 12:21:31
Version 4	2020-11-03 12:20:25
Version 5	2020-11-01 12:57:08



Edge device

For AI

1. 資料收集

資料來源為邊緣設備拍攝出來的圖片，自動上傳至邊緣端，當邊緣端將圖片辨識後，再自動上傳至雲端，即可當作訓練一個模型的training data。

2. 訓練模型

當雲端蒐集到一定數量的圖片後，即可開始訓練模型，利用驗證集以及評估指標留下表現最佳的模型。

3. 部署

利用此AIoT的平台，能自動部署，由於是利用容器化的技術，不受限於單一的作業環境，方便不屬於各種邊緣設備上，除此之外也能利用排成調度來選擇你所需要的服務來調度container有相當高彈性。

For Platform

1. 更貼近使用者

在AIoT的架構下，將原本單一的雲端平台分為較貼近使用者的邊緣端及 雲端。

邊緣端為AIoT服務的主要運算者，目的是分散原本單一的雲端平台中雲端所執行的運算量，並且由於位置較接近使用者，傳輸速率較快，能為使用者提供更快速的服務。

2. 有效利用雲與邊的優勢

在雲數據中心設備的運算能力較好原因下，可以處理龐大的數據量，藉由使用者回傳的數據中逐漸訓練出越來越貼近使用者需求的服務，我們在雲端利用邊緣設備的資料訓練並產生新的模型，如此一來模型的準確率會逐漸提高。

3. 將服務從雲端延伸到邊緣

在架構的選擇上，我們所選擇的是KubeEdge作為我們延伸至邊緣端的技術，主要為KubeEdge相較於Kubernetes更適合作為邊緣的架構選擇。

For Users

1. 不斷的服務提升

使用者在邊緣設備上的使用，除了提供資料外，由於邊緣端不斷的更新，提供了新的服務及更高準確率的技術。

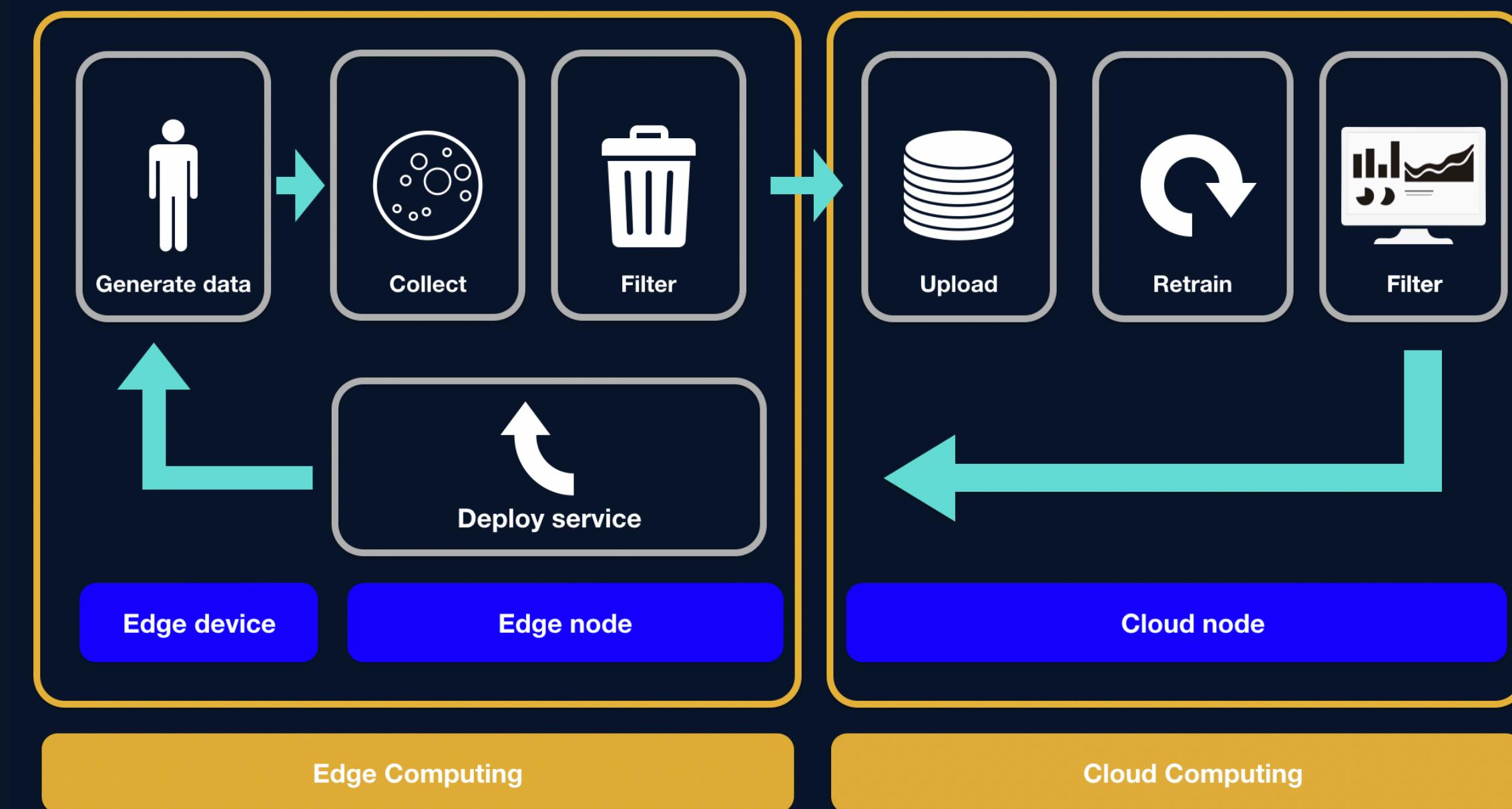
2. 檢視訓練集的控制

使用者能夠藉由網頁的操作，將圖片做分類，當辨識結果不如預期時能控制雲端將模型重新訓練。

3. 選擇不同的服務

使用者能自由選擇模型版本來做部署。

End to end ML pipeline life cycle





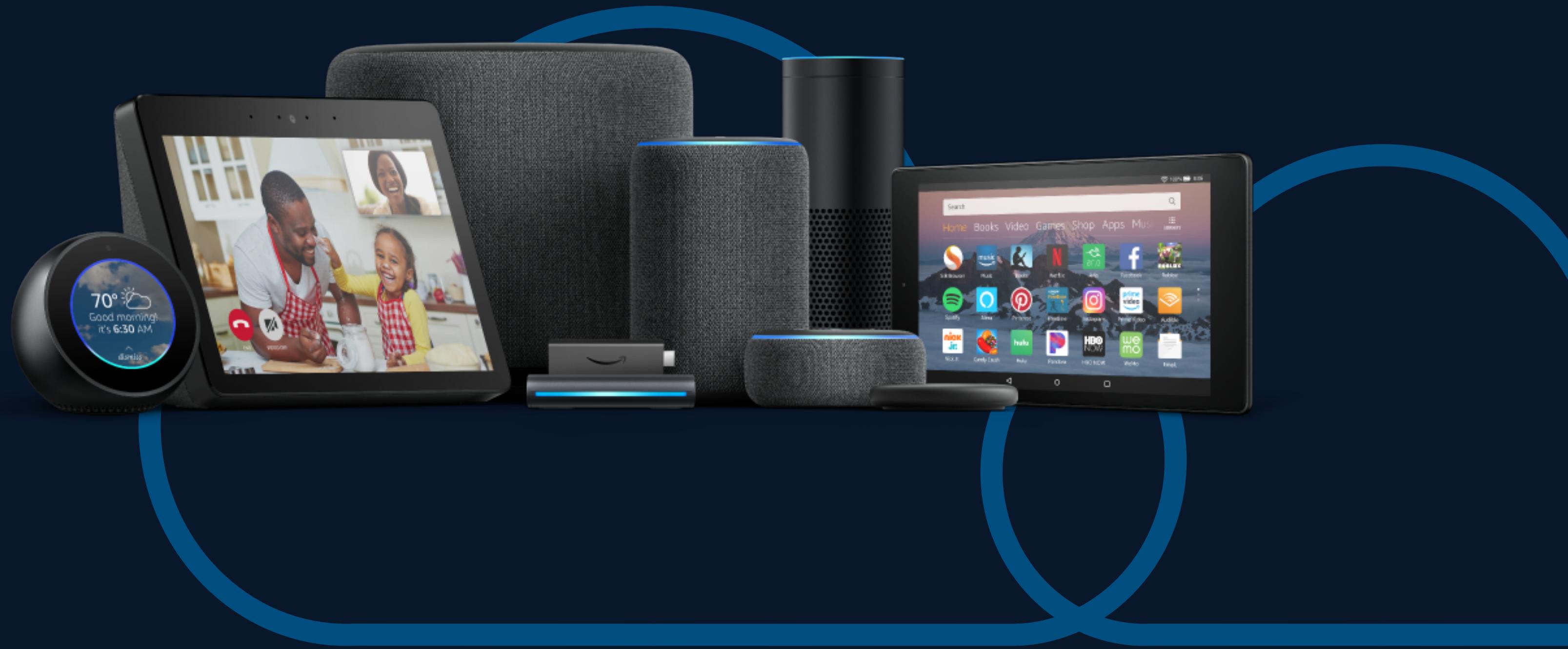
End to end ML pipeline

which



empowered Edge computing

Real World Situation



AIoT Platform others application



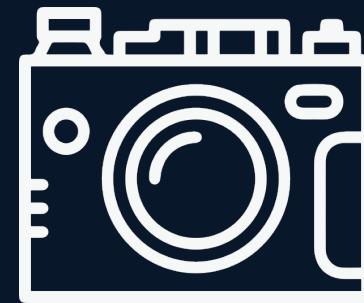
Air Monitor



Domotics



Streaming



Watchman

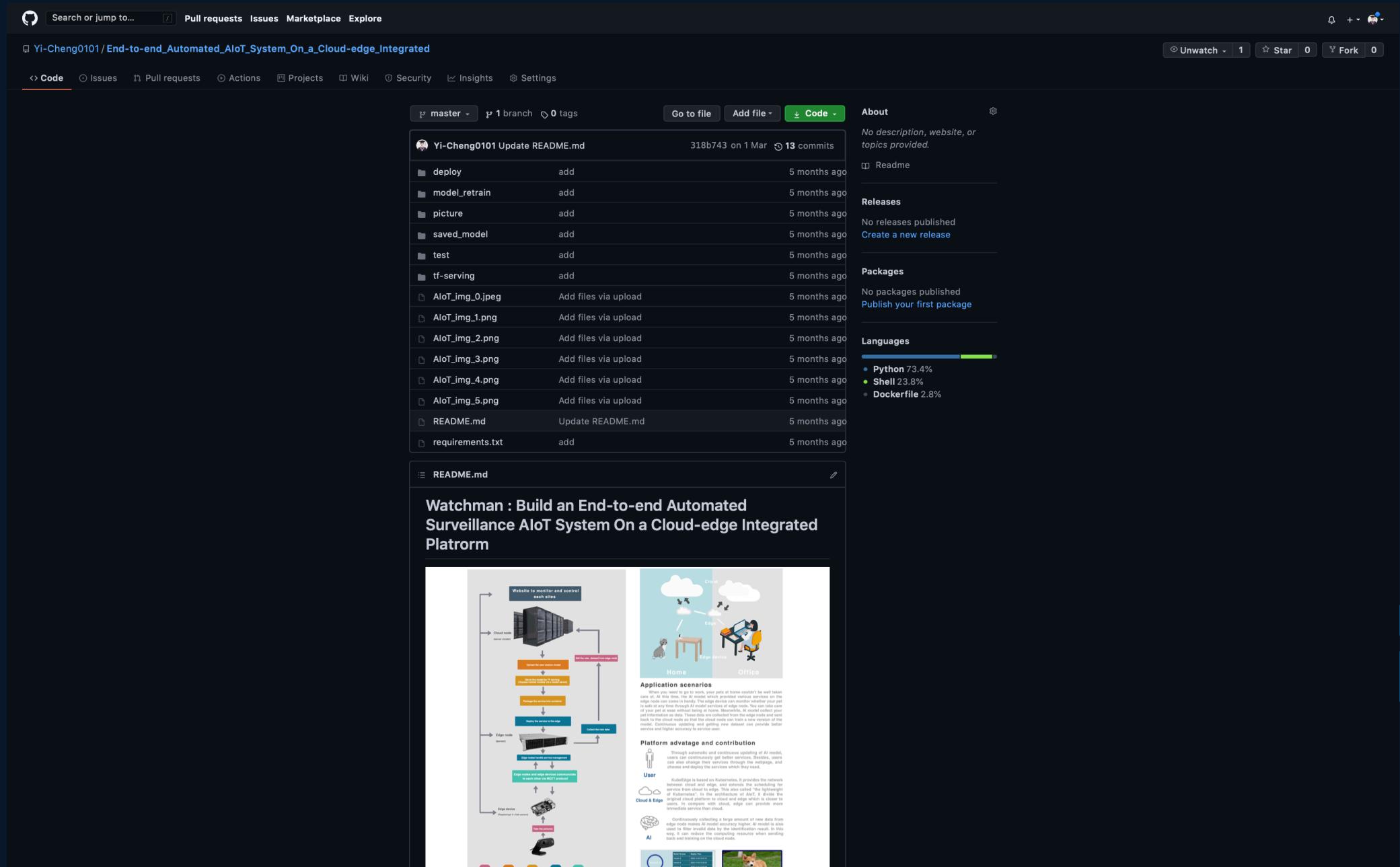


Transportation



Factory

Github Repo



https://github.com/Yi-Cheng0101/End-to-end_AIoT_System_On_a_Cloud-edge_Integrated

Thanks !!