



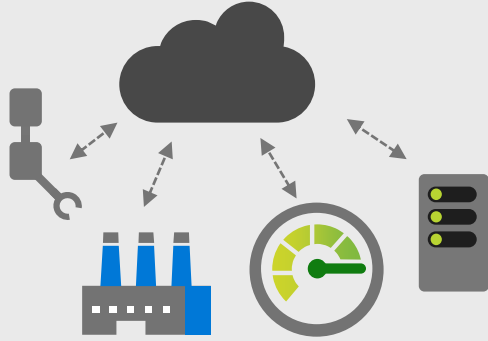
# Best Practices of Implementing Intelligent Edge Solutions with Azure IoT & AI

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Solution Architect  
Strategic Engagements & Industrial IoT, Microsoft

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IoT Solution Architect  
Partner Devices and Solutions, Microsoft



# IoT in the Cloud and on the Edge

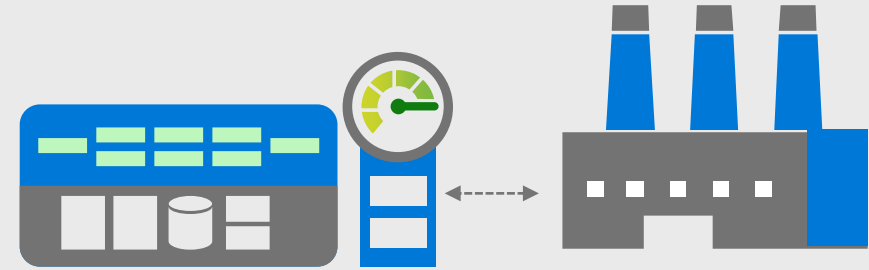


## IoT in the Cloud

Remote monitoring and management

Merging remote data from multiple IoT devices

Infinite compute and storage to train machine learning and other advanced AI tools



## IoT on the Edge

Low latency tight control loops require near real-time response

Protocol translation & data normalization

Privacy of data and protection of IP

Symmetry

# Azure IoT Edge



Move cloud and custom workloads to the edge, securely



Seamless deployment of AI and advanced analytics



Configure, update and monitor from the cloud



Compatible with popular operating systems

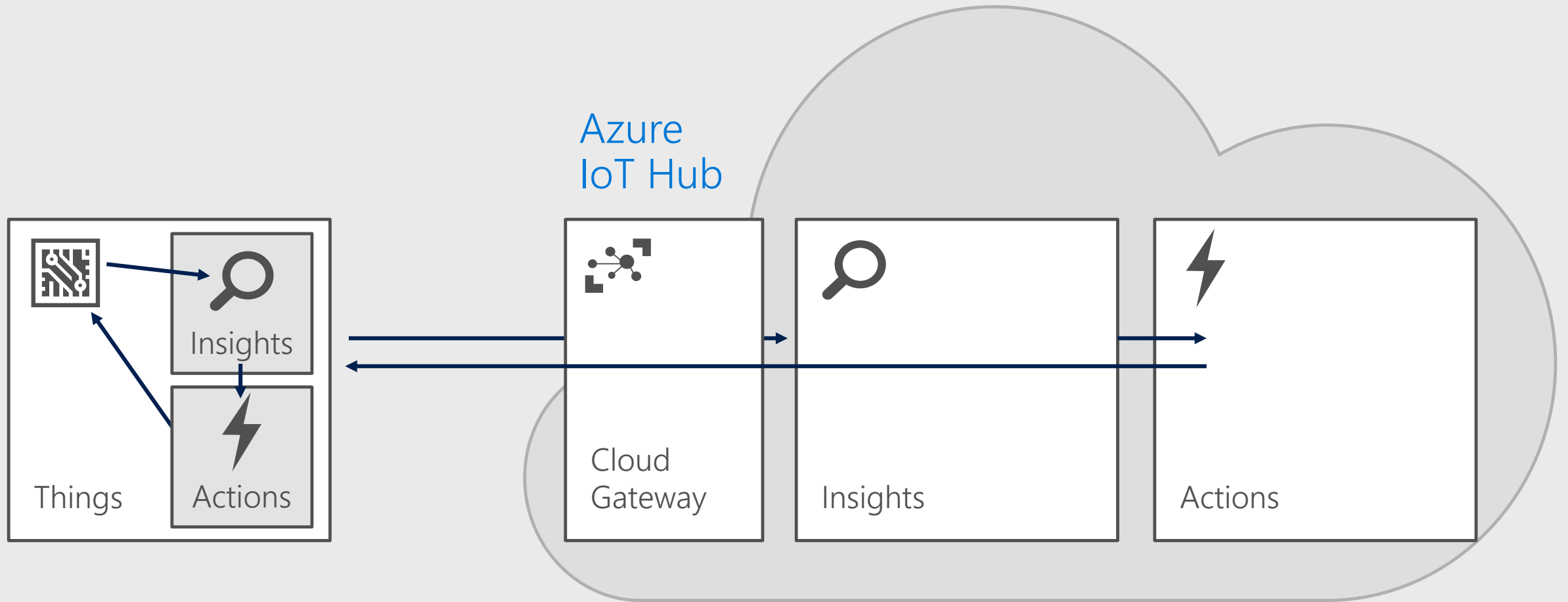


Code symmetry between cloud and edge for easy development and testing



Secure solution from chipset to cloud

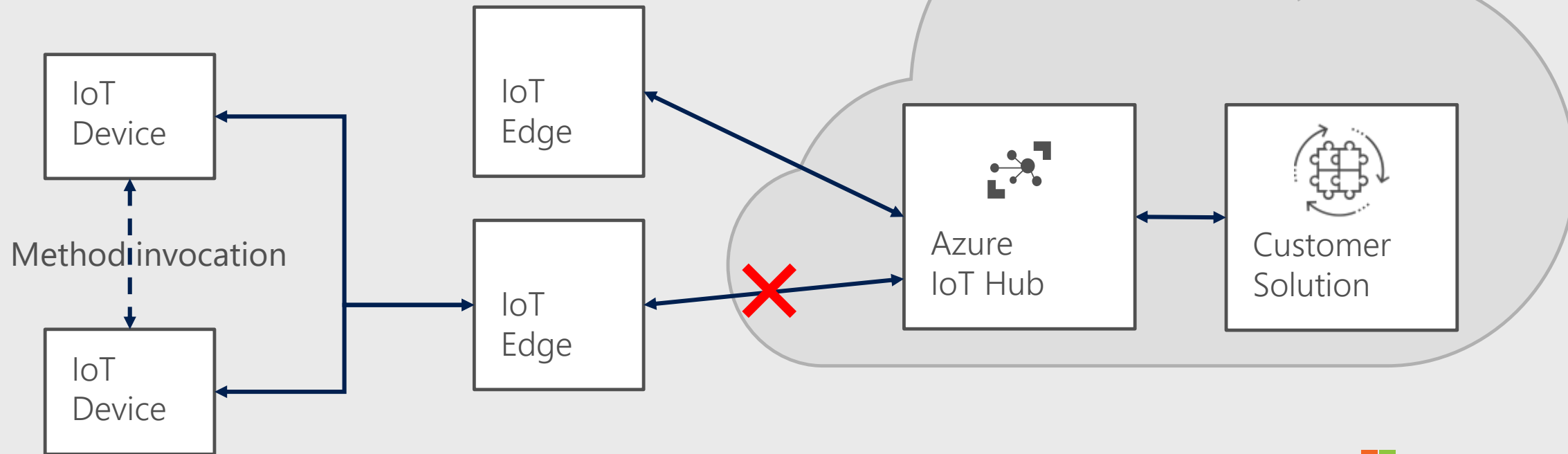
# IoT Pattern + Edge



# IoT Pattern

## Offline Support!

- Indefinite offline operation after one-time sync with IoT Hub!
- Downstream IoT devices can connect to offline Edge device and queue messages for deferred cloud delivery - no code changes, just works!
- Edge + downstream devices can restart and reauthenticate when offline.
- Local Inter-device communication facilitated by Edge Runtime.



# Platform Support

## Tier1

Generally Available

Operating System	AMD64	ARM32
Raspbian-stretch	No	Yes
Ubuntu Server 16.04	Yes	No
Ubuntu Server 18.04	Yes	No

Public Preview

Operating System	AMD64	ARM32
Windows 10 IoT Core (April 2018 update)	Yes	No
Windows 10 IoT Enterprise (April 2018 update)	Yes	No
Windows 10 Server 1803	Yes	No

## Tier2

Operating System	AMD64	ARM32
CentOS 7.5	Yes	Yes
Debian 8	Yes	Yes
Debian 9	Yes	Yes
RHEL 7.5	Yes	Yes
Ubuntu 18.04	Yes	Yes
Ubuntu 16.04	Yes	Yes
Wind River 8	Yes	No
Yocto	Yes	No

# Concept

## Azure IoT Edge Runtime

Installs and updates workloads on the device.

Maintains Azure IoT Edge security standards on the device.

Ensures that IoT Edge modules are always running.

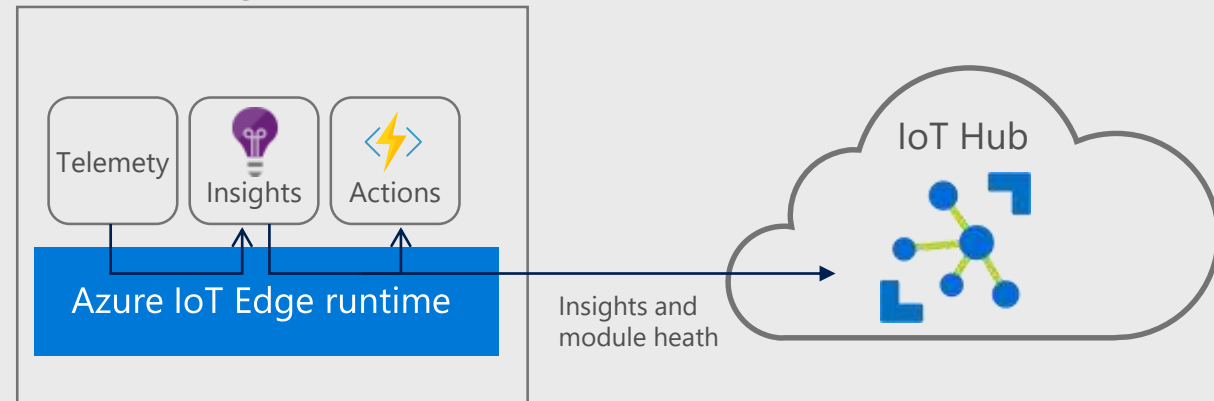
Reports module health to the cloud for remote monitoring.

Facilitates communication between downstream leaf devices and the IoT Edge device.

Facilitates communication between modules on the IoT Edge device.

Facilitates communication between the IoT Edge device and the cloud

Azure IoT edge device



# Concept

## Routing

FROM <source> WHERE <condition> INTO <sink>

Sources – source of messages

/messages/modules/{mid}/outputs/{out1}

Condition – expression on messages properties/body

sensorType = “temp” and alert = true

Sinks – destination for messages (endpoints)

\$upstream

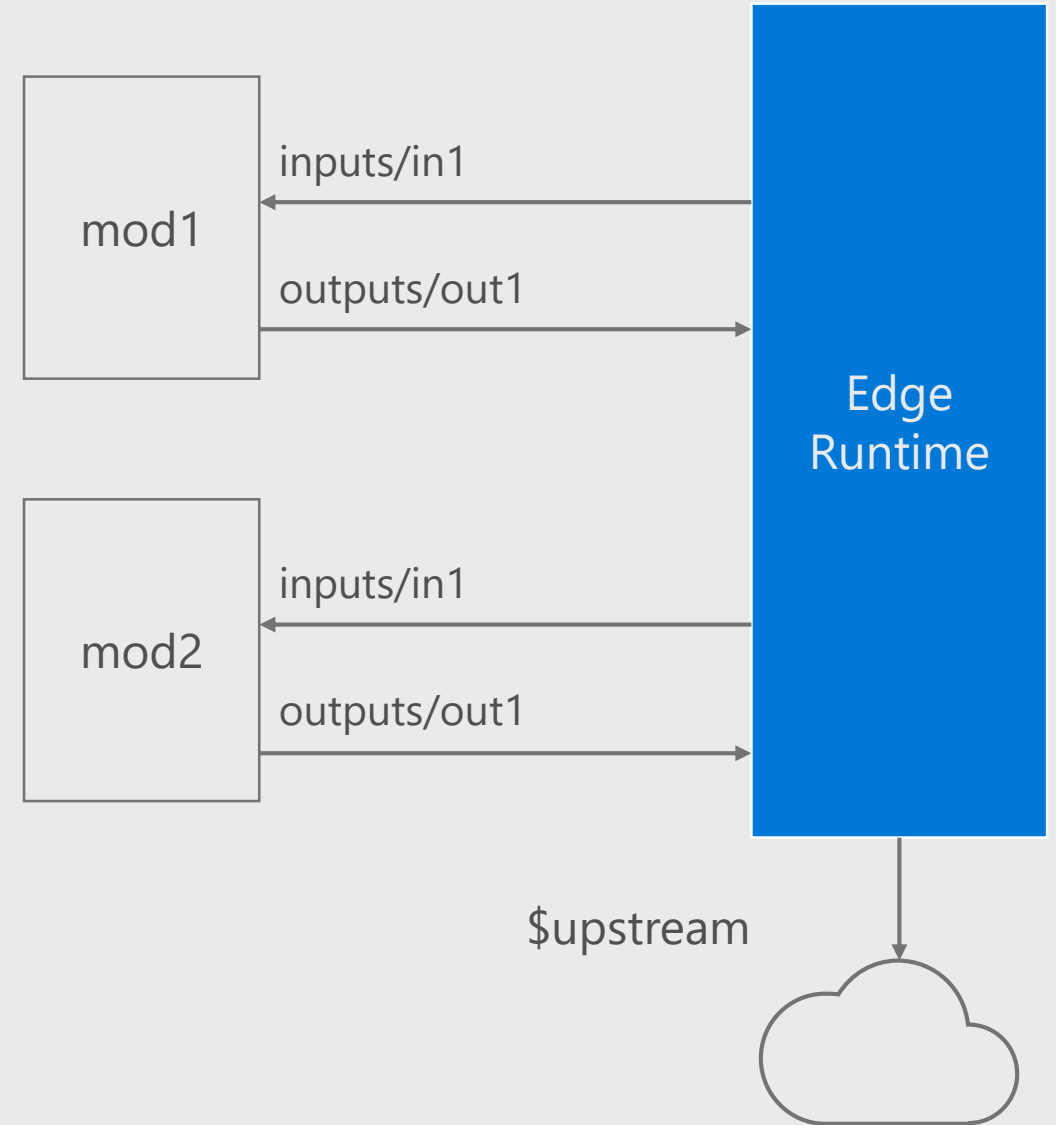
brokeredEndpoint(“/modules/{mid}/inputs/{in1}”)

For example:

FROM /messages/modules/mod1/outputs/\*

WHERE sensorType = “temp”

INTO brokeredEndpoint(“/modules/mod2/inputs/in1”)

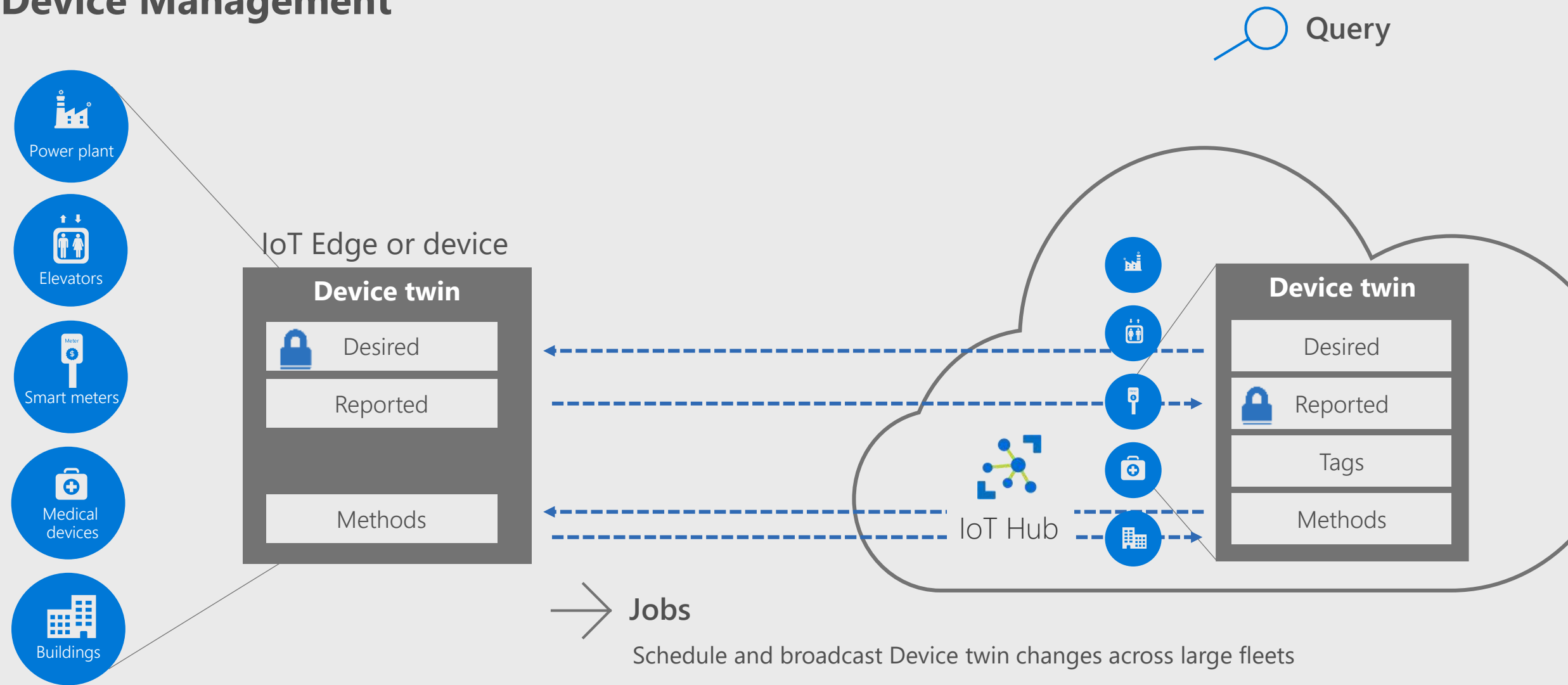


Query Language

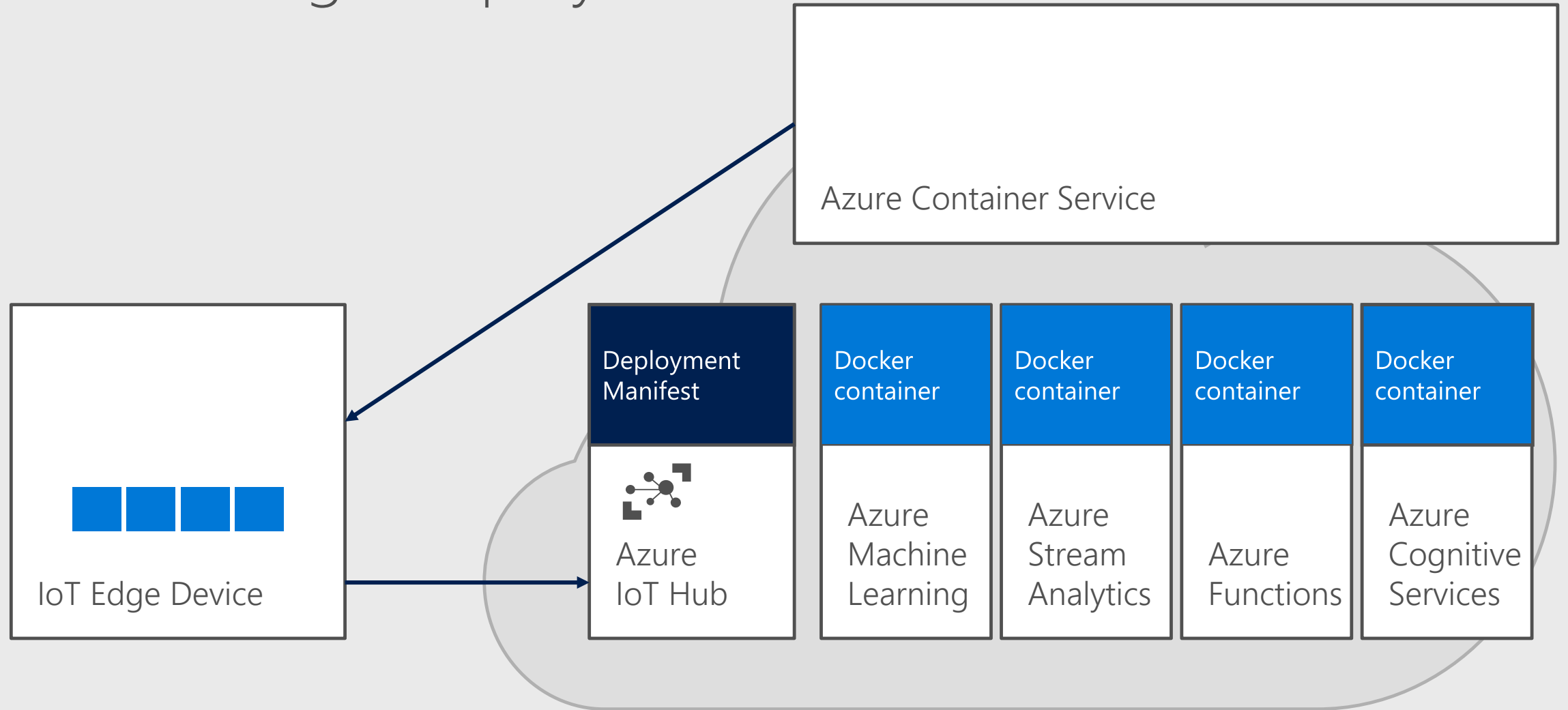


# Concept

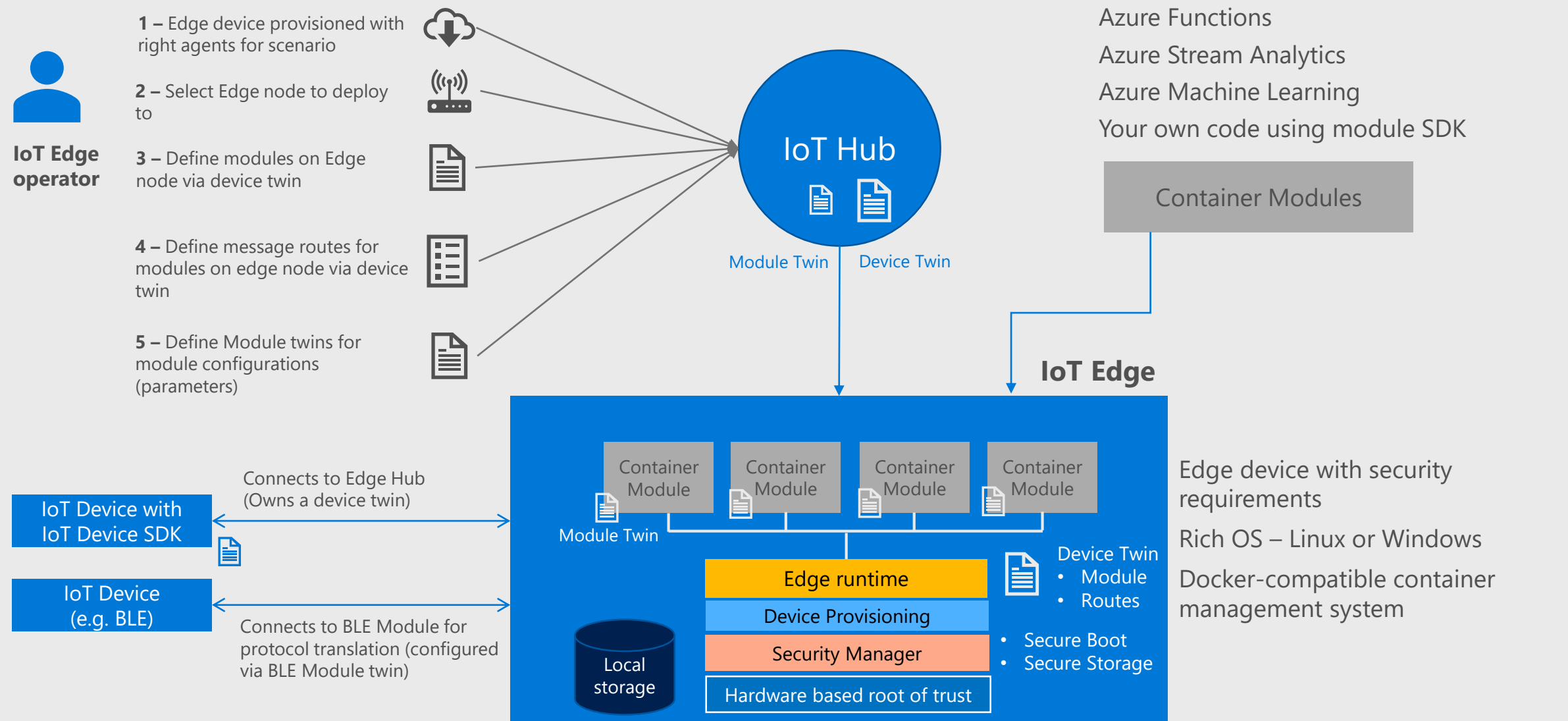
## Device Management



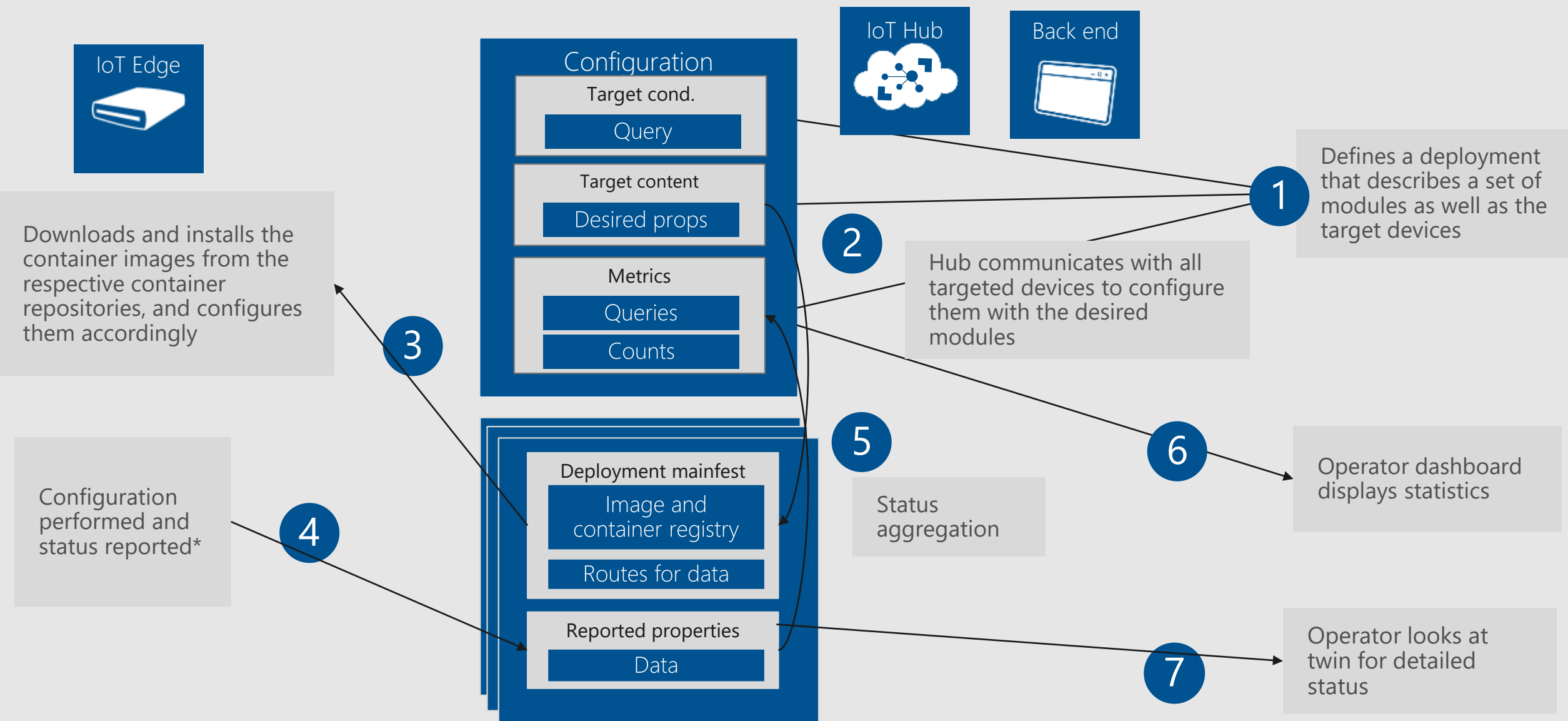
# Azure IoT Edge Deployment



# Azure IoT Edge in action



# IoT Edge Automatic Deployment



# Certified hardware for Azure IoT Edge

## Azure Certified for IoT Device Catalog

Provides an easy way to discover cross-platform IoT device and starter kits for intended use case

More than 1000 certified hardware already listed on [catalog.azureiotsolutions.com](https://catalog.azureiotsolutions.com)

Upcoming changes to device catalog website for improved discoverability and usability:

- Featuring best-in-class certified devices
- Ability to provide detail product description at glance
- Intuitive ways to search for the devices

## Expansion of the existing program to support IoT Edge devices

New set of requirements for IoT Edge devices specifically

Existing certification for IoT devices remains intact

IoT Edge device certification certify against Azure IoT Edge functionality, device management and security

Hardware manufacturers can start submitting the IoT Edge devices for certification from [partner dashboard](#)

We are working with hardware manufacturers for certified IoT Edge devices

Send questions to [iotcert@microsoft.com](mailto:iotcert@microsoft.com)

# Certified hardware for Azure IoT Edge

- Docker compatible container management system requires to be pre-installed
- Basic functionality of device management such as using device twin for reboot, FW/OS updates are required
- Optional requirements for additional security capabilities with 4 levels
- Devices can continue to run Azure IoT Edge. Microsoft is only certifying pre-installed Azure IoT Edge runtime

Security Feature	Standard Feature	Secure Element	Secure Enclave
<b>Secure Hardware Requirements</b>	None	Standalone security processor e.g. TPM and secure elements.	Integrated security processor
<b>Expectation</b>	Edge base security processes	Secure hardware protection of storage and use of secrets e.g. keys	Secure Element feature plus protection of execution environment
<b>Examples of Typical Transactions</b>	All transactions in accordance with deployment risk assessment	<ul style="list-style-type: none"> <li>- Authentication</li> <li>- Session key generation</li> <li>- Certificates processing</li> </ul>	All Secure Element transactions plus: <ul style="list-style-type: none"> <li>- Metering</li> <li>- Billing</li> <li>- Secure I/O</li> <li>- Secure Logging</li> </ul>
<b>Max Security Grading</b>	Level 2	Level 4	Level 4

Grading	Level 1	Level 2	Level 3	Level 4
Requirements	<ul style="list-style-type: none"> <li>- Custom</li> </ul>	<ul style="list-style-type: none"> <li>- Azure Device SDK</li> </ul>	<ul style="list-style-type: none"> <li>- Azure Device SDK</li> <li>- FIPS 140-2 Level 2</li> <li>- Common Critical EAL 3+</li> </ul>	<ul style="list-style-type: none"> <li>- Azure Device SDK</li> <li>- FIPS 140-2 Level 3</li> <li>- Common Criteria EAL 4+</li> </ul>

## Advantech-EIS-D210



To fulfill customer requirements in equipment connectivity, data visualization, and predictive maintenance applications, Advantech offers the EIS-D210 Edge Intelligence Server, which is equipped with an Intel® Celeron® Processor N3350 and comes integrated with AWS Greengrass and Microsoft Azure IoT Edge, thus ensuring that IoT devices can respond quickly to local events, interact with local resources, operate with intermittent connections, and minimize the cost of transmitting IoT data to the cloud.



## UC-8112-ME-T with Azure IoT Edge



RISC-based communication-centric computing platform with 1 GHz CPU, 1 GB RAM, 2 Ethernet, 2 serial ports, USB port, SD Socket, pre-installed US LTE module and -40 to 70°C operating temperature with LTE module and Microsoft Azure IoT edge installed.



## MyPi Industrial IoT Integrator Board



A Raspberry Pi Compute module based Industrial IoT Integrator board specifically designed specifically for the Industrial IoT market MyPis architecture, components, O/S and feature set have all been chosen to provide you with maximum functionality and value for money. Utilises the Raspberry Pi Compute Module as its CPU section allowing users to leverage the most widely supported and easiest to use development platform available.



# Control data through its lifecycle

## Existing



### At rest

Encrypt inactive data when stored in blob storage, database, etc.

#### Examples include:

Azure Storage Service Encryption for Data at Rest

SQL Server Transparent Database Encryption (TDE)



### In transit

Encrypt data that is flowing between untrusted public or private networks

#### Examples include:

HTTPS

TLS

## New



### In use

Protect/Encrypt data that is in use during computation

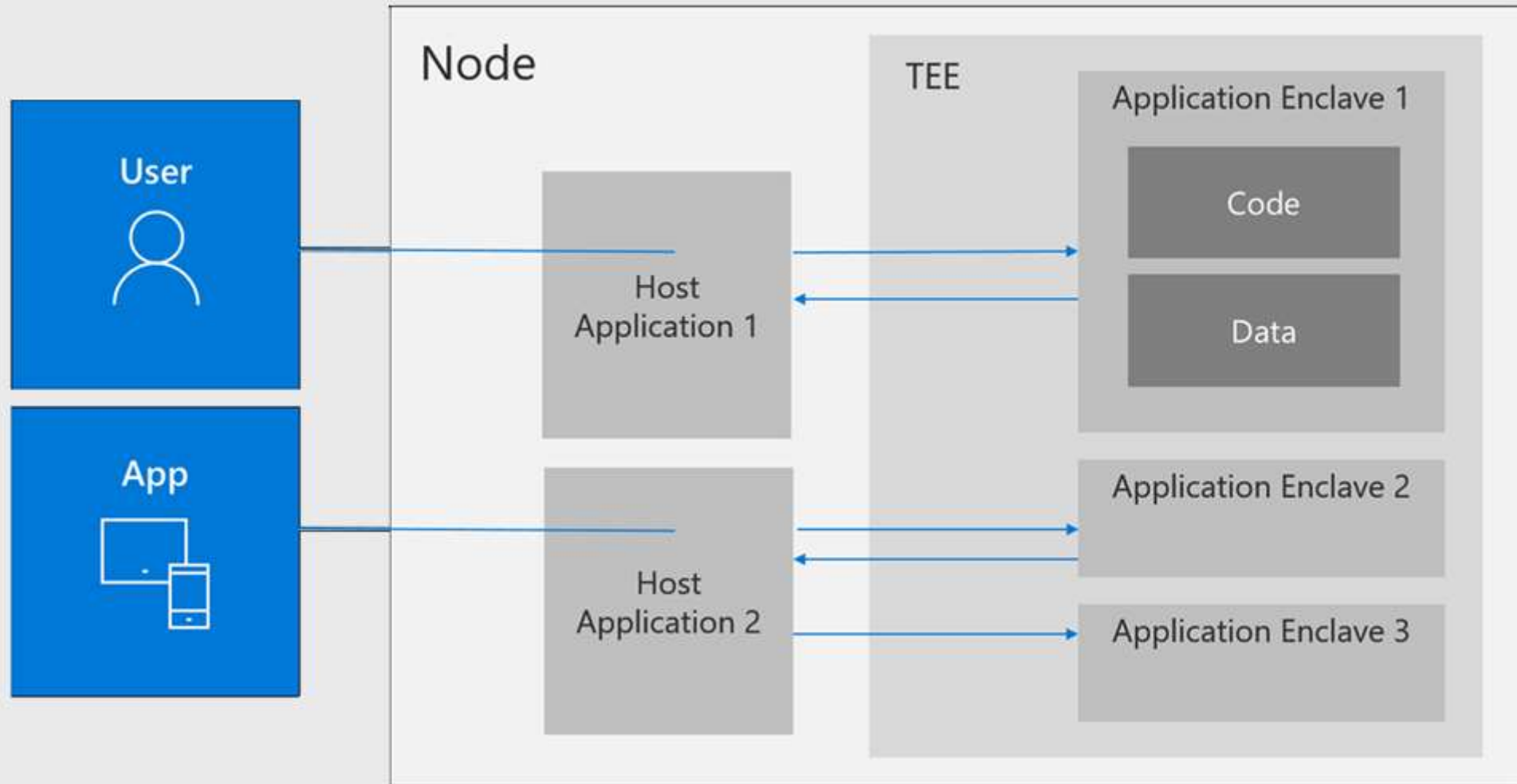
#### Examples include:

Trusted Execution Environments such as Intel SGX and VBS

Homomorphic encryption



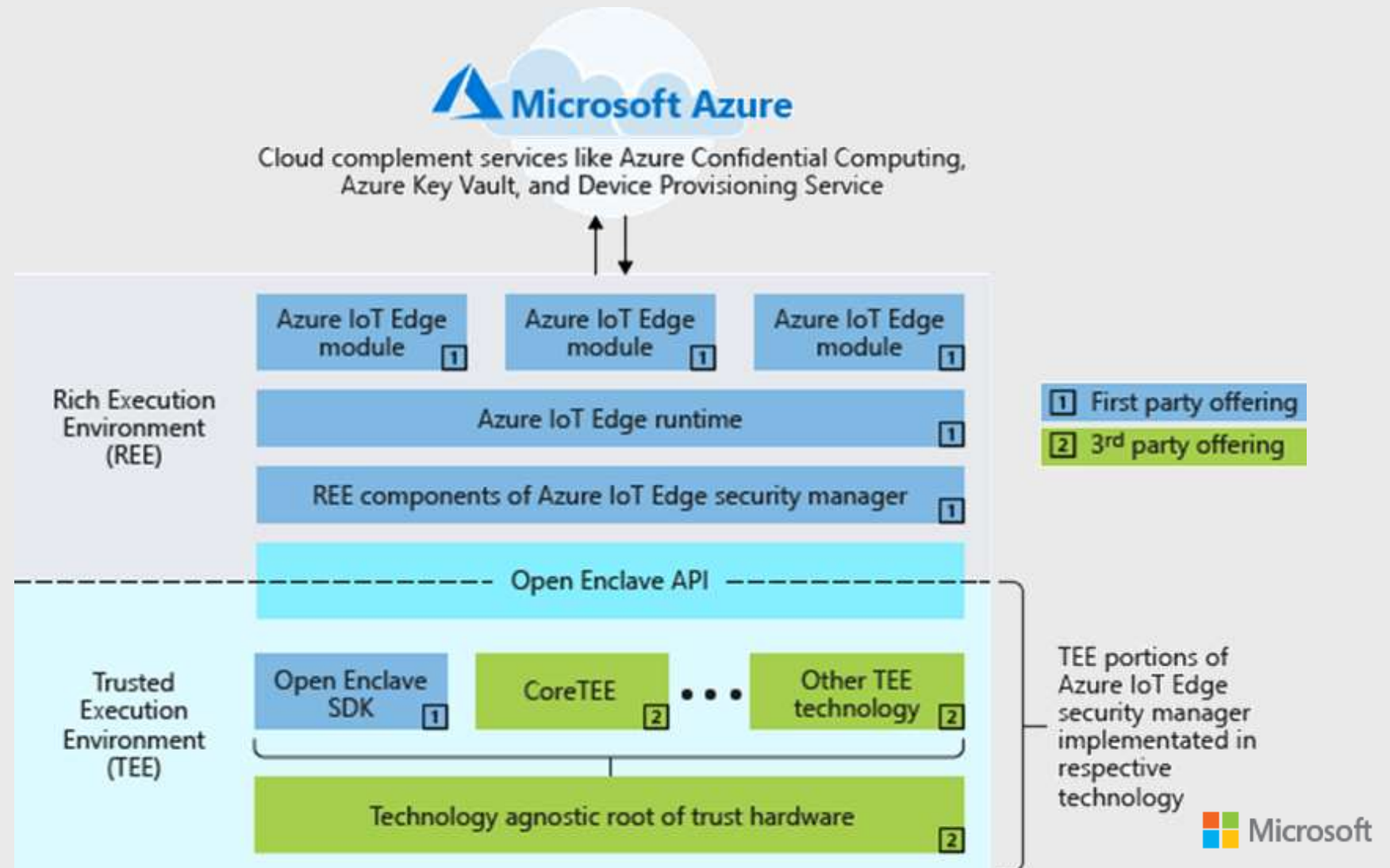
# TEE Based Application Development



TA : Trusted Application

# Azure IoT Leverages the Protection of Trusted Execution Environments (TEE) Hardware from any Capable IoT Device

In addition to data at rest and data in transit, now protect code and data when in use.



# Azure IoT Edge Module in Azure Marketplace

## Solution developers:

Discover certified pre-built modules  
Integrate certified pre-built modules

## Publishers:

Share your modules  
Monetize your modules  
Supports “free” and “bring your own license”

The screenshot displays the Microsoft Azure Marketplace website. The top navigation bar includes links for Overview, Solutions, Products, Documentation, Pricing, Training, Marketplace (selected), Partners, Support, Blog, and More, along with a Free account button. Below this, a secondary navigation bar lists Azure Marketplace, Apps (selected), Consulting services, Sell, and Learn. The main content area is titled 'Browse apps' and features a search bar and several filter dropdowns: Trials (All), Operating System (All), Publisher (All), Pricing Model (All), and Product Type (All). A sidebar on the left lists various categories, with 'Internet of Things >' expanded to show 'IoT Edge Modules' as the selected category. The main results area, titled 'Results in IoT Edge Modules (17)', displays a grid of six module cards. Each card includes a logo, the module name, the publisher, a brief description, and a 'Get it now' button with a heart icon for favorites. The modules shown are: AVEVA IoT Edge HMI (by Aveva), Nebulus SNMP Receiver (by Codit), Azure Blob Storage on IoT Edge (by Microsoft), Alleantia ISC Industry 4.0 edge gateway (by Alleantia srl), Nebulus Serial Port Receiver (by Codit), and SQLite (by Microsoft).

Microsoft Azure

Overview Solutions Products Documentation Pricing Training Marketplace Partners Support Blog More Free account >

Azure Marketplace Apps Consulting services Sell Learn

Browse apps

Search Marketplace

Trials: All, Operating System: All, Publisher: All, Pricing Model: All, Product Type: All

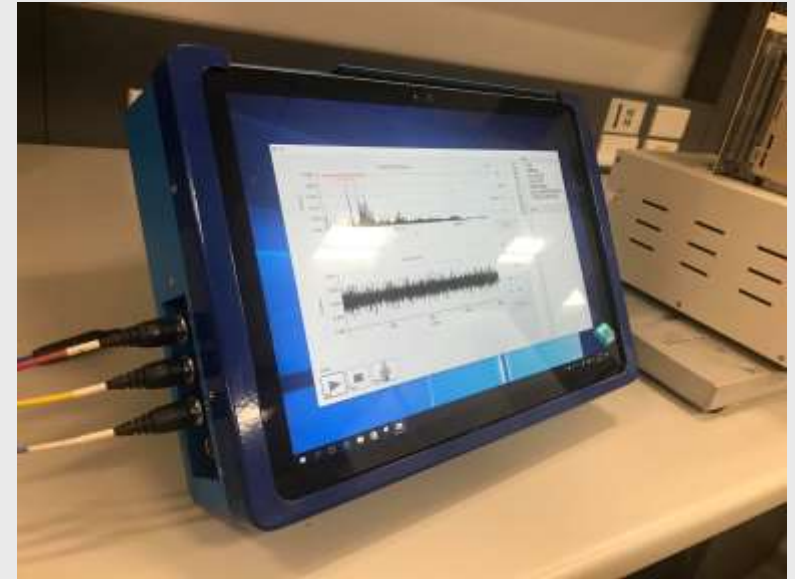
Results in IoT Edge Modules (17)

- AVEVA IoT Edge HMI**  
By Aveva  
AVEVA IoT Edge HMI  
Get it now
- Nebulus SNMP Receiver**  
By Codit  
Receiver which can receive SNMP Variables from a table  
Get it now
- Azure Blob Storage on IoT Edge**  
By Microsoft  
Azure consistent blob storage on IoT Edge.  
Get it now
- Alleantia ISC Industry 4.0 edge gateway**  
By Alleantia srl  
Industrial connectivity software with simple web interface, no coding  
Get it now
- Nebulus Serial Port Receiver**  
By Codit  
Receiver that will be activated on startup and connects to a configured Serial Port on its  
Get it now
- SQLite**  
By Microsoft  
IoT Edge module capable of accessing sqlite databases  
Get it now

# Industrial Use Case



**Prognosis Monitoring System**



**Gateway + Data Acquisition Module**



**Motor + Controller +  
Accelerometer**



**Accelerometer**



# Industrial Use Case

## Remote monitoring of equipment health

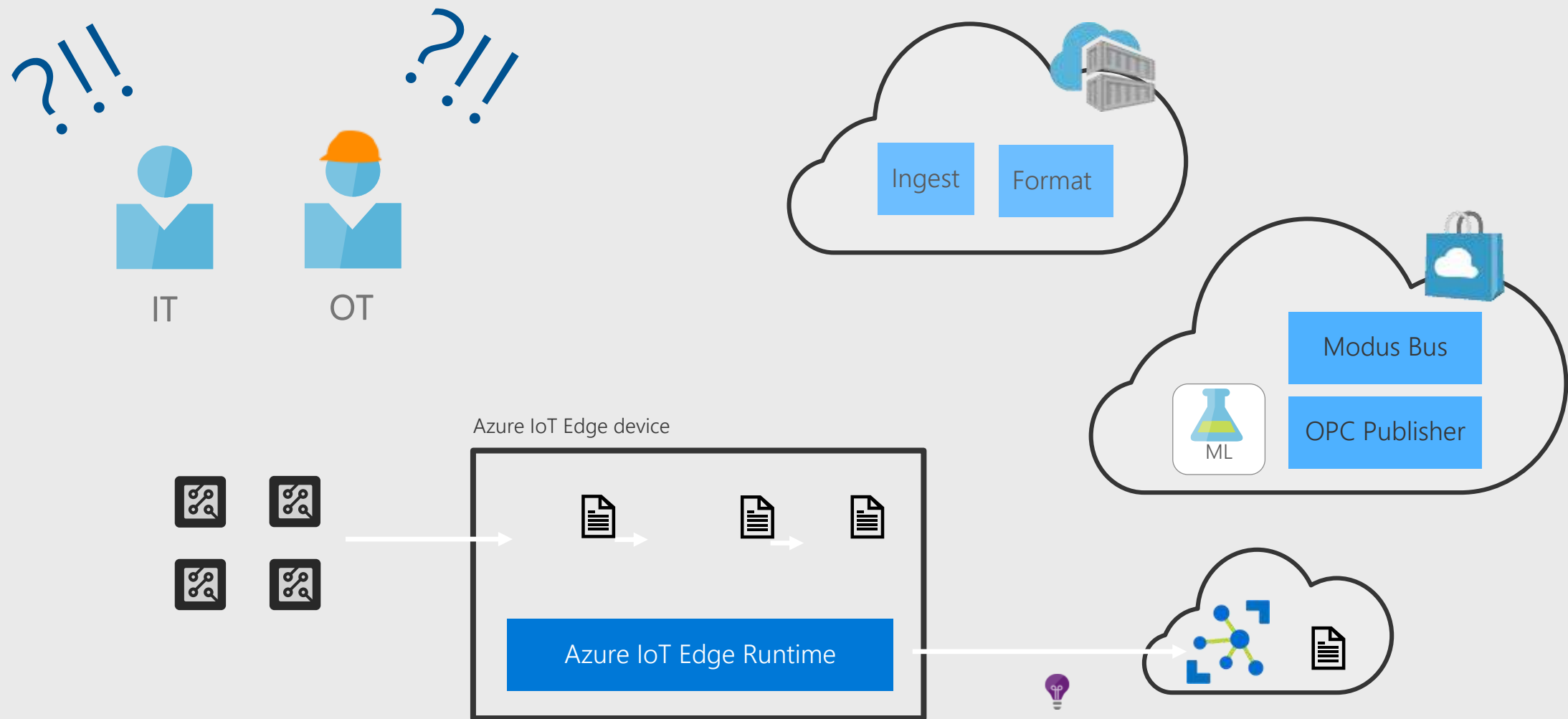
Fear of height? No problem because you can be behind your desk

## Prepare the suppliers for maintenance way in advance

No more aching arms – you know exactly what went wrong and what needs to be brought along



# Industrial Use Case



# Therefore, we need to support both IT and OT's works -

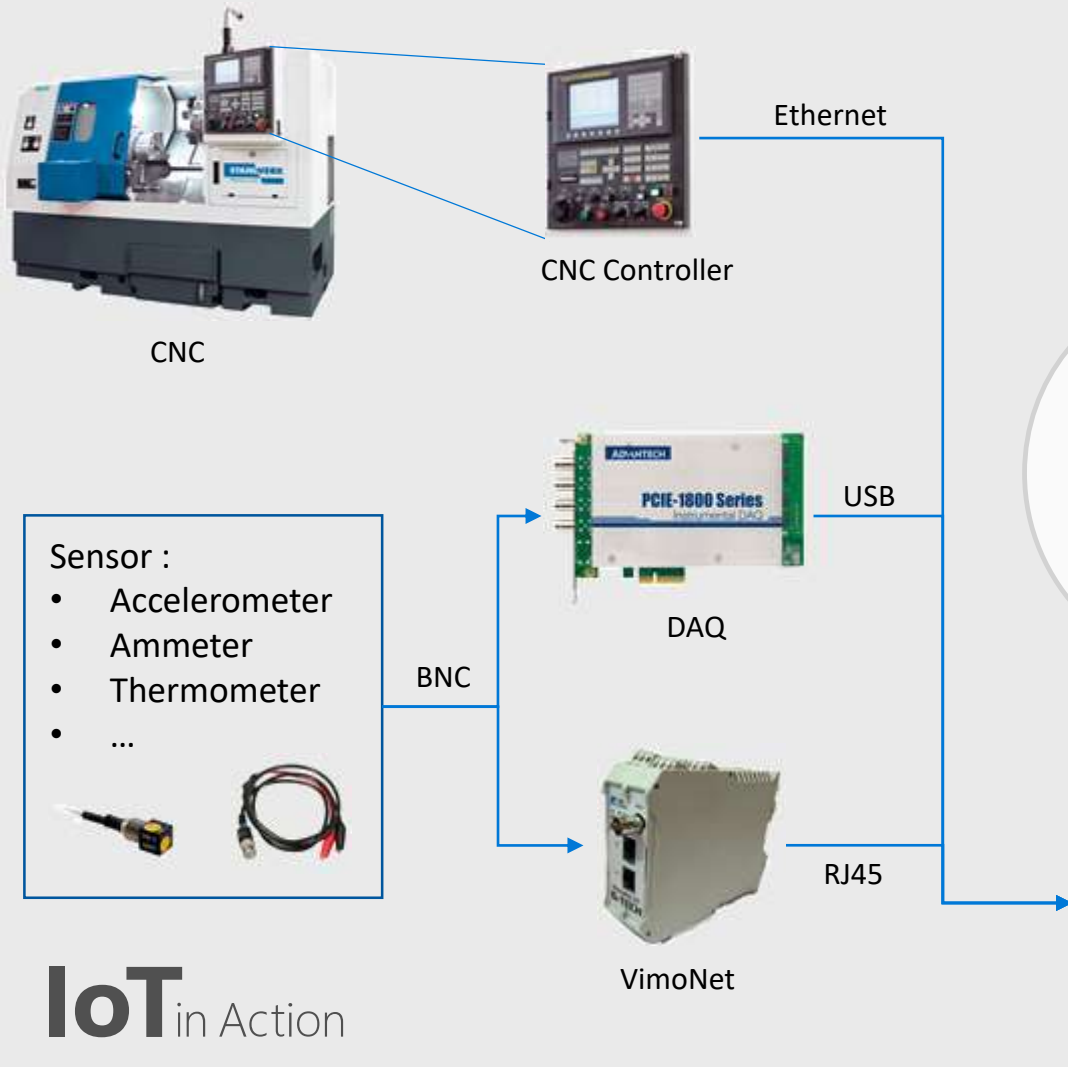
## **OT – Operate and Optimize the edge module**

- a) Need a more intuitive way to do configuration things
  - a) Choose edge module type
  - b) Decide instance of each module
  - c) Set configuration
  - d) Data routing
  - e) UI design
- b) No permission to operate Azure Portal to avoid service interrupt by incorrect operation.

## **IT – Deploy and Manage the edge module**

- a) Implement the edge module by taking requirement of OT
  - a) Implementation of consistent data modeling
  - b) Skill transfer to OT
- b) Set initial value of configuration
  - a) Edge module credentials
  - b) Image url
  - c) Create Container options

# Industrial Use Case



## Azure Market Place

- For Customer
  - One simple place to discover all the capabilities that can be deployed to an edge device.
  - All the modules are certified for quality and scanned for security vulnerabilities.
- For Service Provider
  - Publicize and monetize your IP
  - Bill anyone using the module securely, automatically, and without writing a bunch of sensitive billing logic.



防碰撞



製程優化



顫振抑制



加工助手



單機稼動率

## Azure IoT Hub & Edge

- Seamless deployment of AI and advanced analytics from cloud to the edge
- Centralized configure, update and monitor from the cloud

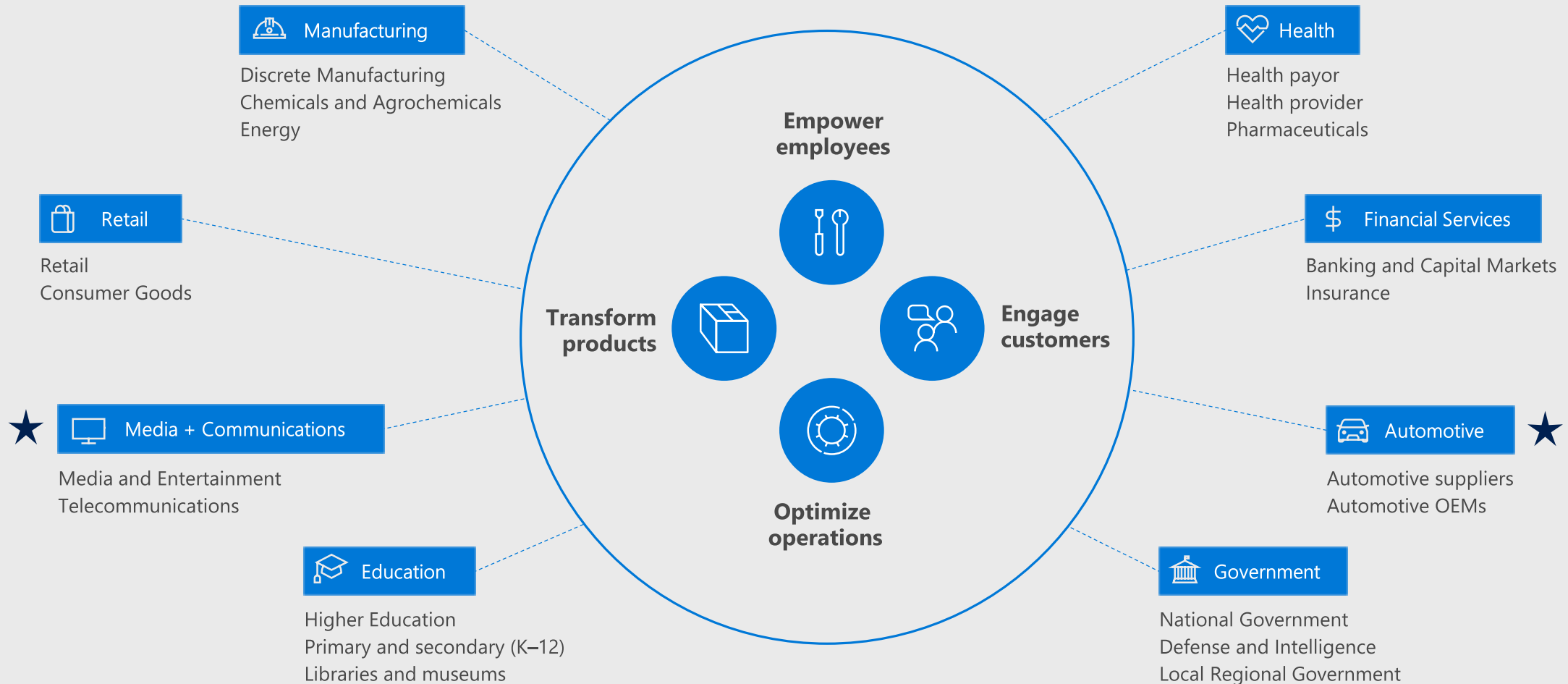
## Pre-install Azure IoT Edge & VMX software

- Support various commercial CNC controllers, PLC and DAQ.
- Move cloud analytics and custom workloads to device securely. Such as data normalization, ML Model, OEE engine...
- Perform anomaly detection on the device itself and respond to emergencies as quickly as possible.



# AI priority industry

★ New industries that are a priority in FY19



**FY19 Industry Initiatives:**  
*Recruit for AI solutions*

# Azure is the best place for AI

Accelerate time to value  
with agile tools and  
services



Pretrained AI  
services



Powerful  
tools



Comprehensive  
platform

Innovate with AI everywhere  
in the cloud, at edge and  
on-premises



Cloud



Edge



On-premises

Use any language, any  
development tool and any  
framework



python

PYTORCH

ONNX



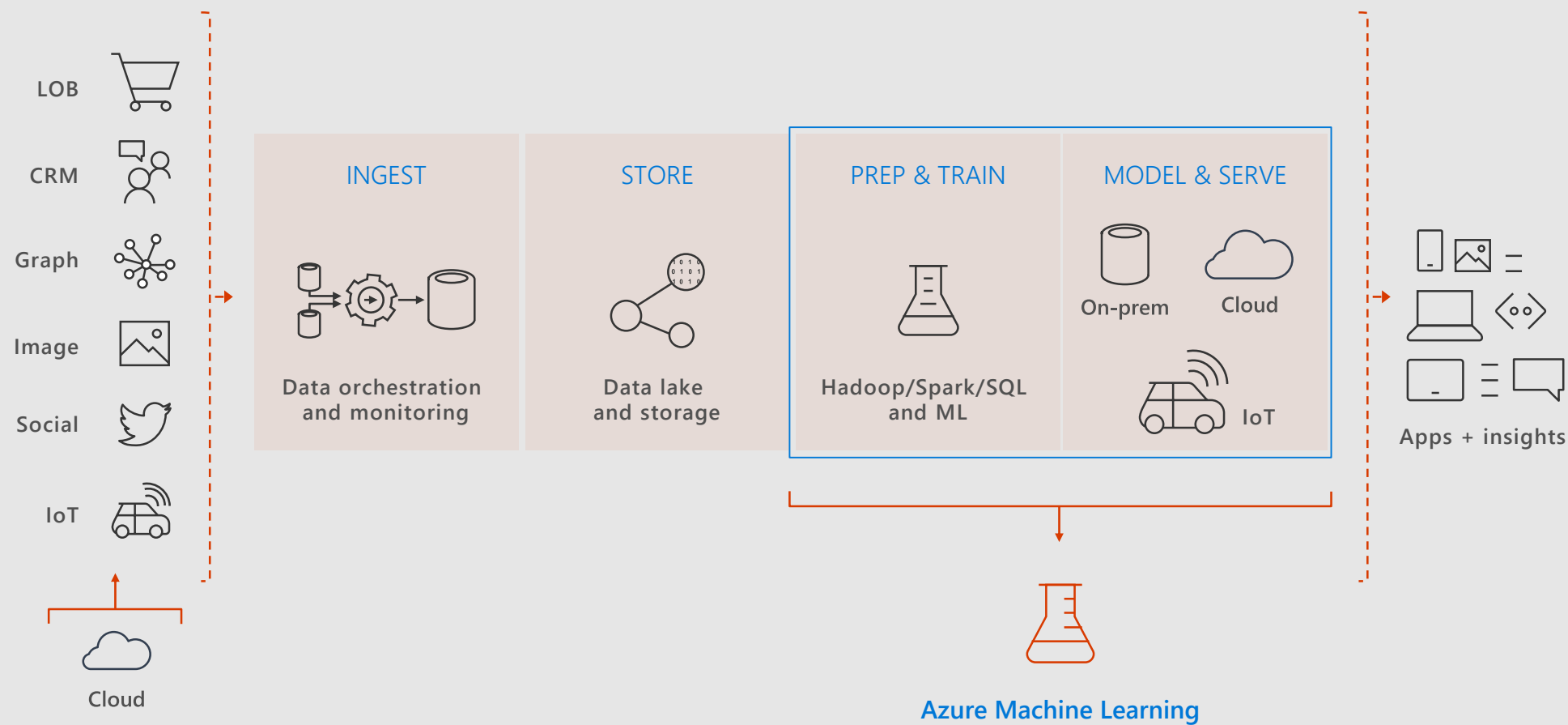
TensorFlow

Spark

Benefit from industry leading  
security, privacy, compliance,  
transparency and AI ethics  
standards

>90% of Fortune 500 companies  
use Microsoft Cloud

# The AI development lifecycle



# Machine learning & AI portfolio

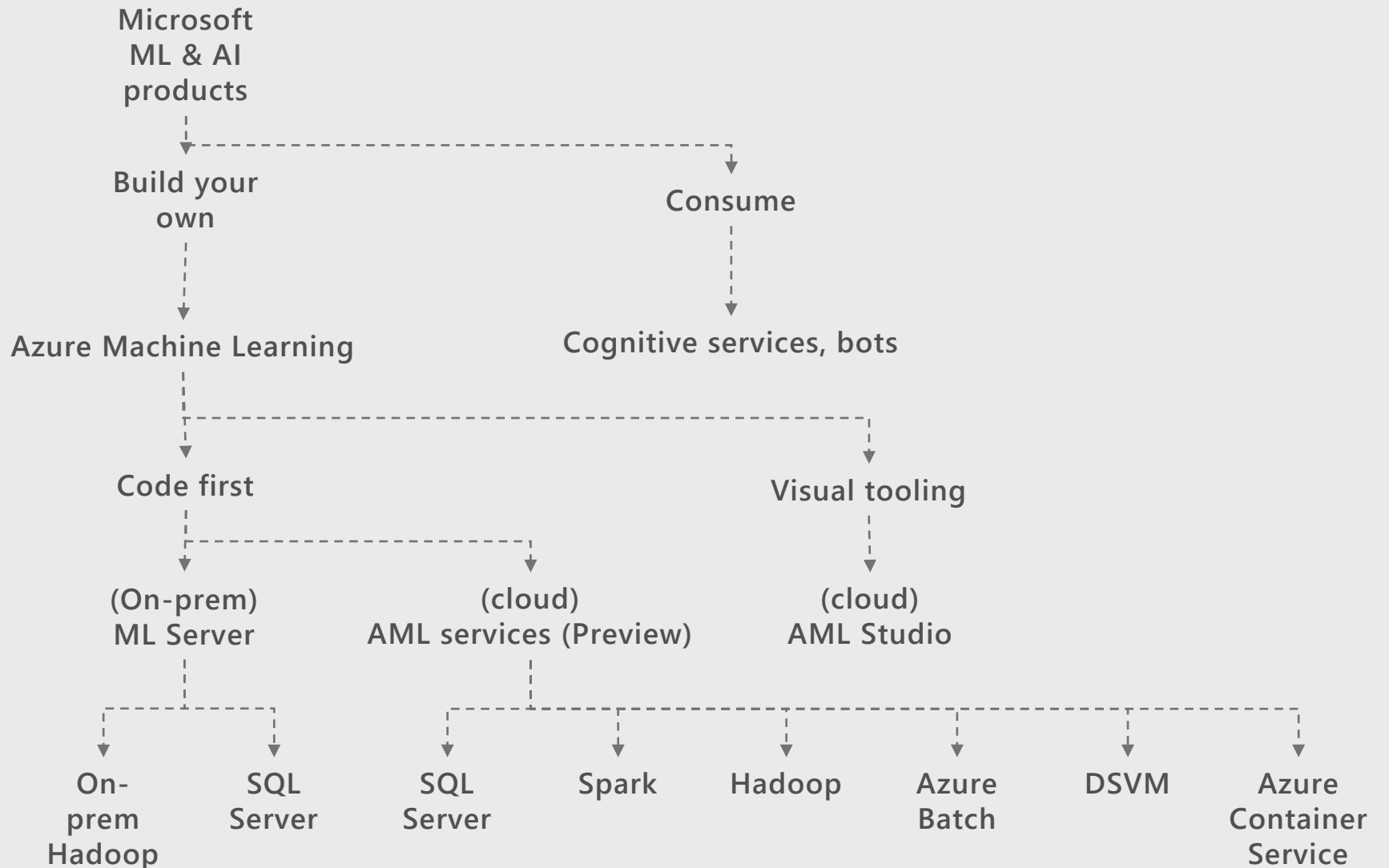
When to use what?

Build your own or consume pre-trained models?

Which experience do you want?

Deployment target

What engine(s) do you want to use?



# Development Flow of AML

1. Use estimated value to create a web service that computes the area of a circle

2. Load the workspace, retrieve the latest run

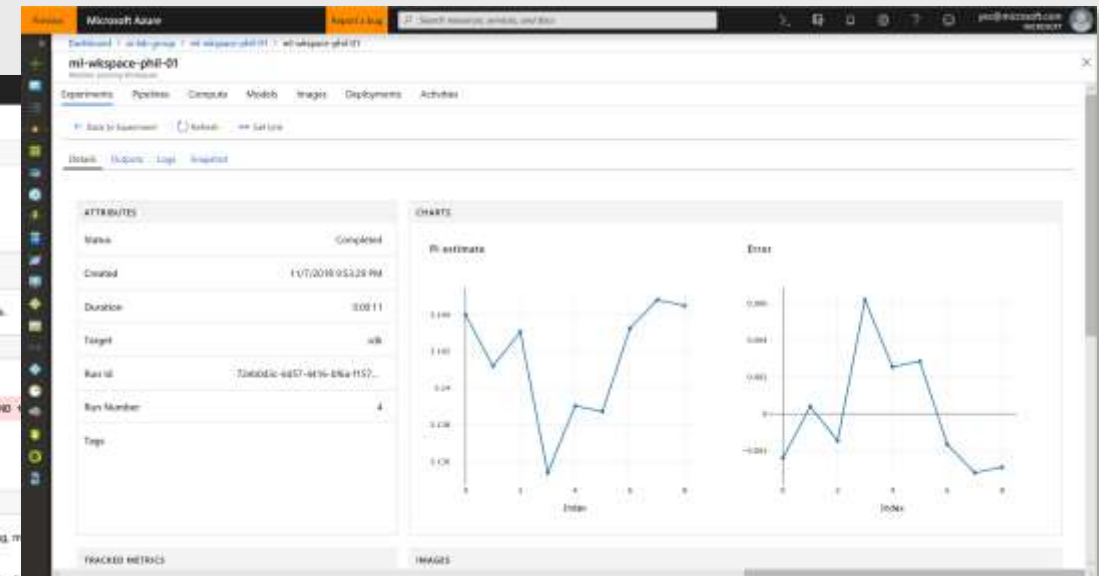
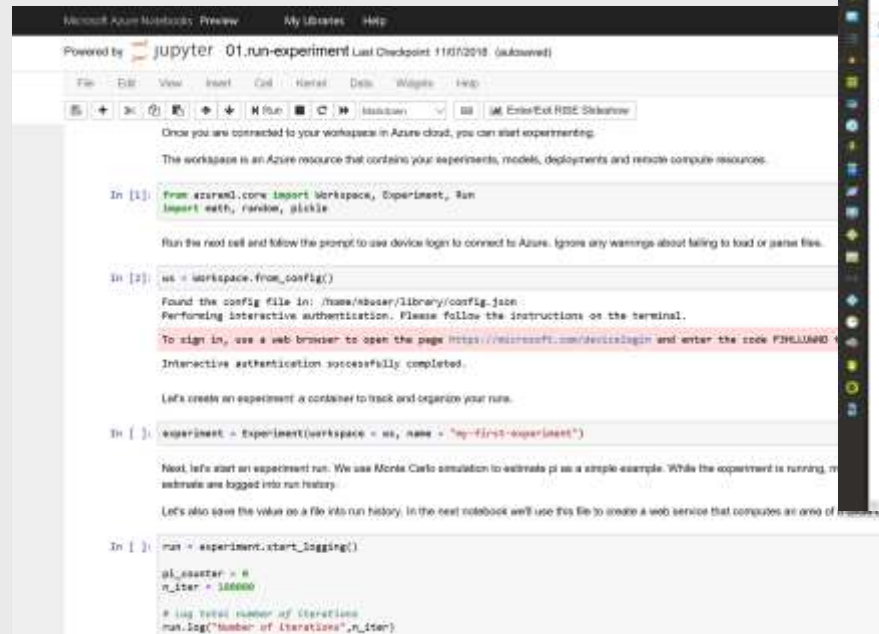
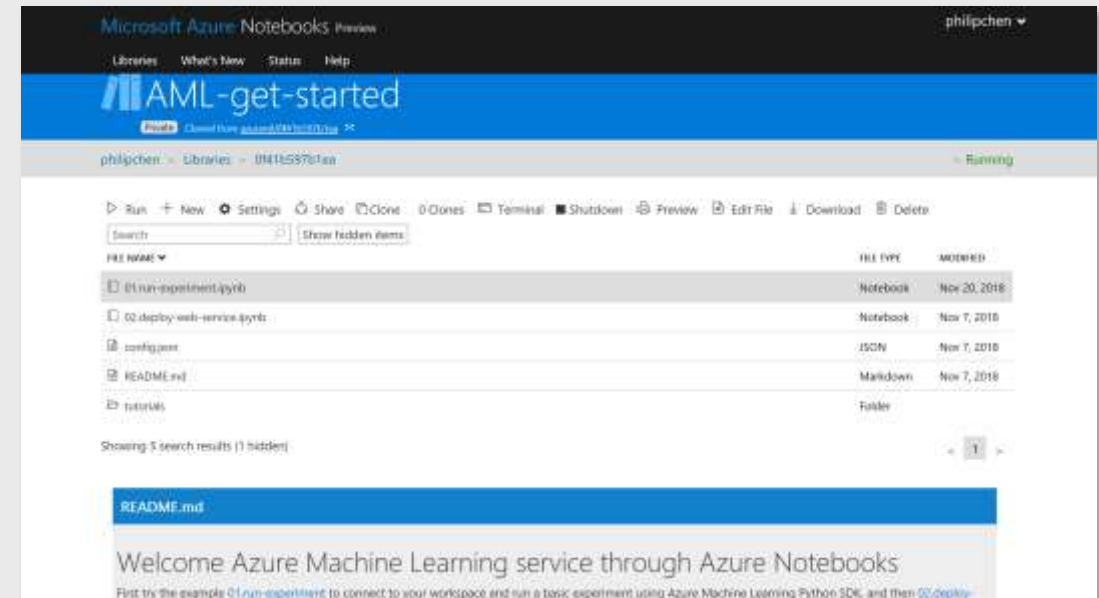
3. Use saved a file containing the pi value into run history. Register that file as a model

6. Deploy the web service on Azure Container Instance

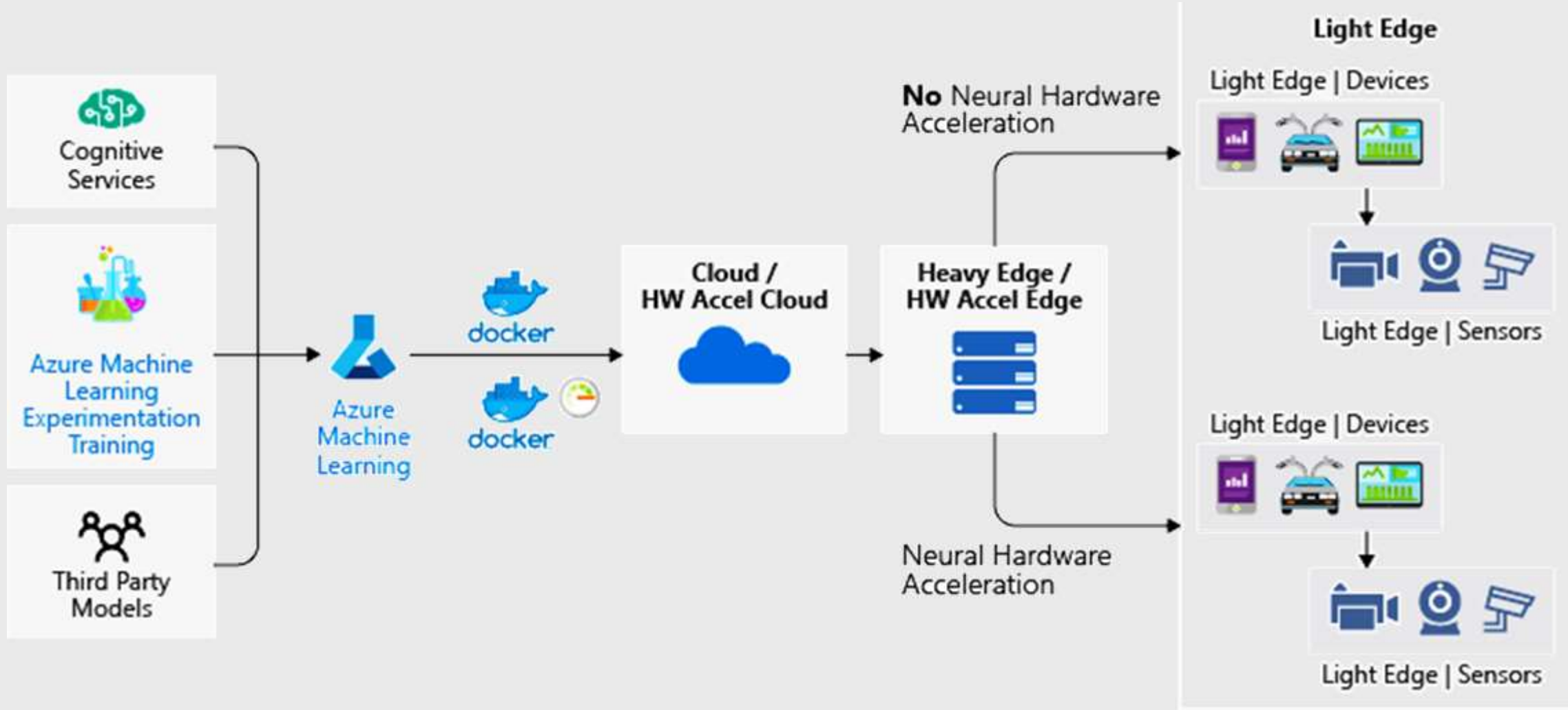
5. Specify the library dependencies of your scoring script as conda yml file.

4. Create a scoring script that consists of two parts: an init method that loads the model, and a run method that gets invoked


















7. Try out the web service by passing in data as json-formatted request



# Model Management – Inferencing Target



# Examples of real-world AI Applications

Vision 	Speech 	Language 	Knowledge 	Search 								
<div><div>What is in the image or video?</div></div>	<div><div>Give me directions to the nearest local branch.</div></div>	<div><div>Play today's customer call recording.</div></div>	<div><div>QnA Pair of this site?</div></div>	<div><div>Search for 'fraud prevention.'</div></div>								
<div><table><tbody><tr><td>Category</td><td>People; 5 faces</td></tr><tr><td>Adult/Racy?</td><td>False/False</td></tr><tr><td>Dominant colors</td><td><div><div></div><div></div><div></div></div></td></tr><tr><td>Accent color</td><td><div><div></div></div></td></tr></tbody></table></div>	Category	People; 5 faces	Adult/Racy?	False/False	Dominant colors	<div><div></div><div></div><div></div></div>	Accent color	<div><div></div></div>	<div></div> <div><div>Convert spoken audio to text</div><div>Convert text to spoken audio</div><div>Extract intent of user</div></div>	<div>Natural Language Processing</div> <div><div>Intent: PlayCall</div><div>Content: Customer#</div><div>DateTime.date: today</div></div> <div><div>Now Playing</div><div>11/29/2016 Customer Call</div></div>	<div>Here are the top results:</div> <div><div>Customer Relationship Management – 5 Key Trends for 2014 CRM</div><div>Oct 28, 2015 – Here are FIVE key trends in 2014 that would help marketers in rolling ... Of late, marketers are looking at customer lifecycle management (CLM)</div><div>Predictive Customer Lifecycle Management (CLM)</div><div>The purpose of Customer Life-cycle Management (CLM) is to maximize both customer retention and .... Predictive trend analysis provides business visibility.</div><div>Trends 2016: The Future of Customer Service</div><div>Jan 5, 2016 – The top 10 customer service trends for 2016 that .... North American Consumer</div><div>Language Around Customer Lifecycles in the Banking Industry</div><div>View PDF</div></div>	<div>Here is what I found:</div> <div><div><div>Information Communications Media Market News</div><div>It also investigates the top three expected Fraud Detection and Prevention programs, in terms of demand in key markets...</div></div><div><div>The Big Question: In-House or Outsourced Fraud Protection?</div><div>First, let's point out that there is not one absolute answer—there are "pros" and "cons" to each. Those who favor in-house...</div></div><div><div>How to Protect Your Business from Online Fraud this Holiday Season</div><div>Michael heads fraud prevention tool. Online and mobile shopping are expected to continue growing apace...</div></div></div>
Category	People; 5 faces											
Adult/Racy?	False/False											
Dominant colors	<div><div></div><div></div><div></div></div>											
Accent color	<div><div></div></div>											
Computer Vision	Speech service	Language Understanding	QnA Maker	Bing News Search								



# Cognitive Services Containers

Give your apps a human side



- Run Cognitive Services on-premises and at the edge
- High throughput / low latency
- Control over model updates
- Portable architecture



# Cognitive Services Supporting Containers



## Vision

Video Indexer

Computer Vision

Face

Emotion

Content Moderator

Custom Vision



## Speech

Speaker Recognition

Bing Speech

Custom Speech

Translator Speech

Unified Speech

Speech to Text  
w. Custom Speech

Text to Speech  
w. Custom Voice

Speech Translation  
w. Custom Translator



## Language

Text Analytics

Bing Spell Check

Translator Text

Language Understanding  
(LUIS)



## Knowledge

QnA Maker

Custom Decision



## Search

Bing Entity Search

Bing Autosuggest

Bing Search

Web Search

Image Search

News Search

Video Search

Bing Statistics add-in

Bing Visual Search

Bing Custom Search



## Labs

Project Gesture

Project Local Insights

Project Academic  
Knowledge

Project Entity Linking

Project Knowledge  
Exploration

Project Event Tracking

Project Answer Search

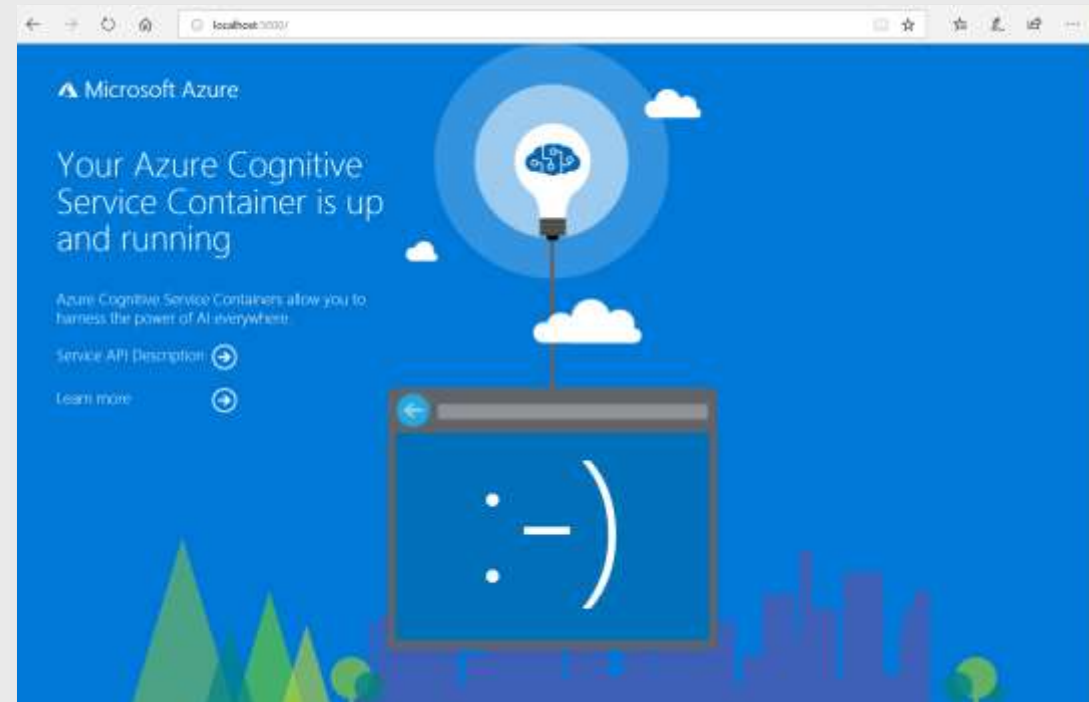
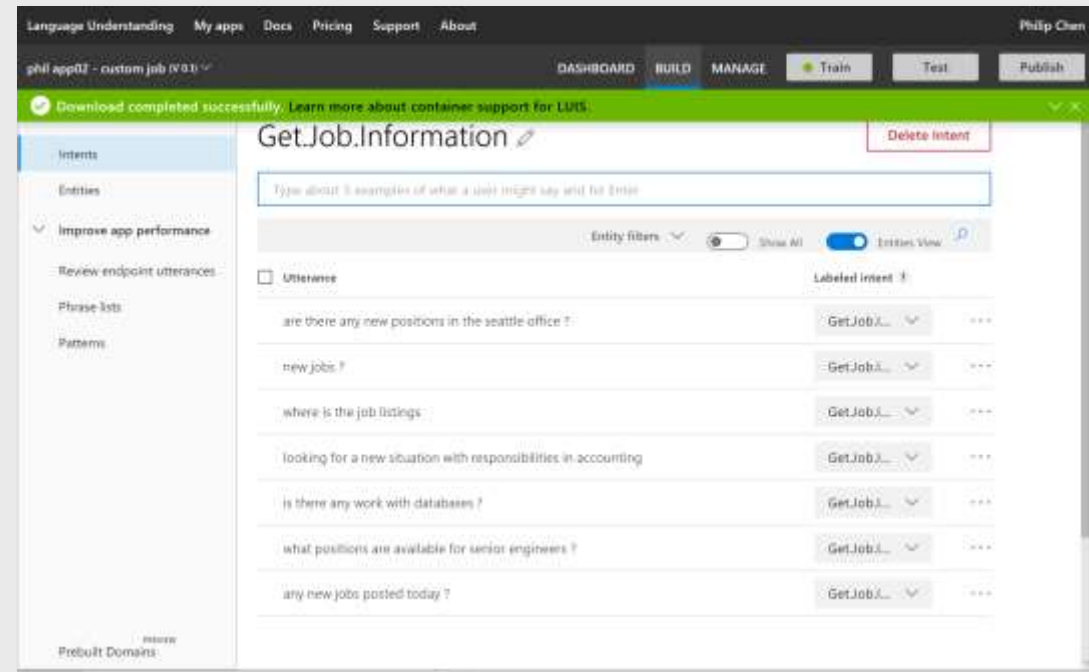
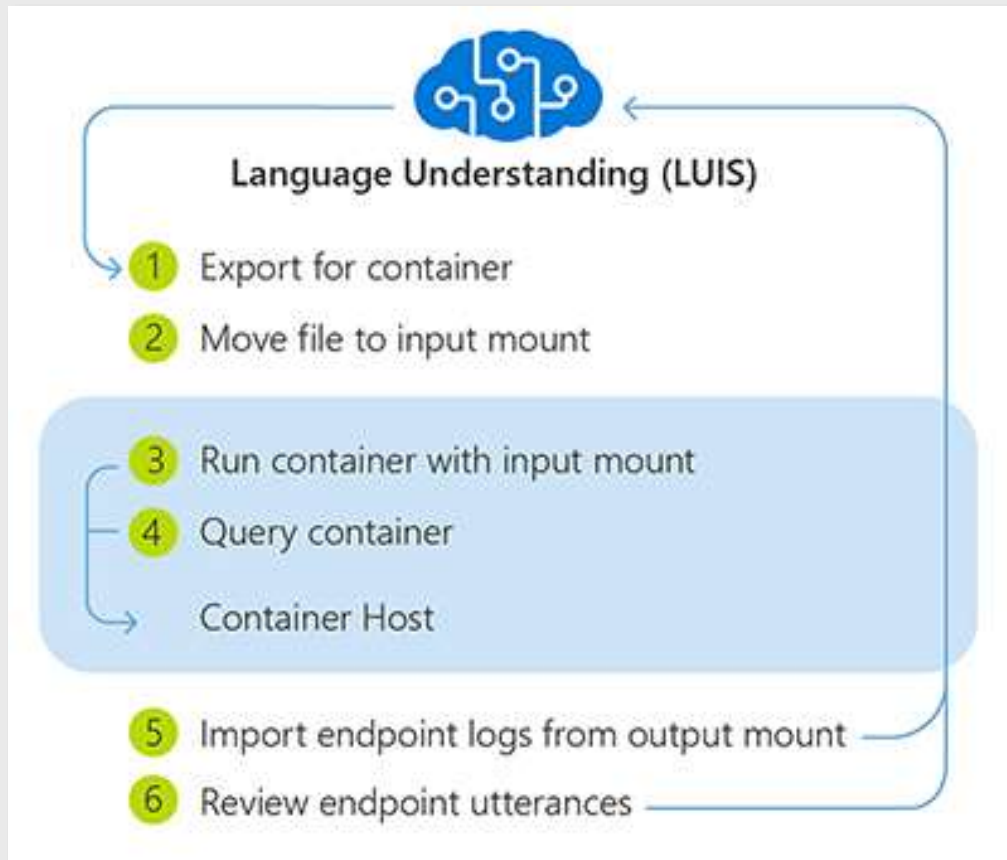
Project URL Preview

Project Anomaly Finder

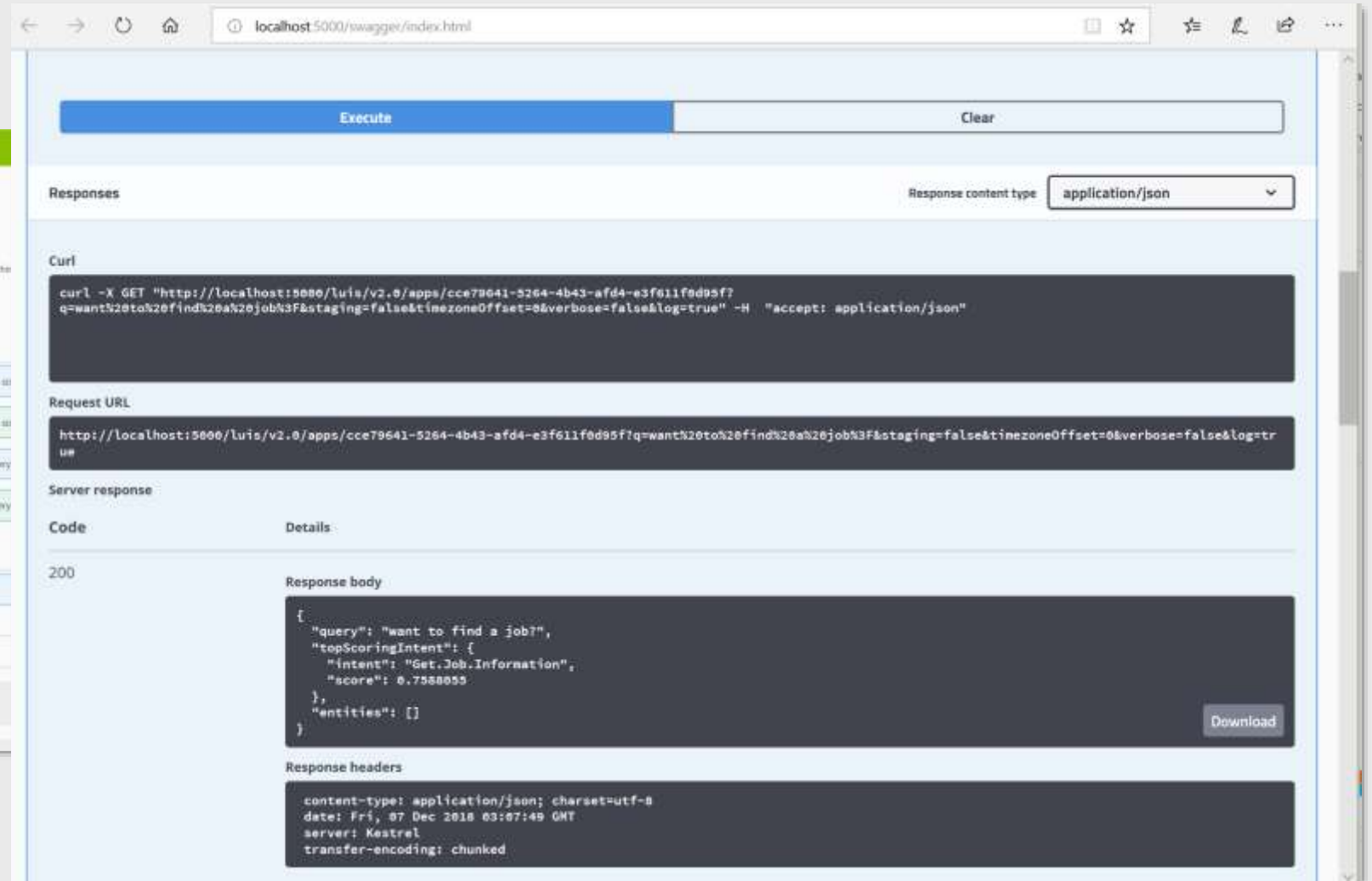
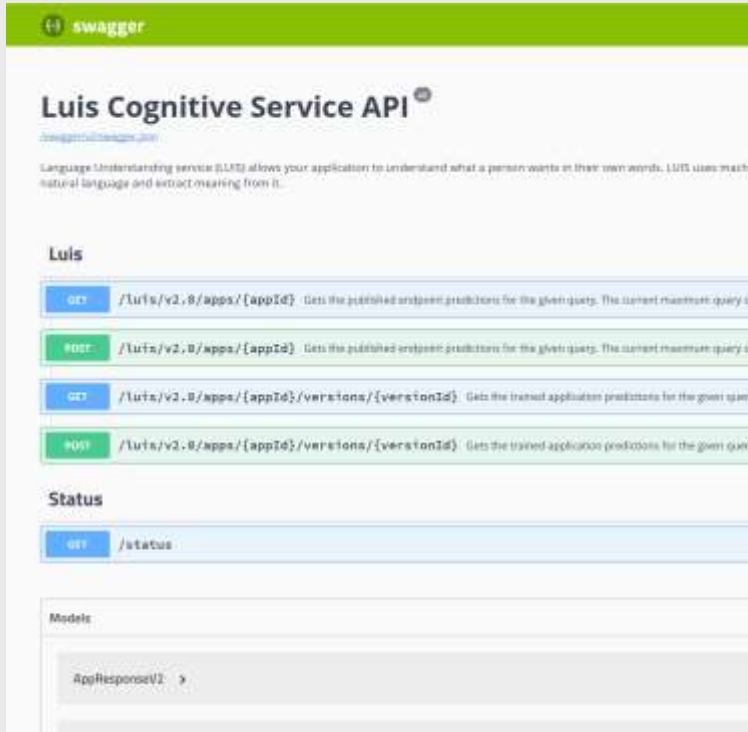
Project Conversation  
Learner

Project Personality Chat

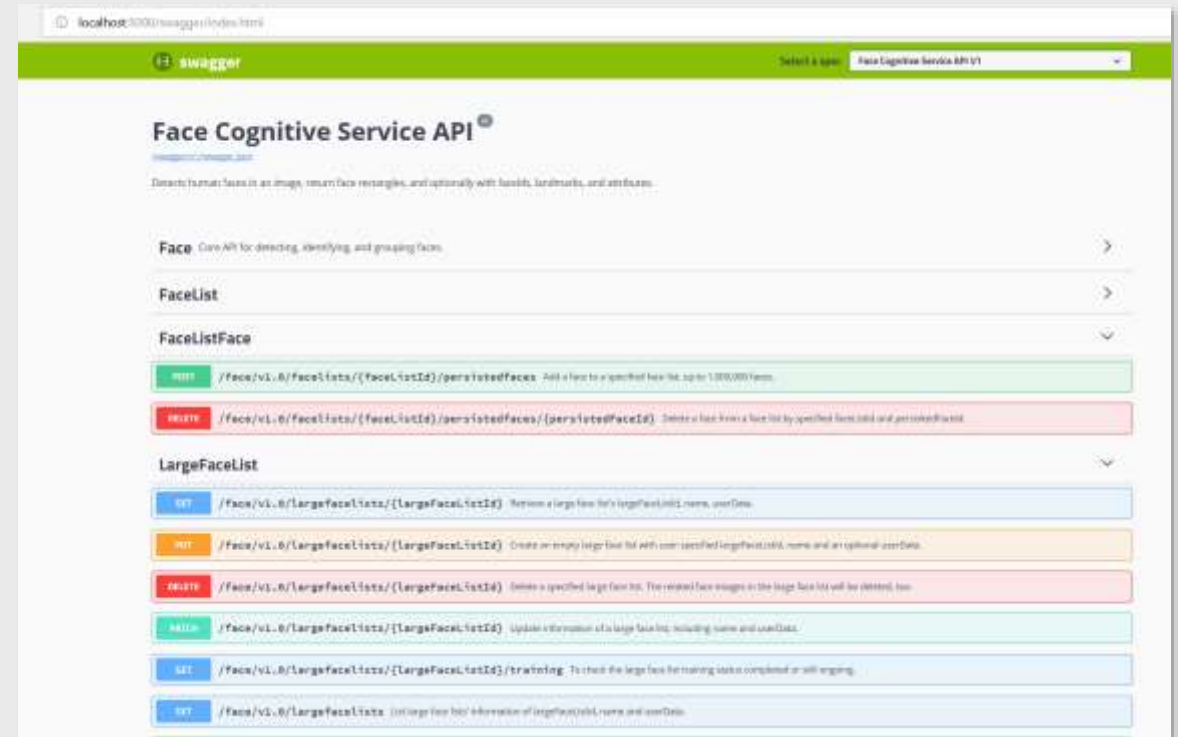
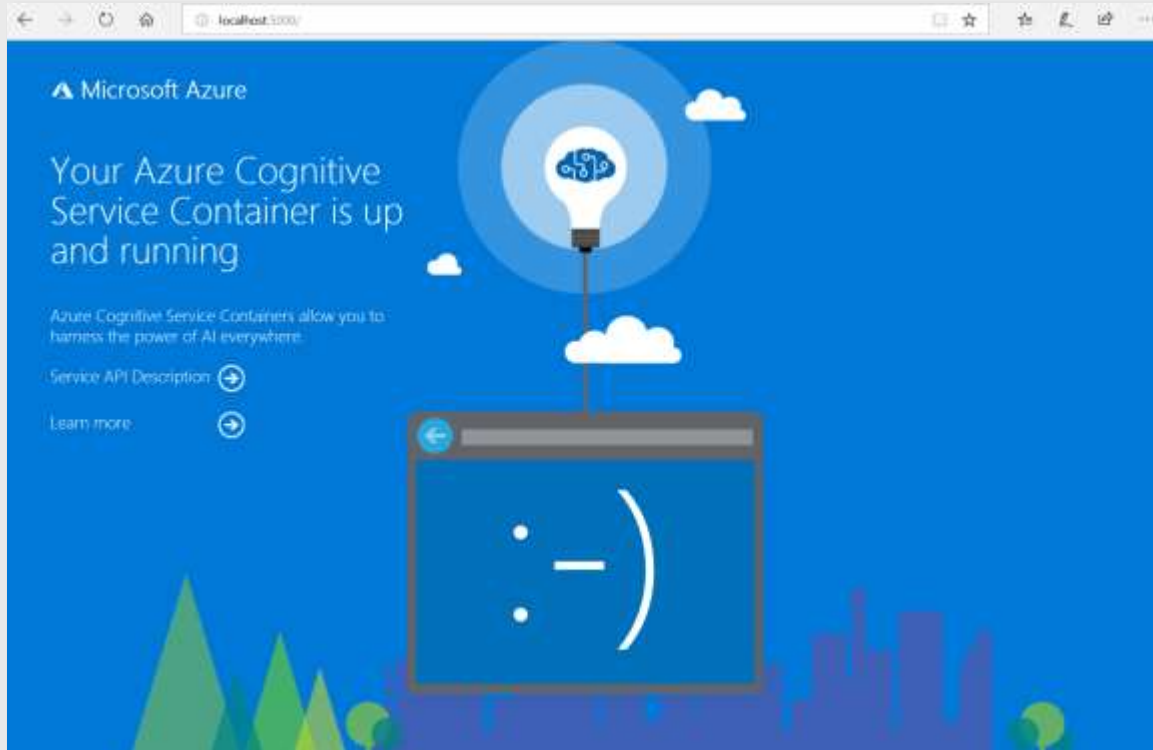
# Train a new LUIS App



# Deploy LUIS container on Edge and Test it!



# Try to recognize Face from your Edge device





# Try it out! Detect a face in image at Edge side

The image shows a Swagger UI interface for a face detection API. The API endpoint is `http://localhost:5000/face/v1.0/detect?returnFaceId=true&returnFaceLandmarks=false`. The parameters are:

- `returnFaceId` (boolean, query): A boolean value indicating whether to return face ID for the same face. The default value is true. (set to `true`)
- `returnFaceLandmarks` (boolean, query): A boolean value indicating whether to return face landmarks. The default value is false. (set to `false`)
- `returnFaceAttributes` (string, query): Specifying one or more face attributes to analyze: headPose, smile, facialHair, glasses, emotion, hair, makeup, occlusion, accessories. Note that face attribute analysis has an additional parameter: `returnFaceAttributes - Specifying one or more`.
- `form` (file, formData): Upload image as form data. (set to `IMG_1065v3`)

The response is a JSON object:

```
{
  "faceId": "1bd0fba2-5485-492f-aabd-c083fed30be",
  "faceRectangle": {
    "top": 440,
    "left": 802,
    "width": 147,
    "height": 147
  }
}
```

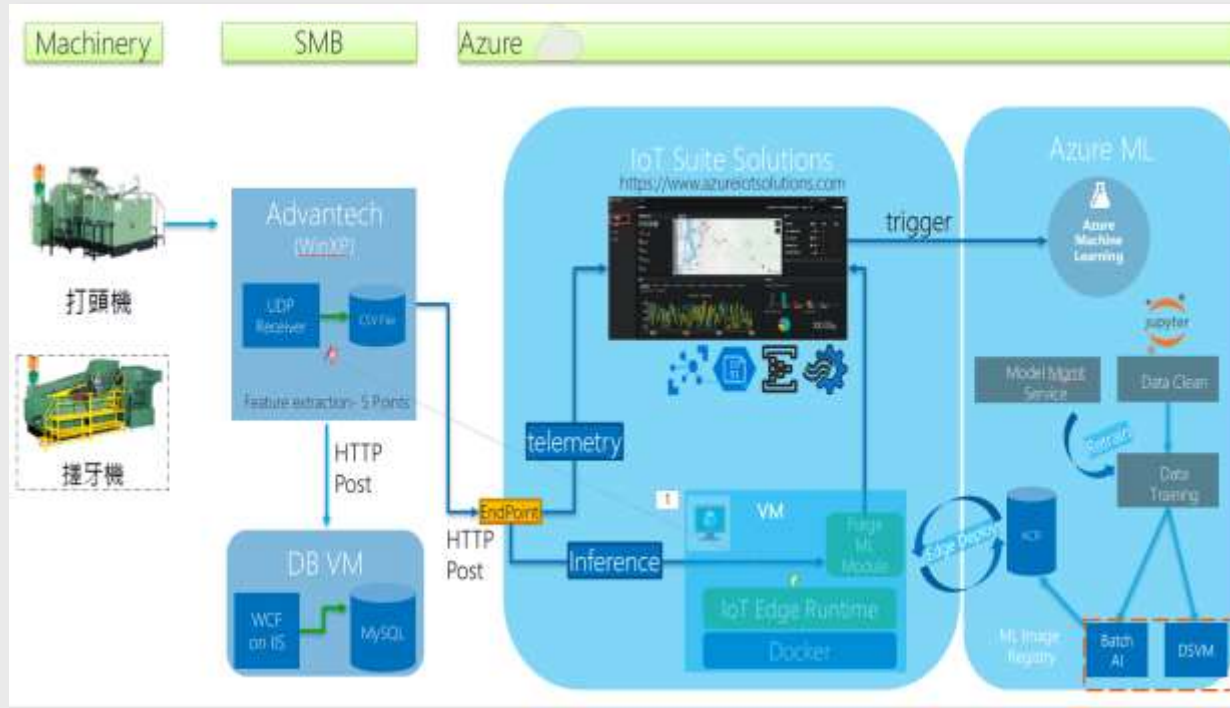
The response headers are:

```
content-type: application/json; charset=utf-8
date: Fri, 07 Dec 2018 03:54:28 GMT
server: Kestrel
transfer-encoding: chunked
```

# Types of AI Agents

Scenario	Retail	Finance	Insurance	Telecoms	Government	Automotive	Manufacturing	Healthcare	Media	Events
Customer service	✓	✓	✓	✓	✓	✓	✓	✓		✓
Customer retail	✓	✓	✓	✓				✓		
Audio/speech analysis	✓	✓	✓	✓	✓				✓	
Translation		✓	✓							
Surveillance		✓			✓					
Knowledge extraction		✓	✓	✓			✓			
Video/photo analysis		✓			✓				✓	
Product identification	✓						✓	✓		
Digital assistant						✓				
Footfall analysis	✓									✓
HD maps and object detection						✓				

# MIRDC MCAP IoT ML Platform

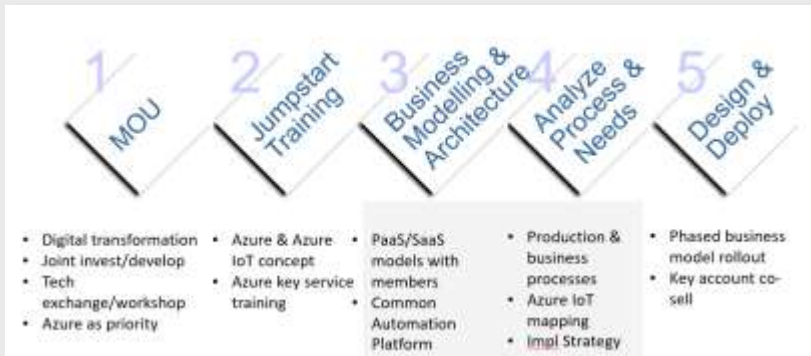


## Common Automation Platform

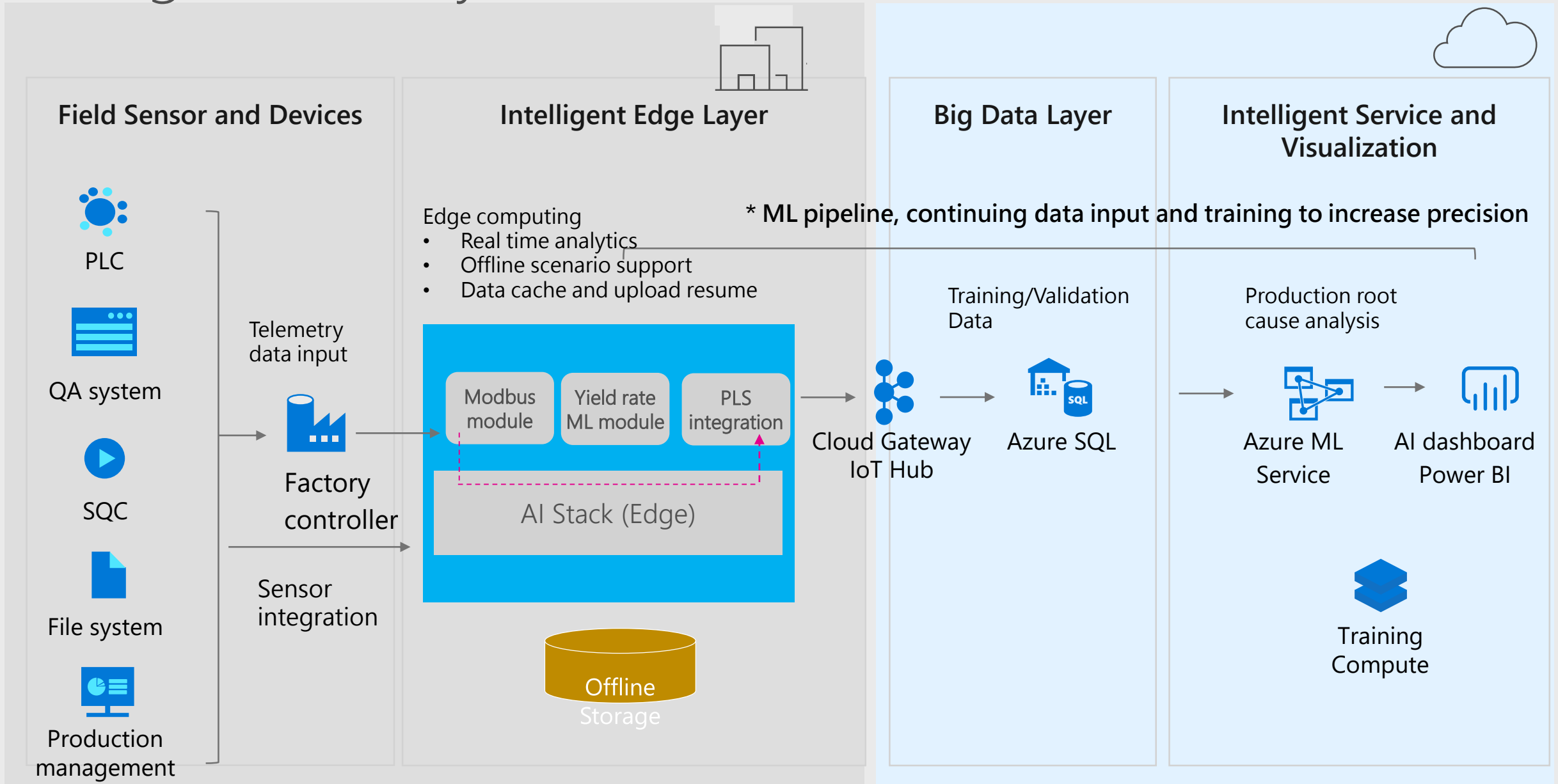
- Smart Manufacturing accessible to SMB
- Expand sale and reduce maintenance cost
- Hybrid Cloud for Easy Adoption
- Edge for small sized company
- SaaS and PaaS dual models
- Semi-government Status for fast customer reach
- Fast drive digital transformation to member companies via common automation platform

## Fast Tech Transfer

- Rapid tech transfer to large account/member company
- Azure multi-tenant SaaS

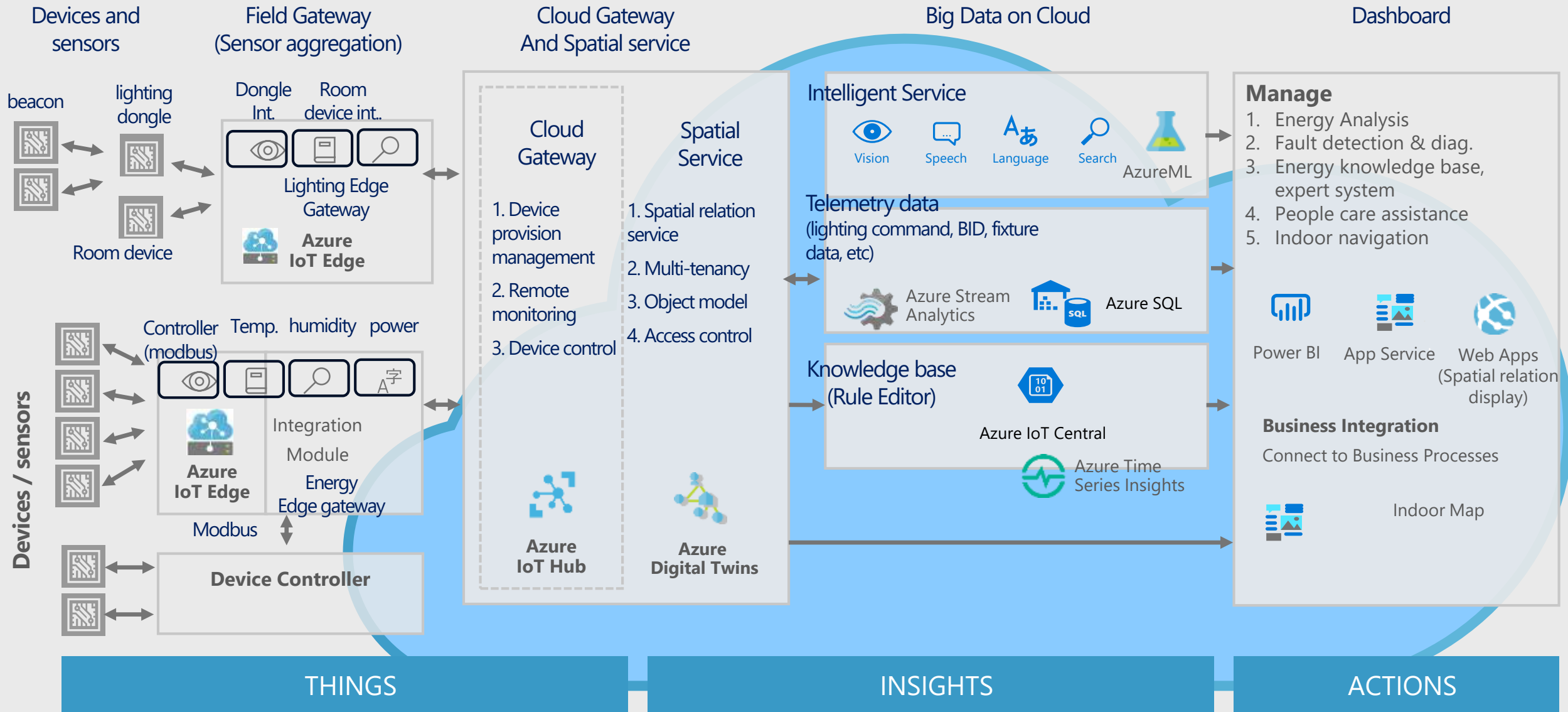


# Intelligent Factory Solution





# Partner Connected Office – Reference Architecture



Thank you



**IoT** in Action