Leveraging Microsoft Cloud for IoT and Embedded Applications

Integrating Device Connectivity in IoT & Embedded devices

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Microsoft

EASTRONICS

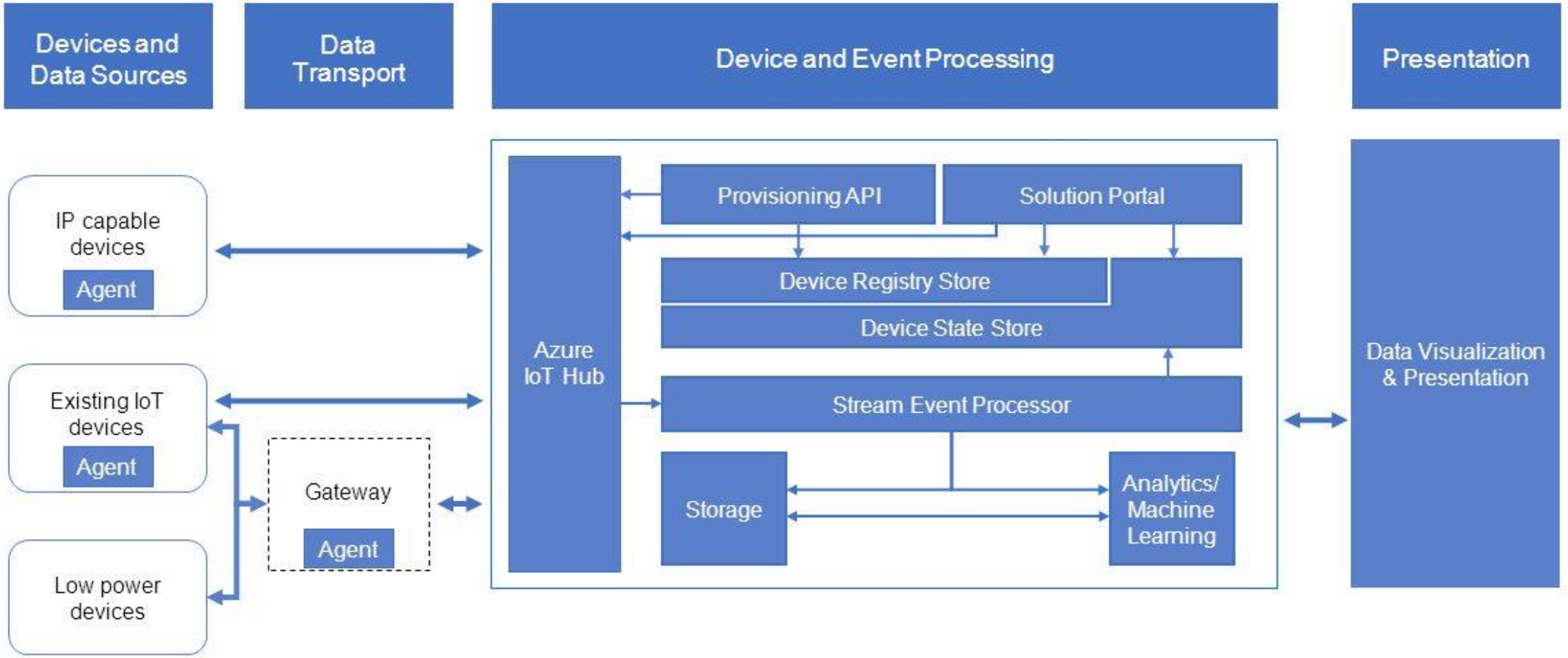
About me

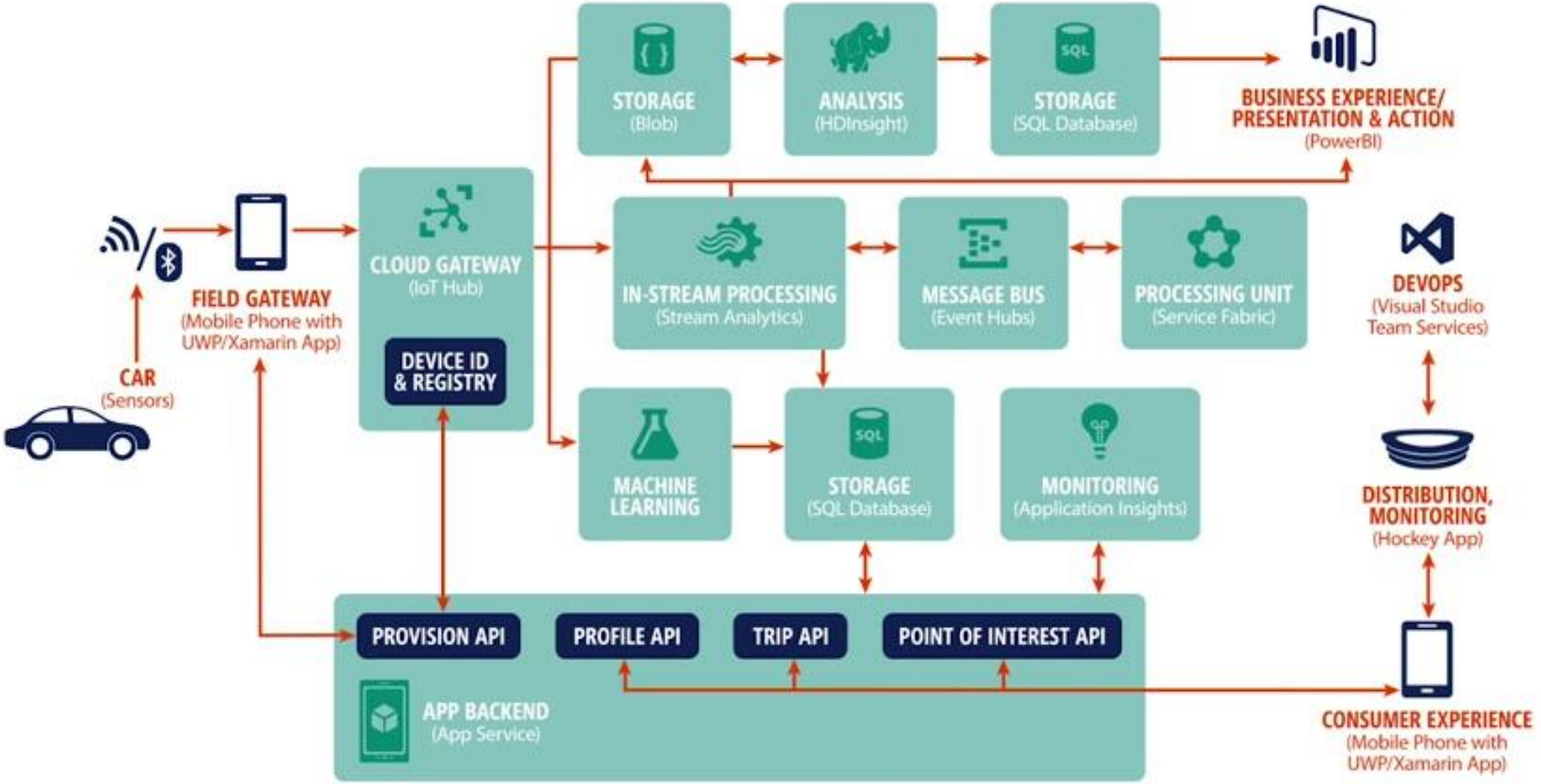
- **Tom Zamir** – IoT Solutions Specialist
  - Independent Consultant
  - Helping Companies design and implement IoT strategies from Device to Cloud to Customer
  - Background in IT/OT and DevOps Engineering
  - Experience with Agro-tech startups and device manufactures
  - Working experience with various IoT Platforms, hardware and software configurations
- Why am I here
  - Partnership with **EASTRONICS** to offer complete end-to-end IoT Solutions on Azure
  - Expertise in IoT Cloud Infrastructure and Azure
  - Passion for emerging IoT Technologies and the **Azure IoT Offerings**

Agenda

- IoT Architecture and Device Lifecycle
- The **Azure IoT Hub**
- Adding Connectivity to your devices with **Azure IoT Device SDK**
- Managing your devices with **Azure IoT Services SDK**
- Operating on the edge with **IoT Edge Gateway SDK**
- Orchestrating your IoT solution with the **Azure IoT Suite**
- Demo - Cloud to Cloud capabilities

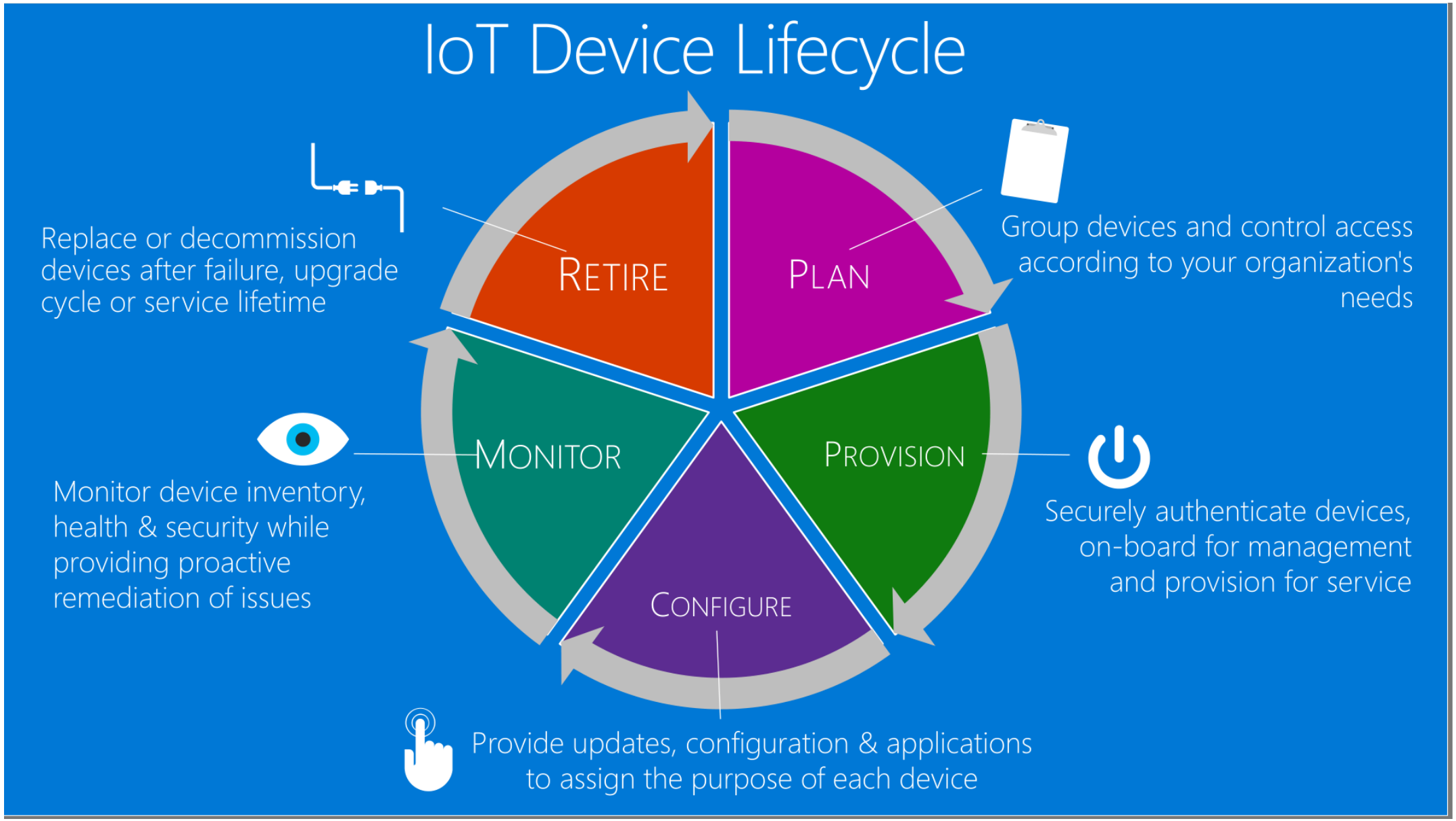
Azure IoT Reference Architecture





Sensor to User Application Solutions

IoT Device Lifecycle

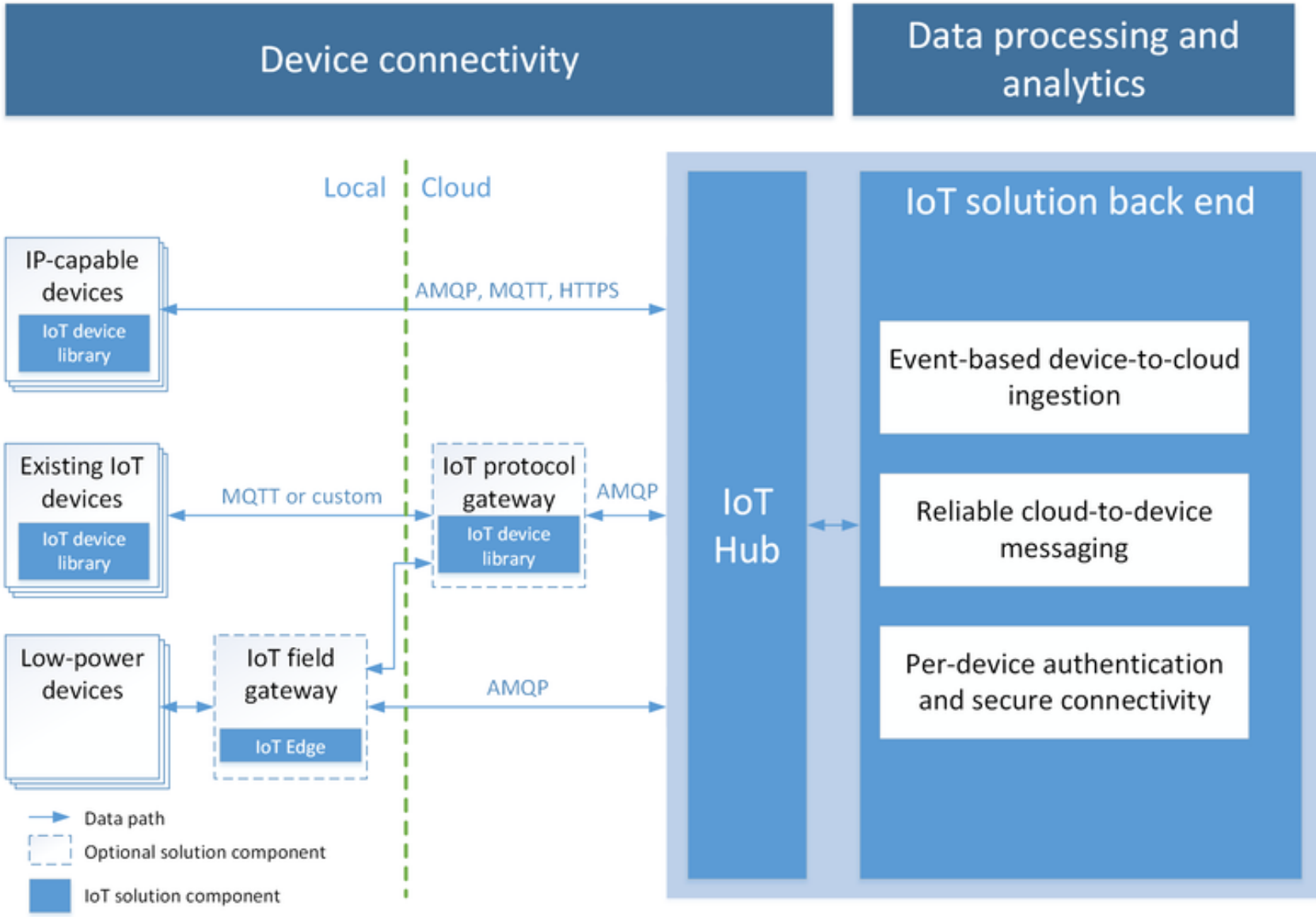


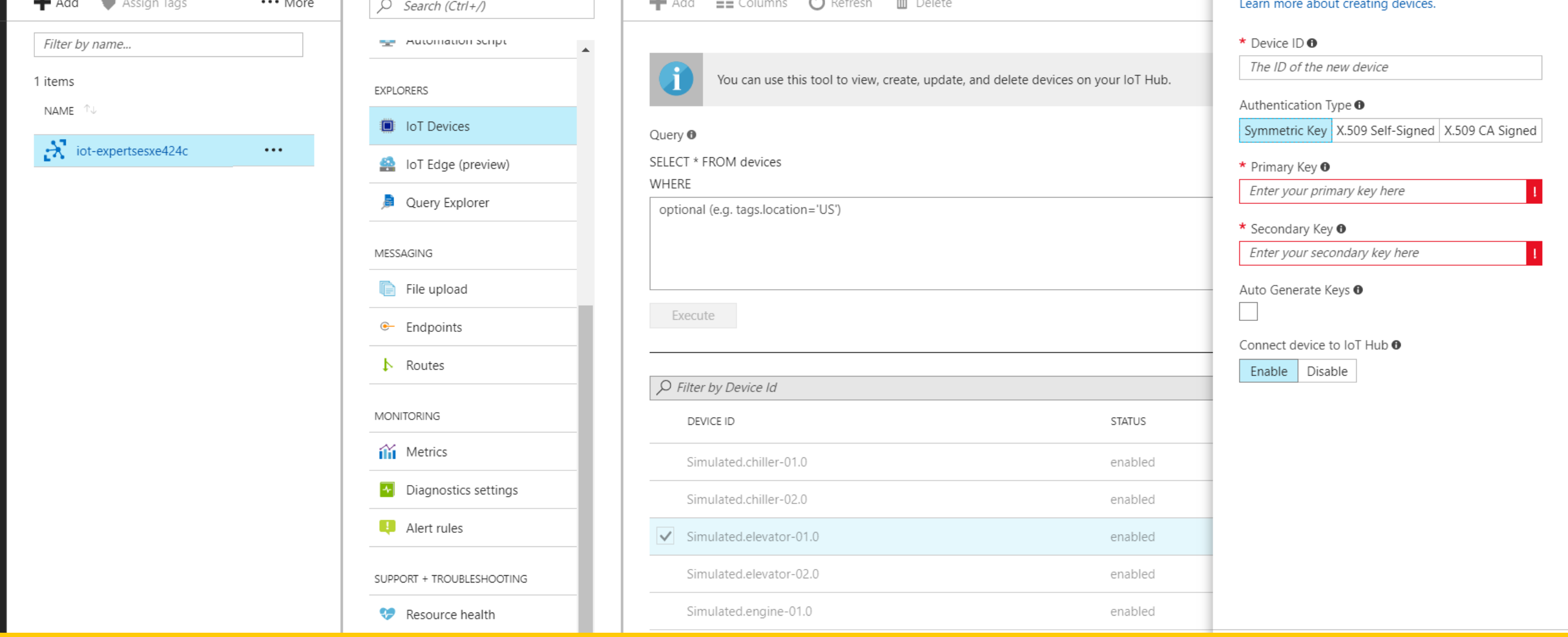
Azure IoT Hub

- Establish bi-directional communication with billions of IoT devices
- Authenticate per device for security-enhanced IoT solutions
- Register devices at scale with IoT Hub Device Provisioning Service
- Manage your IoT devices at scale with device management
- Extend the power of the cloud to your edge device

Azure IoT Hub

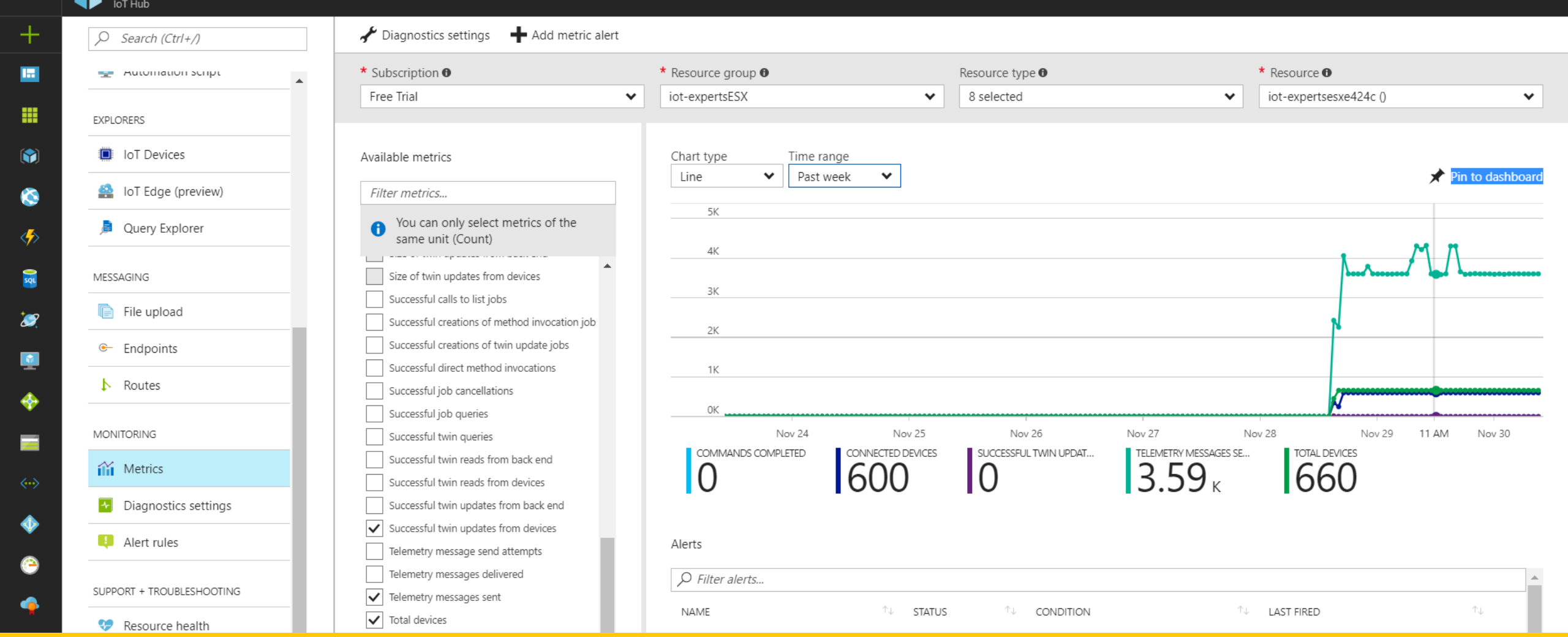
- Device Twins
- Device authentication and secure connectivity
- device-to-cloud messages
- Rule-base data routing
- Monitoring device connectivity and Operations
- IoT protocols and extensibility
- Scale and High Availability
- Open-source SDKs





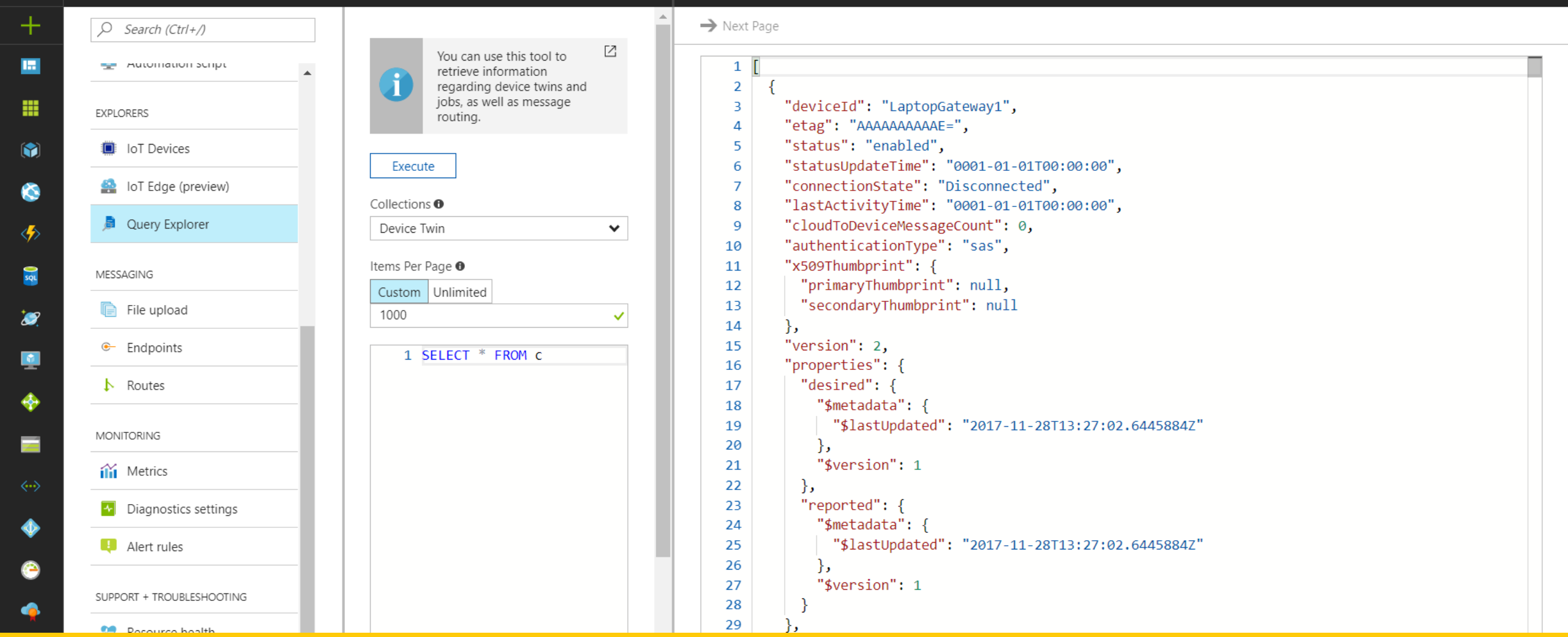
Azure IoT Hub – Manage your Devices

Add, remove, view, interact with your devices



Azure IoT Hub – Monitor your Hub/Devices

Quickly visualize your network, identify bottlenecks, alerts, and overall hearlth



Azure IoT Hub – Query Explorer

Query traffic on your IoT Hub, from incoming payloads, to job execution

Azure IoT SDKs (open source)

Azure IoT SDKs

- **Device SDK -** enable you to build apps that run on your IoT devices. These apps send telemetry to your IoT hub, and optionally receive messages from your IoT hub.
- **Service SDK -** enable you to manage your IoT hub, and optionally send messages to your IoT devices.
- **Azure IoT Edge SDK -** enables you to build gateways for devices that don't use one of the supported protocols. Gateways can also process messages on the edge.

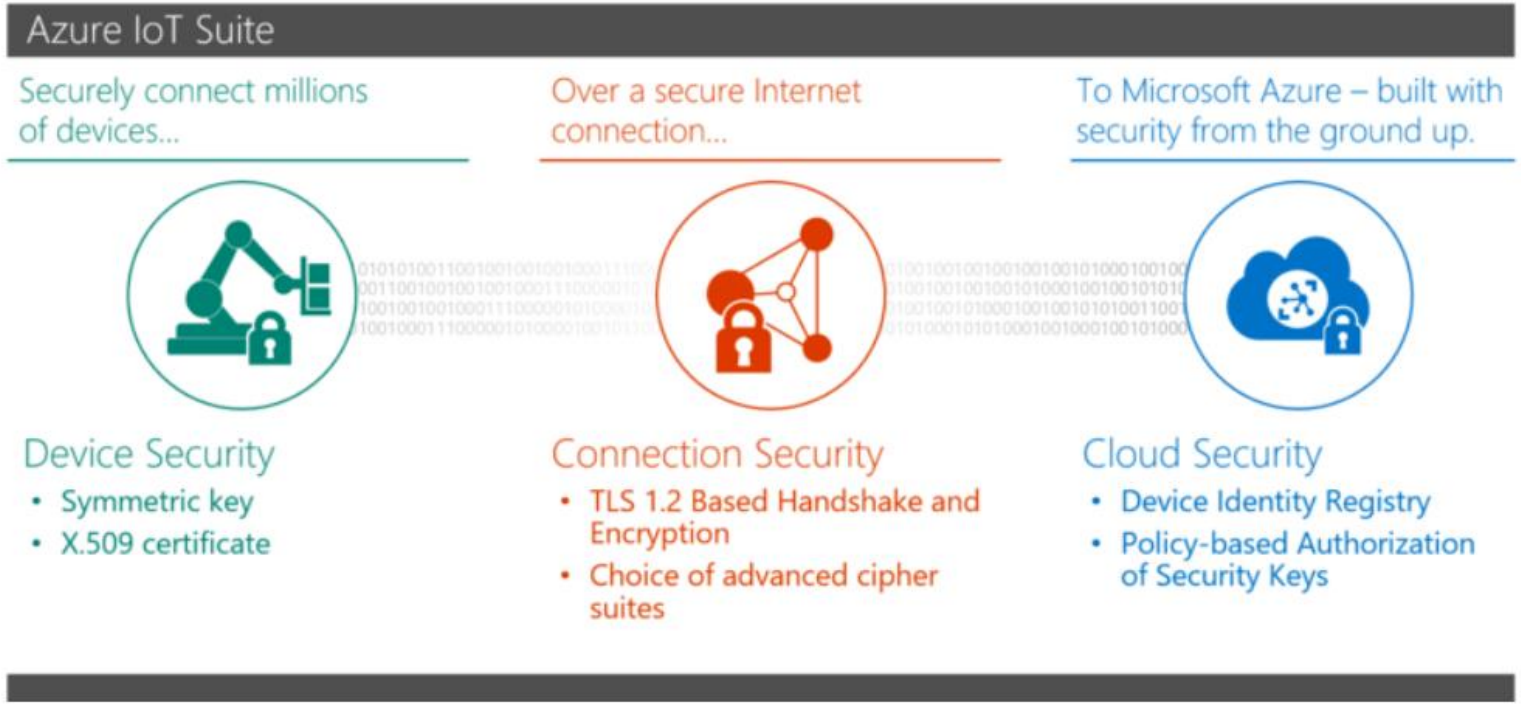
Azure IoT **Device** SDK

Azure IoT **Device** SDK

- Device Authentication
- Send and receive massages to the Azure IoT Hub.
- Communicate with the service via AMQP, MQTT or HTTP.
- Synchronize an Azure IoT Hub device Twin with Azure IoT Hub from a device
- Implement Azure IoT Hub Direct Device Methods on devices
- Implement Azure IoT Device Management features on devices

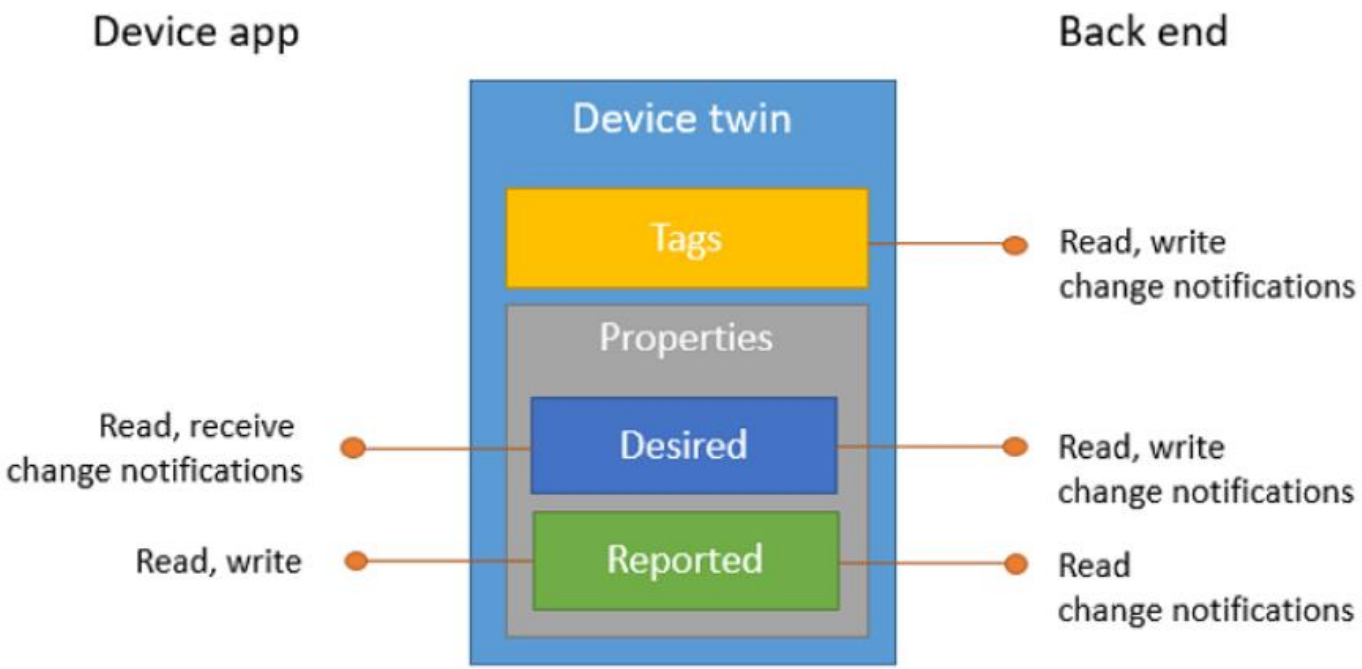
Azure IoT **Device** SDK – Authentication

- Symmetric Key
- X.509 Certificate
- TLS 1.2 Encryption
- Trusted Platform Module (TPM)



Azure IoT **Device** SDK – Device Twins

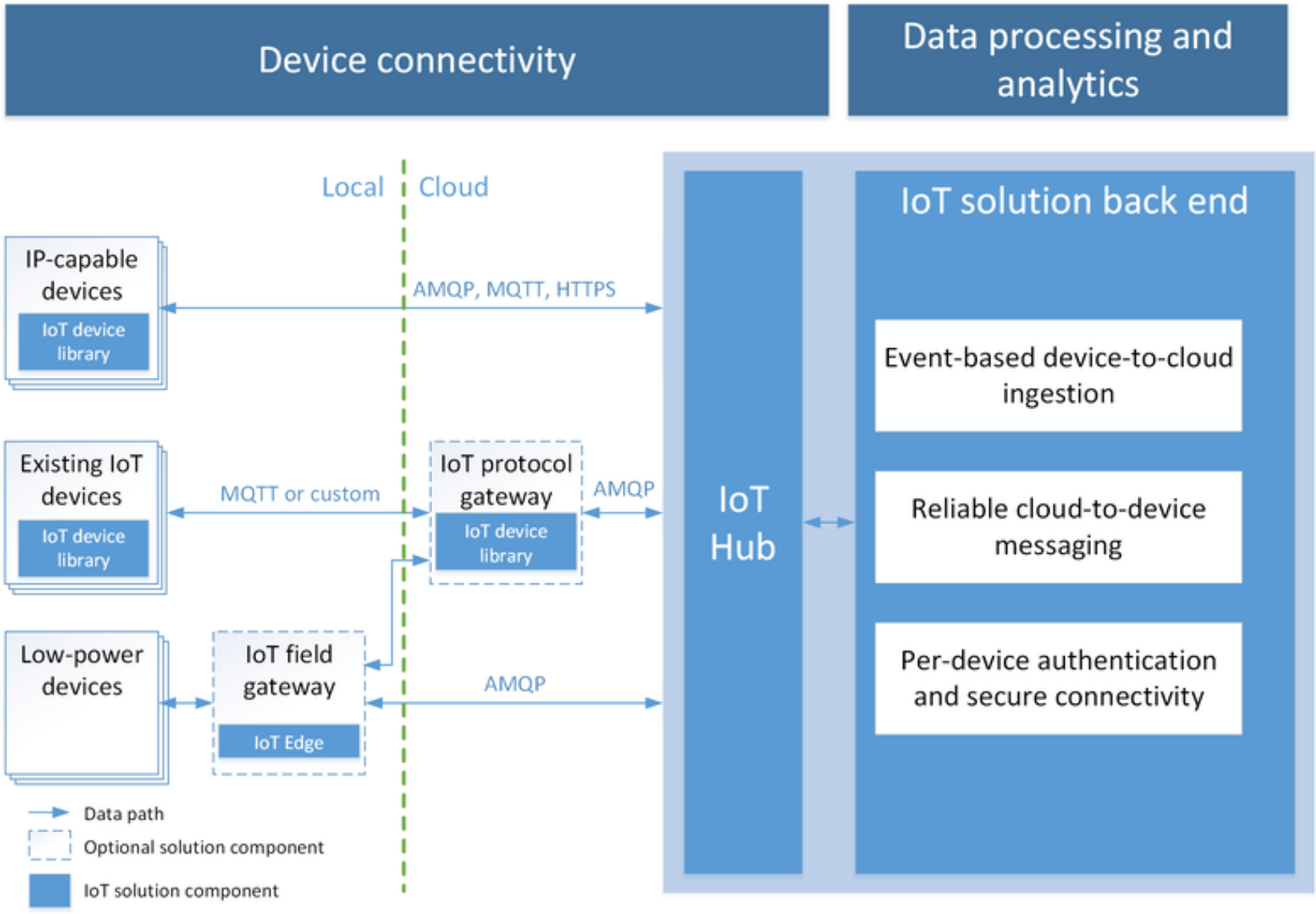
- Device Metadata
- Device tags
- Device configurations
- Device long-running operations (firmware updates)



Azure IoT **Device** SDK – cont.

More features

- Direct methods
- Upload to blob storage
- Send/Receive Messages
- Retry polices



Azure IoT **Device** SDK - Example

Add IoT functionality to Digital Door Viewer

Previous model functionality:

- When motion sensor active, show camera feed on digital screen
- Click to take picture and save to SD card

New model

- When motion sensor active, capture image and upload to cloud
- Send Alerts to Mobile Phone
- Analyze with FACE API
- Optional: unlock door if face recognized using BLE door-lock, remote-unlock door

Azure IoT **Services** SDK

Azure IoT **Services** SDKs

- Send and Receive messages from Azure IoT Hub.
- Communicate with the service via AMQP, MQTT or HTTP.
- Update Azure IoT Hub device Twins
- Set Jobs to run operations on multiple devices
- Implement Azure IoT Hub Direct Device Methods on devices
- Implement Azure IoT Device Management features on devices

```
'use strict';

var Client = require('azure-iothub').Client;

var connectionString = '<Hub Connection String>';
var targetDevice = '<Device Id>';
var methodParams = {
  methodName: '<Method Name>',
  payload: '[Method Payload]',
  responseTimeoutInSeconds: 15 // set response timeout as 15 seconds
};

var client = Client.fromConnectionString(connectionString);

client.invokeDeviceMethod(targetDevice, methodParams, function (err, r
  if (err) {
    console.error('Failed to invoke method \'' + methodParams.methodNa
  } else {
    console.log(methodParams.methodName + ' on ' + targetDevice + ':')
    console.log(JSON.stringify(result, null, 2));
  }
});
```

Azure IoT **Services** SDKs

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});
```

Azure IoT **Services** SDK

Features	Support	Description
Identity registry (CRUD)	✔	Use your backend app to perform CRUD operation for individual device or in bulk.
Cloud-to-device messaging	✔	Use your backend app to send cloud-to-device messages in AMQP and AMQP-WS, and set up cloud-to-device message receivers.
Direct Methods operations	✔	Use your backend app to invoke direct method on device.
Device Twins operations	✔*	Use your backend app to perform device twin operations. *Twin reported property update callback and replace twin are in progress.
Query	✔	Use your backend app to perform query for information.
Jobs	✔	Use your backend app to perform job operation.
File Upload	✔	Set up your backend app to send file upload notification receiver.

Azure IoT **Services** SDKs - Example

When inventory is added to ERP

- Provision new device in IoT Hub – set Device twin {
  - Status = Inventory
  - Location = Warehouse 1 }

When item is ordered, where Order to Cash process is: Inventory -> Test - > Ship

  - Set Device twin { status = testing}

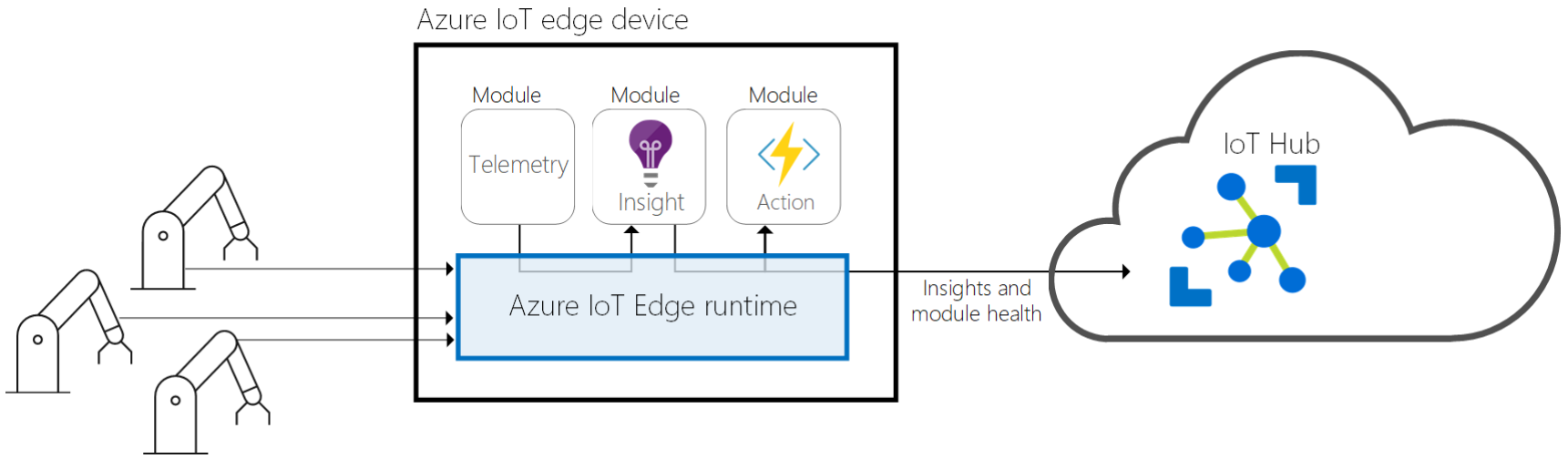
When device is shipped to Customer

  - Set device twin { status = production; customer = John Brown, Counter=Canada}

Azure IoT **Edge Gateway** SDK

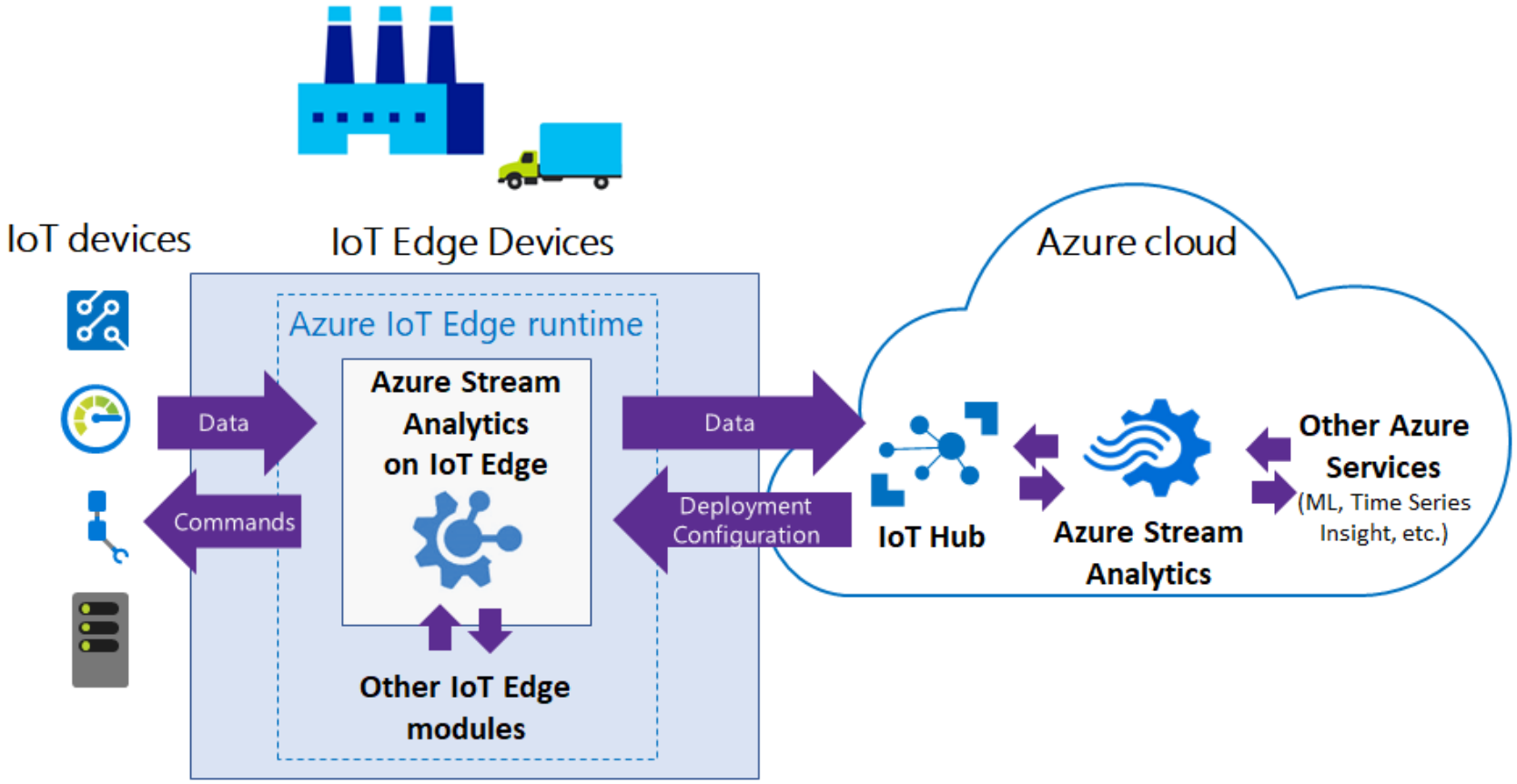
Azure IoT Edge **Gateway** SDK

- **BYOH – Bring your own Hardware**
- **BYOC - Bring your own code**
- **Artificial Intelligence and Machine Learning on the edge**
- **IoT Edge cloud interface**
- **Multiple Protocols**

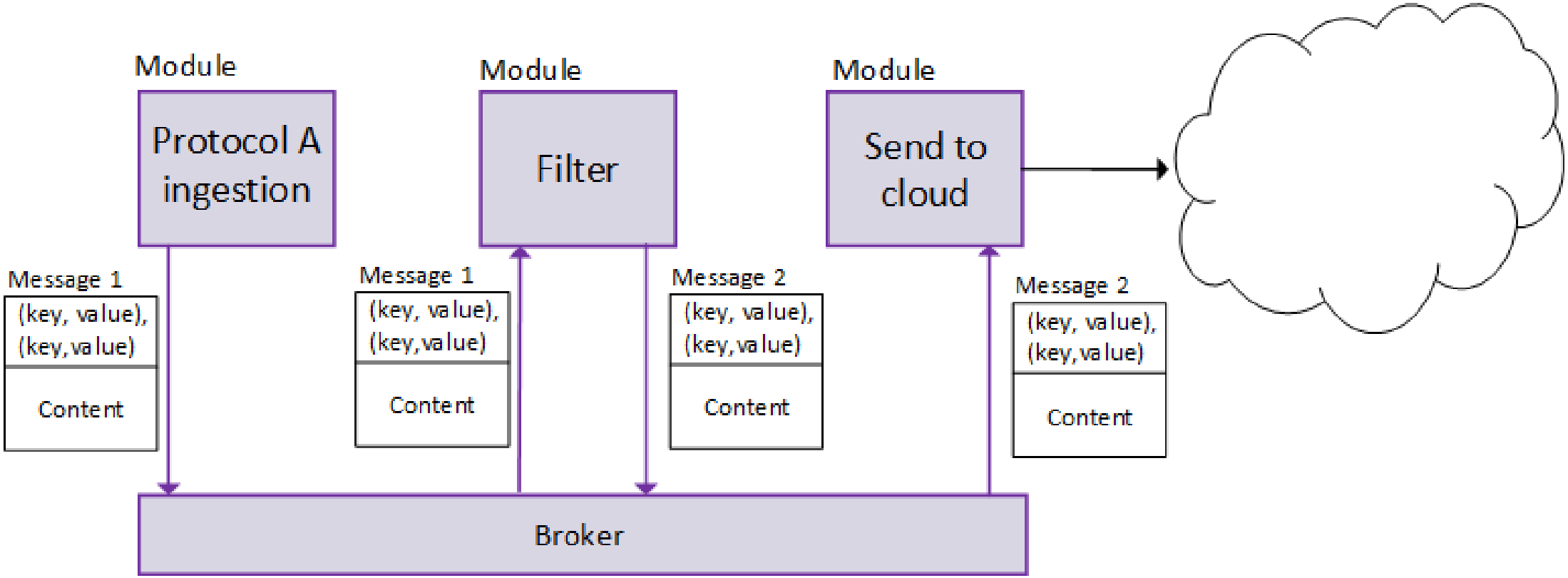


Azure IoT **Edge Gateway** SDK

- Deploy Cloud Logic
- Modular approach
- Filter data
- Machine Learning on the Edge
- Azure Functions on the Edge
- Manageable at Scale
- Runs on Windows/Linux

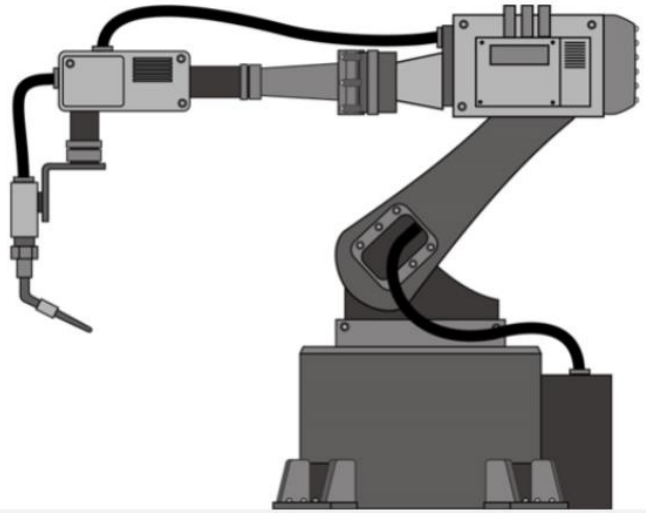


Azure IoT **Edge Gateway** SDK - Modules



Azure IoT **Edge** SDK - Example

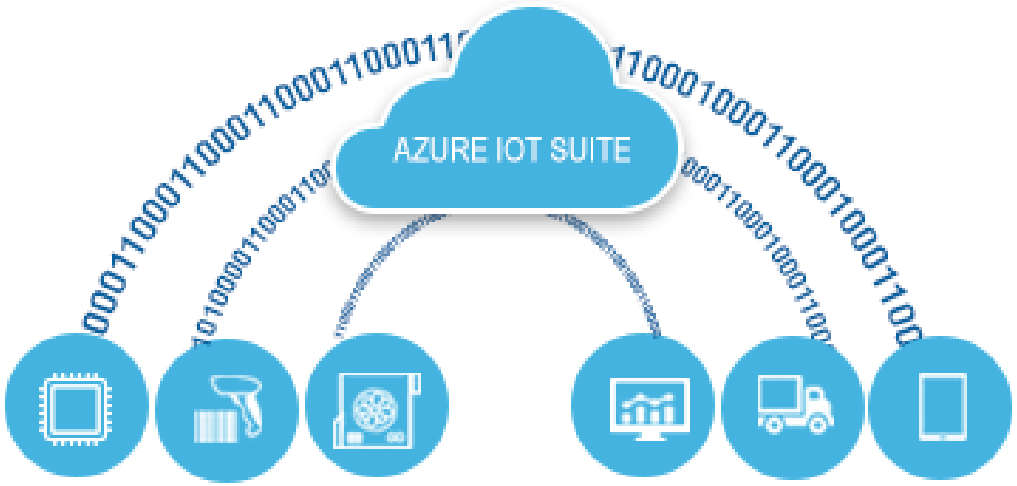
- Your Industry 4.0 Customer wants to connect a new machine to the Gateway and to see the data in his Connected Factory Solution.
  - After receiving the specifications, your engineers develop a new module to support it.
  - Deploy the new module to the IoT Edge Gateway at Customer location
  - Provision device to Customer Solution
  - Assign new rules to device
  - View data



Azure IoT **Suite** & **Time Series Insights**

Azure IoT Suite

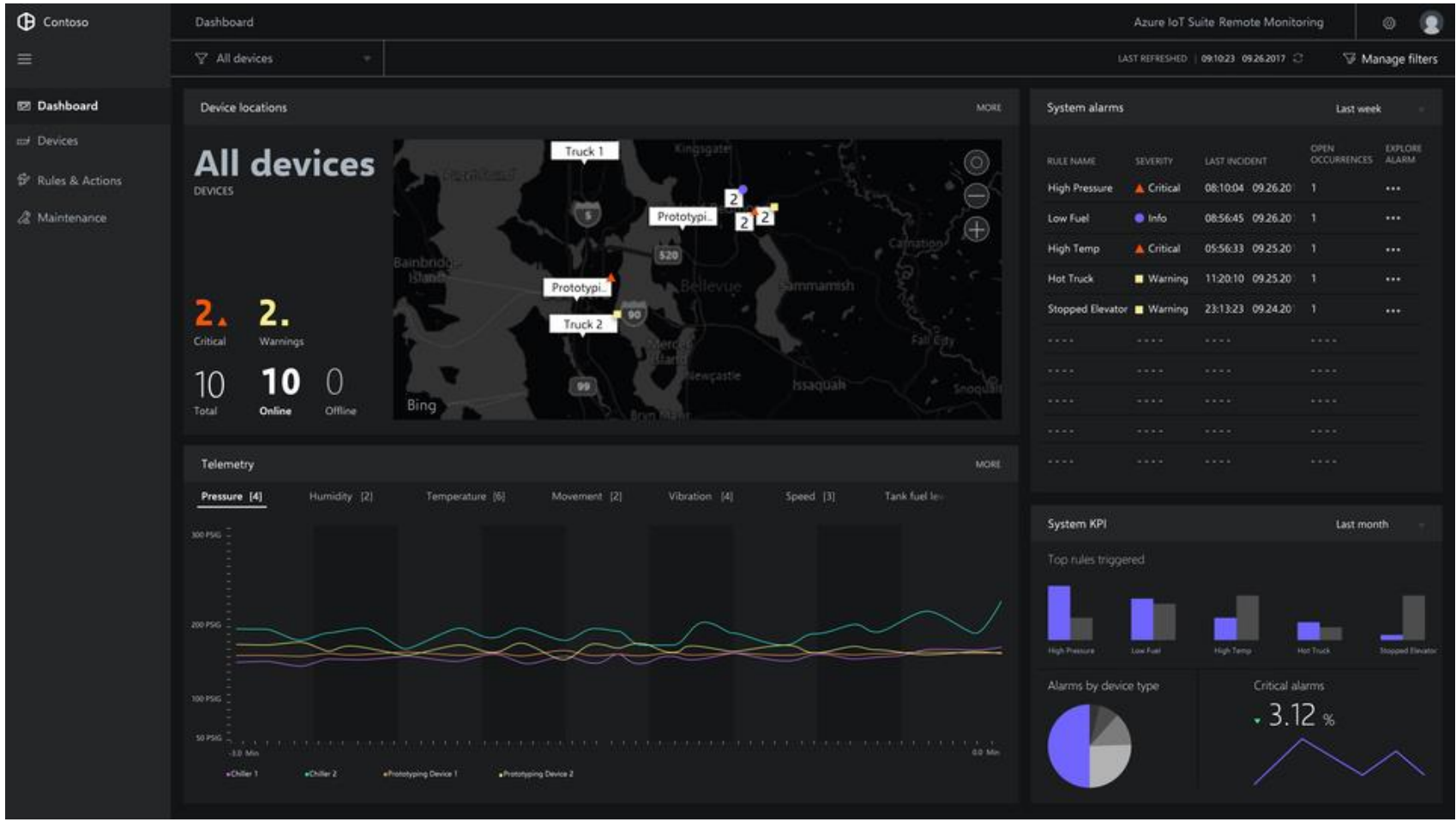
- **Remote Monitoring / Predictive Maintenance / Connected Factory**
- **Start in minutes**
- **Customize to your own needs**
- **Connect your devices and systems**
- **Discover new insights**
- **Enhance security**



Azure IoT Suite

Remote Monitoring

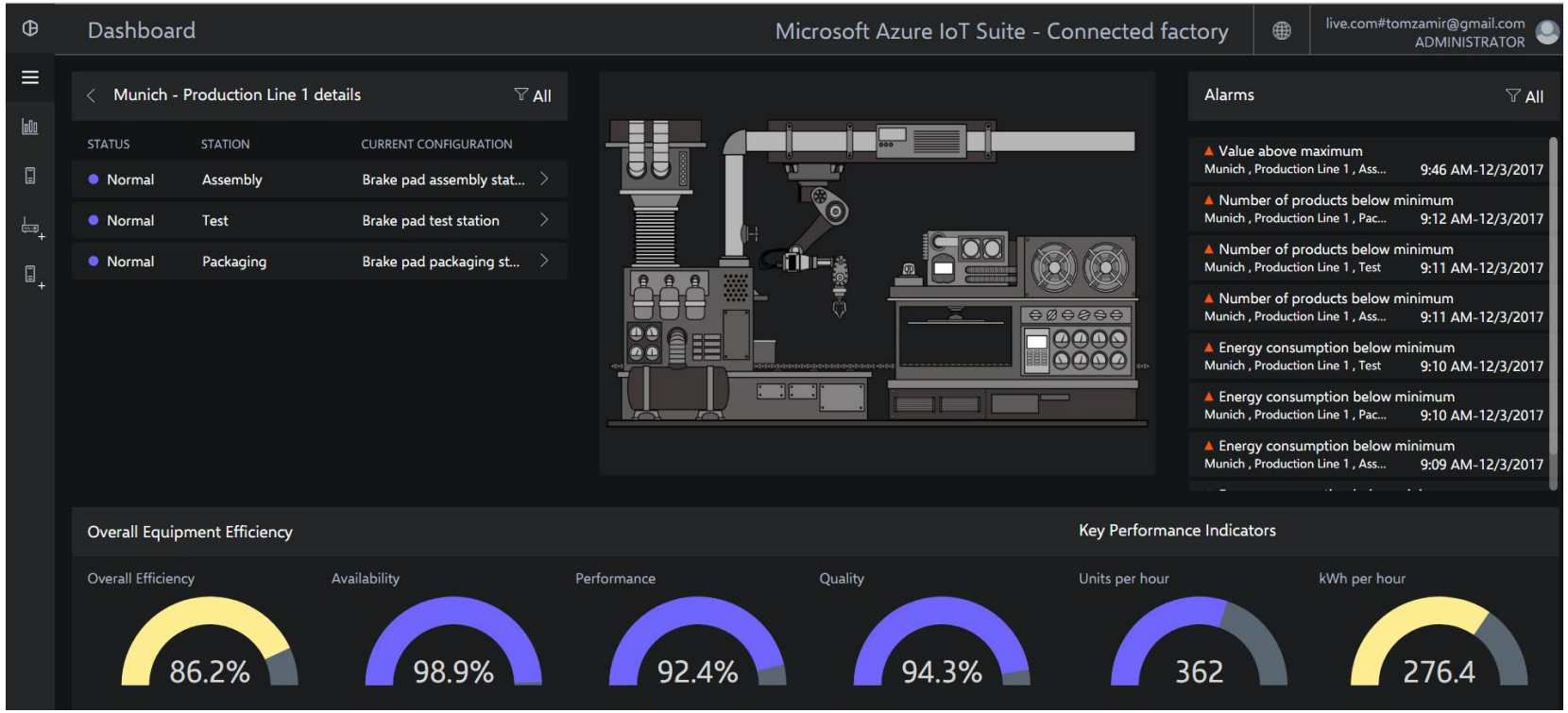
- View and interact with Alerts
- Monitor devices
- Filter by device type
- Add new devices



Azure IoT Suite

Connected Factory

- Connect to OPC UA server
- Deploy gateway to connect
- Setup Alerts and KPIs
- Filter by device type
- Acknowledge alerts



Time Series Insights

- Storing time series data in a scalable way.
- Near real-time data exploration.
- Root-cause analysis and anomaly detection.
- It can ingress from 1 million to 100 million events per day, with a default retention span of 31 days.

Azure IoT **Cloud to Cloud** Demo

Azure IoT – Cloud to Cloud Capabilities

- **Use REST API to interact with Azure IoT Hub**
- **Send real-time data to Azure Event Hub**
- **Use Stream Analytics to route the data everywhere**
- **Use PowerBI to Visualize and Analyze**

Demo

Cloud To Cloud - DEMO

Monitoring Flow - Sensor to Cloud

Light Sensor -> U-Control Wireless Node - > U-Control Gateway -> Telit DeviceWise
Telit DeviceWise -> Azure Event Hub -> Stream Analytics -> Database & PowerBI

Control Flow Cloud to Light Relay

Telit DeviceWise <--> U-control Gateway <--> U-Control Control Unit -> Light
Telit DeviceWise -> Azure Event Hub -> Azure Stream Analytics -> DocumentDB & PowerBI

Thank You!

COME VISIT ME AT THE BOOTH

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