AZURE IoT Hub

Microsoft

IoT Hub


https://docs.microsoft.com/en-us/azure/iot-hub/

Azure IoT Hub

Enterprise scale and integration

Millions of devices
Multi-language, open source SDK
HTTPS/AMQP/MQTT
Send telemetry
Receive commands
Device management
Device twins
Queries and jobs

End-to-end
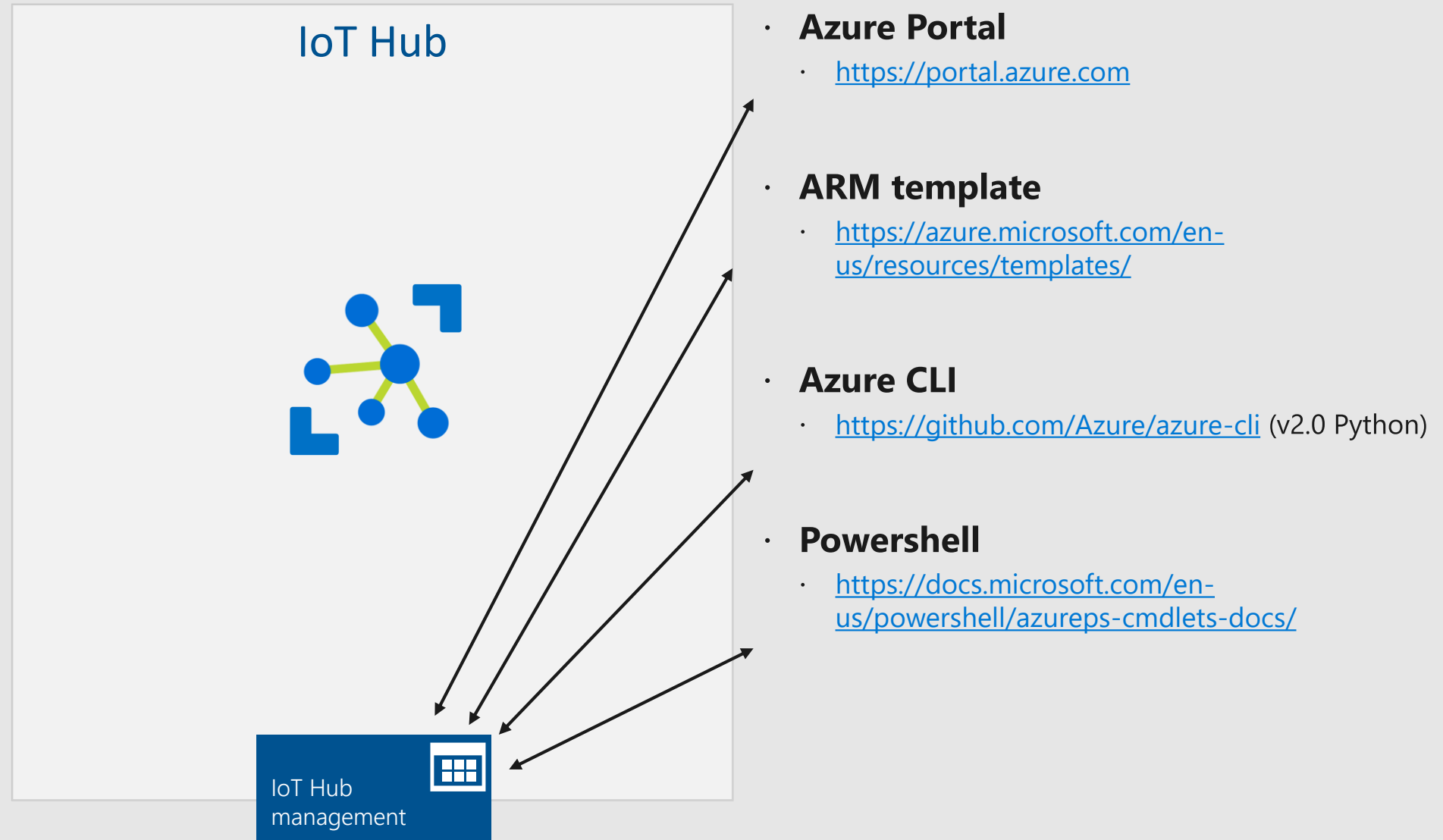
Billions of messages
Scale up and down
Declarative message routes
File upload
Web sockets and multiplexing
Azure monitor
Azure resource health
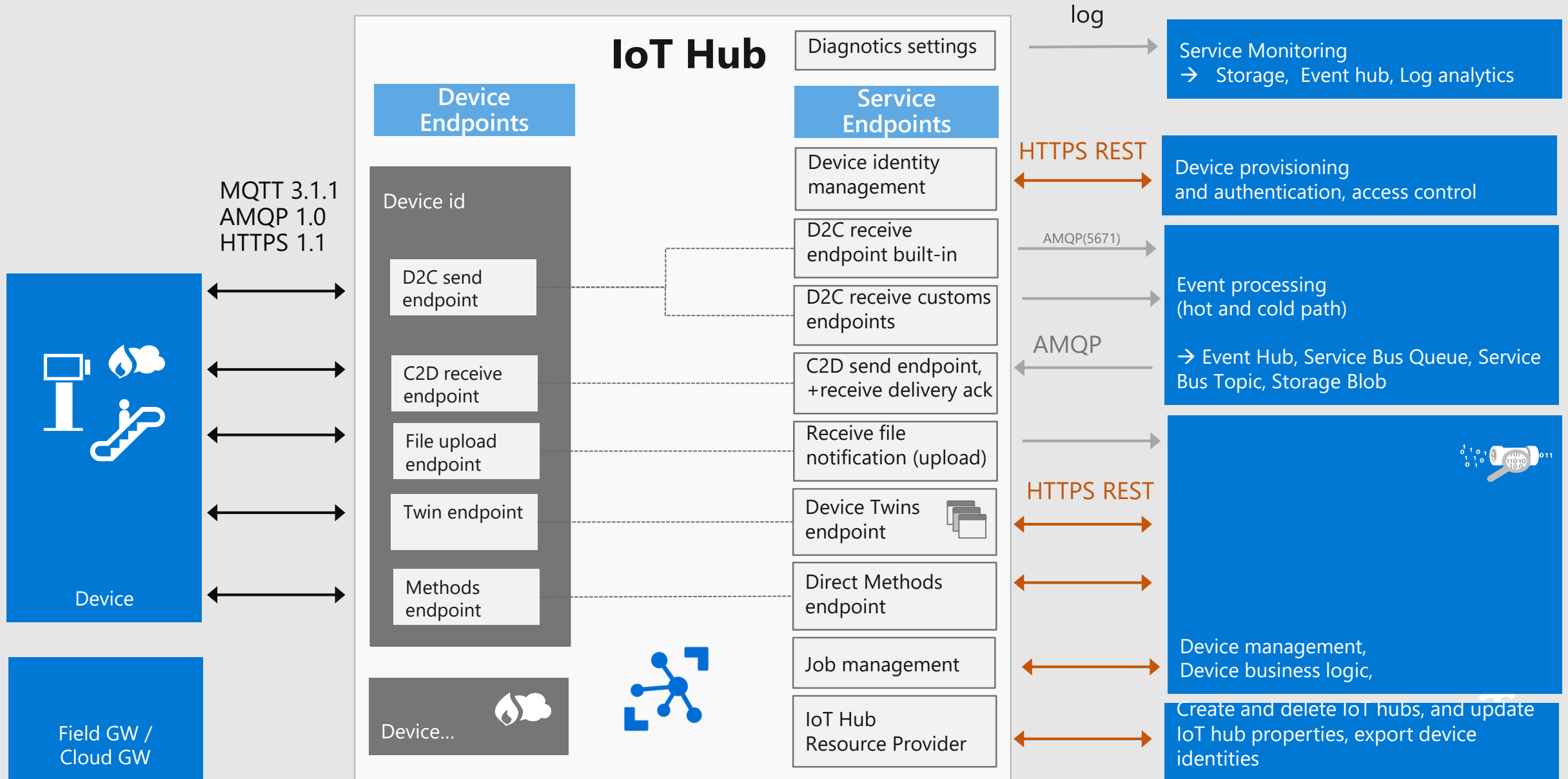Configuration management security
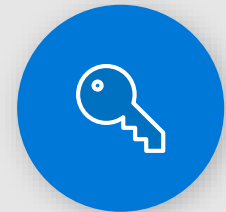
Bi-directional communication

Per device certificates
Per device enable/disable
TLS security
X.509 support
IP whitelisting/blacklisting
Shared access polices
Firmware/software updates

Many ways to customize your IoT Hub

IoT Hub
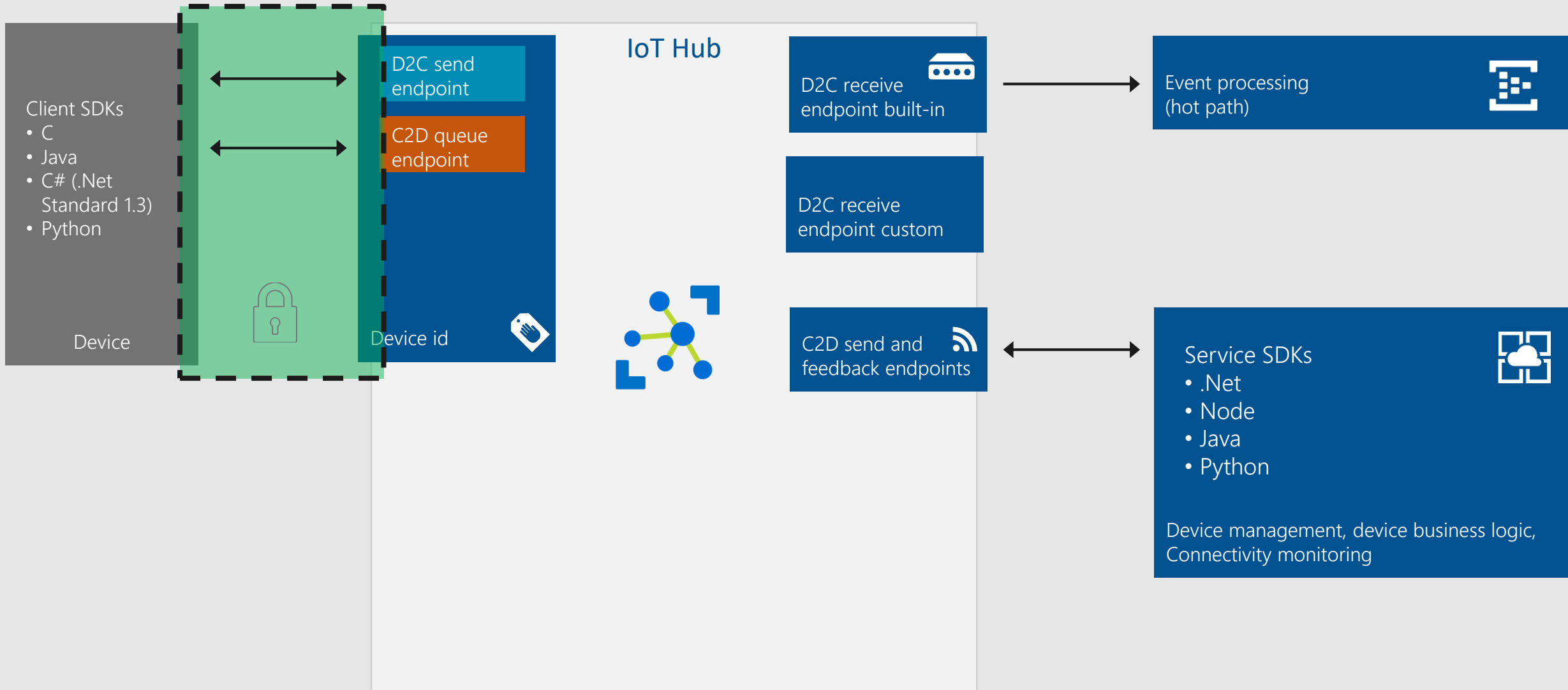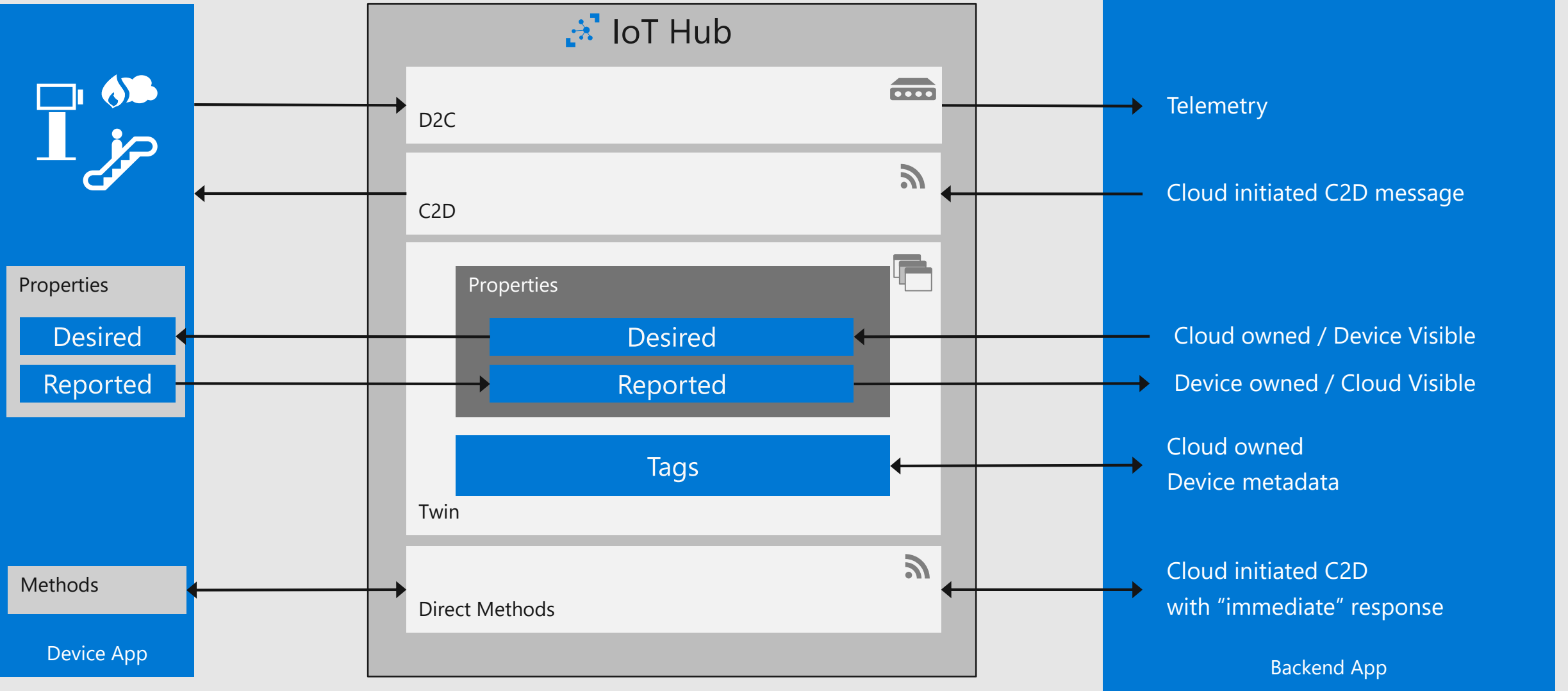
IoT Hub management

- **Azure Portal**
  - https://portal.azure.com

- **ARM template**
  - https://azure.microsoft.com/en-us/resources/templates/

- **Azure CLI**
  - https://github.com/Azure/azure-cli (v2.0 Python)

- **Powershell**
  - https://docs.microsoft.com/en-us/powershell/azureps-cmdlets-docs/

Azure IoT Hub Endpoint

https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-devguide-endpoints

IoT Hub

log

Diagnotics settings

Service Monitoring
→ Storage, Event hub, Log analytics

Device Endpoints

Service Endpoints

MQTT 3.1.1
AMQP 1.0
HTTPS 1.1

Device id

Device identity management

HTTPS REST

Device provisioning and authentication, access control

D2C send endpoint

D2C receive endpoint built-in

AMQP(5671)

D2C receive customs endpoints

Event processing (hot and cold path)

C2D receive endpoint

C2D send endpoint, +receive delivery ack

AMQP

→ Event Hub, Service Bus Queue, Service Bus Topic, Storage Blob

File upload endpoint

Receive file notification (upload)

Twin endpoint

Device Twins endpoint

HTTPS REST

Methods endpoint

Direct Methods endpoint

Job management

Device management, Device business logic,

Device...

IoT Hub Resource Provider

Create and delete IoT hubs, and update IoT hub properties, export device identities

Device

Field GW / Cloud GW

Send/receive data via IoT Hub

Device

Client SDKs
- C
- Java
- C# (.Net Standard 1.3)
- Python

IoT Hub

D2C send endpoint

C2D queue endpoint

Device id

D2C receive endpoint built-in

D2C receive endpoint custom

C2D send and feedback endpoints

Event processing (hot path)

Service SDKs
- .Net
- Node
- Java
- Python

Device management, device business logic, Connectivity monitoring

Manage through Device Twin and Methods

IoT Hub

Device App

- Properties
  - Desired
  - Reported
- Methods

IoT Hub:
- D2C
- C2D
- Twin
  - Properties
    - Desired
    - Reported
  - Tags
- Direct Methods

Backend App:
- Telemetry
- Cloud initiated C2D message
- Cloud owned / Device Visible
- Device owned / Cloud Visible
- Cloud owned
  Device metadata
- Cloud initiated C2D with "immediate" response

D2C scenario recommendations

	D2C message	Twin's Reported Properties	File Upload
Scenario	Telemetry and alerts (time series, read sequential)	Synchronizing long-running workflows, such as configuration and software updates.	Large media files. (cold storage)
Size	Up to 256KB messages (up to 7 days)	Maximum reported properties size is 8KB.	Maximum file size supported by Azure Blob Storage.
Frequency	High	Medium	Low

C2D scenario recommendations

	Direct methods	**Twin's Desired Properties**	**C2D messages**
Scenario	Commands that require immediate confirmation	Long-running commands	One-way notifications to the device
Size	8KB requests / 8KB responses. Immediate response	Maximum 8KB	64KB, up to 48 days One queue / device Guaranty of delivery (TTL, feedback)
Frequency	High	Medium	Low

Send device to cloud messages

IoT Hub messages

Device to cloud message:
"message": {
 "systemProperties": {
 "contentType": "application/json",
 "contentEncoding": "utf-8",
 "iothub-message-source": "deviceMessages",
 "iothub-enqueuedtime": "2017-05-08T18:55:31.8514657Z" },
 "appProperties": {
 "processingPath": "<optional>",
 "verbose": "<optional>",
 "severity": "<optional>",
 "testDevice": "<optional>"
 },
 "body": "{\"Weather\":{\"Temperature\":50}}"
 }
}

Device Twin:
{
  "tags": {
    "deploymentLocation": {
      "building": "43",
      "floor": "1"}
  },
  "properties": {
    "desired": {
      "telemetryConfig": {
        "sendFrequency": "5m"},
      "$metadata": {...},
      "$version": 1
    },
    "reported": {
      "telemetryConfig": {
        "sendFrequency": "5m",
        "status": "success"},
      "batteryLevel": 55,
      "$metadata": {... },
      "$version": 4
    }
  }
}

Device

IoT Hub

$twin.tags.building = 43

severity = "high"

$body.Weather.Temperature = 50 AND $twin.properties.desired.telemetryConfig.sendFrequency = '5m'

routing queries

D2C built-in endpoint

Custom endpoints connectors

Event processing (hot path)

Event Hub

Service Bus Topics

Service Bus Queues

Storage Blob

Event processing (hot and cold path)

Routing telemetry data

Device

```
Header:
$content-encoding = "utf-8"
$content-type =
"application/json"
my-message-type = "alert"
Body
{
  "Weather":{
    "Temperature":50,
    "Time":"01:23:12Z"
  }
}
```

IoT Hub

D2C receive endpoint

Routing rules (query)

```
SELECT * FROM Devices
WHERE tags.location = "bldg43"
```

```
my-message-type = "alert"
```

```
$body.Weather.Temperature > 75
```

Custom endpoints connectors

Event processing (hot path)

Event Hub

Service Bus Topics

Service Bus Queues

Storage Blob

Event processing (hot and cold path)

Jobs and Queries

IoT Hub

Device Twin/Methods

Devices

Jobs

Schedule and Broadcast Device Twin Changes

Set Desired Properties, Tags, Call Methods

Queries

Query Across Device Twin State

For Business Logic, Reporting and Compliance

Device management, device business logic, Connectivity monitoring

Automatic Device Management

Device app

IoT Hub

Back end

Configuration

- Target cond.
  - Query
- Target content
  - Desired props
- Metrics
  - Queries
  - Counts

Device twins

- Desired properties
  - Data
- Reported properties
  - Data
- Tags

Desired config changed event

Configuration performed and status reported*

Status aggregation

1 Set query for targeted devices, desired props for settings update, and queries for summary statistics

2 Hub updates all twins in scope

3

4

5

6 Operator dashboard displays statistics

7 Operator looks at twin for detailed status

*May involve multiple calls

IoT Hub SDK

Connect your devices

Use the [Azure IoT device SDK](#) libraries to build applications that run on your devices and interact with IoT Hub. Supported platforms include multiple Linux distributions, Windows, and real-time operating systems. Supported languages include:
- C
- C#
- Java
- Python
- Node.js.

IoT Hub and the device SDKs support the following protocols for connecting devices:
- HTTPS
- AMQP
- AMQP over WebSockets
- MQTT
- MQTT over WebSockets

If your solution cannot use the device libraries, devices can use the MQTT v3.1.1, HTTPS 1.1, or AMQP 1.0 protocols to connect natively to your hub.

If your solution cannot use one of the supported protocols, you can extend IoT Hub to support custom protocols:
- Use [Azure IoT Edge](#) to create a field gateway to perform protocol translation on the edge.
- Customize the [Azure IoT protocol gateway](#) to perform protocol translation in the cloud.

IoT Hub REST API

Azure service REST APIs have a corresponding client SDK library.

Certified hardware for Azure IoT
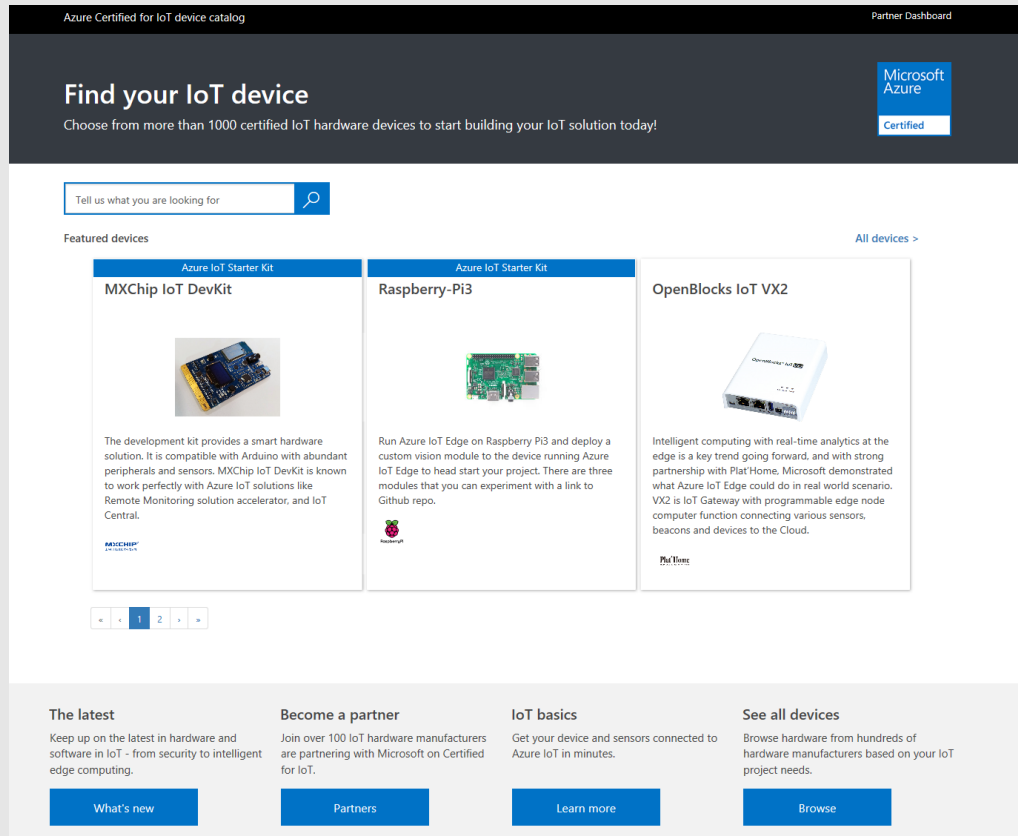
Azure Certified for IoT Device Catalog

- Provides an easy and intuitive way to discover the right IoT device for intended use case

- More than 1000 devices already listed in the device catalog

- Start at https://catalog.azureiotsolutions.com/

Expanded Device Catalog with IoT Edge certified hardware

- Capability based certification for extensibility and long-term sustainability

- Each capability has N number of **levels**. Level 1 being lowest

- Select the best device most suitable for your IoT application

Device Provisionning Service

https://docs.microsoft.com/en-us/azure/iot-dps/

A selection of scenarios

Initial connection	Load balancing	Ownership based	Location based	Re-provisioning
Zero-touch provisioning to a single IoT solution	Across multiple hubs	Connecting devices to their owner's IoT solution based on sales transaction data	Connecting a device to the IoT hub with the lowest latency	Based on a change in the device, e.g. change of ownership
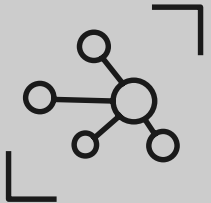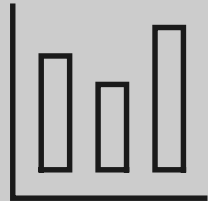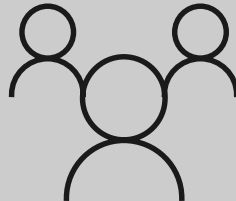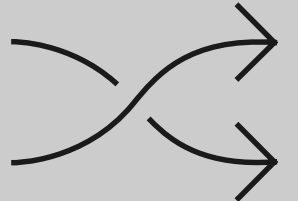
Azure IoT Hub Device Provisioning Service

Simplify with zero touch provisioning

Supports multiple locations

Easiest way to mass-provision devices

URL stability

Enhanced security through HSM/TPM

For any device compatible with IoT Hub

Remove human error

Minimize manual connection requirements

Multitenancy support

Device 100

Device 1000

Device 1

DPS

Device 3

IoT Hub US

IoT Hub India

IoT Hub Japan
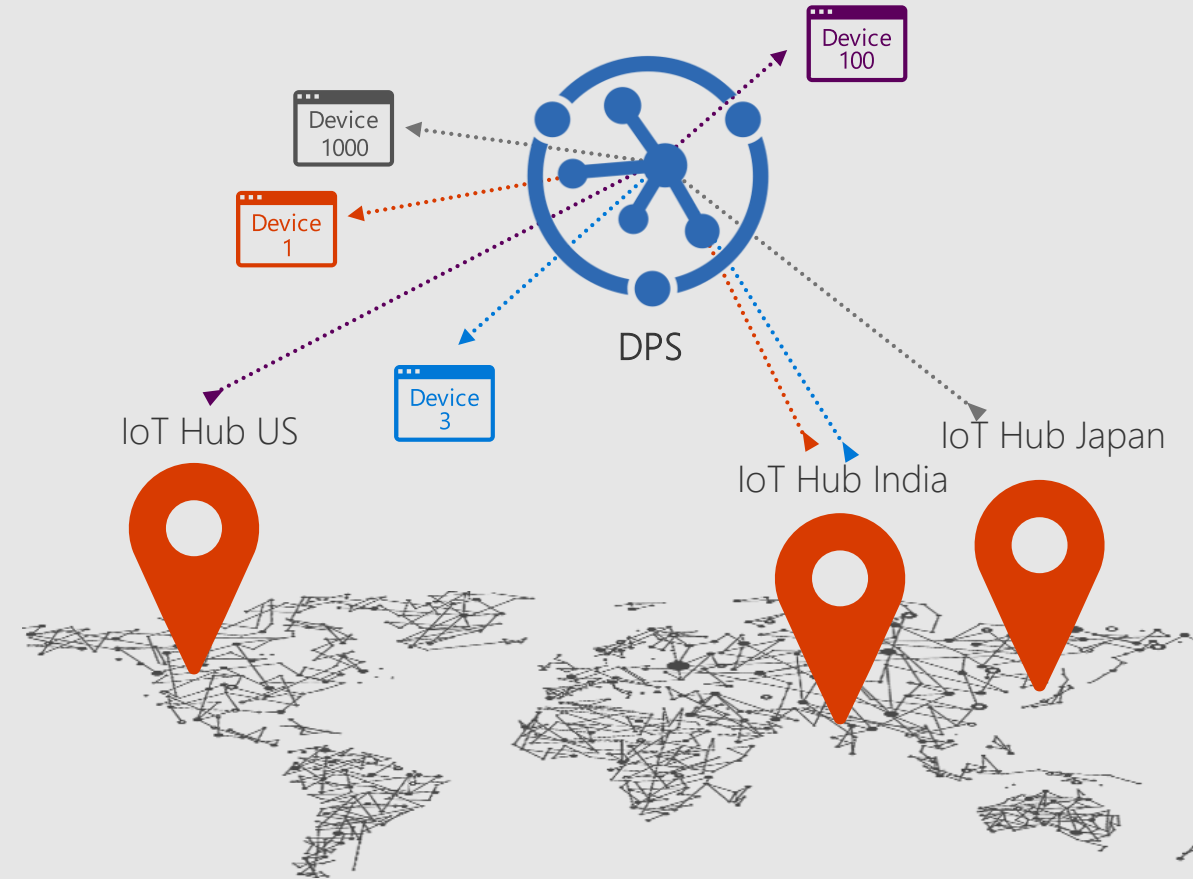
DPS knows exactly which IoT Hub to connect and provision

Setup

Devices know how to phone home

Enrollment list has been populated

IoT hubs have bene linked to DPS

Device allocation policy has been set

Enrollment list

One-stop shop for everything needed to provision a device
- Attestation information
- Initial configuration
- Additional device info

Support for
- Individual enrollments – good for devices with individual configuration needs
- Enrollment groups – good for lots of devices with the same initial configuration

Updatable throughout the supply chain

Linked IoT hubs

Linking an IoT hub to DPS gives DPS permissions to register devices to the hub

Links can be cross-region or cross-subscription

Allocation policies

Determines how DPS assigns devices to linked hubs

- Evenly weighted distribution
- Lowest latency
- Static configuration via the enrollment list
- Custom allocation logic (function)

The allocation policy can be overridden per enrollment entry

Provisioning with DPS

Device enrollment info

Device Provisioning Service

Register new device

Registered device info

IoT Hub

IoT Hub

IoT Hub

IoT Hub

IoT Hub

Device telemetry

Registered device info

IoT Hub

Device telemetry

Initial configuration

...etc

Device

Business logic
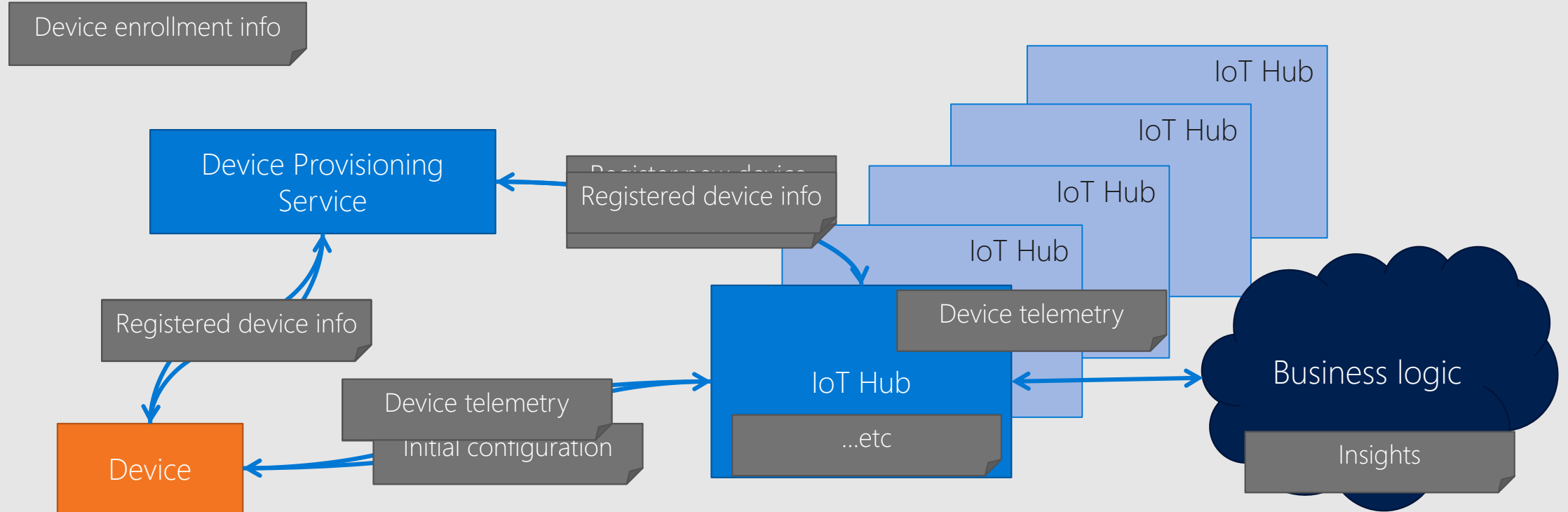
Insights

Time Series Insight

What is Time Series Insight

- Schema-less store, just send data, we determine the shape and track drift
- Easy IoT Hub connection, seconds to configure
- Store, query and visualize billions of events in seconds
- Simple and fast navigation with built in UX
- Can be used alone as a time-series data store

Fully-integrated time series data pipeline

Data parsing and metadata enrichment

Indexing and Scalable storage

Interactive Analytics
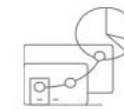
Visualization and APIs

Manufacturing

Oil & Gas

Power & Utility

Smart Building

Smart Energy

Time-series data heavy apps

Time Series Insight high level architecture
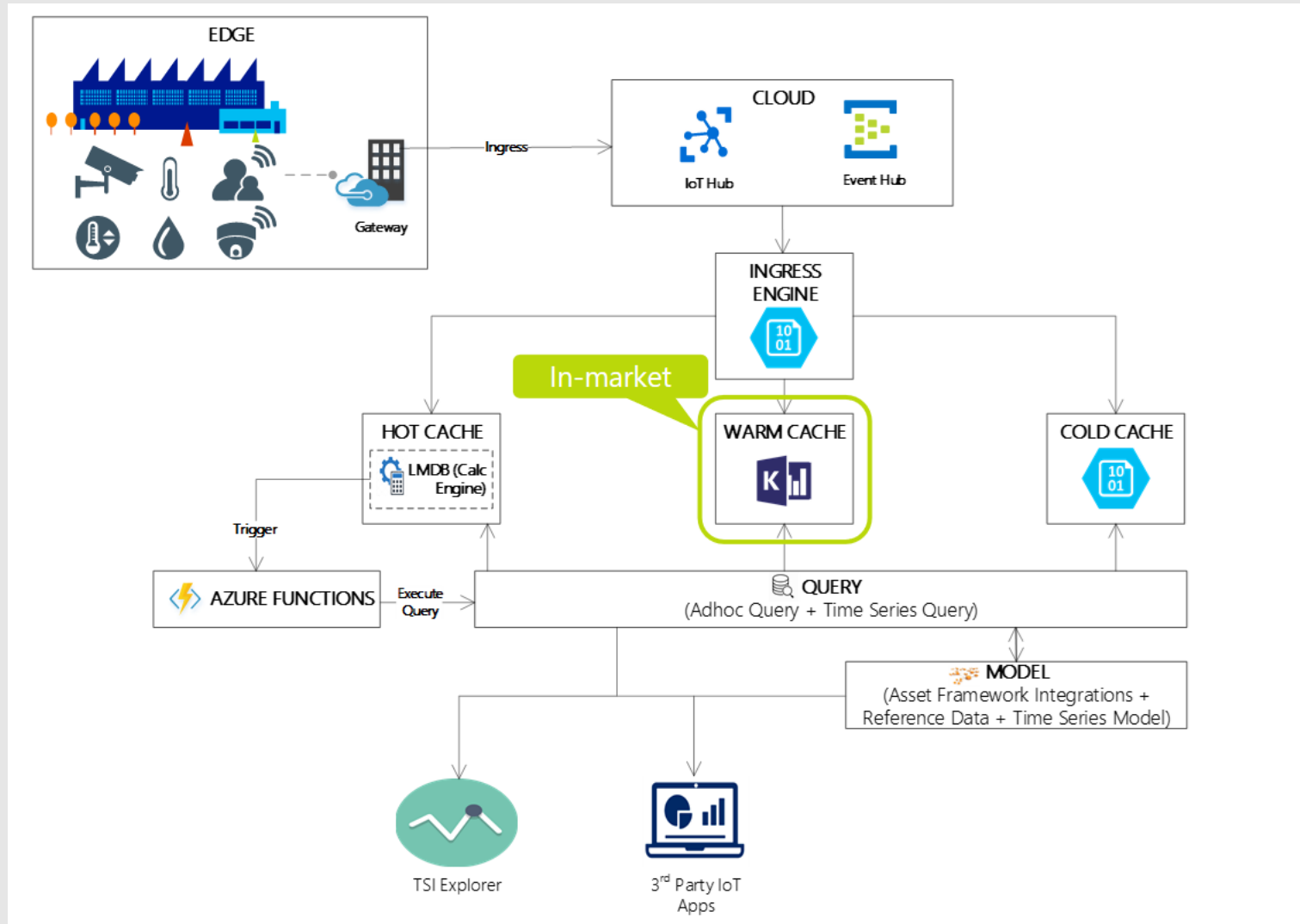
Time Series Data Model
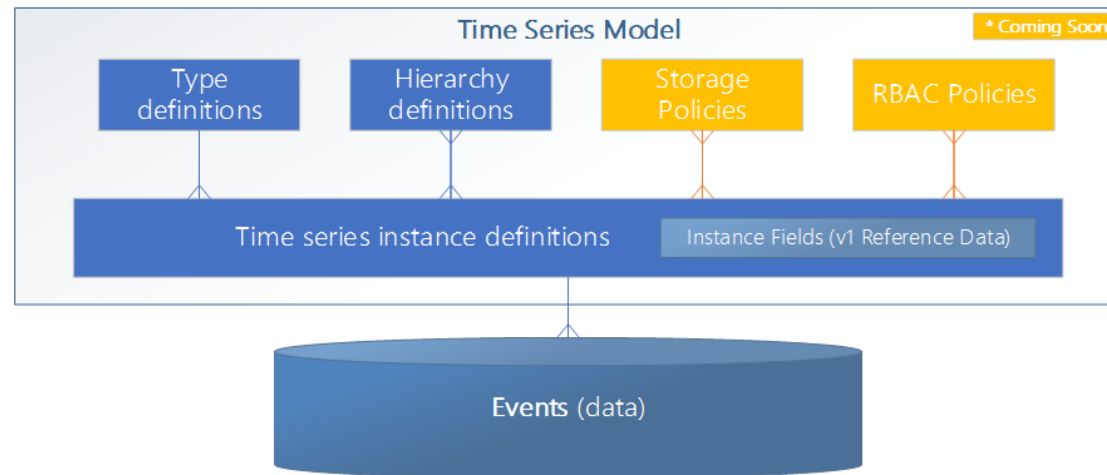
Types	Hierarchies	Instances	Storage & Access Control
• Types define variables associated with a Time series ID. • Users create 'types' by defining a friendly name, description, and associated variables. These are used for computation	• Hierarchies defined by HierarchyIDs organize instances by specifying property names and their relationships • Hierarchies have paths, a top-down parent-child order user wants to create.	• Instance describes a time series, and must have only one Type • Event count is the default type • Instance are mapped to one more hierarchies, they inherit all properties from the hierarchies	• Still Developing...

Time Series Query
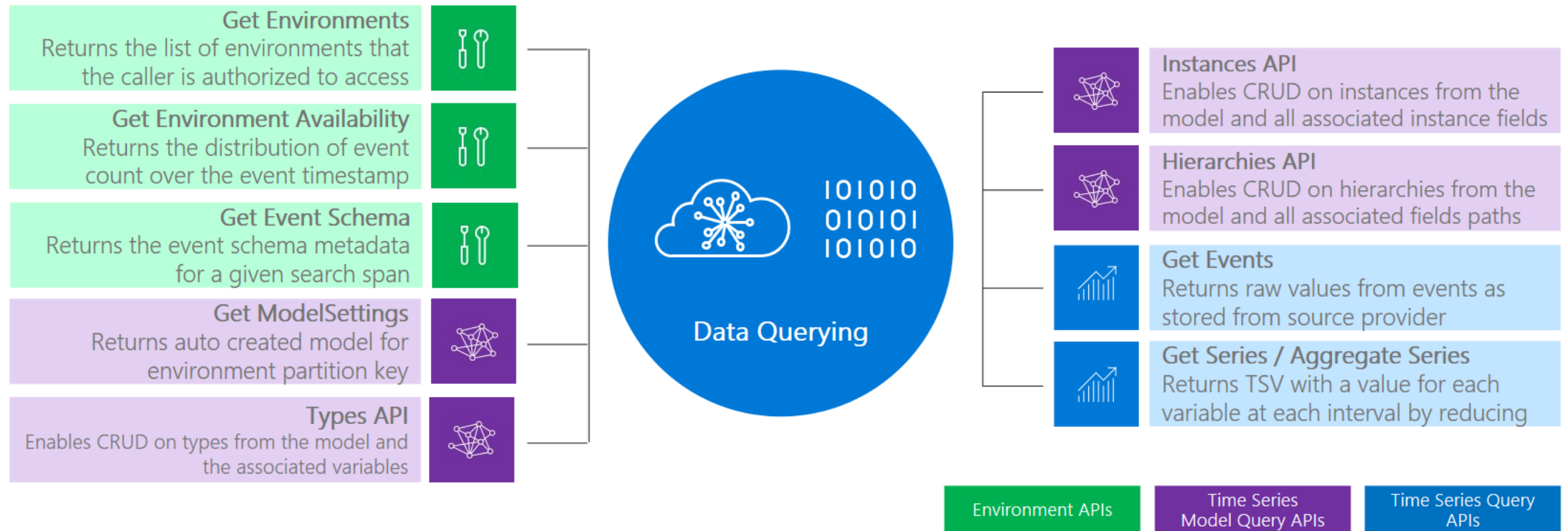
AZURE IoT Tools

Dev and trainings

Microsoft

Manage Azure assets your Way

Microsoft has made it a priority to give you the control and flexibility to manage cloud assets in multiple ways.

Azure Portal
(Management API)
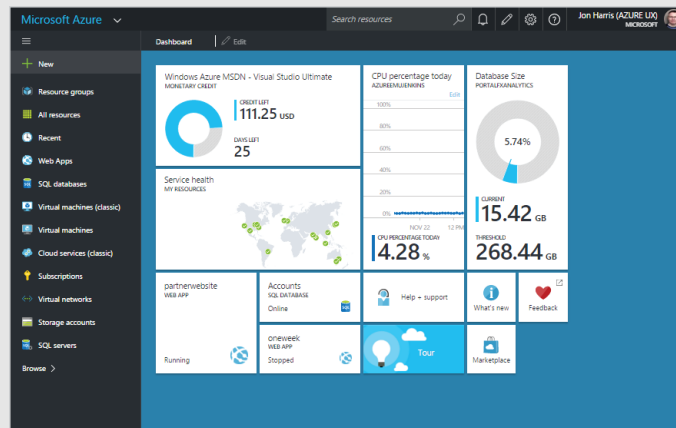
Azure CLI

Azure PowerShell
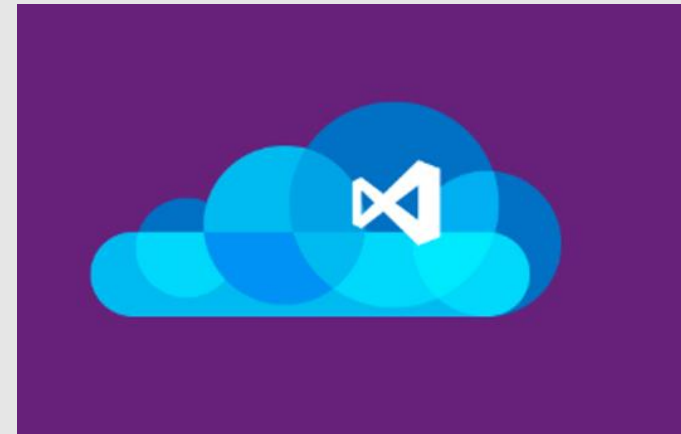
Visual Studio

VS code

VS Code IoT Workbench

VS Code IoT Toolkit

https://github.com/Microsoft/vscode-iot-workbench
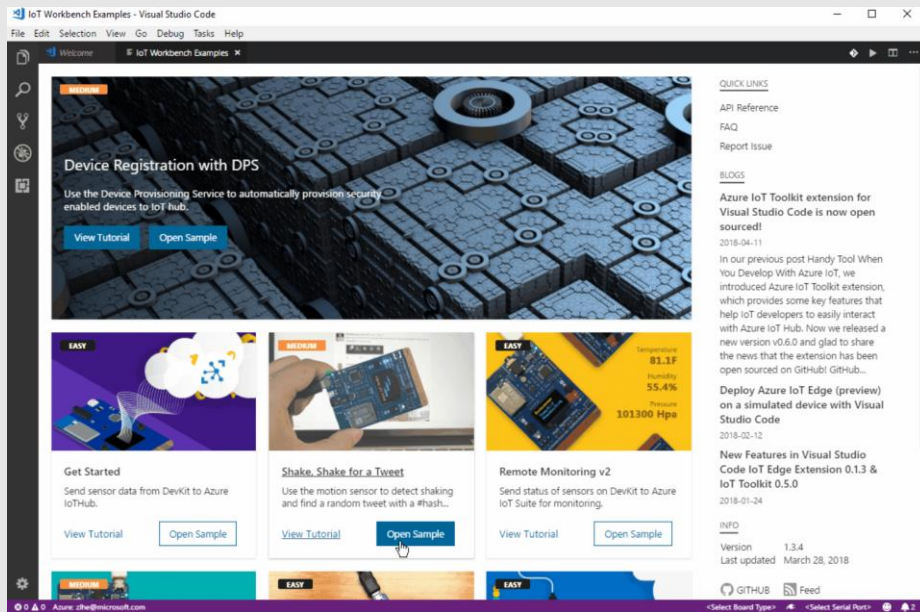
https://marketplace.visualstudio.com/items?itemName=vsciot-vscode.azure-iot-toolkit
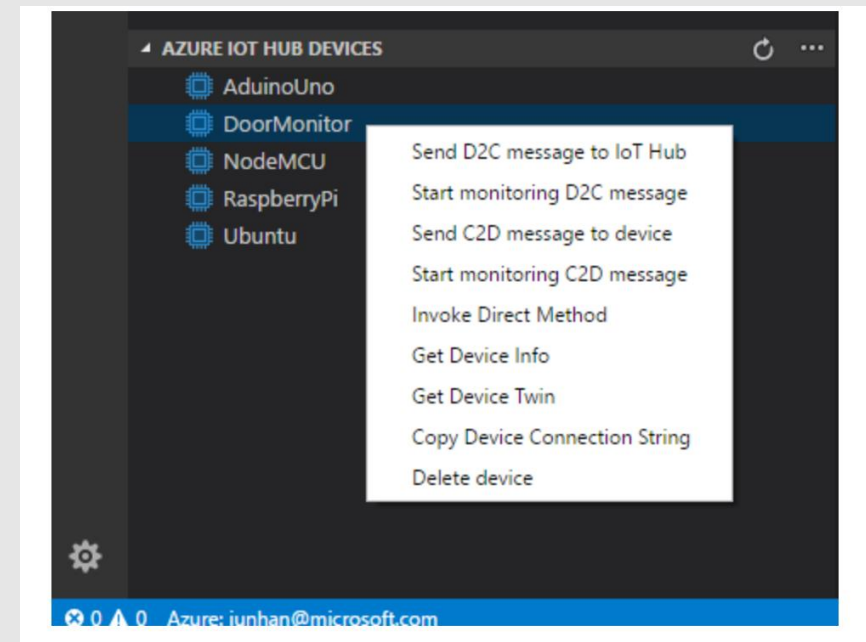
Azure IoT School

IoT School

https://iotschool.microsoft.com/

Azure IoT developer Boot camp

https://iotschool.microsoft.com/en-us/iot/learning-paths

Microsoft Professional Program for Internet of Things

MPP for Internet of Things (IoT)

https://academy.microsoft.com/en-us/professional-program/tracks/internet-of-things/

Reference Architecture

The document offers an overview of the IoT space, recommended subsystem factoring for scalable IoT solutions, prescriptive technology recommendations per subsystem, and detailed sections that explore use cases and technology alternatives.
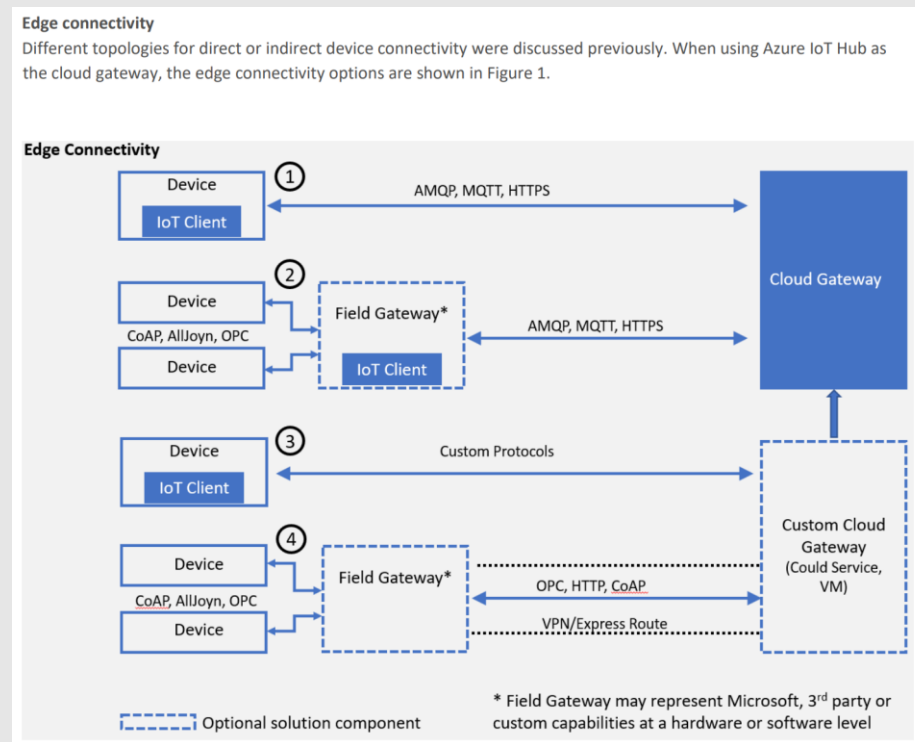
Videos IoT show

Internet of Things show
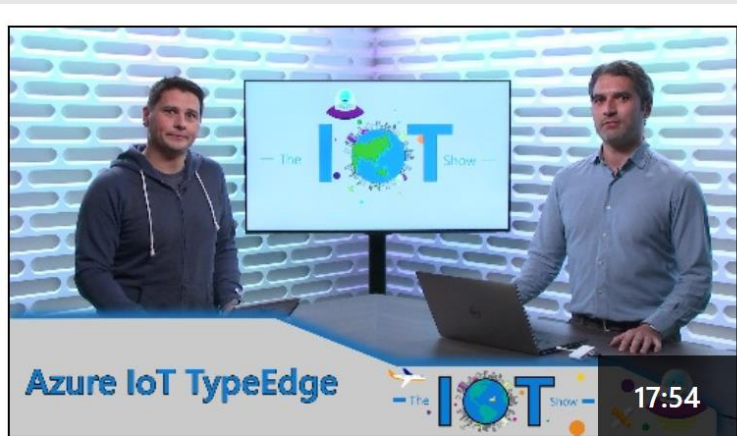
Internet of Things Show
Azure IoT TypeEdge : a strongly-typed development experience for Azure IoT Edge
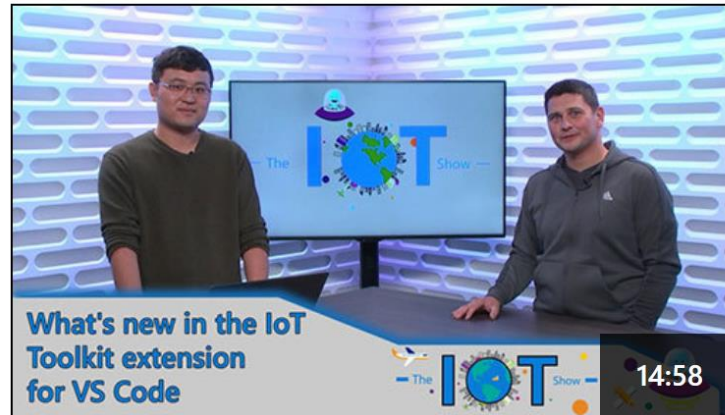
Internet of Things Show
What's new in the IoT Toolkit extension for VS Code
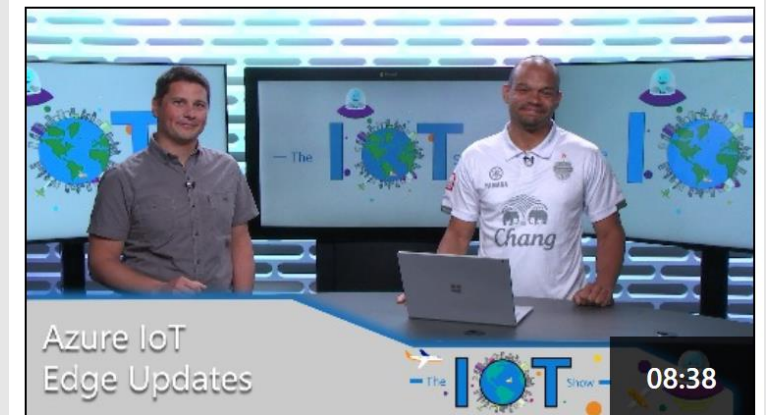
Internet of Things Show
Azure IoT Edge updates

NEWS: Blogs IoT

Get All the fresh News   https://azure.microsoft.com/en-us/blog/topics/internet-of-things/

Streamlined IoT device certification with Azure IoT certification service

Thursday, December 13, 2018

For over three years, we have helped customers find devices that work with Azure IoT technology through the Azure Certified for IoT program and the Azure IoT device catalog.

Koichi Hirao, Senior Program Manager, Azure IoT

Azure Stream Analytics on IoT Edge now generally available

Tuesday, December 4, 2018

Today, we are announcing the general availability of Azure Stream Analytics (ASA) on IoT Edge, empowering developers to deploy near-real-time analytical intelligence closer to IoT devices, unlocking the full value of device-generated data.

Jean-Sébastien Brunner, Principal Program Manager Lead, Azure Stream Analytics

Microsoft Events Replay

BUILD Developer conference (may) : https://mybuild.microsoft.com/sessions

IGNITE Microsoft user conference (september) : https://myignite.techcommunity.microsoft.com/

learning models in the cloud and on the intelligent edge with Azure Stream Analytics

Krishna Mamidipaka, Chetna Gupta
This session is co-delivered with Ms. Chetna Gupta, Sr. Director of Engineering at Evolve Controls. Continuous streams of data are generated in every industry from sources such as clickstream logs, IoT devices and sensors, business transactions, social feeds, fleet vehicles etc. Within these fast-moving data streams are valuable business insights waiting to be unlocked. Learn how customers are building real-time solutions for building controls, remote monitoring of assets, fleet management, smart grid and network monitoring. See demos and learn how services like Azure Event Hubs, Stream Analytics, Machine Learning and other Azure services work seamlessly together to create your end-to-end real time analytics solutions.
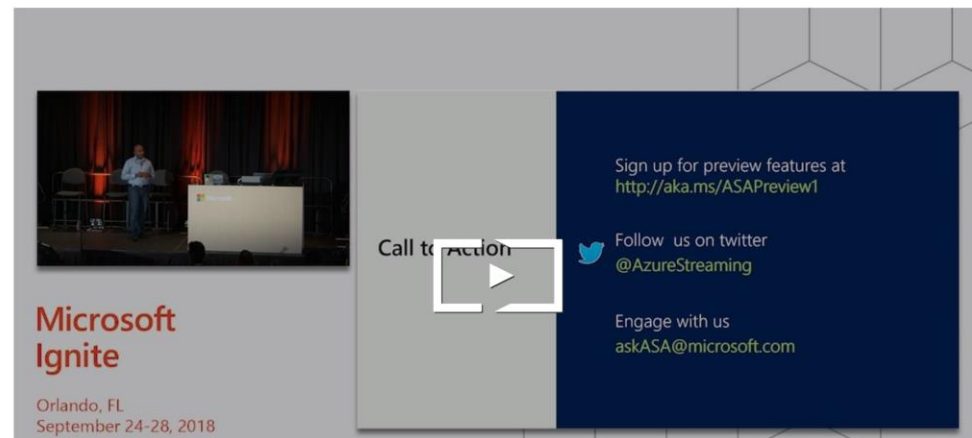
BRK2199 - Explore opportunities for the enterprise with the intelligent edge

Arjmand Samuel
Bring intelligent edge to life in your IoT solutions. The holy grail of IoT is the ability to easily distribute intelligence between the cloud and your devices (the edge). Now you can easily infuse AI and machine learning models, process data, and make real-time decisions at the edge to address many common and mission critical IoT scenarios. In this session, we showcase our newest innovations in edge, such as Microsoft Azure Stack, to help you easily find and certify secure edge hardware, discover and monetize your edge modules, and get started with building edge-enabled IoT solutions.
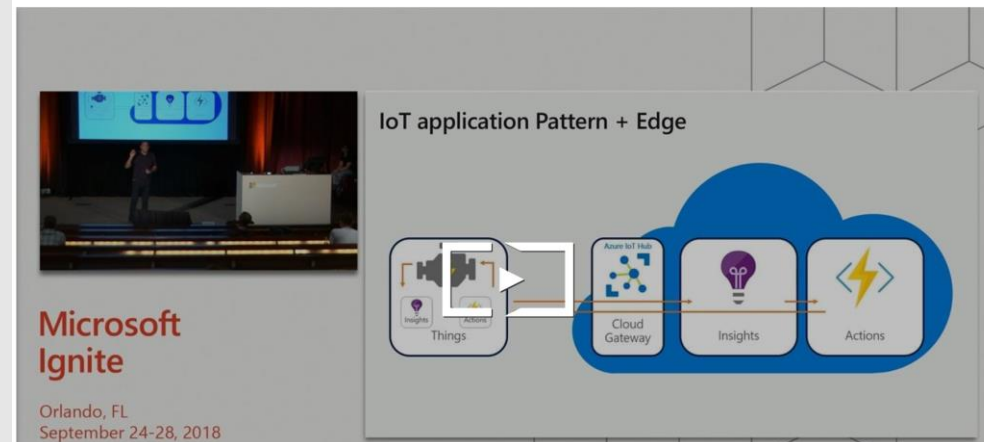
Azure Technical Docs

- Quick start and Tutorials
- Concepts, Architecture
- Development guides, SDK
- Related documentation
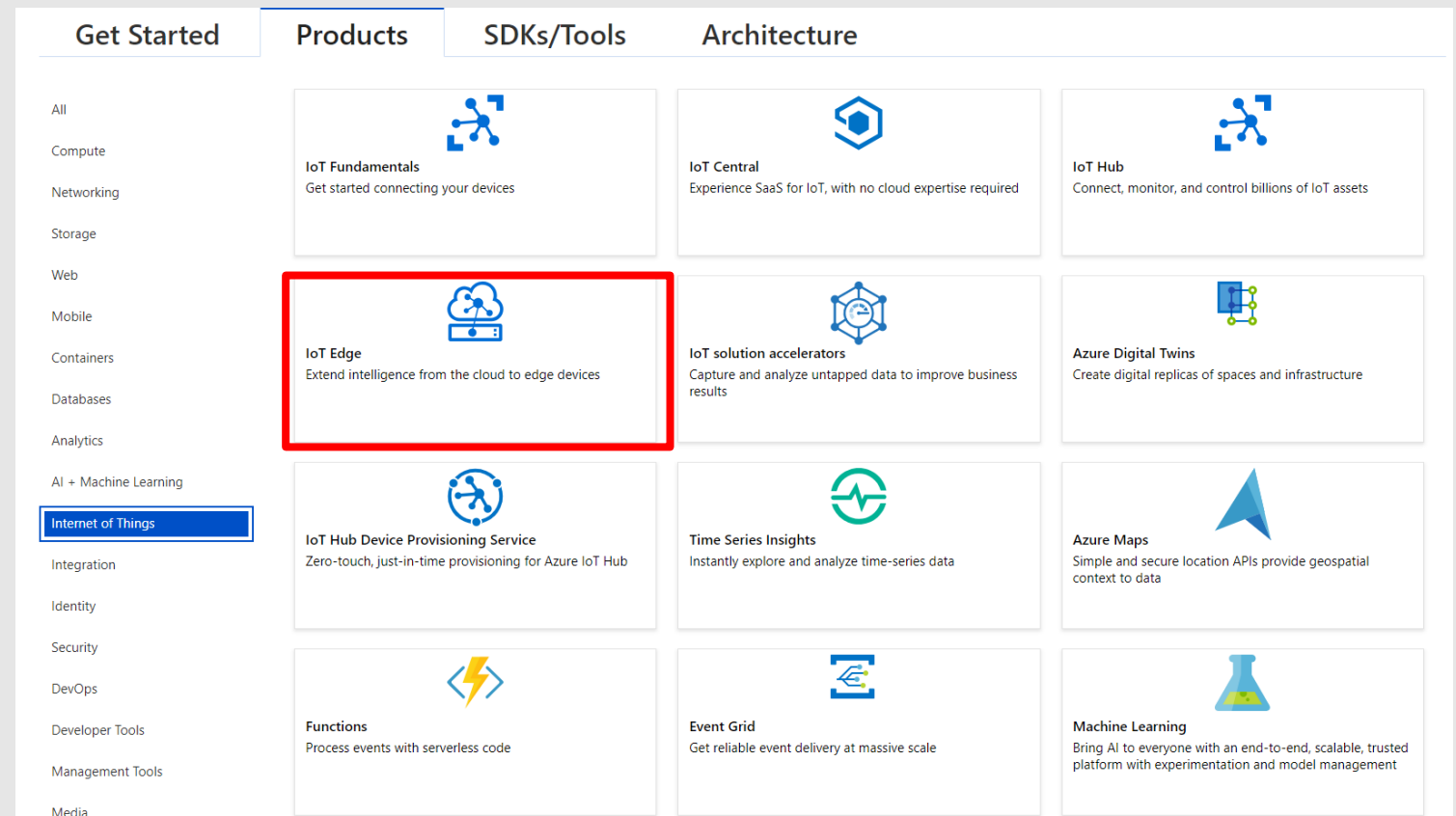
Github

https://github.com/   : Get All SDK, download code samples , Hands on labs

https://github.com/azure/iotedge

https://github.com/Azure/iotedgedev

VS code

Extension VS code for IoT Edge
https://marketplace.visualstudio.com/items?itemName=vsciot-vscode.azure-iot-edge

https://github.com/Microsoft/vscode-iot-workbench

https://marketplace.visualstudio.com/items?itemName=vsciot-vscode.azure-iot-toolkit
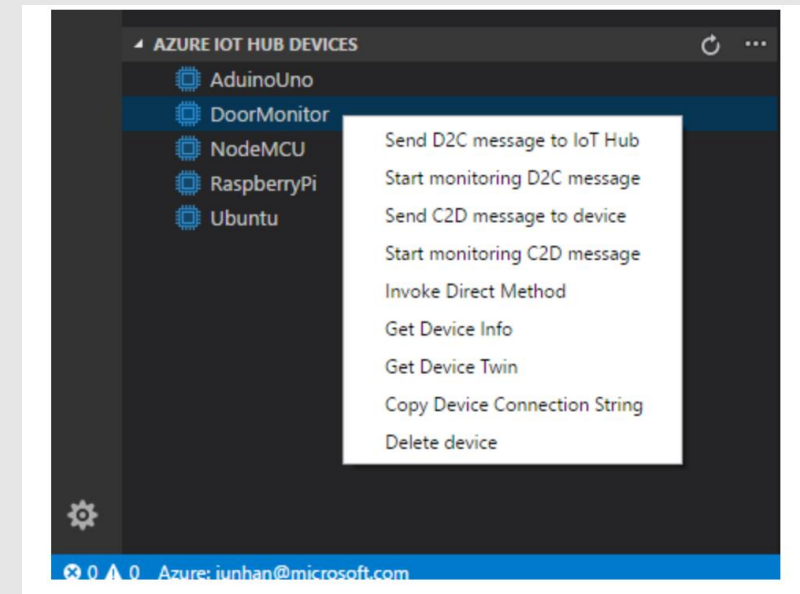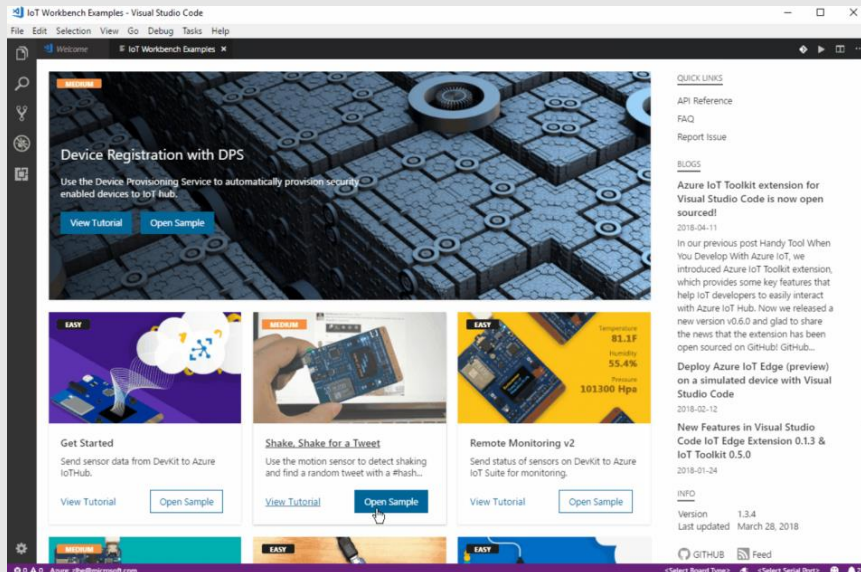
Developpers, Everything starts here ...

https://azure.microsoft.com/en-us/develop/iot/

Microsoft