Microsoft Azure

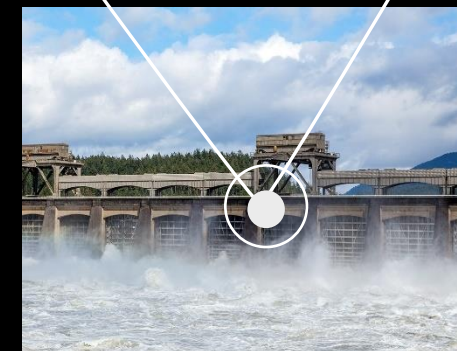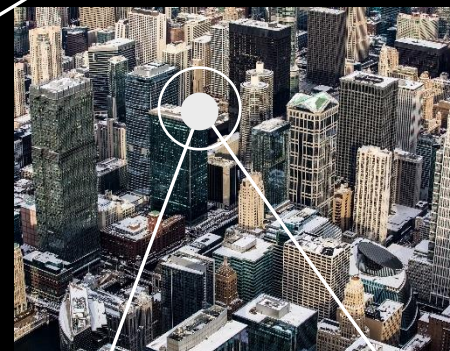# Azure IoT
Transforming your business

Azure Trailblazer Academy

Microsoft
Jan 27, 2021

High-level IoT Architecture

Intelligent processing on edge controlled by cloud

Edge Intelligent Gateways

Provision and send data from devices to Cloud

IoT Devices

Device Management

Cloud Gateway

Configure and control

UI & reporting Tools

Visualize data and learnings

Stream processing and rules evaluations over data

Stream Processing

Business Integration

Store data

Storage

Cold / Hot stores

Machine Learning

Integrate with Business process

Things

Insights

Actions

*Sample architecture, individual services may change based on your needs

Microsoft's comprehensive IoT product portfolio

Azure IoT Priority Verticals	Manufacturing	Retail	Agriculture	Energy	Smart Cities	Healthcare	Transportation

Azure IoT Solutions

Azure IoT Central (SaaS)

Azure IoT Reference Architecture & Accelerators (PaaS)

Dynamics Connected Field Service (SaaS)

Azure Services for IoT

Azure IoT Hub
Azure IoT Hub Device Provisioning Service
Azure Digital Twins
Azure Time Series Insights
Azure Maps

Azure Stream Analytics
Azure Cosmos DB
Azure AI
Azure Cognitive Services
Azure ML
Azure Logic Apps

Azure Active Directory
Azure Monitor
Azure DevOps
Power BI
Azure Data Share
Azure Spatial Anchors

IoT & Edge Device Support

Azure RTOS
Azure Sphere
Azure IoT Device SDK
Azure IoT Edge
Azure Stack Edge

Windows IoT
Azure Certified for IoT—Device Catalog
Azure Stream Analytics
Azure Storage

Azure ML
Azure SQL
Azure Functions
Azure Cognitive Services

Azure Defender for IoT

IoT Central
A fully managed IoT app platform

UPDATED Dashboard updates and improvements

App templates for Industry Verticals

White labeling your SaaS – your brand

Azure IoT Edge support

Azure Sphere support

Dashboard improvements

API Support

2-tiered pricing based on message volume

Both Personal and Shared Dashboards

New support for multiple devices per dashboard tile
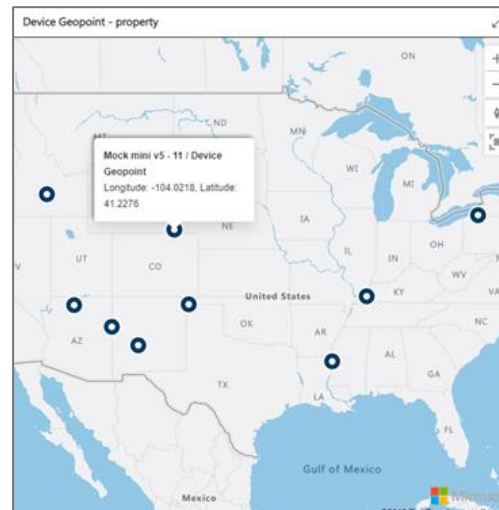
Build dashboards using telemetry across sets of devices
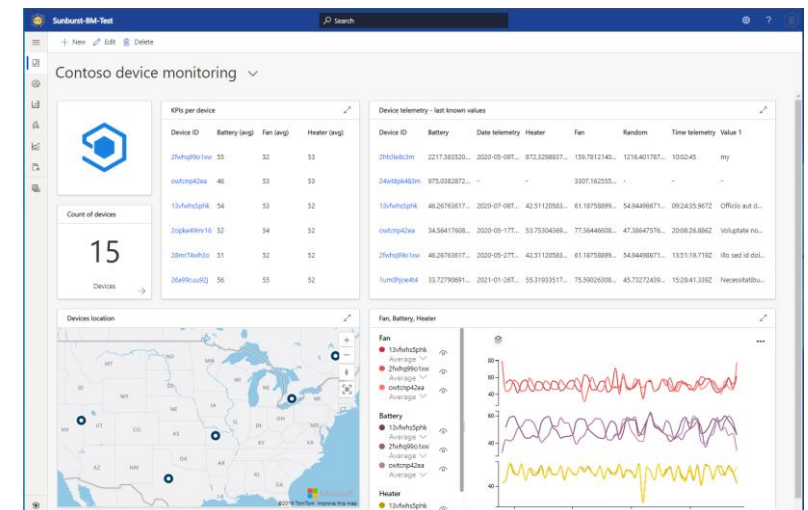
Azure IoT Hub

Bi-directional communication

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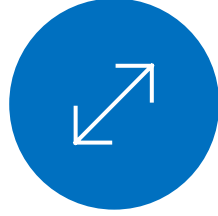
Enterprise scale and integration

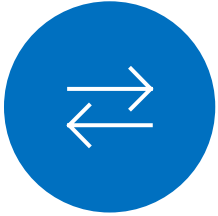- Billions of messages
- Scale up and down
- Declarative message routes
- File upload
- Web sockets and multiplexing
- Azure monitor
- Azure resource health
- Configuration management

End-to-end security

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

Azure IoT Hub

Microsoft Azure

Device — Custom Protocols — Custom Cloud Gateway (Cloud protocol gateway sample)

Device (Client SDK) — AMQP, MQTT, HTTPS — IoT Hub

Device / Device — Field Gateway (IoT Edge) — AMQP, fallback websockets — IoT Hub

Device / Device — Field Gateway — OPC, HTTP,,... / VPN/ExpressRoute — Custom Cloud Gateway (Cloud protocol gateway sample)

Management app
Device registry/Management
Monitoring
Send commands
Client SDK

Applications
- Companion apps
- Dashboards
- Controllers
- ...

Azure Stream Analytics

Applications

Devices & Gateways

Event Hubs

IoT Hubs

Blobs

Reference Data

Stream Analytics

Machine Learning

Event Hubs, Data Lake, Document DB, SQL DB/DW..

Archiving for long term storage/ batch analytics

PowerBI

Real-time dashboard

Azure functions, Service Bus Topics/Queues...

Automation to kick-off workflows
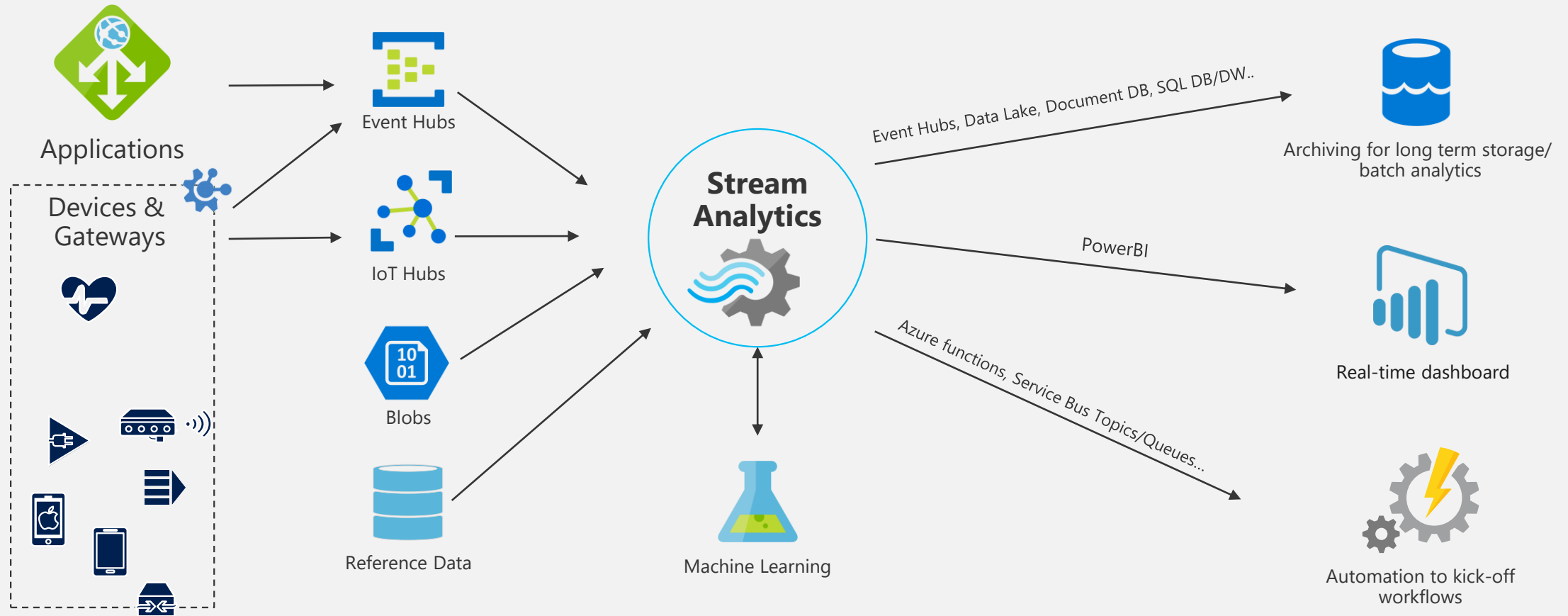
| Event production | | Event Queuing & Stream Ingestion | | Stream Analytics | | Storage & Batch Analysis | | Presentation & Action |

Stream Analytics Query Language (SAQL)

Declarative SQL like language to describe transformations

Filters ("Where")

Projections ("Select")

Time-window and property-based aggregates ("Group By")

Time-shifted joins (specifying time bounds within which the joining events must occur)

and all combinations thereof

Data Manipulation
```
SELECT
FROM
WHERE
HAVING
GROUP BY
CASE WHEN THEN ELSE
INNER/LEFT OUTER JOIN
UNION
CROSS/OUTER APPLY
CAST INTO
ORDER BY ASC, DSC
```

Date and Time
```
DateName
DatePart Day, Month, Year
DateDiff
DateTimeFromParts
DateAdd
```

Scaling Extensions
```
WITH
PARTITION BY
OVER
```

Mathematical
```
ABS
CEILING
EXP
FLOOR
POWER
SIGN
SQUARE
SQRT
```

String
```
Len
Concat
CharIndex
Substring
Lower, Upper
PatIndex
```

Aggregation
```
SUM
COUNT
AVG
MIN
MAX
STDEV
STDEVP
VAR
VARP
TopOne
```

Temporal
```
Lag
IsFirst
Last
CollectTop
```

Windowing Extensions
```
TumblingWindow
HoppingWindow
SlidingWindow
SessionWindow
```

Geospatial
```
CreatePoint
CreatePolygon
CreateLineString
ST_DISTANCE
ST_WITHIN
ST_OVERLAPS
ST_INTERSECTS
```

Anomaly Detection
```
AnomalyDetection_SpikeAndDip
AnomalyDetection_ChangePoint
```

Azure Time Series Insights

A Serverless, Fully Managed Platform as a Service (PaaS) Solution Built for IoT

Ingest, process, store, and query highly contextualized, time-series-optimized, IoT-scale data

Built in rich User Experience for ad-hoc queries and exploration

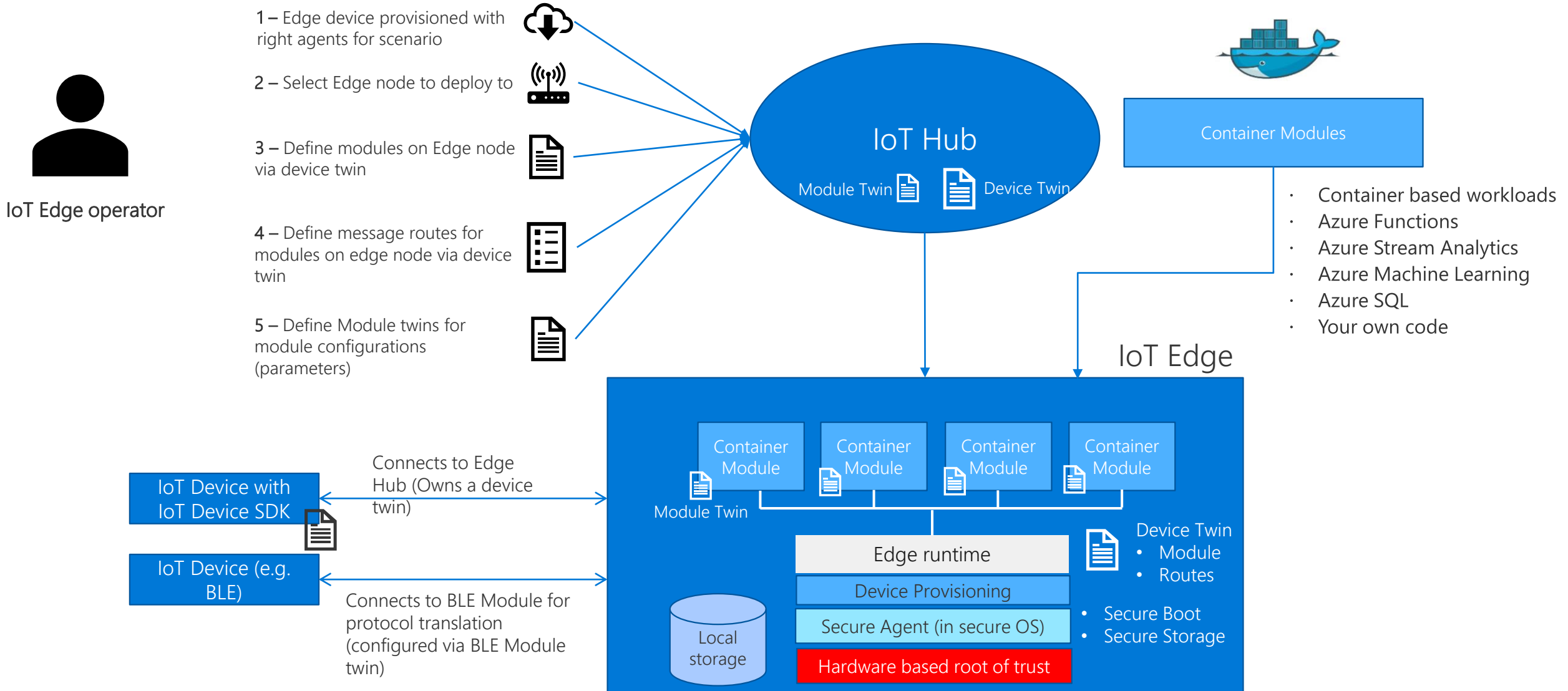Rich analytics APIs for ad-hoc exploration and operational intelligence

JavaScript control library for building custom analytics apps on the TSI platform

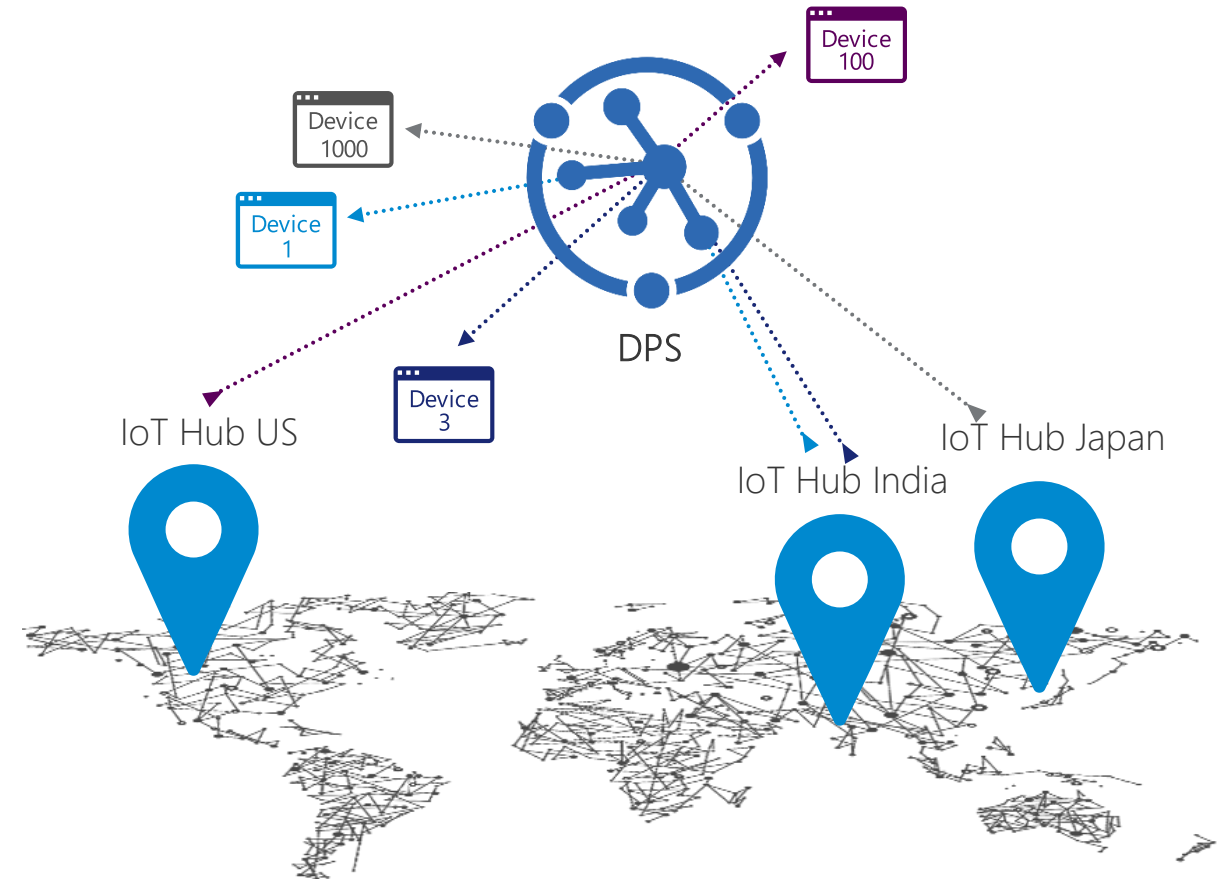## Turn data into decisions with actionable real-time IoT insights

Azure IoT Edge

IoT Edge operator

1 – Edge device provisioned with right agents for scenario

2 – Select Edge node to deploy to

3 – Define modules on Edge node via device twin

4 – Define message routes for modules on edge node via device twin

5 – Define Module twins for module configurations (parameters)

IoT Hub

Module Twin   Device Twin

Container Modules

- Container based workloads
- Azure Functions
- Azure Stream Analytics
- Azure Machine Learning
- Azure SQL
- Your own code

IoT Edge

IoT Device with IoT Device SDK

Connects to Edge Hub (Owns a device twin)

IoT Device (e.g. BLE)

Connects to BLE Module for protocol translation (configured via BLE Module twin)

Container Module

Container Module

Container Module

Container Module

Module Twin

Edge runtime

Device Provisioning

Secure Agent (in secure OS)

Hardware based root of trust

Local storage

Device Twin
- Module
- Routes

- Secure Boot
- Secure Storage

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

- 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 Japan

IoT Hub India

DPS knows exactly which IoT Hub to connect and provision

IoT Lab Architecture

Time Series Insights

IoT Device Simulator

Stream Analytics Job

Power BI

IoT Hub

Azure Storage