

Azure IoT Workshop

Real-time asset tracking

Benjamin Cabé

Principal Program Manager,
Azure IoT

Nov. 3, 2019

Agenda

Introducing the problem – Contoso Art Shipping

Typical IoT architecture

Hands-on labs

Going further

Follow along at: <http://aka.ms/iot-workshop-asset-tracking>

Introducing the problem



Monitoring of high-value parcels
for international company Contoso Art Shipping

Problem statement (1/3)

Contoso's goods are getting tampered, ruined in transit



Increased customer dissatisfaction



Losing customers, revenue



Increased insurance claims

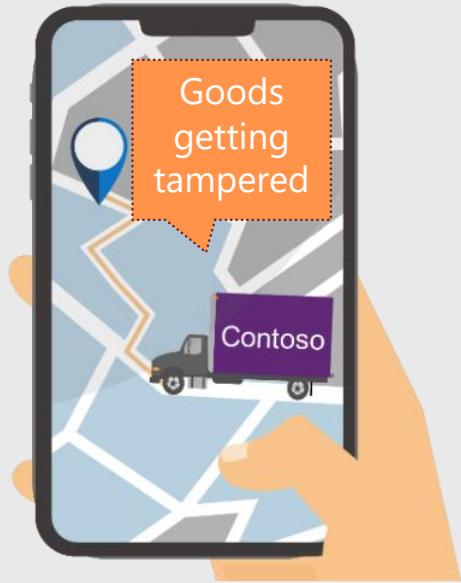
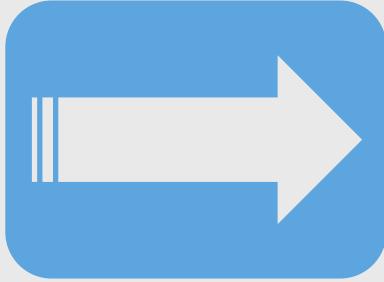
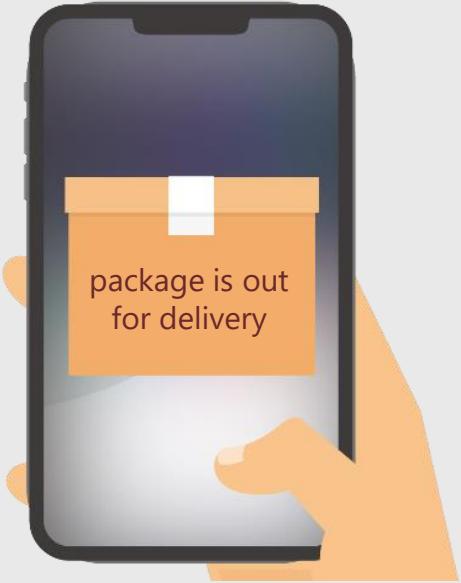


High personnel costs to follow-up on claims

Problem statement (2/3)



Problem statement (3/3)



Contoso already has an ERP and mobile app in place for basic tracking information

They would like to enable real-time tracking of shipments

Contoso Art Shipping's requirements

Track in real-time the physical location and condition of their parcels

Efficiently **store** this data so that it can be accessed and queried

Get **alerts** when abnormal conditions are detected...

... and **visualize** them on a map

Integrate with their existing business application

Scale from a very small deployment to something much bigger

... bonus points if they can be supported by great **developer tools** ☺

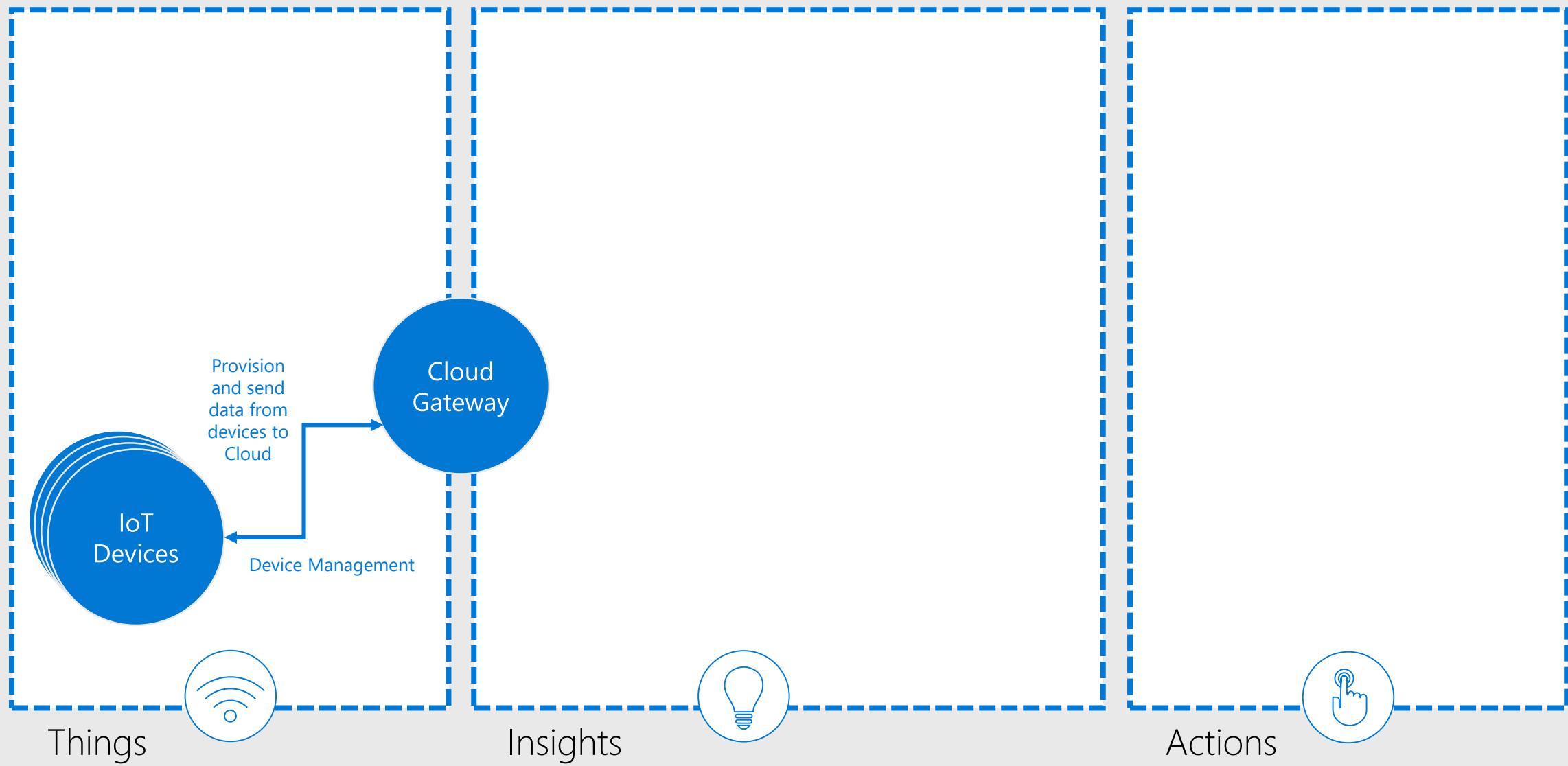
Architecture of an IoT solution



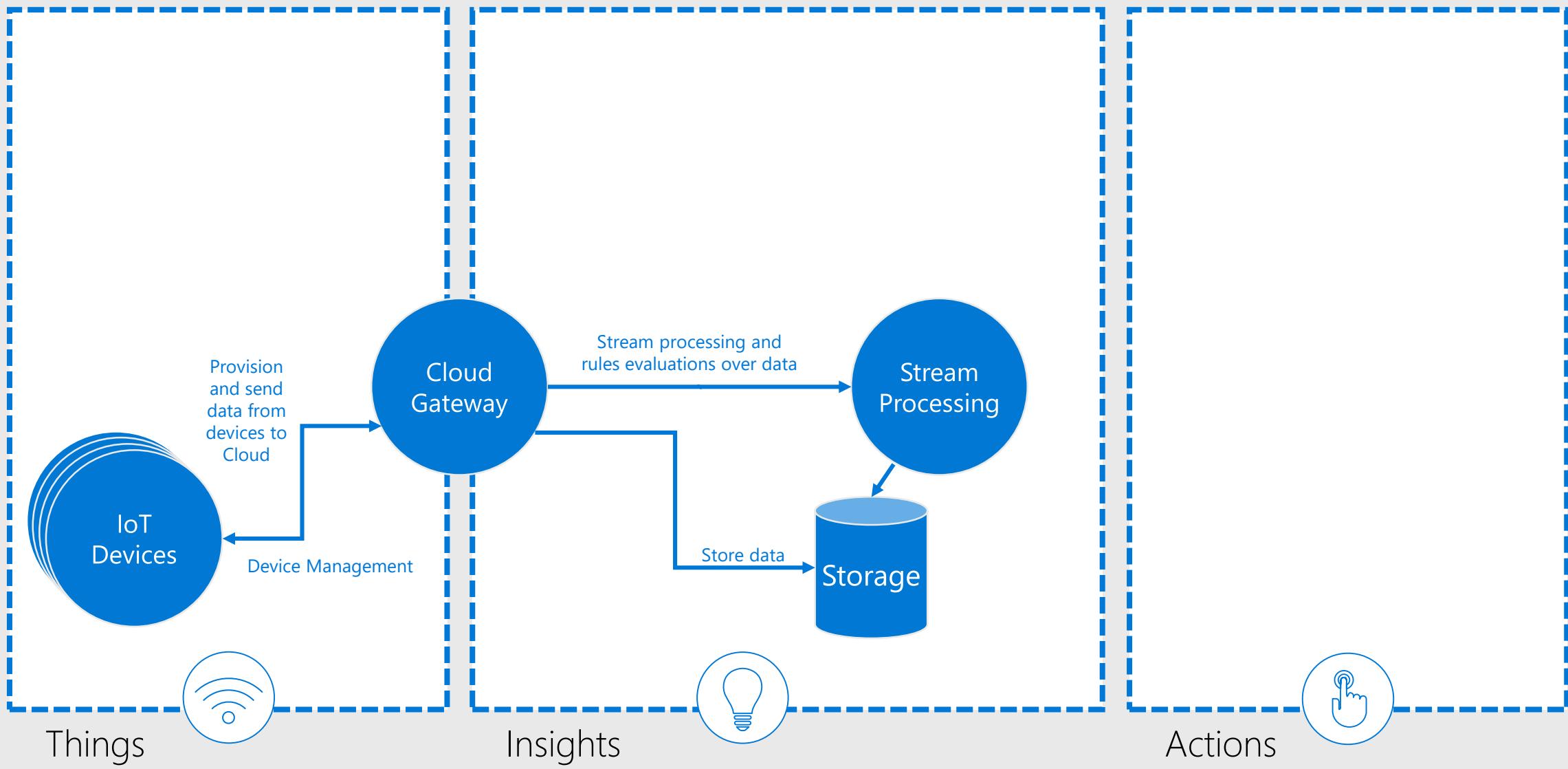
A More Realistic View...



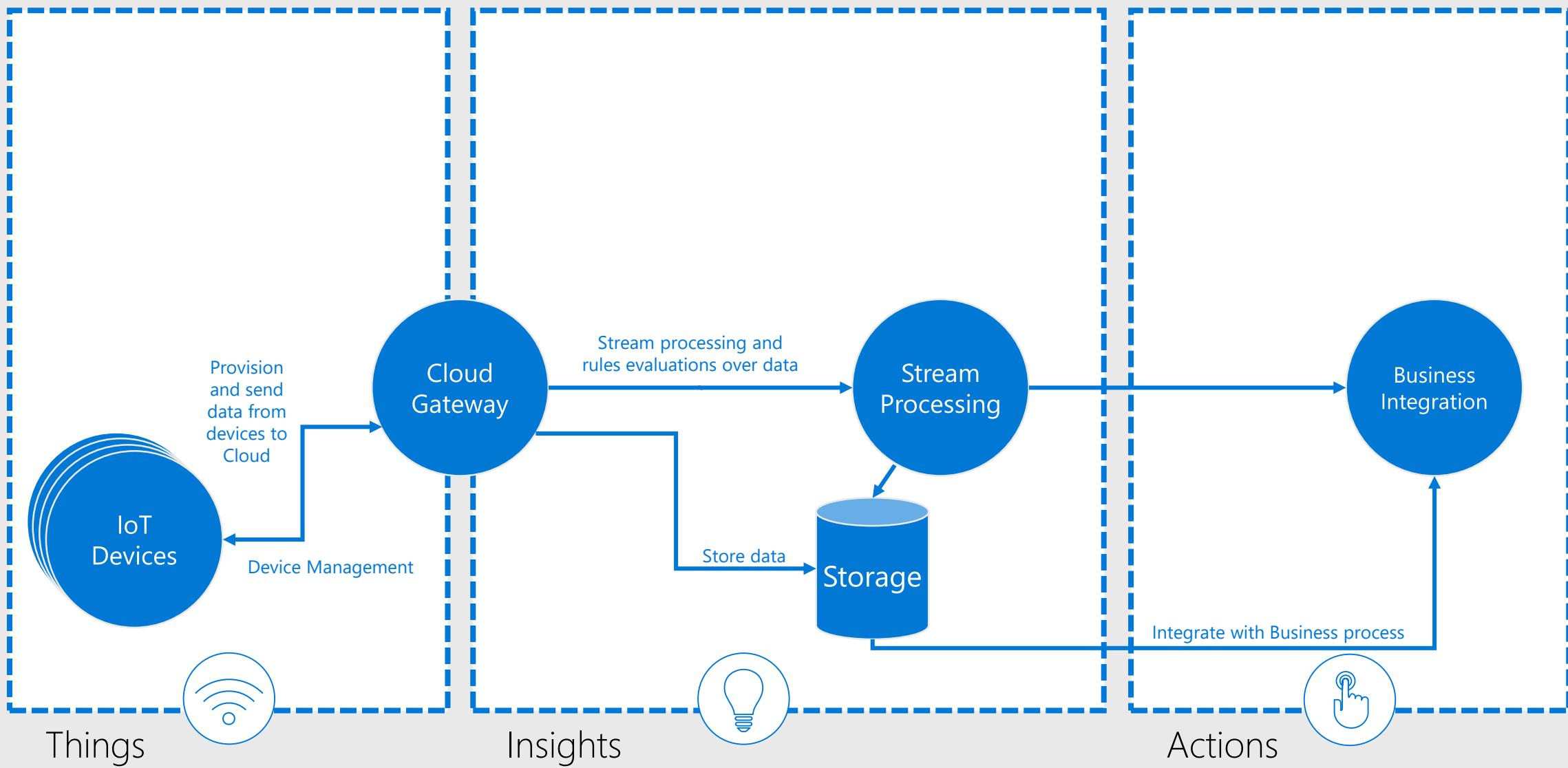
IoT Architecture



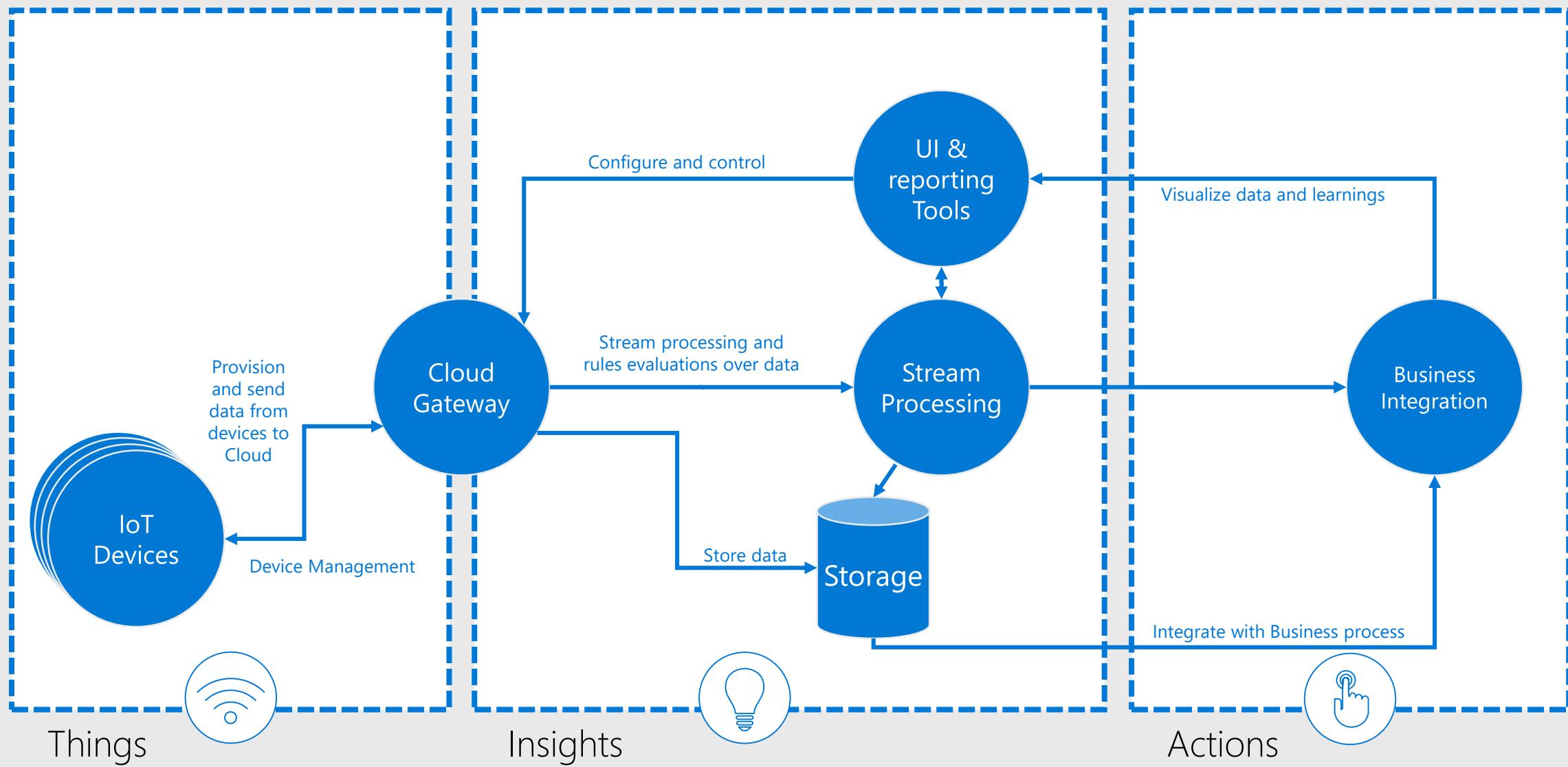
IoT Architecture



IoT Architecture



IoT Architecture



aka.ms/iot-workshop-asset-tracking
Hands-on lab

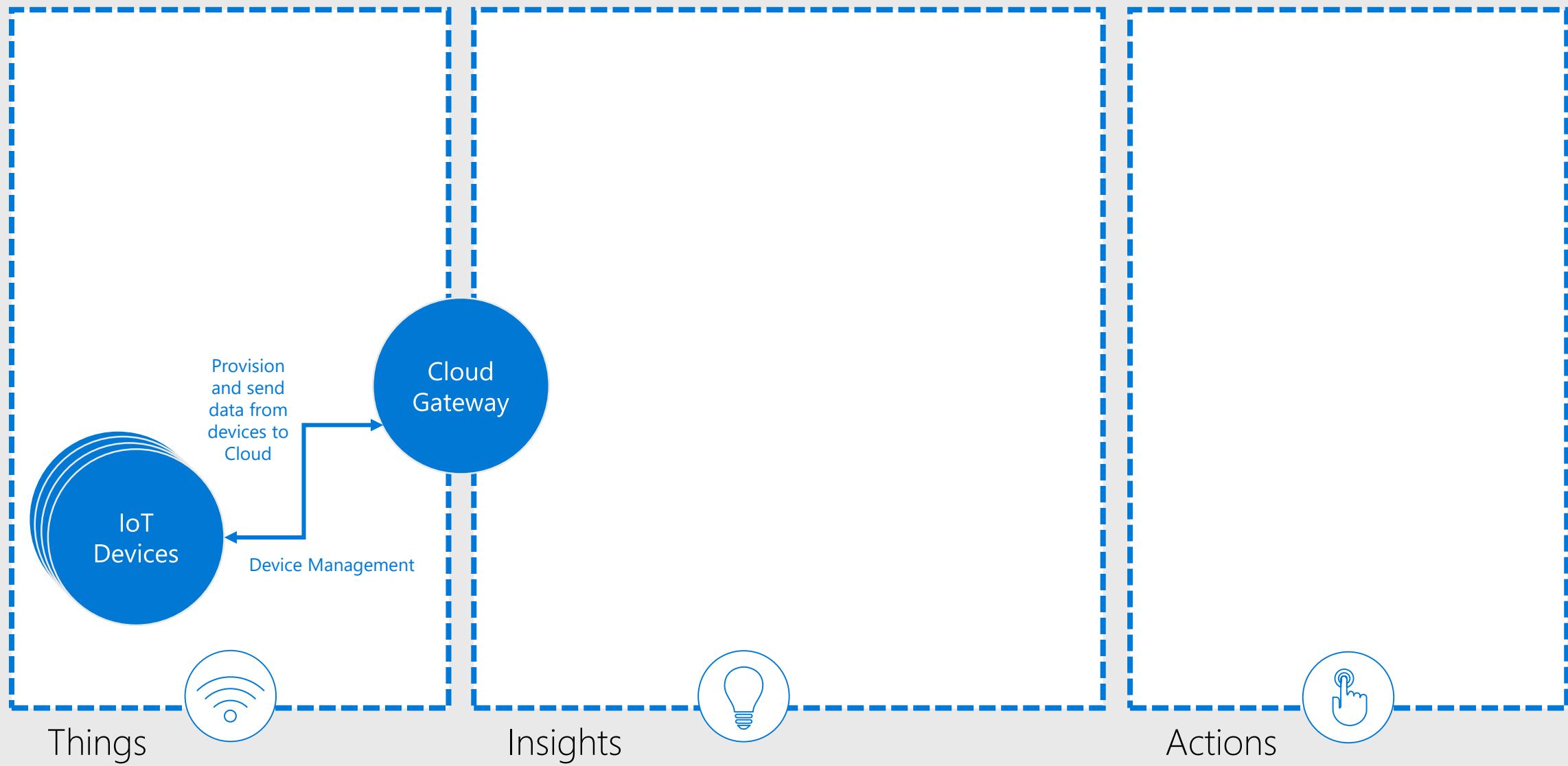
Step 1 – Connecting a device to Azure IoT

Track in real-time the physical location and condition of their parcels

Learning goals:

- How to setup the messaging infrastructure for connecting your IoT devices
- Understand basic security and device management concepts
- Explore IoT Plug-and-Play concepts
- Discover VS Code IoT extensions and Azure IoT Explorer

IoT Architecture



IoT Hub and Device Provisioning Service



Azure IoT Hub



Bi-directional communication



Enterprise scale & integration



End-to-end security

Millions of Devices
Multi-language, open source SDKs
HTTPS/AMQPS/MQTTS
Send Telemetry
Receive Commands
Device Management
Device Twins
Queries & Jobs

Billions of messages
Scale up and down
Declarative Message Routes
File Upload
WebSockets & Multiplexing
Azure Monitor
Azure Resource Health
Configuration Management

Per Device Certificates
Per Device Enable/Disable
TLS Security
X.509 Support
IP Whitelisting/Blacklisting
Shared Access Policies
Firmware/Software Updates
Azure Security Center Support



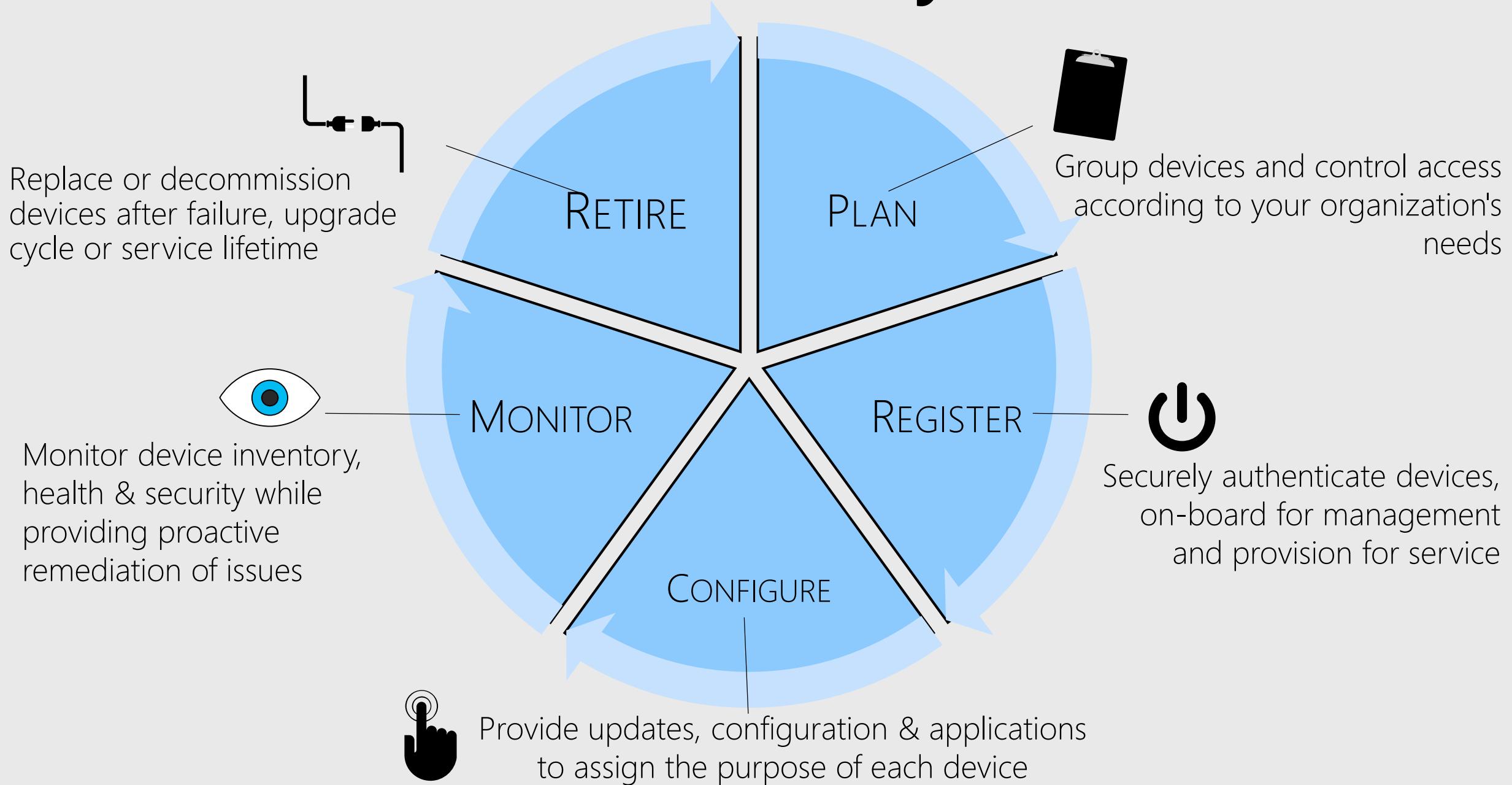
Device Provisioning Service



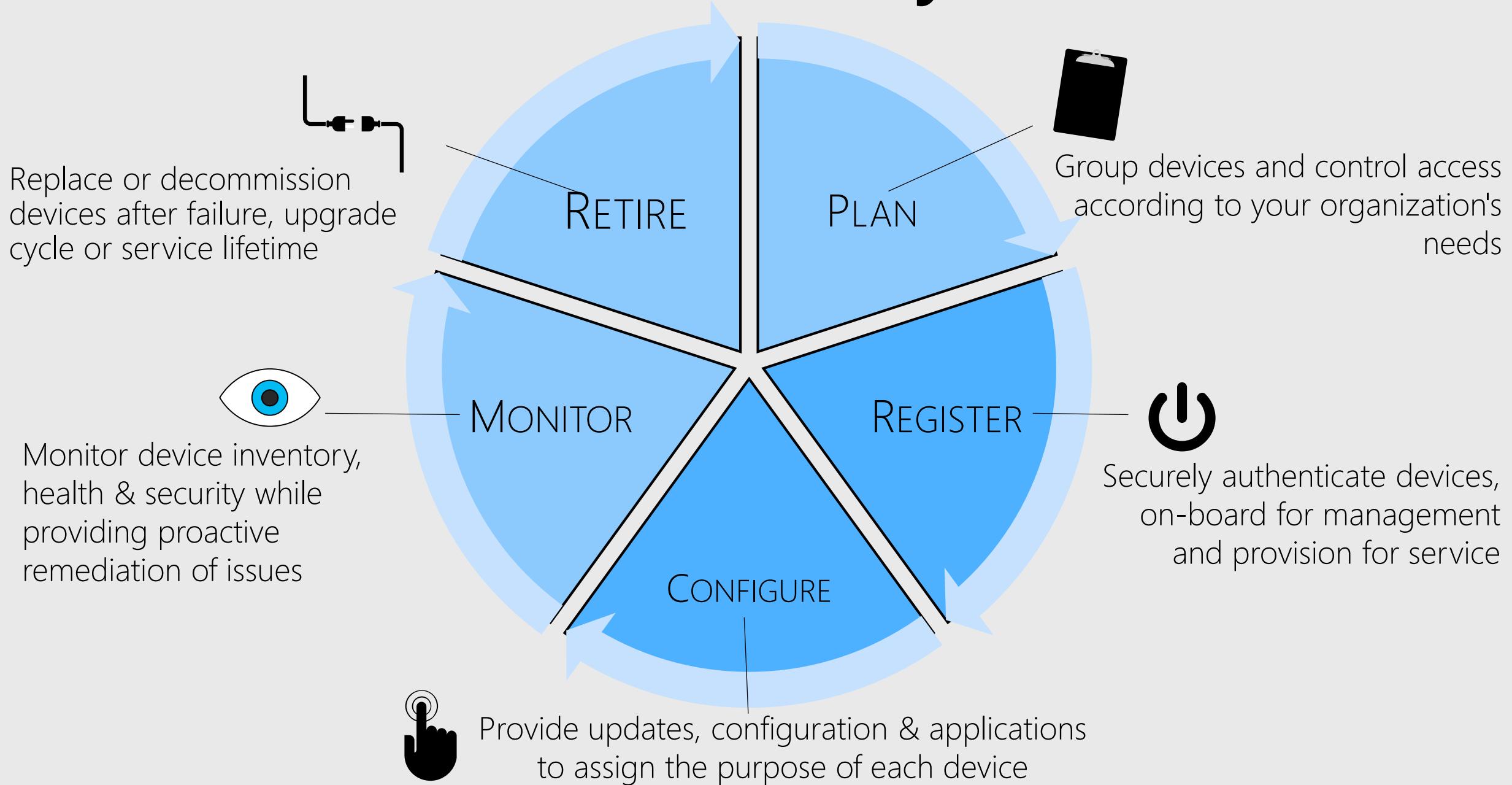
IoT-scale automated provisioning

Zero-touch provisioning
Centralize your provisioning workflow
Load balance across multiple IoT Hubs
Re-provisioning support
Supports TPM + X.509

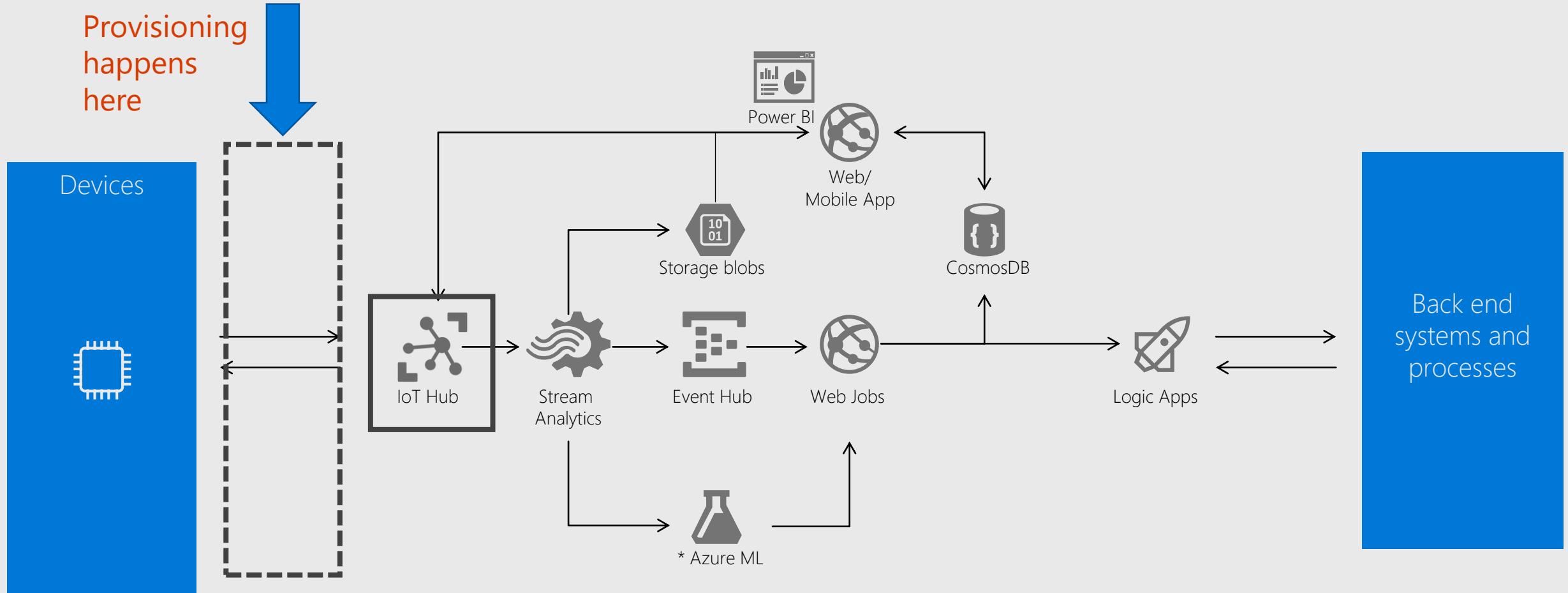
IoT Device Lifecycle



IoT Device Lifecycle



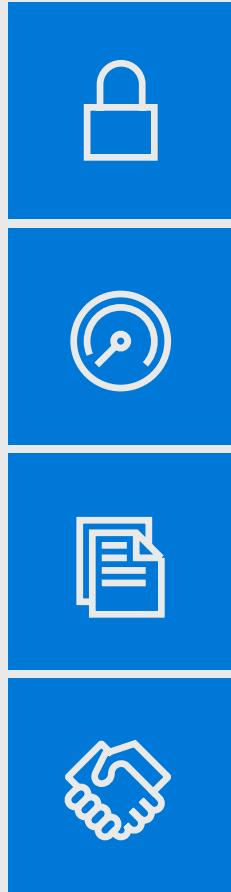
Quick orientation



What is provisioning?



Why provisioning is hard today



Solutions must have per-device revocable access

Provisioning is a manual process

Initial configuration can become irrelevant between manufacturing and deployment

Device supply chains are complex

Azure IoT Hub Device Provisioning Service

Simplify with zero touch provisioning

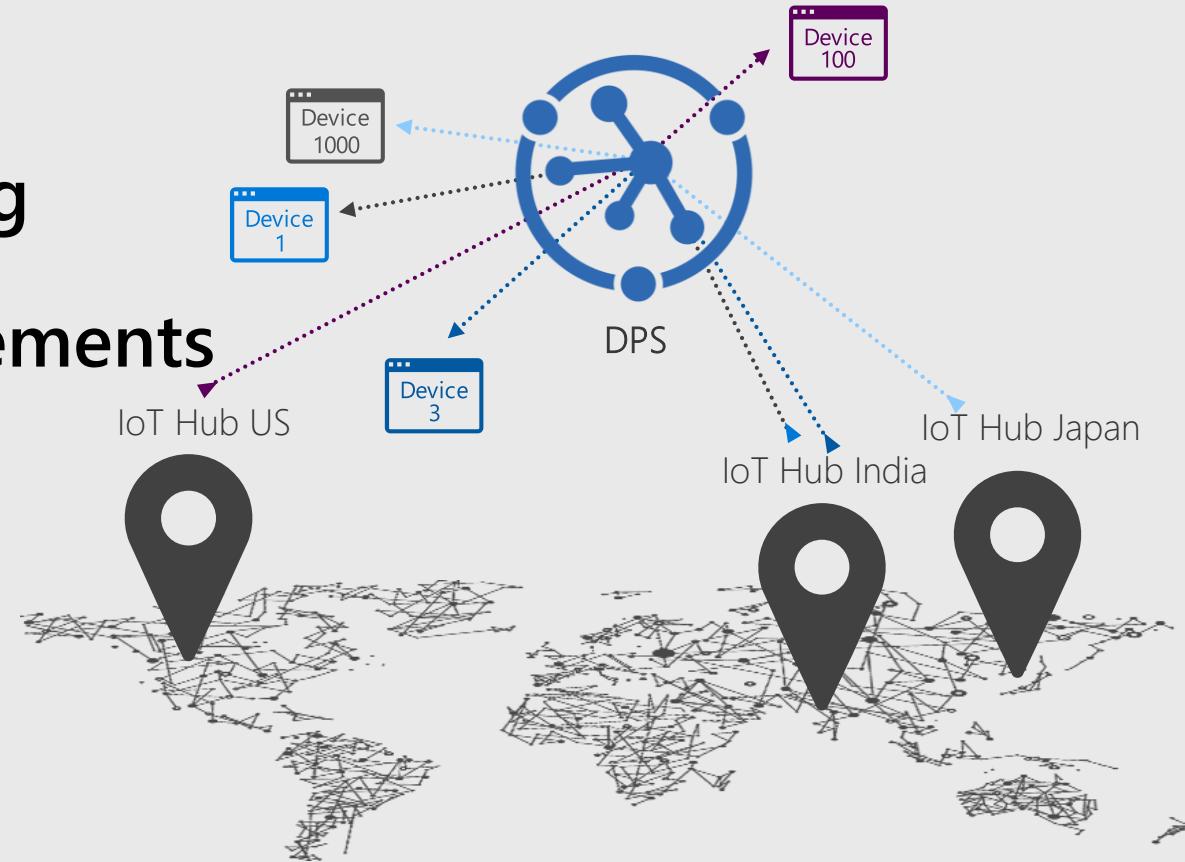
Minimize manual connection requirements

Cross-geo provisioning support

Multitenancy support

Enhanced security

For any device compatible with IoT Hub



DPS knows exactly which IoT Hub to connect and provision

Securely automate the provisioning process

Devices are automatically and securely connected to the IoT Hub service and provisioned with an initial configuration

Multitenancy support

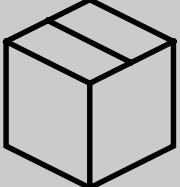
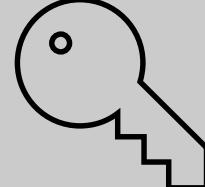
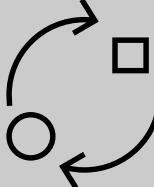
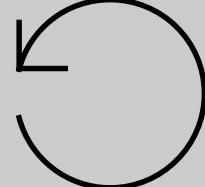
A single DPS can provide service for multiple IoT hubs (in multiple regions)

Flexible device assignment

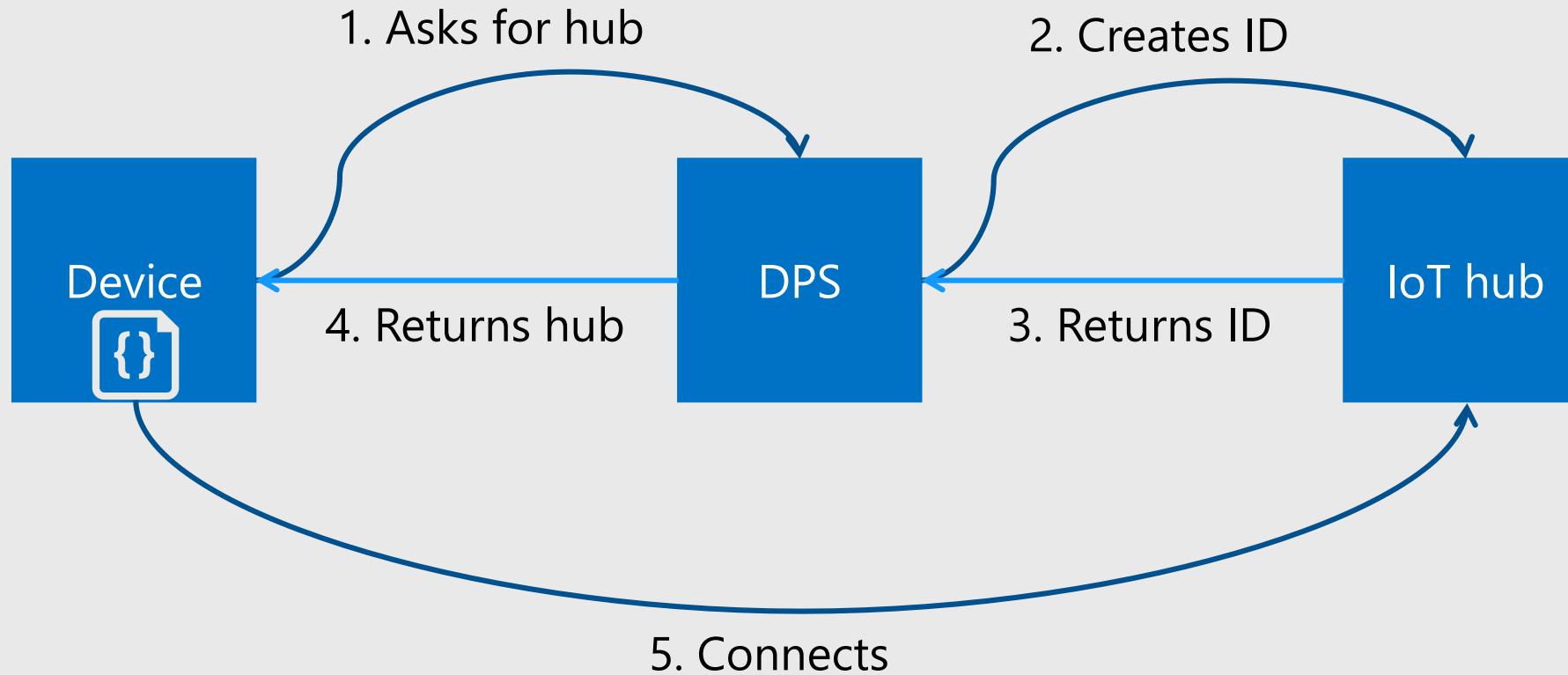
Customers provide rules and logic to assure the right device is attached to the right IoT solution (and associated IoT Hub)



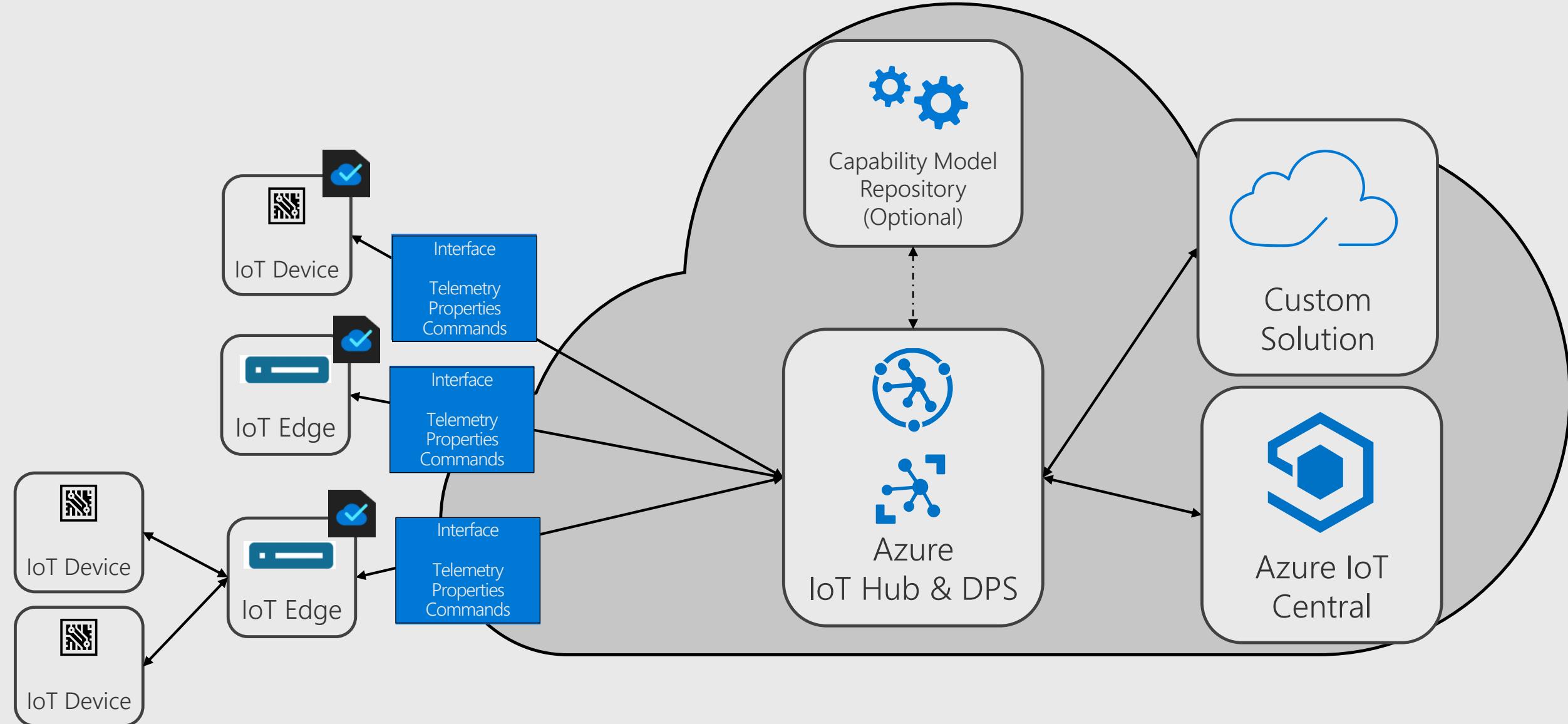
An IoT device's relationship to DPS

Initial setup	Retrieving a key	Rolling a key	Hard reset
Getting the device ready for the first time 	For devices with limited or no key storage capabilities 	Applicable only for devices which connect via a SAS token 	When the device needs to be treated as new in-box 

High level provisioning

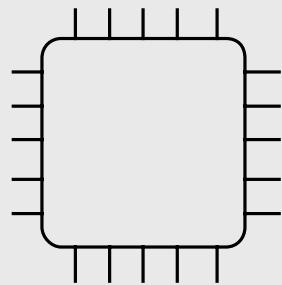


IoT Plug and Play In Platform Context



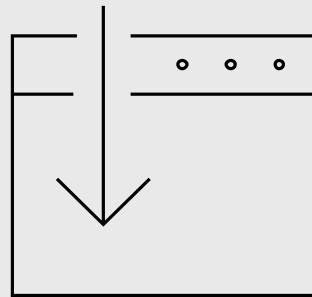
Where are capability models stored?

Device sends capability model ID and version expected for the solution to know
If unknown, the following are the model retrieval options for the solution:



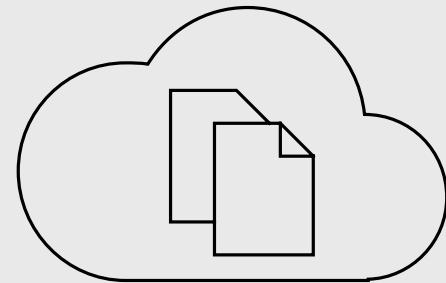
Device Sent

Stored and sent by the device to the solution. Quick and easy but device must be updated if model changes



URI Retrieval

Device sends a URI for retrieval from central location. Great for constrained devices, privacy or for simple on-premises deployments



Capability Model Repository

Can be pre-cached by Azure solutions. Includes publish-time validation/versioning and integration with Azure dev tooling

IoT Plug and Play Repository*

<https://preview.catalog.azureiotsolutions.com>

Capability model and interface workspace and publishing repository experience

Publishing integrated in VS Code and Azure CLI for both interfaces and capability models

Automated validation, collision checks and versioning support

Search, filter, sort, view models & their graphs in model repository UX

Works out-of-the-box with any Azure IoT solution

Will be made available as an open-source project

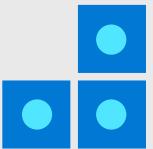
Microsoft will also host a fully managed, multi-tenant instance for always up-to-date for Azure Certified devices; integrated into certification flow

The screenshot shows the 'Company repository' section of the Azure Certified for IoT portal. The left sidebar has 'Company repository' selected. The main area displays a table of capability models:

Capability model	Version	Interfaces	Publisher	ID	Public
DRONE6.347295	01.00.00.00	7	Fabrikam Corp	https://fabrikam.com/int...	✓
DRONE6.01234	01.01.01.02	5	Fabrikam Corp	https://fabrikam.com/int...	

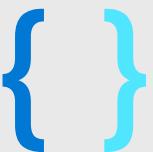
*IMPORTANT: Model repository is never required for IoT Plug and Play

Capability Model Developer Tooling



Azure IoT Device & Service SDKs

Updated with IoT Plug and Play support for all languages



Azure IoT Device Workbench extension for Visual Studio Code

IntelliSense and validation for authoring models
Generate skeleton device code from capability models
Works with Microsoft model repository



Azure IoT CLI extension

Author / retrieve capability models & interfaces
Test device and service code

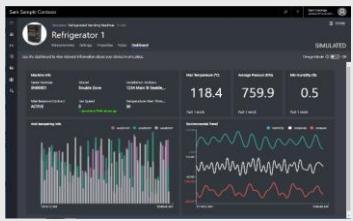


Azure IoT Explorer

Updated to allow discovery and examination of IoT Plug and Play devices

Partner Solutions & Azure IoT Central

Devices that just work out of the box with no code required



Easy to certify plug and play devices

Easy for customers and partners to find plug and play devices that just work

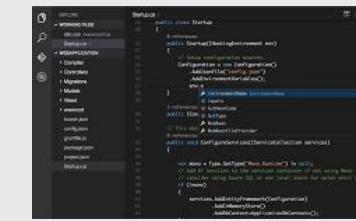
Azure IoT Device Catalog IoT Plug & Play Certified



Azure IoT Device Simulation

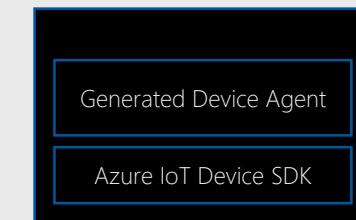


VS Code



Device Capability Model
JSON-LD Schema

IoT Plug and Play Device Software



Easy to model device capabilities, easy to generate device software skeleton

Easy to develop device software and ensure it just works with IoT solutions

IoT Hub, DPS, PnP

Step 1 – Hands-on

<http://aka.ms/iot-workshop-asset-tracking>

Setup IoT Hub and DPS

Configure asset tracking device

Explore capabilities thanks to PnP

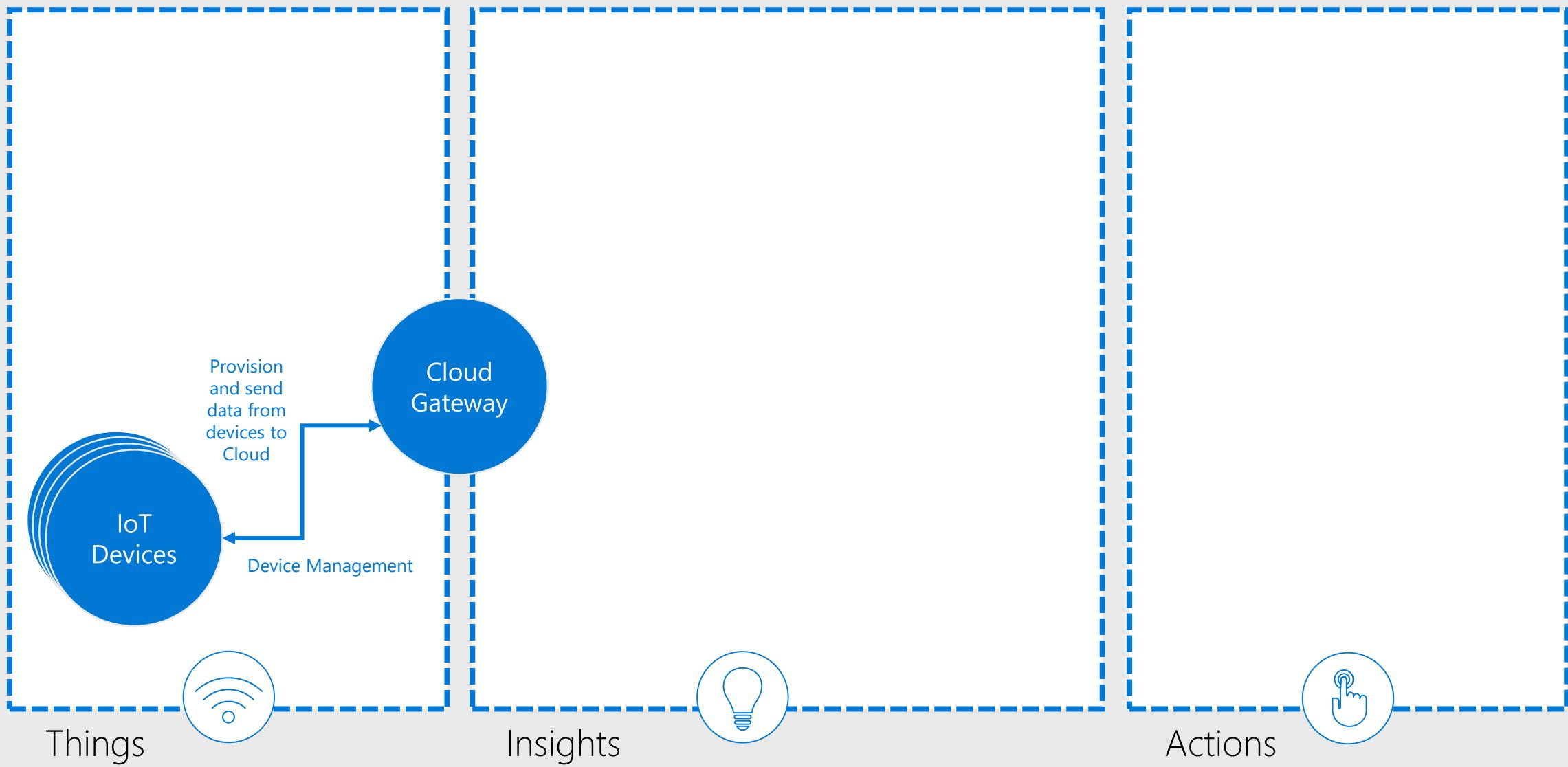
Step 2 – Setting up an IoT data pipeline

Efficiently store this data so that it can be accessed and queried

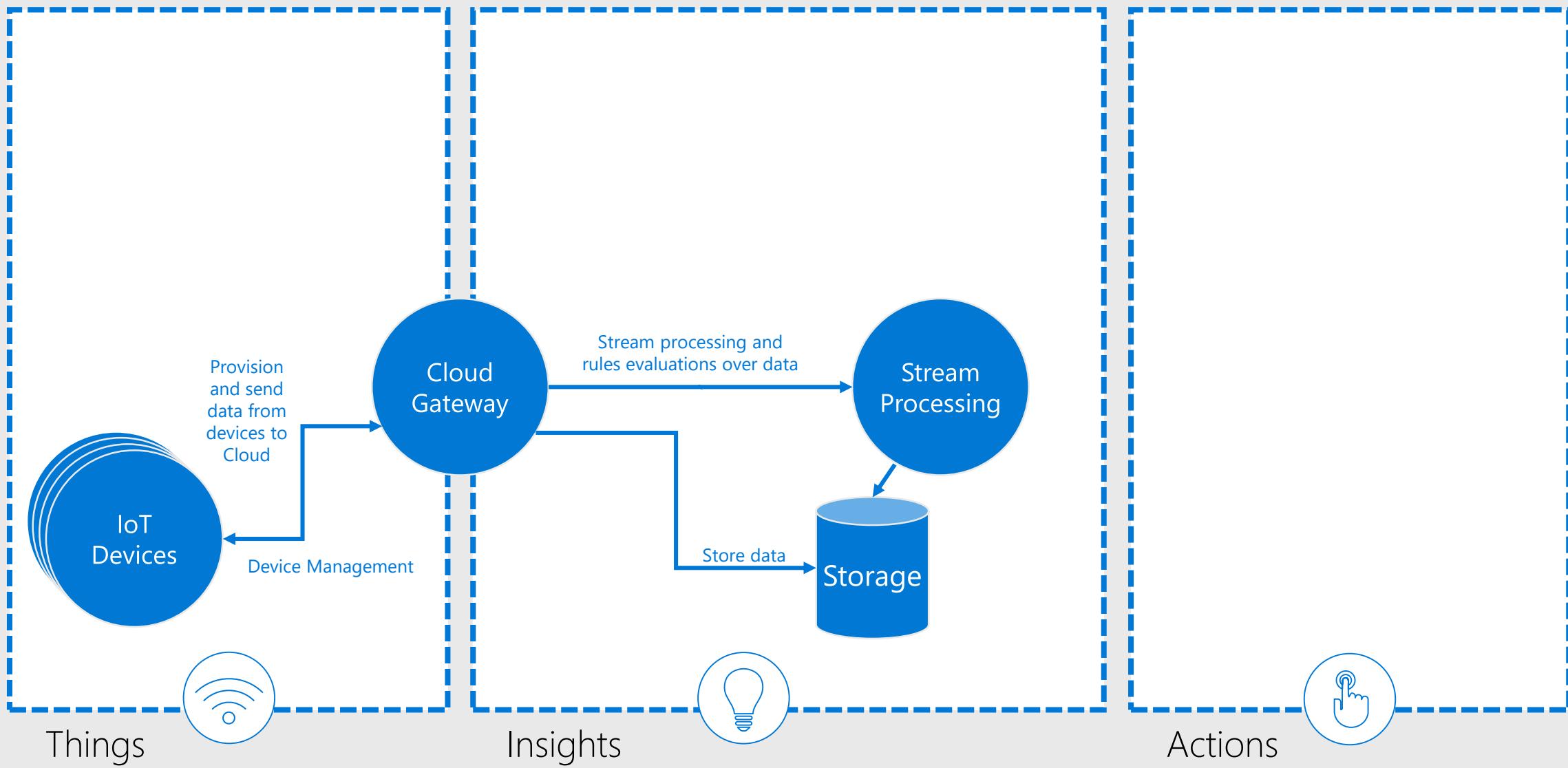
Learning goals:

- How to implement short-term and long-term retention using Azure Time Series Insights
- How to use TSI built-in data explorer to perform data analytics

IoT Architecture



IoT Architecture



What is Azure Time Series Insights

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



Fully managed, end-to-end PaaS solution to ingest, process, store, and query highly contextualized, time-series-optimized, IoT-scale data



Connect to a variety of data solutions using TSI's flexible data platform

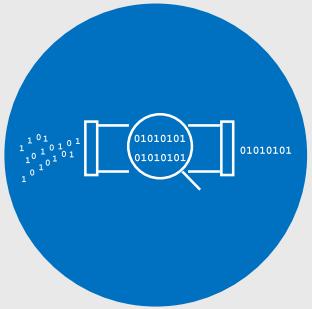


Use rich analytics APIs and UX for ad-hoc exploration and operational intelligence

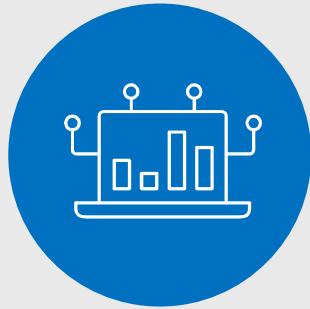


Use JavaScript control library for building custom analytics apps on the TSI platform

IoT Data Characteristics



Lacks
structural
consistency



Needs
contextualization

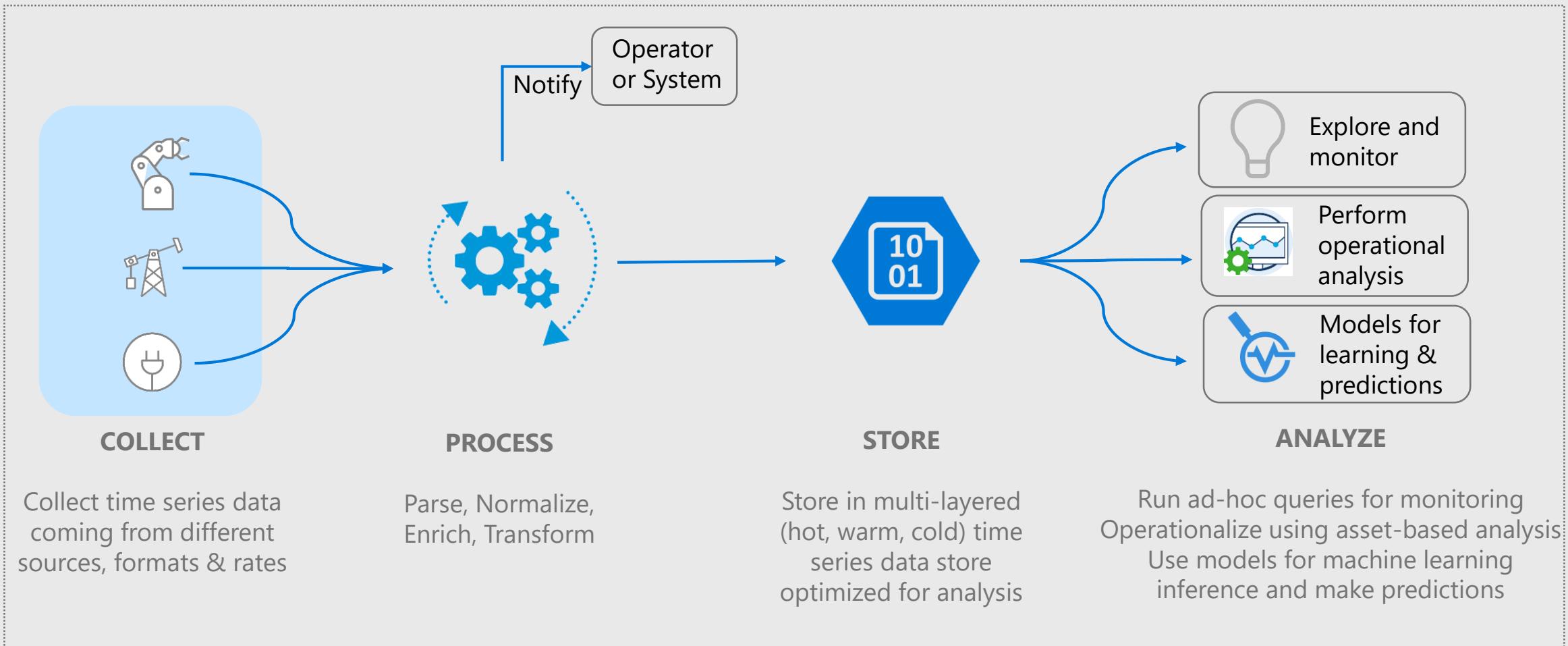


Often used with
other data



Infinite
retention

Canonical IoT Data Pipeline

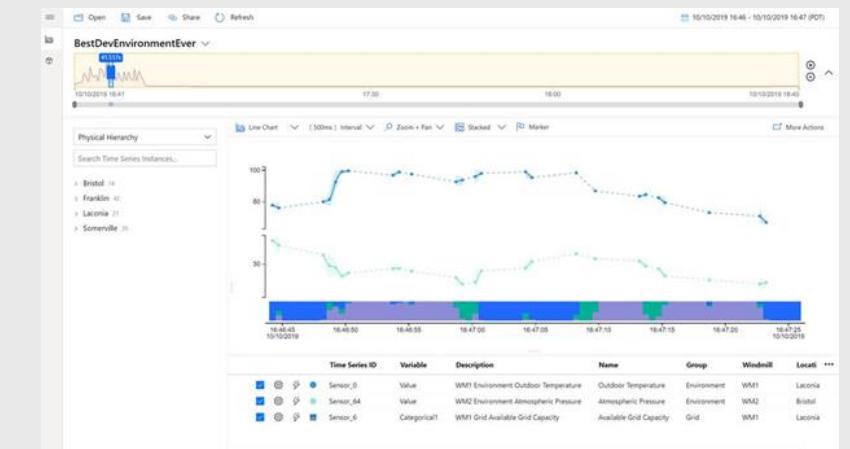
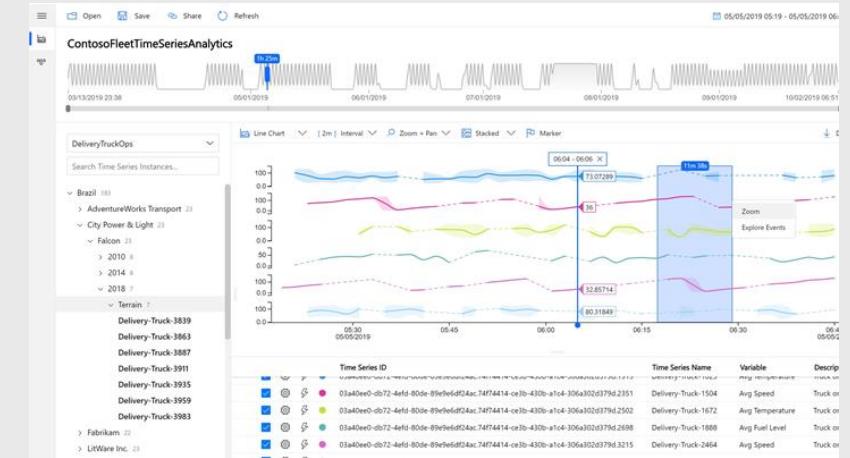


Azure Time Series Insights



NEW CAPABILITIES

- ✓ Multi layered storage with warm and cold analytics support providing customers with the option to route data for interactive analytics over short timespans and operational intelligence over decades of historical data
- ✓ Flexible data platform that allows customers to take data stored in open source Apache Parquet to other advanced data solutions such as Spark, Databricks, Jupyter for predictive maintenance, machine learning and AI
- ✓ Rich query APIs and user experience to support interpolation, scalar and aggregate functions, categorical variables, scatter plots, and time shifting between time series signals for in-depth analysis.
- ✓ Enterprise grade scale and performance at all layers of the solution to support customers' industrial IoT solution needs
- ✓ Rich extensibility through Power BI connector to enable customers to take their time series queries directly into Power BI for a unified BI and analytics view



Time Series Insights

Step 2 – Hands-on

<http://aka.ms/iot-workshop-asset-tracking>

Setup TSI environment

Setup event sources

Explore data

Step 3 – Anomaly detection

Getting alerts when abnormal conditions are detected

Learning goals:

- How to extract insights from real-time IoT Data using Azure Stream Analytics
- How to turn alerts into actions
- How to store alerts into Time Series Insights, alongside telemetry

Azure Stream Analytics In a Nutshell



Unlocking Real-time Insights

Time to Insight is Critical

- Reducing decision latency can unlock business value

Insights are Perishable

- Window of opportunity for insights to be actionable

Ask Questions to Data in Motion

- Can't wait for data to get to rest before running computation



Real-time Stream Processing

Simple Event Processing

- Filter
- Transform
- Enrich
- Split
- Route

Event Stream Processing

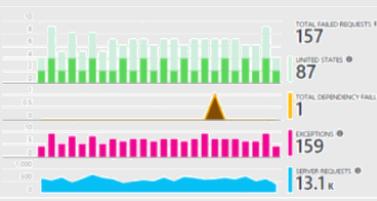
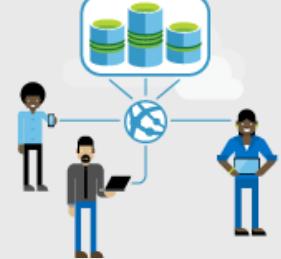
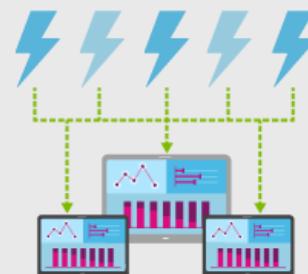
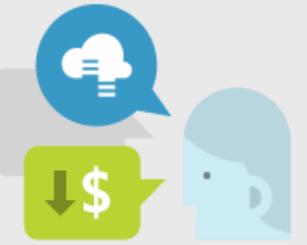
- [Simple event processing] +
- Aggregate
- Rules

Complex Event Processing

- [Event Stream Processing] +
- Pattern detection
- Time windows
- Joins & correlations

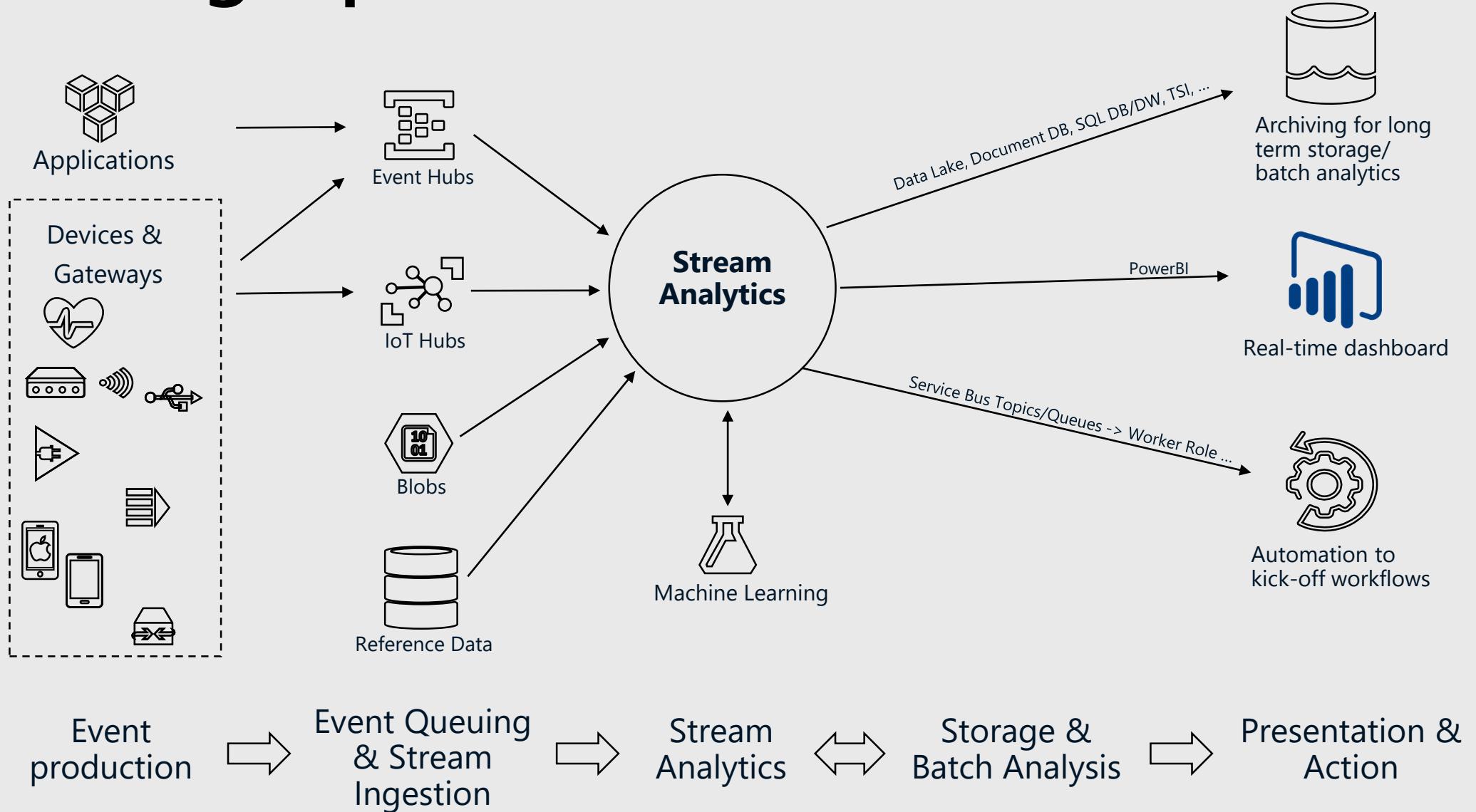


Scenario Examples

Real-time Fraud Detection	Streaming ETL	Predictive Maintenance	Call Center Analytics
			
IT Infrastructure and Network Monitoring	Customer Behavior Prediction	Log Analytics	Real-time Cross Sell Offers
			
Fleet monitoring and Connected Cars	Real-time Patient Monitoring	Smart Grid	Real-time Marketing
			

and many more...

Streaming Pipeline



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

Aggregation

SUM
COUNT
AVG
MIN
MAX
STDEV
STDEVP
VAR
VARP
TopOne

Date and Time

DateName
DatePart Day, Month, Year
DateDiff
DateTimeFromParts
DateAdd

String

Len
Concat
CharIndex
Substring
Lower, Upper
PatIndex

Temporal

Lag
IsFirst
Last
CollectTop

Mathematical

ABS
CEILING
EXP
FLOOR
POWER
SIGN
SQUARE
SQRT

Windowing Extensions

TumblingWindow
HoppingWindow
SlidingWindow

Geospatial (preview)

CreatePoint
CreatePolygon
CreateLineString
ST_DISTANCE
ST_WITHIN
ST_OVERLAPS
ST_INTERSECTS

Scaling Extensions

WITH
PARTITION BY
OVER

Stream Analytics Job

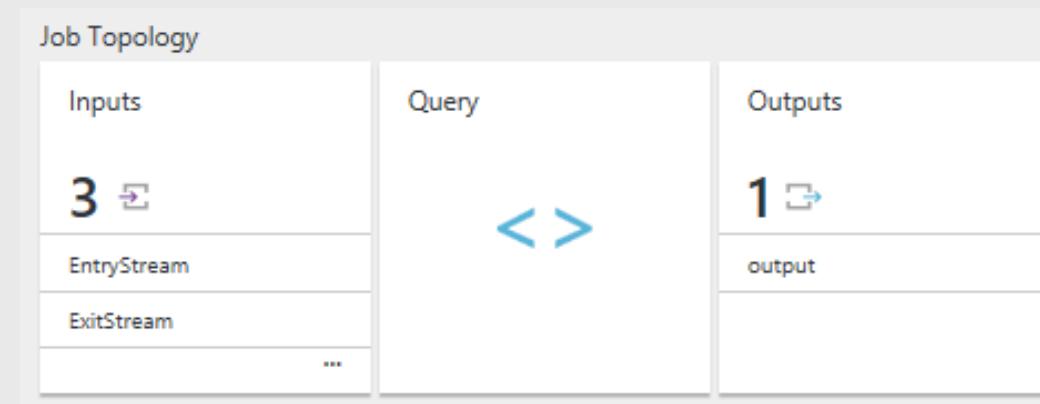
Users construct and deploy jobs to ASA

Job definition includes inputs, a query, and output

Inputs are from where the job reads the data stream

Query runs for perpetuity unless explicitly stopped and transforms the input stream

Output is where the job sends the job results to



Azure Stream Analytics

Step 3 – Hands-on

<http://aka.ms/iot-workshop-asset-tracking>

Setup ASA job

Create query to detect anomalies

Visualize anomalies in TSI

Step 4 – Map visualization

Learning goals:

- How to use Azure Maps web control
- How to combine Time Series Insights and Azure Maps web SDKs
- Advanced Azure Maps features, e.g heatmap

Azure Maps Overview



What is Azure Maps?

A collection of geospatial services for creating solutions that meet the requirements of enterprise customers in their line of business and consumer applications.

Enterprise Ready

- ✓ Enterprise Scale
- ✓ Global Availability
- ✓ Web and Mobile SDKs
- ✓ Integrated with other Azure Services
- ✓ Maps updated weekly
- ✓ Traffic data updated every minute

Trusted Platform

- ✓ Azure Security Compliant
- ✓ Azure Active Directory Tenancy
- ✓ GDPR {Azure Privacy} Compliant
- ✓ Accessibility, Usability, Globalization and Localization Compliant

Competitive, Flexible Pricing

- ✓ Generous free limits
- ✓ Access Azure Maps with any Azure subscription (trial, pay as you go, Enterprise Agreement)
- ✓ Multiple pricing tiers for your specific needs
- ✓ No upfront cost
- ✓ Only pay for what you use



Best of Breed Content Partnerships



Maps
Points of Interest
Geocoding
Routing
Road networks
Traffic



Mobility Services
Public Transit Networks
Real-time Transit data
Micro-mobility data



AccuWeather
Current Weather
Forecast Weather
Weather along route

**Updates from content partners made
instantly available in Azure Maps!**

A platform of geospatial APIs for the enterprise



Maps

Render maps and satellite imagery across many geographies in several styles



SDKs

Web and Android SDKs to integrate Azure Maps into applications



Routing

Multi-algorithmic routing, batch routing and matrix routing



Search

Find addresses, points of interest, landmarks, using a multitude of search algorithms or in batch



Spatial Operations

Create Geofences, measure great circle distance, closest point and point in polygon



Traffic

Real-time traffic flow and incident detail, measuring distance to back or front of the line



Time Zones

Obtain time zone and current time information from any location



Geolocation

Query for the location of an IP address



Mobility

(Public Transit)
Get real time intelligence on public transit services



Data Storage

Host your private map data in Azure Maps

NEW

capabilities



Weather services

Historical, Current and Predicted Weather Services with Radar and Satellite maps



Power BI integration

Integration with Power BI w/ rich data service and more powerful capabilities



Gov Cloud support

Azure Maps services availability through Azure Government Cloud

Microsoft's messaging: Azure Maps/Bing Maps

The following is the official Microsoft messaging regarding Bing and Azure maps:

Microsoft customers have a rich choice of options from which to source location and mapping data. Our guidance on which service to choose reflects the preference and status of a customer's implementation of location data. For those enterprise customers already using (or looking to use) Azure, we would recommend they use Azure Maps. Similarly, we'd recommend customers who have a preference for TomTom mapping data to also turn to Azure Maps. For existing Bing Maps for Enterprise customers, if your current services are meeting your needs, we encourage you to stay on your existing service. All customers should work with their Microsoft team to determine which of the services will best serve the individual customer requirements for production grade, fully deployable services.

Azure Maps

Step 4 – Hands-on

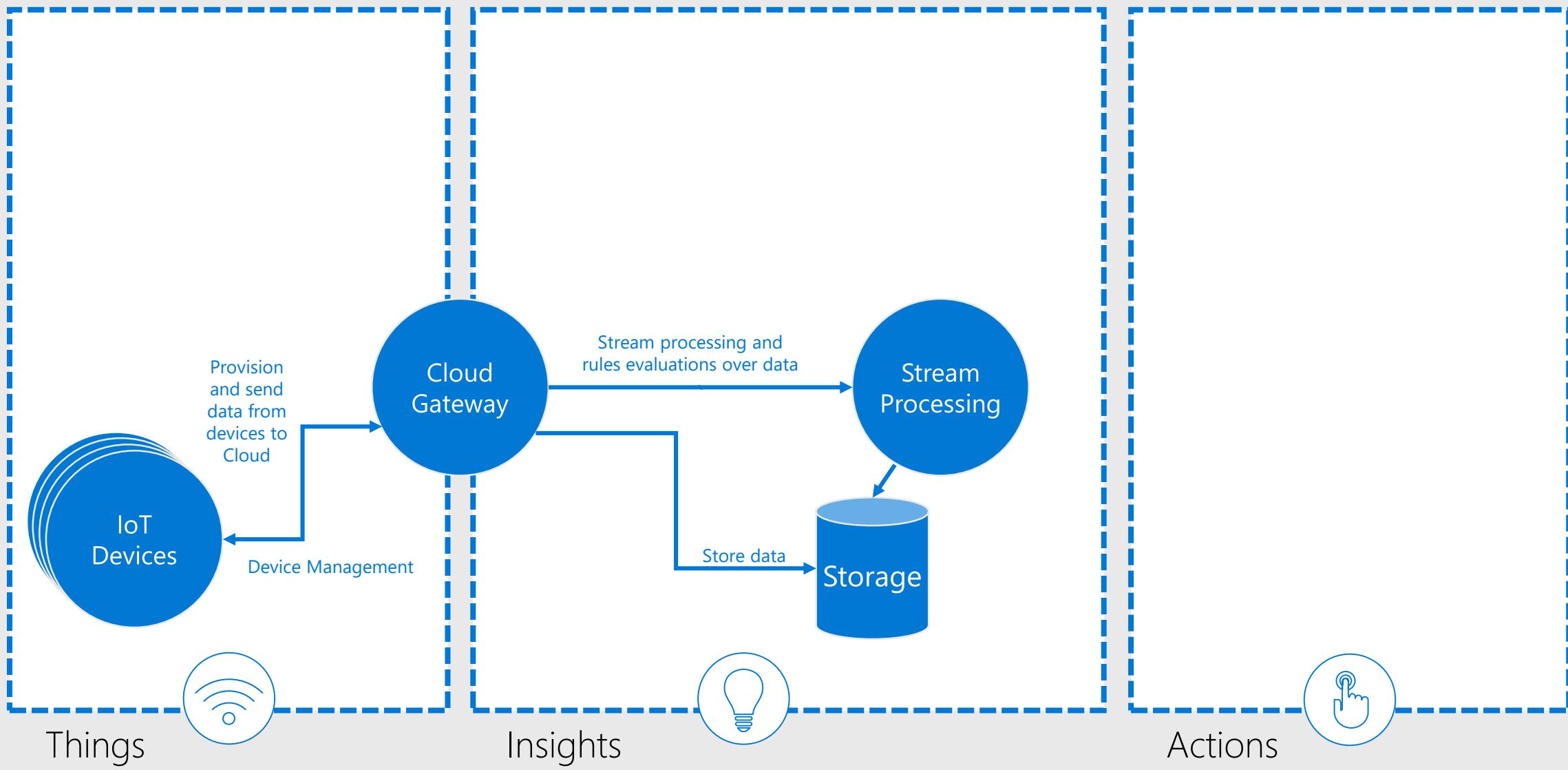
<http://aka.ms/iot-workshop-asset-tracking>

Setup Azure Maps subscription

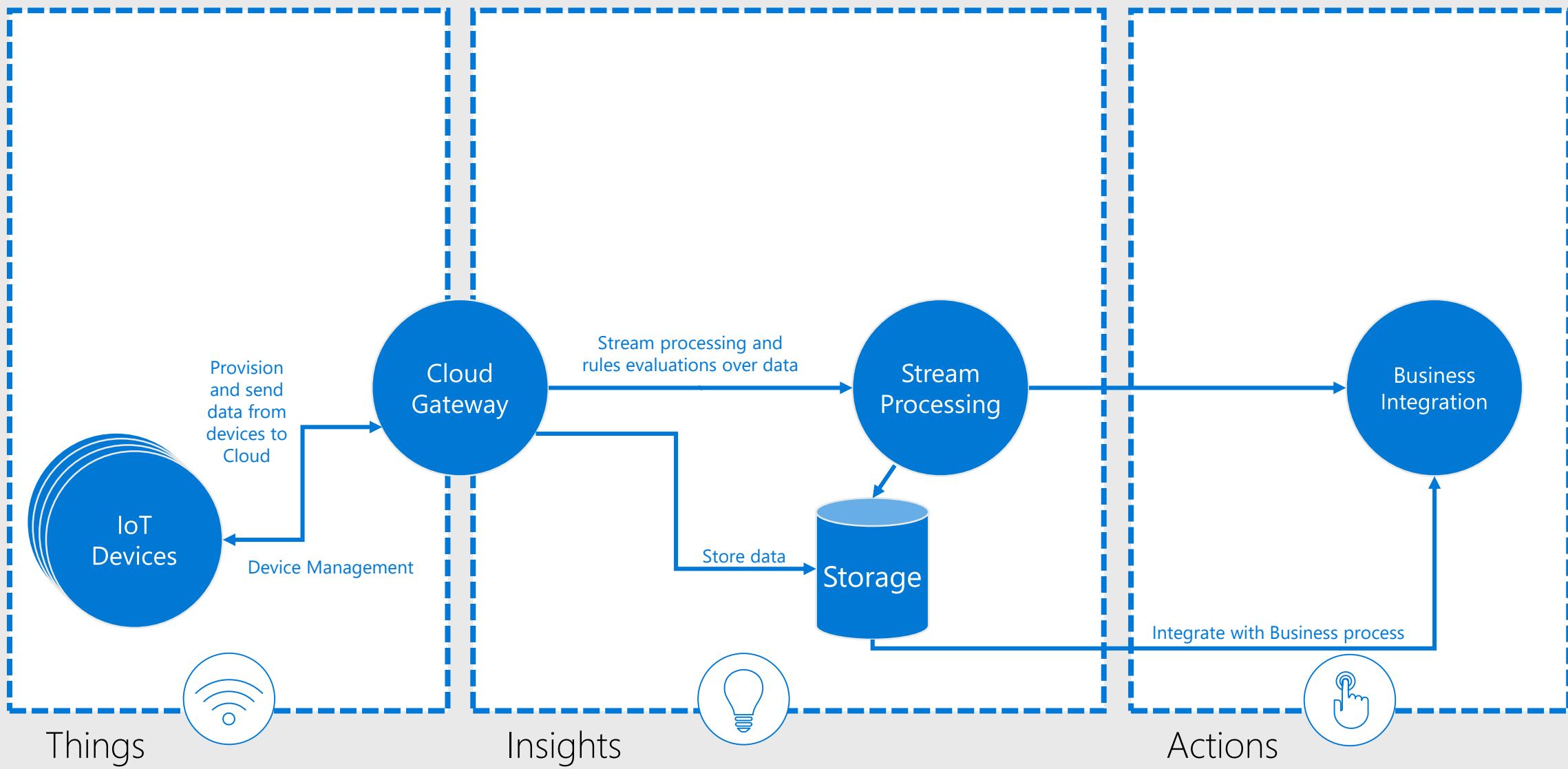
Use Azure Maps and TSI SDK

Explore Azure Maps REST API

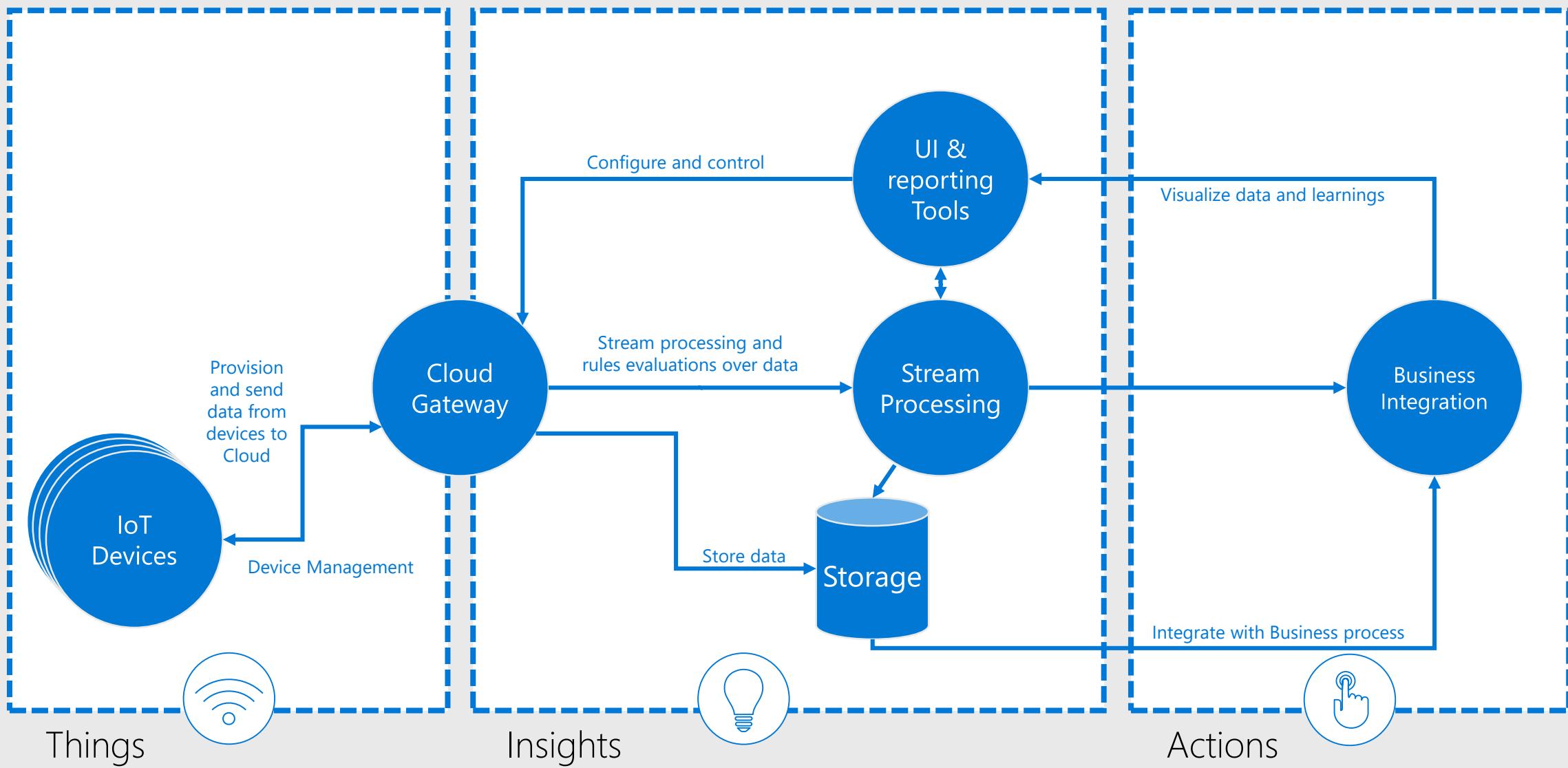
IoT Architecture



IoT Architecture



IoT Architecture



Logics Apps, Power Apps

Step 5 – Live Demo

Refine Stream Analytics job

LogicApps workflow

PowerApps and CDS integration

IoT Central

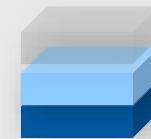
A fully managed IoT application platform

- ✓ Highly secure
- ✓ Enterprise-grade
- ✓ Predictable pricing
- ✓ Industry-focused



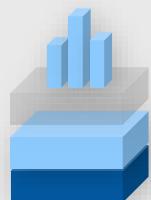
Get connected

Connect IoT devices to the cloud faster than any other platform.



Stay connected

Reconfigure and update devices with centralized device management.



Transform

Bridge the gap with connectors and extensibility APIs.

What is an IoT Central application template?

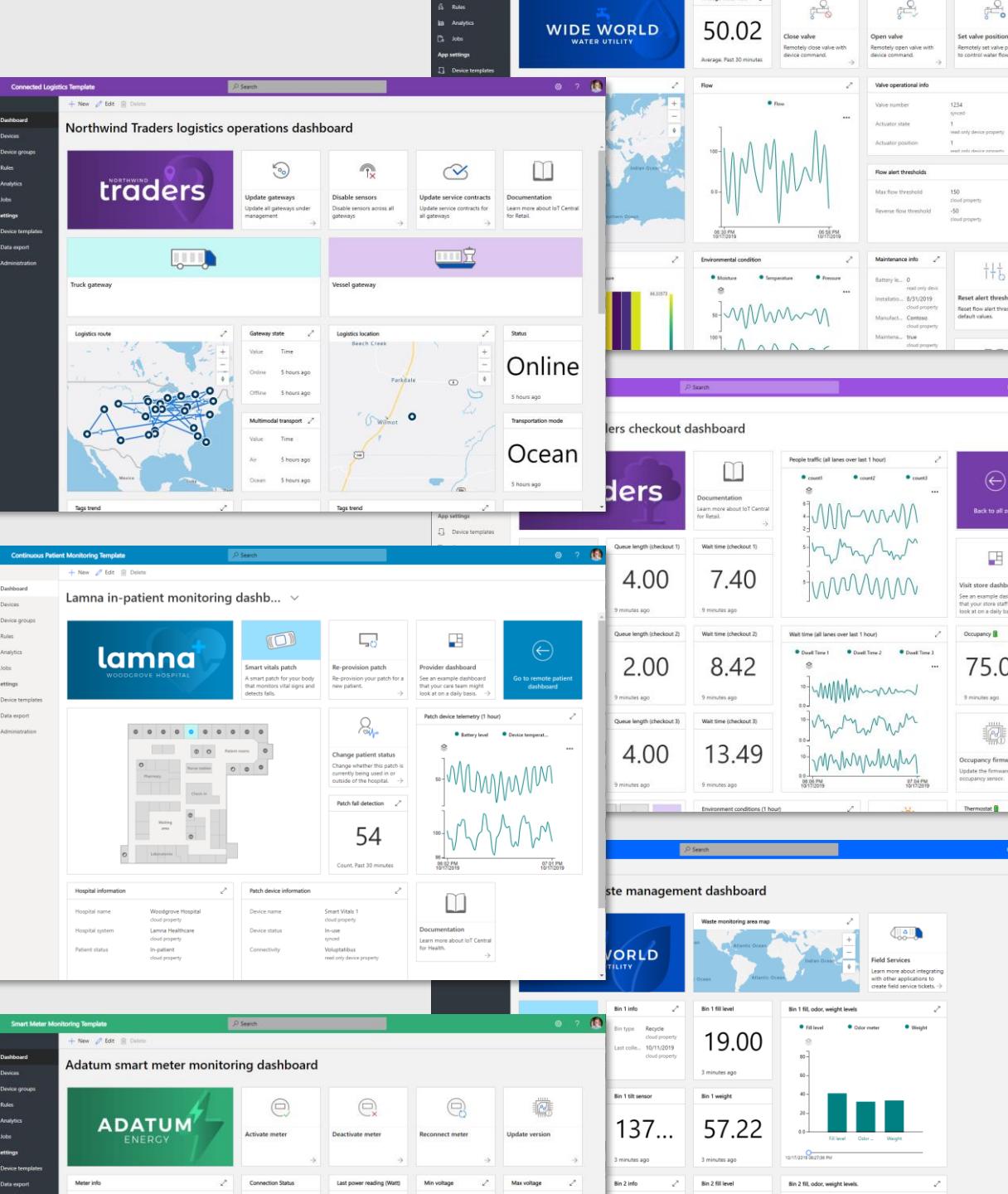
App templates are **tools to help solution builders kickstart their IoT solution development**

They consist of:

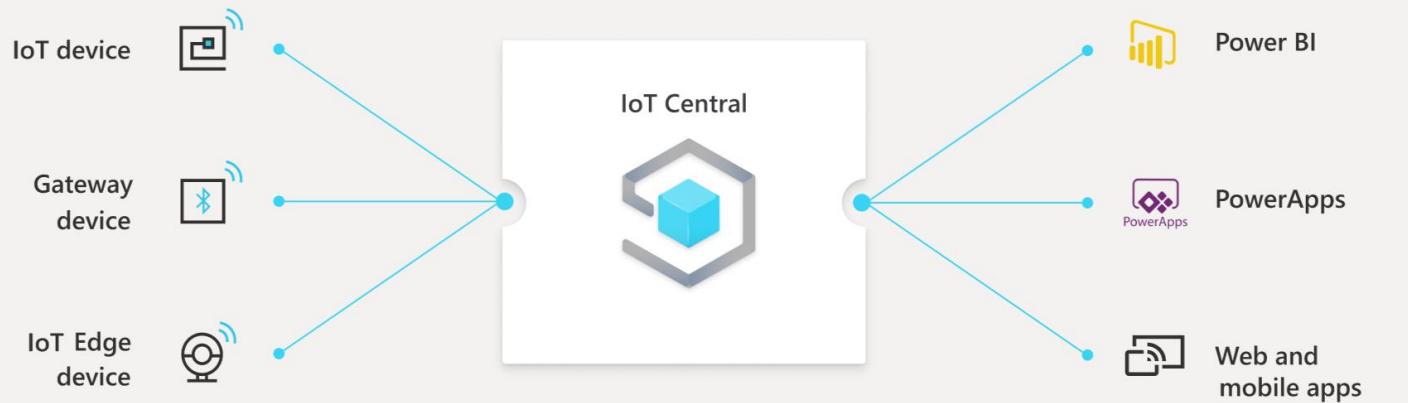
- Sample operator dashboards
- Sample device templates
- Simulated devices
- Pre-configured rules and jobs
- Rich documentation including tutorials

Brand templates using the white labeling feature

Sell to customers directly or through AppSource
Your brand, your SaaS



How do I build with IoT Central?



Take Action

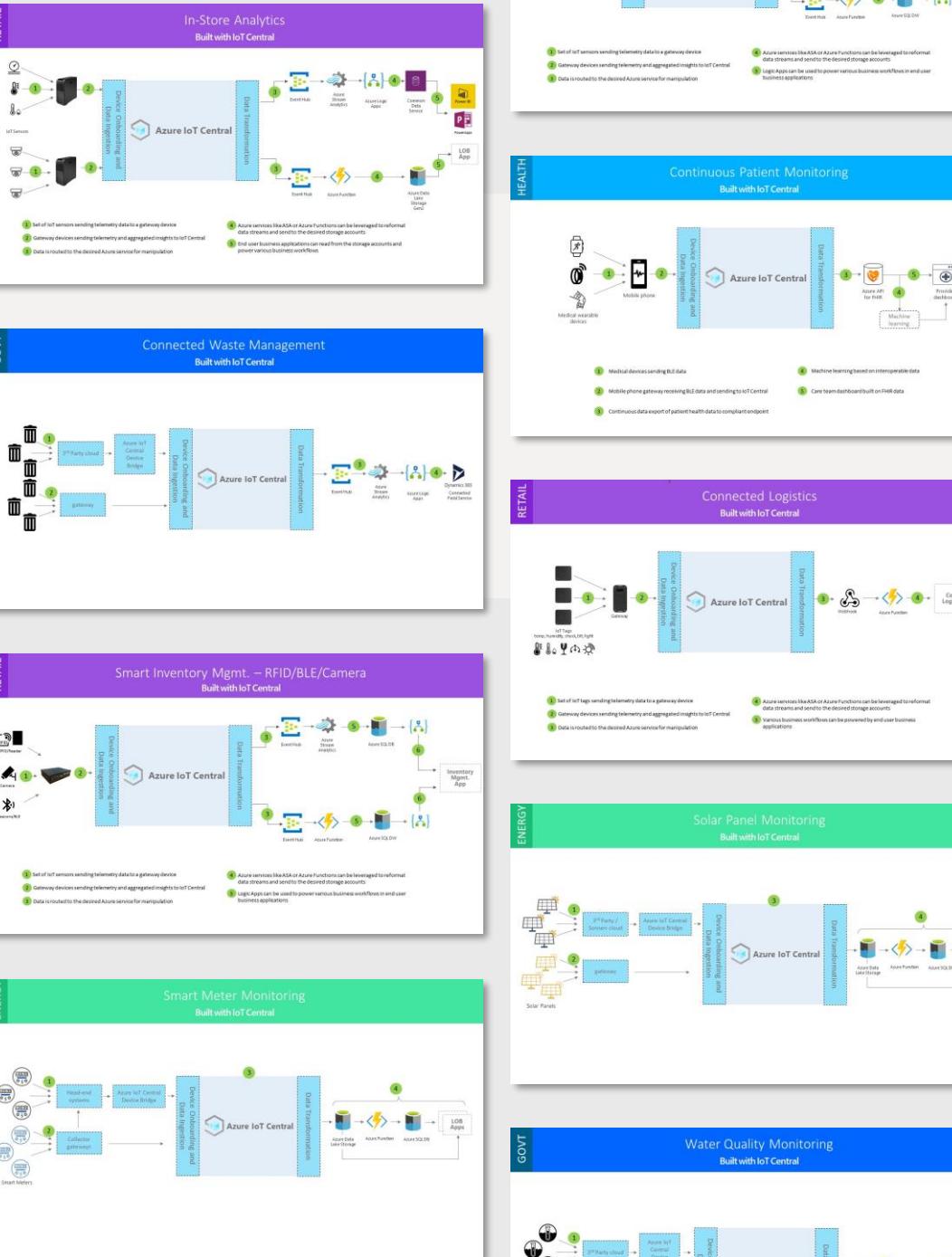
- No-code/Low-code actions with Microsoft Flow and Logic Apps

Integrate IoT Insights

- Continuous IoT data routing through Event Hub and Service Bus
 - Build data pipelines using the breadth of Azure Services

Build Solutions

- IoT Central public APIs for device modeling, provisioning, lifecycle management, operations (updating/commanding), and data querying



Going further



IoT Tech Community

aka.ms/iottechcommunity

Blog posts

News & Announcements

Weekly recap

Microsoft | Microsoft Tech Community | Communities | Events | Blogs | Microsoft Learn | Info Center | Search the community | Sign In

Internet of Things (IoT)

The space to share experiences, engage and learn from experts.

7,350 Members [Join](#)

Search this community

Latest Activity [Newest](#) Popular Experts Unanswered

Couldn't keep up with IoT news this week? Here is your weekly #ThisWeekInIoT digest

Olivier Bloch (@Olivier_Bloch_IOT) in Internet of Things on 11-01-2019

Have you noticed the buzz around Microsoft IoT this week? If you have not, then check out the links below to learn more. If you have noticed the buzz, then chances are you might have missed some news and updates as there were a LOT! The Microsoft IoT team... [Read More](#)

567 Views 0 Likes 0 Replies

Azure IoT Device Simulator-.Net Core 3.x version

Jon Mikel Inza (@jonmikeli) in Azure IoT on 11-01-2019

Hi all, In case it can help, you will find [here](#) an Azure IoT Device Simulator upgraded to .Net Core 3.x. The solution allows to simulate a broad part of the Azure IoT Device SDK. Those capabilities include features like:

- C2D messages based on JSON templates

[... Read More](#)

90 Views 0 Likes 0 Replies

Azure Security Center for IoT Webinar: End-to-End Security

Valon Kolica (@Valon_Kolica) in Azure Security Center for IoT on 10-31-2019

Discover how you can implement end-to-end security for your IoT solution: from your devices, to the edge, and to IoT Hub. Monitor the health of your IoT devices in near real-time. Find and eliminate threats and manage your security posture using ASC for

[... Read More](#)

21 Views 1 Like 0 Replies

Announcing AI@Edge community pages!

Jussi Niemela (@Jussi_Niemela) in Internet of Things on 10-31-2019

If you are building hardware or end-2-end IoT solutions utilizing intelligence in the edge take a look at [AI@Edge community](#) pages. This portal is aimed to support the discussion taking place in this TechCommunity and get you started with development by pr... [Read More](#)

240 Views 1 Like 0 Replies

Issue with Vision AI Developer Kit

Diaa Ala ElAbd (@Diaaalaq) in IoT Devices on 10-21-2019

Your camera is downloading Azure IoT Edge runtime

Why is this taking so long?

The camera is downloading the runtime and then it's trying to download the Azure IoT Edge image. This is a known issue with the current version of the Azure IoT Edge runtime. We are working on a fix and will release it soon.

Internet of Things (IoT) Announcements

Latest on the Channel 9 IoT Show

The Microsoft Connected Vehicle Platform: An Introduction

Latest Blog Posts

Secure End-to-End

Smart Intelligent Decision

Seamless Simplify Operations

Couldn't keep up with IoT news this week? Here is your weekly #ThisWeekInIoT digest

Olivier Bloch (IOT) in Internet of Things
11-01-2019

Top Contributors

Olivier Bloch (IOT)
100 Posts 66 Likes 1 Solutions

John Spear
53 Posts 21 Likes 0 Solutions

hellotechie
20 Posts 17 Likes 0 Solutions

Jussi Niemela
18 Posts 15 Likes 1 Solutions

ShiSh Shridhar
12 Posts 15 Likes 0 Solutions

More Resources

IoT at Microsoft

IoT Show

aka.ms/iotshow

Announcements

Tech talks & Deep Dives

Demos

Customer & Partner spotlights



Channel 9

all content shows events

search channel 9



sign in

Internet of Things Show



Last episode: 4 days ago

New video every Monday (sometimes more!). Subscribe to stay up-to-date with latest Microsoft IoT announcements, product and features demos, customer and partner spotlights, top industry talks, and technical deep dives with IoT Show!

NEW: IoT Show is expanding to a new technical live-streaming events called IoT Deep Dive twice a month! Come learn about how to build IoT solutions and...

[show more](#)

10 Authors:



[Filters](#) [Sort by](#) [Tag](#) [Author](#) [With](#)



The Microsoft Connected Vehicle Platform:
An Introduction

Oct 28, 2019 at 12:00PM
by Olivier Bloch, MAAllen

Are you interested in connected vehicles? (aka.ms/IoTShow/mcvp) Did you know that Microsoft counts some of the largest car manufacturers in the world as customers of its Microsoft Connected Vehicle...

2 ratings [0 comments](#)

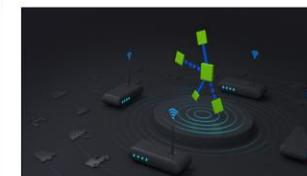
[view episode](#)



Deep Dive: Building IoT Solutions with
IoT Central



IoT at Ignite: Big news and useful tips for IoT
developers and operators



Deep Dive: Using CI/CD to Deploy IoT Edge
Modules with Confidence



Retail Location Analytics with Azure Maps



Azure IoT Hub integration with Azure
Event Grid



IoT in Action Global Event Series-Building
New Experiences

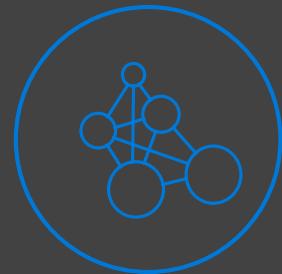
Azure IoT Reference Architecture



Foundational

A foundational guide for how to build native cloud IoT solutions.

Make your subsystems independently scalable, maintainable, and deployable.



Comprehensive

Provides component descriptions and tech recommendations.

Adjust for your skillset and solution.



Reliable

Helps you start from patterns that have worked with other partners

<https://aka.ms/iotrefarchitecture>

*Would you like to provide feedback? Do you have an idea or suggestion based on your experience with IoT?
We would love to hear it! email AzureIoTRefArcVoice@microsoft.com*



IoT breakout sessions

Driving growth and transformation with Microsoft IoT

Tuesday, 9:15 – 10:00 am (BRK1088)

Sam George + CH Robinson

In pursuit of the perfect pour: how Starbucks tackled IoT at scale

Wednesday, 10:30 – 11:15 am (BRK2228)

Galen Hunt + Starbucks

IoT for Enterprise Developers and IT Pros

Friday, 9:00 – 10:15 am (BRK3281)

Olivier Bloch and Arjmand Samuel

IoT theater sessions

Monday

Build your custom IoT solution with Azure IoT Central	2:50 pm	THR2248
Time Series Insights – end-to-end analytics for IoT workloads	5:45 pm	THR3146

Tuesday

AI at the Edge: using IoT Edge to remove latency, cost, and privacy roadblocks to IoT deployments	1:15 pm	THR2238
Unlocking Location Intelligence with Azure Maps	3:40 pm	THR2261

Wednesday

Integrate devices to your solution quickly with IoT Plug and Play	1:15 pm	THR2254
Bring IT security practices to IoT: how to stop threats and improve security posture	1:50 pm	THR2291

