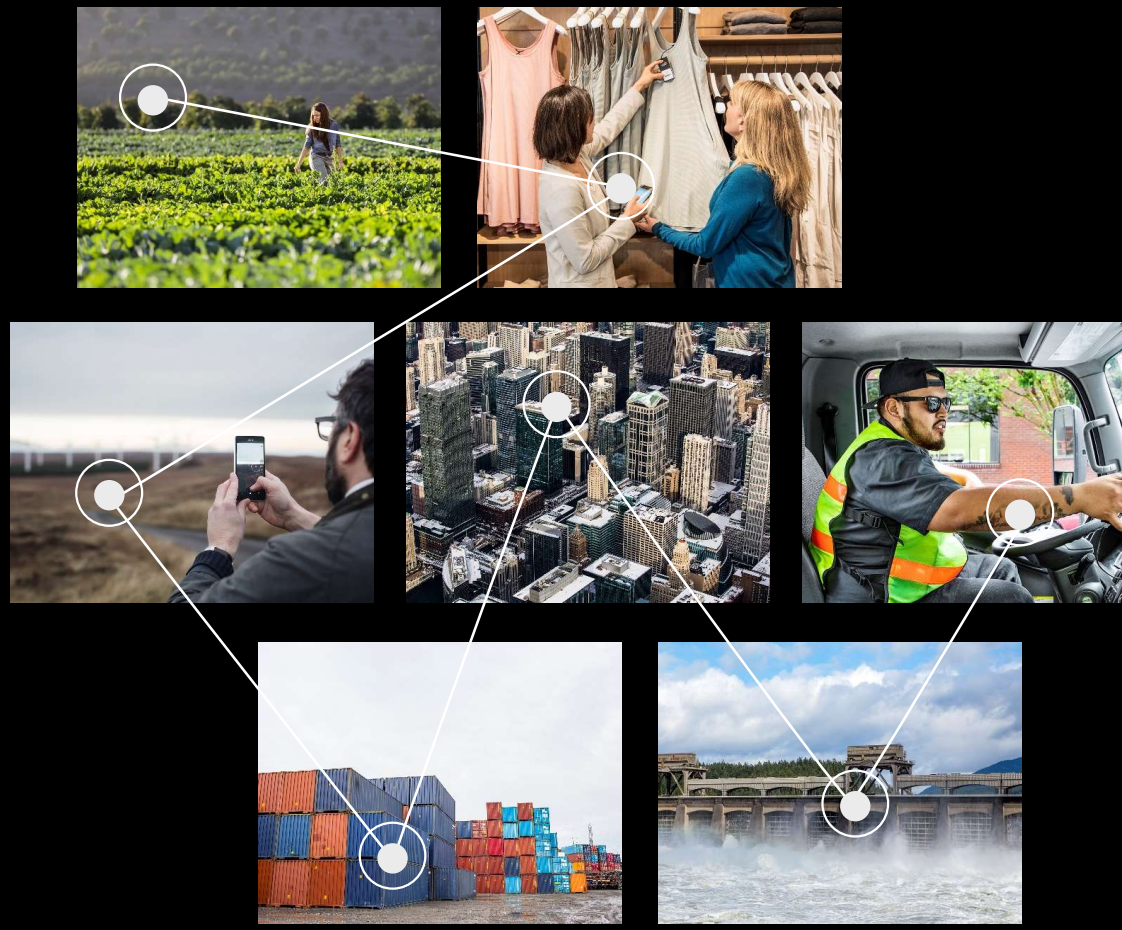
Microsoft Azure

Build end-to-end IoT solutions

Messaging processing, analytics, and business integration

Pamela Cortez
Microsoft Azure IoT



Build end-to-end IoT solutions – Workshop Series

https://aka.ms/IoT-online-workshop

Transform your business with IoT

Devices and device communication

Device provisioning at scale

Messaging processing, analytics, and business integration

Work with Azure IoT Edge

Messaging processing, analytics, and business integration

Time Series Insights

Azure Stream Analytics

Message Routing

Event Grid Integration

Developer Resources & Getting started

Microsoft IoT

Broadest portfolio

Industry Solutions

Manufacturing | Retail | Agriculture | Energy | Smart Cities | Healthcare | Transportation

IoT app services

Azure IoT Central

Dynamics Connected Field Service

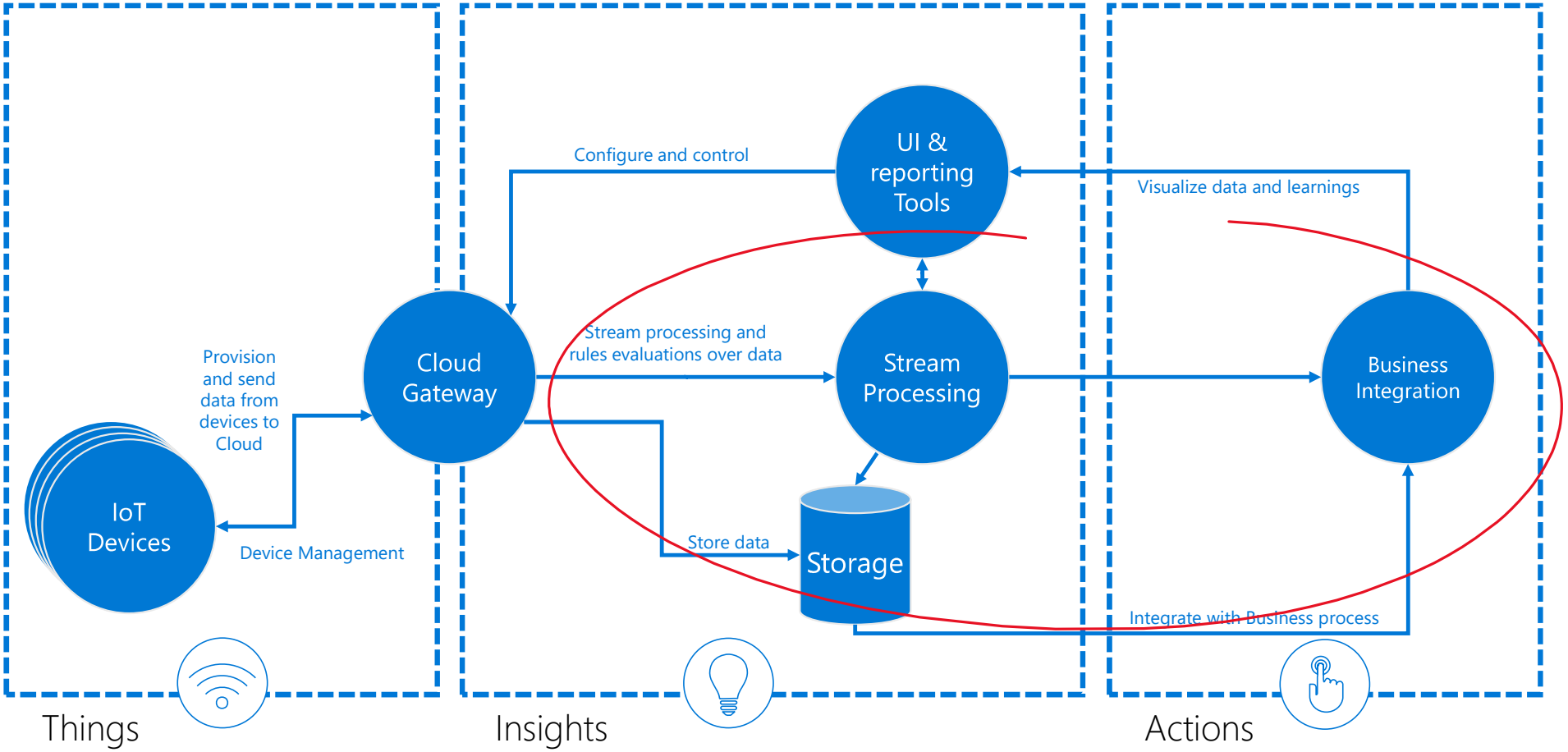
Azure services for IoT

- Azure IoT Hub
- *Azure IoT Hub Device Provisioning Service*
- Azure Digital Twins
- Azure Time Series Insights
- Azure Maps
- Azure Security Center for IoT
- 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

High-level IoT Architecture



Messaging processing, analytics, and business integration

Time Series Insights

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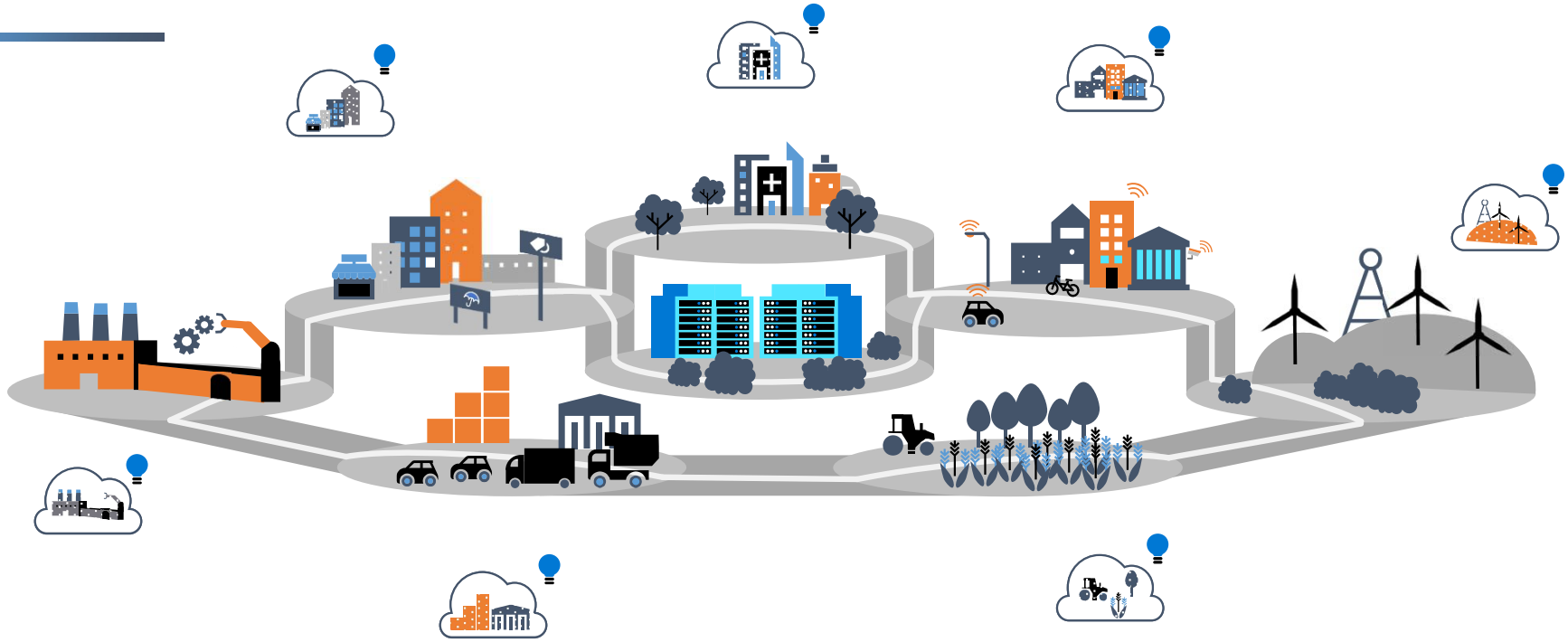
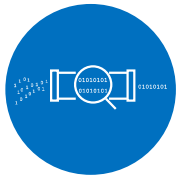
Developer Resources & Getting started

Pursuing new opportunities



4 Problems with IoT Data



Lacks structural consistency

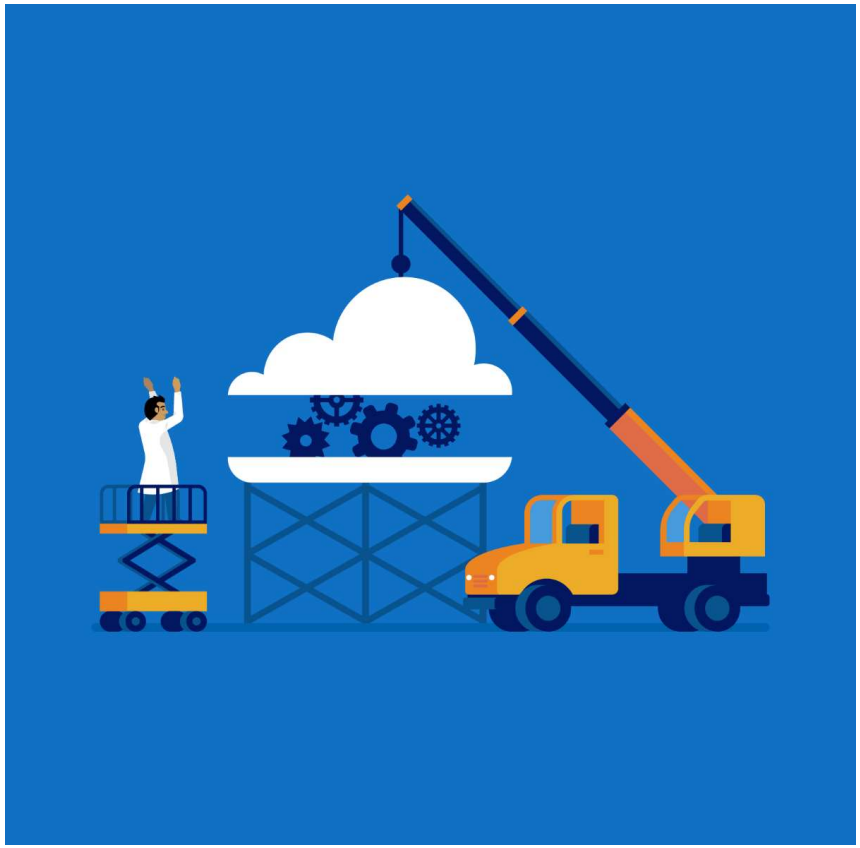
Needs contextualization

Requires infinite storage

Limited connections

Problems with IoT Data

Lacks structural consistency



Data coming from sensors and assets do not have consistent structures making it extremely difficult to aggregate and compare.

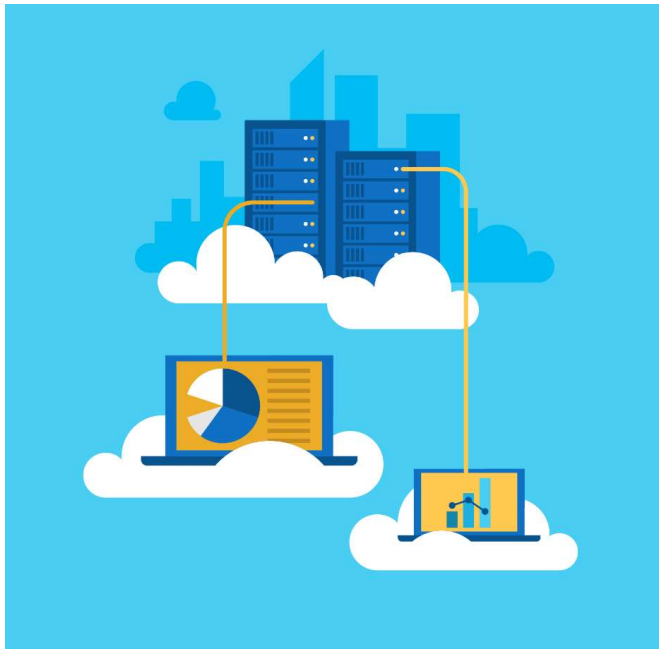
Problems with IoT Data

Needs contextualization

To analyze sensor and asset data accurately, you need the context of where the data came from, the asset's relationship to other sensors, and access to historical performance in one place.

Problems with IoT Data

Requires infinite storage

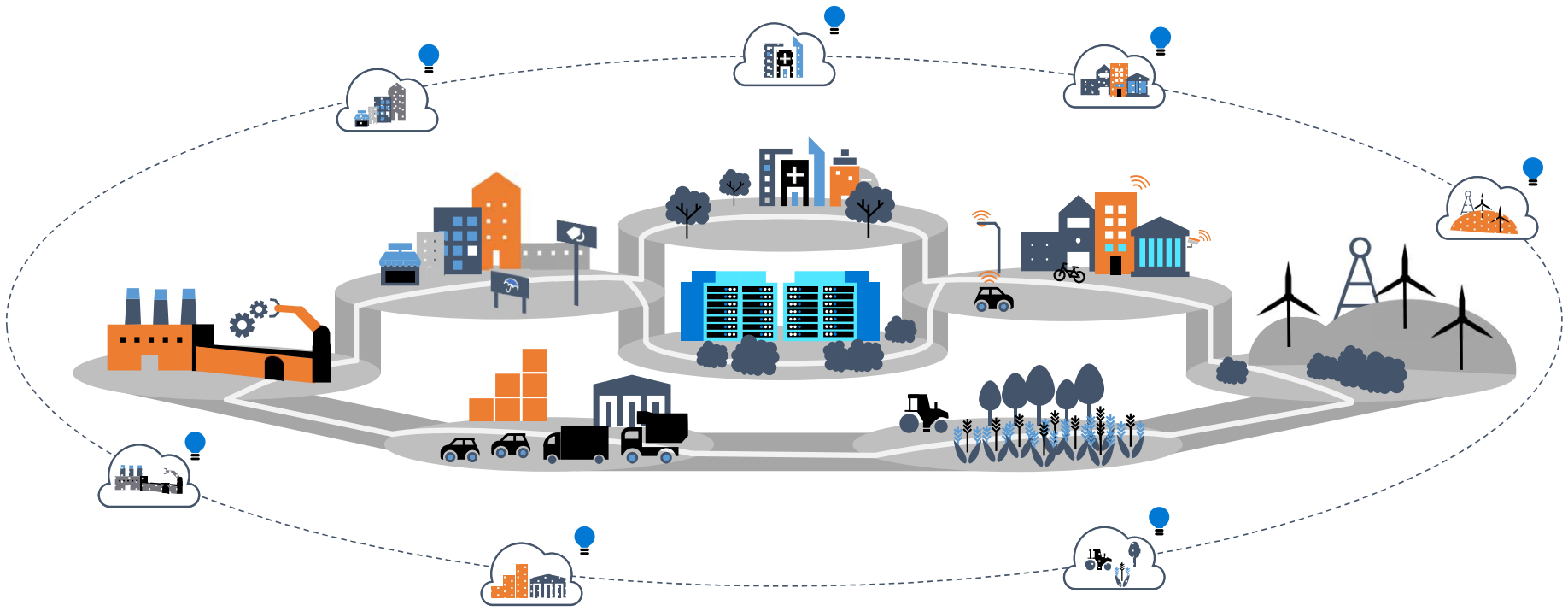


Access to the billions of IoT events created over decades of capturing data needs to be easy and immediate.

Problems with IoT Data

Limited connections

IoT data needs to be analyzed and consumed next to other business data to show the true business impact of IoT initiatives.



PURPOSE-BUILT

CONTEXTUAL

ACCESSIBLE

INSIGHTFUL

Azure Time Series Insights

A Serverless, Fully Managed Data Analytics Solution (PaaS) Built for IoT

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

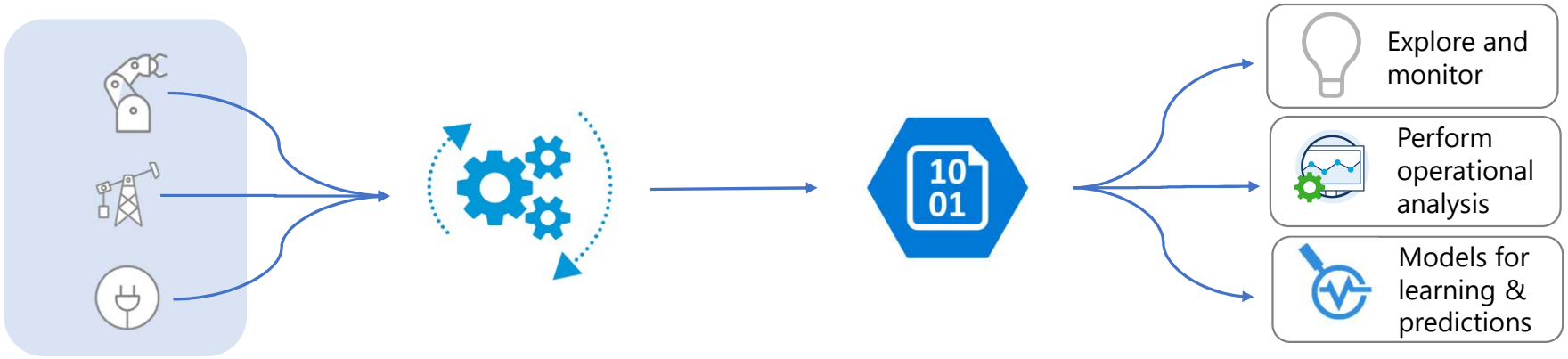
Use JavaScript control library for building custom analytics apps on the TSI platform

Automated scaling and Pay-As-You-Go Pricing

Turn data into decisions with actionable real-time IoT insights

Built for IoT

Turn inconsistent, unstructured data into useable information



COLLECT

Collect time series data coming from different sources, formats & rates

PROCESS

Parse, Normalize, Enrich, Transform

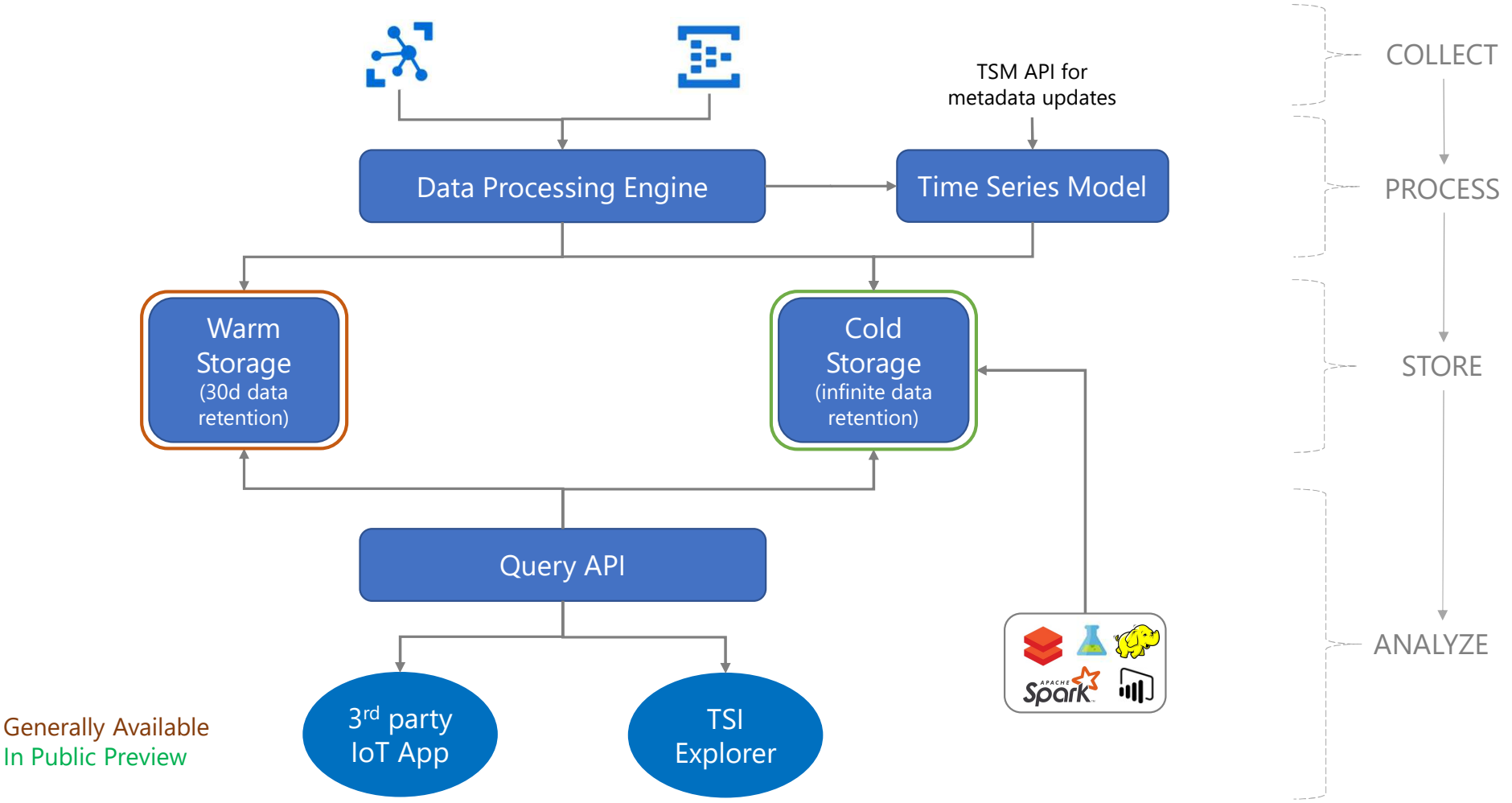
STORE

Store in multi-layered time series data store optimized for a variety of analysis

ANALYZE

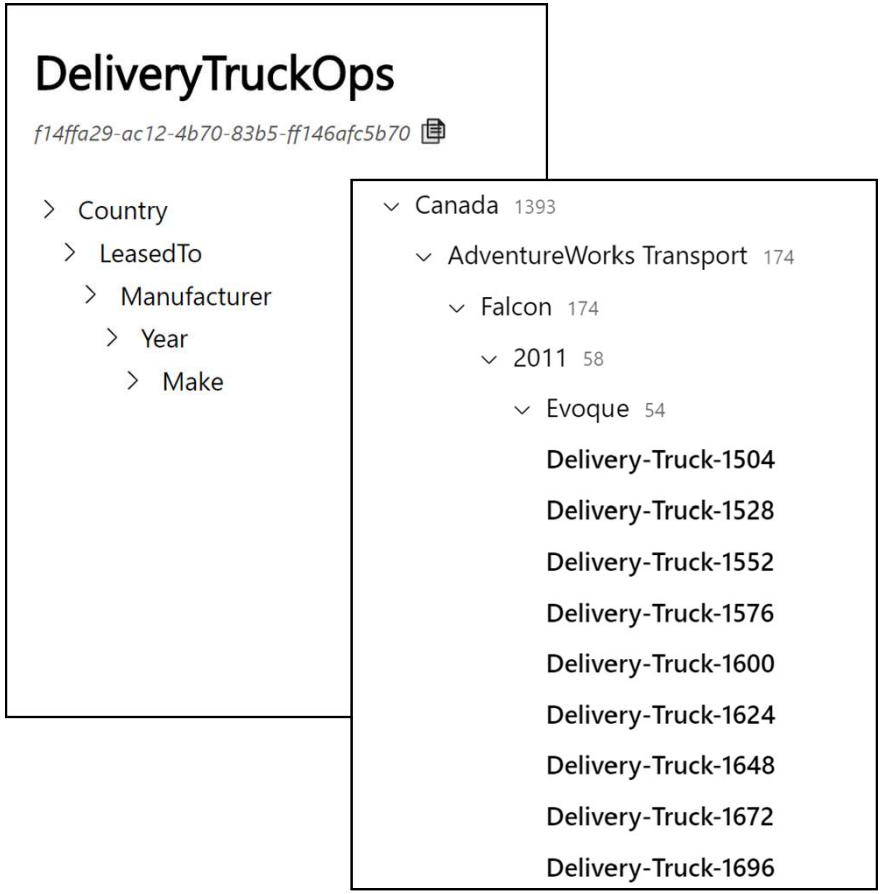
Run ad-hoc queries for monitoring; operationalize using asset-based analysis; use models for machine learning inference and make predictions

High Level Architecture



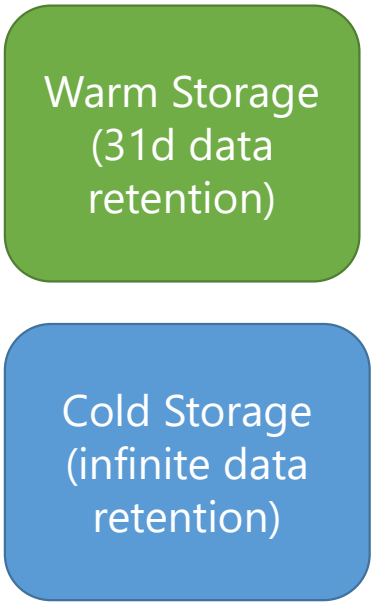
Contextualize data for better insights

- Build custom contextual models based on relationships, hierarchies, asset types, variables, etc.
- Upload current models to get started quickly.



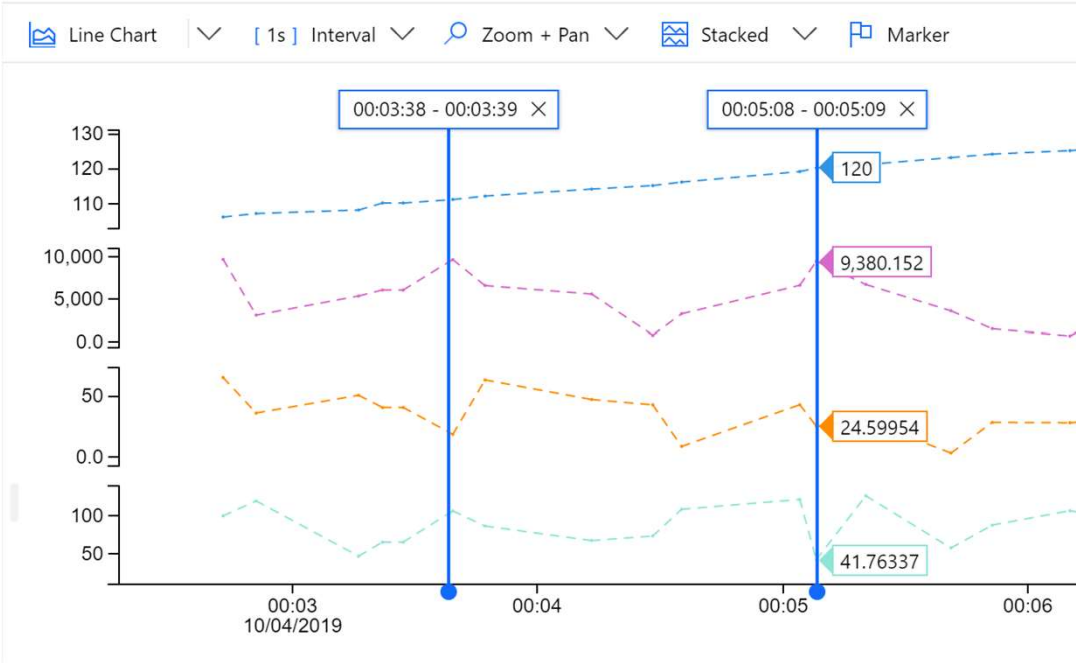
Access your data when you need it

- Multi layered storage with access to warm and cold analytics.
- Integrate time series data into your own visualization tools with our open APIs.
- Flexible storage platform allows custom storage containers based on your business needs.
- Connect to and interop across a variety of advanced analytics scenarios such as predictive maintenance and machine learning using familiar technologies including Apache Spark™, Databricks, Jupyter, etc.



Insights to make business decisions

- Visualize data for quick anomaly detection.
- Run concurrent queries to scale IoT insights.
- Reconstruct missing data for complete analysis.
- Stay on connected to reality with near real-time data.
- See data in context of business KPIs with PowerBI connector.



Put yourself in this situation:

- You have a fleet of trucks delivering goods all over the world.
- Unfortunately, your trucks in Canada are requiring more maintenance recently which hurts your profitability.
- You're tasked with figuring out why and proposing a solution.

Uncovering the Why

Anomaly detection and diagnosis

Examples:

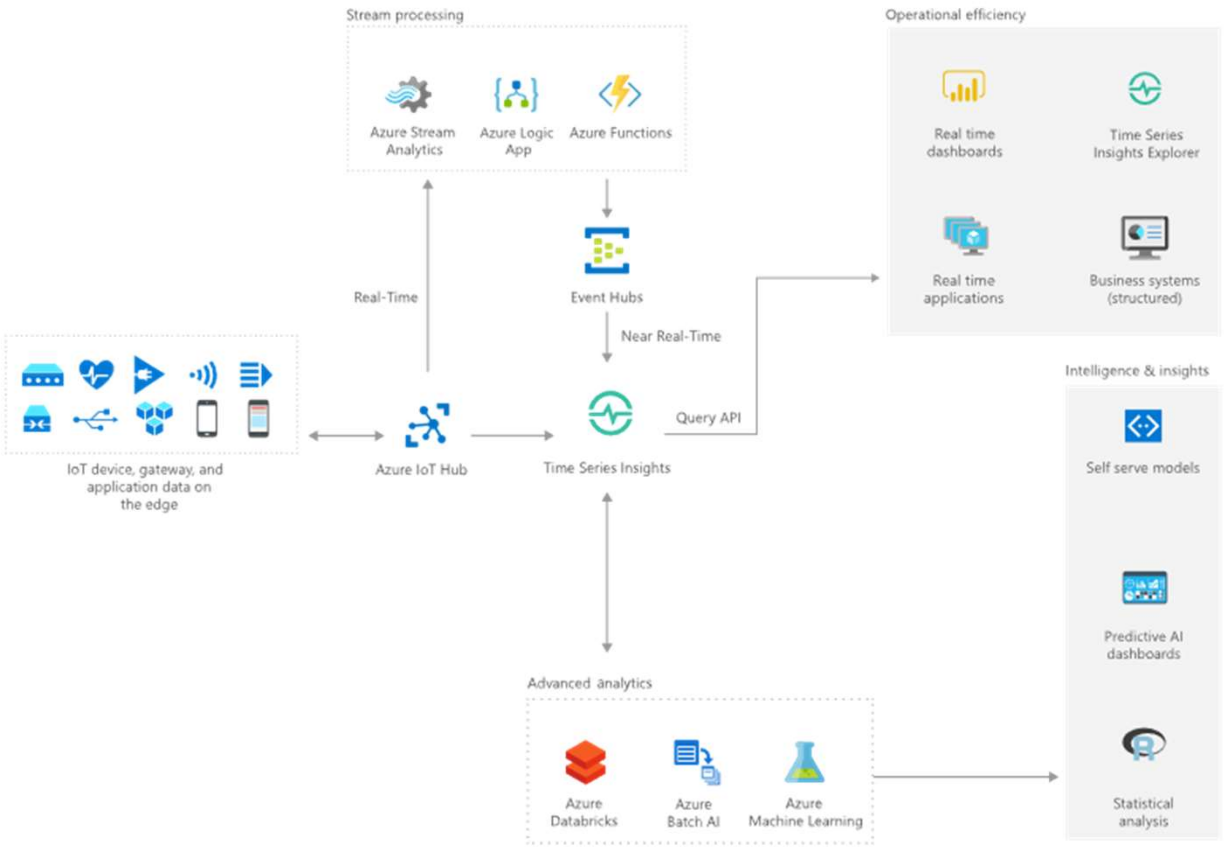
- Understanding why equipment requires extra maintenance.
- Searching why inventory was damaged.
- Researching why production declined on an assembly line.
- Chasing down a defect in the supply chain process.

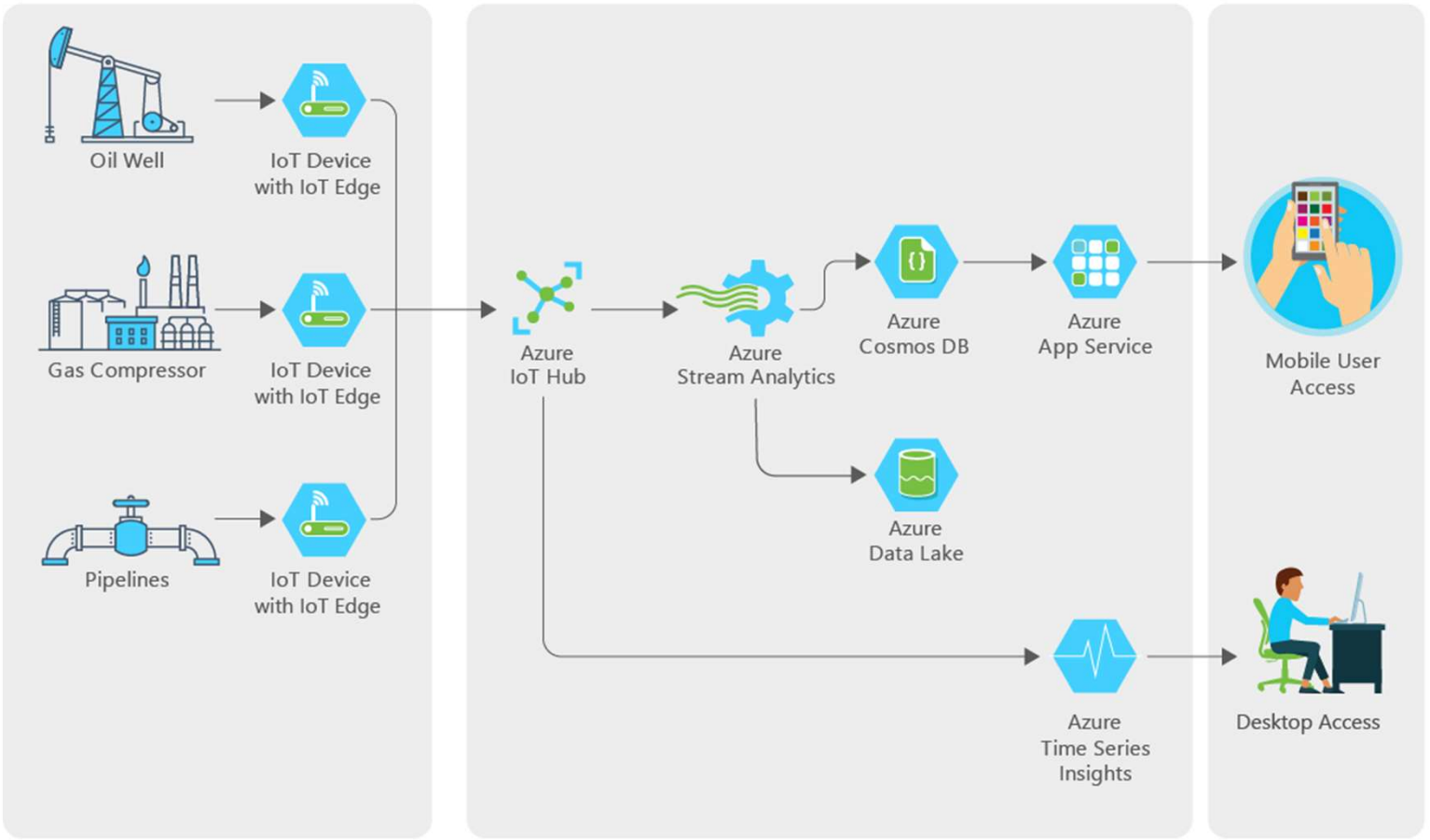
Improving operations

Operational intelligence and advanced analytics

Examples:

- Monitor equipment performance at scale
- Identify process inefficiencies
- Diagnose the health of equipment
- Optimize supply chain and production

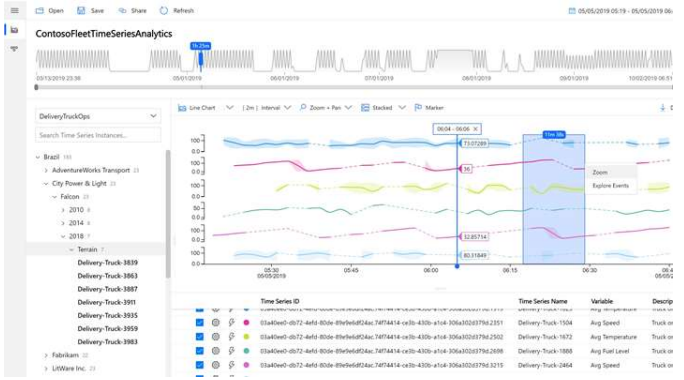


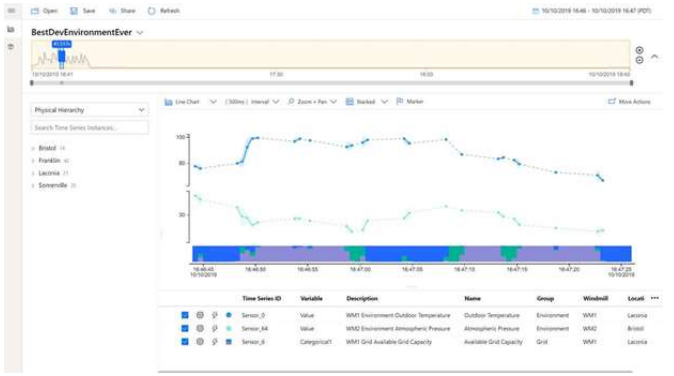

Oil Well
IoT Device with IoT Edge
Gas Compressor
IoT Device with IoT Edge
Pipelines
IoT Device with IoT Edge
Azure IoT Hub
Azure Stream Analytics
Azure Cosmos DB
Azure App Service
Mobile User Access
Azure Data Lake
Azure Time Series Insights
Desktop Access

Azure Time Series Insights

Capabilities

- Multi layered storage with warm and cold analytics support with the ability to route data to warm store for interactive analytics over short timespans and to cold store for operational intelligence over decades of historical data
- Flexible data platform that supports taking data stored in open source Apache Parquet to other advanced data solutions such as Spark, Databricks, Jupyter for predictive maintenance, machine learning and AI
- Bulk import support to bring decades of historical data in batch mode into TSI's data lake store and get it ready for analytics
- Rich query APIs and user experience to support interpolation, scalar and aggregate functions, categorical variables, scatter plots, and time shifting of time series signals for in-depth analysis.
- Enterprise grade scale and performance at all layers of the solution to support' industrial IoT needs
- Rich extensibility through PowerBI connector to support time series query integration directly in PowerBI to provide a unified view of BI and time series analytics



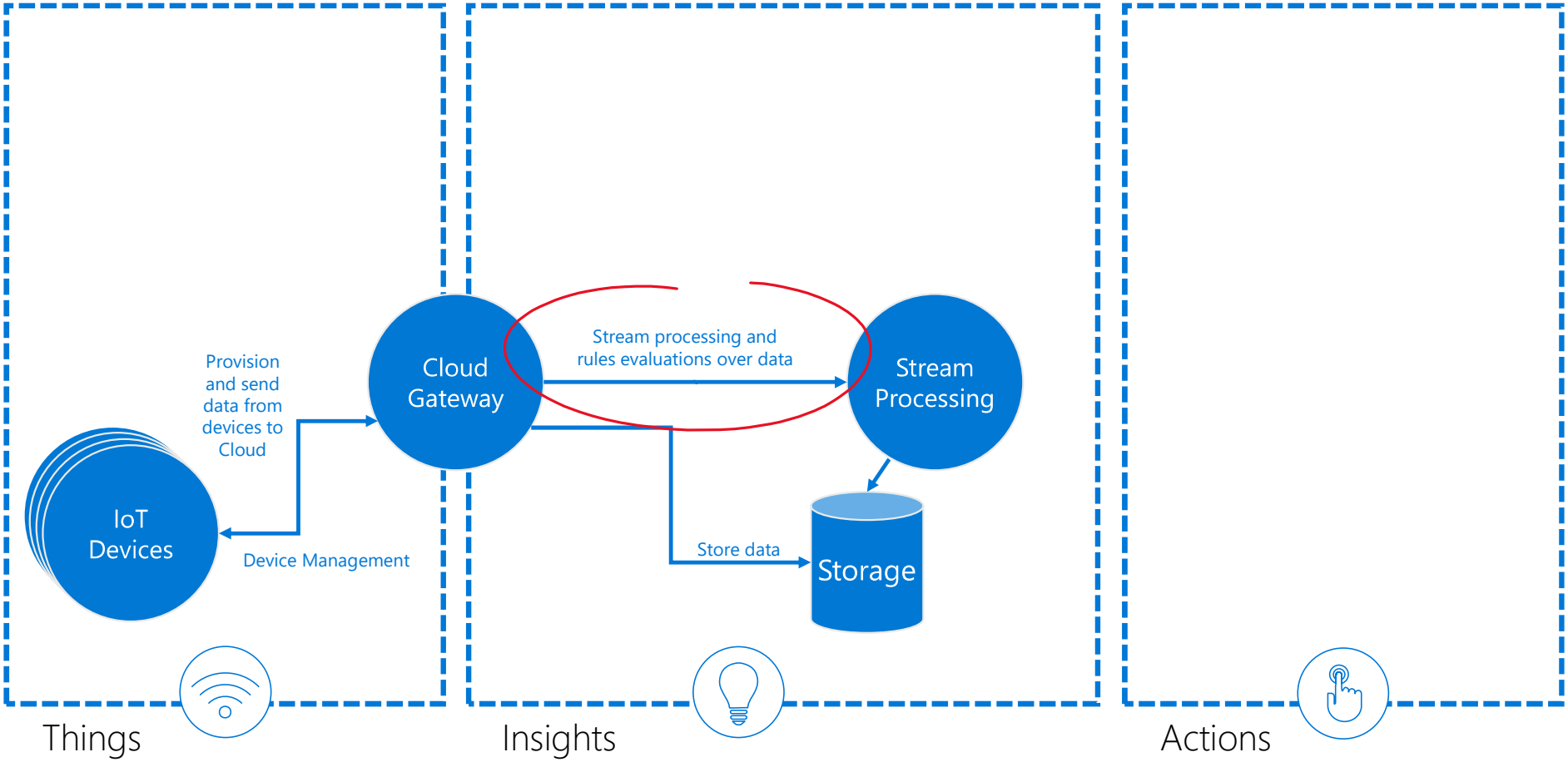


Messaging processing, analytics, and business integration

- Time Series Insights
- Azure Stream Analytics

- Message Routing
- Event Grid Integration
- Developer Resources & Getting started

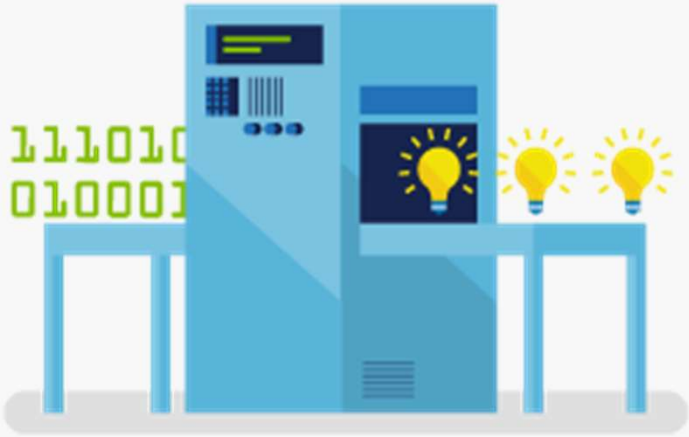
High-level IoT Architecture



Unlocking Real-time Insights

Time to Insight is Critical

Reducing decision latency can unlock business value



Insights are Perishable

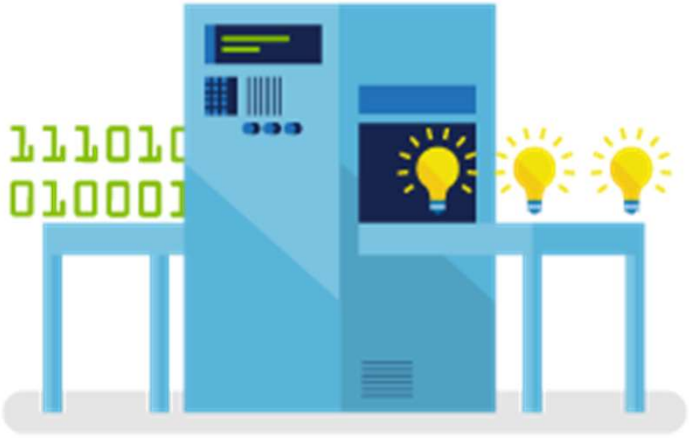
Window of opportunity for insights to be actionable

Ask Questions to Data in Motion

Can’t wait for data to get to rest before running computation

Why real-time analytics?

- **Insights are Perishable**
  - Window of opportunity is limited
- **Time to Insight is Critical**
  - Reducing decision latency can unlock business value
- ***You can now query Data in Motion***



Fully Managed PaaS offering for real-time analytics

Programmer productivity

Simple SQL language extensible with JavaScript and C#

Built-in Analytic functions

Azure Portal, VS Code, Visual Studio, PowerShell, REST APIs

Best in class debugging tools

Intelligent Edge, and Cloud

Same queries running either on Edge, Cloud or Azure Stack

Leveraging IoT Edge for security and deployment

Serverless and low TCO

Fully managed Job service: no clusters to manage or VMs to provision

Pay as you go: pay by minute, start, stop on-demand

Scale-up and scale-out

Easy to get started

Native, Zero code integration with 15+ Azure services

"<5 minutes to solution"

Enterprise grade

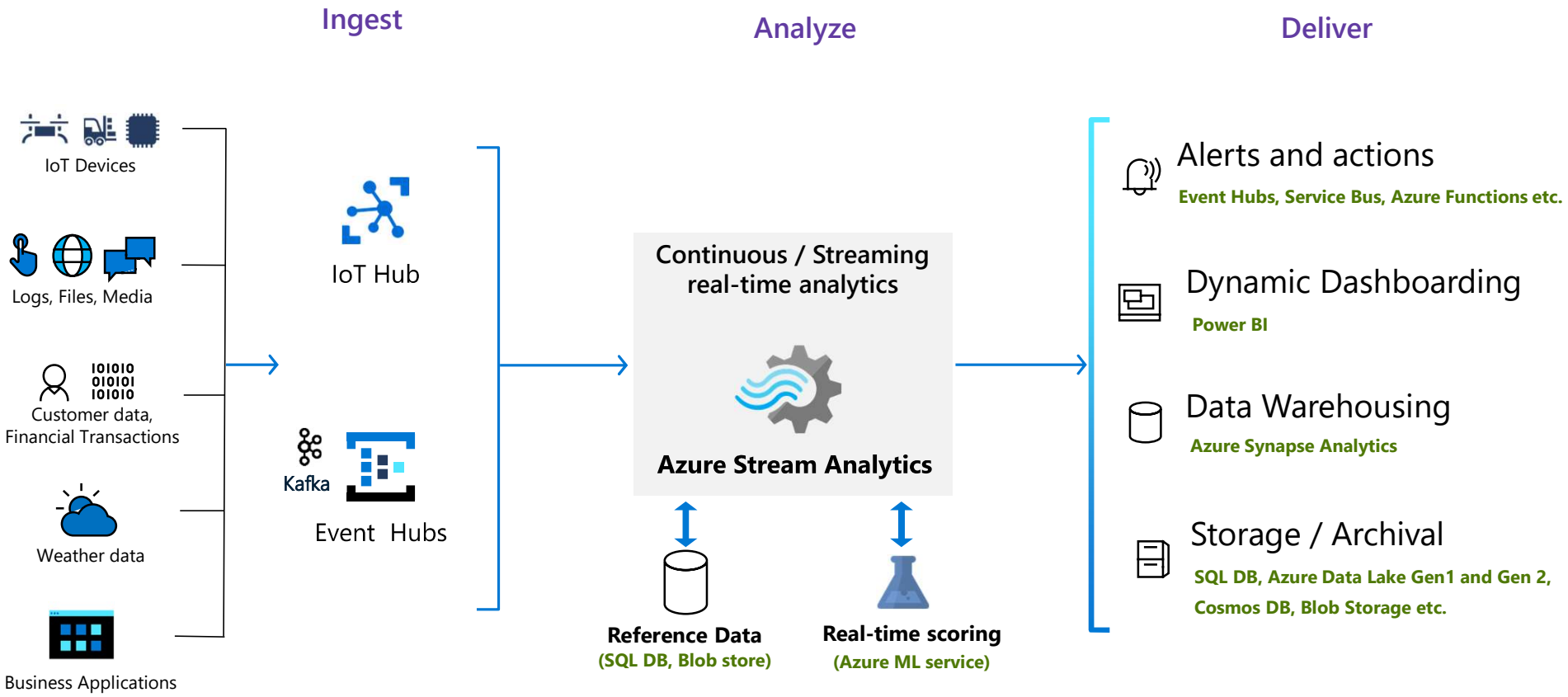
99.9% job level SLA

Highly certified and compliant

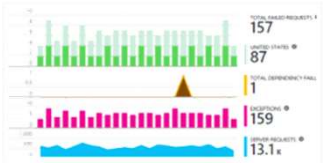
26 regions worldwide

Millisecond latencies

Real-time analytics with Stream Analytics



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…

Real-time Stream Processing

Simple Event Processing

- Filter
- Transform
- Enrich
- Split
- Route

Event Stream Processing

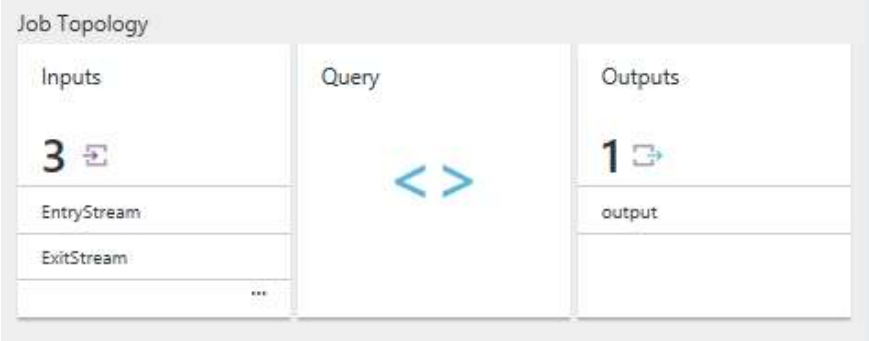
- [Simple event processing] +
- Aggregate
- Rules

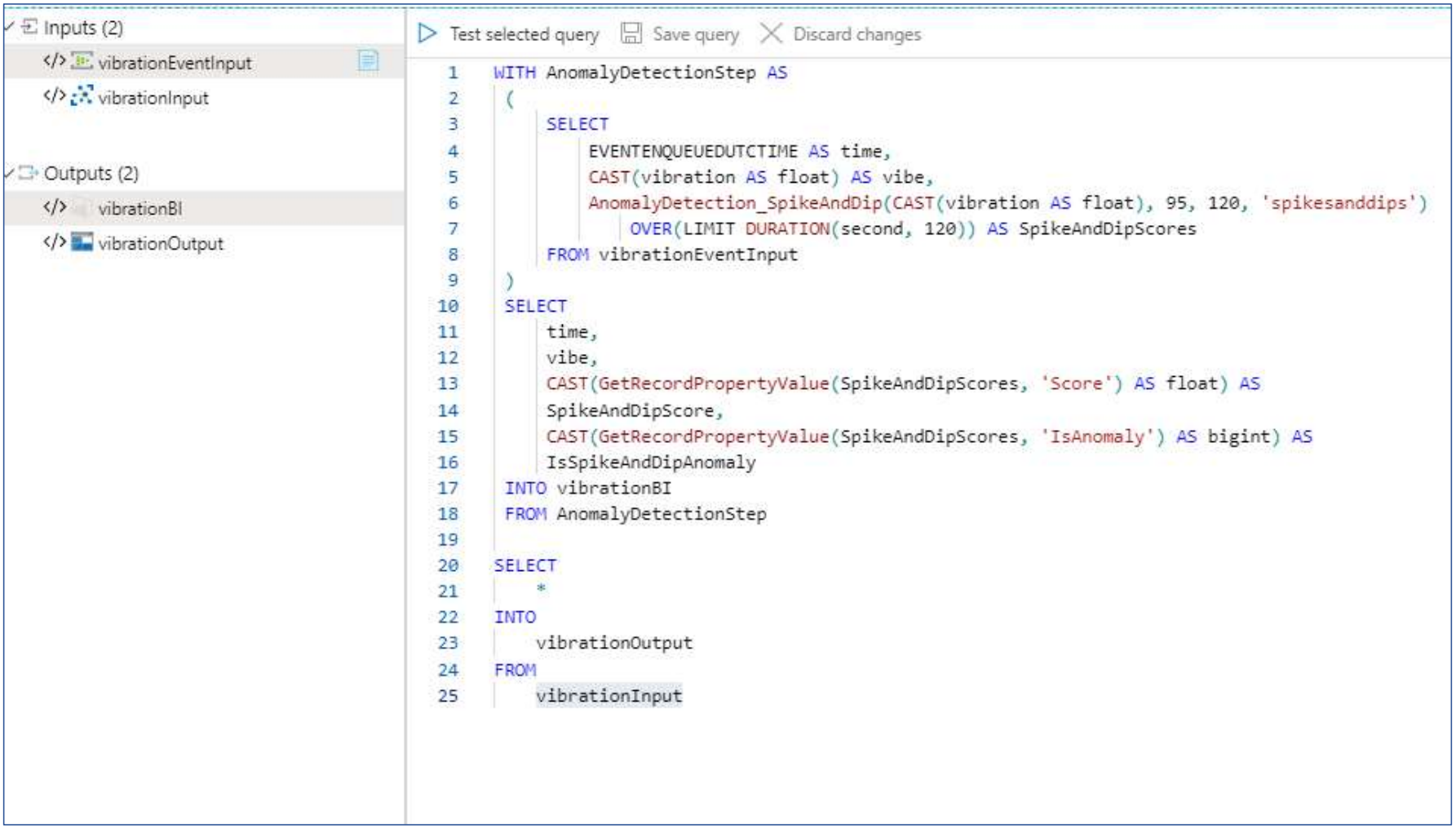
Complex Event Processing

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

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




Inputs (2)
vibrationEventInput
vibrationInput
Outputs (2)
vibrationBI
vibrationOutput
Test selected query
Save query
Discard changes
1 WITH AnomalyDetectionStep AS
2 (
3 SELECT
4 EVENTENQUEUEDUTCTIME AS time,
5 CAST(vibration AS float) AS vibe,
6 AnomalyDetection_SpikeAndDip(CAST(vibration AS float), 95, 120, 'spikesanddips')
7 OVER(LIMIT DURATION(second, 120)) AS SpikeAndDipScores
8 FROM vibrationEventInput
9)
10 SELECT
11 time,
12 vibe,
13 CAST(GetRecordPropertyValue(SpikeAndDipScores, 'Score') AS float) AS
14 SpikeAndDipScore,
15 CAST(GetRecordPropertyValue(SpikeAndDipScores, 'IsAnomaly') AS bigint) AS
16 IsSpikeAndDipAnomaly
17 INTO vibrationBI
18 FROM AnomalyDetectionStep
19
20 SELECT
21 *
22 INTO
23 vibrationOutput
24 FROM
25 vibrationInput

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

Temporal
- Lag
- IsFirst
- Last
- CollectTop

Windowing Extensions
- TumblingWindow
- HoppingWindow
- SlidingWindow

Scaling Extensions
- WITH
- PARTITION BY
- OVER

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

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

Geospatial (preview)
- CreatePoint
- CreatePolygon
- CreateLineString
- ST_DISTANCE
- ST_WITHIN
- ST_OVERLAPS
- ST_INTERSECTS

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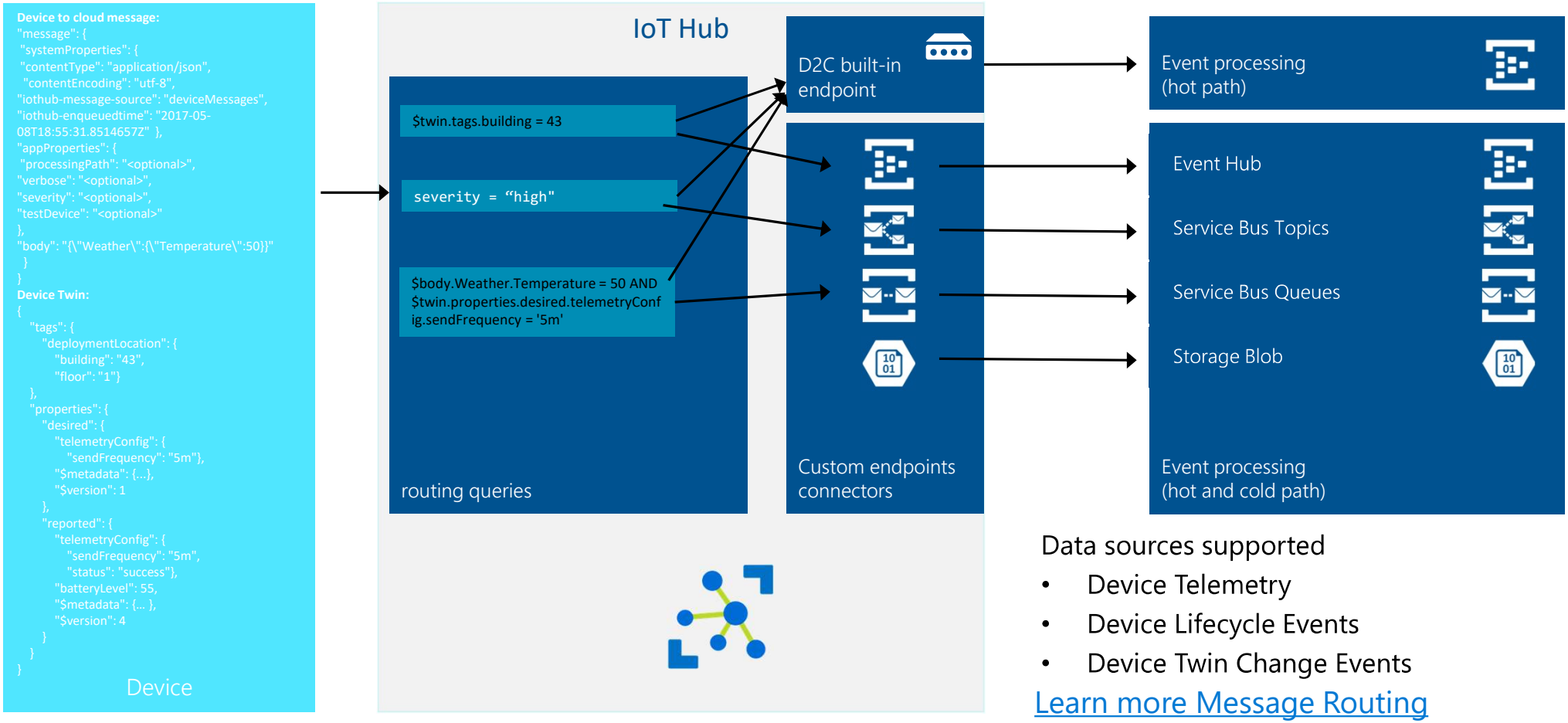
IoT Hub Message Routing



Data sources supported

- Device Telemetry
- Device Lifecycle Events
- Device Twin Change Events

[Learn more Message Routing]

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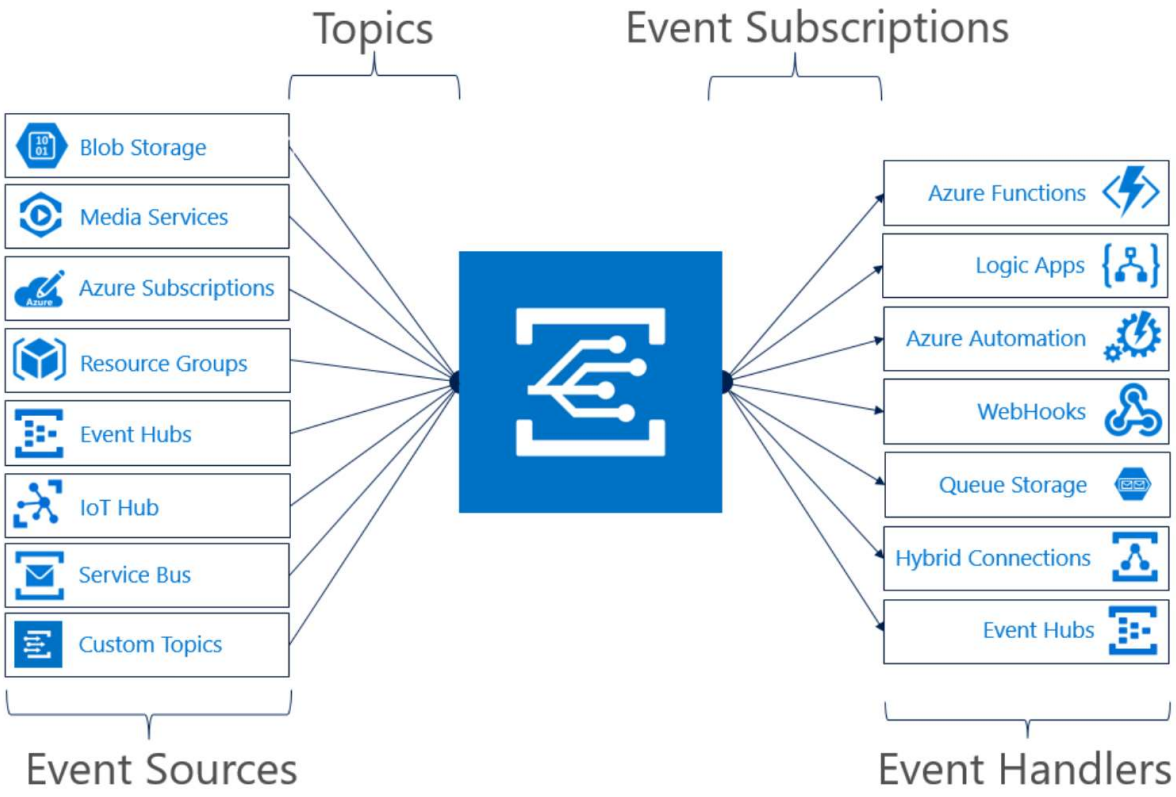
Serverless Integration



Events supported:

- Device Telemetry
- Device Created/Deleted Events
- Device Connected/Disconnected Events

[Learn more about Event Grid]

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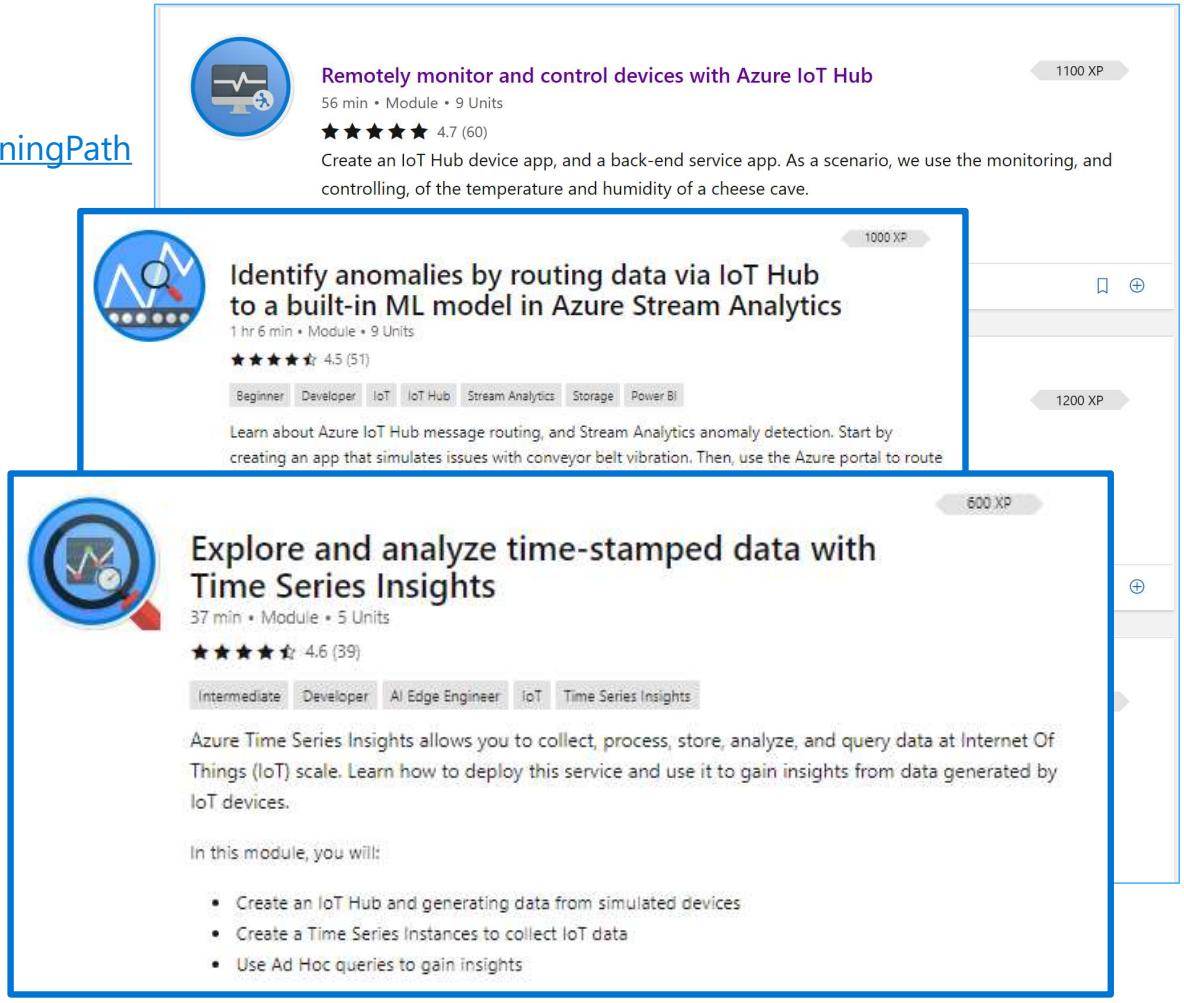
Get Started Now!

https://aka.ms/SecurelyConnectDevicesLearningPath

https://aka.ms/IntroAzureIoTLearningPath



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- Transform your business with IoT
- Devices and device communication – *IoT Hub*
- Device provisioning at scale – *Device Provisioning Service*
- Messaging processing, analytics, & business integration – *Time Series Insights, Event Grid, Azure Stream Analytics*
- Work with Azure IoT Edge – *IoT Edge*

Hands-on End to End IoT Solution Tutorial

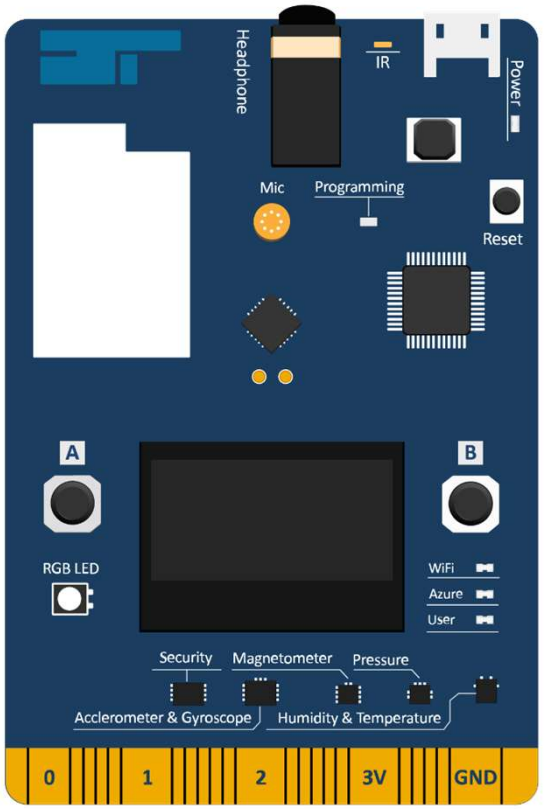
Azure IoT Workshop: Real-time asset tracking for international company Contoso Art Shipping

Tutorial:

https://azure.github.io/iot-workshop-asset-tracking/

IoT DevKit (MXChip):

https://microsoft.github.io/azure-iot-developer-kit/



Learn how to get started with IoT

Building IoT solutions with Azure Developer Guide
https://discover.microsoft.com/azure-iot-building-solutions-dev-guide/

Microsoft Learn learning paths

http://aka.ms/mslearniot

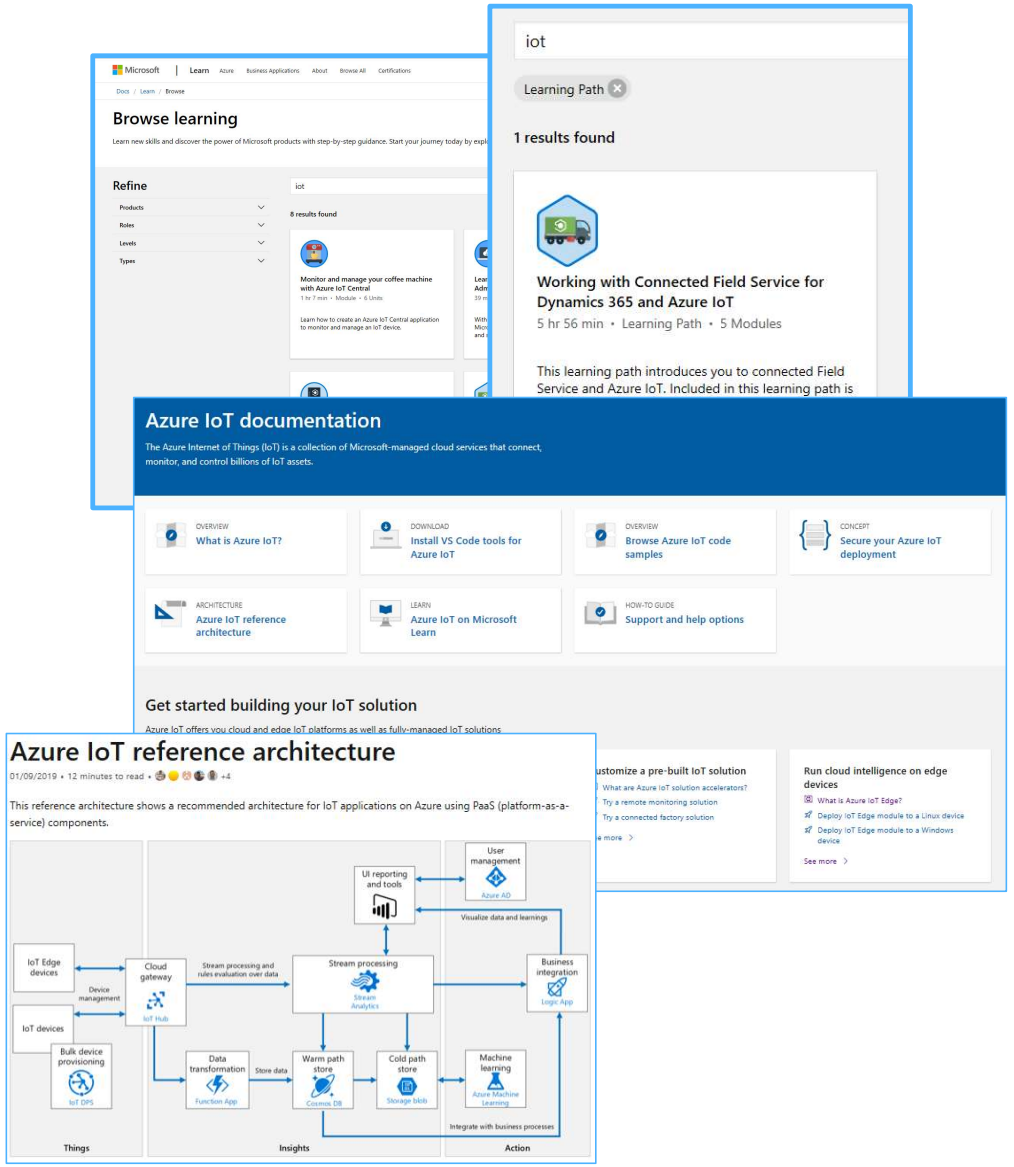
Microsoft Learn is a newer learning platform that offers sandbox online training

Azure IoT Reference Architecture Guide
https://docs.microsoft.com/azure/architecture/reference-architectures/iot/

This reference architecture shows a recommended architecture for IoT applications on Azure using PaaS (platform-as-a-service) components.

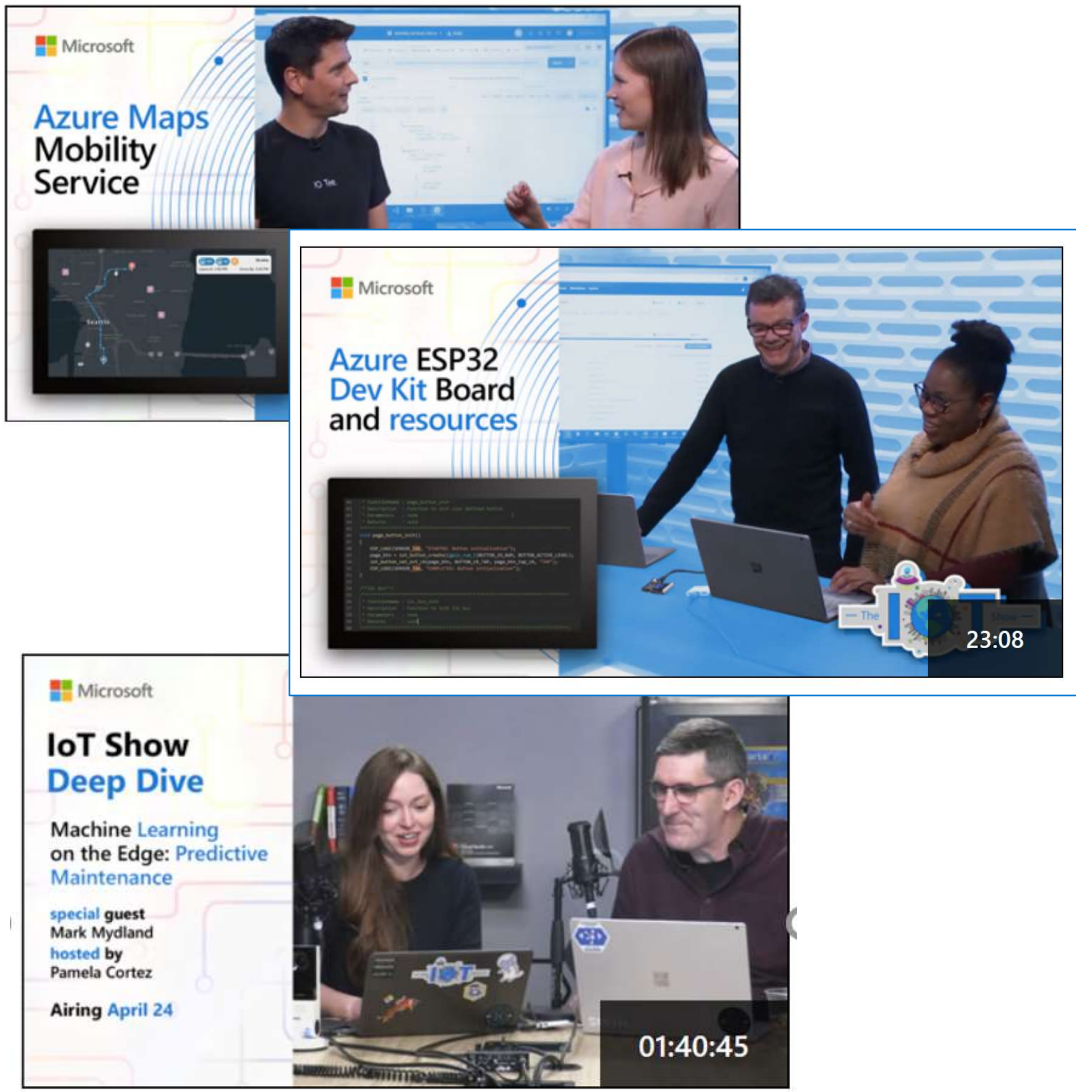
Azure IoT Docs

Getting Started, Tutorials, How-to guides, reference, whitepapers



IoT Show

New video every Monday (Deep Dives on Wednesdays!) 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! aka.ms/IoTShow



IoT Tech Community

Community forum to stay to update on latest announcements, connect with other developers, share your projects, and ask questions!

Fast growing vibrant community

One Microsoft IoT voice

http://aka.ms/iottechcommunity