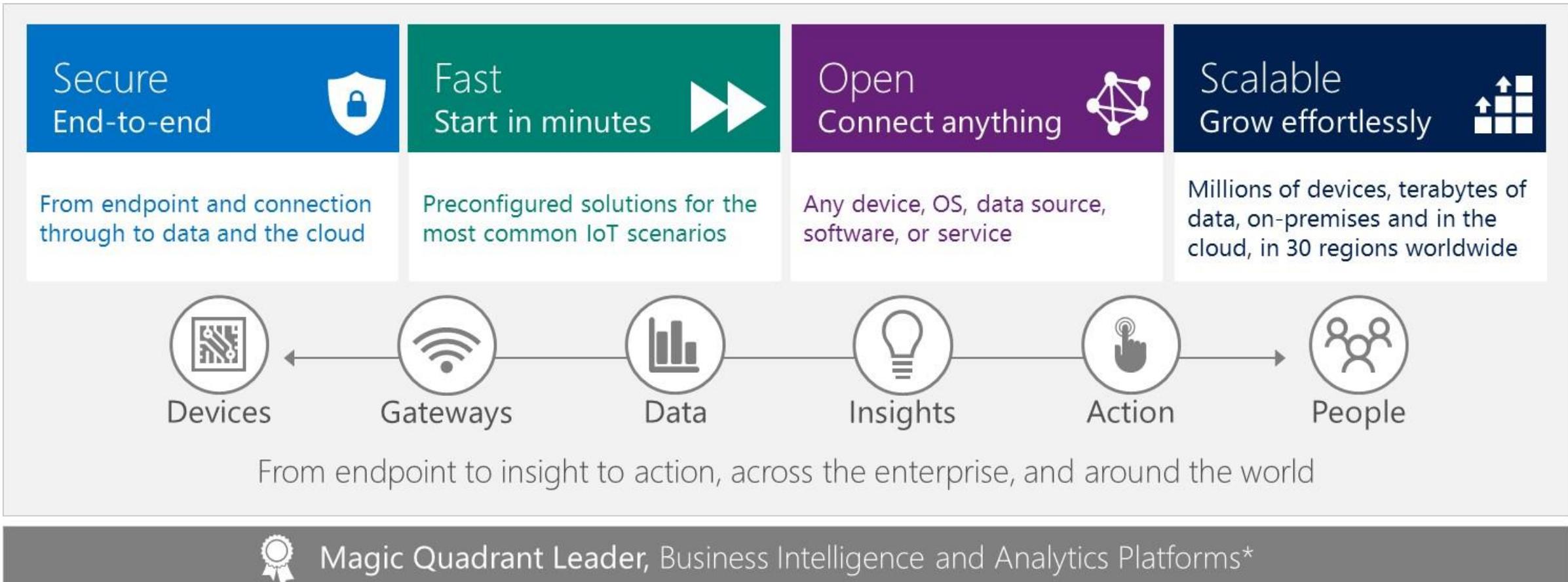




Microsoft Azure IoT Suite and Analytics Technical Briefing

Andrey Vykhotsev
Moscow 21.03.2018

Azure IoT Suite: Ready for the enterprise



Built on the industry's leading cloud



Elements of Azure IoT Suite

Connect and scale
with efficiency



Preconfigured solutions



SDK



Connect and control

Analyze and act
on new data



Event processing



Predictive analytics



Data visualization

Integrate and transform
business processes



Workflow integration



Push and broadcast
notifications



ID and access management

Elements of Azure IoT Suite

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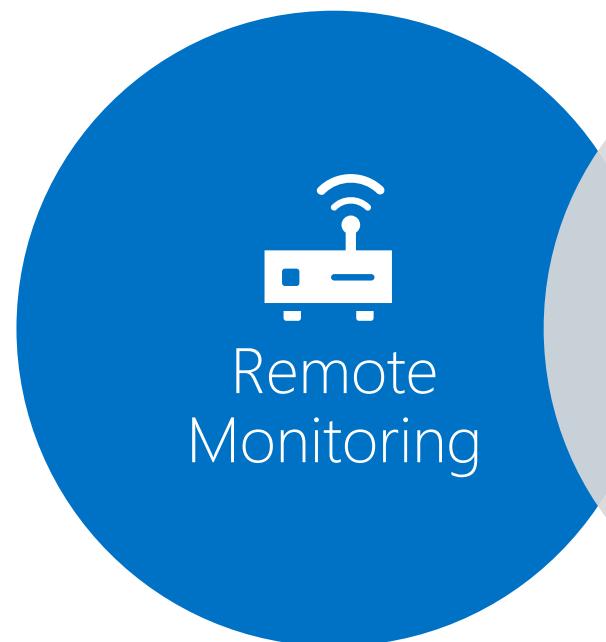


Push and broadcast
notifications

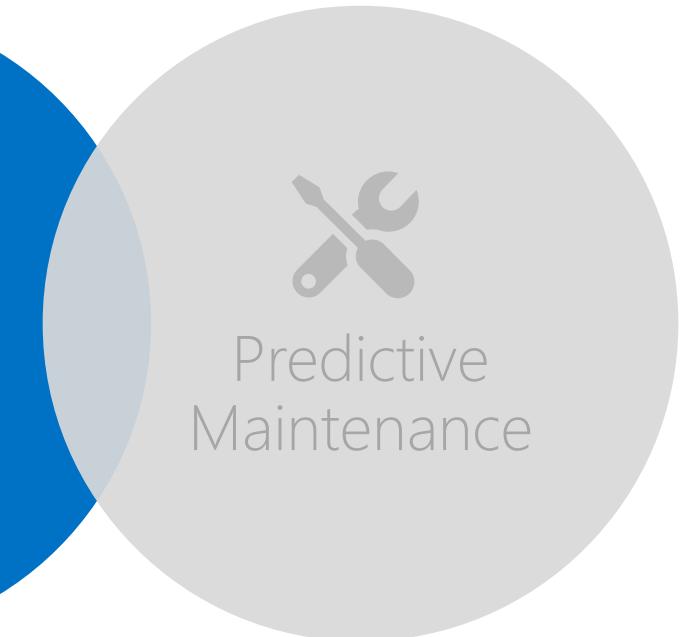


ID and access management

Preconfigured Solutions: Remote Monitoring



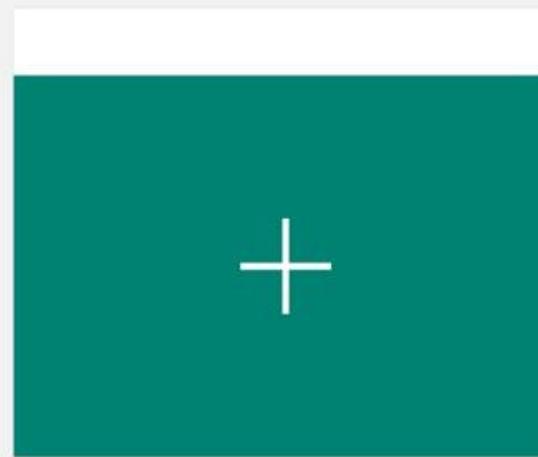
Remote
Monitoring



Predictive
Maintenance

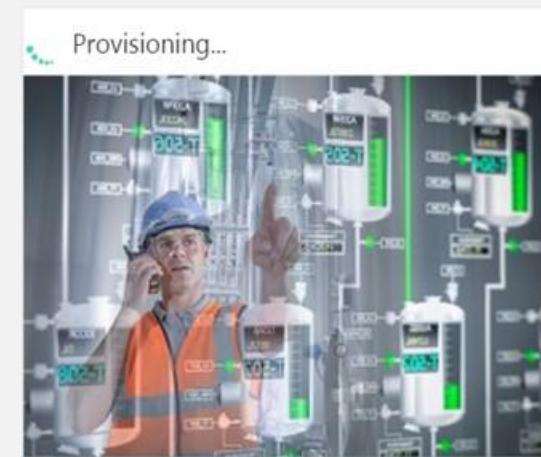
More to come...

Provisioned solutions



Create a new solution

Create your own fully integrated provisioning solution



RMsolution

Monitor events and conditions from your devices in the field.

Details

RMsolution



Provisioning your **Remote monitoring** solution, in **East US** region.

Provisioned solutions



Create a new solution
Create your own fully integrated provisioning solution

Starting...



RMsolution
Monitor events and conditions from your devices in the field.

Launch

RMsolution

- Starting

See your pre-configured solution running here:

[Solution dashboard](#)

Modify your solution

Guidance on editing your solution and managing network resources can be found in the [Resource group](#) in the Azure portal.

Azure Management Portal:
<https://portal.azure.com/>

RMsolution
[GitHub repository](#)

Resources

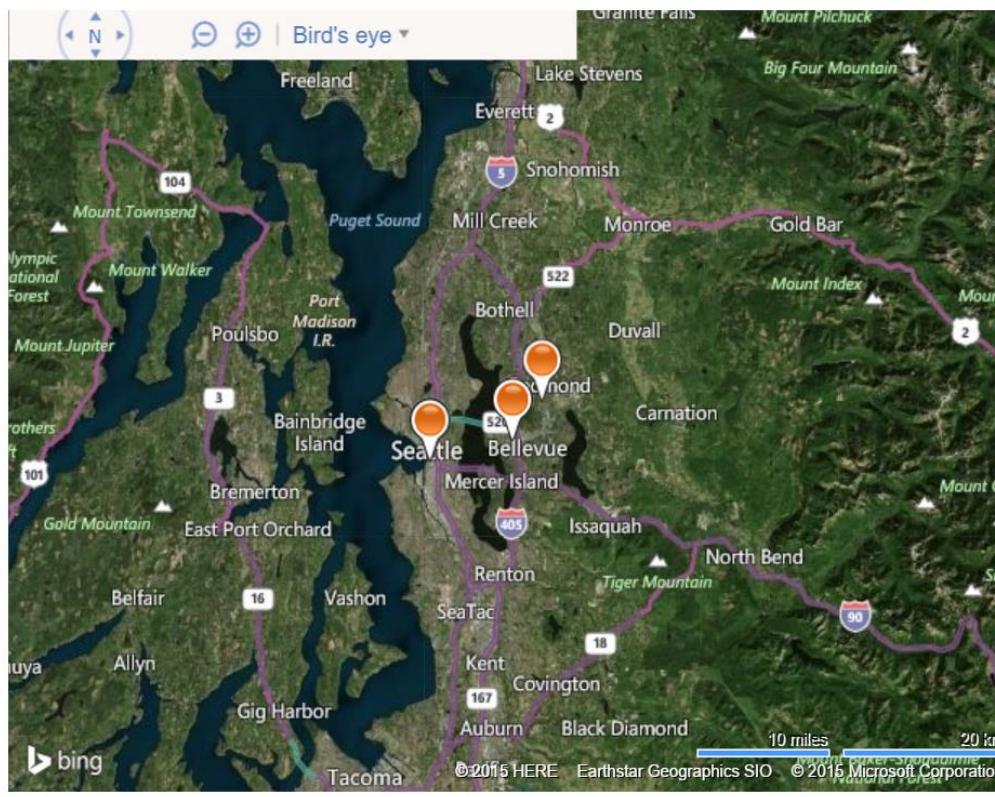
Azure IoT Suite [pricing & details](#)

[Developer documentation](#)

[Instructional videos](#)

Actions

[Delete Solution](#)



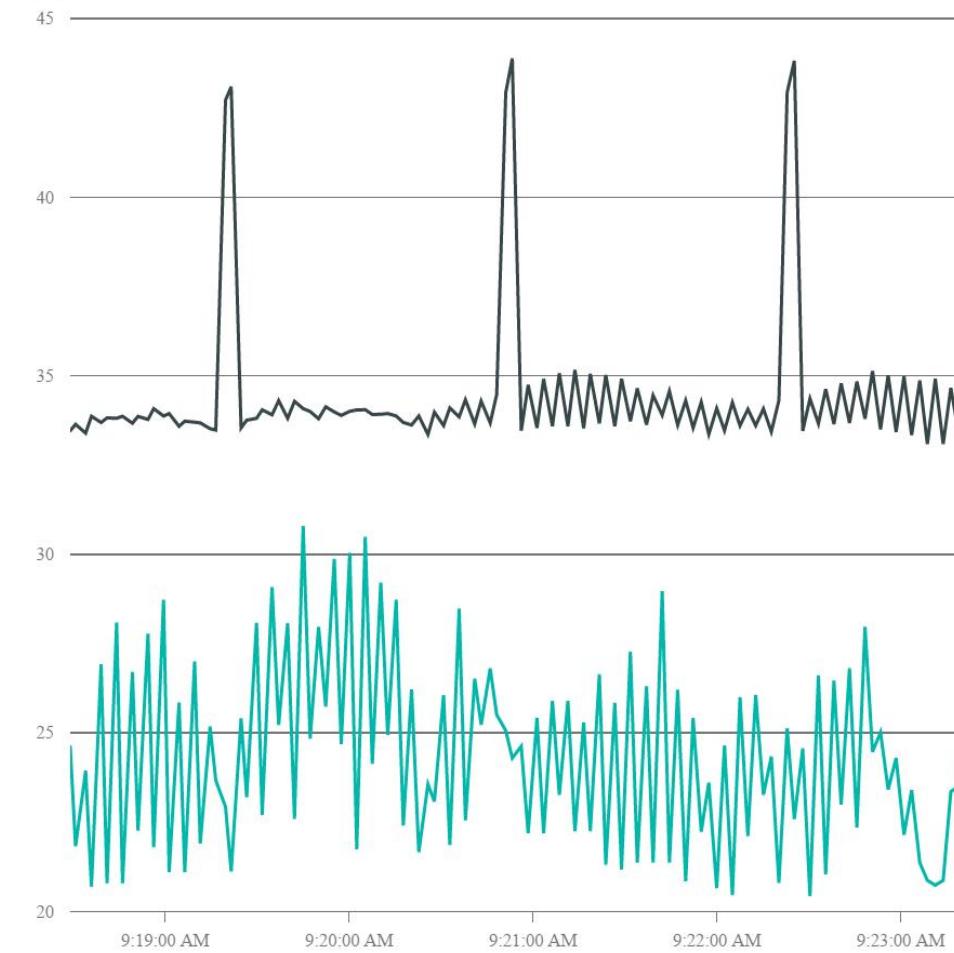
Alarm History

TIME	DEVICE ID	RULE OUTPUT	VALUE
09/29/2015 9:22:25 AM	SampleDevice001_363	AlarmTemp	43.817
09/29/2015 9:22:25 AM	SampleDevice001_363	AlarmHumidity	22.588
09/29/2015 9:22:23 AM	SampleDevice001_363	AlarmTemp	42.933
09/29/2015 9:22:23 AM	SampleDevice001_363	AlarmHumidity	25.135

Device to View: SampleDevice001_363

Telemetry History

● Humidity ● Temperature



Max of device humidity



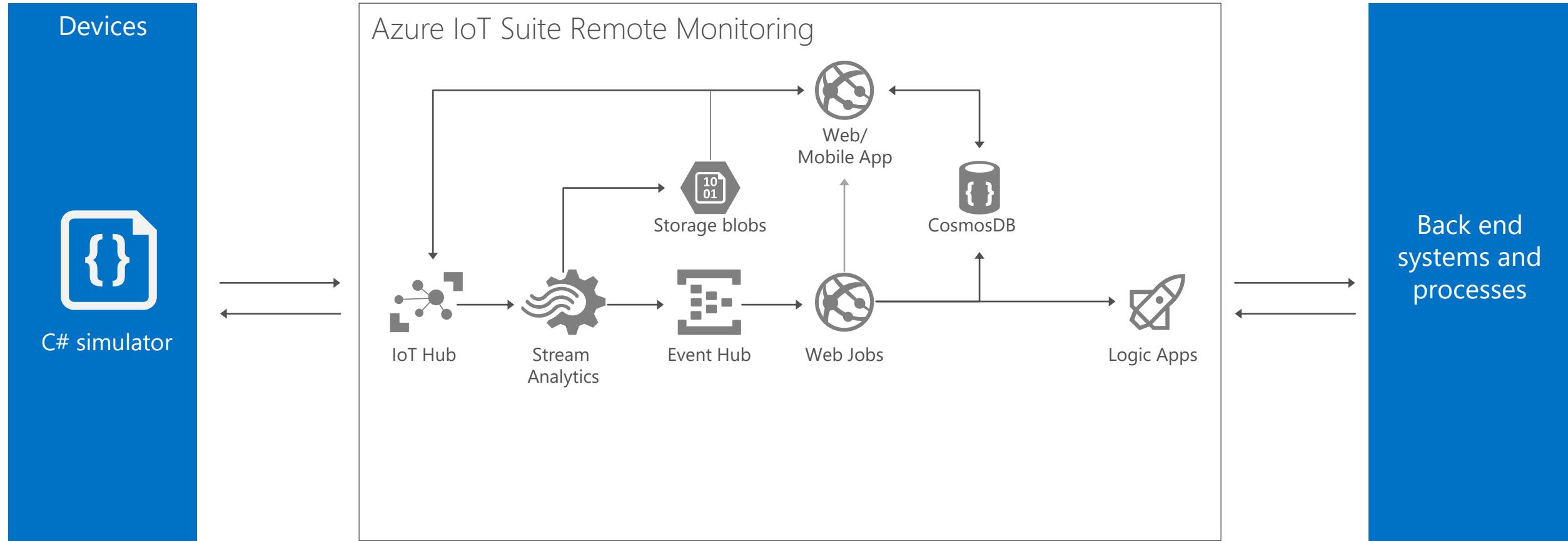
Min of device humidity



Average of device humidity



What you get with remote monitoring preconfigured solution





Resource groups

All resources

Recent

Web Apps

SQL databases

Virtual machines (classic)

Virtual machines

Cloud services

Subscriptions

Browse >

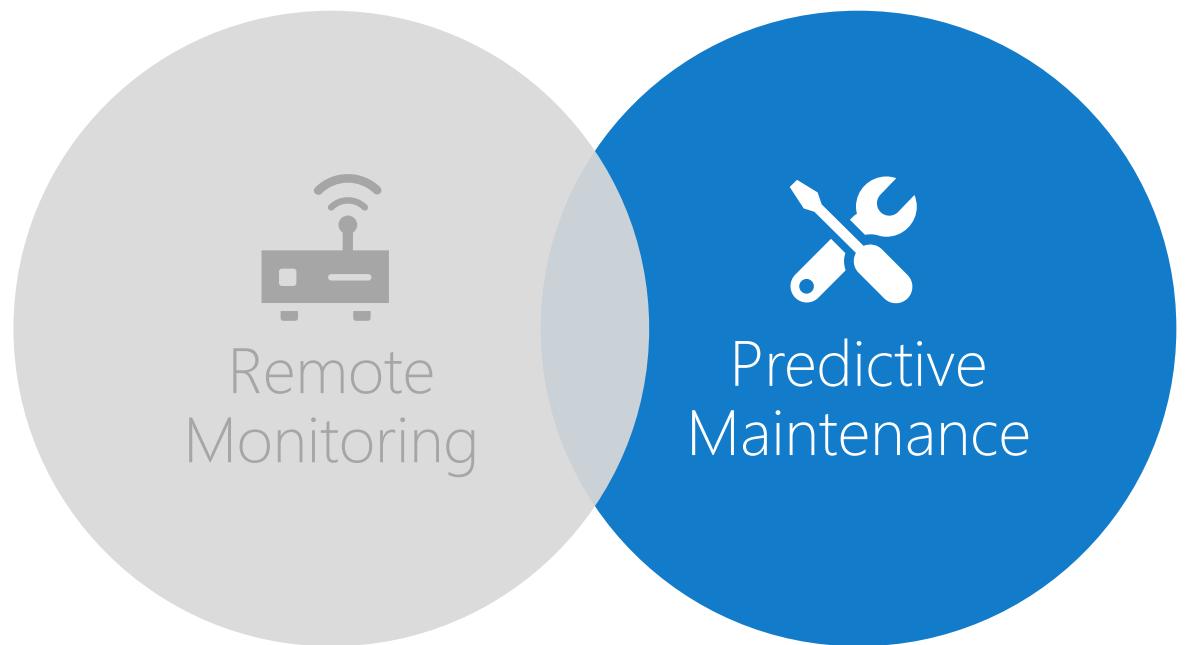
All resources

Add Columns Refresh

Filter items ...

NAME	RESOURCE GROUP	LOCATION	SUBSCRIPTION
SolutionRM	SolutionRM	East US	Visual Studio Enterprise wi...
SolutionRM	SolutionRM	East US	Visual Studio Enterprise wi...
SolutionRM-DeviceInfo	SolutionRM	East US	Visual Studio Enterprise wi...
solutionrm-iotsuite	SolutionRM	East US	Visual Studio Enterprise wi...
SolutionRM-map	SolutionRM	West US	Visual Studio Enterprise wi...
SolutionRM-plan	SolutionRM	East US	Visual Studio Enterprise wi...
SolutionRM-Rules	SolutionRM	East US	Visual Studio Enterprise wi...
solutionrmstore	SolutionRM	East US	Visual Studio Enterprise wi...
SolutionRM-Telemetry	SolutionRM	East US	Visual Studio Enterprise wi...

Preconfigured Solutions: Predictive Maintenance



More to come...

Predictive Maintenance

Identify target outcome

Determine ultimate outcome, for example, remaining useful life of an asset

Inventory data sources

Identify all the potential sources of data, including the types and amounts available. The desired outcome will determine what is essential/optional

Capture and combine data

Connect all of your data to a single place

Model, test and iterate

Identify unexpected patterns by developing statistical models using advanced analytical techniques and then stack rank the models

Validate the model

Apply the model to live, streaming data and observe how it works in real world/real time conditions

Integrate into operations

Operationalize the model by adjusting maintenance processes, systems and resources to act on near real time data. Make ongoing improvements by gaining insights from machine learning and advanced analytics

Solution types



Predictive maintenance

Anticipate maintenance needs and avoid unscheduled downtime by connecting and monitoring your devices for predictive maintenance.

[Select](#)

Remote monitoring

Connect and monitor your devices to analyze untapped data and improve business outcomes by automating processes.

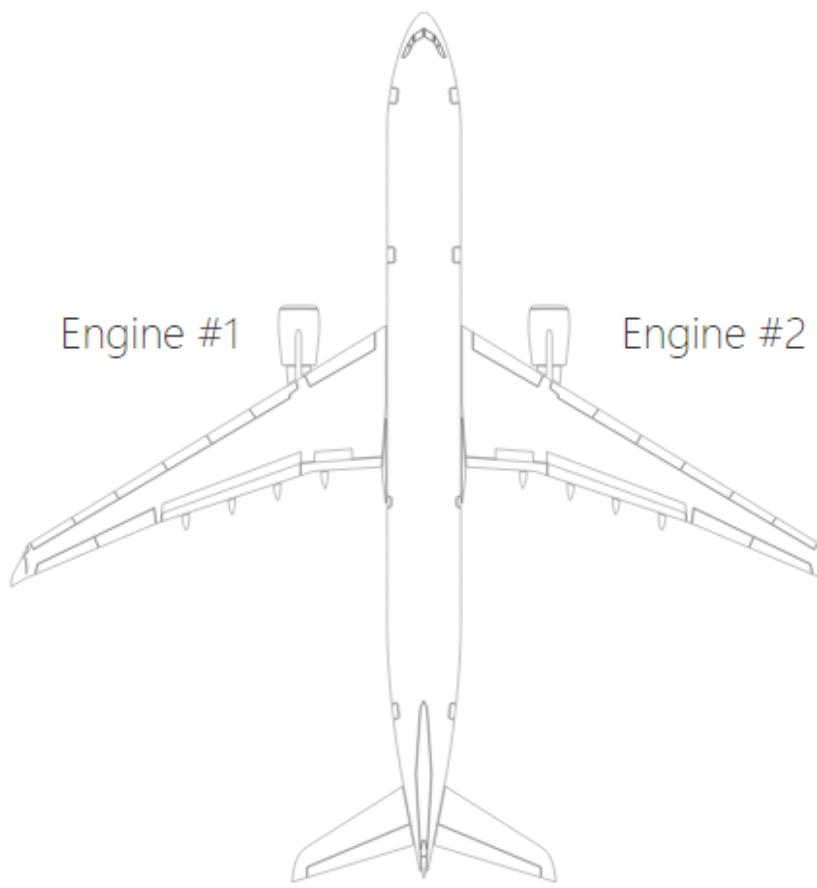
[Select](#)



DASHBOARD

Aircraft map

Simulation stopped

[Start simulation](#)

Sensor history

Sensor 9

Sensor 11

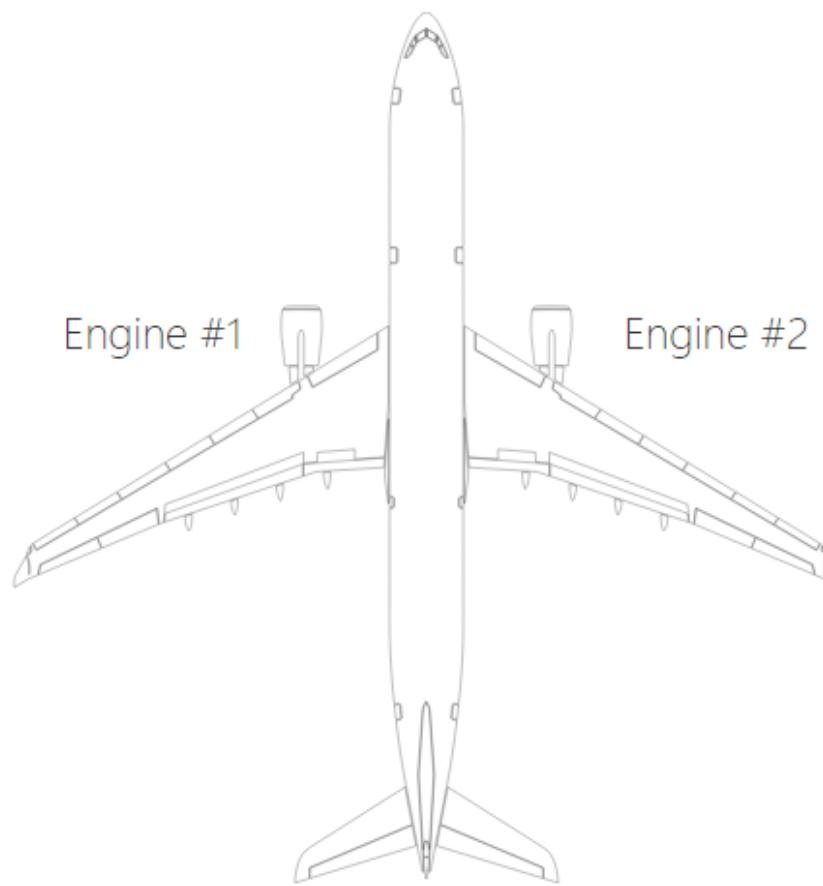
Sensor 14

Sensor 15

Remaining Useful Life (RUL)
IN DAYSN/A
ENGINE #1N/A
ENGINE #2Cycles
#N/A
ENGINE #1N/A
ENGINE #2Remaining Useful Life (RUL) history
IN DAYS

Aircraft map

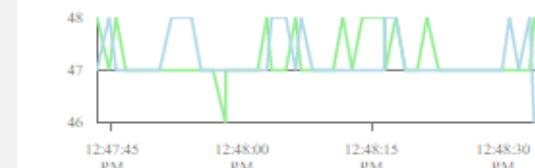
Simulation in progress

[Stop simulation](#)

Sensor history

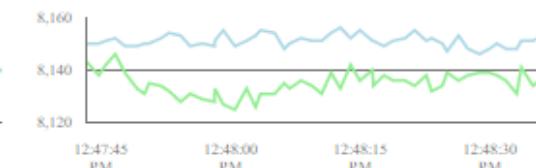
Sensor 9

Engine 1 Engine 2



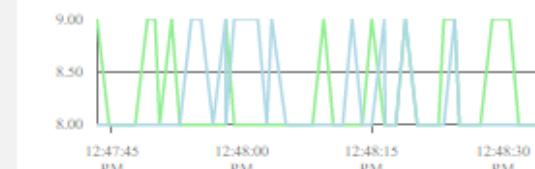
Sensor 11

Engine 1 Engine 2



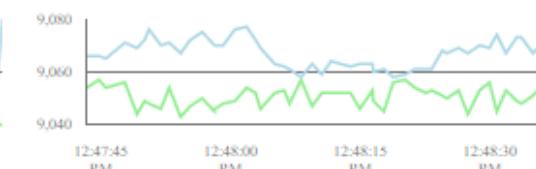
Sensor 14

Engine 1 Engine 2



Sensor 15

Engine 1 Engine 2



Remaining Useful Life (RUL)

IN DAYS

206
ENGINE #1195
ENGINE #2

Cycles

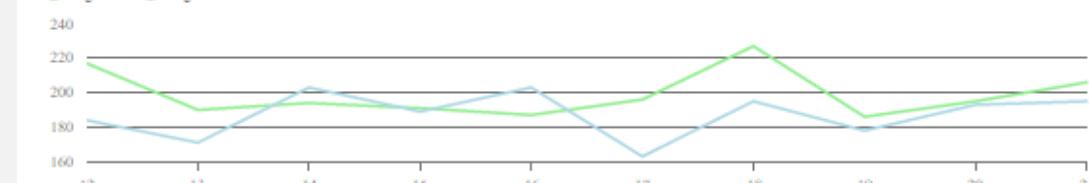
#

21
ENGINE #121
ENGINE #2

Remaining Useful Life (RUL) history

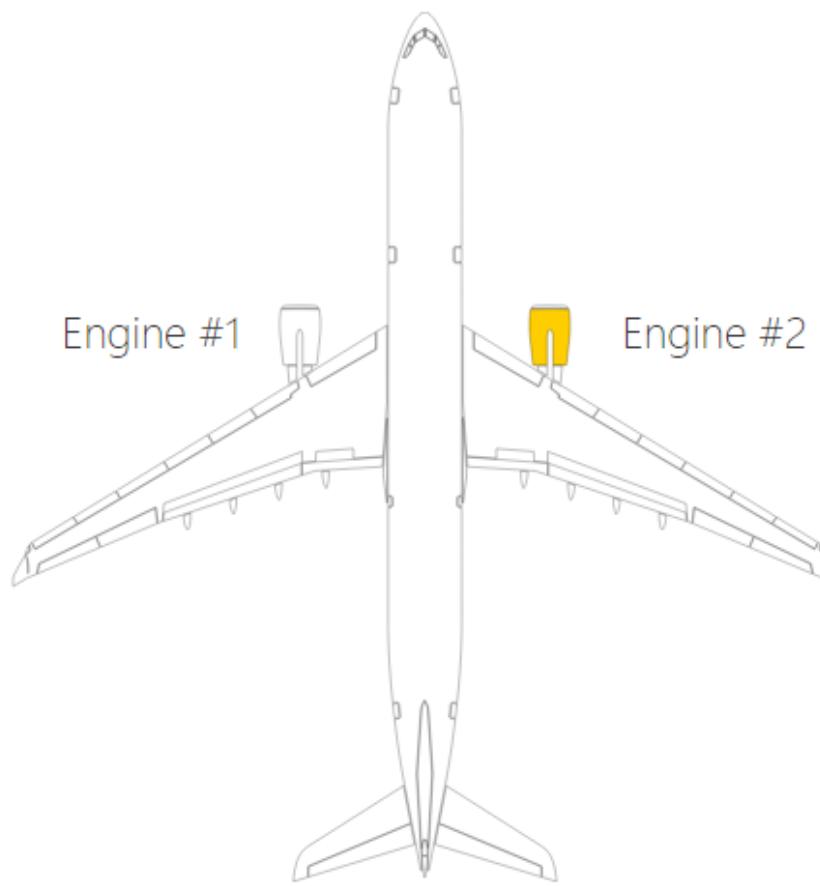
IN DAYS

Engine 1 Engine 2



Aircraft map

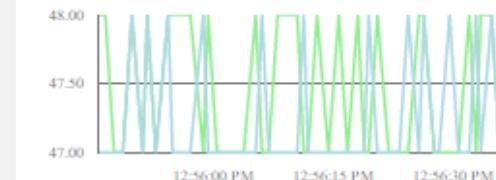
Simulation in progress

[Stop simulation](#)

Sensor history

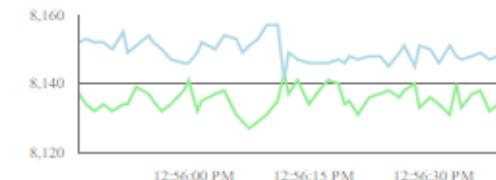
Sensor 9

Engine 1 Engine 2



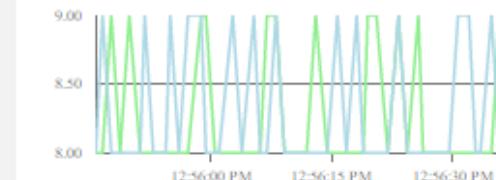
Sensor 11

Engine 1 Engine 2



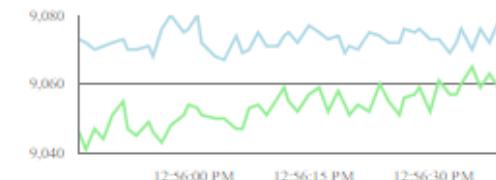
Sensor 14

Engine 1 Engine 2



Sensor 15

Engine 1 Engine 2



Remaining Useful Life (RUL)

IN DAYS

162
ENGINE #1152⚠
ENGINE #2

Cycles

#

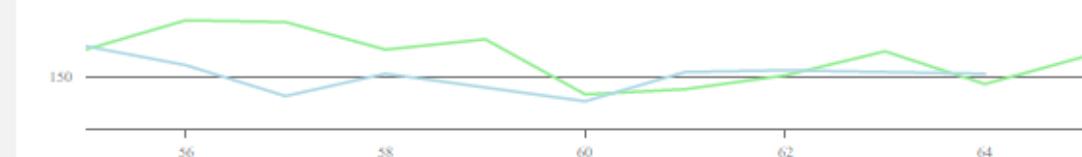
65
ENGINE #165
ENGINE #2

Remaining Useful Life (RUL) history

IN DAYS

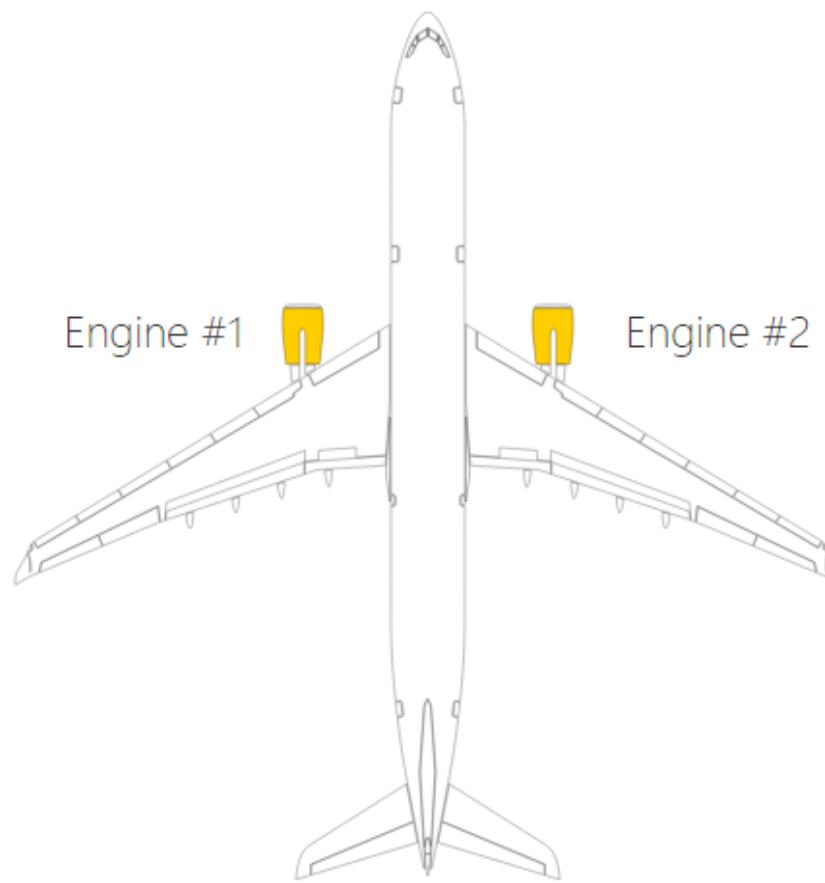
Engine 1 Engine 2

200



Aircraft map

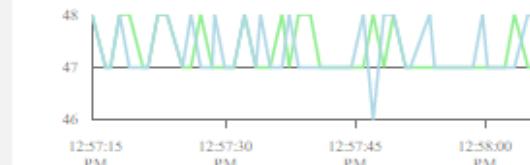
Simulation in progress

[Stop simulation](#)

Sensor history

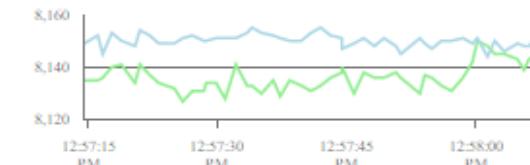
Sensor 9

Engine 1 Engine 2



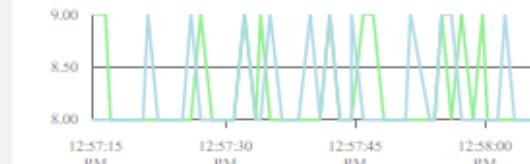
Sensor 11

Engine 1 Engine 2



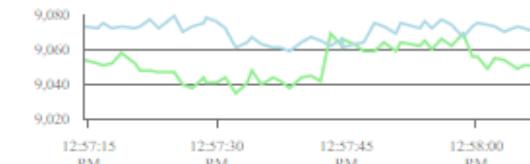
Sensor 14

Engine 1 Engine 2



Sensor 15

Engine 1 Engine 2



Remaining Useful Life (RUL)

IN DAYS

159

ENGINE #1

139

ENGINE #2

Cycles

#

72

ENGINE #1

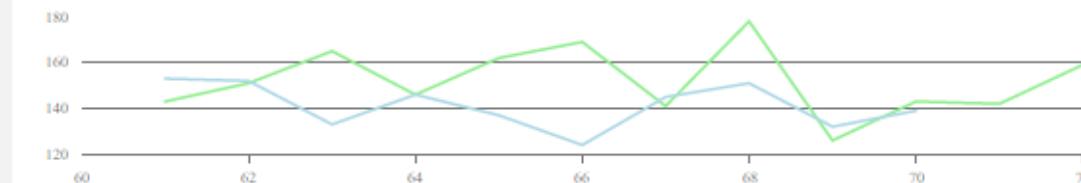
73

ENGINE #2

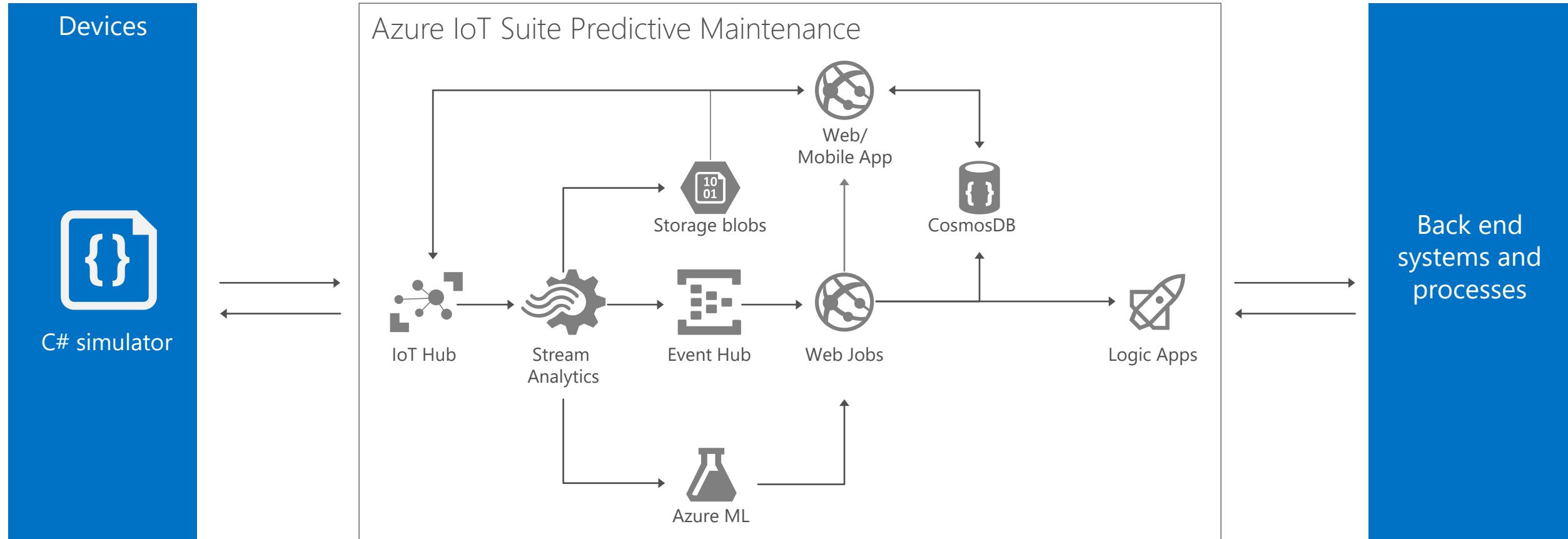
Remaining Useful Life (RUL) history

IN DAYS

Engine 1 Engine 2



What you get with predictive maintenance solution



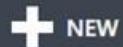
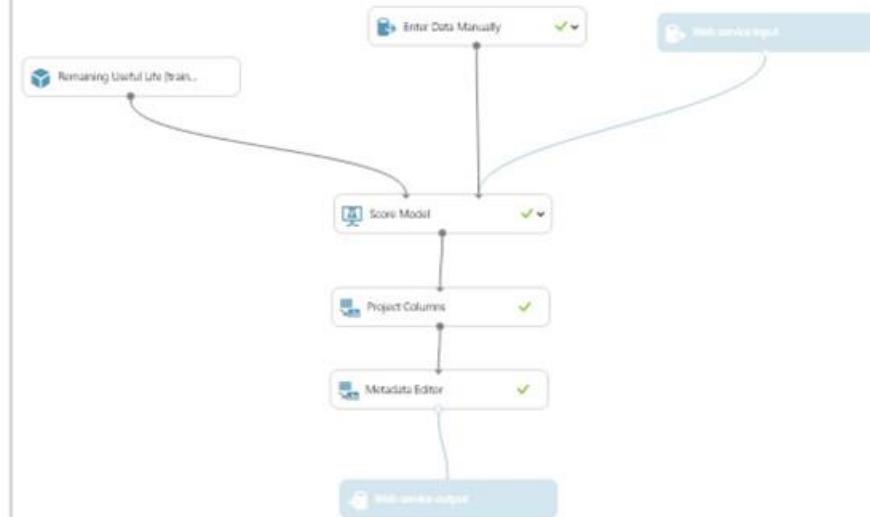


EXPERIMENTS

experiments

MY EXPERIMENTS SAMPLES

	NAME	AUTHOR	STATUS	LAST EDITED	
<input type="checkbox"/>	Remaining Useful Life [Predictiv...	Microsoft Corporation	Finished	12/1/2015 4:08:19 AM	
<input type="checkbox"/>	Remaining Useful Life [Predictiv...	Microsoft Corporation	Draft	12/1/2015 4:08:11 AM	
<input type="checkbox"/>	Remaining Useful Life Engines	Microsoft Corporation	Draft	12/1/2015 4:08:03 AM	



NEW



DELETE



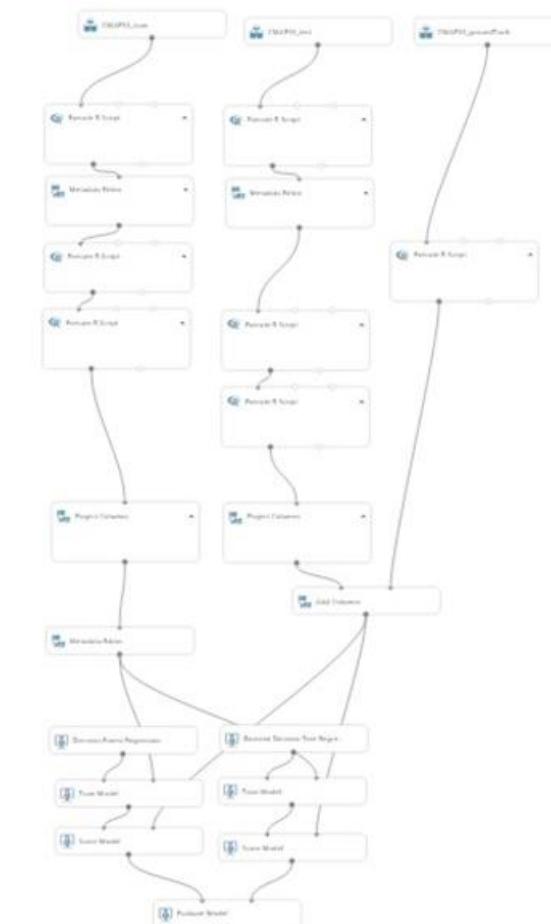
COPY TO WORKSPACE

EXPERIMENTS

experiments

MY EXPERIMENTS SAMPLES

	NAME	AUTHOR	STATUS	LAST EDITED	
<input type="checkbox"/>	Remaining Useful Life [Predictiv...	Microsoft Corporation	Finished	12/1/2015 4:08:19 AM	
<input type="checkbox"/>	Remaining Useful Life [Predictiv...	Microsoft Corporation	Draft	12/1/2015 4:08:11 AM	
<input checked="" type="checkbox"/>	Remaining Useful Life Engines	Microsoft Corporation	Draft	12/1/2015 4:08:03 AM	



NEW



DELETE

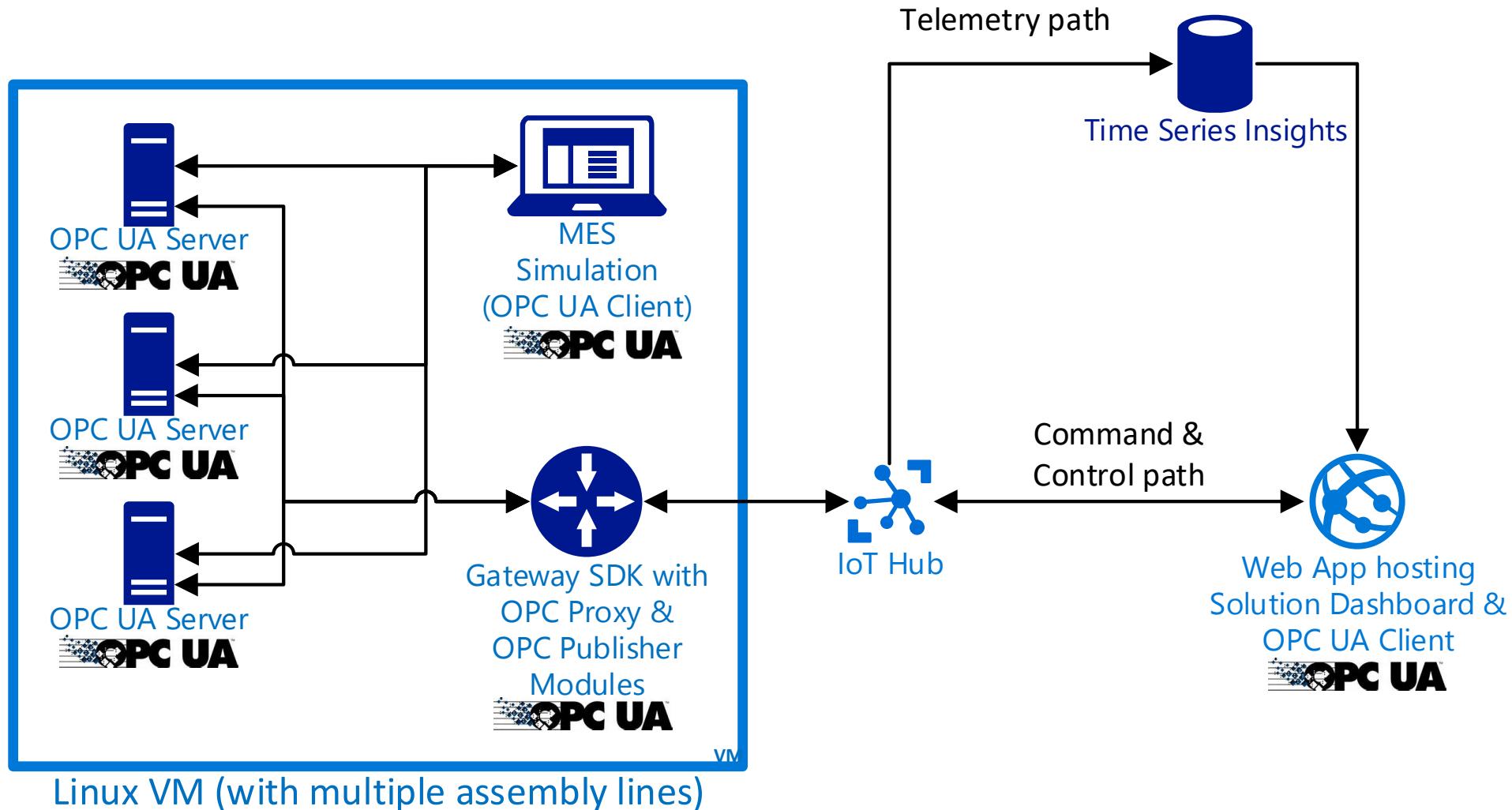


COPY TO

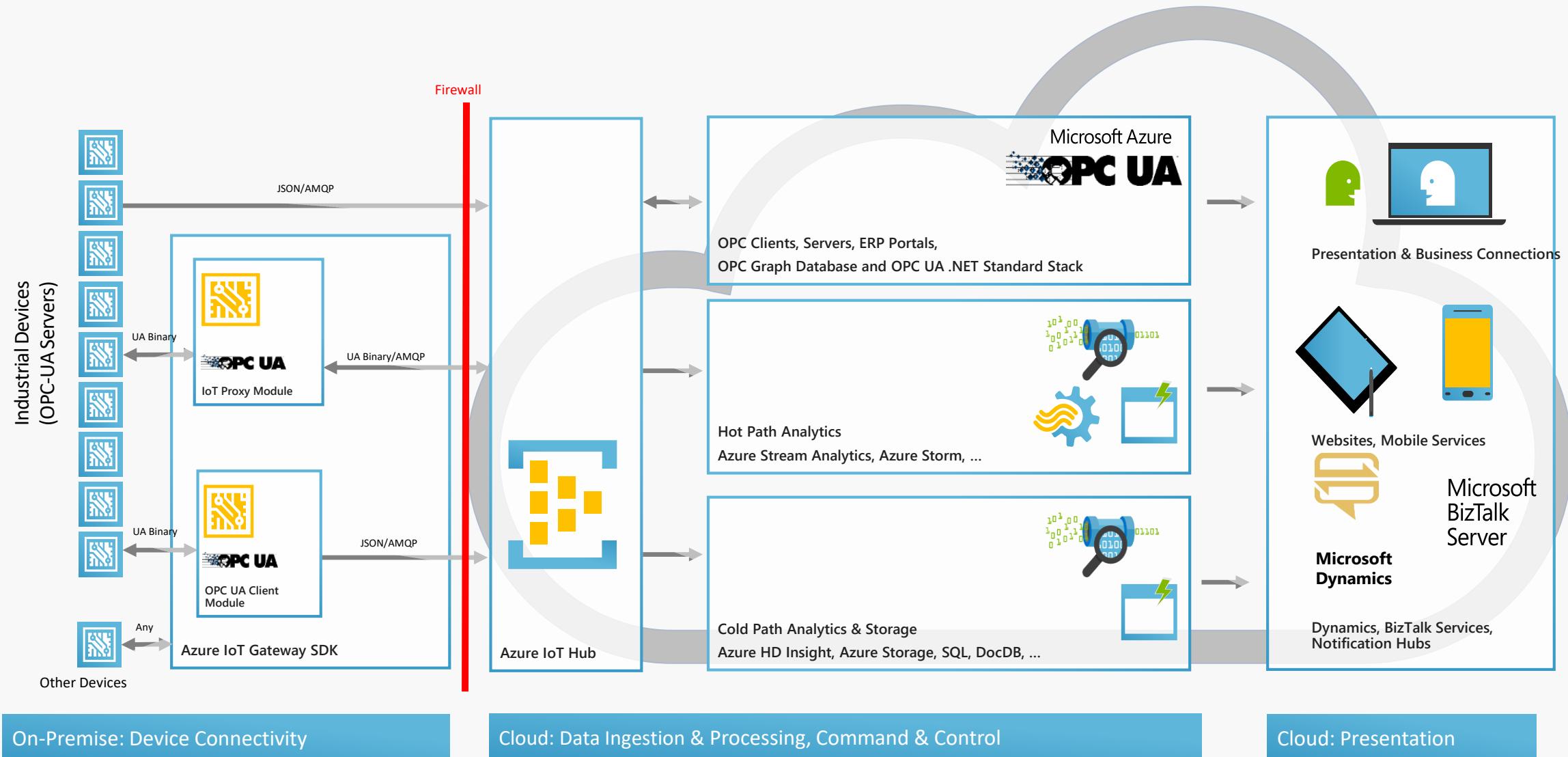
Azure IoT Suite Connected Factory



Azure IoT Suite Connected Factory Architecture



OPC UA Integration into Azure IoT Suite



Elements of Azure IoT Suite

Connect and scale
with efficiency



Preconfigured solutions



SDK



Connect and control

Analyze and act
on new data



Event processing



Predictive analytics



Data visualization

Integrate and transform
business processes



Workflow integration



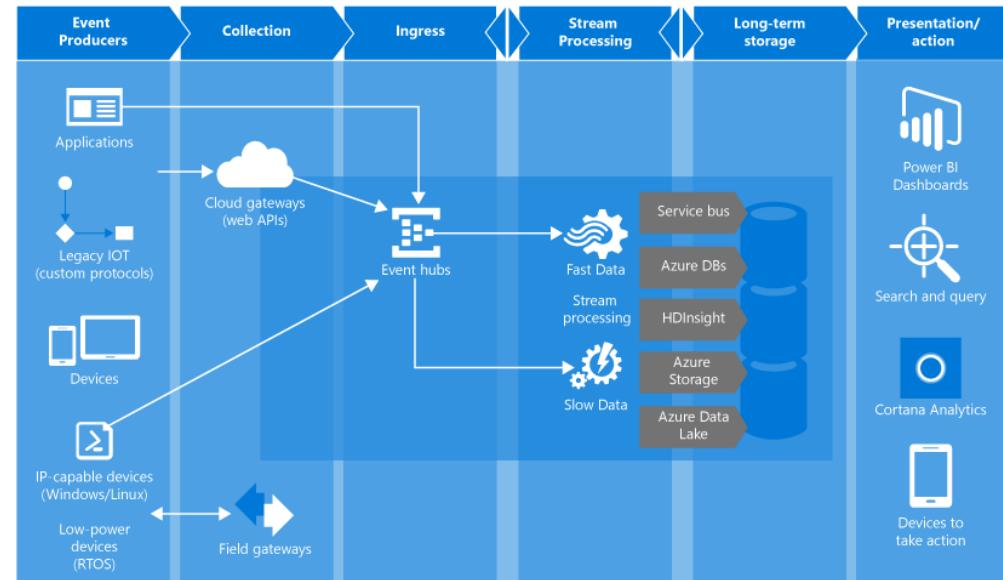
Push and broadcast
notifications



ID and access management

Event hubs

- **Event producers/publishers**: An entity that sends data to an event hub. An event is published via AMQP 1.0 or HTTPS.
- **Capture**: Enables you to capture Event Hubs streaming data and store it in an Azure Blob storage account.
- **Partitions**: Enables each consumer to only read a specific subset, or partition, of the event stream.
- **SAS tokens**: Identifies and authenticates the event publisher.
- **Event consumers**: An entity that reads event data from an event hub. Event consumers connect via AMQP 1.0.
- **Consumer groups**: Provides each multiple consuming application with a separate view of the event stream, enabling those consumers to act independently.
- **Throughput units**: Pre-purchased units of capacity. A single partition has a maximum scale of 1 throughput unit.



Event Processing Azure Stream Analytics





DASHBOARD



DEVICES



RULES



ACTIONS

Rules (4)

STATUS	RULE ID	DEVICE ID	DATA FIELD	OPERATOR	THRESHOLD	RULE OUTPUT
Enabled	0e0d533c-87e5-47a8-a1d6-0fc8c149199a	Intel	Temperature	>	45	AlarmTemp
Disabled	6a842d60-4513-4a91-b997-ca126da46eef	SampleDevice001_84	Humidity	>	75	AlarmHumidity
Enabled	804f7e84-b41c-4c1b-a123-76fe4f305d1a	SampleDevice001_84	Temperature	>	45	AlarmTemp
Enabled	f613050a-24a8-4d22-b28a-5776b75e7a3a	TexasInstruments	Humidity	>	88	AlarmHumidity

> Properties

Device Properties

DEVICE ID
Intel

Rule Status

[Disable Rule](#)

Rule Properties

DATA FIELD
TemperatureOPERATOR
>THRESHOLD
45RULE OUTPUT
AlarmTemp[Edit](#)

Real time event processing

Uncover real time insights

Perform real time analytics across multiple streams

Rapid Deployment

Use simple SQL syntax, auto distributed for scale

Mission critical reliability

Fully managed, low latency, high throughput

Create real time alerts

Flag alerts and alarms for attention

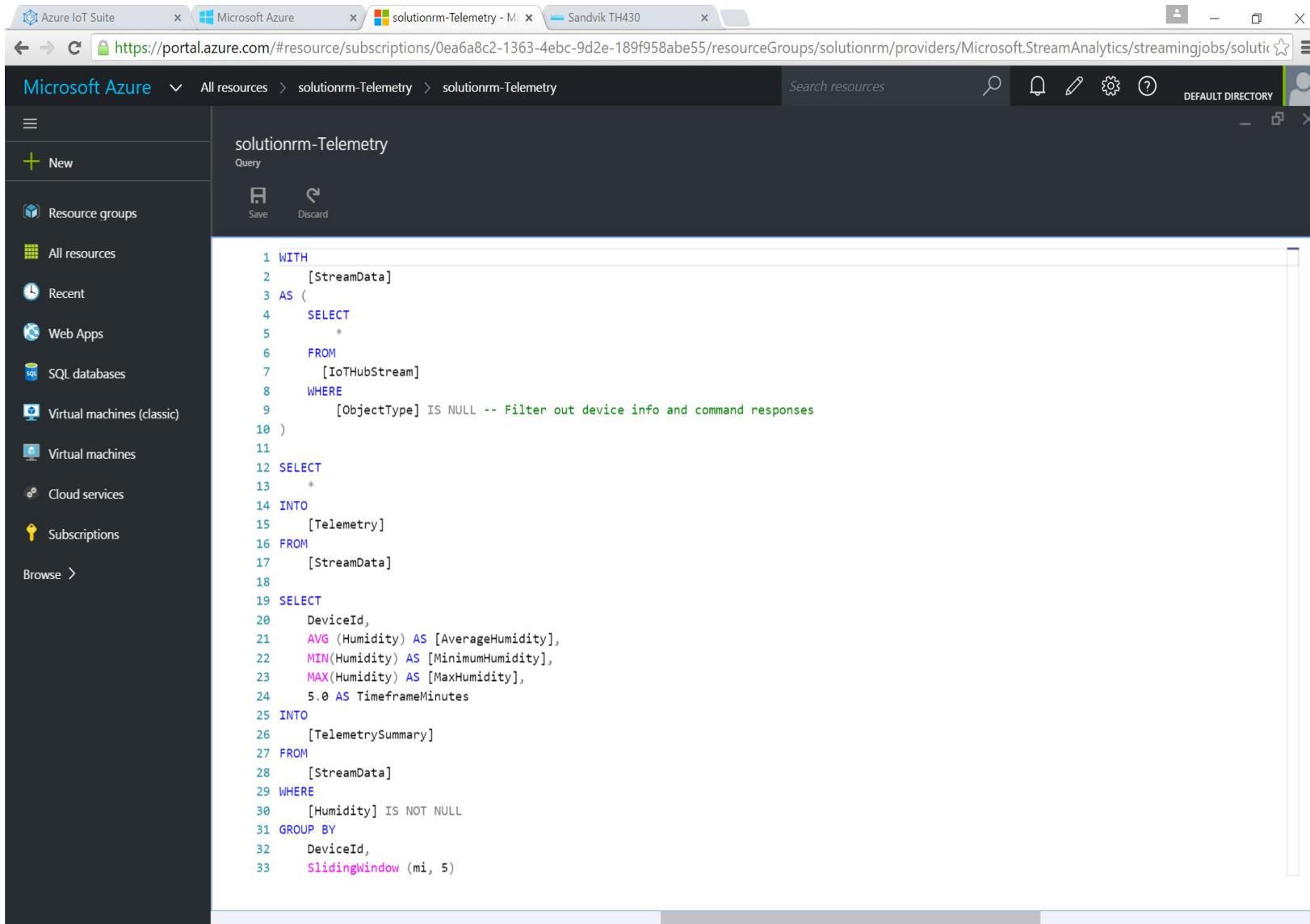
High volume

Analyze millions of data points per second

Highly scalable

Enterprise grade, predictable solution

Add or edit jobs using simple ASA interface



The screenshot shows the Microsoft Azure Stream Analytics interface. The left sidebar contains navigation links for IoT Suite, Microsoft Azure, Resource groups, All resources, Recent, Web Apps, SQL databases, Virtual machines (classic), Virtual machines, Cloud services, Subscriptions, and a 'Browse' link. The main area is titled 'solutionrm-Telemetry' and 'Query'. It displays the following ASA SQL code:

```
1 WITH
2     [StreamData]
3 AS (
4     SELECT
5         *
6     FROM
7         [IoTHubStream]
8     WHERE
9         [ObjectType] IS NULL -- Filter out device info and command responses
10 )
11
12 SELECT
13     *
14 INTO
15     [Telemetry]
16 FROM
17     [StreamData]
18
19 SELECT
20     DeviceId,
21     AVG (Humidity) AS [AverageHumidity],
22     MIN(Humidity) AS [MinimumHumidity],
23     MAX(Humidity) AS [MaxHumidity],
24     5.0 AS TimeframeMinutes
25 INTO
26     [TelemetrySummary]
27 FROM
28     [StreamData]
29 WHERE
30     [Humidity] IS NOT NULL
31 GROUP BY
32     DeviceId,
33     SlidingWindow (mi, 5)
```

Rule based interface

Simple implementation and rule development using ASA UI

Multi-channel

Analyze multiple channels of information simultaneously, in real time

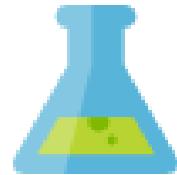
Predictive Analytics Azure Machine Learning



Advanced Analytics & AI Portfolio

Azure Machine Learning Studio

(GUI interface, R, Python, operationalization through webservices, Azure only)



SQL Server Machine Learning Services

(on-prem & Azure*, license SQL Server, R/Python inside Stored Procedure, operationalization SQL, interface SQL, models stored in table)



BUSINESS
POWER USERS



DATA SCIENTISTS



Azure Machine Learning Services

(code-first, Python (R comming), model management, runs locally, in docker – Azure /on-prem, use your own IDE, operationalize through webservices)

AZURE



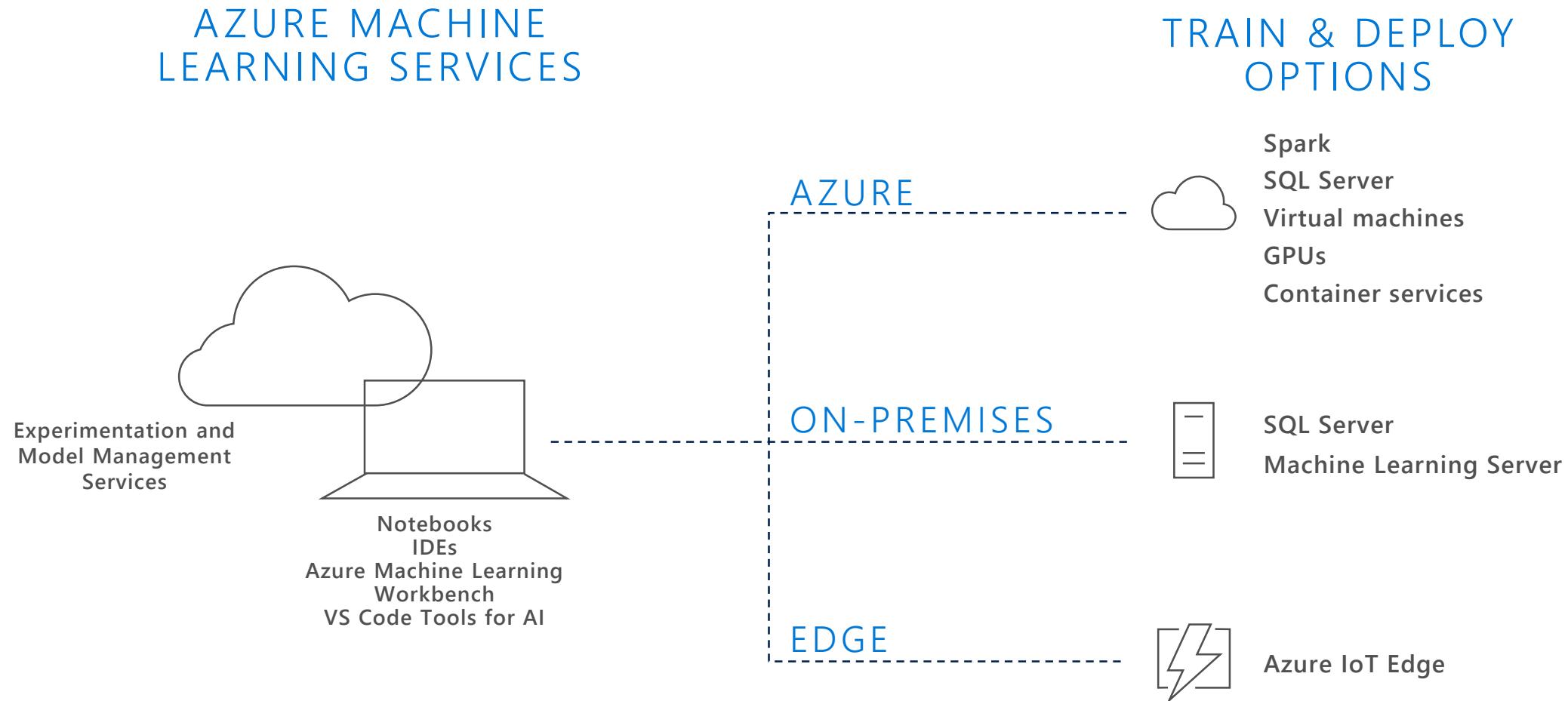
ON-PREMISES



Machine Learning Server

(on-prem & Azure**, license SQL Server, R/Python, pushdown R/Python to Hadoop/Spark, SQL Server, Operationalization module – webservices, interface R/Python, use your own IDE)

New Capabilities



Azure Machine Learning



What is Azure ML?

Azure Machine Learning is an integrated, end-to-end data science and advanced analytics solution. It enables data scientists to prepare data, develop experiments and deploy models at cloud scale.



Experimentation

Experimentation service allows data scientists to execute their experiments locally, in Docker containers, or in Spark clusters through simple configuration. It manages run history, provides version control, and enables sharing and collaboration.



Data Preparation

Data Preparation provides a set of tools for efficiently exploring, understanding, and fixing problems in data. It allows you to consume data in many forms and transform that data into cleansed data that is better suited for downstream usage.



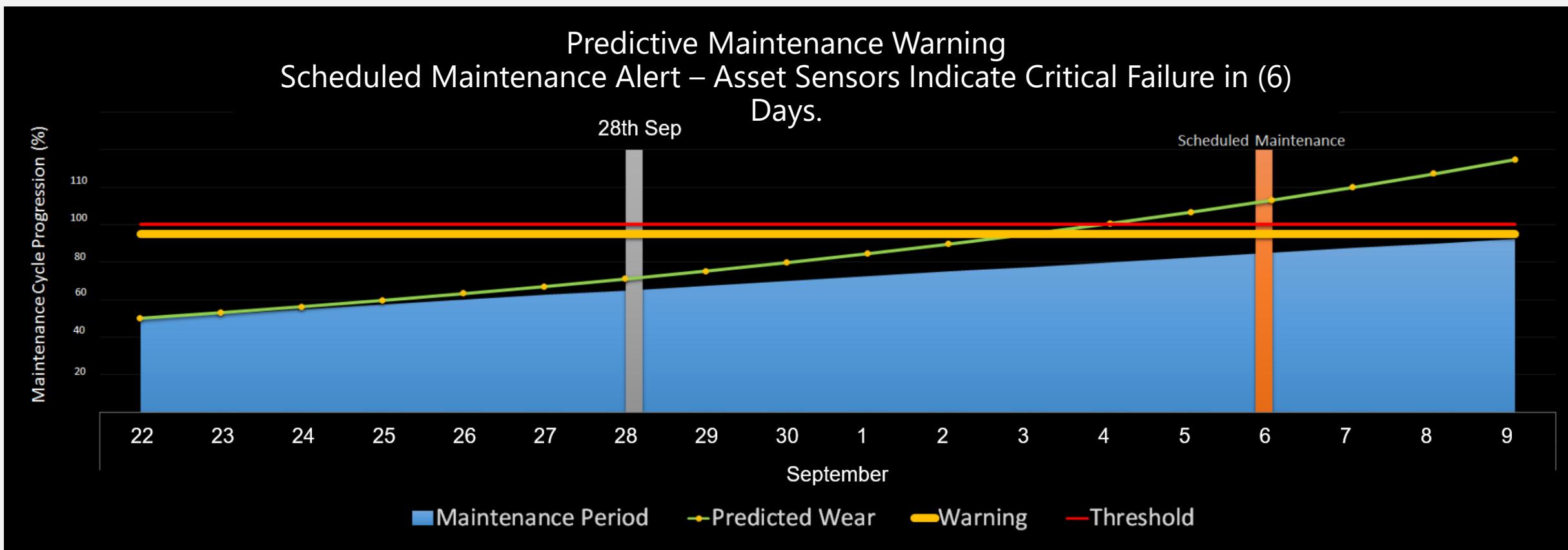
Model Management

Model management enables data scientists to manage and deploy machine-learning workflows and models as containerized web services. It provides flexibility for on-prem, IoT edge, as well as cloud-based deployment. It also enables model versioning, telemetry tracking and more.

Integrated predictive analytics

Empower with proactive analysis

Machine learning solutions enable powerful predictive analytics solutions, leveraging historical data and real time device ingestion input.



Cloud based predictive analytics

Use ML studio to create

Access and prepare data,
Create, test and train models

Rapid deployment

Single click deploy to production via API service

Drag and drop algorithms

Simple UI for straightforward algorithm creation

Algorithm libraries

Utilize library of preconfigured algorithm
solutions

ML API service

Models available as URL, call from any endpoint

AML - Drag & Drop + Best in Class Algorithms

Microsoft Azure Machine Learning | Home Studio Gallery PREVIEW

In draft

Predictive Maintenance Demo - Training - Original

Properties

Experiment Properties

- START TIME -
- END TIME -
- STATUS CODE InDraft
- STATUS DETAILS None

Go to web service

Prior Run

Summary

Training predictive maintenance demo

Description

Enter the detailed description for your experiment.

Quick Help

Search experiment items

Saved Datasets

Trained Models

Transforms

Data Format Conversions

Data Input and Output

Data Transformation

Feature Selection

Machine Learning

OpenCV Library Modules

Python Language Modules

R Language Modules

Statistical Functions

Text Analytics

Web Service

Deprecated

TrainingData.csv

Project Columns

Multiclass Decision Forest

Split

Train Model

Score Model

Evaluate Model

```
graph TD; A[TrainingData.csv] --> B[Project Columns]; B --> C[Multiclass Decision Forest]; B --> D[Split]; C --> E[Train Model]; D --> E; E --> F[Score Model]; F --> G[Evaluate Model]
```

NEW

RUN HISTORY

SAVE

DISCARD CHANGES

RUN

SET UP WEB SERVICE

PUBLISH TO GALLERY

Data Visualization Power BI



Built-in data visualization with Power BI

Real time capabilities

Ingest, analyze and display data as it happens

Secure access

Secure, live communication with data source

Query data

Intuitive, natural language query tool

Integrated systems

Integrate with other business systems and enrich device data with intelligence from other business systems, e.g. CRM, ERP

Highly accessible analytics

Cloud based dashboard and analytics tool

360° view of business KPI's

Customize dashboards to address concerns and performance metrics

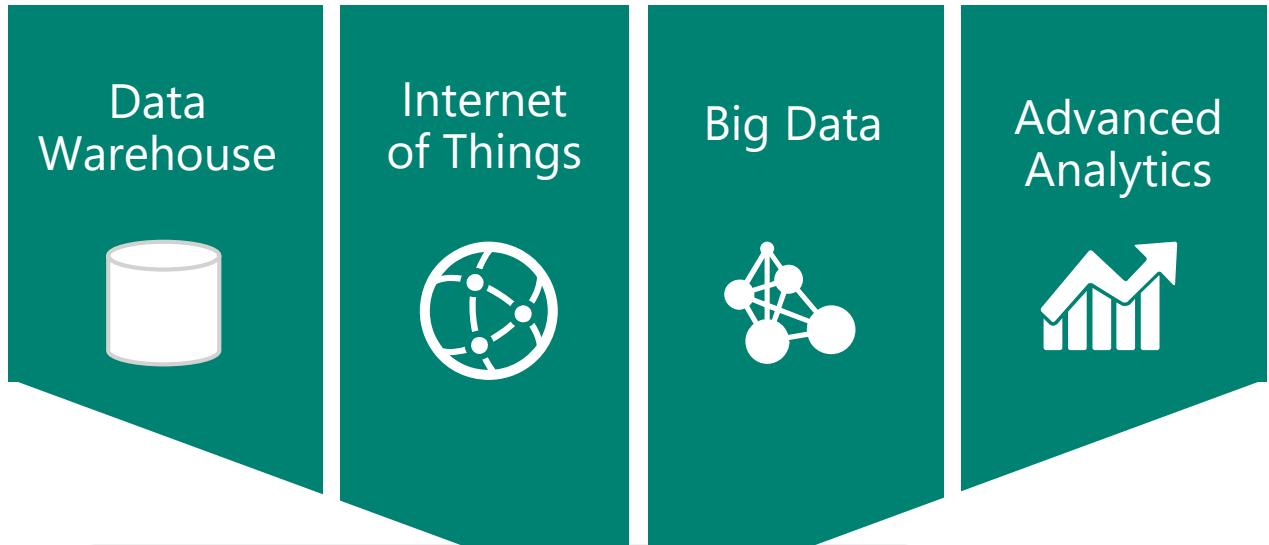
Cross platform support

View data via web platform, on any device

Pre-built dashboards

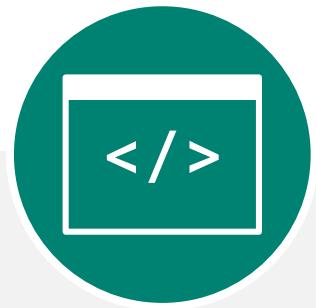
Utilize standard dashboards for rapid deployment, based on popular solution demands

Seamless integration



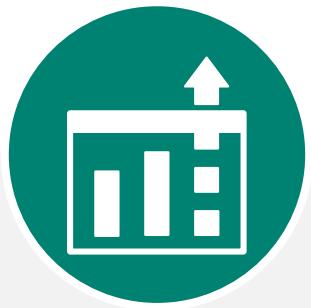
Seamless integration across the Microsoft Data Platform provides quicker and more cost effective deployment for any data project

Power BI for developers*



Embed

Power BI experiences directly into your public facing websites and blogs



Extend

Power BI and your reach with organizational content packs and custom visuals



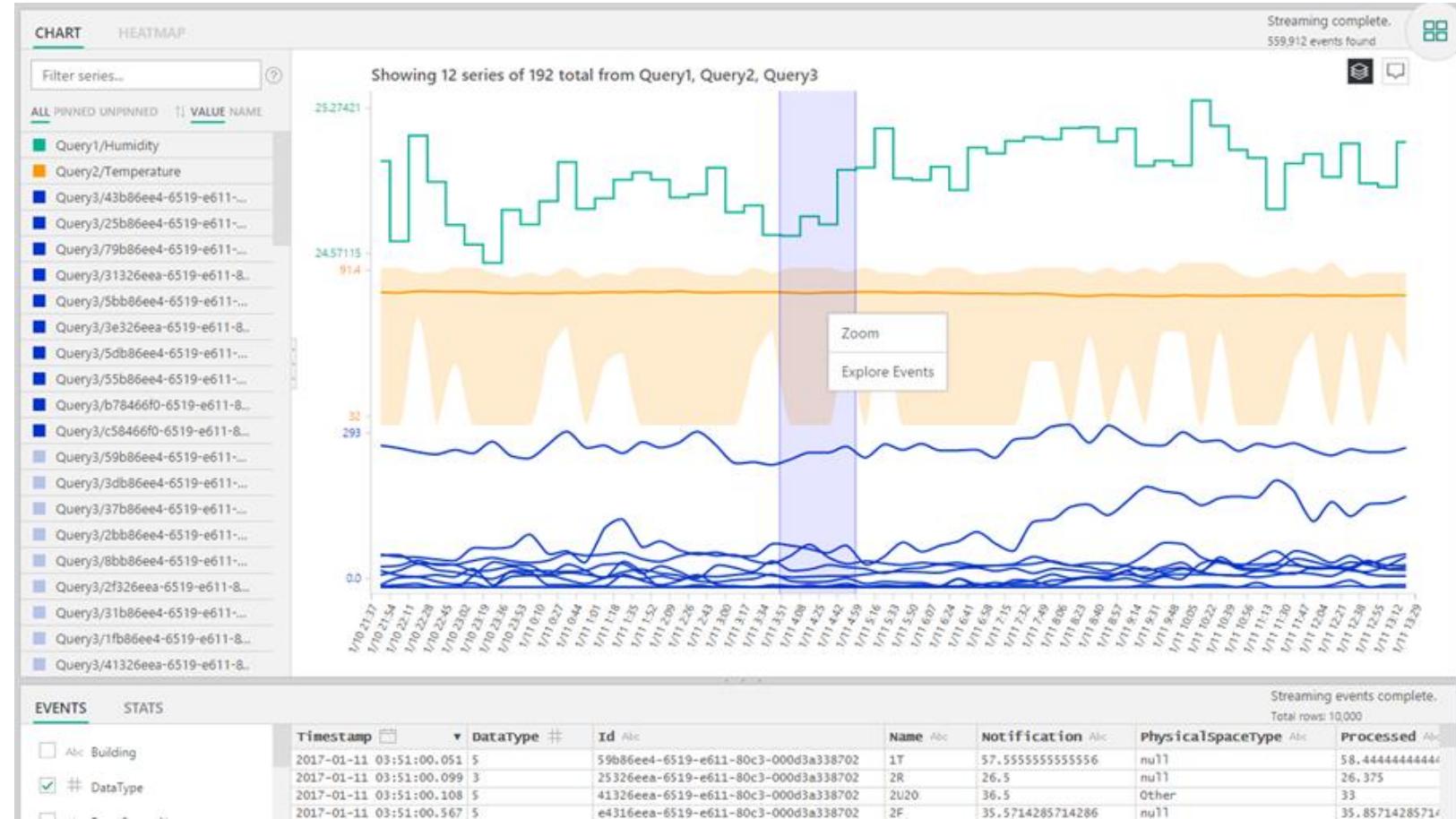
Integrate

user-defined Power BI experiences into your app

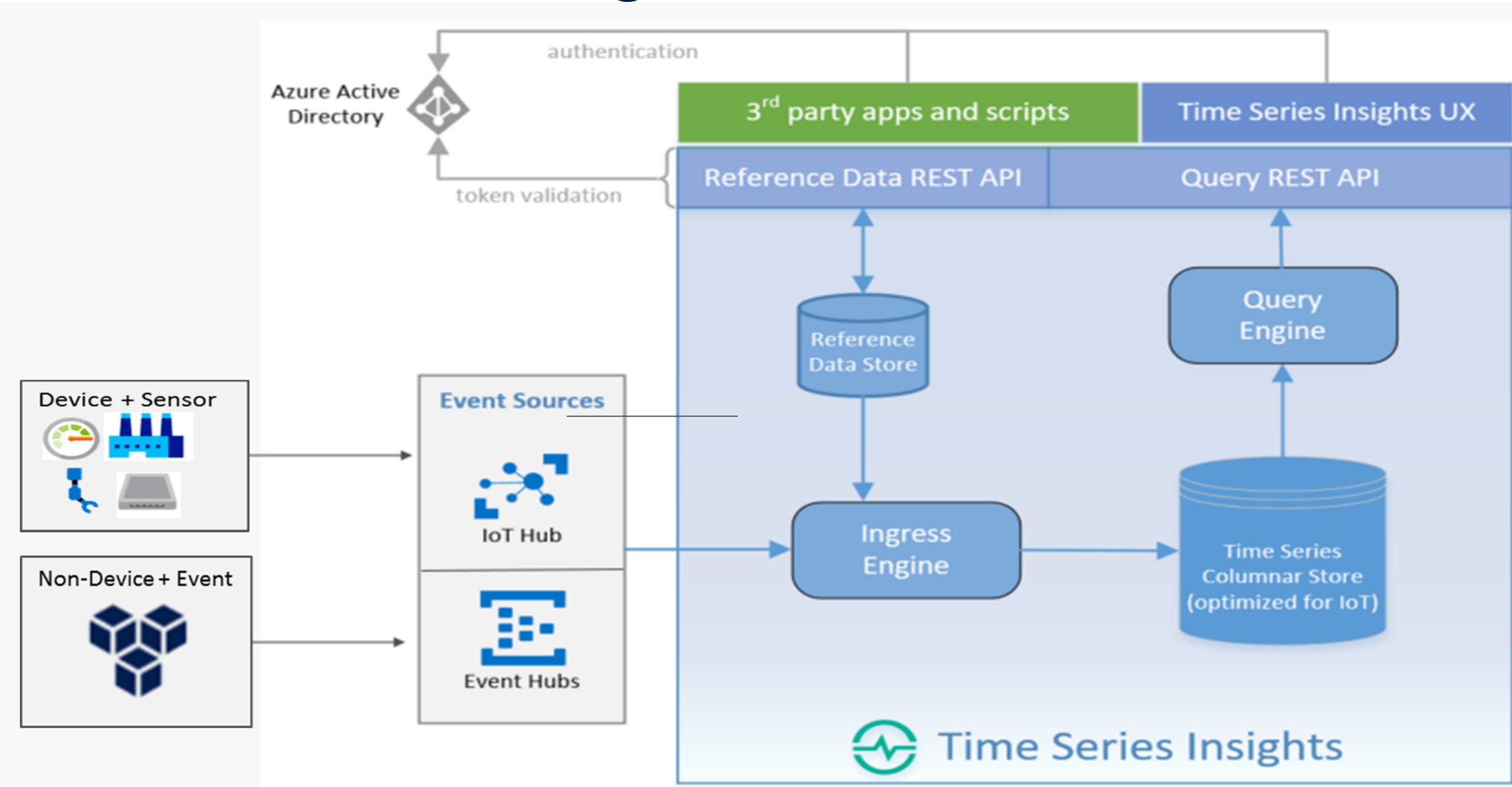
Azure Time Series Insights

Azure Time Series Insights is a fully managed analytics, storage, and visualization service that makes it incredibly simple to explore and analyze billions of events simultaneously.

- Get near real-time insights in seconds
- Start in seconds, scale in minutes
- Create a global view of your IoT-scale data
- Leverage the power of Time Series Insights in your Apps and Solutions



Azure Time Series Insights: Architecture



Elements of Azure IoT Suite

Connect and scale
with efficiency



Preconfigured solutions



SDK



Connect and control

Analyze and act
on new data



Event processing



Predictive analytics



Data visualization

Integrate and transform
business processes



Workflow integration



Push and broadcast
notifications



ID and access management

Big Data Analytics in Azure

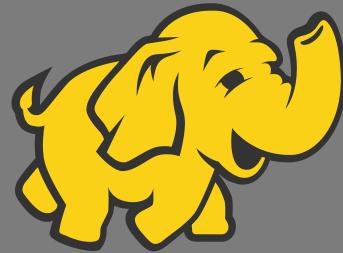
CLUSTER

Virtual Machines



CLUSTER

HDInsight



Hadoop, Spark,
HBase, & Storm

PLATFORM-AS-A-SERVICE

Data Lake
Analytics

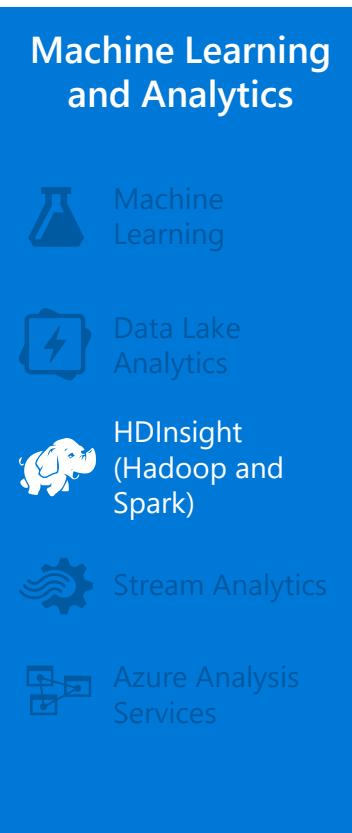


User-installed Hadoop distros
on a **cluster** of user-managed
VMs

Specific Hadoop distro on a
Azure-managed VM **cluster**

Big Data as a Service

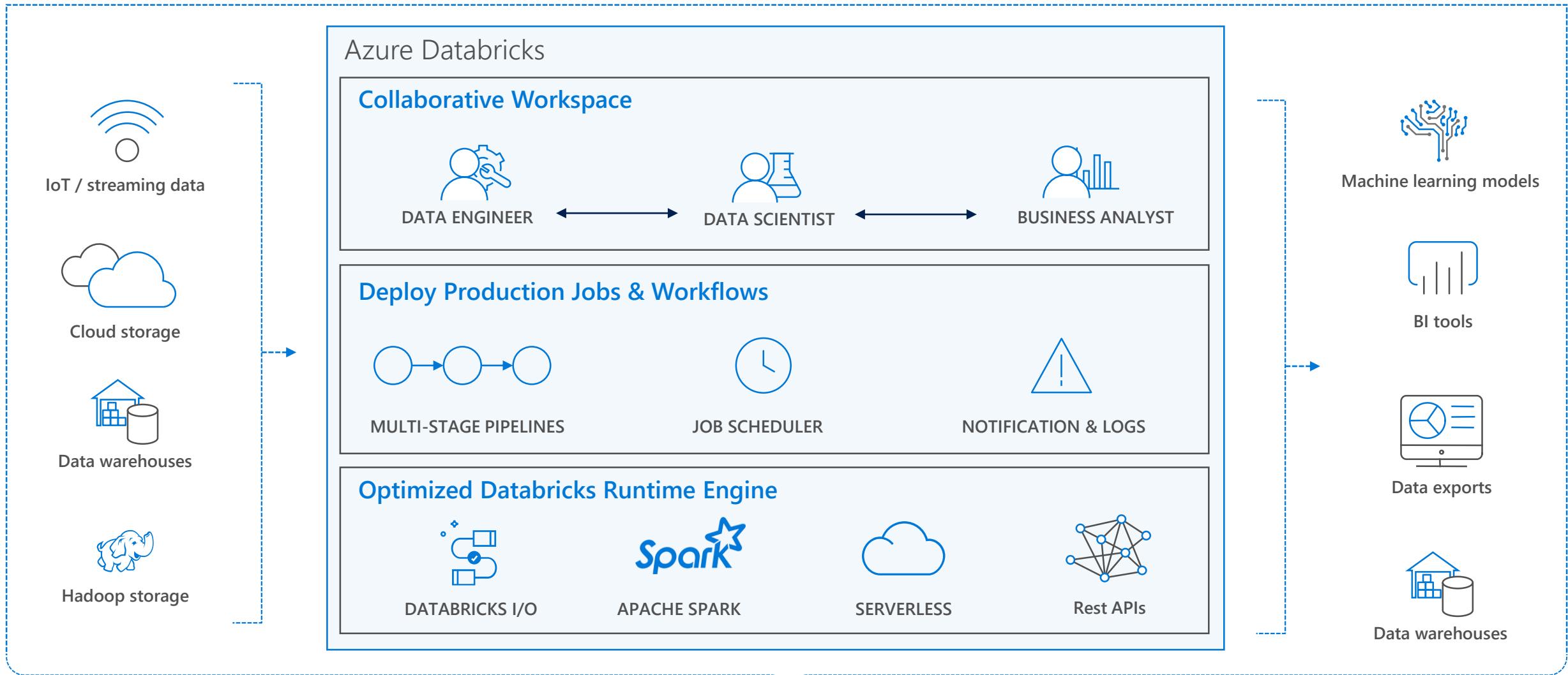
Comprehensive set of managed Apache big data projects



Core Engine

- Scale to petabytes on demand
- Process unstructured and semi-structured data
- Develop in Java, .NET, and more
- Skip buying and maintaining hardware
- Deploy in Windows or Linux
- Spin up an Apache Hadoop cluster in minutes
- Visualize your Hadoop data in Excel
- Easily integrate on-premises Hadoop clusters

Azure Databricks



Enhance Productivity

Build on secure & trusted cloud

Scale without limits

Big data analytics made easy



Data Lake Analytics



SQL Data Warehouse



SQL Database



Data Lake Store



Storage Blobs



SQL Database in a VM

- Analyze data of any kind and size
- Develop faster, debug and optimize smarter
- Interactively explore patterns in your data
- No learning curve—use U-SQL, Spark, Hive, HBase and Storm

- Managed and supported with an enterprise-grade SLA
- Dynamically scales to match your business priorities
- Enterprise-grade security with Azure Active Directory
- Built on YARN, designed for the cloud

Elements of Azure IoT Suite

Connect and scale
with efficiency



Preconfigured solutions



SDK



Connect and control

Analyze and act
on new data



Event processing



Predictive analytics



Data visualization

Integrate and transform
business processes



Workflow integration



Push and broadcast
notifications



ID and access management

A photograph showing two men in a workshop or office environment. One man is standing and leaning over a desk, looking at a tablet screen. The other man is standing behind him, also looking at the screen. They are surrounded by various electronic equipment, cables, and a whiteboard with sticky notes. The room has large windows and concrete walls.

Visit



www.InternetofYourThings.com
to get started

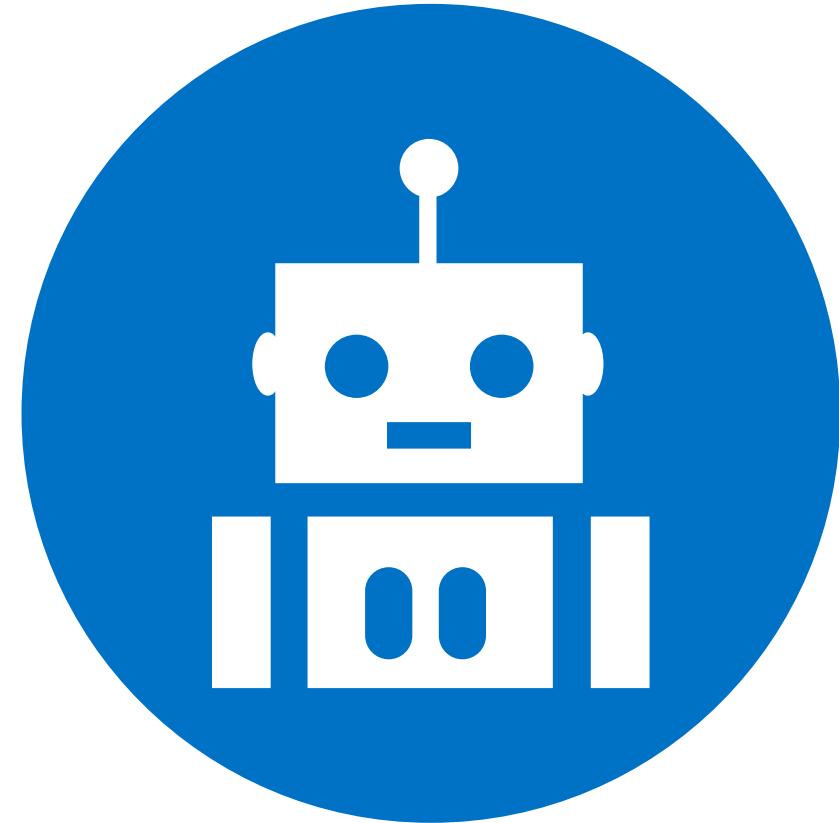


Microsoft

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Appendix



Cloud-to-cloud
Connectivity



Connectivity capabilities

ERICSSON



cisco

Jasper



Device Control

Use SMS to command devices
to “reboot” or “wake up”,
troubleshoot and take action



Connection Management

Changing SIM status, rate plan,
use advanced analytics
connection efficiency



Global View

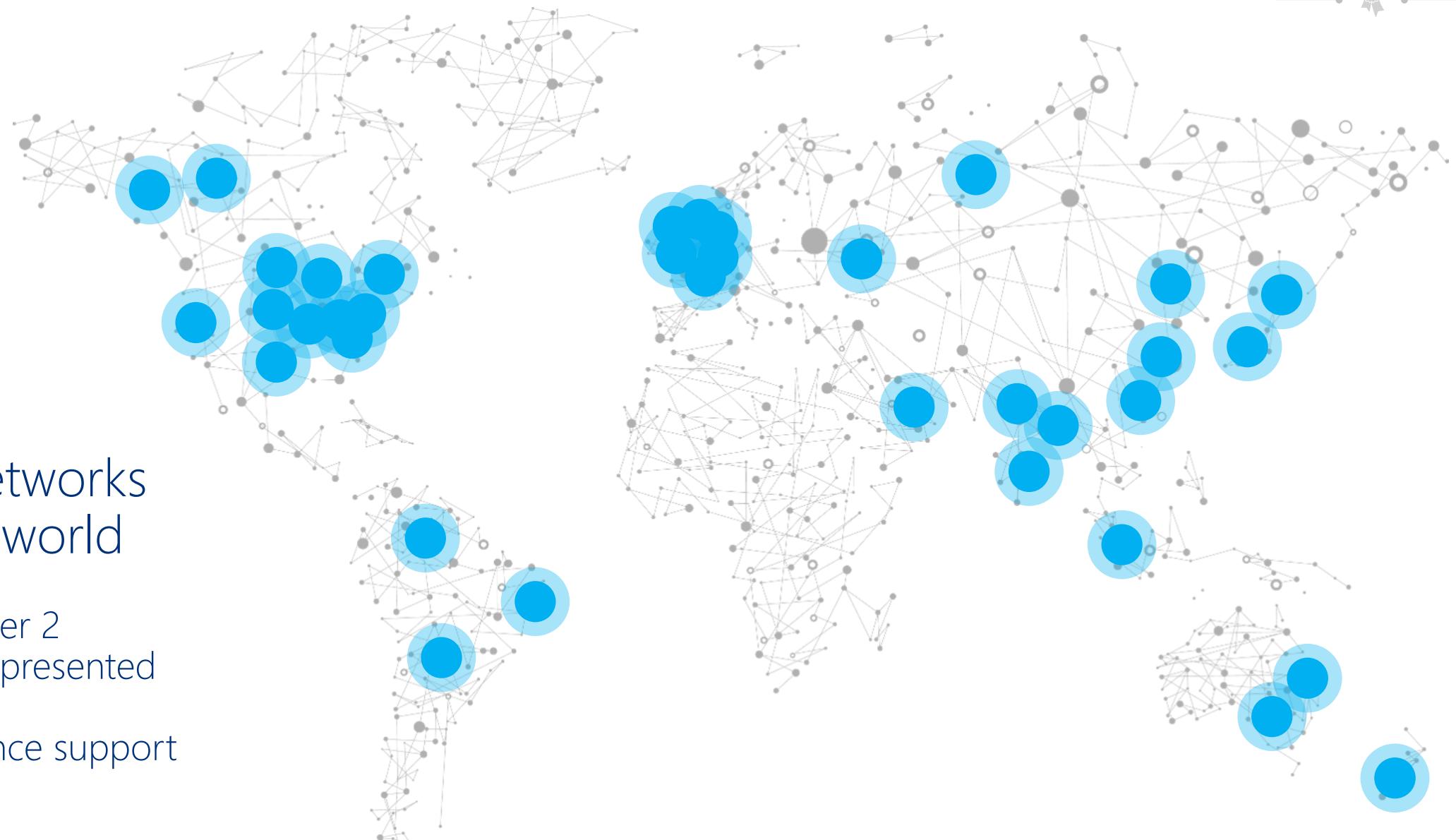
Visualize and manage all your
SIM connects assets across all
your locations

Operator networks

40

operator networks
around the world

- Tier 1 and tier 2 networks represented
- GSMA alliance support



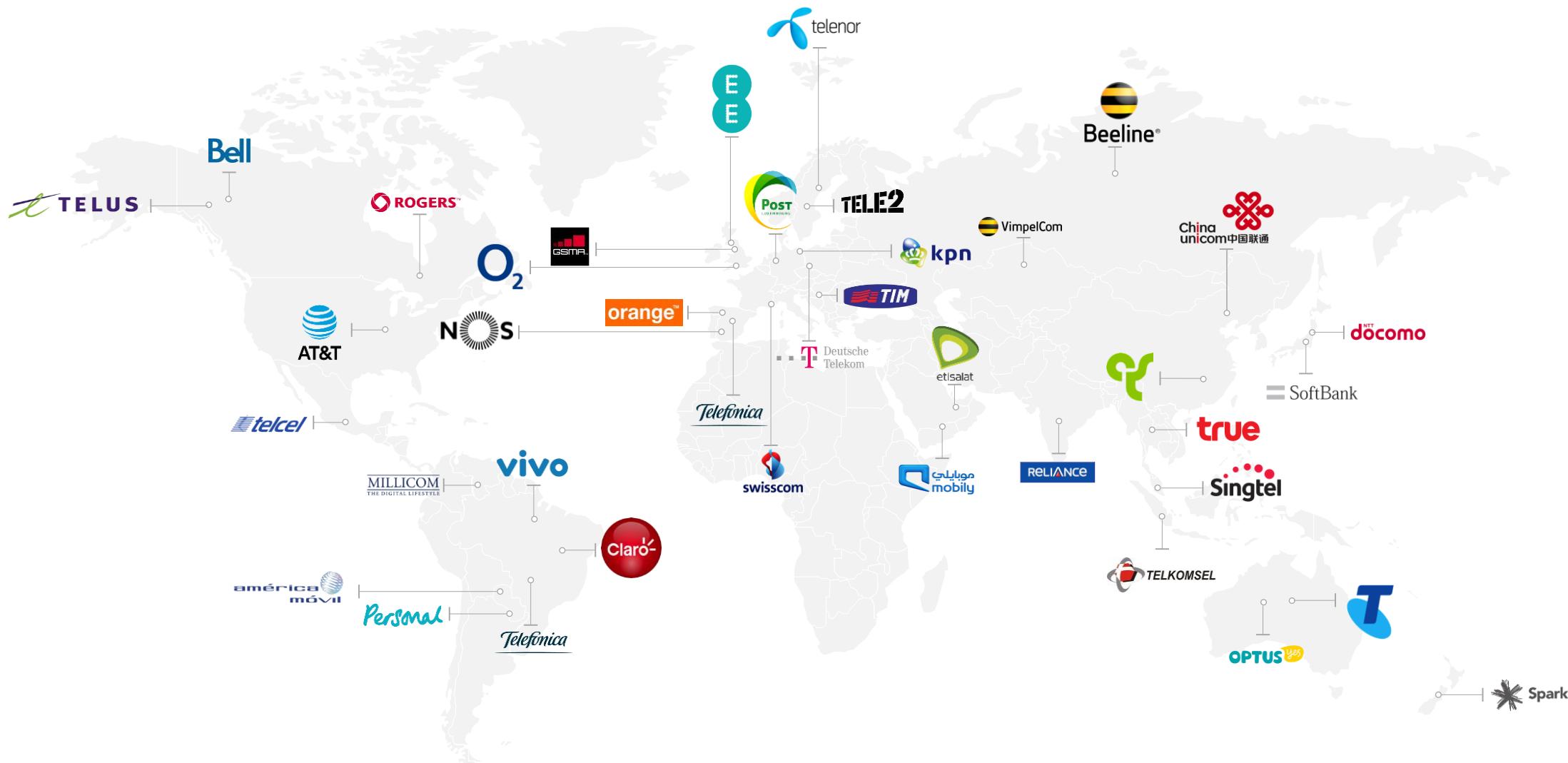
Operator networks



Operator networks



Operator networks



Many aspects of connectivity

Functionality

- Device-to-cloud telemetry,
- Cloud-to-device commands and notifications,
- File uploads/downloads



Security

- Device security,
- Cloud security,
- Channel security, ...



Monitoring

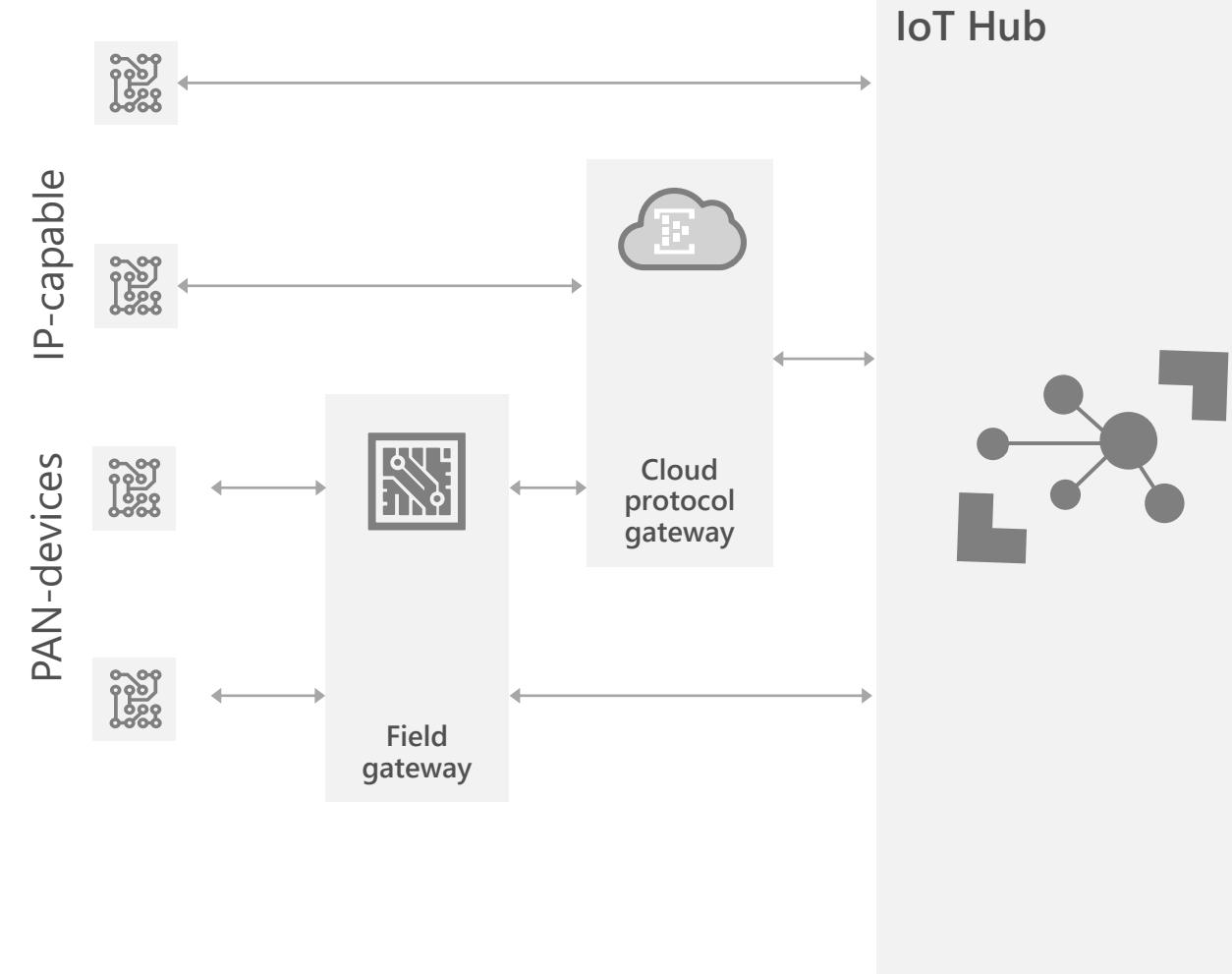


Identify malfunctioning devices when they cannot be reached directly

Reach and customization



- RTOS/Linux/Windows/non-IP capable,
- Network/application protocols,
- Authentication schemes



Manufacturing (1 of 2)

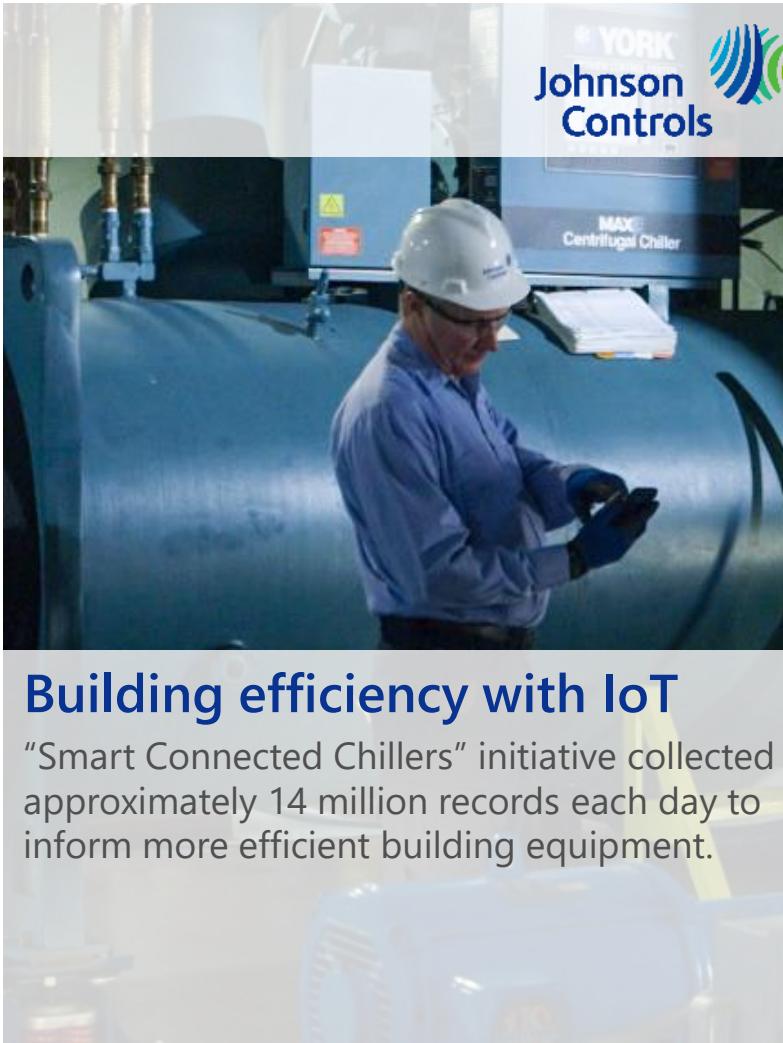


Rockwell Automation

Moving from action to insights

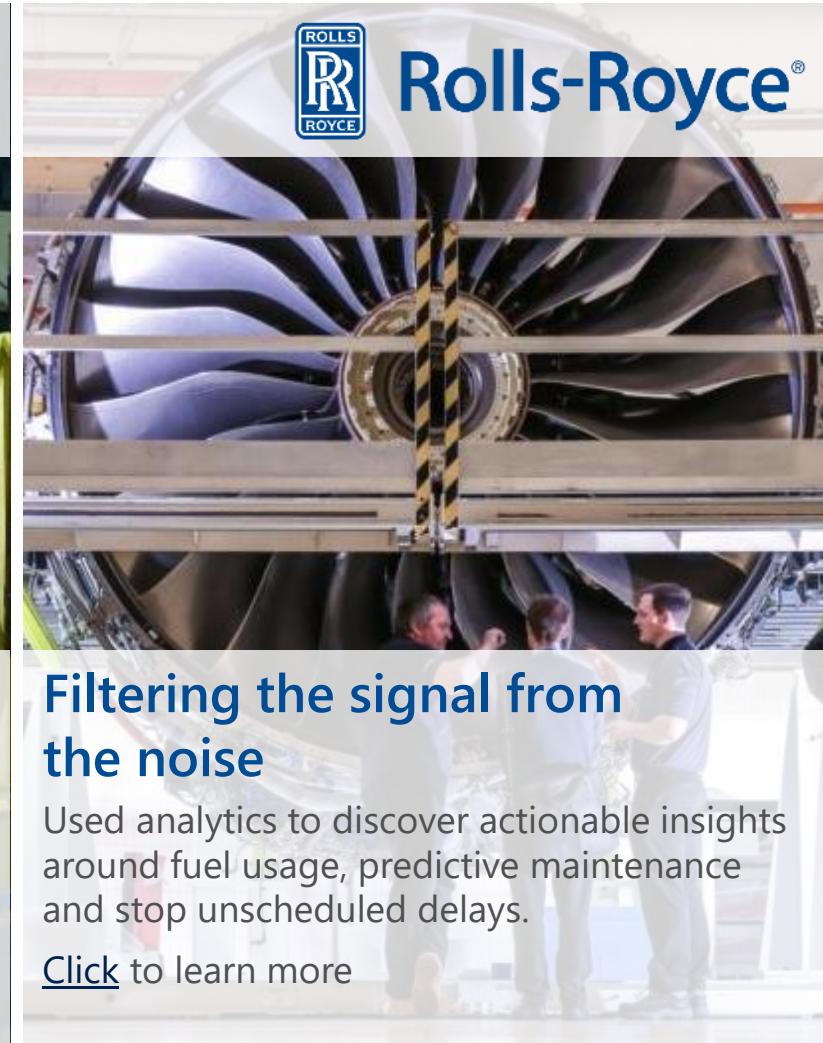
Reduced development time and cost by 80% by gathering and analyzing data more efficiently and increasing automation across the company.

[Click to learn more](#)



Building efficiency with IoT

"Smart Connected Chillers" initiative collected approximately 14 million records each day to inform more efficient building equipment.



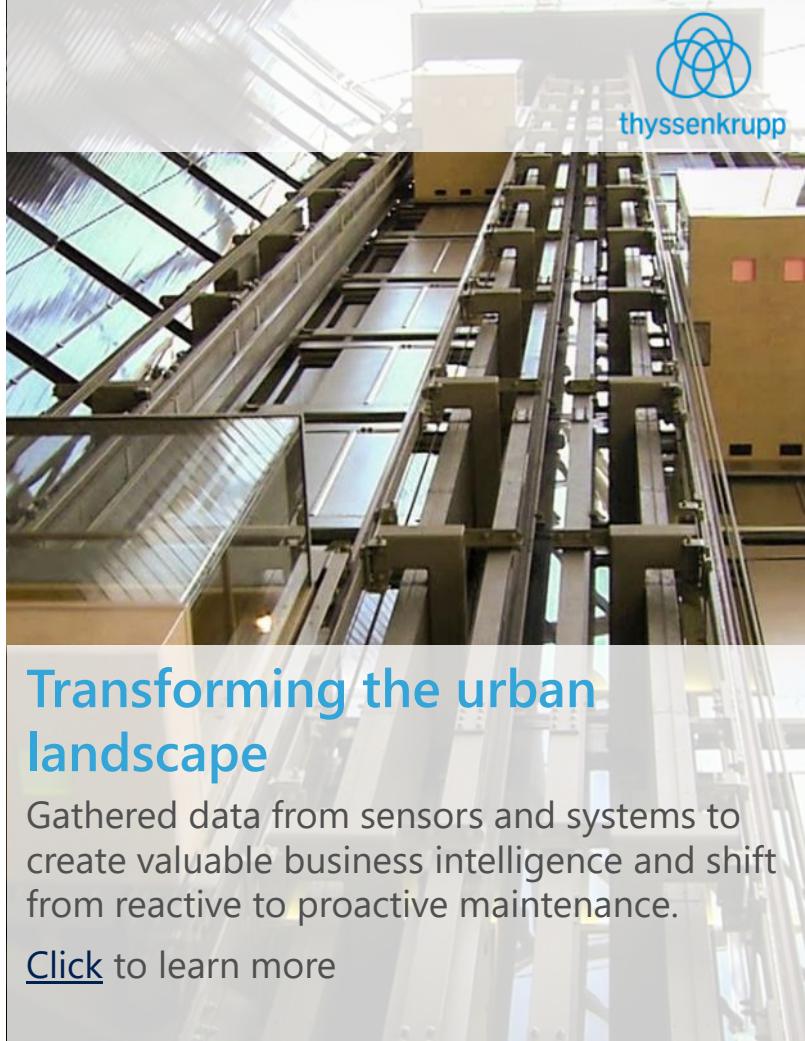
Rolls-Royce

Filtering the signal from the noise

Used analytics to discover actionable insights around fuel usage, predictive maintenance and stop unscheduled delays.

[Click to learn more](#)

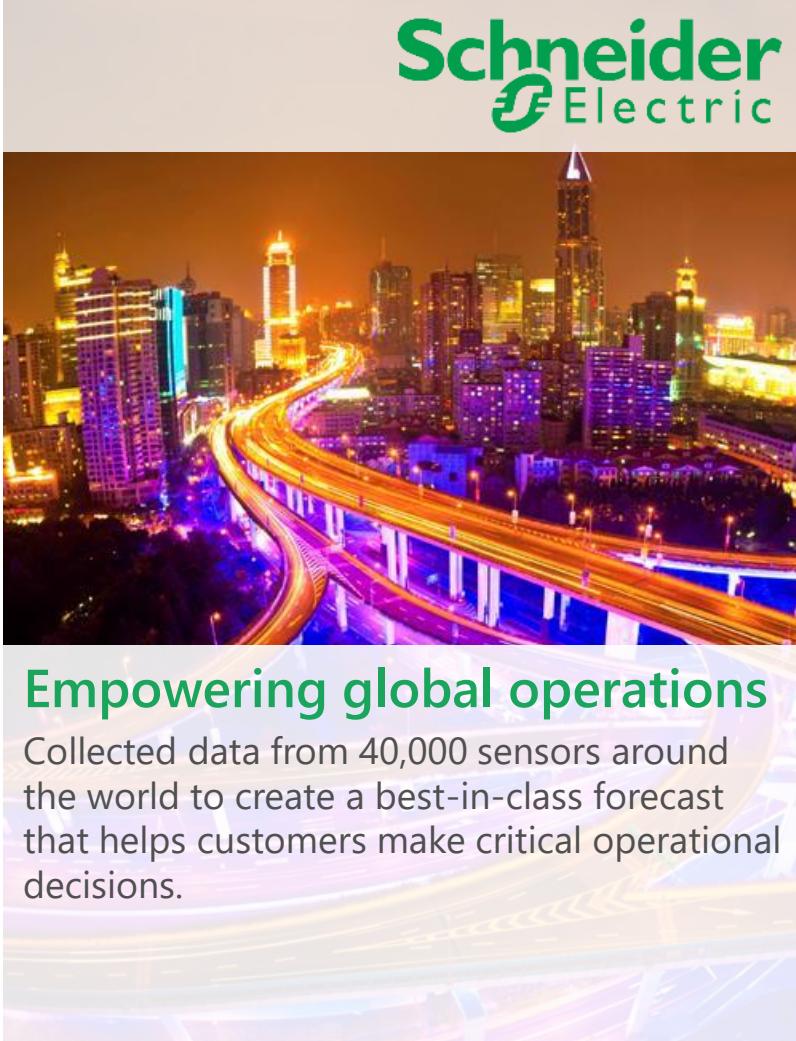
Manufacturing (2 of 2)



Transforming the urban landscape

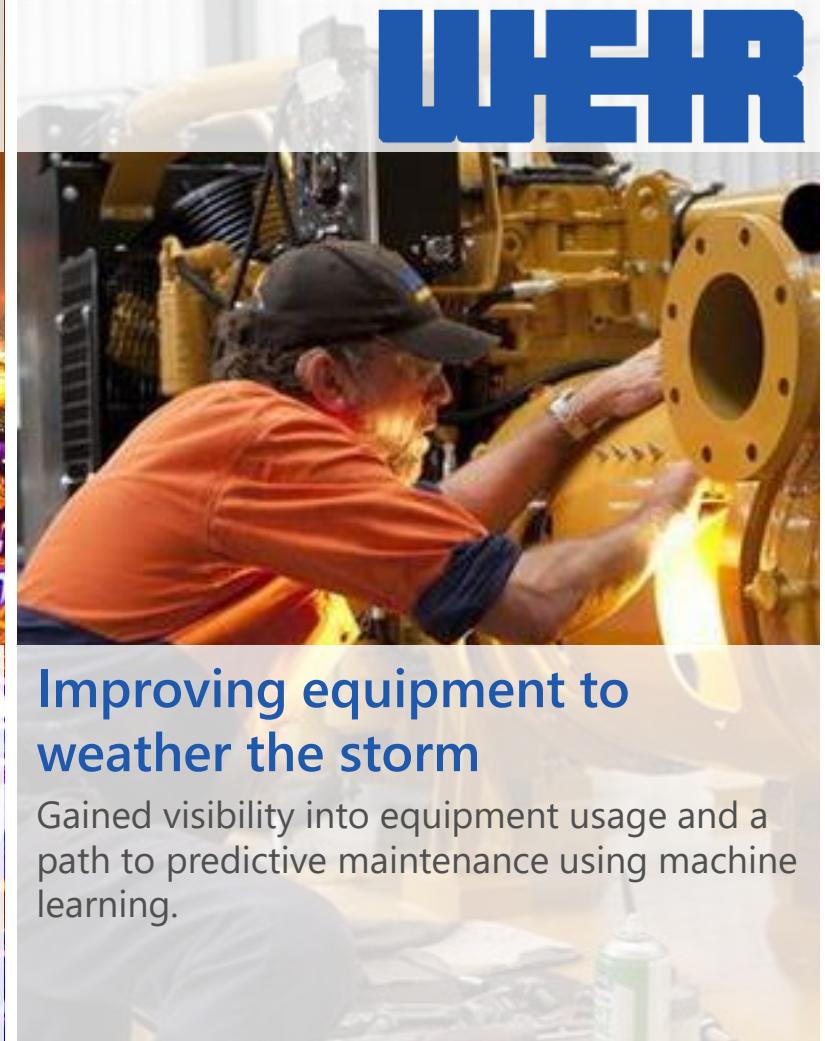
Gathered data from sensors and systems to create valuable business intelligence and shift from reactive to proactive maintenance.

[Click](#) to learn more



Empowering global operations

Collected data from 40,000 sensors around the world to create a best-in-class forecast that helps customers make critical operational decisions.



Improving equipment to weather the storm

Gained visibility into equipment usage and a path to predictive maintenance using machine learning.

Retail



Connecting the unconnected

Gathered data from sensors and systems to create valuable business intelligence and shift from reactive to proactive maintenance.

[Click to learn more](#)



Data transforms beverage business

Increased the actionable insight pulled from company data across all areas of the company by deploying Microsoft Azure Machine Learning.

[Click to learn more](#)

Banking



A growing bank's new approach

Leveraged company wide data to predict how likely customers are to go to other financial institution and drive better product features.

[Click to learn more](#)



Fast, friendly, and reliable banking

Developed a complete business intelligence suite to track company data in under a week in order to drive up engagement and accounts sharehold.

[Click to learn more](#)

Government



The Internet of (Farm) Things

Deployed IoT sensors in different farms to learn how to optimize use of Maryland's 93,000 acres of the farmland and maximize production.

[Click to see more](#)

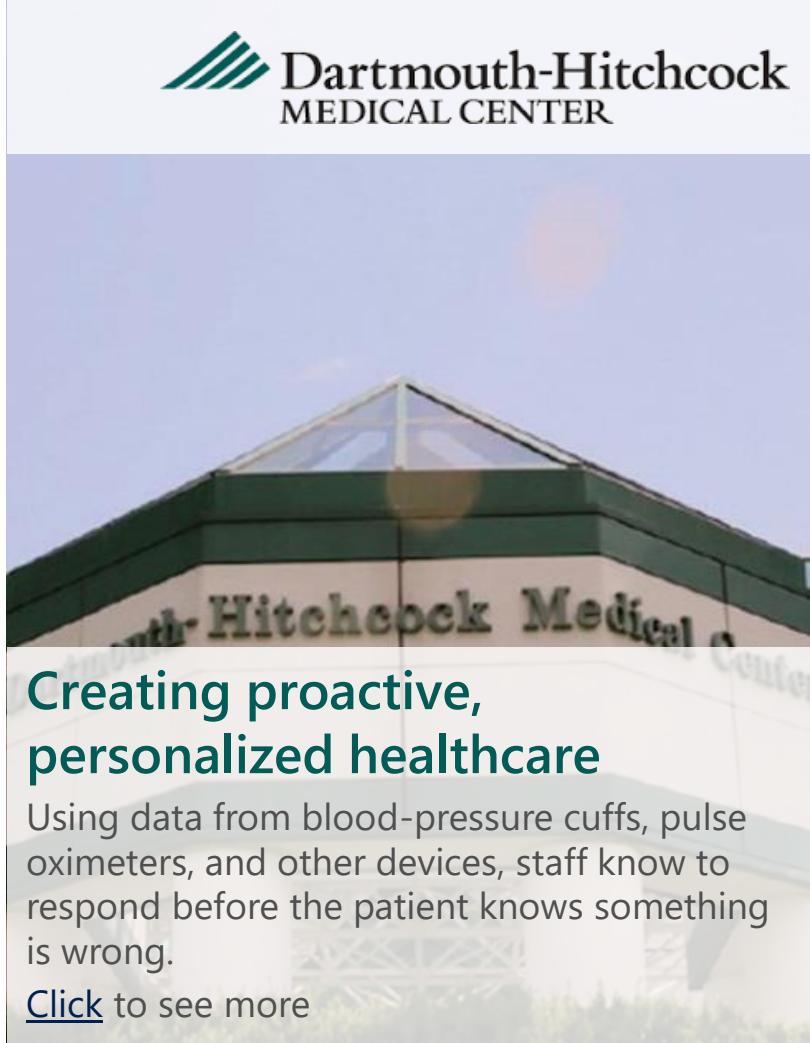


How Glasgow is reinventing itself

Developed apps to help citizens use services and business find growth opportunities using data from IoT sensors across the city.

[Click to see more](#)

Health

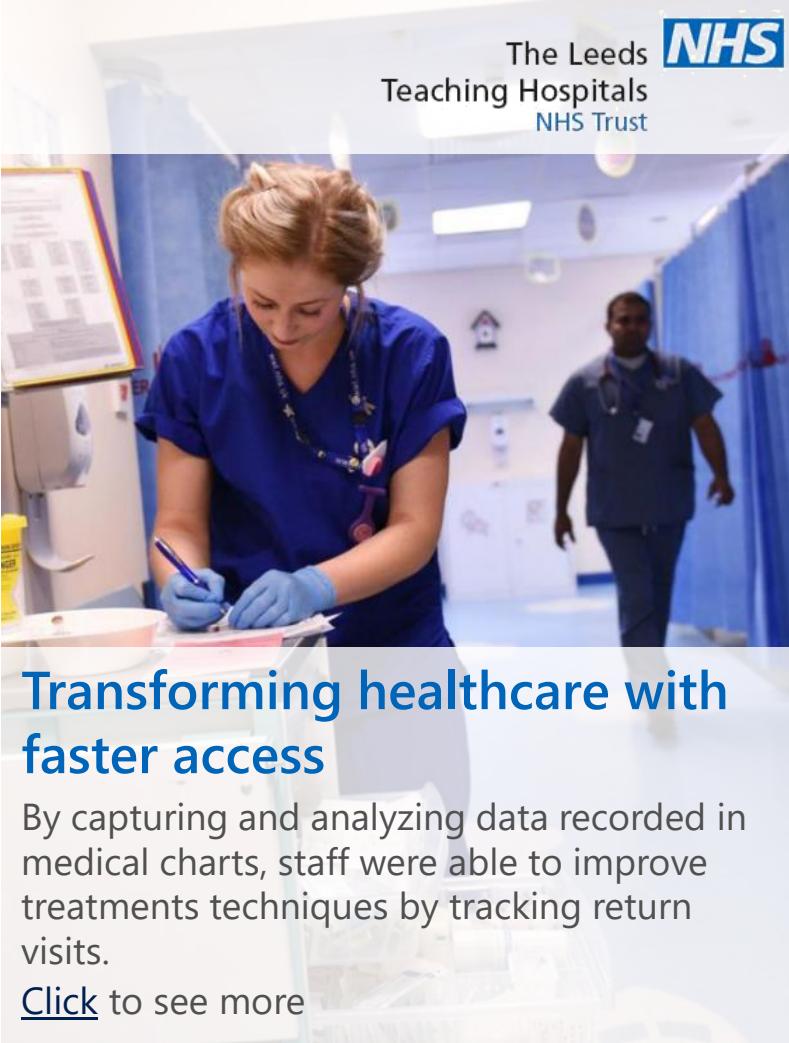


Dartmouth-Hitchcock MEDICAL CENTER

Creating proactive, personalized healthcare

Using data from blood-pressure cuffs, pulse oximeters, and other devices, staff know to respond before the patient knows something is wrong.

[Click to see more](#)



The Leeds Teaching Hospitals NHS Trust

Transforming healthcare with faster access

By capturing and analyzing data recorded in medical charts, staff were able to improve treatments techniques by tracking return visits.

[Click to see more](#)



Great River Medical Center

Building a connected hospital

Reduce medication delivery times and inventory costs by connecting dispensary devices with electronic medical records.

[Click to see more](#)

Construction



LAING O'ROURKE

Embracing the possibilities of IoT

Increased worker safety by monitoring data from the individuals and the environment for warning signs of heatstroke and dehydration.

[Click to see more](#)

LOGO

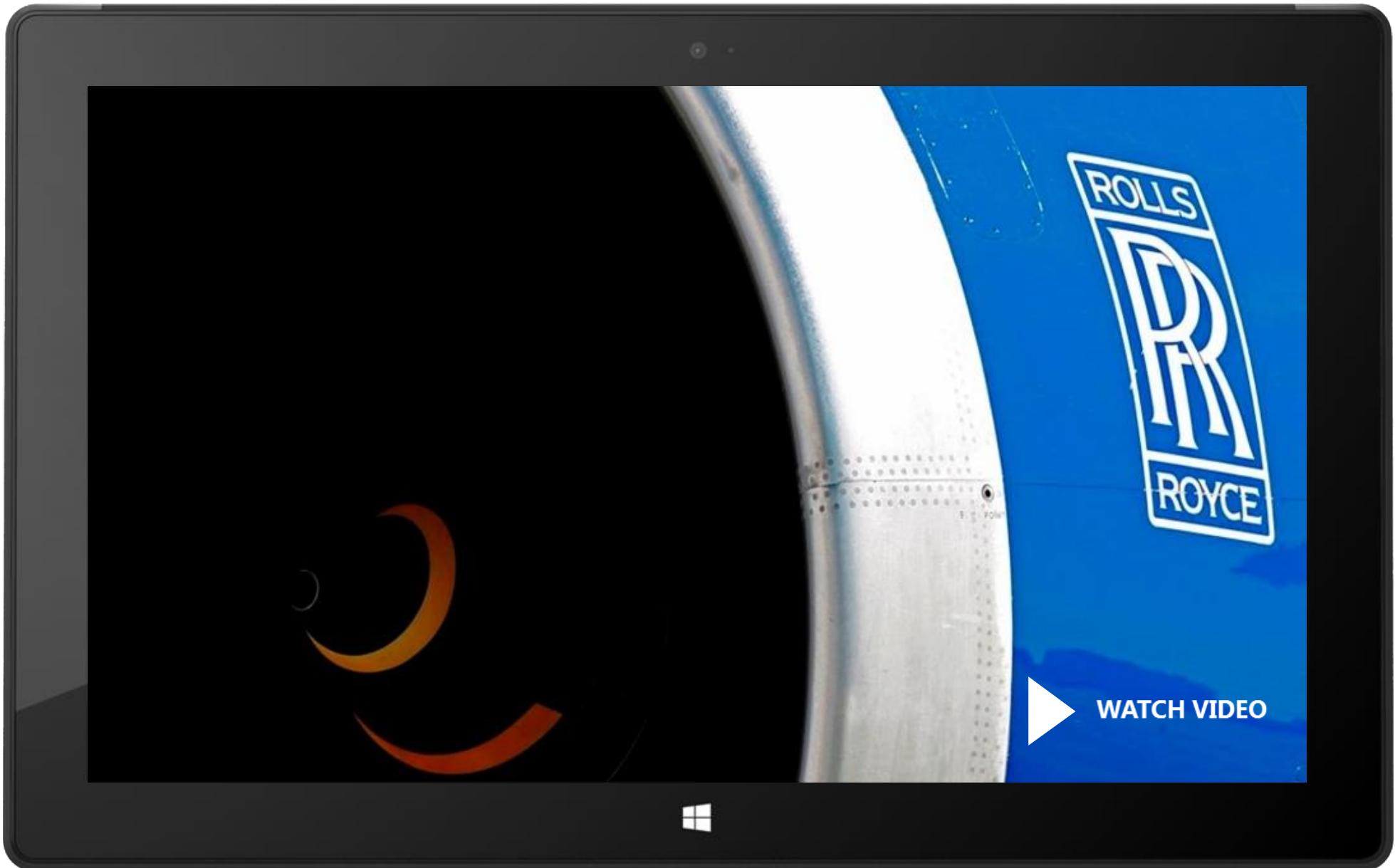


Case Study Title

Information about customer

Click to see more

Rolls-Royce demo



Full Power BI capabilities



Data visualization with full Power BI

Power BI

Vehicle Health Analysis Dashboard

LOADING...

Vehicles in operation Vehicles requiring maintenance

7800 923

Average speed Aggressively driven vehicles

57.85 2012

Fuel efficient vehicles Average speed, tire pressure, engine...

368 0 100 200 300 400
Bellevue Redmo... Sammamish Seattle

Vehicles in operation by city

Averages of Fuel, Engine Temperature by Model

Model Average of fuel Average of engine temperature

Compact ... Convertible Coupe Family Sal... Hybrid Large SUV
Bellevue 290.00 19.50 260.00
Redmond 280.00 20.00 270.00
Sammamish 270.00 20.50 260.00
Seattle 280.00 20.50 290.00

Aggressively driven vehicles by model

Increase Decrease Total

Compact car Convertible Family Saloon Hybrid Large SUV Medium SUV Sedan Small SUV Sports Car Station Wagon Total
81.00 289.00 107.00 140.00 407.00 120.00 110.00 442.00 95.00 2012.00

Revenue BY STATE

Recalled vehicles by model,city

Family Saloon	Medium SUV	Sports Car	Compact car
Redmond 12.00	Seattle 5.00	Seattle 4.00	Bellevue 1.00
Seattle 8.00	Bellevue 5.00	Redmo... Seattle 3.00	Redmo... Bellevue 2.00
Hybrid	Large SUV	Bellevue 2.00	Seattle 1.00
Seattle 8.00	Convertible	Seattle 4.00	Bellevue 1.00
Bellevue 7.00	Redmon...	Bellevue 2.00	Bellevue 1.00
Sammamish 7.00	Samma...	Bellevue 1.00	Bellevue 1.00

Fuel efficient vehicles by model

Probabil...
Maintenance
Bellevue
Redmond
Sammamish
Seattle

The screenshot shows a complex dashboard with multiple cards and charts. The top row includes a gauge for average speed (57.85), a bar chart for fuel efficient vehicles (368), and a timeline chart for aggressively driven vehicles (2012). Below these are two large charts: one for vehicle distribution by city (map) and another for fuel efficiency by model (bubble chart). The bottom section contains a heatmap for recalled vehicles by model and city, and a bar chart for fuel efficient vehicles by model.

Rich visuals

Standard and custom graphing options

External data

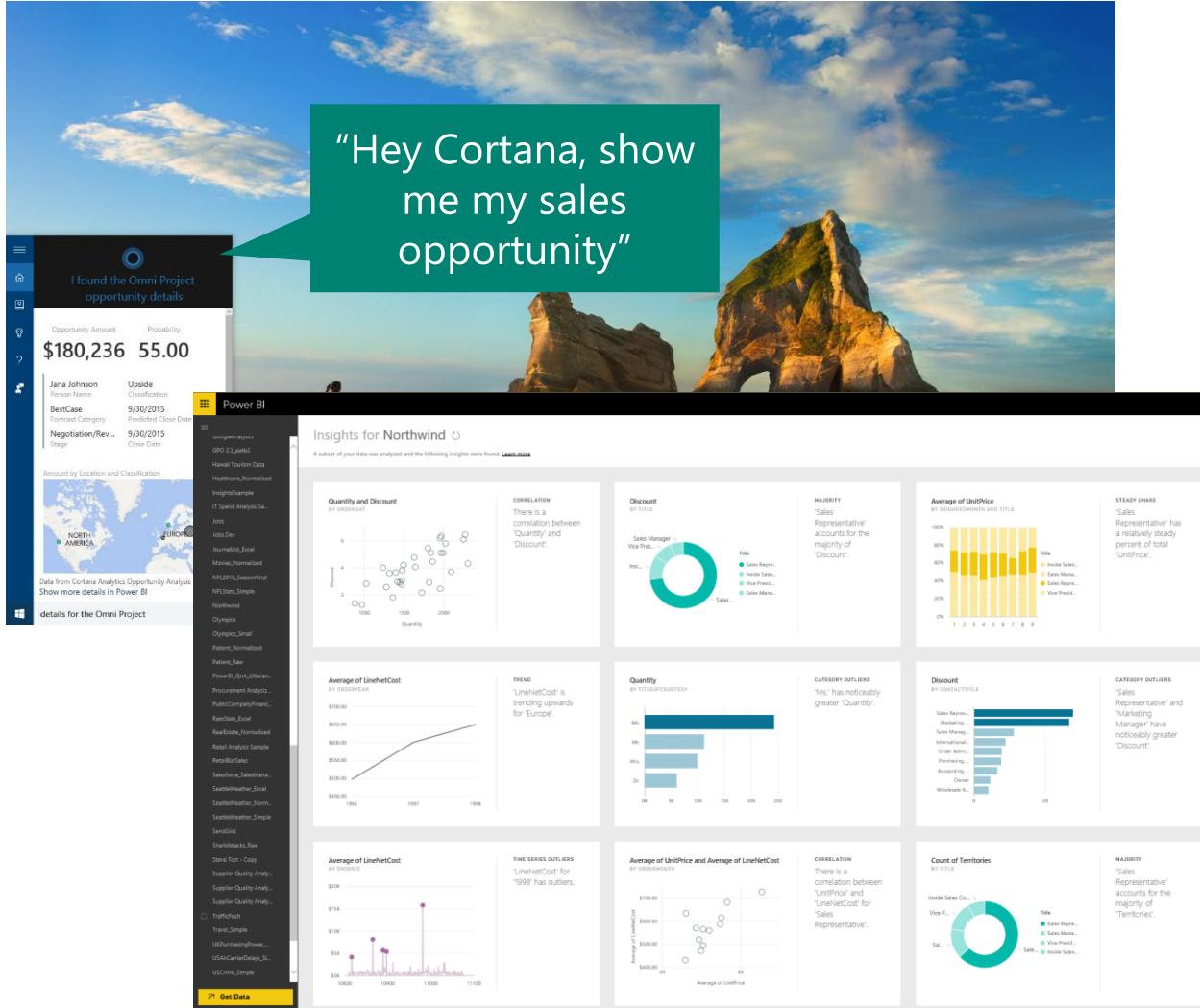
Integrate external data feeds to add value to device data, or pull in external information such as weather or market information

Custom dashboards*

Build heat maps and visually track data

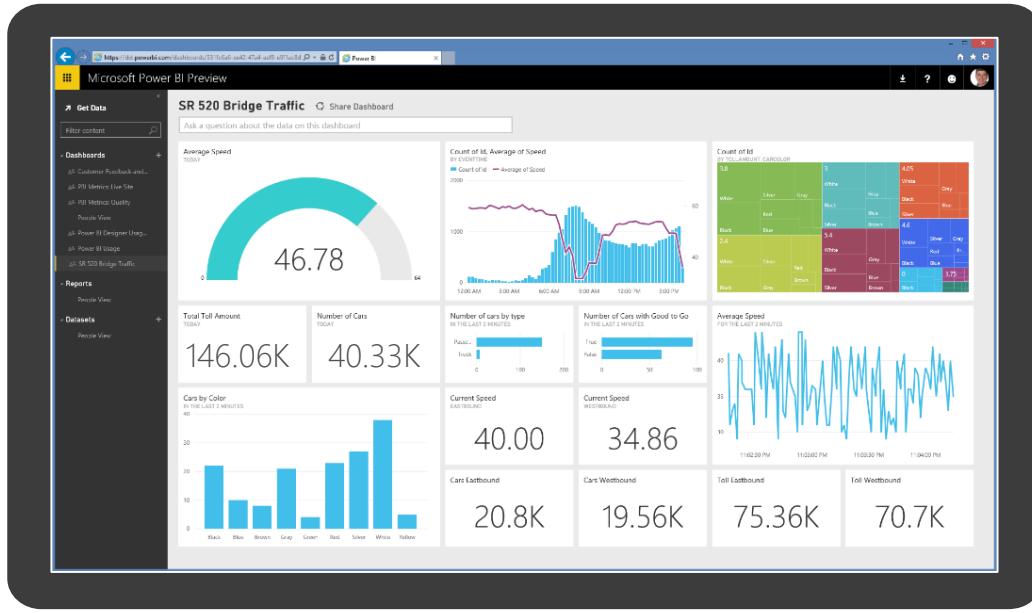
*Power BI subscription required

Experience your data in new ways



- Natural language query—ask questions of your data more naturally
- Cortana integration—allows you to access your data from Windows 10
- Quick insights—auto discover patterns and insights in your data

Live dashboards & reports



- Live dashboards provide a 360° view of your business
- Track your data in real-time with support for streaming data
- Drill through to underlying reports to explore in more detail
- Pin new visualizations and KPIs to monitor performance

Mobile apps



- ➔ Native apps for iPad, iPhone, Android and Windows devices
- ➔ Receive alerts to important changes in your data
- ➔ Share and collaborate with colleagues and take action



Windows



iOS



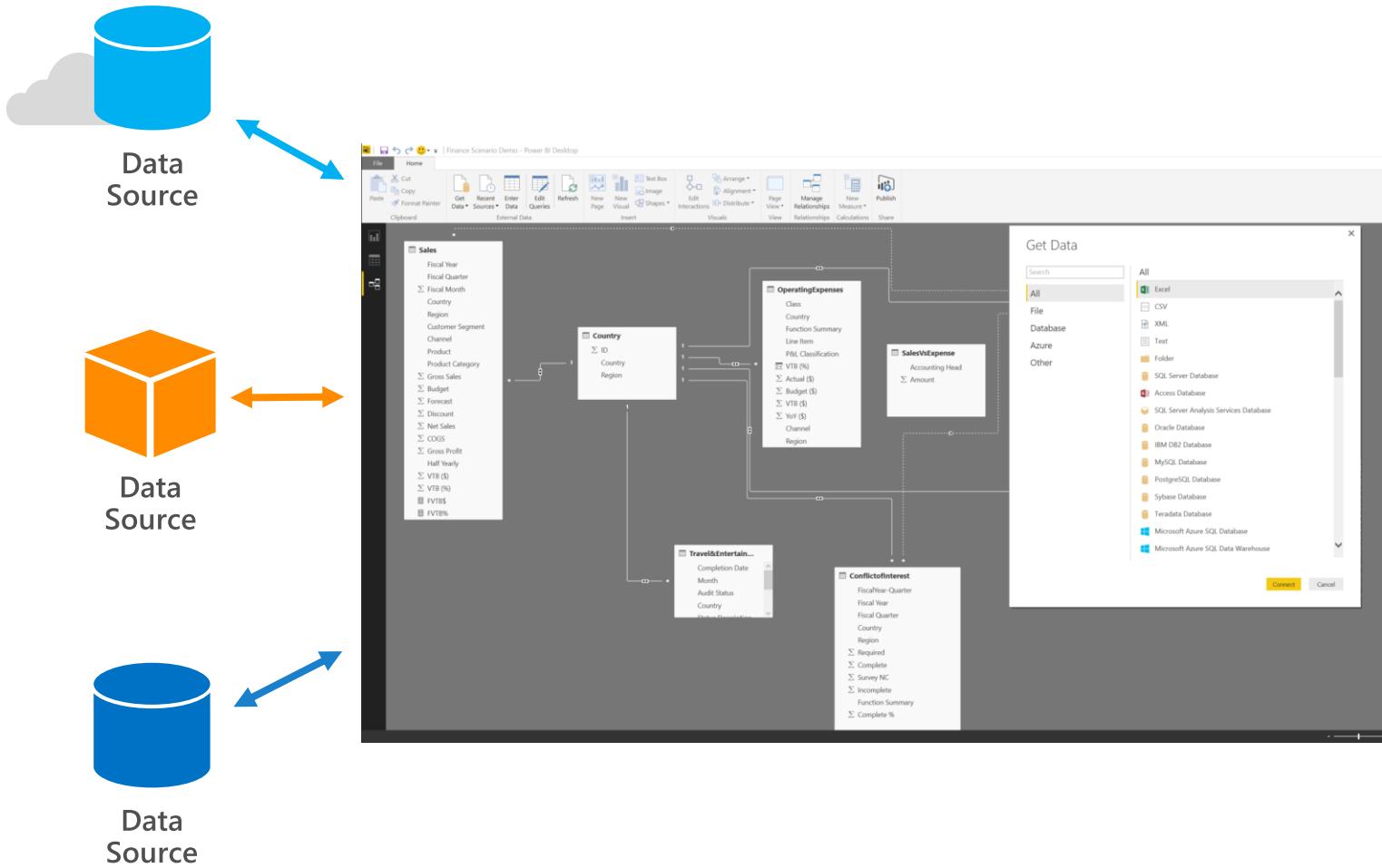
Android



HTML5

Connect to all the data around you

One data preparation experience across Excel & Power BI Desktop



- ➔ **Connect** to a broad range of data across on-premises and cloud
- ➔ **Shape, transform, and clean** data for analysis
- ➔ **Join and model** data from multiple data sources and different types
- ➔ **Extend** your analysis with support for technologies such as R for advanced analytics



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