Microsoft Azure IoT Suite

Technical Scenario: Analyze, Monitor and Act on Data

Nayana Singh
Program Management, Azure IoT, January 2017
Azure IoT Suite: Ready for the enterprise

Secure
End-to-end
From the endpoint, through the connection, to data, applications, and the cloud

Fast
Start in minutes
Preconfigured solutions for the most common IoT scenarios

Open
Connect anything
Any device, OS, data source, software, or service

Scalable
Grow effortlessly
Millions of devices, terabytes of data, on-premises, in the cloud, in the most regions worldwide

From endpoint to insight to action, across the enterprise, and around the world

Magic Quadrant Leader, Business Intelligence and Analytics Platforms

Built on the industry’s leading cloud
38
Announced Azure regions world wide

Hyper-Scale Capacity
3.5 Trillion Messages / Week

12
Azure IoT regions world wide
Elements of Azure IoT Suite

1. Connect and Manage Devices & Gateways
   - Preconfigured solutions
   - Gateway & Devices
   - Connect and control

2. Analyze data & Generate insights*
   - Real time analytics
   - Data visualization
   - Predictive analytics*

3. Integrate into business systems
   - Workflow integration
   - Push and broadcast notifications
   - ID and access management

4. Secure IoT Infrastructure

5. Customize IoT Architecture

* Only applies to predictive maintenance
## Elements of Azure IoT Suite

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Azure IoT Analytics Patterns

**Device**
- RTOS, Linux, Windows, Android, iOS
- On-Device App Analytics
- On-Gateway Analytics

**Collection**
- Gateway
- Ingest, Filter, Send

**Ingestion**
- IoT Hub
- Device Twin
- Routing
- Device Twin

**Stream Analysis**
- Stream Analytics
- Machine Learning
- Event Hub
- Service Bus
- Apache Storm/Spark

**Storage & Batch Analysis**
- Storage Blobs / Tools
- SQL DB / SQL DW
- Document DB
- Data Lake
- Casandra DB

**Presentation & Action**
- Web/thick client dashboards
- Search and query
- Data analytics (Power BI)
- Devices to take action

**Analytics**
- On-Device App Analytics
- On-Gateway Analytics
- In-Cloud Analytics
- In-Cloud Hot-Analytics
- In-Cloud Cold-Analytics
- In-Cloud Analytics
Batch Analytics (Cold Path)

DATA SOURCES
- On-Prem Storage (Ex: SQL Server, Oracle, DB2, MySQL)
- SaaS Data Sources (Ex: SQL Server, Oracle, DB2, MySQL)

INGEST
- Ex: File Upload via IoT Hub

PREPARE
- Batch Data Movement (Ex: SSIS, Azure Data Factory, Sqoop, IoT Hub via File Upload)
- Transform, Combine, Clean, etc.

ANALYZE
- Orchestration, Movement, Scheduling, Monitoring
- Data Aggregation, Data Science, etc.

PUBLISH
- Ex: Azure Data Factory, Oozie

CONSUME
- Presentation, Dashboarding

Cloud Storage
- Ex: Azure Data Lake, Azure SQL DB, Azure SQL DW, HDFS, Cassandra, HBase

IoT Hub
Near Real Time Analytics (Hot Path)

**DATA SOURCES**
- Devices

**INGEST**
- Scalable device data ingestion
  - Ex: Azure IoT Hubs, Kafka, Kinesis

**PREPARE**

**ANALYZE**
- Stream Processing
  - Ex: Azure Stream Analytics, Storm, Spark
- Machine Learning
  - Ex: Azure Machine Learning, Mahout

**PUBLISH**
- Storage
  - Ex: Azure Data Lake, Azure SQL DB, Azure SQL DW, HDFS, Cassandra, HBase

**CONSUME**
- Orchestration, Movement, Scheduling, Monitoring
  - Ex: Azure Data Factory, Azure Function, Oozie

Presentation, Dashboarding
Analytics with IoT Suite preconfigured solutions

* Azure ML

* Machine Learning available with Predictive Maintenance only
Real time analytics
Azure Stream Analytics

Learn more at: https://docs.microsoft.com/en-us/azure/stream-analytics/
## Scenario Examples

<table>
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<tr>
<th>Real-time Fraud Detection</th>
<th>Streaming ETL</th>
<th>Predictive Maintenance</th>
<th>Call Center Analytics</th>
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<td><img src="image1.png" alt="Real-time Fraud Detection" /></td>
<td><img src="image2.png" alt="Streaming ETL" /></td>
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<td><img src="image12.png" alt="Real-time Marketing" /></td>
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</table>

...and many more...
## Azure Stream Analytics

- **Uncover insights in real time**
  - Perform low latency analytics across multiple data streams

- **Rapid development**
  - Use simple SQL syntax to develop and deploy powerful analytics

- **Extensive out of the box integrations**
  - Ready integration with Blob Storage, ML, Power BI, Service Bus etc,

- **Fully Managed**
  - No maintenance. No performance tuning. Zero upfront costs

- **Enterprise Grade**
  - Guaranteed event delivery, auto recovery and 3x9s availability

- **Hyperscale**
  - Distributed architecture can analyze millions of events a second
Streaming Pipeline

- **Event production**
- **Event Queuing & Stream Ingestion**
- **Stream Analytics**
- **Storage & Batch Analysis**
- **Presentation & Action**

- **Applications**
- **Devices & Gateways**
  - IoT Hubs
  - Service Bus Topics/Queues
  - Worker Role
  - Automation to kick-off workflows
- **Event Hubs**
- **IoT Hubs**
- **Blobs**
- **Reference Data**
- **Machine Learning**
- **PowerBI**
- **Real-time dashboard**
- **Archiving for long term storage/batch analytics**
- **Data Lake, Document DB, SQL DB/DW, ...**
Write powerful analytics using SQL like language

Advanced job monitoring
Rich visual tooling to debug queries and monitor jobs

Real time data enrichment
Easily join and score streaming data with static reference data or function call-outs.

Out of order and late arrival policies
Account for lag among gateways or sensors through simple configurations and settings
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
Predictive Analytics
Azure Machine Learning

Learn more at: https://docs.microsoft.com/en-us/azure/machine-learning/
Microsoft Azure Machine Learning
Built for a cloud-first, mobile-first world

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<th>Integrated</th>
<th>Collaborate</th>
<th>Deploy in minutes</th>
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<td>No software to install, no hardware to manage, and one portal to view and update.</td>
<td>Simple drag, drop and connect interface for Data Science. Tested algorithms, integrated R and Python support.</td>
<td>Share workspace to collaborate across the globe. View run history and past results.</td>
<td>Operationalize models in the cloud with a single click. Monetize in Machine Learning Marketplace.</td>
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Steps to Build a ML Solution

1. De/Refine business problem
2. Extract data
3. Develop model through iterations
4. Deploy model
5. Monitor model's performance
Integrated predictive analytics

Empower with proactive analysis

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

Predictive Maintenance Warning
Scheduled Maintenance Alert – Asset Sensors Indicate Critical Failure in (6) Days.
Common Classes of Problems

Classification

Regression

Recommenders

Anomaly Detection

Clustering
Azure Machine Learning Ecosystem

Provision Workspace

- Get Azure Subscription
- Create Workspace

Build ML Model

- Get/Prepare Data
- Evaluate Model Results
- Build/Edit Experiment
- Create/Update Model

Deploy as Web Service

- Publish Web Service

Publish an App

- Azure Data Marketplace

http://Azure.com/ml

https://Studio.azureml.net
http://gallery.azureml.net

https://datamarket.azure.com/browse?query=machine+learning
Azure ML Samples

Classification

Regression
Azure ML Samples

Clustering

Recommender

Anomaly Detection
R/Python/SQL

- Most popular data science languages supported!
- R
  - Execute R Script module
  - Create R model
  - Custom R modules
- Python
  - Execute Python Script
- SQL
  - Apply SQL Transformation
AML - Drag & Drop + Best in Class Algorithms
Data Visualization
Power BI

Learn more at: https://docs.microsoft.com/en-us/azure/power-bi-embedded/
Power BI overview

- **SaaS solutions**
  - E.g. Marketo, Salesforce, GitHub, Google analytics
- **On-premises data**
  - E.g. Analysis Services
- **Organizational content packs**
  - Corporate data sources, or external data services
- **Azure services**
  - E.g. Azure SQL, Stream Analytics
- **Excel files**
  - Workbook data and data models
- **Power BI Desktop files**
  - Related data from files, databases, Azure, and other sources

- **Content packs**
- **Natural language query**
- **Sharing & collaboration**
- **Live dashboards**
- **Visualizations**
- **Reports**
- **Datasets**
- **Data refresh**

### Power BI Desktop

- Prepare
- Explore
- Report
- Share

### Power BI REST API

```
{ 
  "name": "String",
  "columns": [ 
    { 
      "name": "String",
      "data_type": "String"
    }
  ]
}
```
Power BI Embedded

Manage in a familiar environment - Azure

- Manually or programmatically provision workspaces
- Create datasets and reports
- Embed reports in your app
- Control refresh behavior and credentials
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

*This is for Power BI embedded. More customizations are available with full Power BI.
PCS: Predictive Maintenance azureiotsuite.com
Predictive Maintenance workflow

- **Web Job**
  - Simulated Device

- **IoT Hub**
  - Consumer Group

- **Azure Stream Analytics**
  - Job 1 Device Info
  - Job 2 Telemetry

- **Azure Storage (Blob)**
  - RUL Output
  - Telemetry History
  - Input Dataset

- **Web App**
  - Dashboard
  - Device Portal

- **Document DB (Device Registry)**

- **Web Job**
  - Event Processor Host

- **Azure ML**
  - Training Data
  - Trained Model

- **Event Hub**
Demo Summary

- Azure IoT Hub sends data to Azure Stream Analytics
- Edits jobs in ASA (Streaming versus Reference Data)
- Using Azure ML to calculate the Remaining Useful life of the engine
- Sinking data from ASA to AML
- Sinking streaming dataset from ASA to Power BI
- Visualizing data in PowerBI
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Get started today

Go to www.InternetOfYourThings.com

Connect with your regional IoT team

View Preconfigured Solution Demo

Select a partner

Get Started Now

Explore IoT Documentation tab on Azure.com

Send Feedback
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