Securely Connecting and Managing Industrial IoT Devices at Scale

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Industrial IoT Market

Focused on next-generation manufacturing that generates a convergence between industry, business, and internal functions and processes.

<table>
<thead>
<tr>
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<th>Industrie 4.0 in Germany</th>
<th>Society 5.0 in Japan</th>
<th>Made in China 2025</th>
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</thead>
<tbody>
<tr>
<td>Trends</td>
<td>Mass production ↓ Mass customization</td>
<td>Buy ↓ Lease</td>
<td>Pay upfront ↓ Pay as you go</td>
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The Industrial Revolution

1st: Mechanization, water power, steam power

2nd: Mass production, assembly line, electricity

3rd: Computer and automation

4th: Cyber physical systems
Industrie 4.0
What’s changed?

• Increasing need to optimize and predict system performance

• Need for geographically scattered assets that function together as a system

• Scalable systems that support a growing volume of instrumentation and data accessibility

• Improve security of devices and systems

• Integrate multiple protocols and standards

• Solutions require a mix of legacy and newer equipment including intelligent sensors and actuators
Challenges

- Security
- Downtime
- Legacy Equipment
Challenge: Brownfield Environments

IT Systems
- CRM
- Asset Management
- ERP
- Supply Chain
- Finance
- Maintenance
- Compliance

Enterprise (IT)  Operations (OT)

Various Protocols
SCADA, DCS, etc.
Opportunities

IoT Drives Manufacturing Innovation

Here-and-now Real-time Remote Monitoring

Predictions, Machine Learning, and Edge AI

Smart Factory Closed Loop Automation and Intelligence

- Event-based digital monitoring for optimized operations, stock handling, improve OEE, and reduce MTBR
- Automated alerting connected to ERP, Asset and operational services to create fully automated, data-driven operations
- Data logging and analytics platform. Integrated data types reduce MTBF and optimize productivity
Popular Industrial IoT Use Cases

Predictive Maintenance

Predictive Quality

Asset Condition Monitoring
ISA 95 & ISA 99 Industrial Edge Architecture

L5 Cloud
L4 ERP/SAP
L3 MES
L2 AB CIP Protocol/Modbus/OPC/Other Industrial Protocols
L1 PLC
L0 Industrial Equipment

AWS IoT
Telemetry channel (MQTT)
File channel (HTTPS)
Greengrass on Industrial Gateway

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Use Case

Predictive Maintenance

Understand current health of equipment and predict machine failure before business operations is impacted

- Ingest sensor data from PLC’s, MES and Vision Systems
- Improve performance in the factory by monitoring OEE
- Monitor condition of factory machines
- Detect equipment anomalies Kinesis with and trigger notifications with SNS
- Predict equipment failure using advanced analytics with SageMaker
- Run ML models at the edge with Greengrass ML inference
- Filter data at the edge so that all the data does not need to be sent to the cloud
- Visualize and report on Equipment Time to Failure and Predictive Maintenance using dashboards
Problem

An Oil and Gas company had the inability access their IoT data. Other business units within the enterprise owned and controlled the assets in the field and while many had IoT data, they were not in a position to have that data leave their on-premise environment.

Solution

By using AWS IoT, this customer is able to preprocess the IoT data coming from their field assets, enrich that data with various internal and external data sources, and provide a time-series optimized data store. This empowers their in-house data science team to build and train machine learning models on top of data sets derived from the data store.

Impact

The customer’s goals were to validate their hypothesis that IoT data, with proper analysis, provides meaningful value to the enterprise. In the near future, the customer expects to take the anomaly detection models they authored and test them for deployment at the edge.
Use Case
Predictive Quality

Quickly pinpoint product quality issues related factory output, rather than equipment performance

- Ingest industrial sensor data from PLC’s, MES, and Vision Systems
- Ingest quality data (Inspection Images) into S3
- Improve product quality and uptime in the factory by monitoring OEE
- Monitor quality of finished products using Vision Systems
- Use streaming analytics to detect quality anomalies and trigger notifications
- Use advanced analytics to analyze product quality images to detect and predict quality issues
- Analyze product quality at the edge using Greengrass ML Inference
- Visualize and report on product quality using dashboards
Predictive Quality Architecture
Predictive Quality Architecture with AWS IoT Analytics
Problem
Valmet delivers technology and automation with multiple dependent processes running in parallel. Data analytics is needed to optimize Valmet’s customers’ processes.

Solution
Valmet is building a new digital twin capability to allow paper mill operators view equipment and process data during production runs. AWS IoT Analytics is at the core of this solution training ML models for paper quality forecasting and scheduling metrics generation for digital twin view-generation.

Impact
AWS IoT Analytics allows Valmet to combine historical models of equipment performance with live data from current operations to glean insights that help them to further provide solutions that enable their customers to produce paper with lower costs and optimum quality.
Use Case

Asset Condition Monitoring

Monitor and scale industrial equipment and understand asset condition for one or more monitored parameters of assets

- Ingest sensor data from PLC’s, MES, and Vision Systems
- Improve performance in the factory by monitoring OEE
- Monitor condition of factory equipment through sensor data—temperature, vibration, error codes, etc.
- Filter data at the edge so that all the data does not need to be sent to the cloud
- Use streaming analytics to detect condition anomalies and trigger notifications
- Build ML Models in SageMaker to detect and predict equipment condition deterioration and failure
- Analyze Vibration and other sensor data at the edge with Greengrass ML
- Visualize and report on equipment condition using dashboards
Condition Monitoring Architecture with AWS IoT Analytics

- **AWS IoT Analytics**
  - IoT Rule (alerts)
  - IoT Rule (all data)
  - AWS IoT Analytics
  - AWS IoT/Greengrass/Device Management/Device Defender

- **MES/SCADA**
  - Protocol conversion
  - Greengrass

- **Factory Machines**
  - Protocol conversion

- **Vision**
  - Protocol conversion

- **Pinpoint**
  - Email
  - SMS

- **Amazon QuickSight**
  - Jupyter Notebook

Other AWS services and components include:
- **IoT Cert**
- **Cognito**
- **CloudTrail**
- **CloudWatch**
- **IAM**

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Problem
A Global Mining Company was looking to measure rough roads on mines as potholes can cause damage to mining equipment that is extremely expensive. The Mining Company was looking to understand the degradation of mining equipment, such as Excavators.

Solution
The Global Mining Company turned to AWS to place gateways and vibration sensors on trucks. The customer collects data from equipment, which allows them to identify potholes and other problems on mining routes that can contribute to equipment degradation.

Impact
AWS IoT allows the Global Mining Company to continuously monitor equipment status, health, and performance to detect issues in real-time. It also helps the company detect road issues and identify equipment degradation over time to minimize unexpected downtime.
Industrial IoT Use Cases and Solutions

- Adds real time contextualization to the sensor payload from external sources
- Provides tools to identify correlation factors and to predict device failure
- Visualizes the anomaly with your devices for you to proactively remediate issues
## Industrie 4.0 Tenets and Why AWS?

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<td>Interoperability</td>
<td>Local AWS Lambda with AWS Greengrass to integrate protocol other than MQTT &amp; HTTP</td>
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<td>Virtualization</td>
<td>AWS IoT Shadows work in both local AWS Greengrass and the AWS Cloud with thing types and custom attributes</td>
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<td>Decentralization</td>
<td>Leverage 11 AWS Regions to subscribe to AWS IoT topics using selective rules</td>
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<td>Real-Time Capability</td>
<td>AWS Greengrass achieves lower latency with local devices to support critical automated decision making for mission critical industrial use cases</td>
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<tr>
<td>Service-Oriented</td>
<td>Multiple layers of AWS Lambda functions addressing increasingly deeper layers that can be orchestrated with AWS Step Functions invoked by AWS IoT or Amazon API Gateway</td>
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<td>Modularity</td>
<td>AWS Greengrass for a hybrid end-to-end process with local real-time processing and cloud agility for stream processing, analysis and archival</td>
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<td>Security</td>
<td>AWS IoT Device Defender secures your fleet of industrial devices by continuously auditing the security policies associated with your devices to ensure they are secure at all times</td>
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<td>Analytics and Insight</td>
<td>AWS IoT Analytics cleans, filters, transforms, and enriches IoT data before storing it in a time-series data store for analysis and advanced analytics</td>
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<td>Lifecycle Device Management</td>
<td>AWS IoT Device Management makes it easy to securely onboard, organize, monitor, and remotely manage industrial devices at any scale</td>
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What Sets AWS Industrial IoT apart?

<table>
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<td><strong>Industrial IoT Vision</strong></td>
<td>Reference architectures built for popular industrial use cases so you can quickly get started</td>
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<td><strong>Service Breadth and Depth</strong></td>
<td>AWS IoT services allow you to gather data from, run sophisticated analytics on, and take actions in real-time on your diverse fleet of IoT devices from edge to the cloud</td>
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<td><strong>Security</strong></td>
<td>Built-in device authentication and authorization to keep your IoT solutions secure. Continuously audit policies associated with your devices, monitor your device fleet for abnormal behavior, and receive alerts if something doesn’t look right. You can even take corrective actions</td>
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<td><strong>Scalability</strong></td>
<td>Reliably scale to billions of devices and trillions of messages</td>
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<td><strong>IoT Analytics and Machine Learning</strong></td>
<td>Sophisticated analytics including pre-built machine learning models for common IoT use cases, and machine learning inference at the edge capabilities</td>
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<td><strong>Partner Network and Community</strong></td>
<td>Rich ecosystem of technology and consulting partners such as Intel, TI, Microchip, Bsquare, C3 IoT, Splunk, and Accenture</td>
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<td><strong>Trusted and Proven</strong></td>
<td>Customers such as Pentair and Kemppi have achieved business outcomes such as increased revenue and faster time to market</td>
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Thank You!