OSIsoft Technologies for the Industrial IoT and Industry 4.0

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Industry 4.0

Industry 1.0

1. End of 18th century
   Use of water and steam power to run mechanical production facilities

Industry 2.0

2. Beginning of 20th century
   Use of electrical power to enable work-sharing mass production

Industry 3.0

3. Early 1970s
   Use of electronics and IT to automate production

Industry 4.0

Today
   Use of cyber-physical systems to monitor, analyze, and automate business

Digital Transformation

Source: www.saphanatutorial.com
Industry 4.0 Drives Digital Transformation

- Operational Excellence
- Product Innovation
- New Services
- Reduce Costs
- Increase Revenue

Digital Transformation
OSISFT’S 8 ENABLERS OF INDUSTRY 4.0

1. Real-time connectivity and monitoring
2. Analytics ready historical data
3. Open access to real-time and historical data for reality development
4. Cloud based data exchange and Web based connectivity
5. Three decades of hardening against security threats
6. End to end connectivity from edge devices to analytics applications
7. 450+ options for real-time, historical, and transactional data connectivity
8. Seamless data transfer between on-line and off-line systems and asset analytics

Boston Consulting Group (BCG)
“Smart Manufacturing (SM) is integrating network-based data and information that comprises the real-time understanding, reasoning, planning and management of all aspects of a manufacturing and supply chain enterprise.”

“The goal is to build a cloud-based, open-architecture platform that integrates existing and future plant level data, simulations and systems across manufacturing seams and orchestrate business real time action.”

Source: SMLC Membership Information Brochure
“Connecting people with sensor based data in ways that were **physically** or **economically** unrealistic before”
What’s Driving the Industrial IoT?

- **Quantity**
  - $↓
  - Sensors

- **Capability**
  - $↑
  - Hardware

- **Availability**
  - $↓
  - Connectivity

**Note:** The $ symbol might indicate cost or financial aspects related to the components.
Interest in IoT is Enormous
IoT is Driving Innovation Across the Industrial World
There are Inherent Risks and Challenges

Data Silos
Data Ownership
Data Context

Assets
Automation Systems
Edge Devices / Sensors
Traditional PI System Architecture

On Premises

PI System Data Infrastructure

Native PI Clients

3rd Party Applications

3rd Party Applications

Native PI Clients

Automation System

Automation System

Automation System

Automation System

3rd Party Applications

Native PI Clients

Sensor

Sensor

Sensor

Sensor

Asset

Asset

Asset

Asset

PLC

Sensor

Sensor

Sensor

Sensor
OSIsoft Industrial IoT Architecture for the Enterprise

3rd Party Cloud Services/Apps

PI System Data Infrastructure

Automation System

Open Edge Module

OMF App

Gateway

Edge Data Store

PI Connector

3rd Party Cloud Services/Apps

On Premises

Edge

3rd Party Cloud Services/Apps

Cloud

On Premises

Smart Sensor

PLC

Asset

Sensor

Asset

Sensor

Asset

Sensor

Asset

Sensor
Extending the Time Series Infrastructure from the Edge to the Enterprise

IoT Solution 1

IoT Solution 2

IoT Solution 3

IoT Solution 4

IoT Solution 5

Connectivity Platform

M2M Platform

Enterprise Operations Infrastructure

Assets

Automation Systems

Edge Devices / Sensors

IoT solutions
1. Accessing all Operations Data
2. Supporting the largest deployments
3. PI Vision
4. Supporting fleet-wide Questions & Queries
5. OSIsoft Cloud Services
Ensuring no matter where your operational data resides, there are OSIsoft technologies available to collect and store this data.
Pervasive Data Collection Architecture

Enterprise PI Server

- On Premises
- DMZ
- Edge

PI Connector Relay

- PI Connector
- PI Connector
- Open Edge Module
- OMF Application

PI Connector Relay

- PI System
- Edge Data Store
- Edge Data Store

Windows
Linux
Linux / RTOS
Any OS

Assets
Automation Systems
Edge Devices
Sensors

Remote Assets
Edge Devices
Sensors
PI Connector Relay Architecture Enhances Security and Network Flexibility for IIoT Data Patterns

Data buffering
Data filtering
Data compression

X.509 Certificates

PI Server Security (WIS)
PI Connectors for Linux Add Connectivity for Remote and Mobile Assets

Data buffering
Data filtering
Data compression

X.509 Certificates

PI Server Security (WIS)

Remote Network
DMZ
Corporate Network

Enterprise PI Server

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Built for Purpose Storage, Access and Calculations for Edge Devices

Edge Data Store → PI Connector Relay → Enterprise PI Server

Data storage
Data access
Calculations
Data filtering
Data compression

X.509 Certificates

Remote Network → DMZ → Corporate Network

Data buffering

PI Server Security (WIS)

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Edge Data Store Components

- **OMF Application**
- **Edge Connector**
  - Data Access
  - Data Storage
  - Calculations
  - Relationships

**PI / OCS Connectivity**

**PI Connector Relay**

**Enterprise PI Server**
- Data buffering
- X.509 Certificates
- PI Server Security (WIS)

**Networks**
- **Remote Network**
- **DMZ**
- **Corporate Network**
Edge Device Connectivity for the Open Source Community

Open Edge Module

PI Connector Relay

Enterprise PI Server

Remote Network

DMZ

Corporate Network

Input API
Data buffering
OMF Message Generator
SAS Tokens

PI Server Security (WIS)
OMF Extends Remote Asset Connectivity Through Partner Enablement
Data Collection Management

On Premises

DMZ

Edge

Enterprise PI Server

Applications

Admin

PI Connector Relay

PI Connector Admin Server

PI Connector Relay

PI Connector

PI Connector

Open Edge Module

OMF Application

PI Connector

PI Connector

Edge Data Store

Edge Data Store

PI System

Edge Devices

Sensors

Remote Assets

Edge Devices

Sensors

Assets

Automation Systems

Edge Devices

Sensors

Windows

Linux

Linux / RTOS

Any OS

Windows

Windows

Linux

Any OS

Any OS
Data Collection Management

On Premises

DMZ

Enterprise PI Server

Applications

Admin

PI Connector Relay

PI System

Edge Data Store

Edge Data Store

Remote Assets

Edge Devices

Sensors

Assets     Automation Systems    Edge Devices  Sensors

Windows

Linux

Any OS

OSIsoft.
Edge Analytics Appliance Using Embedded OSIsoft Technology
Micro Modular Data Center Monitoring Using Embedded OSIsoft Technology

Dell's Micro Modular Data Center
Presented at SF UC 2017
Remote Asset Monitoring Using Embedded OSIsoft Technology

Before

- Occasional data loss
- Restrictive interface deployment

After

- Data buffering – no data loss
- Flexible connector architecture
- Compression – minimize bandwidth
- Filtering – further minimize bandwidth
- Secured connectivity
Evolution of the PI System

Expand
Increase the volume & velocity of operations data

Extend
Associate quality information with measured values

Ease
PI system tools designed to work across the enterprise
Performance and Scalability

Expand

Increase the volume & velocity of operations data

- 2010: Millions of AF elements
- 2014: Asset Analytics – 10x PE
- 2015: Concurrent Recalculation
- 2016: Notifications – 100x
- 2017: New SQL Architecture
  100M+ event frames
- 2017: Future data
- 2009: AF High Availability
- 2007: Data Archive High Availability
- 2012: Data Archive – ~5x throughput
  AF SDK – ~4x throughput
Data Quality

Extend

Data Collection

Collect quality information from source systems

Storage

Natively associate quality information with data

Asset Analytics

Calculations take into account quality of inputs

Developer Technologies

Ingress and egress of data with quality via programmatic means

Visualization

Display data with quality information

Associate quality information with measured values
Management and Administration

Ease

PI system tools designed to work across the enterprise
Application Integration
Windtopia

GE09

Manufacturer: GE

Operating Status: Load Operation

Actual Power: 930.53 kW

Temperatures:
- Nacelle: -10.491 °C
- Gen 1: 9.7192 °C
- Gen 2: 10.563 °C
- Bearing A: 25 °C
- Bearing B: 0.74656 °C
- Gearbox: 62.555 °C
- Tower: -17.778 °C

Blade Angle:
- Blade1 Set Value: 0.13381 °
- Blade1 Actual Value: -0.4704 °
- Blade2 Set Value: 0.076093 °
- Blade2 Actual Value: -0.4704 °
- Blade3 Set Value: 0.16462 °
- Blade3 Actual Value: -0.4704 °

Wind Speed: 10.695 m/s

Rotor Speed: 19.73 rpm

Line Frequency: 59.972 Hz

Grid Data:
- Phase Amps:
  - L1: 905.25 A
  - L2: 894.7 A
  - L3: 886.55 A
- Phase Volts:
  - 326.81 V
  - 323.83 V
  - 326.81 V

Nacelle:
- Position: 20 °
- Revolution: 1.5167 °

Torque:
- Set Value: 62.537 Nm
- Actual Value: 64.104 Nm
Big Data Projects Are Attractive… But There Are Challenges

64% of large enterprises plan to implement a big data project. 85% will be unsuccessful.

Data cleansing and preparation tasks can take 50-80% of the development time and funds.

Source: Harvard Business Review
Data Delivery to Analytics Applications

Source: the PI System

PI Integrators
- Cleanse
- Augment
- Shape
- Transmit

Target: Analytics Packages
- Visual Analytics
- Data Warehouses / Lakes
- Streaming Analytics
PI Integrators for Advanced Analytics

Visual Analytics
- Excel
- Spotfire
- Cognos
- Tableau
- Power BI
- SAP Lumira
- QlikView

Data Warehouse / Data Lake
- SQL
- Microsoft SQL Server
- Oracle 12c
- SAP HANA

Streaming Analytics – 2017
- IoT Hub
- Machine Learning
- Spark
- Kafka
- Stream Analytics
OSIsoft Partner’s Analytics Application
The Four Components of our Cloud Strategy

- **Integrate** with other Cloud Platforms
- **Offer** Hosting Services for the PI System
- **Make** the PI System more serviceable
- **Deliver** native, complementary Cloud Services
Overview

OSIsoft Cloud Services

- Secure, Distributed, Multi-tenant platform
- Maintained & Managed by OSIsoft
  - Developed on Microsoft Azure
- Complementary to PI Systems on premises
  - Easily share your PI data
  - Leverage new technologies (Big Data, ML...)
An Infrastructure Approach

- Sign-up Provisioning
- Security Authentication
- Logging Telemetry
- Scale out

Cloud Services Infrastructure
An Infrastructure Approach…

First Commercial Offering

Cloud Connect

Cloud Services Infrastructure

Data Queuing

Data Sharing Broker
Extending the Platform

Cloud Connect

Cloud Services Infrastructure

Data Ingress
Data Persistence
Data Calculations
Data Visualization
Adding New Offerings

More Commercial Offerings

Cloud Connect

Data Sharing

Display Sharing

Cloud Services Infrastructure
Enable Partners and App Providers

Cloud Connect  Data Sharing  Display Sharing  Partners Apps

Cloud Services Infrastructure

Developer Toolkit
OSIsoft Cloud Services

- Expertise Providers
  - ELEMENT ANALYTICS®
  - falkonry

- Business Partners
  - esri
  - SAP®

- Service Providers
  - Outotec
  - PetaSense

- Business Partners
  - BP
  - EP

- Control Hardware
  - SP

- IT Hardware

- Other Operational Data
  - Facilities
  - Logistics

Customer A
- Plant

Customer B
- Plant

Customer C
- Plant

Enterprise

Process Equipment

Control Hardware

IT Hardware

Other Operational Data
Questions

Please wait for the microphone before asking your questions

Please state your name & company

Please don’t forget to…

complete the Post Event Survey
Thank You