The PI System, Microgrids and Architecture

Chuck Wells
Industry Principal, Microgrids
OSIsoft
Discussion Topics

• Overview of OSIsoft PI System
• Microgrid Architectural Considerations
• Cybersecure Deployment Patterns
• Conclusions
A LITTLE BIT ABOUT THE PI SYSTEM
What is the PI System?

- Measure & store time series data, especially sensor based information
- Maps data from physical assets to logical abstractions (PI Tags and AF Elements)
- Moves streaming data and events (payload) from sensors (through control system gateways or some aggregator or head end systems), through networks, to infrastructure based services provided by the PI System:
  - analysis, notifications, pre/post processing, trending, alerting, event framing, etc.
- Delivers the raw & mapped data to users via
  - Visualization & Presentation - native client, MS Office, SharePoint, MS SQL Server Stack
  - Applications - Data Access Services
  - Integration - ERP’s (Business Process)
  - Datamarts, BI systems (correlate sensor data with parametric, transactional data)
  - Trans enterprise data exchange (e.g. Demand Response in the utilities market.)
- Span the City’s domain of physical infrastructures, scales and adapts to evolving strategic mandates, and supports multiple use cases over time -> Value Now, Value Over Time...
Typical Data Flow

Data Sources → Interface Node → PI Server → Interface Buffer → Client Stations, Internet Stations
Logical Architecture Diagram

Data Center
- Enterprise Systems
  - ERP
  - Asset Management
  - Fleet Management
  - Trading
  - Planning
- Central Servers
  - Visualization
  - BI and BAM
  - Operations Information
- PI Enterprise Gateway
  - EAM
  - AMI@SAP

Corporate/Enterprise Clients using RtPortal
- ProcessBook
- DataLink
- RtWebParts

Corporate LAN/WAN

Analytics & Notifications
- AF Advanced Computing Engine
- PI Notifications

Visuals
- RTPortal Server
- Smart Clients
  - ProcessBook
  - DataLink
  - Thin Clients
  - PI WebParts
  - PI Views (SAP)

Third Party Application Servers
- Data Left in Place

PI Server (or Collective)

AF Server
- PI Interface Nodes
- Secure LAN

LAN
- Head End System
- MV-90 Data
### OSIsoft Industries & Customers

<table>
<thead>
<tr>
<th>Sector</th>
<th>Description</th>
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<tbody>
<tr>
<td>Power &amp; Utilities</td>
<td>OSIsoft is ranked 1st in the power industry</td>
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<tr>
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<td>DTE Energy, PSE&amp;G, Entergy, British Energy, Iberdrola</td>
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<td>Oil &amp; Gas</td>
<td>100% of the global Top 10 producers use the PI System</td>
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<td>BP, Shell, Chevron, ExxonMobil, Pemex, Total, Petrobras</td>
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<td>Chemicals &amp; Petrochemicals</td>
<td>40 of top 50 Chemical Companies rely on the PI System</td>
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<td>Dow Corning, Eastman Kodak, Cytec, Rhodia</td>
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<td>Pharmaceuticals, Food &amp; Life Sciences</td>
<td>14 of the top 15 Life Sciences companies use the PI System</td>
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<td>Amgen, Bayer, Merck, Allergen, Johnson &amp; Johnson, Roche</td>
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<td>Materials, Mines, Metals &amp; Metallurgy</td>
<td>10 of the top 14 global MMM corporations use the PI System</td>
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<td>Cemex, Cargill, BHP Billiton Yabulu, Codelco</td>
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<td>Pulp &amp; Paper</td>
<td>9 of the top 10 Pulp and Paper companies use the PI System</td>
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<td>Abitibi, Cascades, Inc., International Paper, Kimberley-Clark, OJI Paper</td>
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<td>Critical Facilities, Data Centers &amp; IT</td>
<td>Innovative use of PI System to monitor complex IT environments</td>
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<td>Microsoft, US Army, Cisco Systems</td>
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MICROGRID CONSIDERATIONS
Definition of Microgrid

• The term “microgrid,” is defined as a group of interconnected loads and distributed energy resources (DER) within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and can connect and disconnect from the grid, operate in grid-connected or island mode.

DOE, FOA 0000997
Key drivers for microgrids

• Provide higher power quality for customers
• Reduce cost of energy
• Sell ancillary services to ISOs and area EPS
• Help support higher renewables (up to 100%)
• Sell carbon credits (California Cap and Trade)
Solar intermittency in microgrids (summer)
Baseline Thoughts

• Typical Microgrids can be:
  – Large factories with internal power generation
  – Large industrial, commercial or other critical facilities/complexes with backup power generation such as:
    • Universities
    • Hospitals
    • Data Centers
UCSD Microgrid

• 12 PMUs
  – Six installed
    • 2 SEL 351a
    • 3 Arbiter 1133a
    • 1 FNET (UT)
  – Six additional PMUs installed on campus in 2013

• Over 125 buildings
  – > 57,000 assignable rooms
  – HVAC system by Johnson Controls
  – Additional metering by Schneider Electric
  – ~ 45,000 PI tags (18 months of data, 32 TB of disk)

• Over ~900 vehicles on campus, 1/3rd small electric carts
  – 26 new Level II charging stations being installed (RWE)
  – 25 new Level II charging stations being installed by Ecotality
  – 3 DC Fast chargers being installed (RWE)
Example
Cyber Secure Synchro Phasor (CSSP)
Jacobs School of Engineering
Architecture Overview
UCSD Architecture Overview: Connection to higher level systems

- PI to PI
- PI to ICCP
- PI to DNP3

Data Access:
- ActiveX/COM
- Web Services
- OPC DA/HDA
- OLEDB
- JDBC
- ODBC
CYBERSECURITY AND OSISOFT
<table>
<thead>
<tr>
<th>Healthy Tension</th>
<th>Role 1</th>
<th>Role 2</th>
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<tbody>
<tr>
<td>Role 1</td>
<td>Doing the “right things”</td>
<td>Doing “everything right”</td>
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<tr>
<td>Role 2</td>
<td>Building innovative features</td>
<td>Making sure the product works</td>
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<tr>
<td>Role 2</td>
<td>Generating user value</td>
<td>Preventing bad surprises</td>
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<td>Role 2</td>
<td>Writing a sustainable product architecture</td>
<td>Creating a sustainable infrastructure</td>
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<td>Role 2</td>
<td>Planning for future capabilities</td>
<td>Identify current/future threats</td>
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<td>Role 2</td>
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<tr>
<td>Role 2</td>
<td>Focused on Functionality</td>
<td>Focused on Reliability</td>
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Focused on Functionality

Focused on Reliability

Software Developer in Functionality

Software Developer in Reliability

QUALITY
OSIsoft SDL Leadership

• 4 Security Advisors (Core Team)
  – Incident response commanders
• 35 Security Champions
  – Senior Engineers
  – Every product represented
• IT Security Team
• Customer Support Security Team
  – NERC CIP Personnel Surety Program and Procedures
Previous Engagements / Accreditation

• Idaho National Lab
   – 2005 Assessment
   – 2008 vCampus Live!
   – 2009 vCampus Live!
   – 2011 Cooperative Research
   – 2012 vCampus Live!

• Cigital
   – 2013 Defensive Programming (1)
   – 2014 Defensive Programming (4)

• IOActive
   – 2014 Assessment

• Windows Logo Certification
   – 2008 Server Core
   – 2011 Server Core 2008 R2
   – 2012 Server Core 2012

• US Army NetCom
   – 2009 CoN #201006618
   – 2013 CoN (recertified)

• US NRC
   – 2010 DISA, NIST

• SAP QBS Certification
   – 2012 Veracode
   – 2013 Veracode
High Level T&D Architecture

Substation / RTU

Control Center

DMZ

Corporate Access

External Access

Expected Direction of Attack

SCADA/EMS PI Server

PI Coresight Server

Cloud Gateway

PI Cloud Services

PItoPI

Clients

PI Coresight
Pattern 1: DMZ PI
Pattern 2: PI High Availability
Pattern 3: DMZ PI to PI

Control Network

PI Interface Service

Critical Usage

DMZ

PI-to-PI Interface

Data Traffic Only
(no user queries)

Corporate Domain

Desktop Apps
PI ProcessBook
PI DataLink

Web Apps
PI Coresight
PI Notifications
PI WebParts

Web Server

 galvin center
at ILLINOIS INSTITUTE OF TECHNOLOGY

IEEE PES
Power & Energy Society
Pattern 3+: Absolute Enforcement
ESP Conclusions

• Compliance
  – Define “known or suspicious” malicious communication
  – [CIP-005-5 R1.5] Access point firewall with commercial IDS module

• Security
  – Keep web servers and ‘surfers’ out of DMZ
  – Use PItoPI across ESP access point
  – Configure “Read Only” access where possible
    • [Consider absolute enforcement solutions]
What you can expect from OSIsoft

- Attendant threats and mitigations understood
- Increased logging, telemetry and response
- Transport security everywhere
- Data infrastructure and partner you can count on
References

KB00354 - Windows Security Requirements for PI Server
KB00833 - Seven best practices for securing your PI Server
KB00994 - Whitelisting with AppLocker
KB01062 - Anti-virus Software and the PI System
2820OSI8 - Which firewall ports should be opened for a PI Server?
Microsoft Security Patch Compatibility