Improving Distribution Reliability with Smart Fault Indicators and the PI System

Presented by Cameron D. Sherding, Sr. Software Engineer
Profile of DTE Electric

- 12th Largest US electric utility
- 2.2 million customers
- 671 distribution substations
- 46,000 miles of power lines

<table>
<thead>
<tr>
<th>Customer</th>
<th>Count</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1,920k</td>
<td>34%</td>
</tr>
<tr>
<td>Commercial</td>
<td>197k</td>
<td>44%</td>
</tr>
<tr>
<td>Industrial</td>
<td>1k</td>
<td>22%</td>
</tr>
</tbody>
</table>
Business Challenges

Reduce CAIDI = average duration of power outage

1. Ground crews need to locate faults faster
   – Quickly locating the source of these faults is critical to minimizing restoration time
   – Circuit patrol times can take up to an hour

2. Increase visibility of electrical load on circuits
   – Aging substations may be demoed in the near future
   – SCADA is not a cost-effective option
Business Challenge

Patrol times are long when you don’t know where the fault is
Examples of Ground Faults

- Contact with Trees
- Failing Pole Top Transformer
- Failing Underground Cable
Sensors provide visibility into fault location
Downsides with going straight to the cloud

- Data is isolated from other OT data eg: SCADA / EMS / GIS
- Requires training a team on new tools
- Complicates using new sensor vendors in the future
- Project requirements
  - Must host our own data
  - Must integrate with existing systems

Vendor #1
- Tollgrade Aggregator

Vendor #2
- Cooper Aggregator

SCADA / EMS
GIS
AMI
An Infrastructure Approach to using IoT Sensors

Benefits

- Agnostic to sensor providers
- Easily scale from POC to full size deployment
- Seamless integration with backend systems

The Full PI stack at work

- **Collect**: PI Interface for DNP3
- **Store/Contextualize**: PI Server / AF
- **Deliver**: PI Notifications / AF SDK / Esri Arc GIS / Coresight

Tollgrade Aggregator  Cooper Aggregator  SCADA / EMS  GIS  AMI
Advantages of Wireless Sensors vs SCADA

- Capital Expense
  - SCADA is $30K per install
  - Wireless is $5k per installation

- Deployment Time
  - SCADA takes **months** to deploy
    - Requires a shutdown
    - Significant construction
  - Wireless takes **hours** to deploy
    - Can be installed on live wires
    - 1 bucket truck and 2 people
# Web Based Status Dashboard – Outage Response Team

## Normal Conditions

<table>
<thead>
<tr>
<th>Circuit</th>
<th>SFI</th>
<th>Type</th>
<th>X Amps</th>
<th>Y Amps</th>
<th>Z Amps</th>
<th>Status</th>
<th>Fault</th>
<th>Fault Amps X</th>
<th>Fault Amps Y</th>
<th>Fault Amps Z</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALNPK1969</td>
<td>SFI-A0118</td>
<td>Tolgridge</td>
<td>252</td>
<td>234</td>
<td>235</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>ALNPK1671</td>
<td>SFI-A0117</td>
<td>Tolgridge</td>
<td>80</td>
<td>81</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>ALNPK1671</td>
<td>SFI-A0115</td>
<td>Tolgridge</td>
<td>75</td>
<td>73</td>
<td>74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>ALNPK1833</td>
<td>SFI-A0116</td>
<td>Tolgridge</td>
<td>148</td>
<td>0</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>ALNPK1916</td>
<td>SFI-A0113</td>
<td>Tolgridge</td>
<td>218</td>
<td>160</td>
<td>197</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>ALNPK2044</td>
<td>SFI-A0112</td>
<td>Tolgridge</td>
<td>285</td>
<td>229</td>
<td>247</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
</tbody>
</table>

## During Fault

<table>
<thead>
<tr>
<th>PATON8920</th>
<th>SFI</th>
<th>Type</th>
<th>X Amps</th>
<th>Y Amps</th>
<th>Z Amps</th>
<th>Status</th>
<th>Fault</th>
<th>Fault Amps X</th>
<th>Fault Amps Y</th>
<th>Fault Amps Z</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATON8920</td>
<td>SFI-B0168</td>
<td>-83.220885</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Telemetry Error</td>
</tr>
<tr>
<td>PATON8920</td>
<td>SFI-B0161</td>
<td>-83.214560</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Telemetry Error</td>
</tr>
<tr>
<td>PATON8920</td>
<td>SFI-B0162</td>
<td>-83.221136</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Telemetry Error</td>
</tr>
</tbody>
</table>

@osisoft  #OSIssoftUC  © Copyright 2017 OSIsoft, LLC
Historical Data – Engineers/Planners

Display used by engineers

Display used by planners
Outage Map – Service Operations and Dispatch
Outage Map – Engineering and Operations
Project History

2014
- 95 locations
- Proof of Concept

2015
- 600 locations
- AF SDK Map Integration

2016
- 1200+ locations
- Full scale deployment

2017
- 3000 locations
- PI Integrator for Esri ArcGIS
- Underground Fault Detection
- CYME project

Eliminated

6.6M
Customer Outage Minutes

Avoided Spending

$25M
For equivalent SCADA solution

Eliminated 6.6M Customer Outage Minutes

Avoided Spending $25M For equivalent SCADA solution

Eliminated 6.6M Customer Outage Minutes

Avoided Spending $25M For equivalent SCADA solution

Eliminated 6.6M Customer Outage Minutes

Avoided Spending $25M For equivalent SCADA solution
DTE Energy: Reliability Through Innovation

“As an innovative utility, we were looking for solutions to get more real-time reliability data out of our distribution grid, particularly on older legacy and poorly performing circuits.”

“Now that we have better real-time visibility into our grid, we can safely restore power faster and better plan our capital investments around aging assets before they cause outages.”

Vince Dow
Vice President, Distribution Operations, DTE Energy

Business Challenges

• Determining where to send crews during outages to minimize patrol time
• Integrating data from different types of sensors with multiple backend systems
• Allow crews to visualize real-time sensor data in the field and engineers to visualize historical data in the office

Solution(s)

• Feed all sensor data into PI System using PI Interface for DNP3
• Utilize Asset Framework and Notifications to push events to field and DMS
• PI Coresight and PI ProcessBook to visualize historical data
• Utilize PI Integrator for Esri ArcGIS

Results and Benefits

• Visualization of sensor status on circuit map allows crews to divide circuit into segments and narrow search for faults. Expecting to eliminate at least 6.6 million customer outage minutes annually.
• History of device operation and circuit data gives valuable visibility into legacy parts of the system. To date, avoided spending $25 million for equivalent SCADA solutions.

“As an innovative utility, we were looking for solutions to get more real-time reliability data out of our distribution grid, particularly on older legacy and poorly performing circuits.”

“Now that we have better real-time visibility into our grid, we can safely restore power faster and better plan our capital investments around aging assets before they cause outages.”

Vince Dow
Vice President, Distribution Operations, DTE Energy

Business Challenges

• Determining where to send crews during outages to minimize patrol time
• Integrating data from different types of sensors with multiple backend systems
• Allow crews to visualize real-time sensor data in the field and engineers to visualize historical data in the office

Solution(s)

• Feed all sensor data into PI System using PI Interface for DNP3
• Utilize Asset Framework and Notifications to push events to field and DMS
• PI Coresight and PI ProcessBook to visualize historical data
• Utilize PI Integrator for Esri ArcGIS

Results and Benefits

• Visualization of sensor status on circuit map allows crews to divide circuit into segments and narrow search for faults. Expecting to eliminate at least 6.6 million customer outage minutes annually.
• History of device operation and circuit data gives valuable visibility into legacy parts of the system. To date, avoided spending $25 million for equivalent SCADA solutions.
Contact Information

Cameron D. Sherding
sherdingc@dteenergy.com
Sr. Software Engineer
DTE Electric Company
Less Wires, More Data: Harnessing new technology at the network edge

Presented by Martin Davis, Vice President of IT, J.D. Irving Ltd
Keith Flynn, President & Founder, RtTech Software Inc.
Quality Service
Quality Products
Customer Satisfaction
Since 1882 - 135 Years

Over 15,000 engaged employees
A diversified group of companies, vertically integrated to support each other, committed to the future and continued business growth.
Operational Excellence

Built on

Operational Intelligence

Powered by The PI System
IoT & OSIsoft – J.D. Irving & RtTech

What do we use the PI System for?

- Used across our Manufacturing plants
- Includes:
  - Paper Mills
  - Tissue converting
  - Diaper
  - Frozen Food
IoT & OSIsoft – J.D. Irving & RtTech

IIoT Opportunities

• Capturing information, from anywhere, in real-time
• Optimizing production flow
• Condition-based maintenance automatically creating work orders
• Adjusting production speeds automatically to maximize production while minimizing energy
• Automated vehicles making data-driven decisions
• Transportation and Marine operations
Common Challenges

• Assets not connected to the PI System have no real-time visibility

• What about limitations?
  – Isolated areas of a plant or in the field (outside the plant)?
  – Poor network quality?
  – Mobile assets?

• Or aging or outdated controls with low connectivity?
  – Upgrades are costly. Rip and Replace
  – Networking and installation significant
IoT & OSIsoft – J.D. Irving & RtTech

RtTech Relationship

- RtTech and JDI are long term partners
- JDI helped design & develop RtDUET
- RtDUET and RtEMIS key components of our architecture
- Piloting Cipher
  - Scalable IIoT solution
  - Connect more to PI
IoT & OSIsoft – J.D. Irving & RtTech
Solution: Less Wires, More Data

• Cipher is a drop-in Industrial IoT solution
  – Cost effective “No Rip and Replace”
  – Data from remote assets, integrated in real-time into the PI System
  – Seamless integration to your existing PI system
IoT & OSIsoft – J.D. Irving & RtTech
Solution: Less Wires, More Data
IoT & OSIsoft – J.D. Irving & RtTech
Cipher Connect Embedded Web
Monitor 10 Assets:
$1000 per PLC CAPEX
$300 per device installation
$15/ft cabling/conduit & installation
$1000 System commissioning/test
Total Project = $31,500

“The main cost of an asset monitoring system isn’t the system itself, but the cabling deployment costs.”
IoT & OSIsoft – J.D. Irving & RtTech

Wired vs Wireless: Savings

Monitor 10 Assets:
$600 Wzzard Gateway
$300 Gateway Installation
$6250 – 13 Edge Nodes
$1650 Edge Node/Sensor Install
$500 commissioning/test per site
Total Project = $9,300

$22,200 in savings, nearly 70%!
Contact Information

Martin Davis
Davis.Martin@JD Irving.com
Vice President of IT
J.D. Irving Ltd

Keith Flynn
Keith@RtTechSoftware.com
President and Founder
RtTech Software Inc.
Questions

Please wait for the microphone before asking your questions

State your name & company
THANK YOU