Transmission System Monitoring Pilot-Update
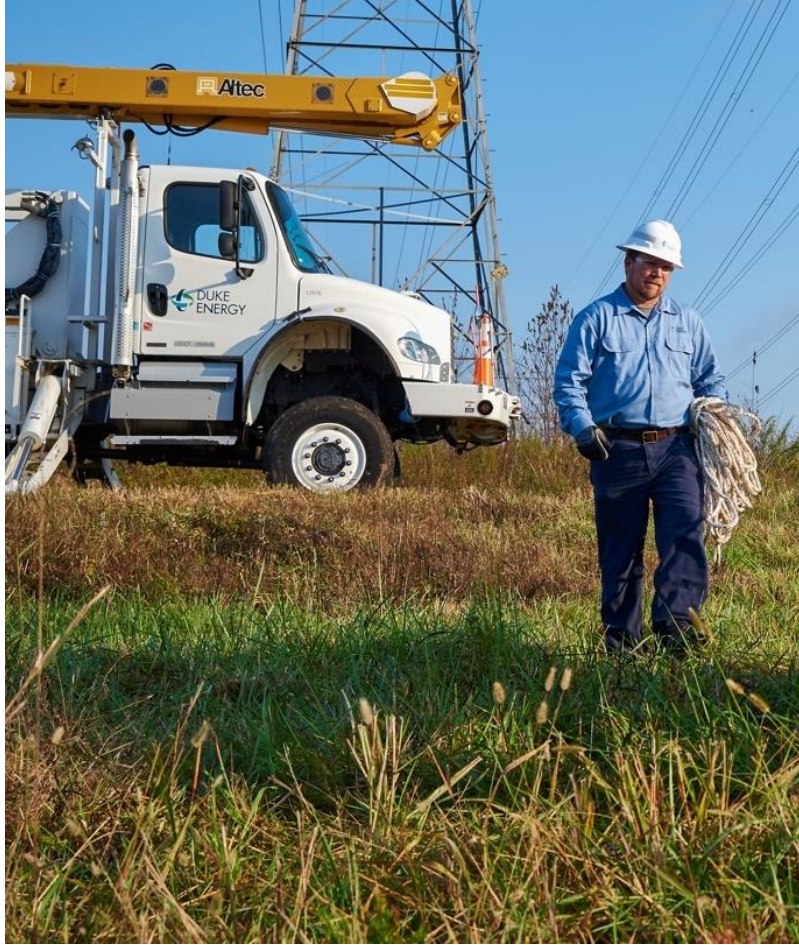
Outline

- Transmission Monitoring System - Background
- Transmission PQ Monitoring Pilot
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- Measures of Success
- OpenXDA Architecture
- Results of Pilot
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Transmission Monitoring System - Background

- Currently Transmission has no ability to <u>remotely</u> monitor system events such as voltage sags that result from faults on the transmission network

- Transmission is lacking the ability to:
  - Remotely trend voltages
  - Remotely determine level of harmonics and flicker – particularly large solar installations
  - Automate fault locations on the transmission system

- Transmission has experienced customer complaints and data was not available to substantiate the type and severity of event

- The need exists to be able to remotely capture system events, precisely locate faults, and determine impacts on industrial and wholesale customers

Transmission PQ Monitoring Pilot - Scope

- Develop a system to capture transmission event data and demonstrate the ability to retrieve, automate, and analyze such data to determine impacts on customers.

- Working with industry partner, EPRI, pilot the use of OpenXDA and PQ Dashboard to develop capability to remotely capture system events and trend system characteristics using existing Digital Fault Recorders (DFRs) in the DEF region.

- Partner with IT and Security to evaluate and ensure compatibility for Duke Energy usage, setup, and communication paths from substation devices to PQ Dashboard

Transmission PQ Monitoring Pilot - Objectives

- Install OpenXDA and related software and test its capabilities of remote connectivity to existing substation DFRs
- Ensure data that is retrieved is compliant with Duke Energy internal security
- Demonstrate the ability to collect system data and to determine impacts to customers
- Determine precise location of system faults using data collected by the remote monitoring system and automate initial notifications
- Determine requirements to expand data collection from other devices such as SEL relays, Power Quality (PQ) monitors, and revenue meters

Transmission PQ Monitoring Pilot - Measure of Success

- Ensure successful installation of software and remote connectivity to DFR and SEL devices installed in substations - *complete*
- Capture system events and analyze data to better facilitate customer complaint investigations – *partially complete*
- Demonstrate the ability to precisely locate and communicate system faults using remote monitoring capability – *issues with accuracy*
- Develop ability to manipulate PQ Dashboard for various event analysis, voltage and harmonic trends and system transients – *in progress*

OpenXDA and Components Architecture
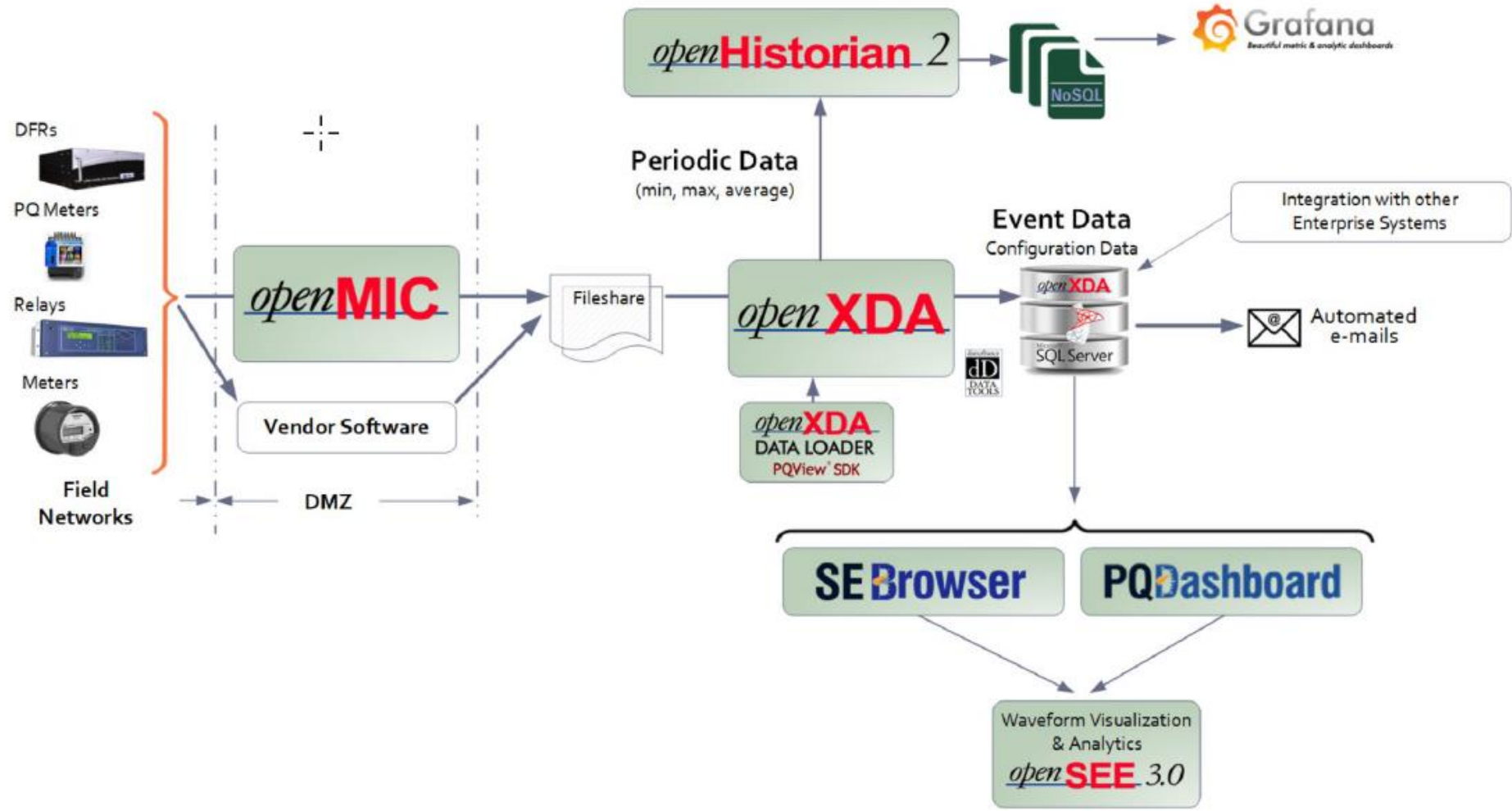
Installation Issues

- While not a specific roadblock, the software installations presented numerous challenges. A large part of the challenge was the lack of clear documentation and the number and order of applications that had to be installed.

- Security, Permissions and Configuration issues required code changes by Stephen Wills.

- Installation required separate installs of multiple software modules

- Each of several updates was handled differently – Patch Fix vs Full Installs.

- Process was very different for Duke IT in that it was not an "off the shelf" install that works first time like they are accustomed to

- Plus, after successful install of Version 2.6 it was decided by Duke to go for Version 3.0 which may not have been fully ready for install

Installation Issues

- Have fully not developed an understanding of how the drop folder function will work.

- Not confident that the software is stable enough and when moving to the next version or release could result in numerous debugging efforts.

- Some "Fixes" broke other functions.

Installation Issues - Solutions

- Documentation for authentications and permissions
- Documentation of how all the various modules interact
- Documentation from an IT perspective for "open-source" software

Device Configuration Issues

- Device configuration can be challenging and very manual.
- No configuration installation instructions.
- Experienced several system errors caused by configuration issues that had to be corrected.
- Example – when configuring DFR two channels assigned to station DC bus and charger current – OpenXDA interrupted as Line Segment that resulted in system error.
- Duplicate record IDs found in table.
- Line record associated with Line Segment twice which resulted in system error.

Device Configuration Issues

- OpenMIC, the device data retrieval tool, requires all devices to have FTP capability. Not all Duke devices have that capability. USI series 2002 have been modified for FTP. New to be installed Series 9000 has the FTP capability.

Functional Issues

- Several buttons are not functional and cause lockups if clicked. Non-functioning buttons should be disabled and marked as "under construction"

- It appears that the web application is not designed to handle multi-user usage. Performance issues were observed by IT during the times the application was functioning, more specifically, PQ Dashboard. Do not know if application performance can be enhanced with use of multiple servers and the use of load balancing server functions

- Power Systems Center (PSC) does not currently include all possible data sources for OpenXDA, particularly steady-state and trend data available from JEMStar II revenue meters- Duke issue

Functional Issues – Fault Location

- There is a lack of documentation or guides for users to use the application including the algorithms they use.
- Accuracy of fault location. Current algorithms may have some issues – Duke has discussed with Stephen Wills.
- The software does not synchronize the waveforms.
- The double-ended fault locating algorithms do not fully utilize data from both ends, resulting in inadequate results.
- Because the DC is not filtered, the DTF curve will have a large AC noise signal on it.
- Software does not calculate DDT for tap faults.
- Software does not allow for phase-phase connected voltages, preventing application on a significant portion of DEC 44kV.
- Accuracy of fault location is of major concern with the current analysis techniques.

Vendor Support Concerns

- Future software development process

- Configuration control

- Release management

- Availability of support from GPA

- Can the software and upgrades adequately function in Production mode

- Lacking on software control and life-cycle management for the applications.

- Newer version of software was delivered that had not had in-depth testing prior to being released (based on the numerous problems and defects encountered).

Next Steps

- Executed Supplemental Project with EPRI and Lifescale Analytics to review configuration for devices Duke plans to use: four different DFRs, SEL735, various SEL relays, JEMStar II revenue meters, and other PQ meters.

- Create full documentation for OpenXDA installation, device configuration, data and data source management, multiple levels of training.

- Develop plan for organization of data sources, i.e. Power System Center, SCADA, field devices, etc.

- Determine how to obtain data from Power System Center.

- Define where OpenXDA Watch folder needs to look for data sources.

- Either connect to or read data from SEL 735.

- Either connect to or read data from JEMStar II – 260 to be installed over next two years.

- Test out TrenDAP.

- Continue to evaluate fault location capability.

- Complete pilot and define next project – AFA, PQ Monitoring, etc.

Questions ?