PQ System Improvements - 2019

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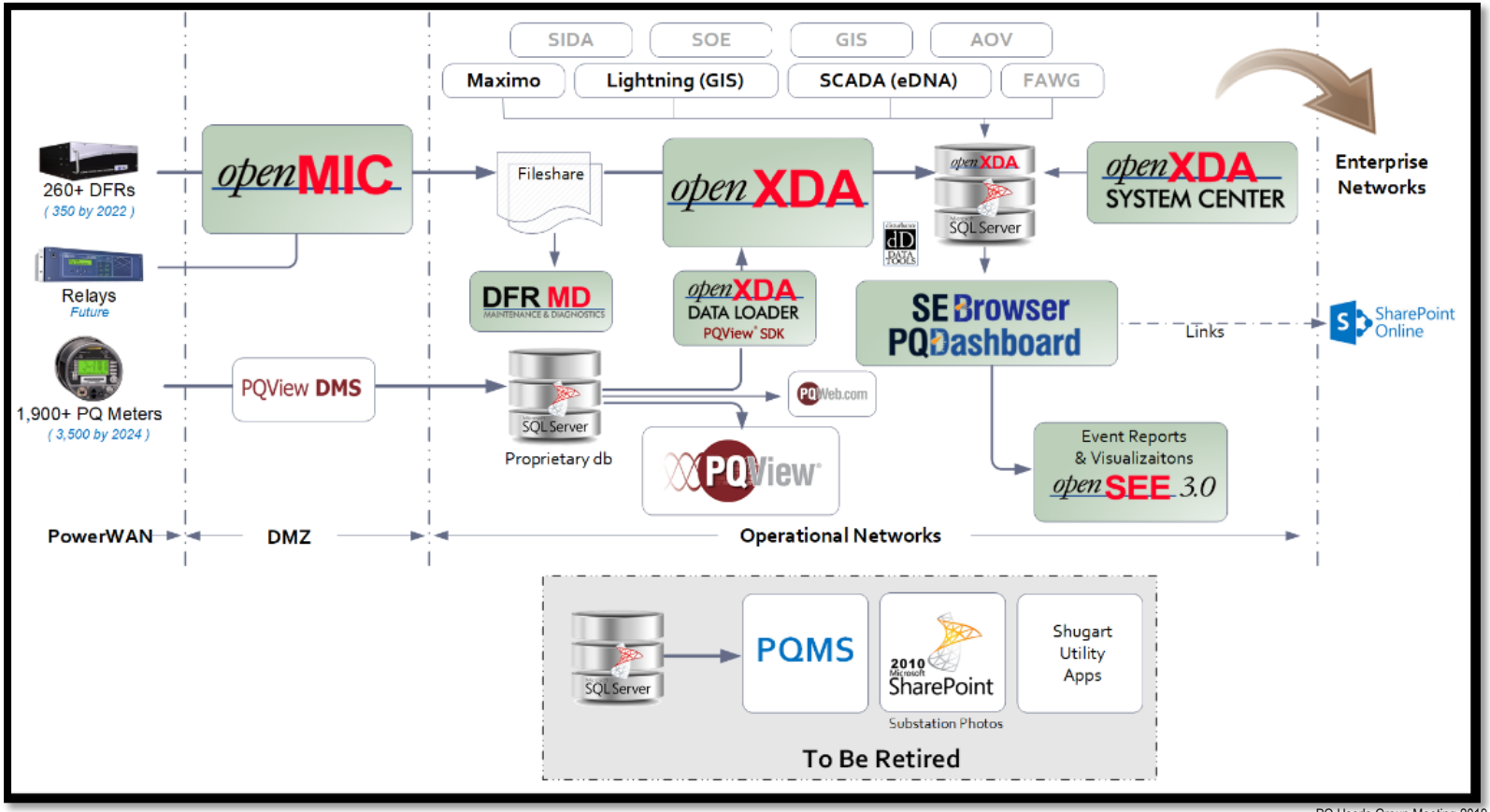
Power Quality Improvement Project

- Approximate one-year effort sponsored by TVA's IT organization to modernize and improve systems supporting TVA's power quality and disturbance monitoring programs
- Includes DFRs and PQ meters
- Includes all phases of PQ information flow:
  - Configuration
  - Collection
  - Curation/Analysis
  - Notification
  - Presentation
  - Periodic Reporting

Project Business Case

- Rapid data growth
  - PQ meters increasing at about 400 meters per year
  - DFRs increasing at about 10 devices per year, but hundreds of channels
  - Inclusion of relay data
- Existing department-grade tools at end-of-life
  - The existing ad-hoc collection of web-pages difficult to maintain
  - PQView and GPA tools growing in capability
- Increasing business importance
  - Compliance
  - Customer satisfaction
  - Conditioned-based maintenance
  - PQ program cost containment through automation

Future State Vision



openXDA PQView Data Loader

- TVA Objective: To integrate event data from DFRs, PQ meters, and other substation devices in an open database
- Developed in 2018 by GPA with EPRI Funds – TVA was the development / implementation test site
- Requires purchase of the PQView4 SDK which is licensed to a specific server
- Logic in the Data Loader minimizes stress on both PQ View and openXDA databases
- Data Loader XML configuration specifies the “sites” to download from PQView, the polling interval, and database connectivity information
- Currently configured at TVA to poll for new events in PQView every 5 minutes and to poll for new trending data every 12 hours
- In production service since February 2019 for approximately 400 sites. Still tweaking the Data Loader as production use of the data grows

System Configuration

openXDA System Center

Integrated Configuration Management

- Project Objective: Integrate and simplify configuration across multiple applications
- Master configuration data to be housed in a single, open database for replication to operating apps and bi-directional integration with TVA corporate systems such as Maximo, GIS, Meter-Set-Change, Billing, etc.
- Configuration to be managed through a single application – openXDA System Center and will include:
  - Meter data
  - Asset information
  - Customer site information

DFR MD

DFR Maintenance & Diagnostics

- Project Objective: Provide awareness of DFR health and alarm on issues
- Includes two production dashboards
  - Comm & substation device monitoring by TVA's 24x7 NOC
  - DFR configuration change annunciation panel for SMEs

Data Collection

Field data collection occurs through two processes:

PQView for PQ Meters and openMIC for DFRs.

PQView4 DMS

Returns Data from PQ Meters

- Infrastructure recently expanded to improve performance from a growing population of PQ Meters
- New hardware in place for 8 instances of PQView4 DMS at the primary control center and 8 instances at the backup control center

openMIC

Returns data from DFRs via FTP
Capability for MODBUS and DNP3

- Project Objective: Reduced data acquisition cycle times and improved data collection robustness through a distributed architecture
- New hardware in place for 3 instances of openMIC at the primary control center and 3 at the backup control center
- TVA experimenting with openMIC to download event files from relays

Data Analysis

eXtensible Disturbance Analytics

openXDA

Automated waveform analytics and notifications

- Project Objective: Extend to be asset-centric rather than line-centric. Add more automated analytics
  - Probable fault cause determination
  - Correlation of voltage sags to fault events
  - Identification of normal-switching events
  - Improved fault typing (L-L-G)
  - Improved techniques to detect a transient.

  & more …

System Event Explorer

openSEE

Browser-based waveform viewer

- Project Objective: Add analytics
  - Show more summary information about events
  - Include user-selectable analytics – e.g., FFT
  - Allow comparison of waveforms from multiple events
- Fully URL-driven to enable embedding any openSEE display state into a link that can be pasted into emails

Extended Analytic Services

openEAS

Sandbox for research grade analytics

- Project Objective: Implement new cap-bank DLL expected from EPRI in late 2019

Automated Notifications

- Project Objective: Enhance existing automated notifications by providing more information on them, e.g.,
  - DFR channels
  - Sag depth

(*Recently implemented new process for self-subscription to emails*)

Data Presentation

EPRI Open PQ Dashboard

PQ Dashboard

Browser-based event filtering / viewing for enterprise

- Project Objective: Optimize for anticipated population of TVA meters (greater than 10,000 devices)

DFR Maintenance & Diagnostics

DFR MD

DFR Health Monitoring

- Project Objective: Provide awareness of DFR health and alarm on issues

System Event Explorer

openSEE

Browser-based waveform viewer

- Project Objective: Add more visualization options
  - Show more summary information
  - Allow comparison of waveforms from multiple events
  - Add tools to

System Event Browser

SE-Browser

Browser-based tool optimized for engineering investigation of events

- Project Objective: Replace existing TVA list-based web systems with modern filtering and display tools
  - Fast filtering to the event of interest
  - MS Outlook-like display – with preview panel
  - Integration with openSEE
  - Launch point for reports

Reporting

- Project Objective: Replace existing web-based reports with a modern reporting framework and implement new reports
  - Fault Summary Report (for an event)
  - Large Sensitive Customer Voltage Sag Report (Monthly)
  - Wholesale Voltage Regulation Report (Monthly)

Thanks.