Advanced Automated Analytics Using OSS Tools

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Presentation Overview

- Open Source Software (OSS) Approach
- Building Blocks of an Automated System
- Examples and Use Cases
- Food for Thought
- Questions

Open Source Software (OSS) Approach

- Stimulates innovation
- Encourages and facilitates collaboration
- Reduces time to deployment
- Reduces cycle time for improvements
- Lowers total cost of ownership
  - Accelerates development
  - Avoids vendor lock-in
  - Lowers on-going software maintenance costs
- Improves code quality
- Improves security through community review

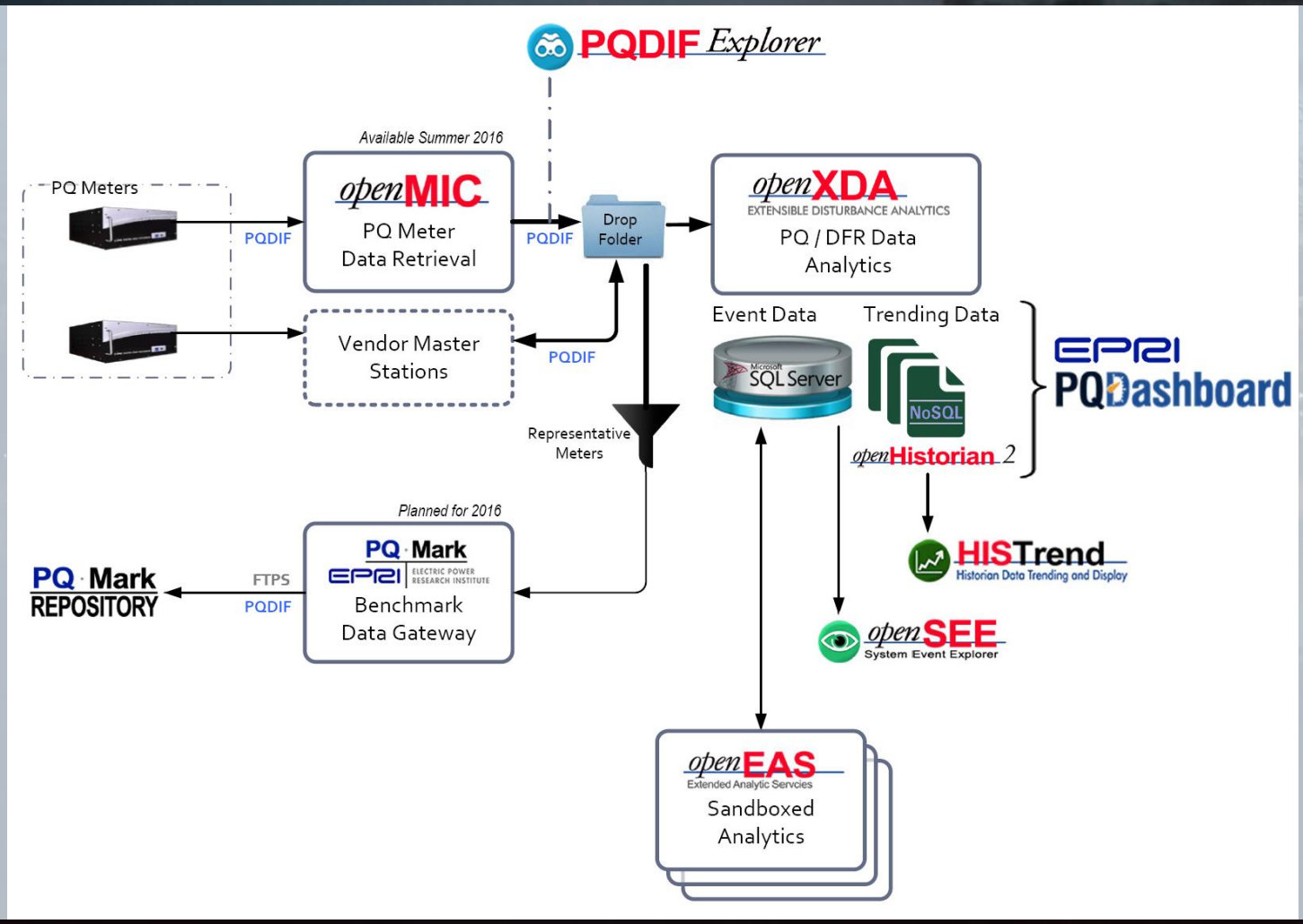
OSS in Electric Utilities

- **EPRI OSS survey published June 2015** (conducted by GPA)
- 16 utility company participants
- 80% large companies – gross annual revenue >$1B
- Nearly a third use OSS in production systems
- About three quarters aren't sure where to find OSS
- Education, examples, support, and 'were to find it' would advance utility use

EPRI Product 3002006348

http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002006348

The Open Source PQ Tool Suite



Building Blocks of an Automated System

- Get the data
- Analyze the data
- Visualize the data

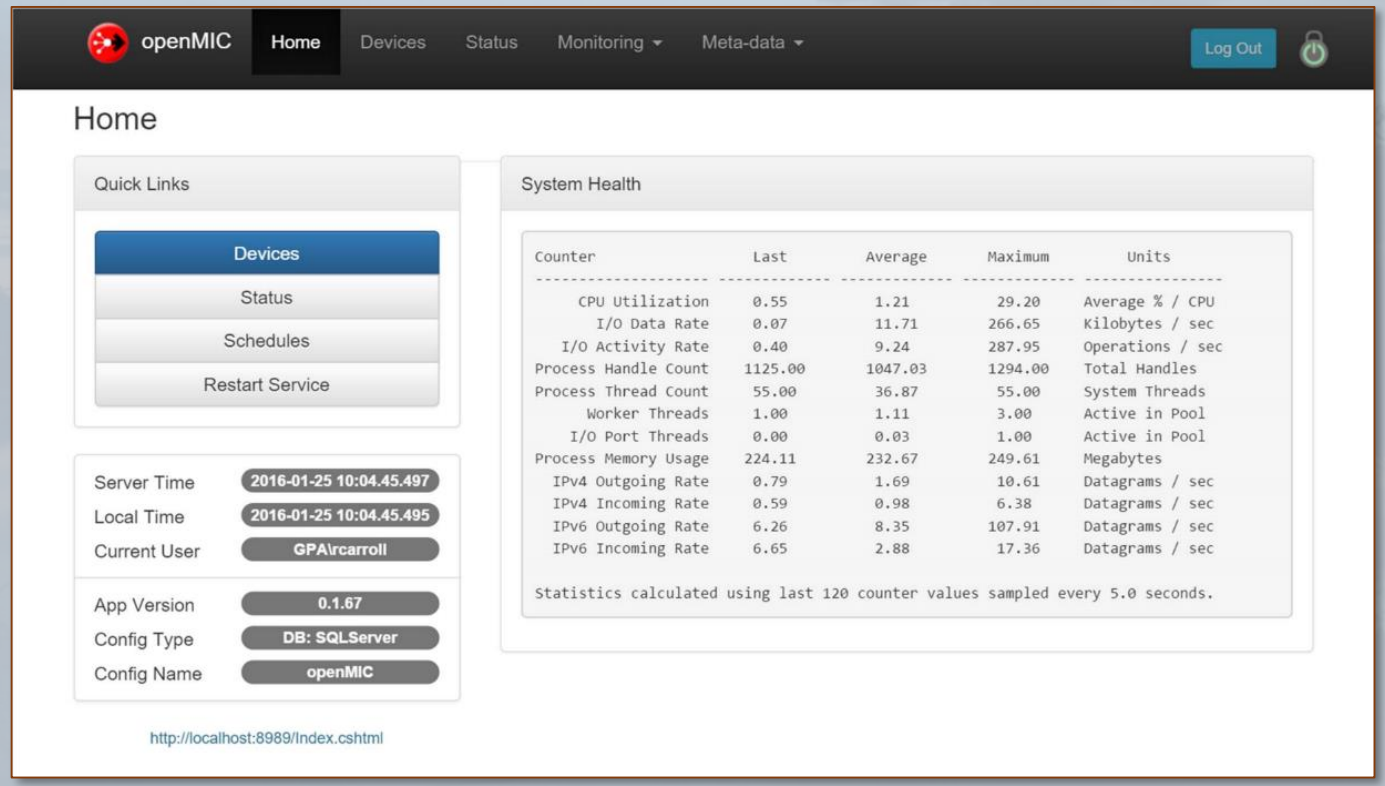
Get the Data

- Physical transport of data from field device to a central repository
- Can be anything from disk copy to fiber network
- Determines the periodicity of data processing
- An OSS project called openMIC can be used to fully automate this step
- https://github.com/GridProtectionAlliance/openMIC

openMIC – Meter Information Collector

Version 0.9

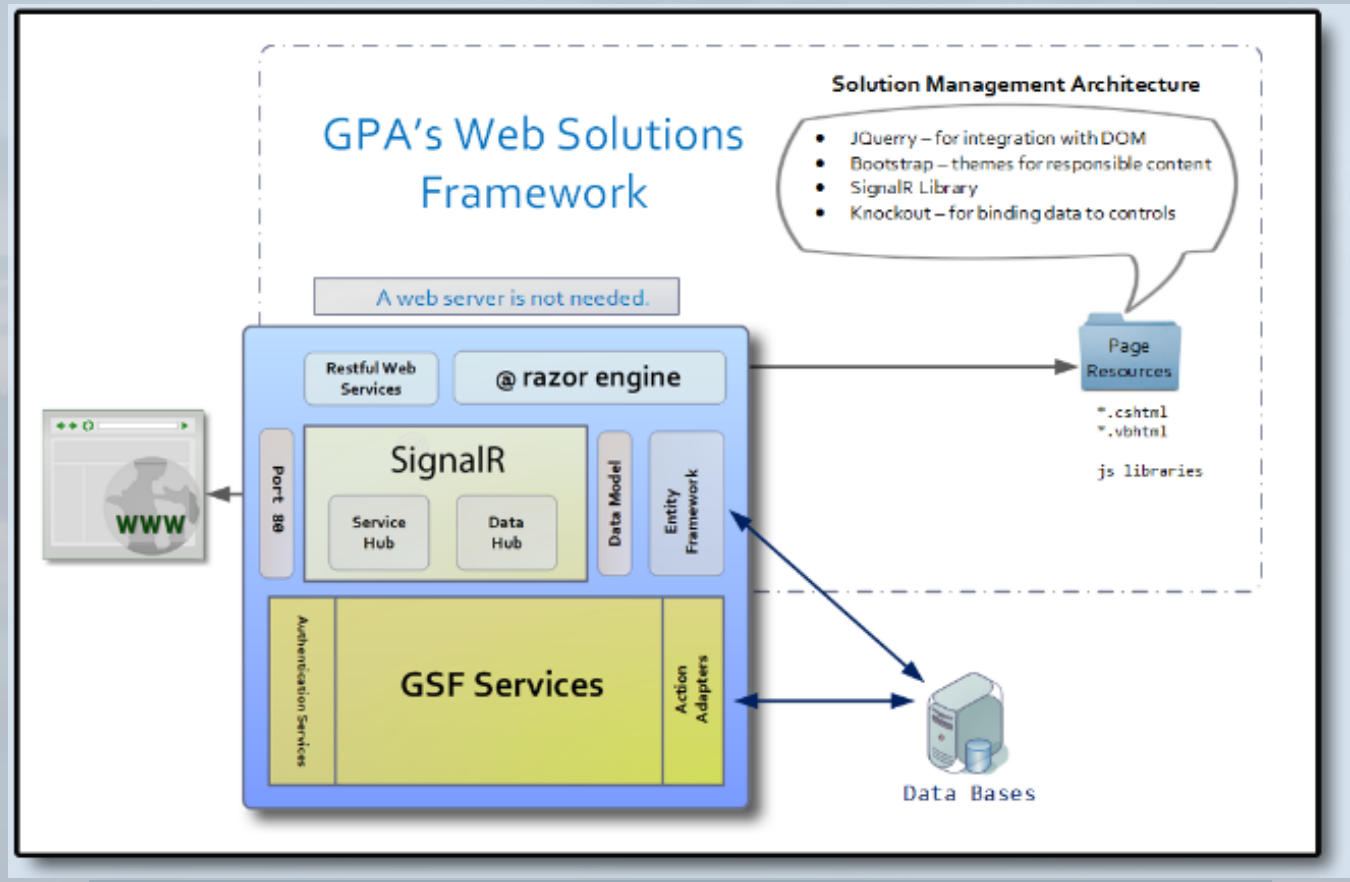
- Schedules device interrogation and manages the data returned from DFRs
  - Via IP
  - Via Modem (RAS & FTP)
- Logs and reports meter problems
- Includes a mobile-ready web app to configure openMIC and view DFR interrogation statistics



GPA's Web Solutions Framework

Version 2.0

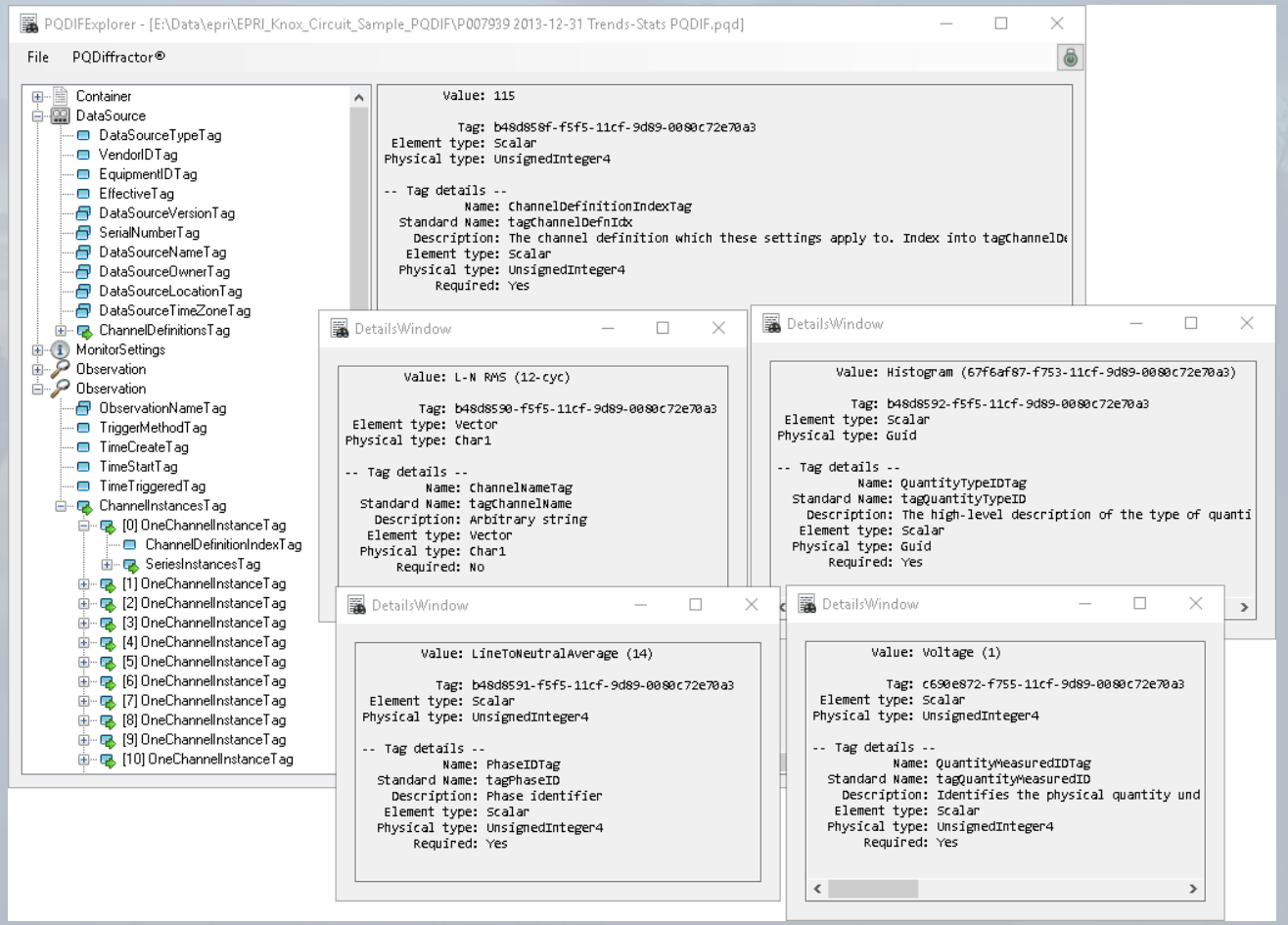
- Allows browser-based interaction with GPA services
- A web server is not required -- but can be used to provide content in different security zones via reverse proxy
- Includes bootstrap which makes content responsive to take the format of the user's platform (mobile, tablet)
- Uses a collection of standard components imbedded in GPA's core code libraries to enable full CRUD interaction with relational data systems.



Used in openMIC, openSPM, MiPlan, and SOETools

PQDIF Explorer
Version 1.0

- Allows discovery of all information within the binary format of PQDIF (IEEE 1159.3) -- including information hidden by higher-level PQDIF parsing tools
- Good validator for vendors developing PQDIF writers
- Valuable implementation example of GPA's open source PQDIF parser



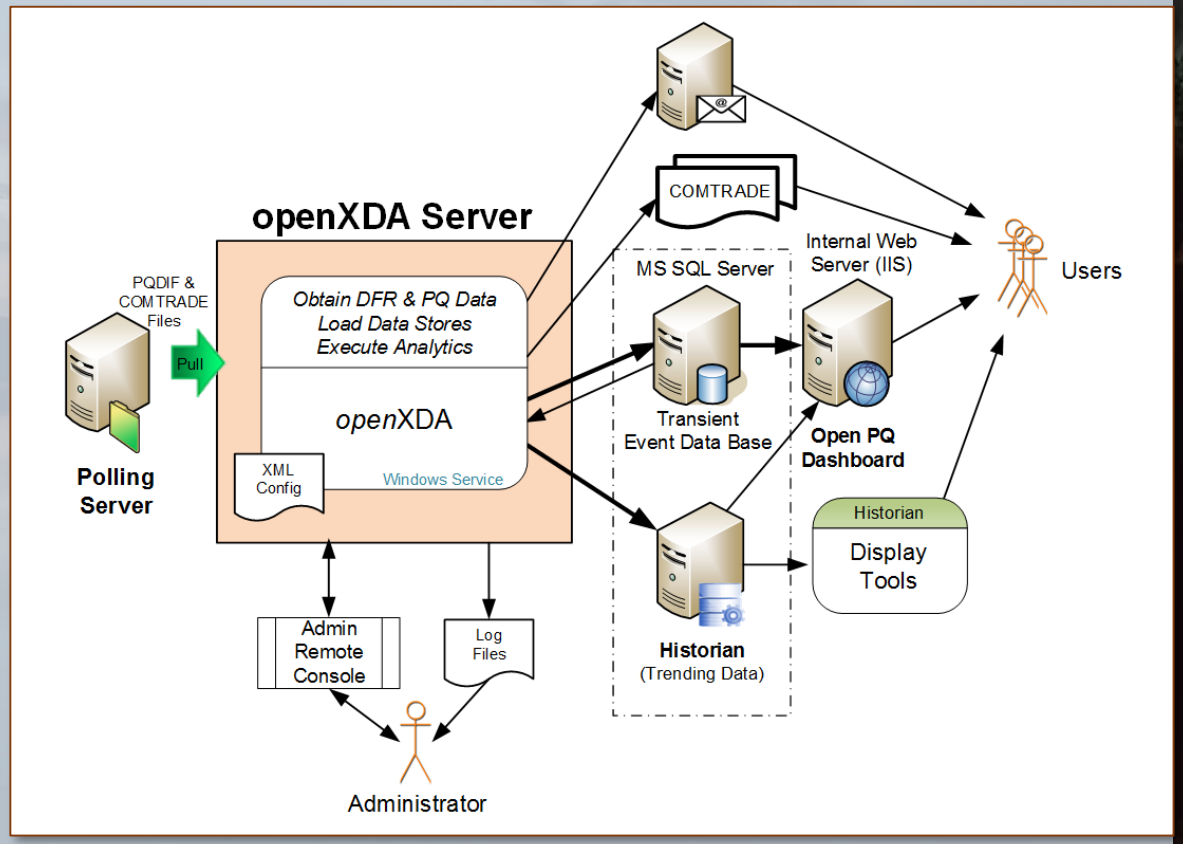
Analyze the Data

- Process the data as quickly as it is available
- No manual interaction to complete the task
- Send appropriate notifications immediately
- Build a database for visualization and analysis
- An OSS project: openXDA can be used to accomplish this step
- The Electric Power Research Institute is a significant contributor
- https://github.com/GridProtectionAlliance/openXDA

*open*XDA – eXtensible Disturbance Analytics

Version 1.51

- Automatically processes and analyzes event files from disturbance monitoring equipment such as DFRs and PQ monitors
- Loads this file-based data into an enterprise grade relational database
- Enables on-the-fly analytics such as single and double ended fault location, voltage sag and swell analysis, breaker timing evaluation, among others.
- Supports both open source and proprietary analytics
- The data layer for Open PQ Dashboard and openSEE



openXDA Major Components

1. Installer for the openXDA service
2. DataLoader Service (includes File Watcher, logging and notification components)
3. Administrator's remote console to DataLoader
4. Logging Systems
5. E-Mail Alerts
6. Database (MS SQL Server)
   - Dashboard & Service Configuration Data
   - Meter Configuration Data
   - Power System Engineering Data
   - Event Data
   - Data Quality Information
   - Daily Trending Summary Data (for speed)
7. Trending Data Historian (openHistorian)
8. System Configuration Manager

openXDA Inputs

- Power System Configuration Data
  - Meter name and location
  - Meter channel definitions
  - Line parameters
- Waveform Data
  - COMTRADE
  - PQDIF
  - EMAX (native format)
  - SEL .eve (SEL-251, SEL-351, Sel-421 relays)

openXDA – Recent Community Activities

- Breaker Timing at GTC
- Ability to apply fault determination logic executed externally to openXDA
- Geographic data display R&D with GTC
- TVA Cap Bank monitoring research at TVA

openXDA – Community Activities for 2016

- Configuration manager
- Extract trending data from ION StruxureWare
- Consume real-time MODBUS data
- Event reclassification and tagging.
- Identification of “Device out of Service”.
- Integration of fault indicator data
- Advanced breaker timing analysis such as phase comparisons and identifying restrikes

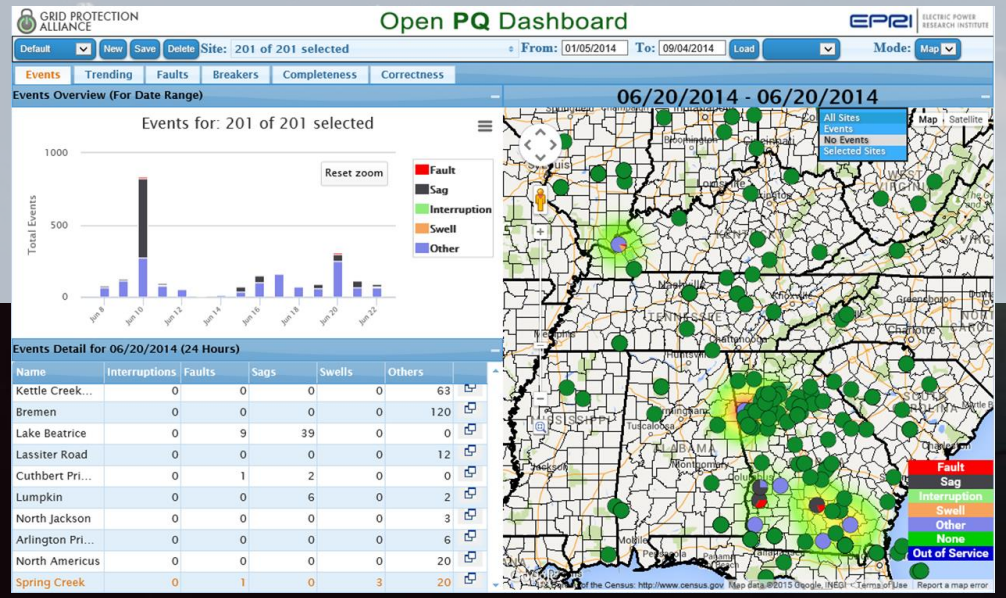
Visualize the Data

- Web based dashboard available company wide
- Secured by user credentials
- Visualize entire fleet of devices regardless of brand or type
- Intuitive displays:
  - Geographic
  - Annunciation panel
  - Historical performance
  - Details by day, site, device, channel
  - Work is underway to overlay related weather data
- An OSS project: Open PQ Dashboard can be used to accomplish this step
- Open PQ Dashboard was initiated by the Electric Power Research Institute
- https://github.com/GridProtectionAlliance/PQDashboard

EPRI Open PQ Dashboard

Version 1.0.3

- A web-based enterprise dashboard that nicely complements traditional vendor-provided waveform analysis tools
- Displays the results of the analytics rise that run automatically in openXDA
- Provides drill-down from wide-area displays to full resolution waveforms



Examples and Use Cases

Automated Analytics in Production

- Fault presence, and type
- Single and double ended fault distance
- Standard Power Quality parameters such as sag, swell, etc.
- Breaker timing assessment
- Historical trend performance
- Data quality:
  - Completeness
  - Correctness
  - Reasonableness

Examples and Use Cases

External Analytic Integration

- Incipient cable fault analysis
- Capacitor switching transient analysis

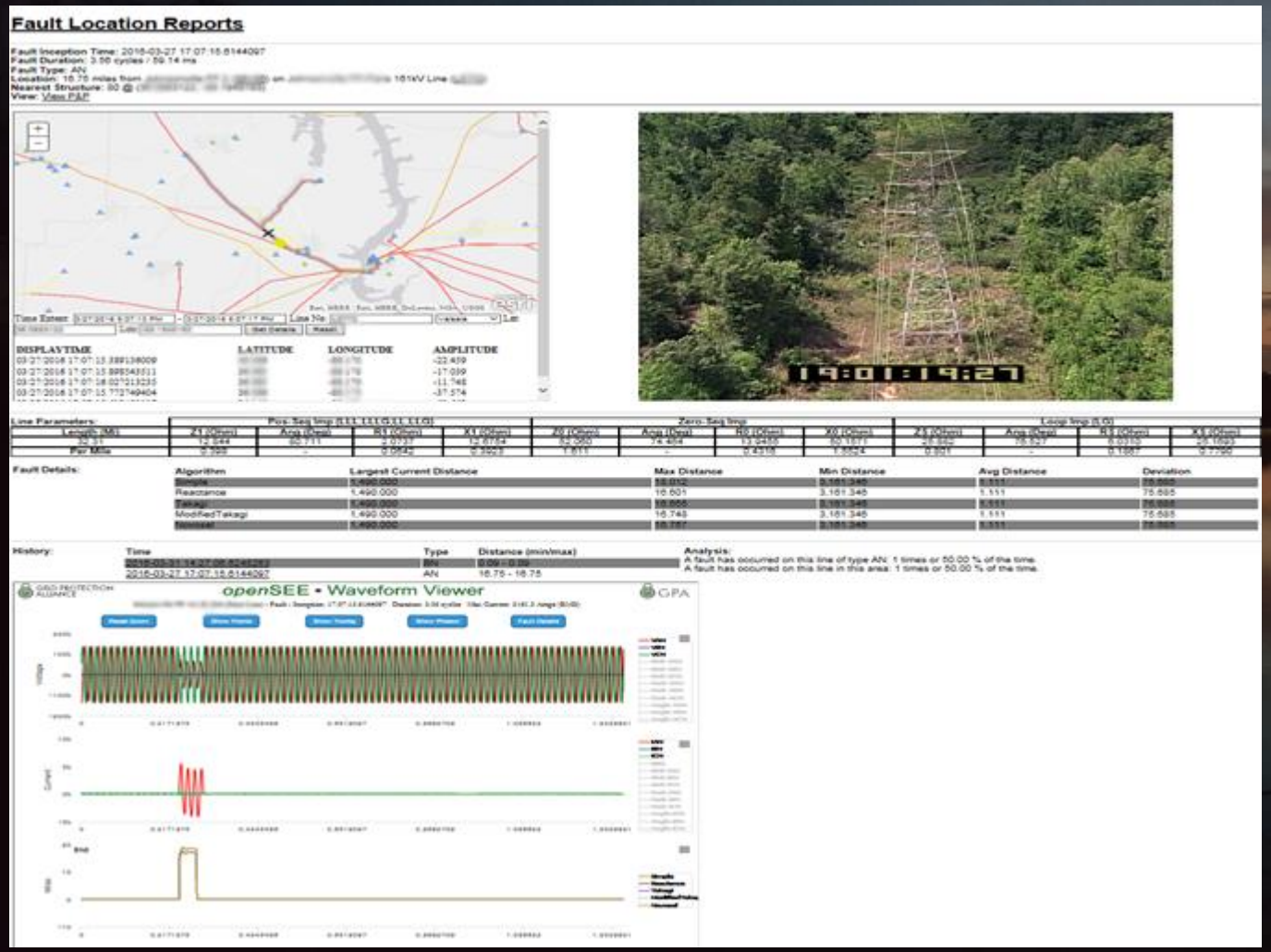
Automated Analytics in Development

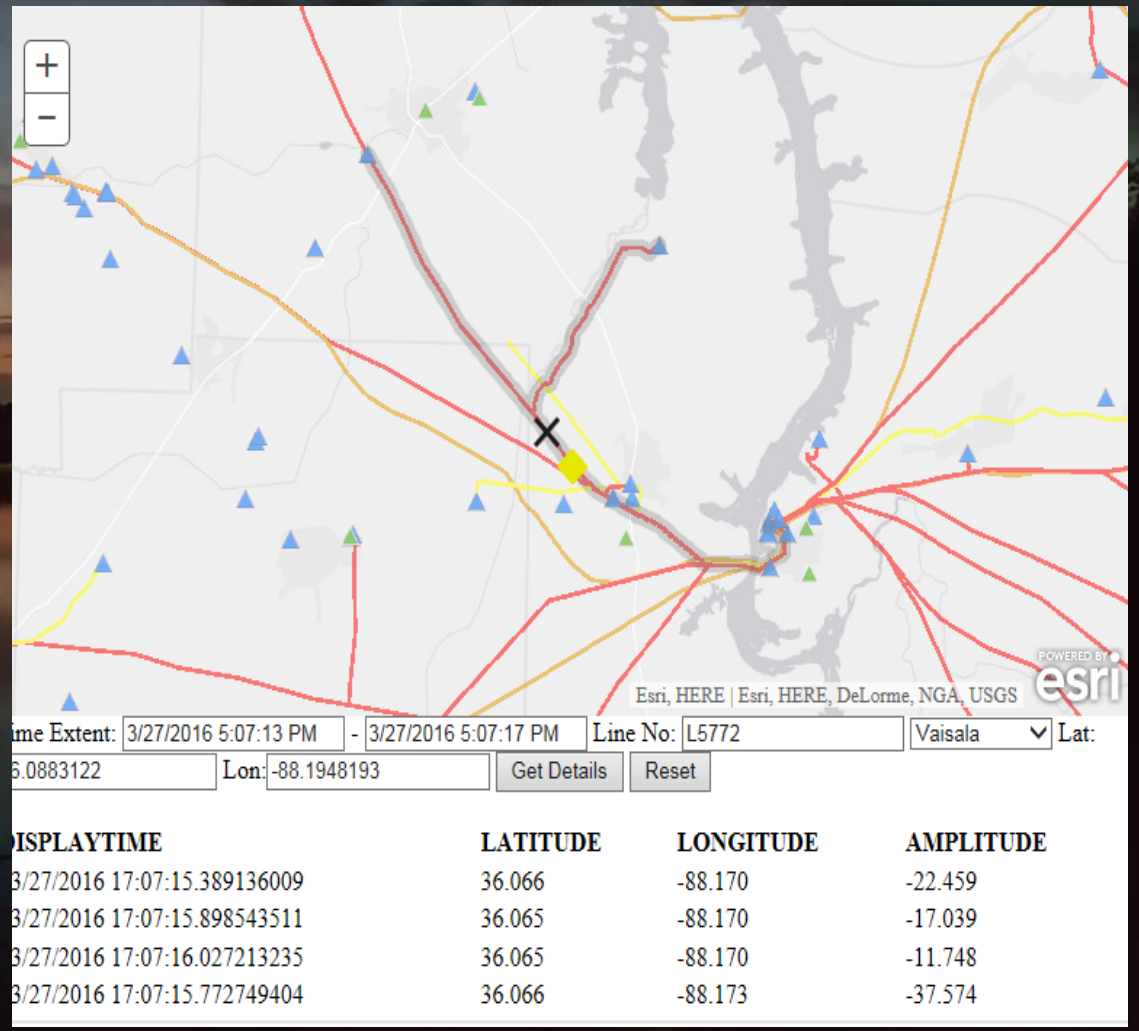
- Advanced breaker operation analysis
- Capacitor health assessment

Automated Lightning Correlation

- A number of utilities have expressed need
- Once the time and location are determined, the automated analytic process can easily interrogate a lightning source such as the TXD-100 and include the results in the database for use in visualizations
- Prerequisites include:
  - Geospatial information for power system structures
  - Access to lightning data source

Example Lightning Integration at TVA





Food for Thought – OSS Building Blocks

- Functional and deployed in operational systems
- Facilitate fully automated advanced analytic systems to perform any analysis appropriate for the type of data available.
- Provide dramatically improved access to information compared to manual methods.
- What we see today, it is only the tip of the iceberg.
- Other functions such as data quality, device availability, and device performance are also being applied in this environment.

Food for Thought – OSS Building Blocks

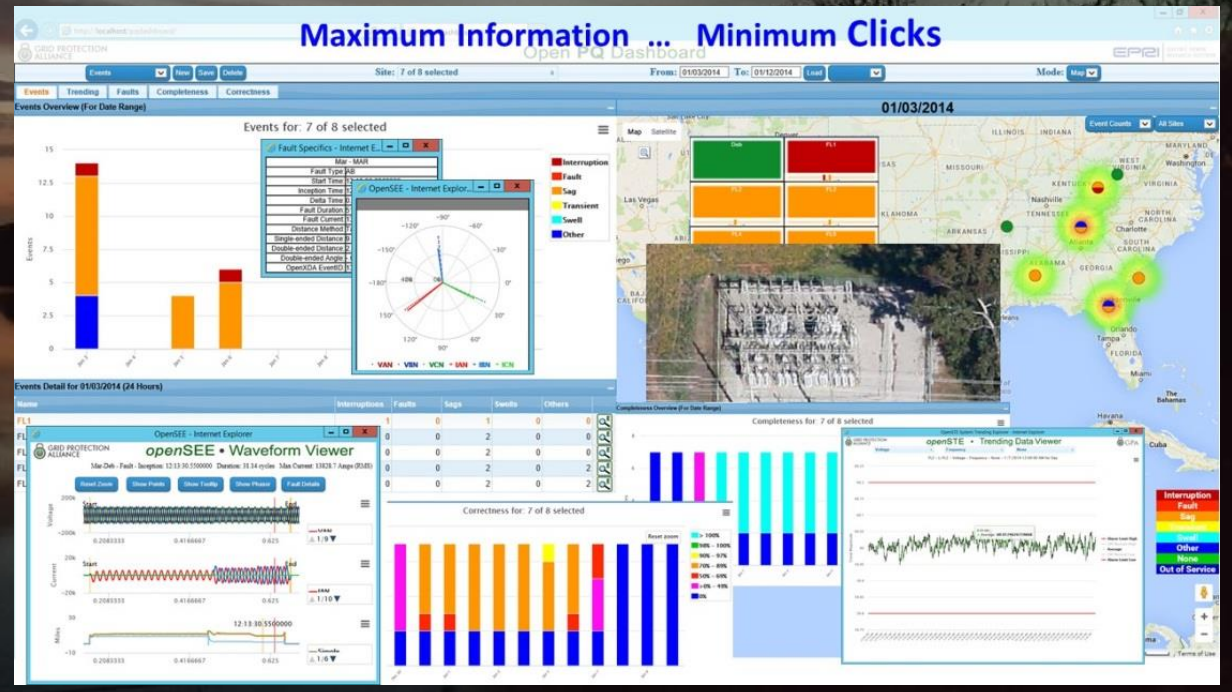
- Each of these OSS building blocks is freely available for enhancement, extension, and adaption.
- Through the collaboration and innovation afforded by the OSS approach, the functions of these blocks continue to grow rapidly.
- Anyone can use them ‘as is’ or become a part of the community to enhance and extend them.
- See links below for information regarding OSS licenses, and the OSS code repositories where the projects are managed.

Food for Thought – References

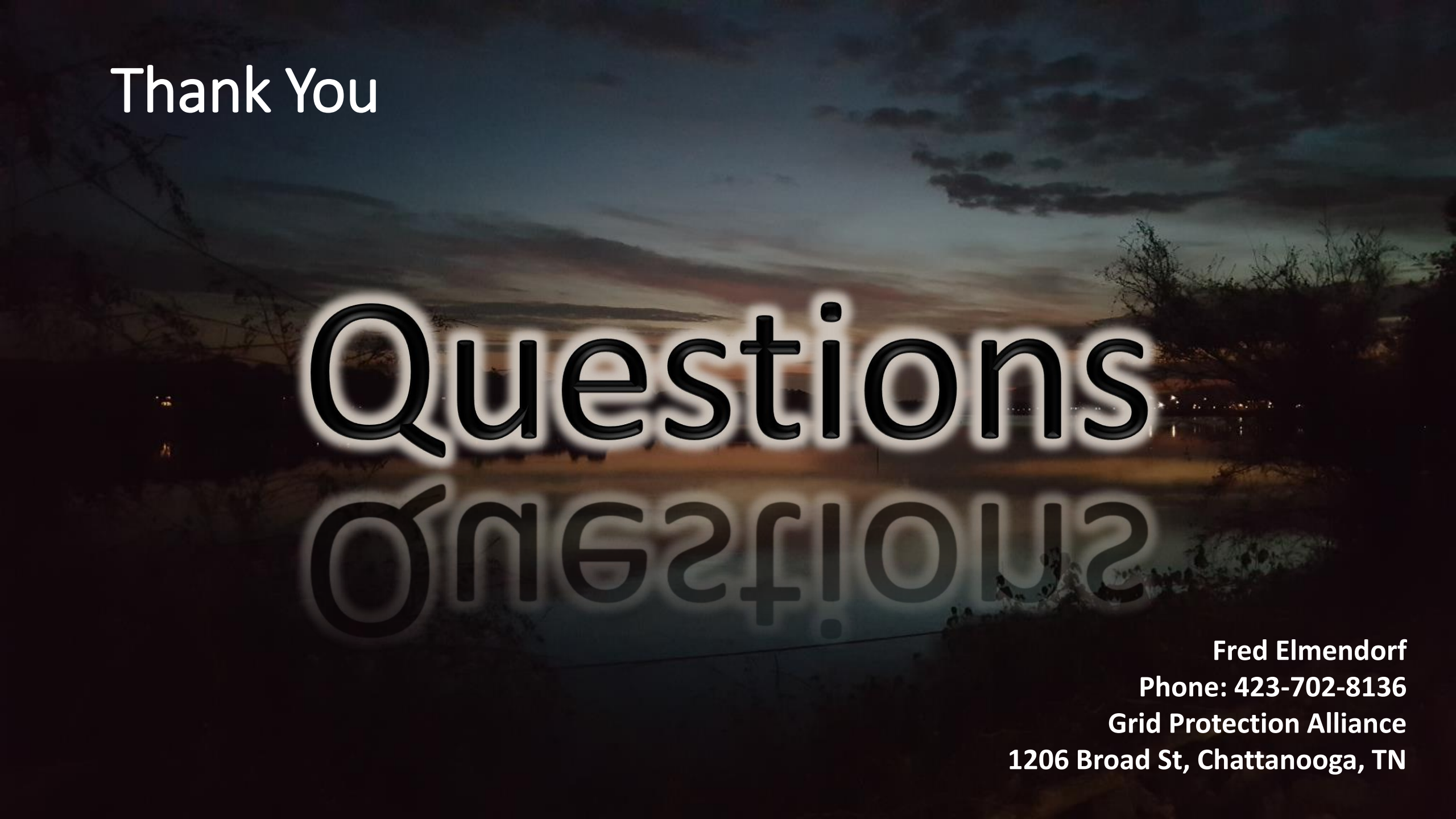
- BSD License https://en.wikipedia.org/wiki/BSD_licenses
- MIT License https://en.wikipedia.org/wiki/MIT_License
- openMIC https://github.com/GridProtectionAlliance/openMIC
- openXDA http://gridprotectionalliance.org/products.asp#XDA
- PQDashboard https://github.com/GridProtectionAlliance/PQDashboard
- OSI https://opensource.com/resources/what-open-source

Food for Thought - Conclusions

- OSS is a good environment to accelerate power system tools
- Building blocks exist to build a fully automated end-to-end system
- Any appropriate analytic can be added
- Automated lightning and weather correlation can be included



Thank You



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