Data Concentration of 7000 Distribution Devices to Facilitate Asset Optimization with the PI System

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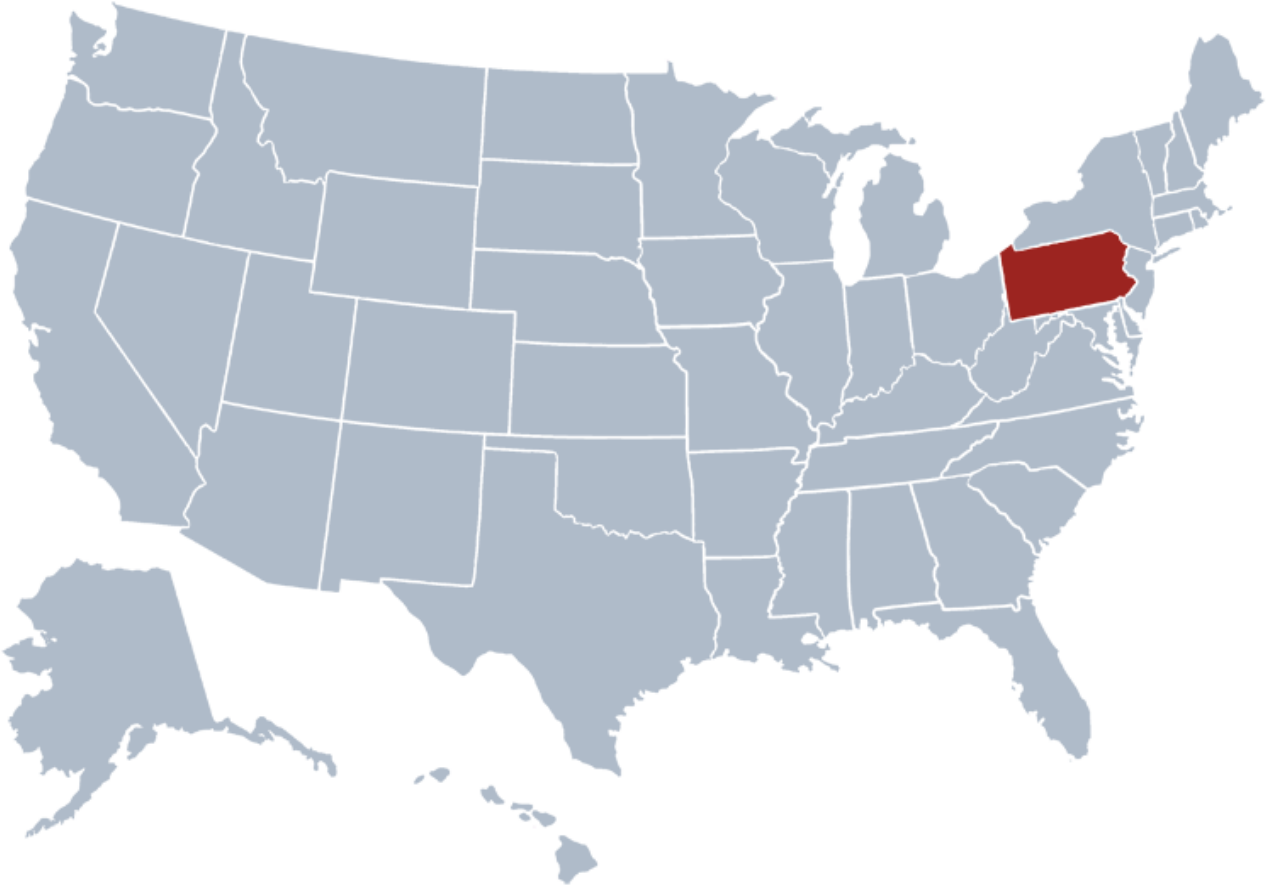
PPL Electric Utilities

- HQ: Allentown Pennsylvania USA
- 1.4 million customers
- 80,000 km of Distribution circuits
- 13,000 km of Transmission lines
- 26,000 sq. km service territory in eastern PA

PPL



PPL Analytics Goals

1. Improve System Reliability (ISR)
2. Implement Condition Based Maintenance programs (CBM)
3. Provide Operational Performance Visibility (OPV)
4. Build a foundation for advanced analytics such as machine learning (FFA)

- Reduce customer interruptions & improve service quality
- Reduce O&M costs through improved maintenance programs driven by asset condition
- Provide key data and asset conditions to support decision making
- Move towards a data driven organization

Completed Business Driven Use Cases for ISR and CBM

These use cases were completed in January 2017

Power Quality Monitoring

- Detect, monitor, and diagnose high voltage events across 350 Distribution Substations
- High Bus voltage monitoring and event root cause analysis
- Foundation to build geospatial visualization for power quality issues

OH Recloser Condition Based Maintenance

- Electrical contacts health assessment and optimized maintenance
- Support real-time notifications of condition issues
- Foundational use case for subsequent Smart Grid asset classes

Capacitor Troubleshooting

- Rapidly determine Capacitor Bank issues by monitoring neutral amps
- Event Frames designed to narrow focus on critical issues, reduce research and analysis time
- Foundation for future predictive analytics for capacitor bank issues

Non-Operational Data needed by Asset Management (ISO 55000)

- Recloser Wear Calculations (# of operations x FM by ø)
- Recloser Battery Voltage check (Digital)
- Capacitor Bank Monitoring (Alarms)
- High Impedance Faults (ArcSense)
- Underground Vault Temps and Water levels (Analogs)

Operational Data needed by System Operators

- Voltage by Phase (Analogs)
- Current by Phase (Analogs)
- VARs (Analogs)
- Switch Status (Digital)
- Alarms (Digital)

Example of Devices – G&W Viper | SEL-651R Relay

- 6,000 Overhead Vacuum Circuit Reclosers
- Plans for 1,000s more
- Can perform individual phase tripping
- Lots of device diagnostic data from relay

Business Drivers That Initiated this Project

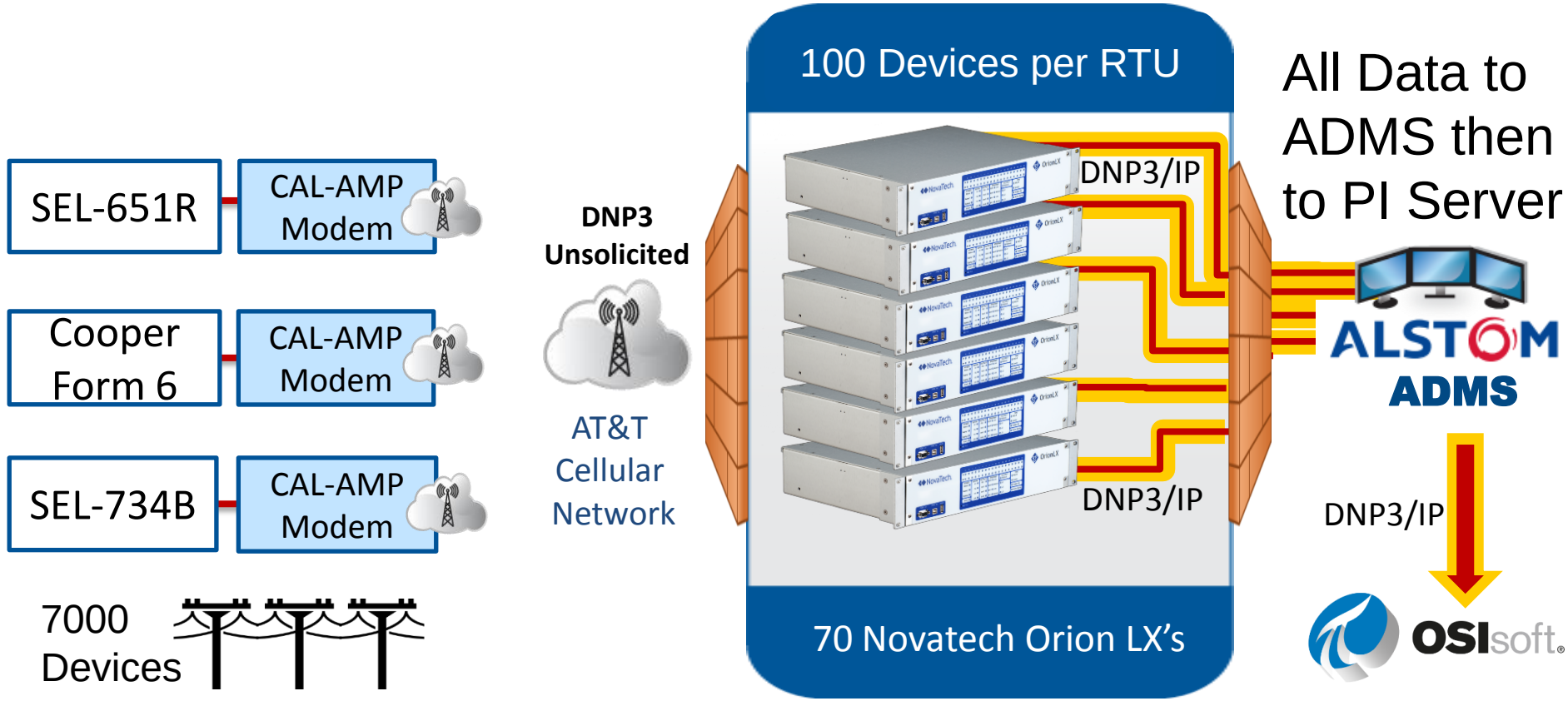
- Desire to leverage the PI System to monitor asset condition and predict maintenance cycles to save O&M dollars.
- Needed an extensible way to feed asset condition data to the PI System *separate* from the DMS system.
- IT team needed a way to add new devices and data to PI dynamically and easily.

Data Concentration Solution

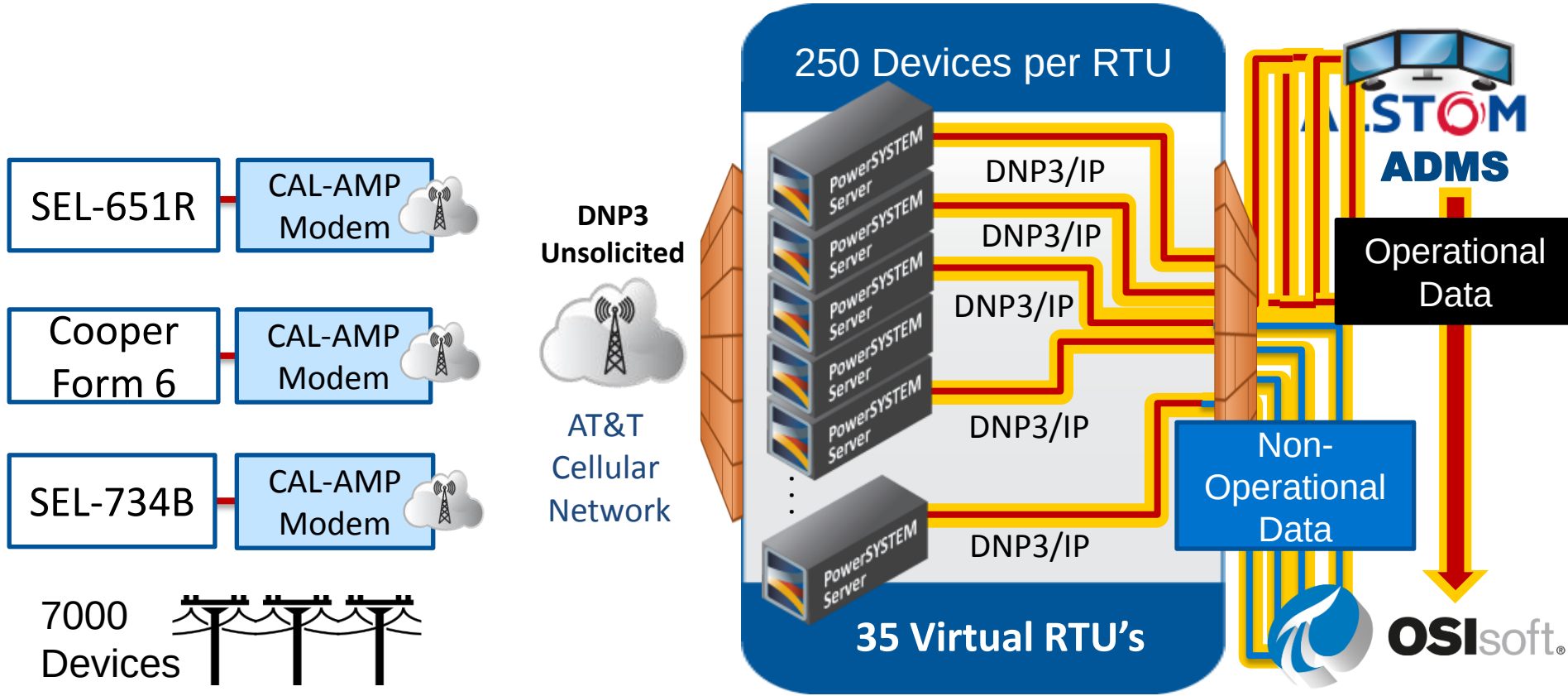
Options to get device data to the central PI Server

1. Direct DNP3 interface from each device to PI Server
   - Impractical
2. Use substation RTU to collect proximity overhead device data
   - Many very rural devices, not ideal
3. Install RTUs on poles
   - More hardware to maintain, very expensive
4. Install RTUs in central data center
   - Previous strategy
5. Virtual RTUs
   - Innovative solution

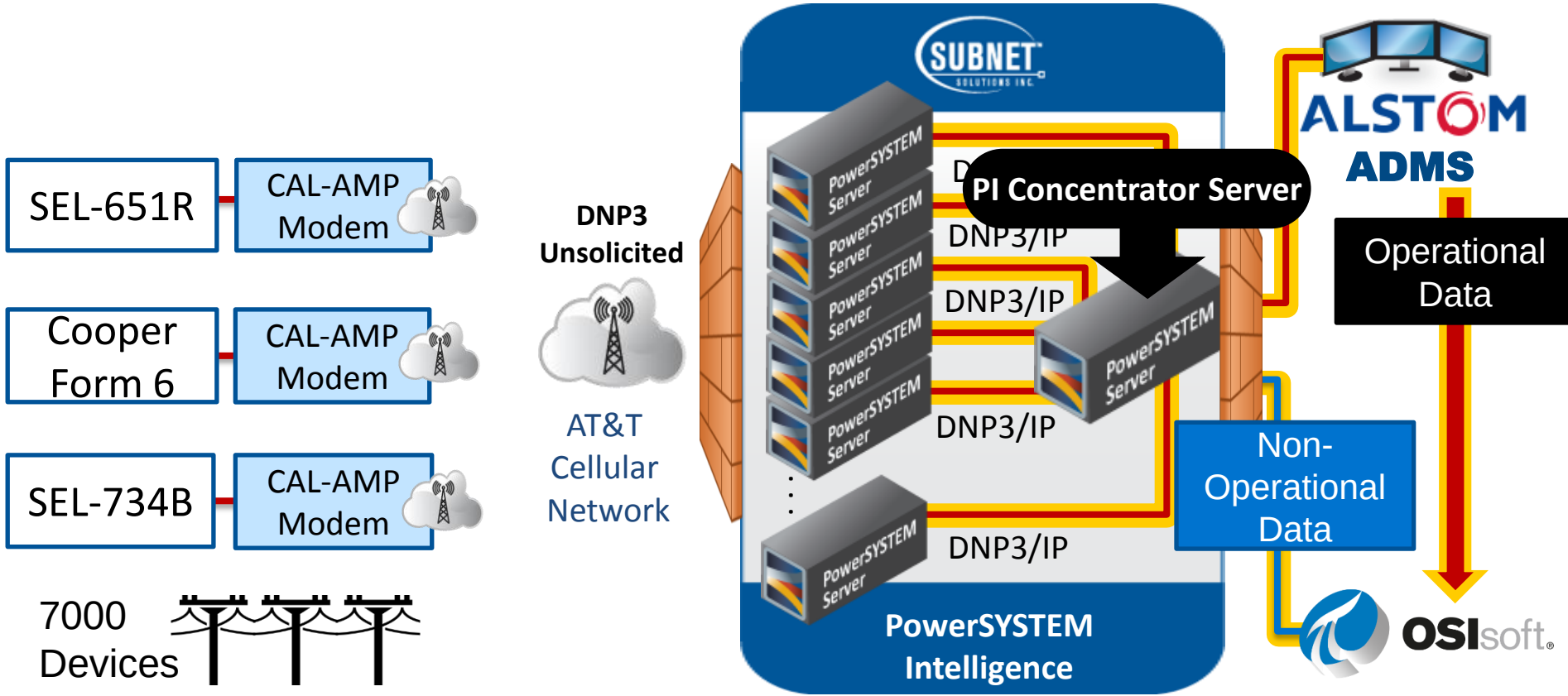
Before Architecture: Physical RTUs in Data Center



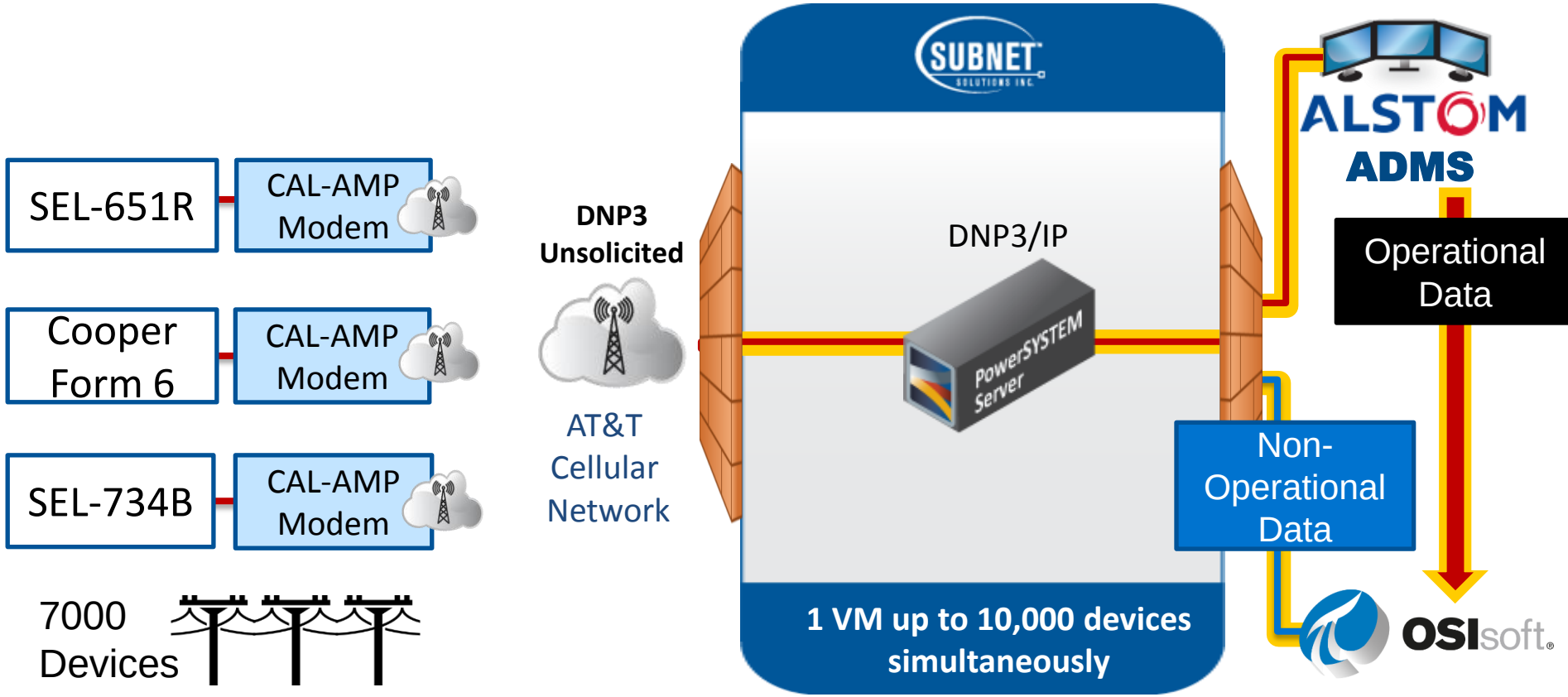
Proposed Architecture: Virtual RTUs



Final Architecture: Two Paths to PI



Future Architecture: One VM for all devices

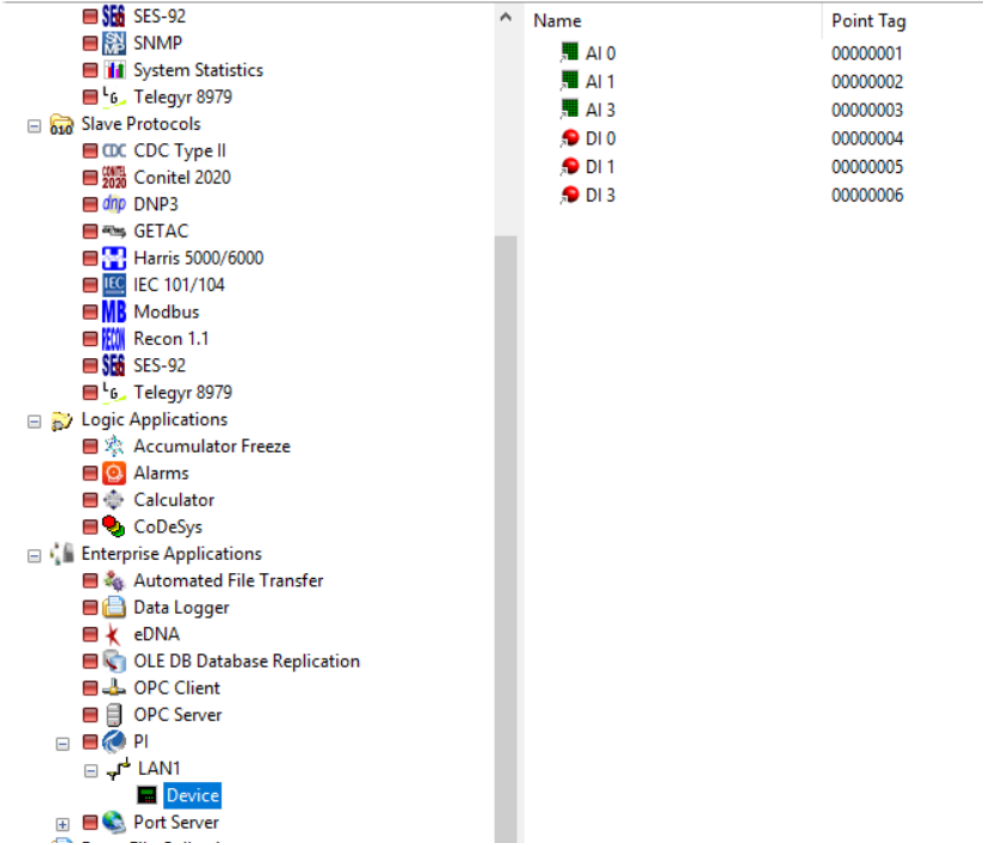


The PowerSYSTEM Server Virtual RTU

- Centralized Device Polling
- Expandable to 1000s of Devices
- Add/Edit Devices on the fly
- Virtual Machine Servers
- One main advantage is the ability to modify, stop, and start DNP devices individually.

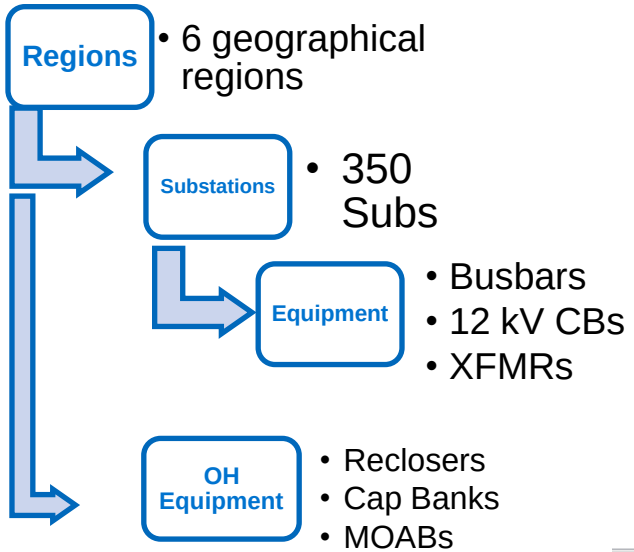
Configuring the SUBNET-PI Interface

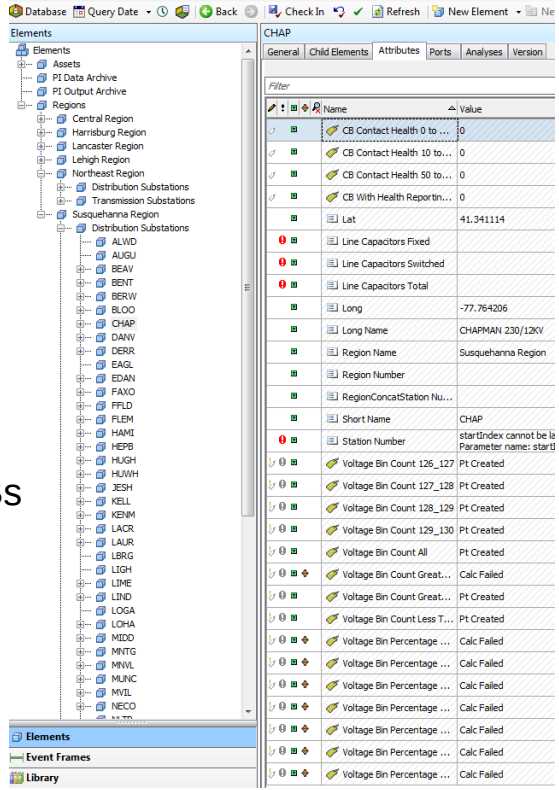
- Uses Native PI SDK
- One DNP connection to PI Server
- Plans to use PI Web API in the future for AF templatizing



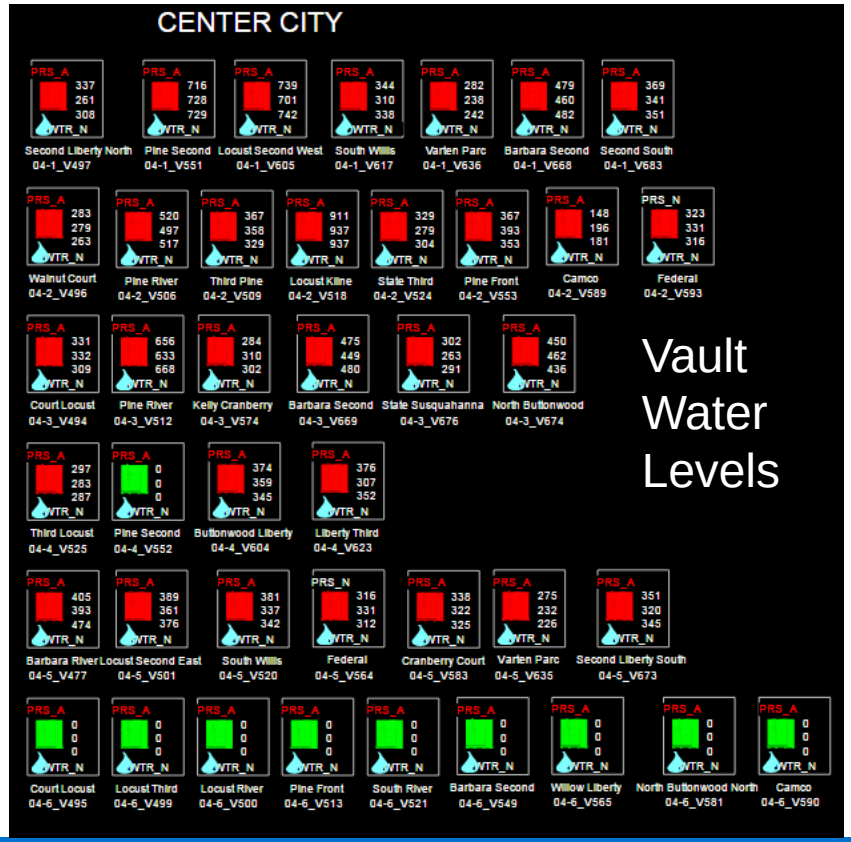
Distribution Asset Framework

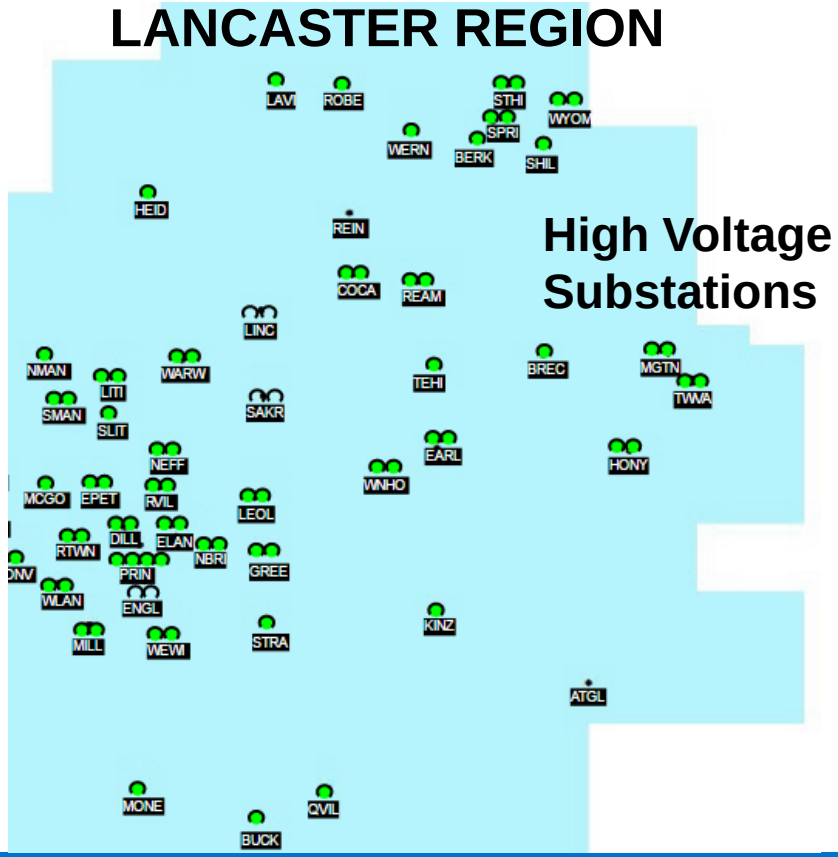
- Asset Framework built for Distribution Substations and Overhead equipment
- 200,000 total tags
- 30,000 analyses tags
- Event Frames templates
- Structured PPL's future analytics strategy

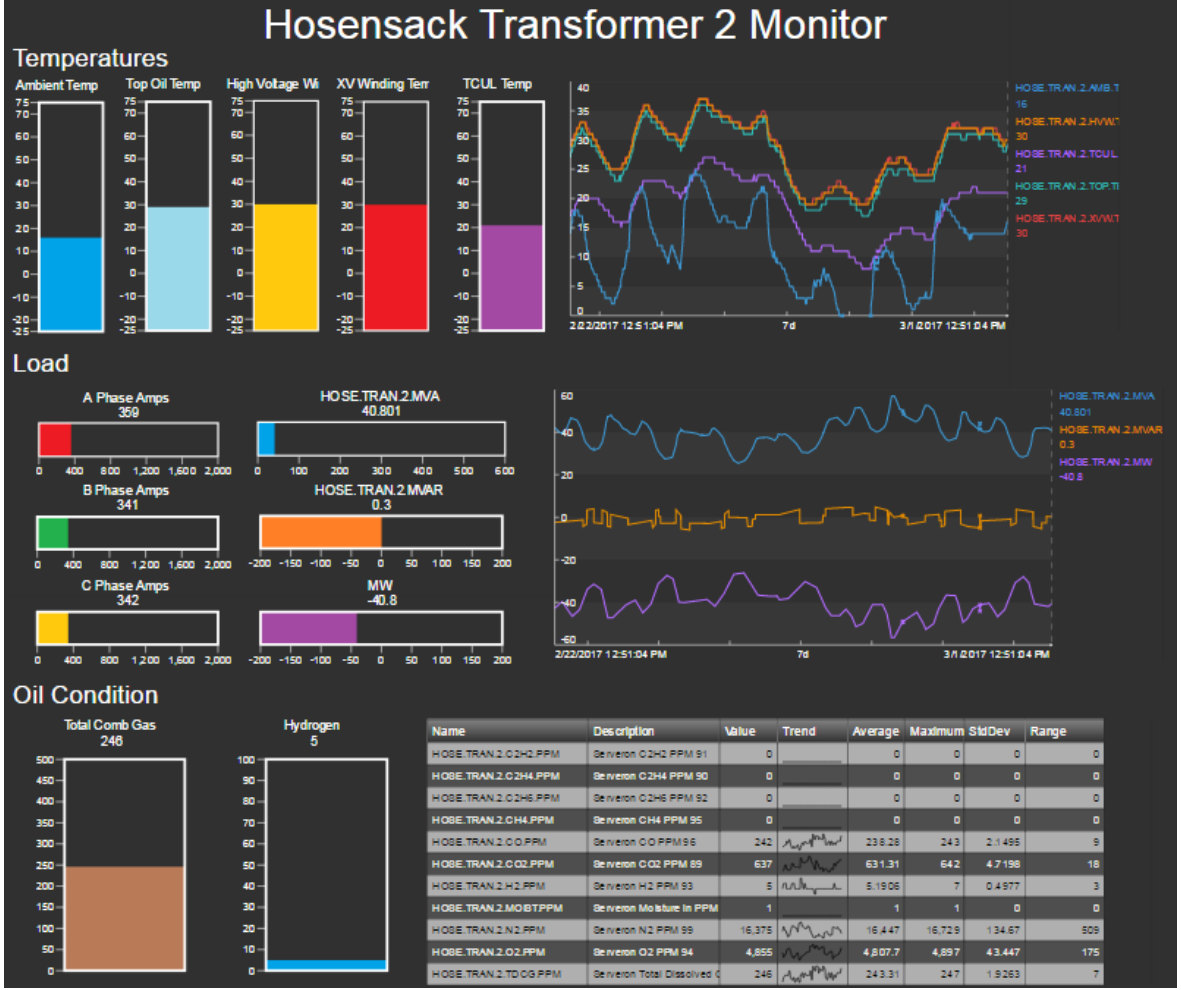




PI Coresight Displays for Operational Intelligence







Asset Framework allows for quick and easy building of rich element relative diagnostic dashboards displaying asset condition.

Value Added to Each Use Case

Power Quality Monitoring

- Detect, monitor, and diagnose high voltage events using Event Frames
- Saved **300+ hours per quarter** in engineer's analysis time

OH Recloser and Circuit Breaker CBM

- Dynamic asset condition monitoring eliminates need for OH Recloser inspection program
- Cost Avoidance of **~$600,000 per year**

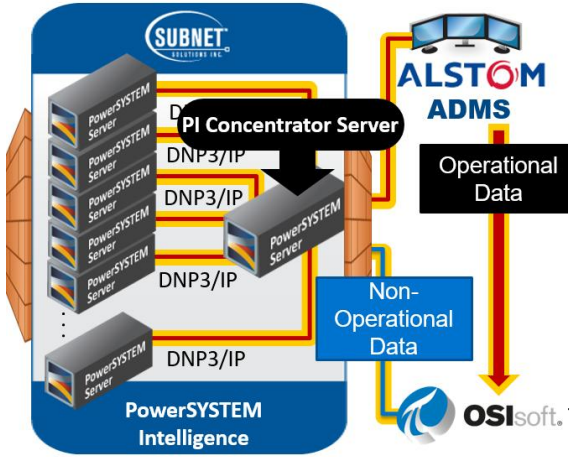
Capacitor Troubleshooting

- Rapidly determine capacitor bank issues using Event Frames
- System Operations reaction time is drastically reduced
- Fewer Diagnostic truck rolls
- Increased key customer voltage satisfaction
- **~$150,000 per year savings**

Data Concentration of 7000 Devices

COMPANY and GOAL

PPL Electric Utilities needed a method to broker data to ADMS and the PI System to drive analytics use cases



CHALLENGE

High costs of physical RTUs and ADMS points inhibited the path to data growth

- Many DNP3 interfaces to both ADMS and the PI System
- Not ideal architecture

SOLUTION

Virtual RTUs replaced physical RTUs and simplified interfaces to ADMS and PI

- 35 VMs poll 200 field devices each
- One collector server aggregates all data and brokers to ADMS and the PI System

RESULTS

Significant savings in operational intelligence and asset management programs

- $600k per year savings in elimination of Recloser inspection program
- $150k per year savings in cap bank issue resolution

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session

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감사합니다

Danke

谢谢

Merci

Gracias

Thank You

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Спасибо

Obrigado