openPDC @ ISO-NE

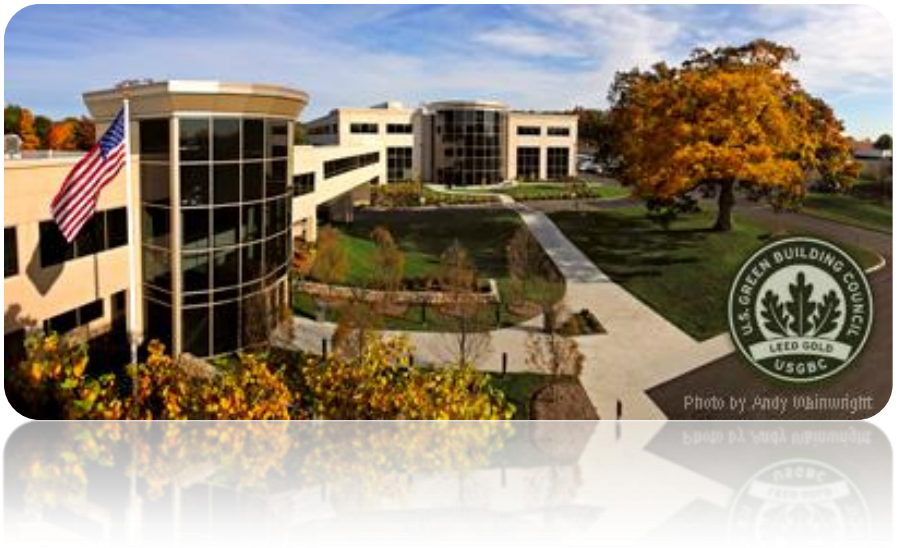
Qiang (Frankie) Zhang
GPA User Forum
Atlanta, GA, Sep. 7, 2011

Outline

- Synchrophasor Data Project Overview
- User Experience
- Lessons Learned
- Data Quality Monitoring System
- Suggestions

About ISO New England

- **Not-for-profit corporation created in 1997 to oversee New England's restructured electric power system**
  - Regulated by the Federal Energy Regulatory Commission (FERC)
- **Regional Transmission Organization**
  - Independent of companies doing business in the market
  - No financial interest in companies participating in the market
- **Major responsibilities:**
  - Reliable **operation** of the electric grid
  - Administer wholesale electricity **market**s
  - **Plan** for future system needs

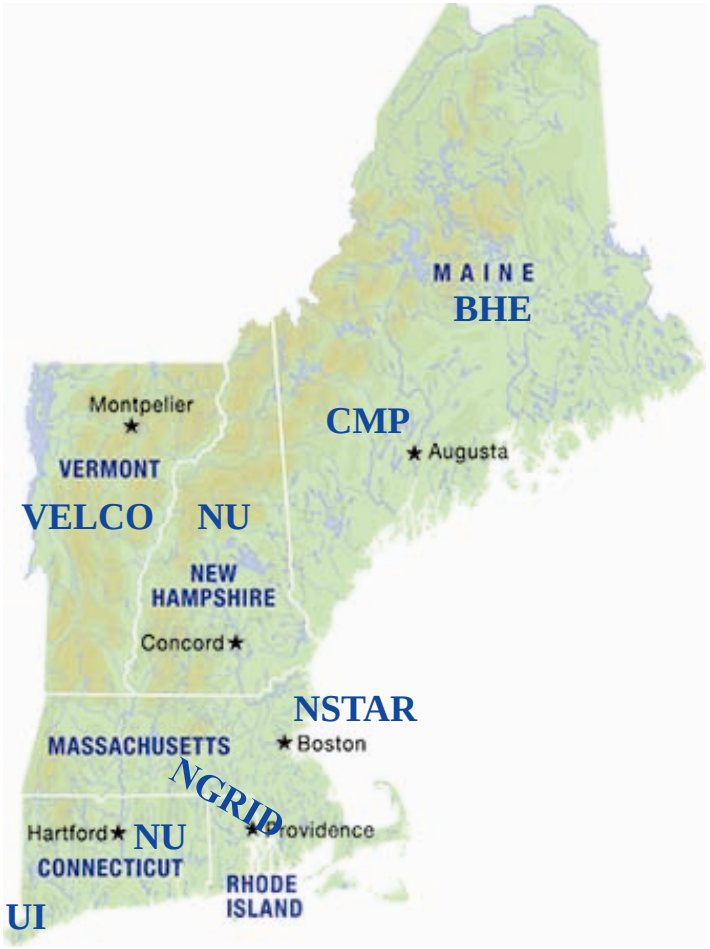


About ISO New England

- 6.5 million electricity customers, population 14 million
- 350+ generators
- 8,000+ miles of high-voltage transmission lines
- 13 interconnections with systems in New York and Canada
- 32,000+ megawatts of total supply (summer)
- 2,500+ MW of demand response (10/10)
- Peak demand:
  - Summer: 28,130 megawatts (8/06)
  - Winter: 22,818 megawatts (1/04)
- 400+ participants in the marketplace
- $12 billion electric energy market (2010)

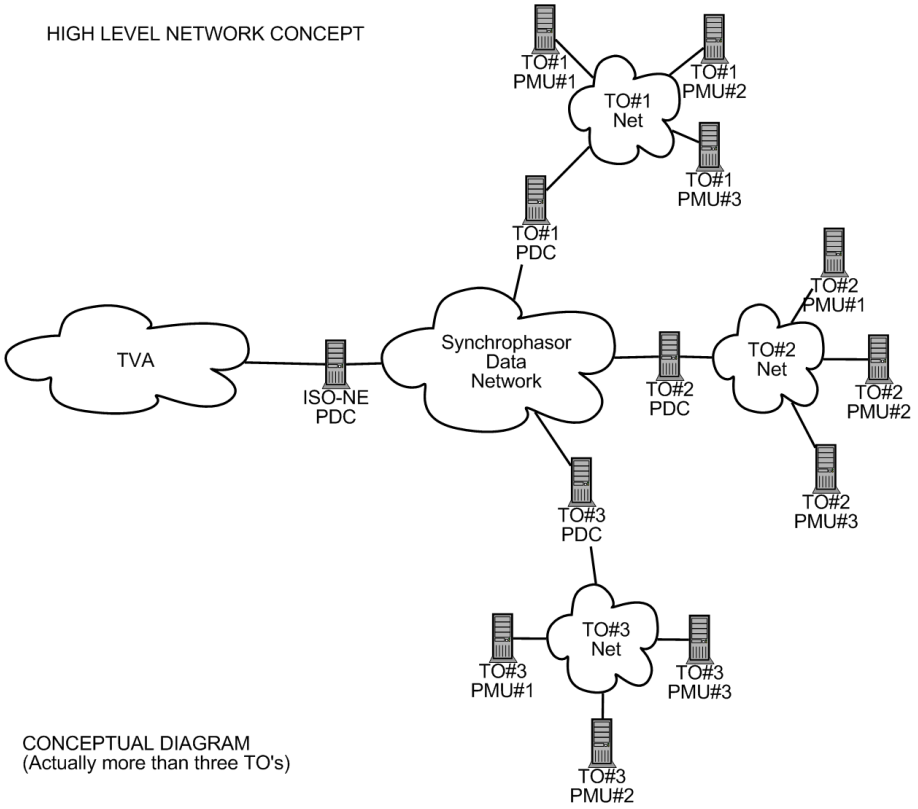
ISO-NE Synchrophasor Project Overview

- Total budget: $18M
- 3 years, 2010 - 2013.
- 7 TOs, 40 Substations.
  - 345kV Observability.
- 7+2 openPDC.
- 3 Applications:
  - ROSE (V&R)
  - TEA/DEMA/VIS (ALSTOM Phasorpoint)
  - Historian (ALSTOM)

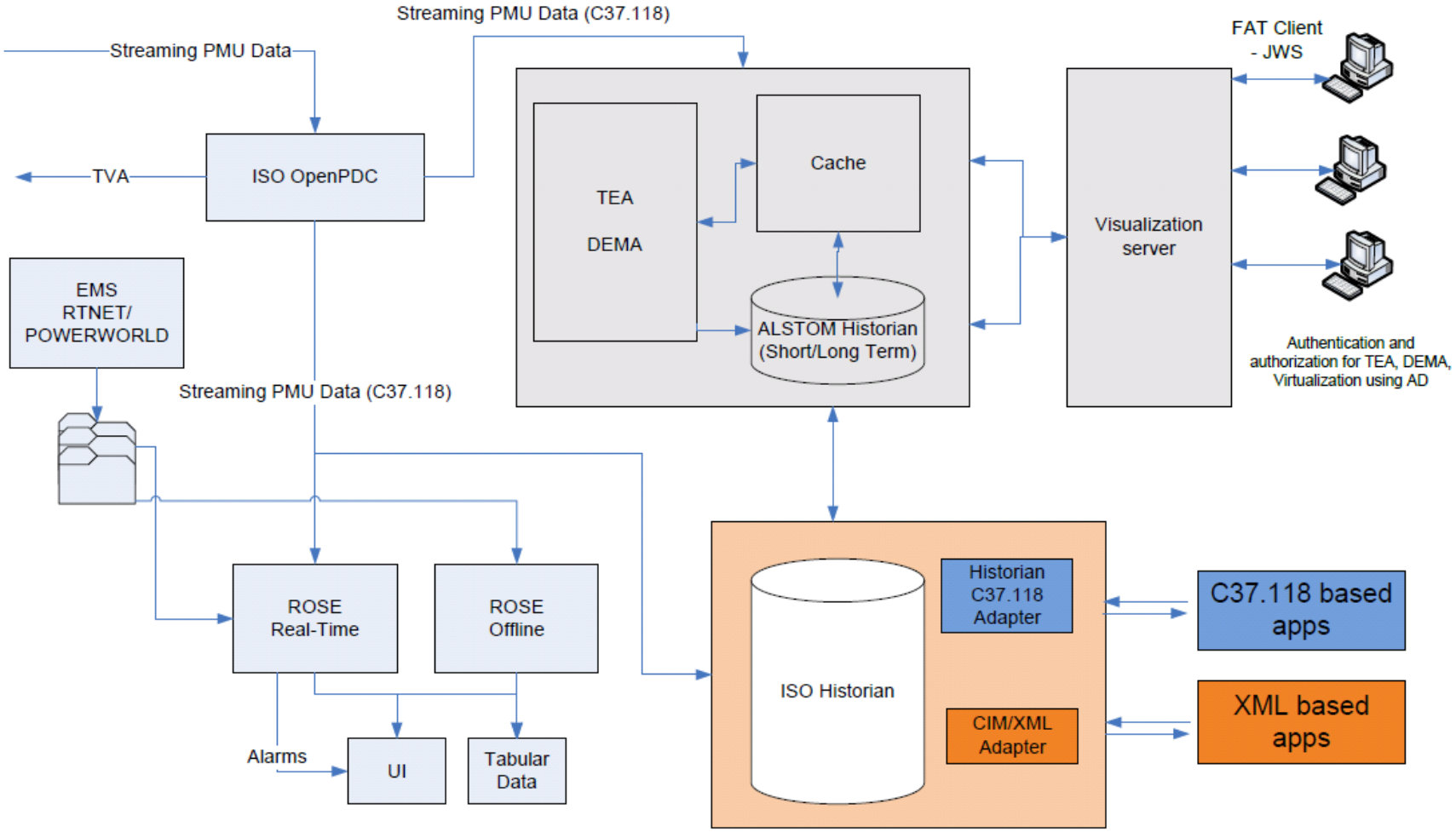


Network Infrastructure

- PMU, DFR, Relay, etc.
- C37.118 - 2005.
- TCP/IP.
- 7 TOs -> ISO communication.
- GPS time signal to each PMU and PDC.



Internal Architecture



Our PDC Requirements

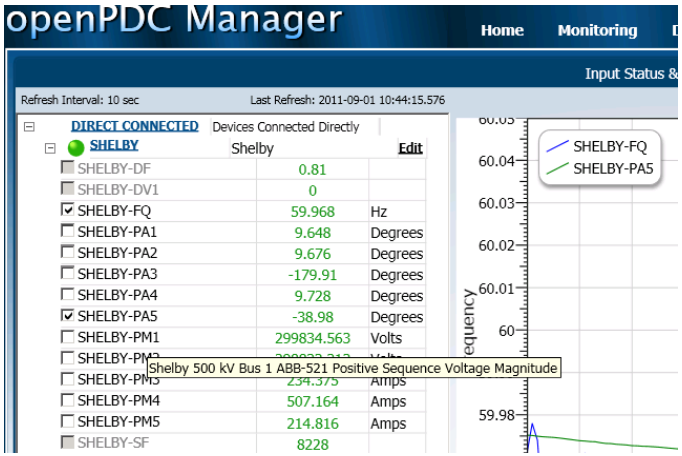
- Stream data to other standalone applications.
- A separate Historian.
- Stream status report/log.
  - PMU data stream changes.
  - Component failure.
- Performance.
  - Latency, availability, capacity.
- Compatibility with other vendors.
  - Conformity with standards.
- Data sanity check.

Why openPDC

- Software PDC
  - Flexibility
- Open source
  - User debugging.
  - Supports outsourcing.
  - Customization.
- Emphasis on advanced adapters
  - Expandability.
  - Code reduction.

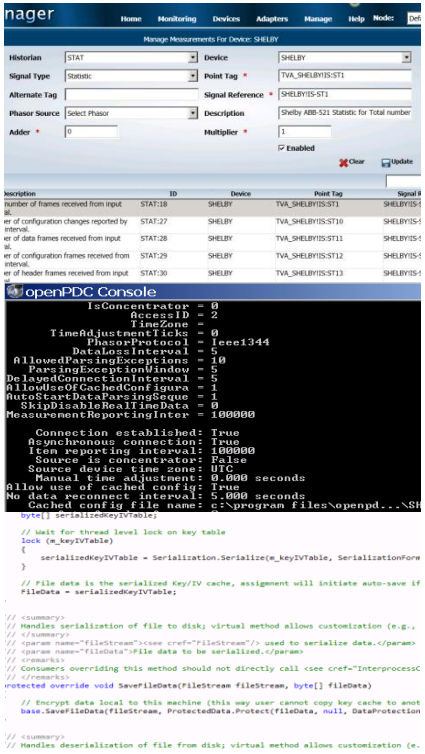
ALSTOM Grid Support

- Documentation and Training.
- Release testing.
- Onsite installation.
- Troubleshooting.
- Customization.
  - Channel name display (in progress).



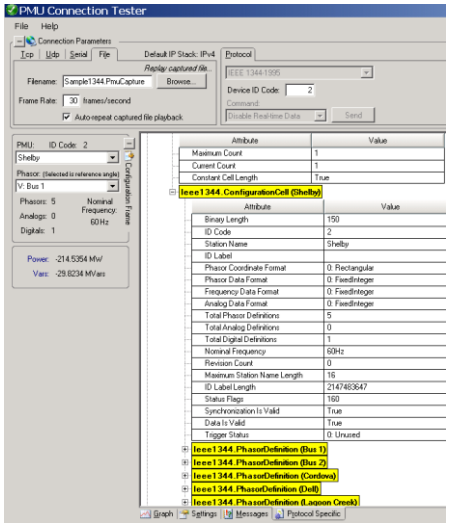
User Experience – openPDC

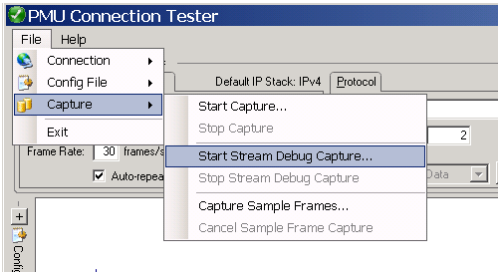
- What we like:
  - Does not tamper with data, yet capable of doing it if desired.
  - Highly Configurable.
  - 3D user experience.
    - Horizontal, **vertical**, development life cycle.
- Improvements:
  - Much more stable now.



User Experience – PMU Connection Tester

- Pre-installation network verification.
- Synchrophasor data validation.
  - C37.118 configuration frame decoding.
  - Voltage, power value display.
  - CSV files for further analysis.
- Troubleshooting.
- Potential usage.
  - A “multi-meter” for PMU vendor and everyone.





Lessons Learned

- User exhaustive tests and feedbacks are important.
  - GPA/ALSTOM have limited test environments/manpower.
    - TCP/IP: “Send config” ->“Stop” will stop everything.
    - Multiple user log in.
- Reliable and accurate time source is very important to the whole synchrophasor project.
- Parameter settings needs investigation.
  - Lead time, lag time.

Data Quality Monitoring System

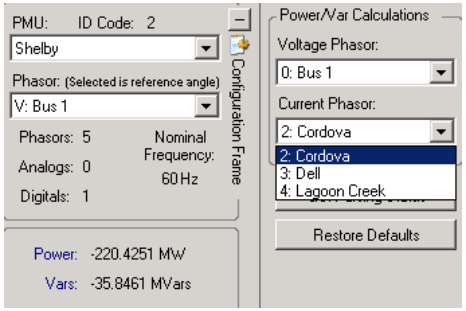
- A new openPDC Adapter.
- 24×7 online monitoring and alarming.
- Ensure applications get “quality data”.
  - Availability, Timeliness, Validity.
- Extends current openPDC data quality monitoring adapters.

Data Quality Monitoring System

- Add other features to make it comprehensive:
  - Reasonability check:
    - Engineering judgment (require experience with PMU data).
    - Endless scenarios: anything can go wrong (R&D).
  - Crosscheck:
    - Compare data with SCADA/SE and other PMUs.
  - Other features:
    - UI reporting for IT daily maintenance monitoring (alarm).
    - Diagnose problem element (source).
- Is “State Confirmation” project still around?

Suggestions

- PMU Connection Tester (very useful tool):
  - Make it a single package that already includes necessary .Net contents (No need to install .Net framework separately).
  - CSV file first line displacement.
  - Output power (P&Q) in CSV files (useful in data validation).
  - Output config file in a more human readable format.

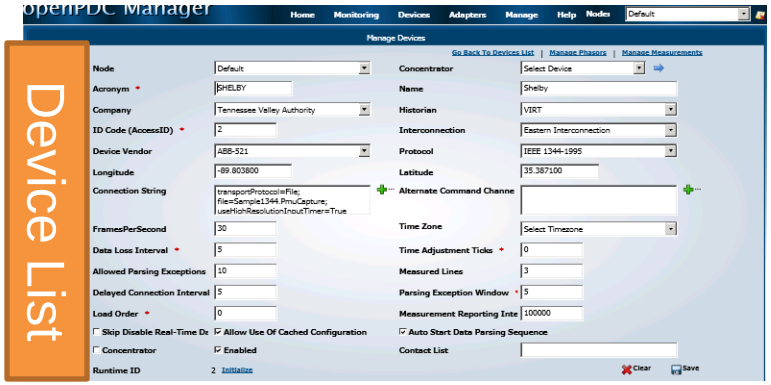



```
<a3:AnalogDefinitionCollection id="ref-9" xmlns:a3="http://schemas.microsoft.com/clr/nsas
  <maximumCount>0</maximumCount>
  <count>0</count>
</a3:AnalogDefinitionCollection>
<a3:DigitalDefinitionCollection id="ref-10" xmlns:a3="http://schemas.microsoft.com/clr/nsa
  <maximumCount>1013</maximumCount>
  <count>1</count>
  <item0 href="#ref-16" />
</a3:DigitalDefinitionCollection>
<a1:PhasorDefinition id="ref-11" xmlns:a1="http://schemas.microsoft.com/clr/nsassem/T
  <parent href="#ref-5" />
  <index>0</index>
  <label id="ref-17">Bus 1</label>
  <scale>2466979</scale>
  <offset>0</offset>
  <type xsi:type="a3:PhasorType" xmlns:a3="http://schemas.microsoft.com/clr/nsassem
  <voltageReference xsi:null="1" />
</a1:PhasorDefinition>
```

Suggestions

- openPDC
  - Better UI experience
    - Easier and faster navigation and configuration.
    - Less unnecessary “confirm”.
    - Make displays more informative and easier to get information from.

Put Actual Measurement in front of Statistics.



Quick Device List left column.

Suggestions

- openPDC cont.
  - Use SQL server more or never – expensive for configuration only.
  - Long term statistics.
  - Put Virtual Historian in initial DB setup.
- Integrate or separate?

Thanks!

Questions?