Alarming and Operations of openPDC at ISO-NE

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Outline

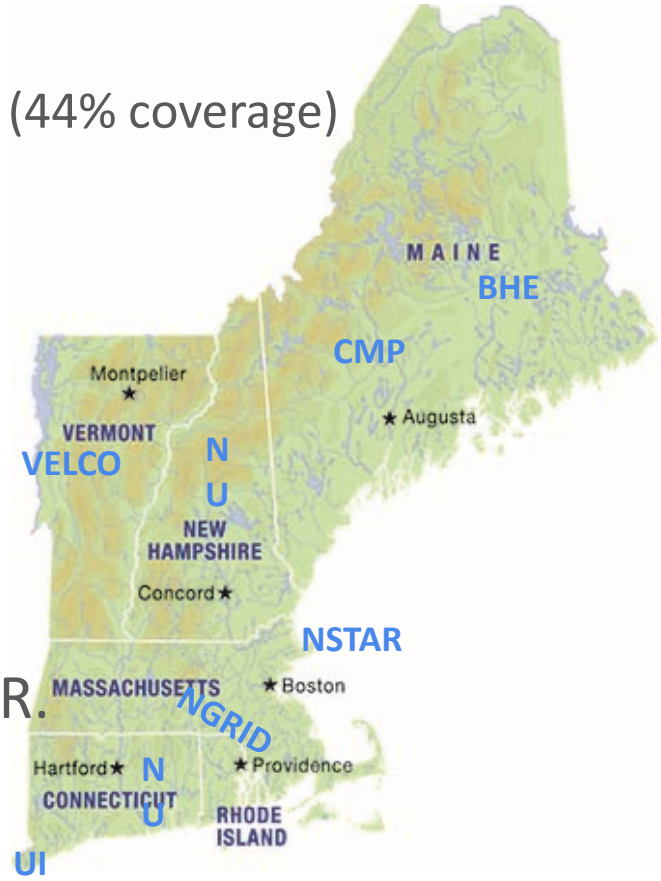
- Project Overview
- Project Status
- Development
- Challenges
- Discussion

ISO-NE SIDU Project Overview

- "Synchrophasor Infrastructure and Data Utilization" – SIDU.
- Purpose: Develop Synchrophasor infrastructure and provide the Smart Grid technology platform, upon which advanced analysis and visualization tools can be deployed to enhance situational awareness.
- DOE Recovery Act Smart Grid Investment Grant (SGIG)
  - Total Budget: $14.9 million
  - Federal share: $6.4 million
  - Project Duration: 7/1/2010- 6/30/2013

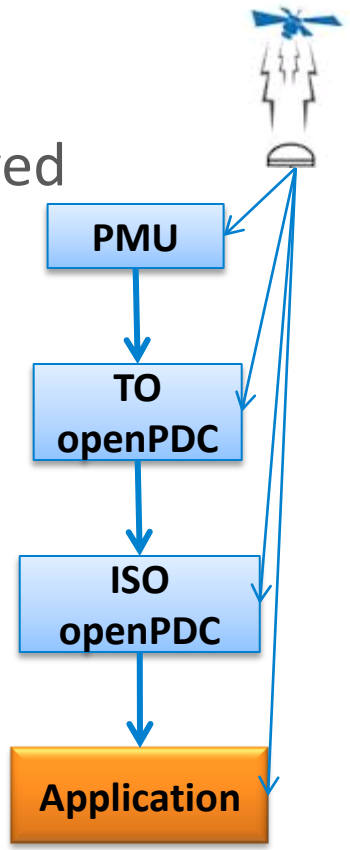
ISO-NE SIDU Project Overview

- PMUs installed at 40 substations.
  - 345 kV network observable – 36 substations (44% coverage)
  - Selected 115 kV substations – 4
  - 30 samples/second data rate
  - Synchrophasor: voltage and current
    - positive sequence OR one phase
  - Synchroscalar: frequency and ROCOF
  - Total: 78 PMUs, 390 synchrophasors.
- PMU, Multi-function Recorder, Relay, DFR.
- 7 Transmission Owners.
- TCP/IP, C37.118-2005 protocol.



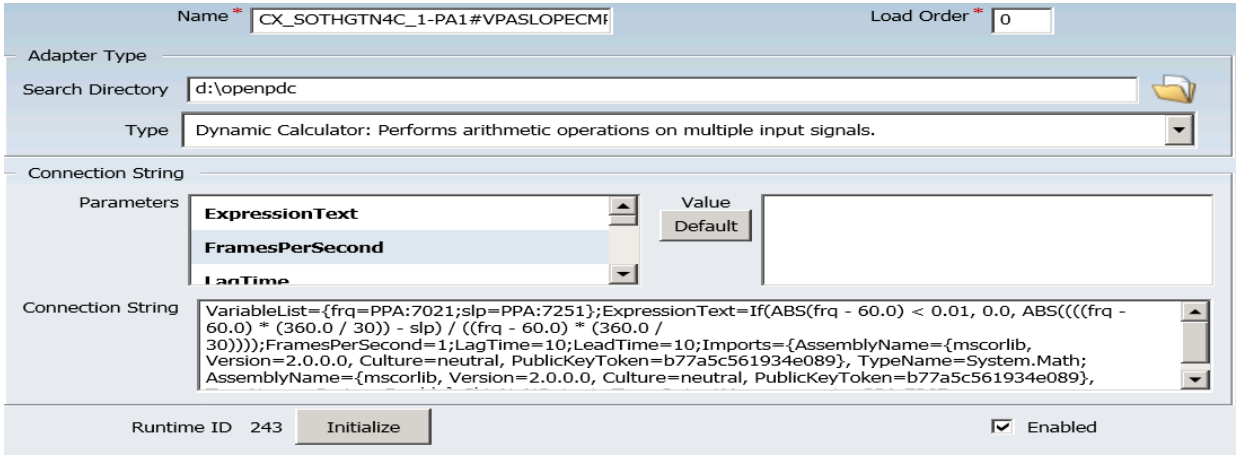
ISO-NE SIDU Project Status

- All PMU data are ready for use by applications.
  - Data validation (manual process) is complete.
- DQMS (Data Quality Monitoring System) is deployed to check data quality online.
  - Only alarms; does not modify data.
- Historical data are readily available online.
  - 1 ½ years data is already available.
  - 3 years raw data storage capability.
- Advanced applications are installed and tested.
  - PhasorPoint, ROSE, Master Station.
- Not in control room; will be used by operation planning engineers.



Development – ISO-NE DQMS

- Alarm: used openPDC provided alarming services (v1.5)
  - How many alarms can openPDC support considering performance?
- PI Adapter
  - Had a hard time bringing data with different sampling rates
- Calculated values: wrote new openPDC action adapters
  - Voltage angle comparison
  - Voltage angle slope – Frequency conformity test

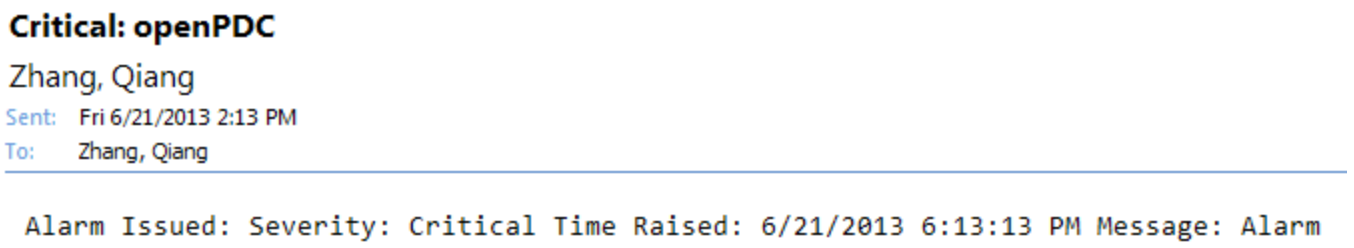


User Development – ISO-NE DQMS

- Alarm View
  - openPDC Manager/Monitoring/Alarm Status
  - Tried SQL Server Report Builder

4/22/2013 3:05:35 PM	4/22/2013 3:06:36 PM	VE_VERNON_2A		Medium	Greater Than	0.20491312824068295		CALC	PPA:3799	0.05	VE_VERNON_2A-PA2#VPASLOPECMP
		VE_VERNON_2B		Medium	Greater Than	0.22258382112374556		CALC	PPA:3800	0.05	VE_VERNON_2B-PA2#VPASLOPECMP

  - Building a better view…
- Critical alarms sent by email.



User Development – ISO-NE DQMS

- Angle Trend – Frequency Conformity Test
  - Synchrophasor angle constantly inc/dec at a specific rate according to F.

$$DROCOA_{Theoretical} = (f - f_0) \times 360 / m$$

  - Linear regression to get real value.
- Actual Case (1)
  - Phenomena:
    - Voltage angles randomly varying around one value – almost flat, but not constant.
    - Voltage angles not moving with other PMUs, causing an islanding alarm in PhasorPoint.
    - Calculated powers were correct – voltages and currents were in phase for that PMU.
  - Reason:
    - An actual measurement signal was used as angle reference instead of the GPS signal.
    - This is acceptable for other purposes; only affects PMU functionality.
- Actual Case (2)
  - Phenomena:
    - Difference between actual angle trend and trend calculated from frequency is 50%.
  - Reason:
    - Frequency is 0.003 Hz higher than nearby substations – within 5mHz C37.118 Max FE.

Future Challenges

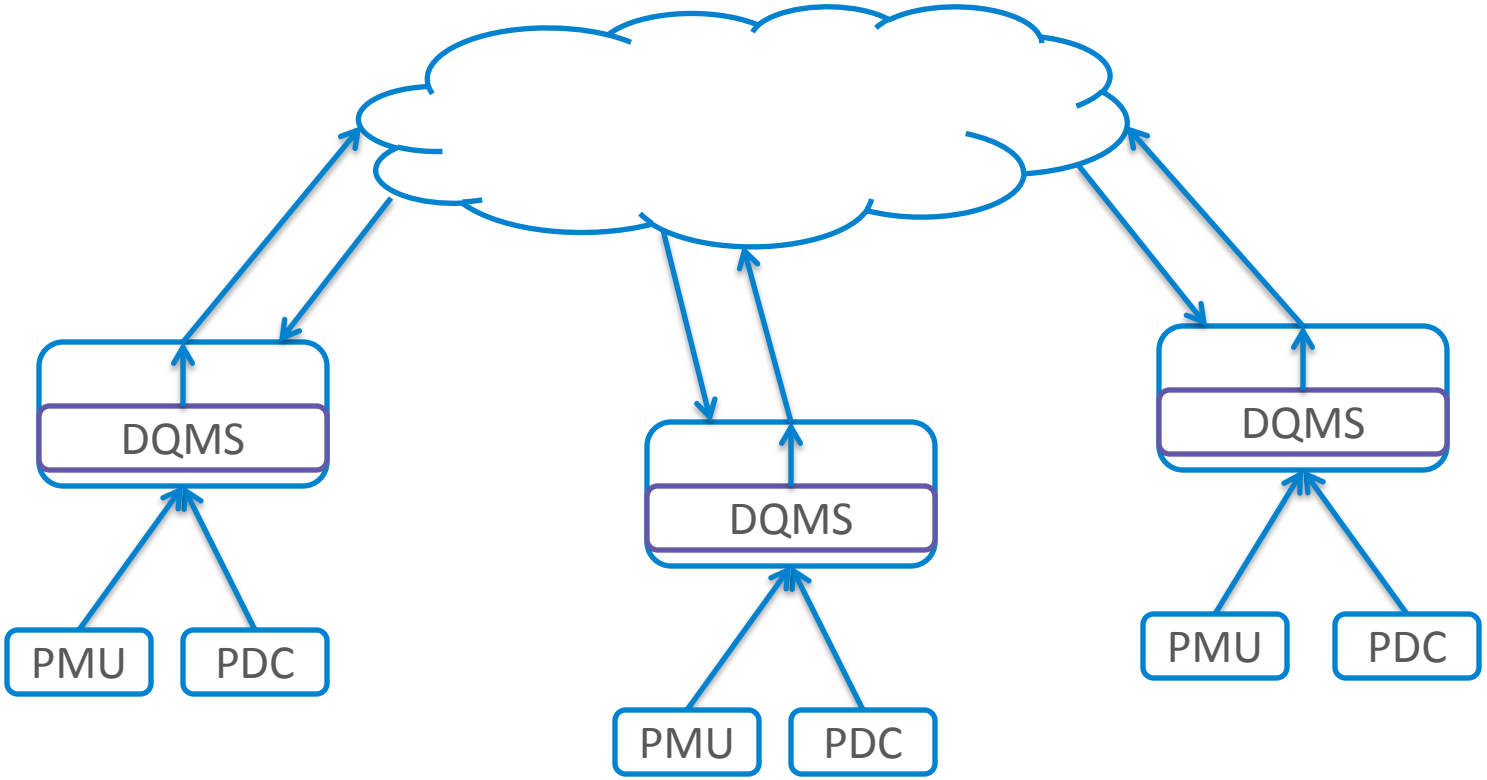
– to address in today's design

- Different types/rates of time stamped data
  - PMU data
  - DFR disturbance data (much higher rate)
  - Lost PMU data (data gap)
  - Other time stamped data
- Need one framework that can:
  - Transmit different types of data online (with priorities set)
  - Time align in historian
  - Easy access for post event analysis
- Network File System (NFS)
  - Historian performance
  - Special needs?

Future Challenges

– to address in today's design

- Data exchange: quality guaranteed?
  - Who is responsible for quality check?
  - How to communicate data quality problems?



Discussion

- Backup plan – necessary for production environment
- DB designs:
  - Relational DB:
    - Easy to check integrity
    - Transactional
    - Easy for backup & restore
    - Prepared for HA
  - Current openPDC DB:
    - Not easy to test transactional integrity.
  - Scenario:
    - One Transmission Owner lost it’s statistics for some PMU devices.
  - Solution: TSM.
- High Availability (HA)
  - Remember: openPDC requires each machine has its own stream.

Questions