Synchrophasors at ComEd Today (and Tomorrow)

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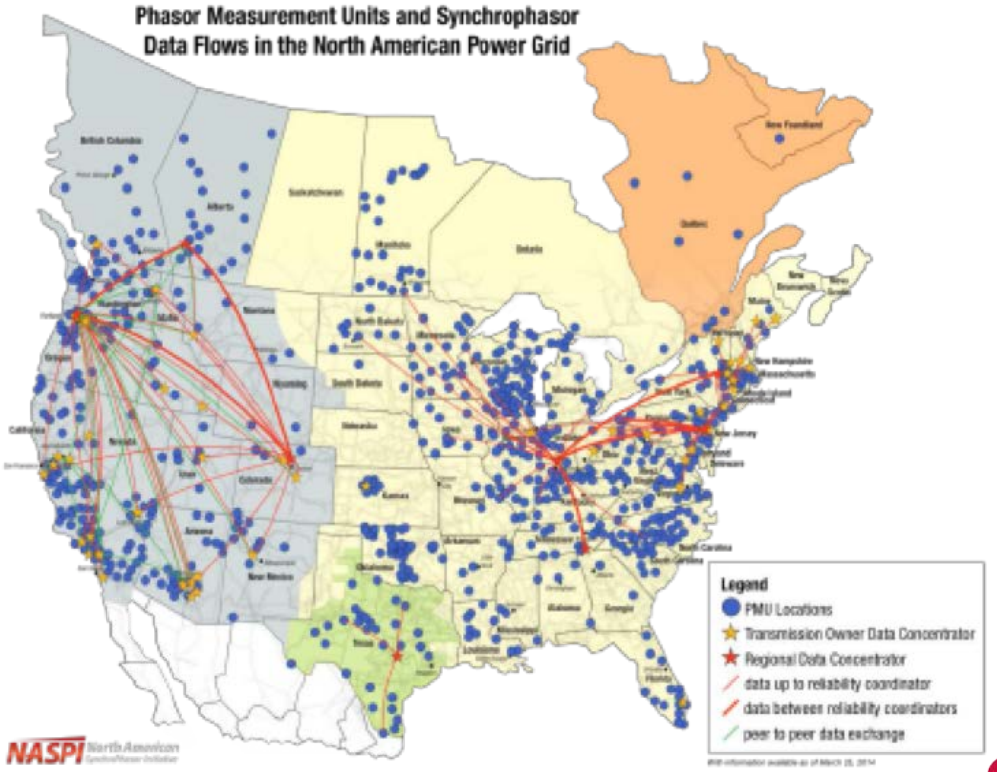
ComEd PMU Installations

- 12 PMUs
  - Initial PMU installations were part of PJM's DOE ARRA effort
- All PMUs send data to a single PDC which forwards the data to PJM
  - All data is sent to a second PC running SEL SynchroWAVE
- PMU installations:
  - 7 substations
  - 9 345kV
  - 3 138kV



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Now What

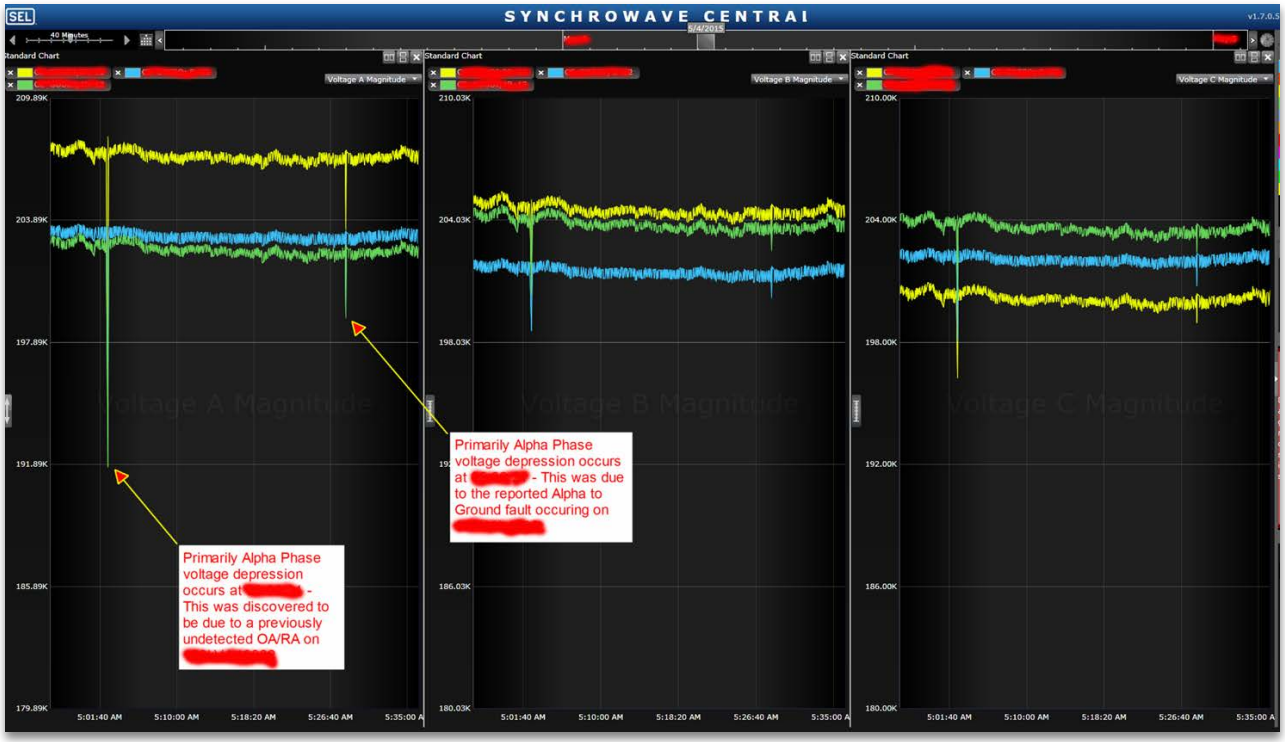
- By late 2012, we had PMU data, but no good way to do anything with it
- The first sets of data were provided to universities (IIT, UIUC) for research and teaching
  - University of Illinois at Urbana-Champaign (UIUC)
    - Data provided for graduate student research
    - This effort will restart soon
  - Illinois Institute of Technology
    - PMU data is being used to support research projects and to develop a short course as part of DOE funded Synchrophasor Engineering Research and Training (SERT) project
- Internal use was limited
  - “What do we do with these things?”
  - Initial work to do comparisons between state-estimator phase angles and PMU data
    - Calculated SE phase angles are archived for comparisons with PMU data
- Collaborative effort with Argonne National Laboratory
  - More information later today
- We needed some bling!

SynchroWAVE

- Installed SynchroWAVE in August 2014
- SynchoWAVE is web based, so it can be readily available to other users
- Useful for real-time and historical analysis
  - Graphical display of PMU data
  - Modal analysis
- Held introductory session with ComEd's real-time analysis group shortly after installations
  - They found interesting things…

Easy Application

- Digital Fault Recorder with Continuous Storage
- Do not underestimate how useful this is!
- What we learned:
  - PMUs can make better DFRs than DFRs



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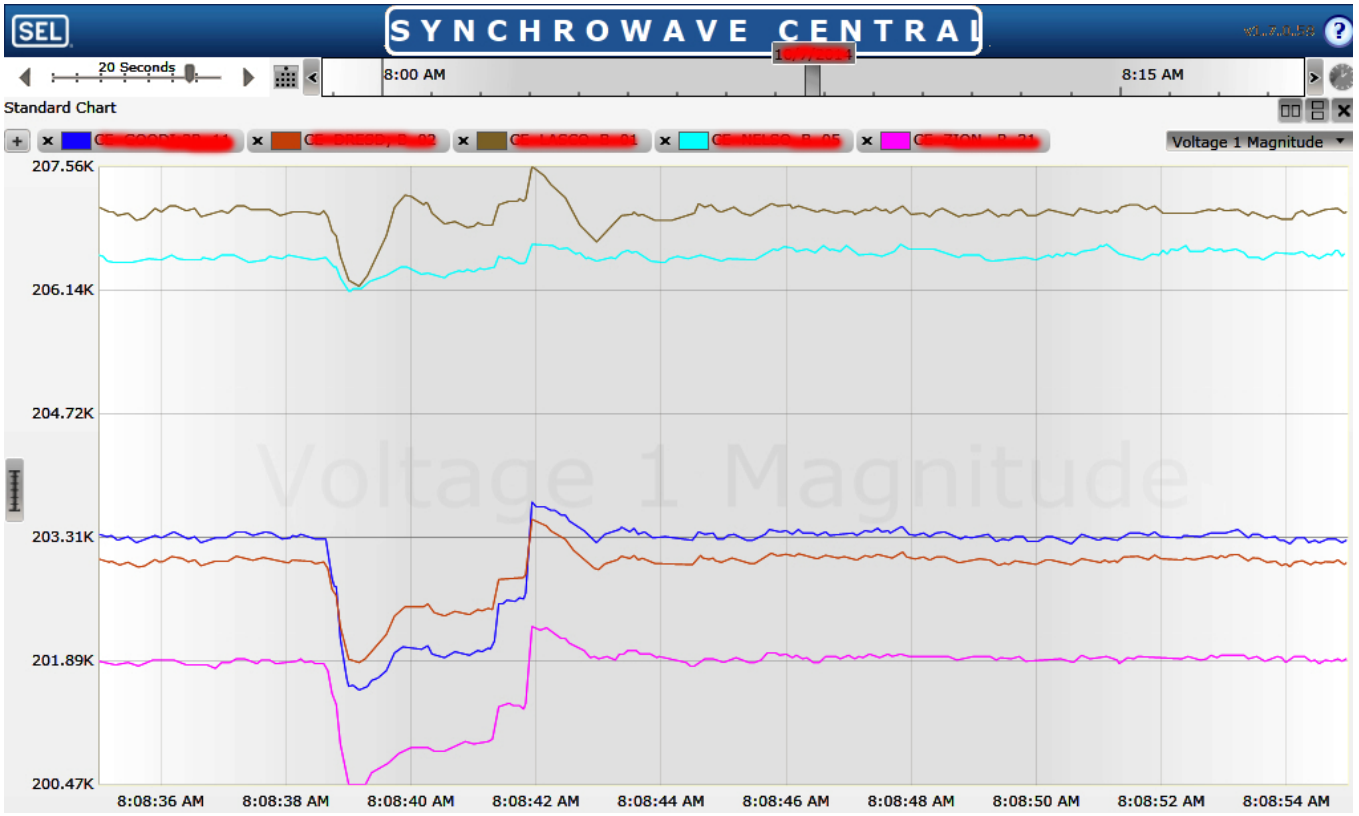
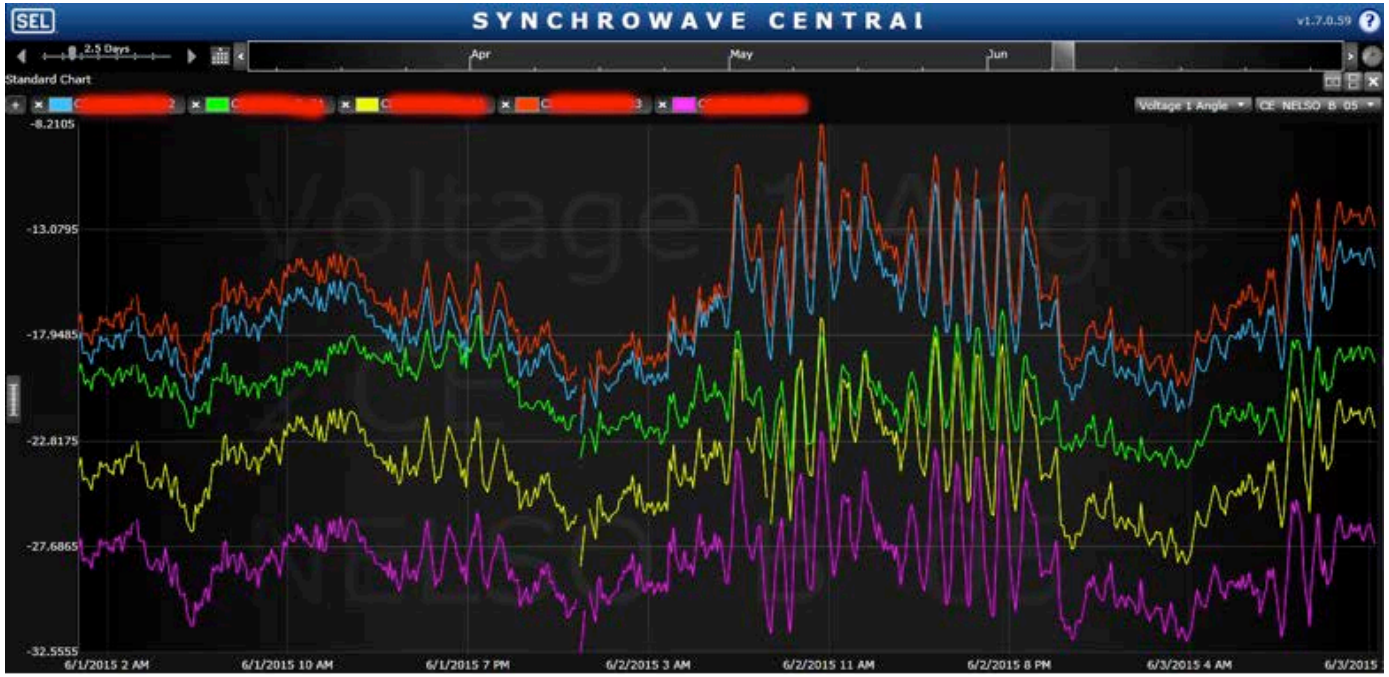
Bad Squirrel

- A squirrel got onto a 12kV bus where it didn't belong…
- What we learned:
  - The squirrel caused a transient seen on the transmission system



Hourly Oscillations

- Oscillations with 1-hour period
  - o Verified in state estimator
  - o Due to flows through ComEd
- What we learned:
  - o Stuff happens



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Going Forward

- Planning for significant increase in the number of PMUs
  - Roadmapping with Quanta is in progress
    - How best to move forward from what we currently have
  - Upgraded PDC and other infrastructure
    - PDC redundancy
    - Data storage
    - Improved access to data
  - Many, many more PMUs
    - Will make sure we get the right data from the right locations on the system
    - Processes to be put into place to simplify PMU installation
    - Eliminate limits to the number of PMUs, for the next few years at least
- Will be putting PMUs on the distribution system
  - This is a natural progression of ComEd's Smart Grid efforts
  - Distribution PMU effort being coordinated with ComEd Smart Grid organization
- Continued collaboration with universities and national laboratories