Synchrophasor Standards: Support and Development

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Outline

• Project objective
• Major accomplishments June 2014 to June 2015 (now)
• Development plans for coming year
• Longer term perspectives
Project Objectives

• Project objectives
  – Develop & harmonize synchrophasor standards
    • Measurements, communications, & data storage
  – Support continuing technology development
    • Assess implementation issues for standards updates
    • Produce guides for synchrophasor applications
    • Provide interpretations for standards & guides
    • Disseminate information about standards & guides
Standards in Measurement Systems

Communication standards
C37.118.2
61850-90-5
DNP3 & ICCP

Measurement standards
C37.118.1
*60255-118-1

Data storage standards
C37.111

Off-line Dynamics Analysis

Real Time Monitoring & Alarming

Future real-time controls:

Data storage standards
C37.111

* Standards under development
Benefit of standards

• Supports technology diversity
  – Assures minimum performance requirements
  – Forms a basis for interoperability
  – Supports competitive market
  – Fosters innovation

• Sets common ground for developers & users
  – Developers willing to risk effort for new products
  – User expectations shaped for what is available
Major Accomplishments in past year

• Continued development of standard IEC/IEEE 60855-118-1
• Completed transactions paper on 37.118.1/1a
• Contributed to:
  – TSS certification program
  – PDC standard development
  – Draft for mapping C37.118.2 data to 61850
• Participated in tutorial on synchrophasors at IEEE GM
• Met with synchrophasor standards group in China
• Related activity
  – PMU testing & application research at NCEPU
  – SOSOPO project & PMU testing at DTU (Denmark)
  – Meetings at EPFL & METAS (Switzerland)
  – Section for Smart Grid Handbook (U. of Manchester, UK)
Some ongoing work—ramp test issue

• Test specifies range, rate, and an exclusion at transitions for non-linearities

• Exclusion is time interval based on reporting rate
  – However reports are only at discrete points

• Are end points of interval to be included or excluded?

• WG voted to include (ie, exclude from evaluation)
New standard – merging unit
(IEC 61850 operation)

- Traditional PMU
  - Contains A/D converters, internal timing
- IEC 61850
  - Electronic transducers & merging units
  - Common characteristics & timing
  - May not match expected performance
New standard – clarify phasor definition

• Original definition taken from basic phasor:
  – \( x(t) = X_m \cos (wt + \varphi) \)
  – \( X = \left( \frac{X_m}{\sqrt{2}} \right) (\cos \varphi + j \sin \varphi) = X_r + jX_i \)
  – \( x(t) = X_m(t) \cos(2\pi f_0 t + (2\pi \int gdt + f)) \)

• New definition starts with general solution sinusoid:
  – \( x(t) = X_m(t) \cos [\psi(t)] \) & \( x(t) = X_m(t) \cos [2\pi f_0 t + f(t)] \)

• Proposed definition explicitly defines parameters:
  – \( x(t) = X_m \cos\{(\omega + C_\omega t) + \varphi\} \)
  – But only applies to incremental linear solution

• Need to explain general solution with derived values
New standard – current plan

• Clarify other points, update reference model
• Align definitions
• Web meetings, meetings at IEEE & IEC events
• Schedule
  – Circulate committee draft (CD) to IEC – February 2016
  – First IEEE ballot – April 2016
  – Final committee draft for vote (CDV) – December 2016
  – Second IEEE ballot – February 2017
  – Final approvals for publication (FDIS) – July 2017
  – IEEE standard – September 2017
  – IEC International Standard (IS) – December 2017
**Risk factors**

- **IEC-IEEE Standard development**
  - Difficult to limit the items participants want to include (the group is very diverse)
  - Arranging meetings challenging—
  - Pressure to have meetings out of North America, but difficult to arrange meetings abroad that NA participants will attend
  - Universally acceptable times for web meetings impossible

- **Technology coordination**
  - Some technology is mostly proprietary, cannot standardize
  - Some aspects too immature for standardization
  - Slow adoption has halted some development
Future development

• Need better characterization of PMU performance
  – With high noise, under faults, CT/PT problems
• Need to document proven methods for data quality
• Evaluate new algorithm research
  – Need improved F and ROCOF techniques
  – Need performance requirements based on application needs
• Investigate & propose changes in communication standards
• Develop data storage & exchange standards
Questions?