DOE/OE Transmission Reliability Program

Synchrophasor Standards: Support and Development

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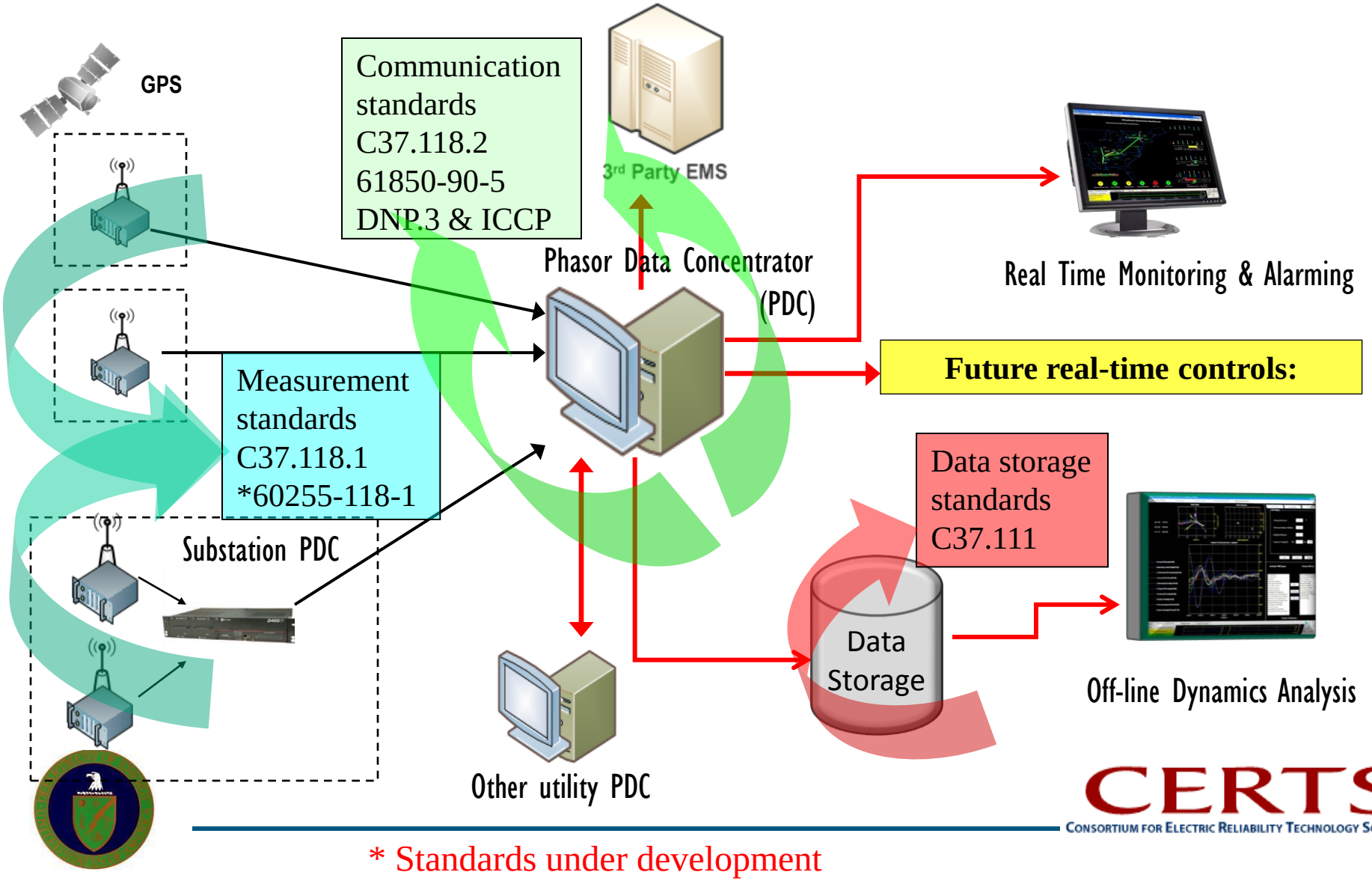
Outline

- 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



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* Standards under development

Benefit of standards

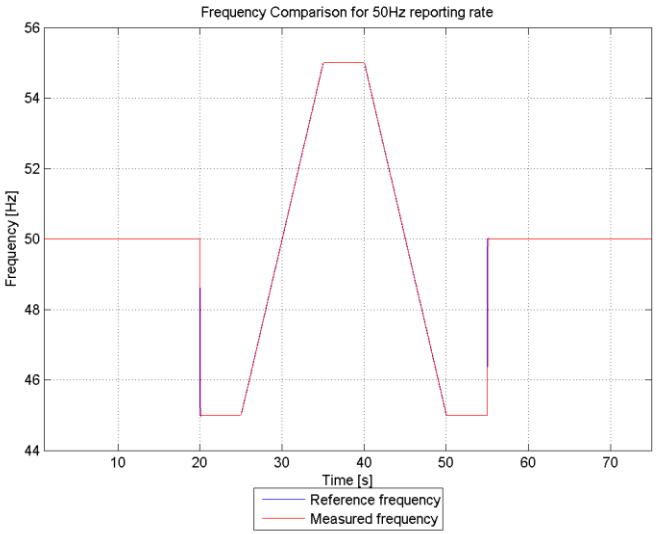
- Supports technology diversity
  - Assures minimum performance requirements
  - Forms a basis for interoperability
  - Supports competitive market
  - Fosters innovation
- Sets common ground for developers & users
  - Developers willing to risk effort for new products
  - User expectations shaped for what is available

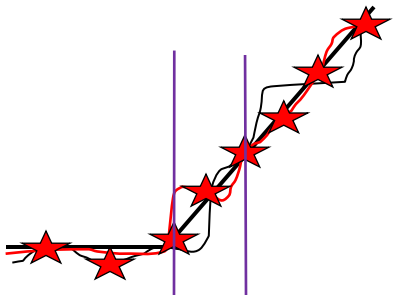
Major Accomplishments in past year

- 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

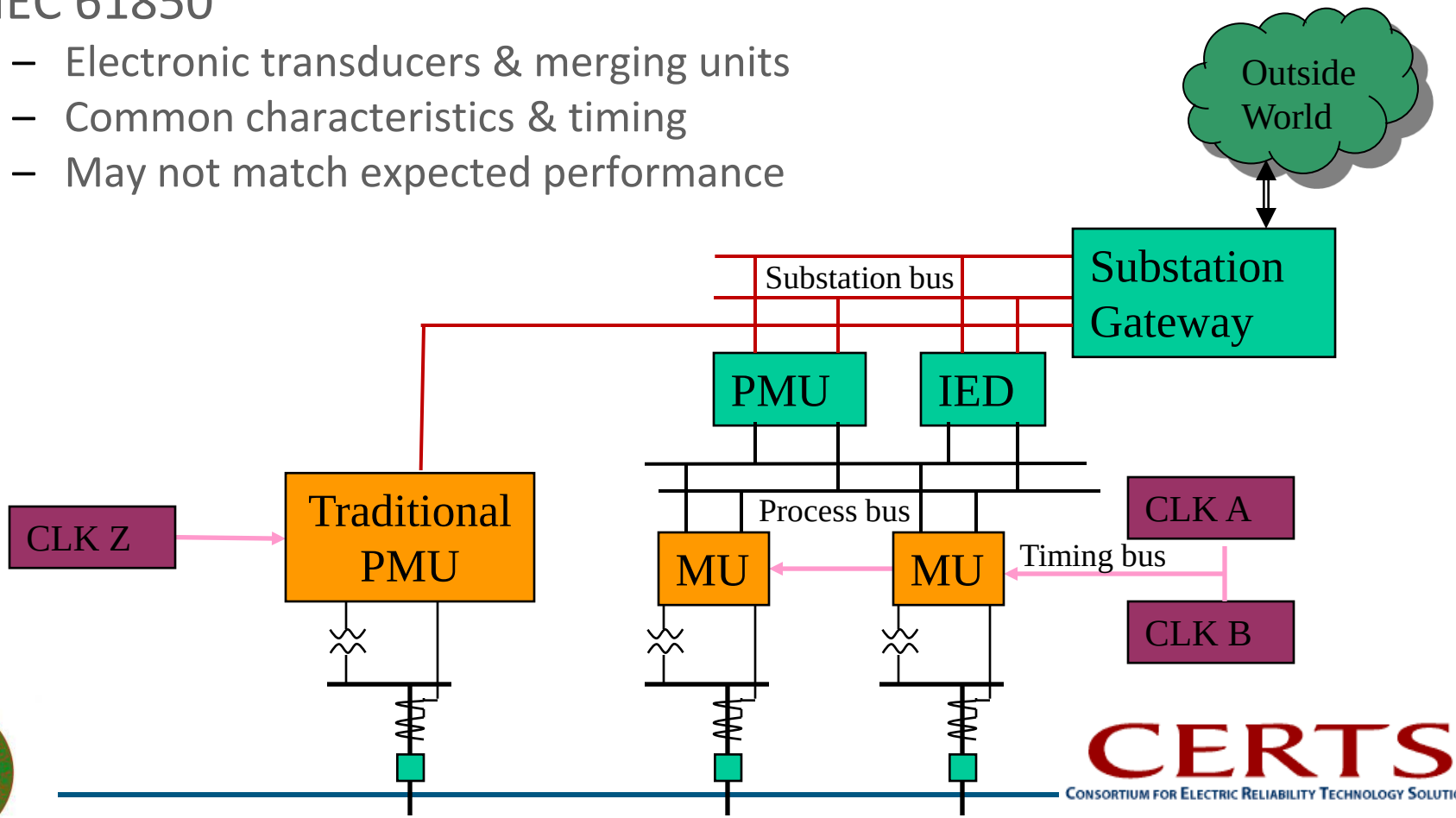
- Test specifies range, rate, and an exclusion at transitions for non-linearities
- Exclusion is time interval based on reporting rate
  - However reports are only at discrete points
- Are end points of interval to be included or excluded?
- WG voted to include (ie, exclude from evaluation)





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:
  - $x(t) = X_m \cos(wt + \varphi)$
  - $\boldsymbol{X} = (X_m / \sqrt{2})(\cos\varphi + j \sin\varphi) = X_r + jX_i$
  - $x(t) = X_m(t) \cos(2\pi f_0 t + (2\pi \int g dt + f))$
- 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:
  - $x(t) = X_m \cos\{(\omega + C_\omega t)t + \varphi\}$
  - But only applies to incremental linear solution
- Need to explain general solution with derived values

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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 do 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?

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