PAP - 13

HARMONIZING IEEE 37.118
WITH IEC 61850 AND PRECISION TIME SYNCHRONIZATION
Agenda – Page 1

- Introductions
- NIST Remarks – Jerry FitzPatrick
- Overview and status of the PAP effort - Ron
- Standards Lessons Learned – Vahid Madani, PG&E
- IEC 61850-90-5 Update – Mark Adamiak, GE
  - IEC 61850-90-5 Overview
  - Implementation Agreement – draft status
Catalog of Standards Status - Ron
Review of last Meeting Notes – Ron
CSWG and SGAC reviews - Ron
SDO Progress and Status Reports (See last meeting notes):
  - IEEE PC37.238 – Galina Antonova
  - IEEE H11 and HTF3 – Ken Martin
  - IEC WG10 – Herb Falk
  - NASPI – Vahid Madani
  - IEEE PC37.242 – Jim Hackett, Vahid or Damir
  - IEEE PC37.244 – Galina Antonova
New items, actions and next meeting
- NIST Remarks – Jerry FitzPatrick
- Framework 2.0 Draft status - Jerry FitzPatrick
IEEE C37.118-2005 is the current world wide standard for synchrophasor data. This standard is being updated and will be published in two parts (118.1 – Measurement and 118.2 – Data Transfer) with the intent of creating a harmonized standard between 118.2 and IEC 61850-90-5.

IEC 61850-90-5 will provide important enhancements in communicating phasor data while still addressing the core data transfer requirements identified in C37.118.

Precision time synchronization is key to many Smart Grid applications. IEEE 1588 (Ver 2.0) has been identified as the network based application to achieve this objective. However a profile (IEEE C37.238 ) for the application of IEEE 1588 to power applications is needed.
PAP13: Overview of Tasks and Status

- Develop Use Cases (done)
- Develop Requirements (done)
- Coordinate CSWG and SGAC reviews
  - CSWG – done
  - SGAC - close
- Keep industry informed (doing it)
- Support IEEE and IEC working groups (doing it)
  - IEC TC 57 – WG10 – IEC 61850-90-5
  - IEEE WG H7 / C7 – IEEE C37.238
- Propose any necessary standards changes:
  - IEC 61850: IEC TC57 WG10
PAP-13 SGIP Activities

- Catalog of Standards Status – IEEE Std C37.238-2011
  - Full document set completed and posted on CoS TWiki page
  - IEEE Std C37.238-2011 – both GB and SGIP votes were successful – October 18
  - IEEE Std C37.238-2011 approved for Catalog of Standards – October 18

- Cyber Security Working Group (CSWG):
  - CSWG liaison to PAP-13 is Sandy Bacik
  - Review of IEEE Std C37.238-2011 is complete
  - Preliminary detailed review of IEC 61850-90-5 is completed

- Smart Grid Architecture Committee (SGAC):
  - SGAC liaison to PAP-13 is Tony Giroti, Bridge Energy
  - Review of IEEE Std C37.238-2011 is complete
  - Preliminary detailed review of IEC 61850-90-5 is pending

- TWiki Updates
Phasor Measurement System

GPS

**Timing standards**
- IEEE 1588 or C37.238-2011

**Communication standards**
- IEEE C37.118.2 *
- IEC 61850-90-5 *
- ICCP

**Phasor Data Concentrator**

**Real Time Monitoring & Alarming**

**Future real-time controls**

**Phasor Data Concentrator**

**Measurement standards**
- C37.118.1 *

**Installation, calibration, test guide**
- C37.242 *

**Substation PDC**

**Other utility PDC**

**Data Storage**

**Phasor Data Concentrator**

**PDC Guide – Requirements, System Communications, Testing**
- IEEE C37.244 *

**Data storage standards**
- IEEE C37.111
- COMTRADE

**Off-line Dynamics Analysis**

* Not yet released
Project Timeline: Simplified + NIST/SGIP

2005
- IEEE C37.118 Published
- NIST SGIP PAP-13

2009
- IEEE Request IEC for Dual Logo
- IEEE & IEC start JTF to develop IEC 61850-90-5

2010
- NIST recommends IEC 61850 for Adoption
- IEEE split C37.118 into C37.118.1 & C37.118.2
- SGIP PAP-13

2011
- 1st DC of IEC 61850-90-5 balloted
- 2nd DC of IEC 61850-90-5 to be balloted
- PAP-13 & SGIP Committee Reviews

2012
- SGIP GB Approval & Recommendation to NIST
- IEC TR 61850-90-5 publication
- IEEE PC37.238, IEEE C37.118.1, C37.118.2 submitted to IEEE SA
- Addition of IEEE C37.238 and IEC 61850-90-5 to NIST Standards Framework Document and the SGIP Catalog of Standards
Vahid Madani, PG&E

- “Standards Lessons Learned”
Mark Adamiak, GE

- IEC 61850-90-5 Overview
- Implementation Agreement – draft status
SDO Progress and Status Reports:

- IEEE PC37.238 – Galina Antonova or Veselin Skendzic
- IEEE H11 and HTF3 – Ken Martin
- IEC WG10 – Herb Falk
- NASPI PSTT – Vahid Madani or Damir Novosel
- IEEE PC37.242 – Jim Hackett, Vahid or Damir
- IEEE PC37.244 – Galina, Vahid or Damir
Back-up Material
IEEE Std 1588 describes a Precision Time Protocol for transferring precise time over Ethernet
- It includes many parameters that need to be mapped to specific applications

New IEEE C37.238 describes a subset of IEEE 1588 (profile) for power systems applications

First ballot in 2010 and comments were resolved
First recirculation was complete (closed on Feb 17th)
- 59 comments being resolved

Submitted to IEEE SA in May 2011
Approved by IEEE SA in June 2011 and published in July 2011
PAP13 recommended adoption to the SGIP Catalog of Standards in September 2011.

Fully compliant clocks could be available 3-6 months after
Compliant PMUs could be available within 1-2 years
IEC 61850-90-5 Technical Report –
(Synchrophasor Data mapping to 61850)

- 61850 is the IEC standard for communication between IEDs
- New development for synchrophasors using 61850 standard

Significant additions
- Draws on wide range of use cases, analysis to protection
- Adds routability to sampled values (using UDP, called R-SV)
- Modeling is extended to the PDC function
- Substation configuration language (SCL) is likewise extended
- Uses MMXU logical node for basic measurements (I, V, P, Q, F, etc.)
- Use Sequence components
- A new security method for multicast encryption

Security in Multicast - Allows key management based upon “stream”, allows PMU/PDC to act as own Key manager

Gives preference to multicast UDP - Applications can perform time alignment function
- C37.118 Does not require time alignment for PDC
Why IEC 61850-90-5?

- Part of broad scope, world-wide electric power interoperability effort for devices & systems:
  - Industry consensus object modeling for power system devices
  - Self-Description and Structured meta Data
  - Publish/subscribe services
  - Fast data services for protection and control (eg tripping over the LAN)
  - Transmitting Waveform Samples in Real-Time
  - LAN-Based Time Synchronization
  - Cyber security (IEC 62351)
  - Substation Configuration Language
  - Automated system engineering tools and processes
  - Testing, verification, and quality assurance processes

- Easier to support and maintain by end user
  - PMU models and functions are integrated with the rest of the substation
  - System functions configured by 61850 automated processes – reduced manual configuration
  - Consistent with other 61850 substation LAN support and devices
  - Leverages available 61850 tools and processes
# IEC 61850-90-5 Use Cases

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Minimum Rates</th>
<th>Allowed Comm Latency</th>
<th>Allowed timing error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchrocheck</td>
<td>4/second</td>
<td>0.1 second</td>
<td>0.05 ms</td>
</tr>
<tr>
<td>Adaptive Relaying</td>
<td>10/second</td>
<td>0.05 second</td>
<td>0.05 ms</td>
</tr>
<tr>
<td>Out-of-Step</td>
<td>10/second</td>
<td>50 – 500 ms</td>
<td>0.05 ms</td>
</tr>
<tr>
<td>Local Oscillation</td>
<td>50/second</td>
<td>5 seconds</td>
<td>0.05 ms</td>
</tr>
<tr>
<td>Current State Estimation</td>
<td>10/second – 1/minute</td>
<td>5 seconds</td>
<td>0.05 ms</td>
</tr>
<tr>
<td>Predictive Dynamics</td>
<td>25/second</td>
<td>20 ms</td>
<td>0.05 ms</td>
</tr>
<tr>
<td>Others…</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Herb Falk Update on IEC 61850-90-5
March 2011
IEC 61850-90-5 Use Cases

- Direct connection with tunnelling or USV service
- The gateway approach
- Wide Area Applications Utilizing Synchrophasors
- Synchro-check
- Adaptive relaying
- Out-of-step (OOS) protection
- Situational awareness
- State Estimation and on-line security assessment
- Archive data (event & continuous)
- Wide Area Controls
IEEE C37.242 Guide for Synchronization, Testing, Calibration and Installation of PMUs

- IEEE Guide is a combination of NASPI PSTT Guides
  - System Test and calibration for laboratory and field applications: Updated to comply with 37.118 improvements
  - Installation of PMU devices based on application requirements and typical bus configurations
  - Overall accuracy and availability of the time synchronization system, including instrumentation channel characteristics and errors, GPS-equipment characteristics and system communication errors
- Started in 2010 on the fast track
- Estimate for balloting in September 2011
- Anticipated final release in December 2011
- Help users with interoperability testing and installations - NOW
IEEE C37.244 PDC Guide

- **PDC functional requirements**
  - Time alignment: Wait Time, Buffer Time, Data Processing
  - Data validation
  - Data re-sampling and filtering and impact on accuracy
  - Data storage, Event detection, Gateway

- **Communication Needs and Requirements**
  - Data flow mgmt.: Late, lost, missing data; Data quality marking
  - System configuration management

- **Test techniques to verify core Functional Requirements**
  - Capacity limitations and determination
  - Comparative measurements (using another PDC)
Below is a status update for PC37.244 - PDC Guide - IEEE PSRC WG C4

- Current is under discussion (not in IEEE format yet)
- New section 5 added - PDC Functions description
- On-going discussions are on PDC functions (Basic and Advanced)
- Remaining PDC functions to be discussed
  - Phasor Data Gateway
  - Configuration Management
- WG has regular conference calls:
  - Monday and Wednesdays at 10am Pacific time
- Those interested, please contact Vasudev Gharpure (WG Vice-Chair) or Galina
IEEE C37.244 PDC Guide Outlook

- Availability to vendors and users: PSTT Guide - Now
- Initial balloting - January 2012
- Publication in May 2012
- Compliant PDCs & Systems Available - Beginning of 2012