0 What: Time Synchronization, IEC 61850 Objects/IEEE C37.118 Harmonization (6.1.2, 6.2.2)

0.1 Abstract:

IEC 61850 has been substantially developed for substations but is seen as a key standard for all field equipment operating under both real-time and non-real time applications. It shall be possible in the future to use IEC 61850 as well to transmit Phasor Measurement Unit data and information according to IEEE C37.118 standard.

Common time synchronization will be a key for many Smart Grid applications. Guidelines on how to achieve that synchronization and addressing different issues related to that synchronization are required. The IEEE 1588 standard will be a key element to achieve that synchronization.

0.2 Description:

Two Standards are related to communications of phasor measurement unit (PMU) data and information. IEEE C37.118 was published in 2005 for PMUs. IEC 61850 has been substantially developed for substations but is seen as a key standard for all field equipment operating under both real-time and non-real time applications. The use of IEC 61850 for wide-area communication is already discussed in IEC 61850-90-1 (Draft technical report) in the context of communication between substations; it is only a small step to use it as well for transmission of PMU data. The models for PMU data need to be defined in IEC 61850. This work item seeks to assist and accelerate the integration of standards that can impact phasor measurement and applications depending on PMU-based data and information.

With IEEE 1588, a standard is available to achieve highly accurate synchronization over a communication network. Several applications related to Smart Grid require time synchronization. Several aspects need to be considered like loss of synchronization, dealing with synchronization islands and resynchronization. Calendar models are required. Check for alignment with 8601. Also, other mechanisms for time synchronization such as GPS or IRIG-B are discussed.

0.3 Objectives:

- Develop contributing technical work to integrate IEEE C37.118 and IEC 61850 under a Dual Logo Standard.
- Participate with SDO working groups to work out technical issues related to the standard integration.
- Support prototyping activities
- Interoperability demonstrations of prototypes (plugfest)
- Validate detailed requirements from Smart Grid applications using common time synchronization and time management.
- Develop, in cooperation with SDO working groups, guidelines for application and role-based time synchronization.

- Develop contributing technical work to prepare standard profiles for IEEE 1588.
- Ensure NASPI-NET and NERC timing requirements are encompassed by work of this group
- Resolve differences between time stamp format and time semantic of C37.118 and 61850 (perhaps add a second timestamp to message)

0.4 Why:

Integrating IEEE C37.118 with IEC 61850 will help to remove overlaps between the standards, which may impede development of interoperable equipment and systems.

IEEE C37.118 is intended to support applications, for example, protection, etc. IEC 61850 is suitable for system-wide applications that require higher publishing rates.

A standards-based approach for time synchronization that addresses the requirements from all applications will support interoperability and facilitate implementation of new Smart Grid applications.

0.5 Where:

IEC 61850 supporting PMU data based on C37.118 will be used between devices exchanging phasor measurement data. The interfaces are within PMU's, relays, master stations, and other equipment involved in phasor measurement monitoring and/or applications based on PMU measurements.

Time synchronization is required across all applications for a Smart Grid.

0.6 How:

For the integration of PMU data based on IEEE C37.118 into IEC 61850, a new work item has already been issued as a joint work item for IEEE and IEC. The work has been circulated within IEC TC57. It is assumed that within IEC, a task force as part of working group 10 will be created to support that work from the IEC side. In IEEE, the PSRC H11 WG is responsible for C37.118. These will be the key SDOs for that part of the work.

From a procedural viewpoint, the integration of PMU data into IEC 61850 cannot be considered as a independent standard. Integration will affect several parts of the existing IEC 61850 standard. Therefore, it is recommended to develop in a first step a technical report (similar to IEC 61850-90-1) that addresses all the issued related to the problem.

While the final responsibility of the work will be in the joint IEEE/IEC task force, this work can contribute technical work to the SDO, can interact with the stakeholders like NASPI, and can support demonstration activities.

For the time synchronization, the IEEE PSRC WG H7 is already working on developing a profile for accurate time synchronization for power system applications. This work is supported by IEC TC57 WG10, so no harmonization is required here. The current activities in the WG are driven on one side by the requirements from PMU and on the other sides by the requirements fro an accurate synchronization of instrument transformers in a substation that are transmitting sampled values as stream of data towards protection and control applications.

This work shall interact with the IEEE working group by developing the requirements for the different applications of Smart Grid, by contributing technical work and by supporting demonstration activities.

0.6.1 Task Descriptions

0.6.1.1 Task 1

Create a document discussing the requirements to transport synchrophasor data including NASPI-NET requirements. This shall be an input for the first meeting of the IEC / IEEE task force to harmonize IEEE C37.118 with IEC 61850. The document will be prepared by Mark Adamiak.

0.6.1.2 Task 2

Prepare a report with IEC 61850-90-x "Using IEC 61850 to transmit synchrophasor data according to IEEE C37.118". The report shall include the following chapters:

- Requirements / Use case
- Impact on models (IEC 61850-7-4x)
- Impact on communication services (IEC 61850-7-2, -8-1, -9-2)
- Impact on engineering

That report will be prepared by the joint task force IEC / IEEE under the lead of Ken Martin.

0.6.1.3 Task 3

Organize rapid prototyping efforts for synchrophasors and interoperability demos. This shall be done during a NIST meeting.

0.6.1.4 Task 4

Finish within IEEE PSRC working group H7 the IEEE PC 37.238, IEEE 1588 (Precision Time Protocol) profile for power systems.

0.6.1.5 Task 5

Do Interoperability demos of products following the IEEE 1588 profile defined by IEEE PSRC H7. This is planned for the next PSRC Meeting in September 2009 as well as for the January 2010 PSRC meeting.

0.6.1.6 Task 6

Validate the detailed requirements from Smart Grid applications on common time synchronization and time management and verify, that they are covered by IEEE PSRC H7 work. The responsibility for this task is NIST.

0.6.1.7 Task 7

Resolve the differences between timestamp formats of 61850 and C37.118. The result shall go in the report according to task 2. Responsible for this task is IEC TC57, WG10.

0.6.1.8 Task 8

Create amendments to IEC 61850 based on the results from report IEC 61850-90-x that is the result of task 2. This will be done by IEC TC57 / WG10.

0.6.1.9 Task 9

Create a testbed for IEEE 1588 and Synchrophasor communication at NIST.

0.6.2 Deliverables

The following deliverables are identified as result of these activities:

- a report IEC 61850-90-x as result of task 1, 2 and 7
- demonstrations of prototypes for synchrophasor transmission using IEC 61850 and of time synchronization (task 3 and task 5)
- IEEE PC37.238 as result of task 4; consider possible updates from task 6
- Amendments to IEC 61850, Edition 2 as result of task 8
- Testbed for IEEE 1588 and synchrophasors at NIST

0.7 Who:

Project Team
NIST Lead: Jerry FitzPatrick
EPRI Lead: Christoph Brunner
SDO Lead: Christoph Brunner Convenor IEC TC 57 WG 10 (IEC 61850)
Other SDOs: IEEE PSRC H11 Committee Chair Ken Martin kemartin8421@comcast.net. IEEE PSRC H7 Committee Chair Bill Dickerson and Galina Antinova IEEE PSRC H3 Committee Chair Bill Dickerson IEEE Power Systems Relay Committee, Communications Subcommittee: Veselin Skendzic IEC TC57 WG19: Paul Skare Paul.Skare@siemens.com IEC TC57 WG15: Frances Cleveland, Xanthus fcleve@xanthus-consulting.com IEC TC38 WG37: Pascal Tantin IEEE PSRC H4 C37.111 COMTRADE: Ratan Das NERC CSSWG: Mark Engels
Users Groups: UCAIug: Mark Adamiak
Technical Team:

NASPI, Performance and Standards Committee, Vahid Madani, VxM6@pge.com NASPI, Alison Silverstein Alex Apostolov (Member IEC TC57, WG10, 19, IEEE PSRC H7)

0.8 When:

Task Description	Completion Date
Task 1: Requirement document for Synchrophasors	September 7, 2009
Task 2: IEC 61850-90-x	Draft DC 2010-01 Draft DTR 2010-05
Task 3: Synchrophasor demo	July 2010
Task 4: IEEE PSRC H7 guideline	Jan 2010 ready for balloting
Task 5: Interop demo 1588	Sept 2009
Task 6: Validate time synchronization requirements	Oct 2009
Task 7: Differences in time stamps C37.118 / IEC 61850	Nov 2009
Task 8: Amendments to IEC 61850	Jan 2011
Task 9: NIST Testbed	Mar 2010