CIGRE Study Committee B5

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

JWG N° B5/D2.67	**Convenor and Leader for SC B5:** Yubo Yuan (CN) **Leader for SC D2:** Roel de Vries (NL) **E-mail address**: yyb97104@sina.com and roel.devries@arbitersystems.eu
Strategic Directions #[2]: 6	**Technical Issues #[3]: 1**
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[6]: 3	
Title of the Group: Time in Communication Networks, Protection and Control Applications – Time Sources and Distribution Methods	

Scope, deliverables and proposed time schedule of the Group:

Background:

In conventional PACS (Protection and Automation Control System), a time reference is needed for the time stamping for tele control signals and for entries of the event recorder and of the fault recorder. Accuracy in the range of 1 ms is normally acceptable for this purpose In the past, a manual resynchronisation of these records was frequently required for fault analysis, especially if the substation reference clock had lost its time synchronisation reference.

Subsequently, some line differential protections and PMU required a better and more reliable synchronisation, often with accuracy requirements in the range of 1 µs. Such accurate time references can be delivered by GPS, which is today widely employed by utilities. New or established standards like (S)NTP, IRIG-B, 1pps, IEEE 1588 and the PTP profiles (IEC/IEEE 61850-90-3 / IEEE C37.238 / ITU-T G.8275) based on it, etc. try to respond to this need.

The importance of the time sources, and their distribution significantly increases with the use of process bus for transmission of Sampled Values for protection and control applications, and time synchronisation can be mission critical. This is also true for local or wide-area applications using phasors calculated from SV streams. For these reasons, a proper design and engineering approach must be used to design the time distribution within a PACS.

Scope:

The aim of the WG is to establish a reference document for time sources and time distribution in Protection, Automation and Control Systems including recommendations and best practices for related specifications and designs. This Technical Brochure will include:

1. Overview of available time sources for PACS, their characteristics, advantages and drawbacks.
2. Discussion and scope of available standards and guides for reference time sources and time synchronisation within PACS and their implementation.
3. Discussion of requirements, in terms of synchronisation accuracy, for different protection and control functions, including Wide-Area Protection and Monitoring and differential protections.
4. Recommendations and constraints for the design of time reference acquisition and

distribution in PACS, including:

- selection of time sources,
- systems featuring process bus, Stand-Alone Merging Units, and Merging Units associated with Non-Conventional Instrument Transformers,
- communication and switch requirements including boundary clocks,
- clock redundancy,
- monitoring of time sources and PACS wide time synchronisation,
- Requirements facilitating testing and commissioning of the PACS wide time distribution system.

5. Accuracy limits, jitter and jitter propagation of the synchronisation signal.
6. Discussion on verification of final timing accuracy in both time sources as well as end devices (IEDs). Including:
   - Temperature dependency
   - Hold-over capabilities
7. Expected behaviour of the time distribution system and of subscribing functions in case of global or partial loss or degradation of the time synchronisation, including use of GLOBAL / LOCAL / NOT SYNCHRONISED signal attributes.
8. Telecom distribution of timing signals as back-up to local clocks.

The WG will address mainly the requirements of PACs related to time synchronization, excluding:

- Cyber Security aspects (already covered by other SC B5 and D2 WGs)

References

1. B5 Colloquium 2017 Auckland - PS1 Special Report and Contributions Q1.05
2. B5 Colloquium 2017 Auckland - Papers 105, 106, 110, 111, 116
3. Hubert Kirrmann, William Dickerson: " Precision Time Protocol Profile for power utility automation application" - PACW Magazine Sept 2016
4. Patrick Wetterwald, Maik G. Seewald: "Time - Sensitive Networking (TSN) in IEC 61850 substation automation networks" - PACW Magazine Sept 2016
5. B. Baumgartner, M. Wehinger, W. Schenk: "IEC 61850-9-3 Does PTP keep its promise?" PAC World Conference Wroclaw (Poland), June 2017

Deliverables:

[X] Technical Brochure and Executive summary in Electra

[X] Electra report

[X] Tutorial[5] (Proposal Forms and Power Point slides)

Time Schedule: start: August 2018 **Final Report**: December 2021

Approval by Technical Committee Chairman:

Date: 11/04/2018

Notes: [1] or Joint Working Group (JWG), [2] See attached Table 2, [3]See attached Table 1,
[4] Delete as appropriate, [5] Presentation of the work done by the WG, [6] See attached table 3

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit