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Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 9-3: Precision time protocol profile for power utility automation

FOREWORD

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IEC subcommittee 65C, Industrial networks, and with IEEE Power Systems Relaying Committee Working Group H24/Substation Committee Working Group C7, of the Power & Energy Society[1] of the IEEE, under the IEC/IEEE Dual Logo Agreement.

This standard cancels and replaces IEC/PAS 61850-9-3 published in 2015.

The text of this standard is based on the following IEC documents:

FDIS	Report on voting
57/1679/FDIS	57/1713/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61850 series, published under the general title *Communication networks and systems for power utility automation*, can be found on the IEC website.

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

1 A list of IEEE participants can be found at the following URL: http://standards.ieee.org/downloads/61850-9-3/61850-9-3-2016/61850-9-3-2016_wg-participants.pdf

INTRODUCTION

General

This part of IEC 61850 specifies a precision time protocol (PTP) profile of IEC 61588:2009 ¦ IEEE Std 1588-2008 applicable to power utility automation, which allows compliance with the highest synchronization classes of IEC 61850-5 and IEC 61869-9.

This part of IEC 61850 applies Layer 2 communication according to IEC 61588:2009 ¦ IEEE Std 1588-2008, Annex F, and uses peer-to-peer delay measurement according to the default profile of IEC 61588:2009 ¦ IEEE Std 1588-2008, Annex J.4, with restricted range of values.

When clocks are singly attached, this profile is a subset of IEC 61588:2009 ¦ IEEE Std 1588-2008 with above restrictions.

When clocks are doubly attached, this profile extends the BMCA of IEC 61588:2009 ¦ IEEE Std 1588-2008 as IEC 62439-3:2016, Annex A, specifies.

NOTE IEC 62439-3:2016, Annex B is identical to this part of IEC 61850, except that doubly attached clocks are mandatory, while this part of IEC 61850 leaves them optional.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 9-3: Precision time protocol profile for power utility automation

1 Scope

This part of IEC 61850 specifies a precision time protocol (PTP) profile of IEC 61588:2009 ¦ IEEE Std 1588-2008 applicable to power utility automation, which allows compliance with the highest synchronization classes of IEC 61850-5 and IEC 61869-9.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61588:2009, *Precision clock synchronization protocol for networked measurement and control systems* ¦ IEEE Std 1588-2008, *IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*[2]

IEC TR 61850-90-4:2013, *Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines*

IEC 62439-3:2016, *Industrial communication networks – High availability automation networks – Part 3: Parallel Redundancy Protocol (PRP) and High availability Seamless Redundancy (HSR)*

ISO/IEC 9646-7, *Open systems interconnection – Conformance testing methodology and framework – Part 7: Implementation conformance statements*

3 Terms, definitions, abbreviations, acronyms, and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61588:2009 ¦ IEEE Std 1588-2008 and IEC 62439-3:2016, as well as the following, apply:

3.1.1
device time inaccuracy
time inaccuracy evaluated or measured between the time signal at the input of a device and the time signal that this device generates

Note 1 to entry: This definition applies to TCs, BCs and media converters.

Note 2 to entry: Device time inaccuracy includes the uncertainties in the computation of the path delay assuming an ideal Pdelay_Resp from an upstream neighbour, and the uncertainty introduced in responding to an ideal Pdelay_Req from a downstream neighbour.

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2 IEEE Std 1588-2008 was adopted as IEC 61588:2009.

3.1.2
grandmaster-capable
ordinary clock or boundary clock that is able to take the role of a grandmaster

Note 1 to entry: A grandmaster-capable clock is not necessarily connected to a recognized standard time source.

3.1.3
grandmaster time inaccuracy
time inaccuracy evaluated or measured between the reference time signal at the input of a grandmaster clock and the time signal(s) that the grandmaster generates

Note 1 to entry: Grandmaster time inaccuracy includes the uncertainty introduced in responding to an ideal Pdelay_Req from a downstream neighbour.

3.1.4
network time inaccuracy
time inaccuracy evaluated or measured between the reference time signal at the input of a grandmaster clock and the time signal at the input of a given slave clock, considering the worst path between the grandmaster(s) and the slave

Note 1 to entry: Network time inaccuracy varies depending on the path the time signals take.

3.1.5
reference time inaccuracy
time inaccuracy evaluated or measured between the time maintained by the international standards laboratories that form the basis for the International Atomic Time (TAI) and Coordinated Universal Time (UTC) timescales and the reference time signal at the input of a grandmaster

Note 1 to entry: Reference time inaccuracy considers e.g. the GPS or the DCF77 time inaccuracy as received at a particular geographical location, at the output of the receiver.

3.1.6
subdomain
region of a time domain delimited by Boundary Clocks, each subdomain having exactly one selected master (Boundary Clock or grandmaster)

3.1.7
time error
deviation from the time reference used for measurement or synchronization caused by a network element, evaluated over a short time span (a few Sync intervals)

3.1.8
time inaccuracy
time error not exceeded by 99,7 % of the measurements, evaluated over a series of 1 000 measurements (about 20 minutes) in steady state

Note 1 to entry: Assuming a Gaussian distribution, this corresponds to three sigma ($3\ \sigma$ = 99,7 %) or no more than 3 points outside the specified interval, out of 1 000 total points evaluated.

3.1.9
total time inaccuracy
time inaccuracy evaluated or measured between the time maintained by the international standards laboratories that form the basis for the International Atomic Time (TAI) and Universal Coordinated Time (UTC) timescales and the time signal at the input of a slave clock

Note 1 to entry: The TimeAccuracy attribute of IEC 61850-7-2 sums the total time inaccuracy and the time inaccuracy of the sampling. Therefore, the mapping from total time inaccuracy to TimeAccuracy is implementation-dependent.