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PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

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 PAS 61850-9-3 has been developed by IEC technical committee 57: Power systems management and associated information exchange, in cooperation with the IEEE Power Systems Relaying Committee Working Group H24/Substation Committee Working Group C7 of the Power & Energy Society of the IEEE, and IEC subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
57/1551/PAS	57/1575/RVD

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single period up to a maximum of 3 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

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

INTRODUCTION

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

This PAS applies Layer 2 communication according to IEC 61588:2009, Annex F, and uses peer-to-peer delay measurement according to the IEC 61588:2009, Annex J.4, default profile with restricted range values.

When clocks have a single attachment, this profile is a subset of IEC 61588:2009 with the above restrictions.

When clocks have an optional double attachment, this profile extends the BMCA of IEC 61588:2009 as IEC 62439-3:2015, Annex A, specifies.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

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

1 Scope

This PAS specifies a precision time protocol (PTP) profile of IEC 61588:2009 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*

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

IEC 62439-3:2015, *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 and acronyms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61588:2009 and IEC 62439-3:2015, as well as the following, apply:

3.1.1
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 time source.

3.1.2
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)

3.1.3
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 σ = 99,7%) or no more than 3 points outside the specified interval, out of 1 000 total points evaluated.

3.1.4
network time inaccuracy
time inaccuracy evaluated or measured between a particular slave clock and the time reference signal of its grandmaster clock(s), considering the worst network topology

3.2 Abbreviations and acronyms

For the purposes of this document, the abbreviations and acronyms given in IEC 61588:2009 and IEC 62439-3:2015, as well as the following, apply:

MIB Management Information Base (RFC 1157)

PICS Protocol Implementation Conformance Statement (ISO/IEC 9646-7)

SNMP Simple Network Management Protocol (RFC 1157)

4 Identification

The identification values for this profile according to IEC 61588:2009, 19.3.3, are:

profileName: IEC 61850-9-3 "Precision Time Protocol profile for Power Utility Automation"

profileVersion: 1.0

profileIdentifier: 00-0C-CD-00-01-xy

Whereas the first nibble of the sixth octet is a bitfield:

– x = 0 for a singly-attached clock
– x = 1 for PRP redundancy
– x = 2 for HSR redundancy
– x = 3 for both PRP and HSR (configurable) redundancy
– y = 0 (minor revision: profileVersion 1.0)

organizationName: IEC Technical Committee 57 Working Group 10

sourceIdentification: A copy of IEC 61850-9-3 can be obtained from the International Electrotechnical Commission (http://www.iec.ch)

NOTE The OUI defined in IEC 61588:2009, Annex J.4, does not apply.

5 Clock types

This PAS distinguishes clocks by their capabilities:

- Ordinary Clocks (OCs) implement one of the following capabilities:
  – Slave-only (defaultDS.slaveOnly = True)
  no port can be in the MASTER state
  – Grandmaster-capable (defaultDS.slaveOnly = False);
  the port (or the port pair in redundancy) can be in the MASTER state

  - Grandmaster-only (defaultDS.slaveOnly = False and clockClass = 6 or 7)
    no port can be in the SLAVE state.
- Transparent Clocks (TCs) correct and forward PTP messages; their ports do not have states in IEC 61588:2009.
- Boundary Clocks (BC) are never slave-only and can have either:
  - exactly one port in the SLAVE state and all other in the MASTER state;
  - all ports in the MASTER state, in which case the BC is the grandmaster.

NOTE Within a time domain, a BC has a port in the SLAVE state in the upper sub-domain and one or several ports in the MASTER state in the lower sub-domain(s); see IEC 61850-90-4.

Atomic clocks are not considered in this specification.

6 Protocol specifications

All clocks shall transmit PTP messages on Ethernet layer 2 according to IEC 61588:2009, Annex F.

All clocks shall use multicast communication using the addresses specified in IEC 61588:2009, F.1.

All clocks shall support the peer-to-peer delay measurement defined in IEC 61588:2009, 10.3 and 11.4.

All clocks shall support the PTP time scale (based on TAI).

All singly attached clocks shall support the default best master clock algorithm in IEC 61588:2009, 9.3.2, 9.3.3 and 9.3.4.

All doubly attached clocks according to IEC 62439-3 shall support in addition the extension to the best master clock algorithm defined in IEC 62439,3:2015, Annex A.

All clocks shall support both 1-step and 2-step synchronization on ingress; they may use 1-step or 2-step synchronization on egress.

All clocks shall support at least one of the three management mechanisms:

1) The alternate management mechanism using the SNMP MIB specified in IEC 62439-3:2015, Annex E and/or
2) The alternate management mechanism using the management objects defined in IEC 61850-90-4:2013, 19.3 and 19.4 and/or
3) The manufacturer-defined fixed values and/or the manufacturer-specific implementation means to address all configurable values as stated in IEC 61588:2009, 15.1.1.

7 Requirements

7.1 Measurement conditions

Steady state is defined as 30 s after a single master starts to send synchronisation messages and 16 s after a change of master, with no change to the environment temperature.

This requirement applies only to clocks that have been energized for 30 minutes to accommodate for instance temperature-controlled oscillators.