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Edition 1.0 2012-05

TECHNICAL REPORT

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Communication networks and systems for power utility automation – Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 61850-90-5, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
57/1144/DTR	57/1207/RVC

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

This technical report has been prepared in a joint effort between IEC and IEEE. A task force consisting of members from the IEC TC 57 WG 10 as well as the IEEE Power and Energy Society/IEEE Power System Relay Committee has prepared that report with task force meetings both at the regular meetings of IEC TC 57 WG 10 as well as at the regular meetings of the IEEE Power and Energy Society/IEEE Power System Relay Committee. Once the technical report is approved and published, the results will be integrated as amendments into the relevant parts of IEC 61850.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

INTRODUCTION

Synchrophasor data as measured and calculated by PMUs are considered to be useful information to assess the condition of the electrical power network.

The synchrophasors and related message formats to transmit synchrophasor data over long distances are defined in IEEE C37.118.

Even though the communication according to IEEE C37.118 has proven to be usable and work well, there is a desire to have a communication mechanism that is compliant to the concept of IEC 61850. This document lays out how this shall be done.

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118

1 Scope

This part of IEC 61850 provides a way of exchanging synchrophasor data between PMUs, PDCs WAMPAC (Wide Area Monitoring, Protection, and Control), and between control center applications. The data, to the extent covered in IEEE C37.118-2005, are transported in a way that is compliant to the concepts of IEC 61850.

However, given the primary scope and use cases, this document also provides routable profiles for IEC 61850-8-1 GOOSE and IEC 61850-9-2 SV packets. These routable packets can be utilized to transport general IEC 61850 data as well as synchrophasor data.

2 Normative references

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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.

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IEC 61850-2:2003, *Communication networks and systems in substations – Part 2: Glossary*

IEC 61850-6:2009, *Communication networks and systems in substations – Part 6: Configuration description language for communication in electrical substations related to IEDs*

IEC 61850-7-1, *Communication networks and systems for power utility automation – Part 7-1: Basic communication structure – Principles and models*

IEC 61850-7-2, *Communication networks and systems in substations – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)*

IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes*

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC 61850-8-1:2011, *Communication networks and systems for power utility automation – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*

IEC 61850-9-2:2010, *Communication networks and systems for power utility automation – Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3*

IEC/TR 61850-90-1, *Communication networks and systems for power utility automation – Part 90-1: Use of IEC 61850 for the communication between substations*

IEC/TS 62351-1, *Power systems management and associated information exchange – Data and communications security – Part 1: Communication network and system security – Introduction to security issues*

IEC/TS 62351-6:2007, *Power systems management and associated information exchange – Data and communications security – Part 6: Security for IEC 61850*

ISO/IEC 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO/IEC 19772, *Information technology – Security techniques – Authenticated encryption Also available as: NIST SP 800-38D*

ITU-T X.234, *Information technology – Protocol for Providing the OSI connectionless-mode transport service*
Amendment 1: *Addition of connectionless-mode multicast capability*

IEEE 802.1Q, *Virtual Bridged Local Area Networks*

IEEE C37.118.1, *Standard for Synchrophasor Measurements for Power Systems*

IEEE C37.118.2:2011, *Standard for Synchrophasor Data Transfer for Power Systems*

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NIST Special Publication 800-38D, Recommendation for Block Cipher Modes of Operation: Galois/Counter Mode (GCM) and GMAC

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RFC 768, User Datagram Protocol

RFC 791, Internet Protocol DARPA Internet Program Protocol Specification

RFC 793, Transmission Control Protocol

RFC 826, An Ethernet Address Resolution Protocol

RFC 894, A Standard for the Transmission of IP Datagrams over Ethernet Networks

RFC 1108, U,S, Department of Defense Security Options for the Internet Protocol

RFC 1240, OSI Connectionless Transport Services on top of UDP Version:1

RFC 2104, HMAC: Keyed-Hashing for Message Authentication

RFC 2406, IP Encapuslating Security Payload (ESP)

RFC 2407, Internet Key Exchange (IKEv1) Protocol

RFC 2474, Definition of Differentiated Services Field (DS Field) in IPv4 and IPv6 Headers

RFC 2991, Multipath Issues in Unicast and Multicast Next-Hop Selection

RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP

RFC 3246, An Expedited Forwarding PHB (Per-Hop Behavior)

RFC 3376, Internet Group Management Protocol, Version 3

RFC 3547, The Group Domain of Interpretation

RFC 5771, IANA Guidelines for IPv4 Multicast Address Assignments

UCA User's Group 61850-9-2LE- Implementation Guideline for Digital Interface to Instrument Transformers using IEC 61850-9-2

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61850-2, IEC 61850-7-2 and IEEE C37.118.1 as well as the following apply.

3.1
IED tool
short for IED configuration tool or IED configurator in the sense of IEC 61850-6

3.2
nonce
number used once

Note 1 to entry: A nonce is some value that varies with time, although a very large random number is sometimes used.

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3.3
part(ial) system
part of a complete system, with a defined, self-consistent part functionality

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3.4
project
system part with ownership of a set of IEDs, typically those located in one substation, and handled by one system configuration tool

3.5
gateway
internetworking system capable of allowing communications/information exchange between two networks that use different communication protocols

3.6
system
union of all communicating application-functions performing some overall task like "management of a substation", via logical nodes

Note 1 to entry: The physical system is composed of all devices hosting these functions and the interconnecting physical communication network.

4 Abbreviated terms

The following abbreviations apply to this document.

APDU	Application Protocol Data Unit
A-Profile	Application Profile
CDC	Common Data Class
CID	Configured IED Description
CT	Current Transformer
DA	Data archiver
DNS	Domain Name Service
DSCP	Differentiated Services Code Point
ECN	Explicit Congestion Notification
EF	Expedited Forwarding
ESP	Electronic Security Perimeter
ET	Event Trigger
FACTS	Flexible Alternating Current Transmission Systems
FC	Functional constraint
FCD	Functionally Constrained Data
FCDA	Functionally Constrained Data Attribute
FSS	Functional Software Specification
GCM	Galois Counter Mode
GDOI	Group Domain of Interpretation
GMAC	Galois Message Authentication Code
GoCB	GOOSE Control Block
GOOSE	Generic Object Oriented Substation Event
GW	Gateway
HMI	Human Machine Interface
HW	Hardware
IANA	Internet Assigned Numbers Authority
ID	Identification
IED	Intelligent Electronic Device – any programmable or configurable device in the system
IGMP	Internet Group Management Protocol
IID	IED Instance Description. Describes an IED instance in a project.
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
KDC	Key Distribution Center
LAN	Local area network
LD	Logical Device (IEC 61850)
LI	Length Identifier. This value contains the length of the SI or PI with which it is associated.
LN	Logical Node (IEC 61850)
m	Mandatory – shall be implemented
MAC	Media Access Control
MSV	Multicast Sampled Value
MSVCB	Multicast Sampled Values Control Block
o	Optional – may be implemented

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