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Incorporating corrigendum June 2020

BSI Standards Publication

Communication networks and systems for power utility automation

Part 90-4: Network engineering guidelines

National foreword

This British Standard is the UK implementation of IEC TR 61850-90-4:2020. It supersedes PD IEC/TR 61850-90-4:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/57, Power systems management and associated information exchange.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments/corrigenda issued since publication

Date	Text affected
30 June 2020	Correction: IEC .nsd files attached

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

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FOREWORD

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 TR 61850-90-4, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- New object model for bridges and clocks based on UML autogeneration.
- An example of SCL configuration with a topology
- Extensions to the time distribution and clock
- Extension of the testing

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

Enquiry draft	Report on voting
57/2088/DTR	57/2159/RVDTR

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 publication has been drafted in accordance with 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.

This IEC standard includes Code Components i.e. components that are intended to be directly processed by a computer. Such content is any text found between the markers <CODE BEGINS> and <CODE ENDS>, or otherwise is clearly labeled in this standard as a Code Component. In the current version of this document, such indication is made at the beginning of each concerned top-level clauses

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If any updates are required to the published code component that needs to apply immediately and can not wait for an amendment (i.e. fixing a major problem), a new release of the Code Component will be issued and distributed through the IEC WebSite. Any new release of the Code Component related to this part will supersede any previously published Code Component including the one published within the current document.

This publication contains attached.nsd files which compose the Code Component of this part. These files are intended to be used as a complement and do not form an integral part of this standard.

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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The growing success of the IEC 61850 series calls for guidelines for engineering Ethernet networks. The IEC 61850 series specifies the basic requirements for the networks but not how to achieve them. Indeed, the IEC 61850 series of standards focuses on data modelling and the interchange of that data, leaving out physical interconnection details that are nevertheless needed for interoperability.

This Technical Report provides definitions, guidelines and specifications for the engineering of IEC 61850-based substation networks, which consists of one or several local area networks. It is also applicable to local area networks outside of the substation, e.g. substation-to-substation links or differential protection links, to which IEDs are directly connected. Data communication over Wide Area Networks is treated in IEC TR 61850-90-12.

This Technical Report addresses issues such as Ethernet technology, network topology, redundancy, traffic latency and quality of service, traffic management by multicast and VLAN filtering, network-based clock synchronization and testing of the network.

This Technical Report is based on existing standards for semantics, services, protocols, system configuration language and architecture. It relies on work done by IEC TC 57 WG 10 (Power system IED communication and associated data models) and IEC TC 57 WG 15 (Data and communications security), on IEC 61918 (*Industrial communication networks – Installation of communication networks in industrial premises*), IEC SC65C WG15 IEC 62439 (*Industrial communication networks – High-availability automation networks*) and IEC 61588 (*Precision clock synchronization protocol for networked measurement and control systems*), on the work of the IEEE 802.1 Working Group, the UCA International Users Group 9-2LE, the IEEE Power System Relaying Committee (PSRC) and on contributions by different companies.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 90-4: Network engineering guidelines

1 Scope

1.1 General

This part of IEC 61850, which is a Technical Report, is intended for an audience familiar with network communication and/or IEC 61850-based systems and particularly for substation protection and control equipment vendors, network equipment vendors and system integrators.

This document focuses on engineering a local area network limited to the requirements of IEC 61850-based substation automation. It outlines the advantages and disadvantages of different approaches to network topology, redundancy, clock synchronization, etc. so that the network designer can make educated decisions. In addition, this document outlines possible improvements to both substation automation and networking equipment.

This document addresses data transfer over the network in IEC 61850, such as transmitting tripping commands for protection via GOOSE messages, and in particular the multicast data transfer of large volumes of sampled values (SV) from merging units (MUs).

This document considers seamless redundancy to increase the network availability under failure conditions and the high precision clock synchronization that is central to the process bus and synchrophasor operation.

This document is not intended as a tutorial on networking or on IEC 61850. Rather, it references and summarizes standards and publications to assist the engineers. Many publications discuss the Ethernet technology but do not address the networks in terms of substation automation. Therefore, many technologies and options have been ignored since they were not considered relevant for a future-proof substation automation network design.

This document does not address network-based security, which is the subject of IEC 62351 and IEC 62443.

This document does not address technologies for wide area networks; these are covered by IEC TR 61850-90-12. Guidelines for communication outside of the substation that uses exclusively the routable Internet Protocol have been published, especially in documents IEC TR 61850-90-1 (substation to substation), IEC TR 61850-90-2 (substation to control center) and IEC TR 61850-90-5 (synchrophasor transmission). However, data flows used in substation-to-substation communication, or substation-to-control centre communication such as R-GOOSE and R-SV are covered when they transit over Ethernet links within the substation.

This document does not dispense the responsible system integrator from an analysis of the actual application configuration, which is the base for a dependable system.

1.2 Namespace name and version

This subclause is mandatory for any IEC 61850 namespace (as defined by IEC 61850-7-1:2011).

Table 1 shows all attributes of (Tr)IEC 61850-90-4:2018A namespace.