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BSI Standards Publication

# Communication networks and systems for power utility automation

Part 90-4: Network engineering  
guidelines

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**National foreword**

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# TECHNICAL REPORT



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## Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMMUNICATION NETWORKS AND  
SYSTEMS FOR POWER UTILITY AUTOMATION –**

**Part 90-4: Network engineering guidelines**

**FOREWORD**

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IEC 61850-90-4, 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
57/1238/DTR	57/1330/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 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.

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- withdrawn,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.

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

**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. Instead, 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 full interoperability.

This Technical Report provides definitions, guidelines and specifications for the network engineering of IEC 61850-based substation automation.

This Technical Report addresses issues such as Ethernet technology, network topology, redundancy, traffic latency and quality of service, traffic management by multicast and VLAN, network-based clock synchronization and testing of the network. It does not address network-based security.

The Technical Report is based on existing standards for semantics, services, protocols, system configuration language and architecture. It is based 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 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 and the IEEE Power System Relaying Committee (PSRC), and on contributions by different companies.

The contents of this Technical Report have been coordinated with the Working Groups producing IEC 62439, IEC 62351 and with the IEEE PSRC.

## COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

### Part 90-4: Network engineering guidelines

#### 1 Scope

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 Technical Report 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 report outlines possible improvements to both substation automation and networking equipment.

This Technical Report addresses the most critical aspects of IEC 61850, such as protection related to tripping over the network. This Technical Report addresses in particular the multicast data transfer of large volumes of sampled values (SV) from merging units (MUs). It also considers the high precision clock synchronization and “seamless” guaranteed transport of data across the network under failure conditions that is central to the process bus concept.

This Technical Report is not 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 Technical Report does not address network security.

This Technical Report does not address substation-to-substation communication, or substation to control centre communication. Inter-substation communication involves WAN technologies other than Ethernet, but when it uses Ethernet on layer 2, parts of this report can be applied. For inter-substation communication which uses exclusively the routable Internet Protocol, more adapted guidelines are in discussion within IEC TC 57, especially in documents IEC/TR 61850-90-1, IEC 61850-90-2<sup>1</sup>, and IEC/TR 61850-90-5, which will be addressed in the WAN engineering guidelines, IEC 61850-90-12<sup>2</sup>.

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

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<sup>1</sup> Under consideration.

<sup>2</sup> Under consideration.