

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 5-21: Application layer service definition – Type 21 elements**





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - webstore.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 5-21: Application layer service definition – Type 21 elements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 25.040.40; 35.100.70; 35.110

ISBN 978-2-8322-6752-3

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
1.1 Overview.....	8
1.2 Specifications.....	9
1.3 Conformance.....	9
2 Normative references.....	9
3 Terms, definitions, symbols, abbreviations, and conventions.....	10
3.1 Terms and definitions from other ISO/IEC standards.....	10
3.1.1 ISO/IEC 7498-1 terms.....	10
3.1.2 ISO/IEC 8822 terms.....	10
3.1.3 ISO/IEC 8824-1 terms.....	10
3.1.4 ISO/IEC 9545 terms.....	11
3.2 Fieldbus data link layer terms.....	11
3.3 Fieldbus application layer specific definitions.....	11
3.4 Abbreviations and symbols.....	17
3.5 Conventions.....	17
3.5.1 Overview.....	17
3.5.2 General conventions.....	18
3.5.3 Conventions for class definitions.....	18
3.5.4 Conventions for service definitions.....	19
4 Concepts.....	20
4.1 Common concepts.....	20
4.1.1 Overview.....	20
4.1.2 Architectural relationships.....	21
4.1.3 Fieldbus application layer structure.....	23
4.1.4 Fieldbus application layer naming and addressing.....	34
4.1.5 Architecture summary.....	35
4.1.6 FAL service procedures.....	36
4.1.7 Common FAL attributes.....	37
4.1.8 Common FAL service parameters.....	37
4.1.9 APDU size.....	38
4.2 Type specific concepts.....	38
4.2.1 Node, AP, and object dictionary.....	40
4.2.2 APO ASEs.....	41
5 Data type ASE.....	41
5.1 General.....	41
5.1.1 Overview.....	41
5.1.2 Basic type overview.....	42
5.1.3 Fixed-length type overview.....	42
5.1.4 Constructed type overview.....	43
5.1.5 Specification of user-defined data types.....	43
5.1.6 Transfer of user data.....	43
5.2 Formal definition of data type objects.....	44
5.2.1 Data type class.....	44
5.3 FAL defined data types.....	45

5.3.1	Fixed-length types	45
5.3.2	String types	48
5.4	Data type ASE service specification	49
6	Communication model specification	49
6.1	ASEs	49
6.1.1	Application process ASE	49
6.1.2	Service data object ASE	55
6.1.3	Process data object ASE	65
6.1.4	Application relationship ASE	68
6.2	ARs	75
6.2.1	Point-to-point user-triggered confirmed client/server AREP (PTC-AR)	75
6.2.2	Multipoint network-scheduled unconfirmed publisher-subscriber AREP (MSU-AR)	76
6.2.3	Multipoint user-triggered unconfirmed publisher-subscriber AREP (MTU-AR)	78
6.3	Summary of FAL classes	79
6.4	Permitted FAL services by AREP role	79
	Bibliography	80
	Figure 1 – Relationship to the OSI Basic Reference Model	21
	Figure 2 – Architectural positioning of the fieldbus application layer	22
	Figure 3 – Client/server interactions	24
	Figure 4 – Pull model interactions	25
	Figure 5 – Push model interactions	26
	Figure 6 – APOs services conveyed by the FAL	28
	Figure 7 – Application entity structure	30
	Figure 8 – FAL management of objects	31
	Figure 9 – ASE service conveyance	32
	Figure 10 – Defined and established AREPs	34
	Figure 11 – FAL architectural components	36
	Figure 12 – Interaction between FAL and DLL	39
	Figure 13 – Publisher-subscriber communication model	39
	Figure 14 – Client-server communication model	40
	Figure 15 – Object model	40
	Figure 16 – ASEs of a Type 21 application	41
	Figure 17 – Data type class hierarchy example	42
	Figure 18 – The AR ASE conveys APDUs between APs	68
	Table 1 – Types of timeliness	27
	Table 2 – Overall structure of the OD	40
	Table 3 – Identify service	52
	Table 4 – Status service	54
	Table 5 – Access rights for object	56
	Table 6 – Read service	57
	Table 7 – Write service	59

Table 8 – Write and Read service	61
Table 9 – Write and Read Multiple service	63
Table 10 – TB-transfer	67
Table 11 – COS-transfer	67
Table 12 – Conveyance of service primitives by AREP role.....	69
Table 13 – Valid combinations of AREP roles involved in an AR	69
Table 14 – AR-unconfirmed send	73
Table 15 – AR-confirmed send.....	74
Table 16 – FAL class summary	79
Table 17 – Services by AREP role	80

Currently in preview, click buy full version

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 5-21: Application layer service definition –
Type 21 elements**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization, comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, issue to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

Attention is drawn to the fact that the use of the associated protocol type is restricted by its intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by its intellectual-property-right holders.

NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-5-21 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

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

- added Write and Read service;
- miscellaneous editorial corrections.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65C/947/FDIS	65C/950/RVD

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

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

A list of all parts of the IEC 61158 series, published under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC web site.

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.

INTRODUCTION

This document is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the “three-layer” fieldbus reference model described in IEC 61158-1.

The application service is provided by the application protocol making use of the services available from the data-link or other immediately lower layer. This document defines the application service characteristics that fieldbus applications and/or system management may exploit.

Throughout the set of fieldbus standards, the term “service” refers to the abstract capability provided by one layer of the OSI Basic Reference Model to the layer immediately above. Thus, the application layer service defined in this document is a conceptual architectural service, independent of administrative and implementation divisions.

Currently in preview, click buy full version

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-21: Application layer service definition – Type 21 elements

1 Scope

1.1 Overview

The Fieldbus Application Layer (FAL) provides user programs with a means to access the fieldbus communication environment. In this respect, the FAL can be considered a window between corresponding application programs.

This part of IEC 61158 provides the common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment as well as material specific to the Type 21 protocol. The term “time-critical” is used to represent the presence of a time-window within which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the time window risks failure of the applications requesting the actions, with attendant risk to equipment, plant, and possibly human life.

This International Standard defines, in an abstract way, the externally visible service provided by the FAL in terms of:

- a) an abstract model for defining application resources (objects) capable of being manipulated by users *via* the FAL service;
- b) the primitive actions and events of the service;
- c) the parameters associated with each primitive action and event, and the form that they take;
- d) the interrelationship between these actions and events, and their valid sequences.

The purpose of this document is to define the services provided to:

- a) the FAL-user at the boundary between the user and the application layer of the fieldbus Reference Model;
- b) systems management at the boundary between the application layer and systems management of the fieldbus Reference Model.

This document describes the structure and services of the IEC FAL, in conformance with the OSI Basic Reference Model (ISO/IEC 7498) and the OSI Application layer Structure (ISO/IEC 9545).

FAL services and protocols are provided by FAL application entities (AEs) contained in the application processes. The FAL AE is composed of a set of object-oriented Application Service Elements (ASEs) and a Layer Management Entity (LME) that manages the AE. The ASEs provide communication services that operate on a set of related application process object (APO) classes. One of the FAL ASEs is a management ASE that provides a common set of services for management of the instances of FAL classes.

Although these services specify how requests and responses are issued and delivered from the perspective of applications, they do not include a specification of what the requesting and responding applications are to do with them. That is, these services only define what requests and responses applications can send or receive, not the functions of the applications