

INTERNATIONAL STANDARD

Industrial communication networks – Fieldbus specifications –
Part 5-11: Application layer service definition – Type 11 elements

(<https://standards.iteh.ai>)

Document Preview

[IEC 61158-5-11:2007](https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007)

<https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007>





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2007 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
Email: inmail@iec.ch
Web: 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 corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch

Tel: +41 22 919 02 11
Fax: +41 22 919 03 00

[IEC 61158-5-11:2007](http://www.iec.ch/online_news/justpub)

https://www.iec.ch/online_news/justpub



IEC 61158-5-11

Edition 1.0 2007-12

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 5-11: Application layer service definition – Type 11 elements**

(<https://standards.iteh.ai>)
Document Preview

[IEC 61158-5-11:2007](https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007)

<https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XC**

ICS 35.100.70; 25.040.40

ISBN 2-8318-9458-1

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
1.1 Overview.....	7
1.2 Specifications.....	8
1.3 Conformance.....	8
2 Normative references.....	8
3 Terms and definitions, abbreviations, and conventions.....	10
3.1 ISO/IEC 7498-1 terms.....	10
3.2 ISO/IEC 8822 terms.....	10
3.3 ISO/IEC 9545 terms.....	10
3.4 ISO/IEC 8824 terms.....	10
3.5 Fieldbus data-link layer terms.....	10
3.6 Fieldbus application layer type-specific definitions.....	11
3.7 Abbreviations and symbols.....	21
3.8 Conventions.....	23
3.9 Nomenclature for references within this standard.....	26
4 Concepts.....	26
4.1 Common concepts.....	26
4.2 Type specific concepts.....	26
5 Data type ASE.....	31
5.1 General.....	31
5.2 Formal definition of data type objects.....	34
5.3 FAL defined data types.....	36
5.4 Data type ASE service specification.....	72
6 Communication model specification.....	73
6.1 ASEs.....	73
6.2 ARs.....	81
6.3 Summary of FAL classes.....	82
6.4 Permitted FAL services by AREP role.....	83
Bibliography.....	84
Figure 1 – RTE-TCnet communication profile.....	27
Figure 2 – Application example by using the CM.....	28
Figure 3 – Global common-memory concept over the RTE-TCnet.....	29
Figure 4 – Relationship of Common Memory and AREP.....	30
Figure 5 – Structure of Type 11 AL ASE.....	31
Figure 6 – Data type class hierarchy example.....	32
Figure 7 – Common memory publisher/subscriber model.....	76
Table 1 – PERSISTDEF.....	44
Table 2 – VARTYPE.....	45
Table 3 – ITEMQUALITYDEF.....	46
Table 4 – STATEDEF.....	50
Table 5 – GROUPEXCEPTIONDEF.....	50

Table 6 – ACCESSRIGHTSDEF	50
Table 7 – HRESULT	51
Table 8 – UUID	58
Table 9 – Data type names for value.....	70
Table 10 – UUID	72
Table 11 – Update memory service parameters	74
Table 12 – Memory-status service parameters	75
Table 13 – AR-Unconfirmed Send	79
Table 14 – AR-get buffered message service.....	80
Table 15 – AR-Status service	80
Table 16 – FAL class summary	82
Table 17 – Services by AREP role	83

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 61158-5-11:2007](https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007)

<https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS – FILELDBUS SPECIFICATIONS –

Part 5-11: Application layer service definition – Type 11 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

NOTE Use of some of the associated protocol types is restricted by their 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 particular data-link layer protocol type to be used with physical layer and application layer protocols in type combinations as specified explicitly in the IEC 61784 series. Use of the various protocol types in other combinations may require permission of their respective intellectual-property-right holders.

International Standard IEC 61158-5-11 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition and its companion parts of the IEC 61158-5 subseries cancel and replace IEC 61158-5:2003. This edition of this part constitutes a technical addition. This part and its Type 11 companion parts also cancel and replace IEC/PAS 62406, published in 2005.

This edition of IEC 61158-5 includes the following significant changes from the previous edition:

- a) deletion of the former Type 6 fieldbus for lack of market relevance;
- b) addition of new types of fieldbuses;

c) partition of part 5 of the third edition into multiple parts numbered -5-2, -5-3, ...

The text of this standard is based on the following documents:

FDIS	Report on voting
65C/475/FDIS	65C/486/RVD

Full information on the voting for the approval of this 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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

NOTE The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

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

ITEH Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 61158-5-11:2007](https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007)

<https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007>

INTRODUCTION

This part of IEC 61158 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/TR 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 standard 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 standard is a conceptual architectural service, independent of administrative and implementation divisions.

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 61158-5-11:2007](https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007)

<https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007>

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-11: Application layer service definition – Type 11 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 viewed as a “window between corresponding application programs.”

This part of IEC 61158 provides common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment and material specific to Type 11 fieldbus. 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 part of IEC 61158 defines in an abstract way the externally visible service provided by the different Types of fieldbus Application Layer in terms of

- a) an abstract model for defining application resources (objects) capable of being manipulated by users via the use of 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 which they take; and
- d) the interrelationship between these actions and events, and their valid sequences.

The purpose of this part of IEC 61158 is to define the services provided to

- 1) the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model, and
- 2) Systems Management at the boundary between the Application Layer and Systems Management of the Fieldbus Reference Model.

This part of IEC 61158 specifies the structure and services of the IEC fieldbus Application Layer, 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 (AE) contained within 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 the management of the instances of FAL classes.

Although these services specify, from the perspective of applications, how request and responses are issued and delivered, they do not include a specification of what the requesting and responding applications are to do with them. That is, the behavioral aspects of the applications are not specified; only a definition of what requests and responses they can send/receive is specified. This permits greater flexibility to the FAL users in standardizing

such object behavior. In addition to these services, some supporting services are also defined in this standard to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this part of IEC 61158 is to specify the characteristics of conceptual application layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of application layer protocols for time-critical communications.

A secondary objective is to provide migration paths from previously-existing industrial communications protocols. It is this latter objective which gives rise to the diversity of services standardized as the various Types of IEC 61158, and the corresponding protocols standardized in IEC 61158-6.

This specification may be used as the basis for formal Application Programming-Interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this specification, including

- a) the sizes and octet ordering of various multi-octet service parameters, and
- b) the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

This part of IEC 61158 do not specify individual implementations or products, nor do they constrain the implementations of application layer entities within industrial automation systems.

There is no conformance of equipment to this application layer service definition standard. Instead, conformance is achieved through implementation of conforming application layer protocols that fulfil any given Type of application layer services as defined in this part of IEC 61158.

<https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-4319-88a5-ab0b465d84a3/iec-61158-5-11-2007>

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60559, *Binary floating-point arithmetic for microprocessor systems*

IEC 61131-1, *Programmable controllers – Part 1: General information*

IEC 61131-3, *Programmable controllers – Part 3: Programming languages*

IEC/TR 61158-1 (Ed.2.0), *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-3-11, *Industrial communication networks – Fieldbus specifications - Part 3-11: Data-link layer service definition – Type 11 elements*

ISO/IEC 646, *Information technology – ISO 7-bit coded character set for information interchange*

ISO/IEC 7498-1, *Information technology – Open Systems Interconnection – Basic Reference Model – Part 1: The Basic Model*

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Basic Reference Model – Part 3: Naming and addressing*

ISO/IEC 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 8824, *Information Technology – Abstract Syntax notation One (ASN-1): Specification of basic notation*

ISO/IEC 8859-1, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*

ISO/IEC 9545, *Information technology – Open Systems Interconnection – Application Layer structure*

ISO/IEC 10646-1, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Architecture and Basic Multilingual Plane*

ISO/IEC 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 61158-5-11:2007](https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007)

<https://standards.iteh.ai/catalog/standards/iec/3ca5d8cc-1c16-43f9-88a5-ab0b465d84a3/iec-61158-5-11-2007>

3 Terms and definitions, abbreviations, and conventions

For the purposes of this document, the following terms as defined in these publications apply:

3.1 ISO/IEC 7498-1 terms

- a) application entity
- b) application process
- c) application protocol data unit
- d) application service element
- e) application entity invocation
- f) application process invocation
- g) application transaction
- h) real open system
- i) transfer syntax

3.2 ISO/IEC 8822 terms

For the purposes of this document, the following terms as defined in ISO/IEC 8822 apply:

- a) abstract syntax
- b) presentation context

3.3 ISO/IEC 9545 terms

For the purposes of this document, the following terms as defined in ISO/IEC 9545 apply:

- a) application-association
- b) application-context
- c) application context name
- d) application-entity-invocation
- e) application-entity-type
- f) application-process-invocation
- g) application-process-type
- h) application-service-element
- i) application control service element

3.4 ISO/IEC 8824 terms

For the purposes of this document, the following terms as defined in ISO/IEC 8824 apply:

- a) object identifier
- b) type

3.5 Fieldbus data-link layer terms

For the purposes of this document, the following terms as defined in IEC 61158-3-11 apply.

- a) DLCEP
- b) DLC
- c) DLPDU
- d) DLSDU

- e) DLSAP
- f) link
- g) network address
- h) node
- i) scheduled
- j) unscheduled

3.6 Fieldbus application layer type-specific definitions

For the purposes of this part of IEC 61158, the following terms and definitions apply.

3.6.1 access protection

limitation of the usage of an application object to one client

3.6.2 active connection control object

instance of a certain FAL class that abstracts the interconnection facility (as Consumer and Provider) of an automation device

3.6.3 address assignment table

mapping of the client's internal I/O-Data object storage to the decentralized input and output data objects

3.6.4 allocate

take a resource from a common area and assign that resource for the exclusive use of a specific entity

3.6.5 application

function or data structure for which data is consumed or produced

3.6.6 application layer interoperability

capability of application entities to perform coordinated and cooperative operations using the services of the FAL

3.6.7 application objects

multiple object classes that manage and provide a run time exchange of messages across the network and within the network device

3.6.8 application process

part of a distributed application on a network, which is located on one device and unambiguously addressed

3.6.9 application process identifier

distinguishes multiple application processes used in a device

3.6.10

application process object

component of an application process that is identifiable and accessible through an FAL application relationship

NOTE Application process object definitions are composed of a set of values for the attributes of their class (see the definition for Application Process Object Class Definition). Application process object definitions may be accessed remotely using the services of the FAL Object Management ASE. FAL Object Management services can be used to load or update object definitions, to read object definitions, and to dynamically create and delete application objects and their corresponding definitions.

3.6.11

application process object class

a class of application process objects defined in terms of the set of their network-accessible attributes and services

3.6.12

application relationship

cooperative association between two or more application-entity-invocations for the purpose of exchange of information and coordination of their joint operation. This relationship is activated either by the exchange of application-protocol-data-units or as a result of preconfiguration activities

3.6.13

application relationship application service element

application-service-element that provides the exclusive means for establishing and terminating all application relationships

3.6.14

application relationship endpoint

context and behavior of an application relationship as seen and maintained by one of the application processes involved in the application relationship

NOTE Each application process involved in the application relationship maintains its own application relationship endpoint.

3.6.15

attribute

description of an externally visible characteristic or feature of an object

NOTE The attributes of an object contain information about variable portions of an object. Typically, they provide status information or govern the operation of an object. Attributes may also affect the behaviour of an object. Attributes are divided into class attributes and instance attributes.

3.6.16

behaviour

indication of how an object responds to particular events

3.6.17

bit-no

designates the number of a bit in a bitstring or an octet

3.6.18

channel

single physical or logical link of an input or output application object of a server to the process

3.6.19

channel related diagnosis

information concerning a specific element of an input or output application object, provided for maintenance purposes

EXAMPLE: validity of data