

This is a preview - [click here to buy the full publication](#)



IEC 61158-6-7

Edition 1.0 2007-12

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 6-7: Application layer protocol specification – Type 7 elements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XG**

ICS 35.100.70; 25.040.40

ISBN 2-8318-9484-0

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
1.1 General.....	9
1.2 Specifications.....	9
1.3 Conformance.....	9
2 Normative references.....	10
3 Terms, definitions, symbols, abbreviations and conventions.....	10
3.1 Terms and definitions from other ISO/IEC standards.....	10
3.2 Terms and definitions from IEC 61158-5-7.....	11
3.3 Additional terms and definitions.....	12
3.4 Abbreviations and symbols.....	16
3.5 Conventions.....	16
3.6 Conventions used in state machines.....	16
4 Abstract syntax of data type.....	17
4.1 Data abstract syntax specification.....	17
4.2 FAL PDU abstract syntax.....	21
5 Transfer syntaxes.....	22
5.1 Compact encoding.....	22
5.2 Data type encoding.....	23
6 Structure of protocol machines.....	82
7 AP-context state machine.....	83
8 Sub-MMS FAL service protocol machine (FSPM).....	83
8.1 General.....	83
8.2 Projection of the SUB-MMS PDUs on the MCS services.....	83
8.3 Projection of the SUB-MMS abort service on the MCS services.....	83
8.4 Construction of a SUB-MMS-PDU from a service primitive.....	84
8.5 Extraction of a valid service primitive from a SUB-MMS-PDU.....	84
8.6 Negotiation of an abstract syntax and a transfer syntax commonly called presentation-context.....	84
8.7 Identification of the SUB-MMS core abstract syntax.....	86
8.8 Identification of the application context name.....	87
8.9 Identification of the ASE of the core abstract syntax and the transfer syntax.....	87
9 Association relationship protocol machine (ARPM).....	87
10 DLL mapping protocol machine (DMPM).....	88
10.1 MPS ARPM and DMPM.....	88
10.2 MCS ARPM and DMPM.....	99
11 Protocol options.....	135
11.1 Conformances classes.....	135
Bibliography.....	155
Figure 1 – Example of an evaluation net.....	17
Figure 2 – Encoding of a CompactValue.....	22
Figure 3 – Organisation of the bits and octets within a PDU.....	24

Figure 4 – Encoding of a Bitstring	27
Figure 5 – Encoding of a Floating point value	28
Figure 6 – Encoding of a structure	29
Figure 7 – Encoding of a Boolean array	30
Figure 8 – Representation of a MCS PDU	36
Figure 9 – Relationships among Protocol Machines and Adjacent Layers	82
Figure 10 – A_Readloc service evaluation net	88
Figure 11 – A_WriteLoc service evaluation net.....	89
Figure 12 – A_Update service evaluation net.....	90
Figure 13 – A_Readfar service evaluation net.....	91
Figure 14 – A_Writefar service evaluation net.....	93
Figure 15 – A_Sent service evaluation net.....	94
Figure 16 – A_Received service evaluation net.....	94
Figure 17 – Association establishment: Requester element state machine	101
Figure 18 – Association establishment: Responder element state machine	102
Figure 19 – Association termination: Requester element state machine	104
Figure 20 – Association termination: Responder element state machine	106
Figure 21 – Association revocation: Requester element state machine	107
Figure 22 – Association revocation: Acceptor element state machine.....	108
Figure 23 – Interactions between state machine in an associated mode data transfer	110
Figure 24 – Transfer service: Requester element state machine	114
Figure 25 – Transfer service: Acceptor element state machine	115
Figure 26 – Unacknowledged transfer: Requester element state machine	116
Figure 27 – Unacknowledged transfer: Acceptor element state machine	116
Figure 28 – Acknowledged transfer: Requester element state machine	118
Figure 29 – Acknowledged transfer: Acceptor element state machine	119
Figure 30 – Numbering mechanism state machine	120
Figure 31 – Retry mechanism state machine.....	122
Figure 32 – Anticipation mechanism state machine	125
Figure 33 – Segmentation mechanism state machine.....	127
Figure 34 – Reassembly mechanism state machine	129
Figure 35 – Interaction of state machine in a non associated data transfer	131
Figure 36 – Unacknowledged transfer: Requester element state machine	132
Figure 37 – Unacknowledged transfer: Acceptor element state machine	132
Figure 38 – Acknowledged transfer: Requester element state machine	133
Figure 39 – Acknowledged transfer: Acceptor element state machine	134
Table 1 – Example of encoding of a SEQUENCE	19
Table 2 – Example of encoding of a SEQUENCE OF	19
Table 3 – Example of encoding of a CHOICE.....	20
Table 4 – Example of encoding of an object identifier	21
Table 5 – Example of encoding of a PDU.....	22
Table 6 – MPS PDU types	25

Table 7 – Fields of a CompactValuePDU	25
Table 8 – Fields of a VariableDescriptionPDU	32
Table 9 – Fields of an AccessDescriptionPDU	33
Table 10 – Fields of a TypeDescriptionPDU	34
Table 11 – Fields of a ListDescriptionPDU	35
Table 12 – Coding of the different MCS PDU types	37
Table 13 – Coding of the variable part of the PDU	37
Table 14 – Structure of association establishment request	38
Table 15 – Structure of an associated establishment response	42
Table 16 – Structure of an association termination request	44
Table 17 – Structure of an association termination response	44
Table 18 – Structure of an association revocation request	45
Table 19 – Structure of an associated transfer request	46
Table 20 – Structure of an associated transfer acknowledgement	46
Table 21 – Structure of a non-associated transfer request	47
Table 22 – Structure of a non-associated transfer acknowledgement	48
Table 23 – Definitions of object classes	50
Table 24 – Definition of Sub-MMS Services	51
Table 25 – Structure of the antiduplication list	123
Table 26 – Structure of the reassembly list	128
Table 27 – PV_R/W parameter values	136
Table 28 – PV_IND parameter values	136
Table 29 – PV_LIS parameter values	136
Table 30 – Constraints on PV_LIS parameter	137
Table 31 – PV_AT parameter values	137
Table 32 – PV_RE parameter values	137
Table 33 – PV_UT parameter values	137
Table 34 – Constraints on PV_RE parameter	137
Table 35 – PH_R_A parameter values	138
Table 36 – PH_R_S parameter values	138
Table 37 – PH_R_P parameter values	138
Table 38 – PH_P_A parameter values	139
Table 39 – PH_P_S parameter values	139
Table 40 – PH_P_P parameter values	139
Table 41 – PH_COH parameter values	139
Table 42 – PH_FIA parameter values	140
Table 43 – PH_SPF parameter values	140
Table 44 – PH_SPM parameter values	140
Table 45 – PH_ACC parameter values	141
Table 46 – PH_RES parameter values	141
Table 47 – PH_AK parameter values	141
Table 48 – PH_RA parameter values	141
Table 49 – PH_SR parameter values	141

Table 50 – PH_CF parameter values	142
Table 51 – Constraints on PH_RA parameter.....	142
Table 52 – Constraints on PH_SR parameter.....	142
Table 53 – PT_OCT parameter values	142
Table 54 – PT_BIN parameter values.....	143
Table 55 – PT_VIS parameter values.....	143
Table 56 – PT_BOO parameter values.....	143
Table 57 – PT_BCD parameter values	143
Table 58 – PT_BTM parameter values	144
Table 59 – PT_INT parameter values.....	144
Table 60 – PT_UNO parameter values	144
Table 61 – PT_FPT parameter values.....	144
Table 62 – PT_GTM parameter values.....	145
Table 63 – PT_TAB parameter values.....	145
Table 64 – PT_STR parameter values	145
Table 65 – Constraints on PT_TAB parameter	146
Table 66 – Constraints on PT_STR parameter	146
Table 67 – Conformance classes for environment management.....	149
Table 68 – Conformance classes for VMD management	150
Table 69 – Conformance classes for PI management.....	151
Table 70 – Conformance classes for domain management.....	152
Table 71 – Conformance classes for variable/variable list management.....	153
Table 72 – Conformance classes for event management	154

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-7: Application layer protocol specification – Type 7 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 from their respective intellectual-property-right holders.

International Standard IEC 61158-6-7 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 61158-6 subseries cancel and replace IEC 61158-6:2003. This edition of this part constitutes an editorial revision.

This edition of IEC 61158-6 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 6 of the third edition into multiple parts numbered -6-2, -6-3, ...

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

FDIS	Report on voting
65C/476/FDIS	65C/487/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.

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 protocol provides the application service by making use of the services available from the data-link or other immediately lower layer. The primary aim of this standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer application entities (AEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

- as a guide for implementors and designers;
- for use in the testing and procurement of equipment;
- as part of an agreement for the admittance of systems into the open systems environment;
- as a refinement to the understanding of time-critical communications within OSI.

This standard is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this standard together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-7: Application layer protocol specification – Type 7 elements

1 Scope

1.1 General

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 standard 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 7 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 standard specifies interactions between remote applications and defines the externally visible behavior provided by the Type 7 fieldbus application layer in terms of

- a) the formal abstract syntax defining the application layer protocol data units conveyed between communicating application entities;
- b) the transfer syntax defining encoding rules that are applied to the application layer protocol data units;
- c) the application context state machine defining the application service behavior visible between communicating application entities;
- d) the application relationship state machines defining the communication behavior visible between communicating application entities.

The purpose of this standard is to define the protocol provided to

- define the wire-representation of the service primitives defined in IEC 61158-5-7, and
- define the externally visible behavior associated with their transfer.

This standard specifies the protocol of the Type 7 fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498) and the OSI application layer structure (ISO/IEC 9545).

1.2 Specifications

The principal objective of this standard is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-7.

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 protocols standardized in parts of the IEC 61158-6 series.

1.3 Conformance

This standard does not specify individual implementations or products, nor does it constrain the implementations of application layer entities within industrial automation systems.

There is no conformance of equipment to the application layer service definition standard. Instead, conformance is achieved through implementation of this application layer protocol specification.

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 61158-3-7, *Industrial communication networks – Fieldbus specifications – Part 3-7: Data-link layer service definition – Type 7 elements*

IEC 61158-4-7, *Industrial communication networks – Fieldbus specifications – Part 4-7: Data-link layer protocol specification – Type 7 elements*

IEC 61158-5-7, *Industrial communication networks – Fieldbus specifications – Part 5-7: Application layer service definition – Type 7 elements*

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

ISO/IEC 8824, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1)*

ISO/IEC 8825, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

ISO/IEC 9506-2, *Industrial automation systems – Manufacturing Message Specification – Part 2: Protocol specification*

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